South Carolina Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

I-26 at I-95 System Interchange Improvement

Technical Memorandum

HYDROLOGIC STUDY AND HYDRAULIC ANALYSIS REPORT

May 2023

REVISIONS				APPROVALS			
REV	DATE	PAGES	DESCRIPTION	BY	DESIGN LEAD	PROJECT MANAGER	CLIENT
							CECS

HYDROLOGIC STUDY AND HYDRAULIC ANALYSIS REPORT FOR THE PROPOSED CONSTRUCTION OF THE I-26/I-95 INTERCHANGE

ROUTE / ROAD NUMBER:	I-26
FILE NO.	N/A
PROJECT NO.	N/A
PIN:	N/A
COUNTY NAME	ORANGEBURG
DATE:	May 2, 2023

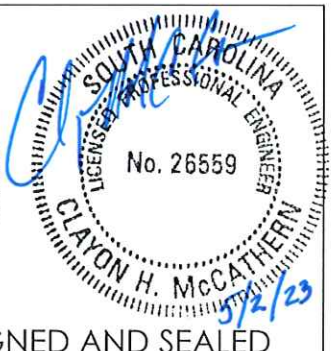
PREPARED BY:	ERP
CHECKED BY:	CHM

Hydraulic Design Reference for this Study is the:

2009

Edition of SCDOT's "Requirements for Hydraulic Design Studies"

COA



SIGNED AND SEALED

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1. INTRODUCTION

1.1 Project Description

This Hydraulic Report was prepared to document the hydrologic and hydraulic analysis for the proposed I-26 and I-95 Interchange improvements (I-26 Exit 169A-B, I-95 Exit 86A-B). These improvements are to address the operational deficiencies of the current interchange configuration. The scope of work includes field surveys, pipe and box culvert inspections, and the preliminary hydraulic design of stormwater systems (pipe culverts, ditches, and closed systems).

The proposed interchange improvements will address merge and weave movements and are expected to involve ramp realignment for added safety. Currently, the interchange consists of two EB and two WB lanes each 12' wide on I-26 and two NB lanes and two SB lanes 12' wide on I-95. Ramps vary in width from 16' to 18'. An 8'x6' concrete box culvert, three separate 6'x6' concrete box culverts, and a 48" concrete pipe culvert have been installed since the construction of the original interchange in 1959. Multiple crosslines have also been installed. Hydraulic data for these culverts and pipes is included in **Section 3**.

It is assumed that video inspection will occur during the design stage to assess the condition of the existing culverts and pipes draining from the median drop inlets and determine if replacements are required. Note that tree removal is underway within the project area, and some pipe outlets have been damaged by equipment. See **Section 6** for examples.

1.2 Design Criteria

Hydraulic design services were provided in accordance with SCDOT "Requirements for Hydraulic Design Studies," dated May 26, 2009, and normal SCDOT practice, unless directed otherwise by SCDOT. See the following page for project-specific design criteria and standards.

1.3 Existing Watershed

The eastern half of the proposed interchange lies within the Spring Branch-Four Hole Swamp Watershed and its western half lies within the watershed for a tributary to Four Hole Swamp. Four Hole Swamp is itself a tributary of the Edisto River. While there have been instances when portions of I-95 north of the project site have been closed due to flood events, there has been no flooding within the project limits that resulted in a road closure. See **Figure 1.1** for a map of the existing watersheds around the project site. See **Figure 1.2** for an aerial map of the project site.

Figure 1.1: Watershed Map for Four Holes Swamp

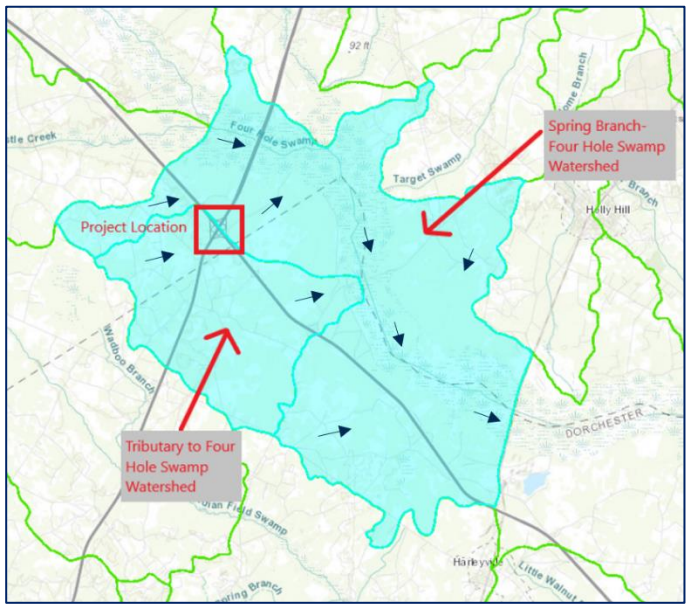
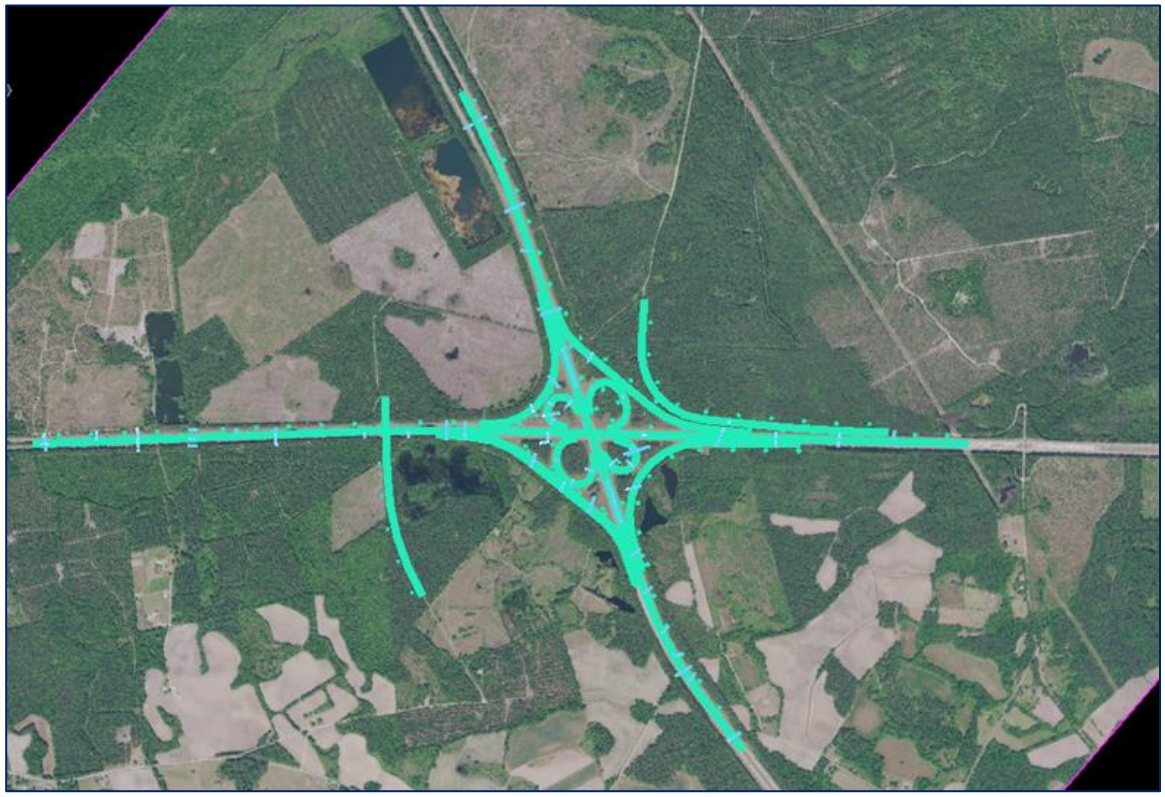


Figure 1.2: Aerial Map of Project Location



The existing land uses within both the Spring Branch-Four Hole Swamp Watershed and the tributary watershed consist mainly of wetlands and wooded areas, with some isolated areas of brush and open fields. Most of the watershed, especially north of I-26, has been managed for pine silviculture. Four Hole Swamp crosses I-95 approximately a mile north of the interchange but several unnamed tributaries pass underneath the interchange in various locations. These tributaries also manifest as numerous ponded areas to the west and south of the interchange. Multiple culverts, cross-lines, and half-lines exist to convey drainage within the interchange and hydraulic analysis of these outfalls is presented in **Section 3**. The watersheds contributing to these outfalls has been heavily modified in the past by construction of a network of drainage channels and ditches. An additional discussion of these outfalls is presented in **Section 5**.

Existing ditches impacted by proposed alternatives will need to be reconstructed to maintain current drainage patterns. Information on alternatives can be viewed in **Section 3.5**.

1.4 FEMA Flood Hazard Zone

Section 2 "PROJECT MAPS" contains the Federal Emergency Management Agency (FEMA) effective flood hazard maps for the project area. The proposed improvements to the interchange site are outside of the flood hazard area, so no floodplain impacts are anticipated.

1.5 Proposed Stormwater Management

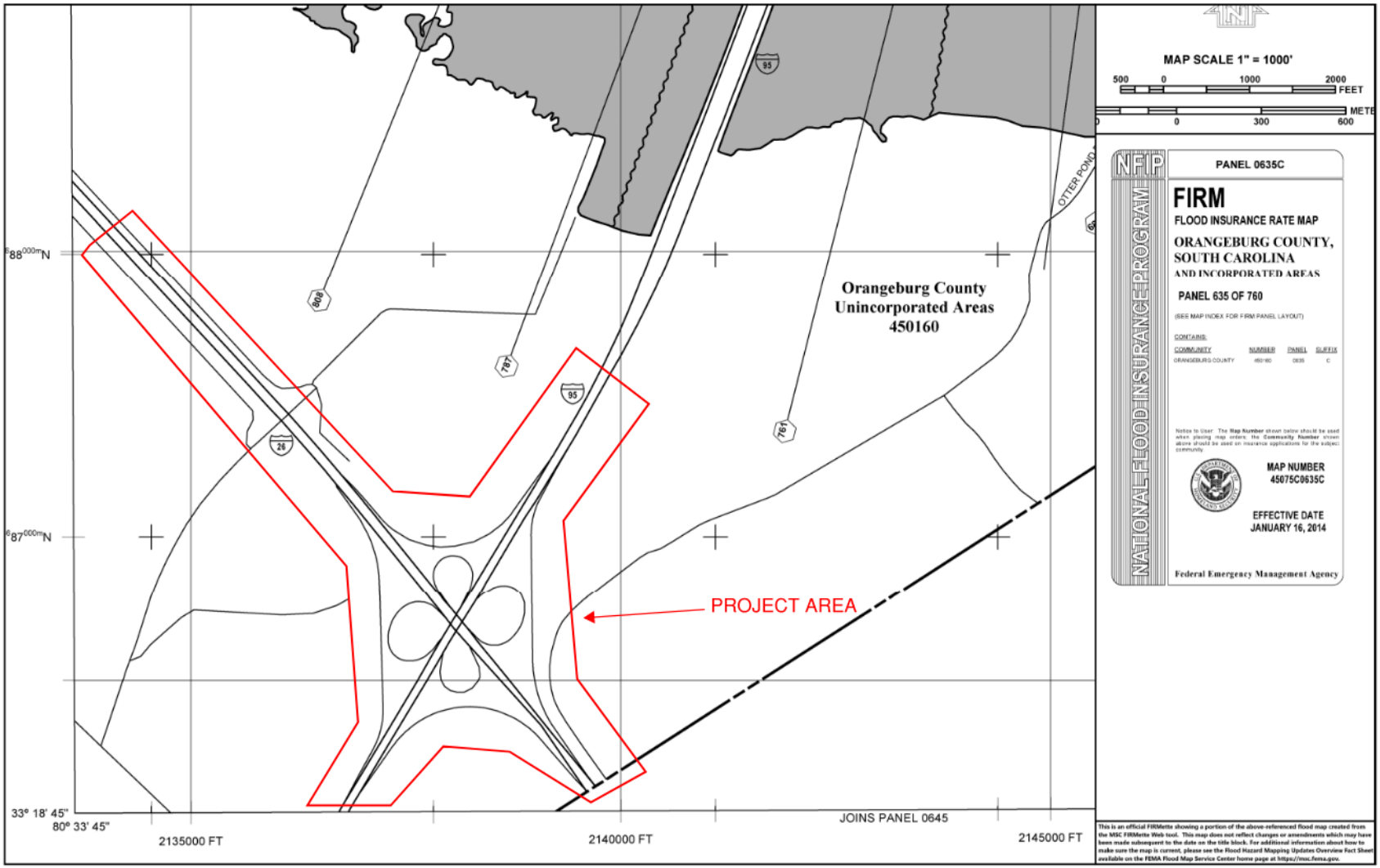
The project site falls within the Four Hole Swamp watershed of the Edisto River Basin. The drainage area passing through the project site is 7.75 square miles (4,960 ac) as delineated using the USGS StreamStats website. The common point of interest for the watershed was taken where Four Hole Swamp crosses U.S. Hwy 15. At this point the total drainage area of Four Hole Swamp is 344 sq mi (220,160 ac).

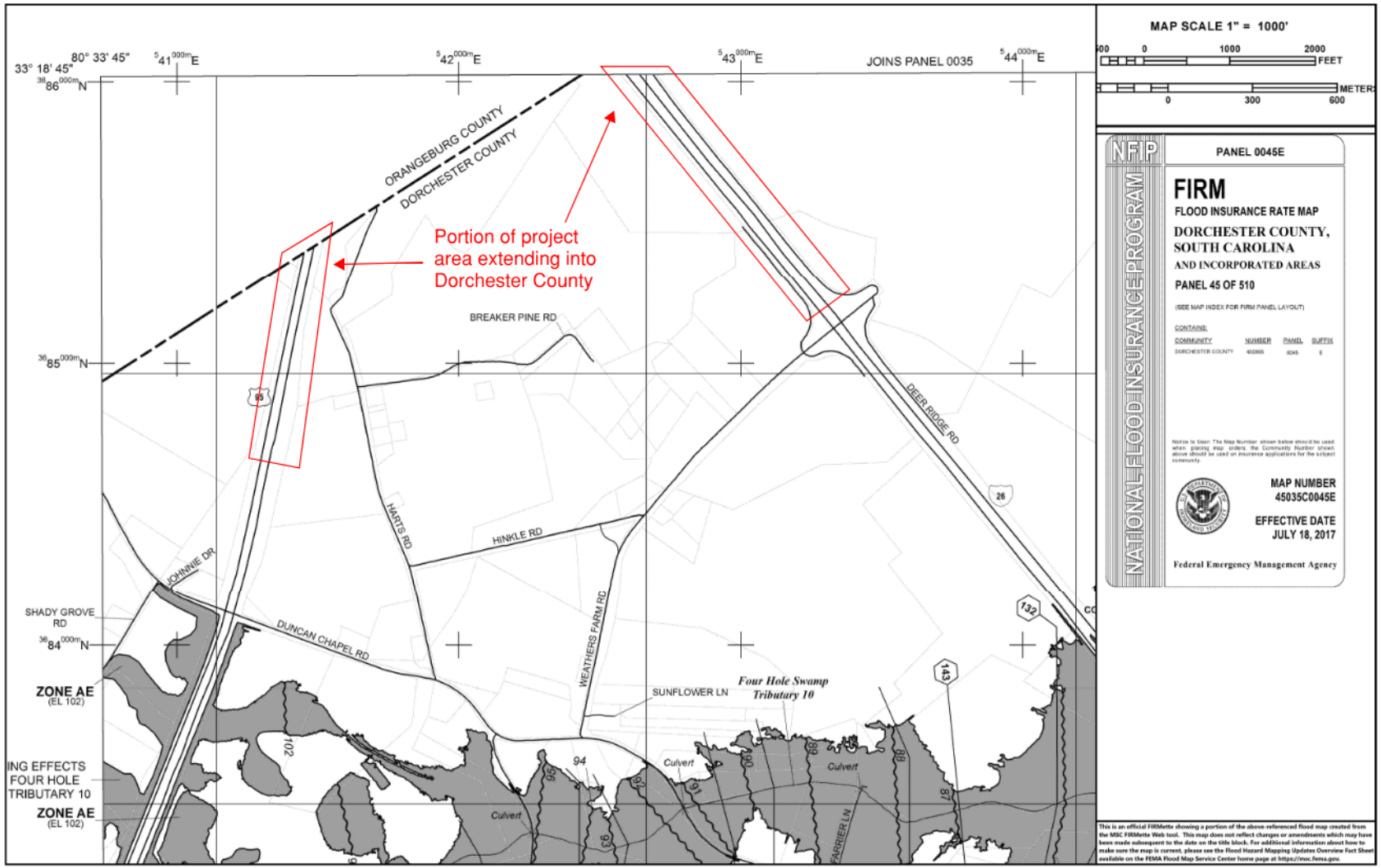
This project consists of realigning interchange ramps which will result in a negligible increase in impervious area when taking into consideration the total drainage area. Furthermore, when considering the large drainage area of the common point of interest of Four Hole Swamp and the comparatively insignificant change in land use of the project site, stormwater management will not be required. However, should there be a need for stormwater management, the project site has available space within the interchange.

1.6 Sediment and Erosion Control

A description of sediment and erosion control measures will be provided during final design by the design-build team.

2. PROJECT MAPS




MAP SCALE 1" = 1000'
0 1000 2000 FEET
0 300 600 METERS
PANEL 0045E
FIRM
FLOOD INSURANCE RATE MAP
DORCHESTER COUNTY, SOUTH CAROLINA
AND INCORPORATED AREAS
PANEL 45 OF 510
MAP NUMBER 45035C0045E
EFFECTIVE DATE JULY 18, 2017
Federal Emergency Management Agency
NATIONAL FLOOD INSURANCE PROGRAM
JOINS PANEL 0035
ORANGEBURG COUNTY
DORCHESTER COUNTY
Portion of project area extending into Dorchester County
BREAKER PINE RD
DEER RIDGE RD
HARTS RD
HINKLE RD
JOHNNIE DR
SHADY GROVE RD
DUNCAN CHAPEL RD
WEATHERS FARM RD
SUNFLOWER LN
Four Hole Swamp Tributary 10
FARRIER LN
ZONE AE (EL 102)
ING EFFECTS FOUR HOLE TRIBUTARY 10
ZONE AE (EL 102)
Culvert
33° 18' 45"
80° 33' 45"

3. HYDROLOGIC & HYDRAULIC ANALYSES OF EXISTING OUTFALLS

The twelve total existing culverts and cross-lines spanning the I-26/I-95 interchange were modeled in HY-8 using elevation information taken from survey. Four culverts used peak discharges calculated with StreamStats. The Rational Method was used to calculate peak discharges for seven cross-lines draining small watersheds less than 100 acres, where StreamStats data did not exist. The SCS Method was used for one culvert that possessed a drainage area greater than 100 acres but less than 1 sq mi. StreamStats information is presented in **Section 3.1**, SCS results are presented in **Section 3.2,** Rational Method calculations are presented in **Section 3.3**, and HY-8 outputs are presented in **Section 3.4**.

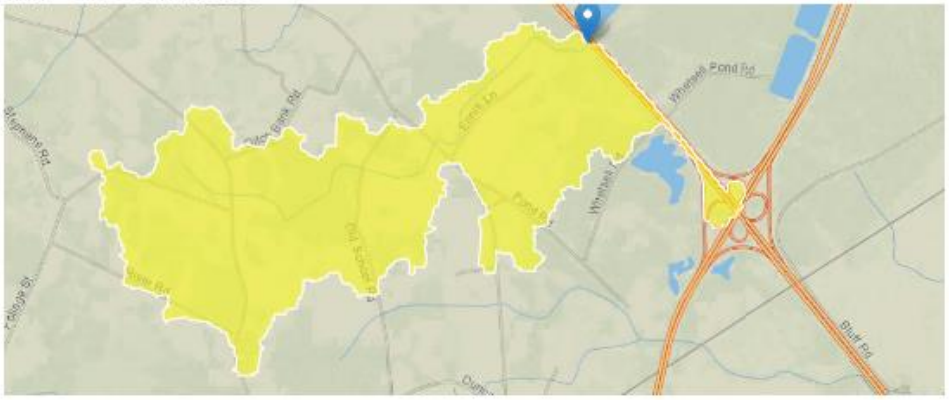
A hydrology data summary table was generated for the culverts and cross-lines (**Table 3.1** in **Section 3.4**) and half-lines (**Table 4.1** in **Section 4**) within the interchange. These tables contain basic identification data, hydrology data, headwater to depth ratios (HW/D) for the 50-year and 100-year storms, field notes, and recommendations. Recommendations include cleaning and extending pipes based on project alternatives. **Table 3.1** also contains re-sizing recommendations based on a HW/D ratio of 1.2 or less for the design storm. For more on assessments of project alternatives, see **Section 3.5**.

3.1 StreamStats

StreamStats outputs were available for four reinforced concrete box culverts (RCBC) within the interchange and are displayed in **Sections 3.1.1-3.1.4**.

3.1.1 BC-1 – 8'x6' RCBC @ I-26 STA 3145+00

Region ID: SC
Workspace ID: SC20221208214757759000
Clicked Point (Latitude, Longitude): 33.33089, -80.56107
Time: 2022-12-08 16:48:18 -0500



I-26 crossing at Sta 3145+00 Existing 8'x6' RCBC

Collapse All

> Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.21	square miles
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	8	inches
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	1.29	percent
PCTREG1	Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley	0	percent
PCTREG2	Percentage of drainage area located in Region 2 - Blue Ridge	0	percent
PCTREG3	Percentage of drainage area located in Region 3 - Sandhills	0	percent
PCTREG4	Percentage of drainage area located in Region 4 - Coastal Plains	100	percent
PCTREG5	Percentage of drainage area located in Region 5 - Lower Tifton Uplands	0	percent

General Disclaimers

Upstream regulation was checked for this watershed.

> Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Southeast US over 1 sqmi 2009 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.21	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Flow Report [Peak Southeast US over 1 sqmi 2009 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other – see report)

Statistic	Value	Unit	PII	PIu	ASEp
50-percent AEP flood	101	ft^3/s	58	176	34.5
20-percent AEP flood	202	ft^3/s	117	349	34
10-percent AEP flood	283	ft^3/s	161	498	35.1
4-percent AEP flood	397	ft^3/s	218	723	37.5
2-percent AEP flood	497	ft^3/s	264	935	39.6
1-percent AEP flood	609	ft^3/s	313	1190	41.9
0.5-percent AEP flood	713	ft^3/s	354	1440	44.3
0.2-percent AEP flood	873	ft^3/s	412	1850	47.7

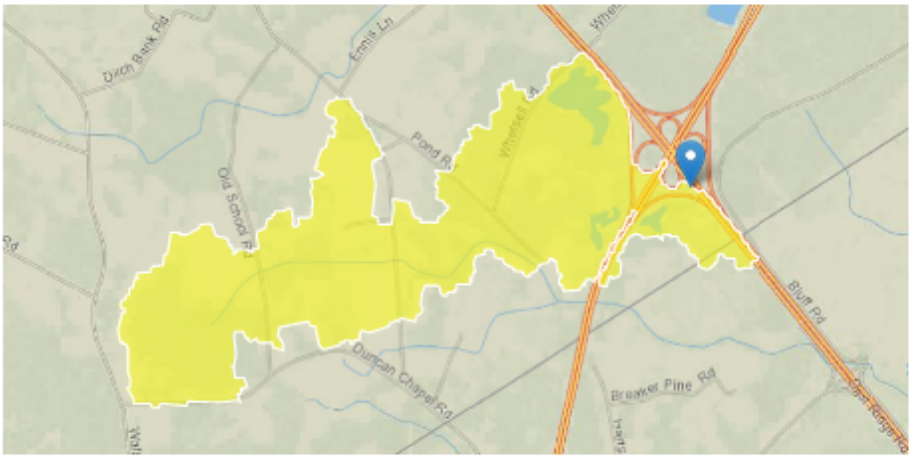
Peak-Flow Statistics Citations

Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina: U.S. Geological Survey Scientific Investigations Report 2009-5156, 226 p. (http://pubs.usgs.gov/sir/2009/5156/)

Application Version: 4.11.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

3.1.2 BC-2 – 6'x6' RCBC @ I-95 NB to I-26 EB Ramp STA 3214+28

Region ID: SC
Workspace ID: SC20221208201902791000
Clicked Point (Latitude, Longitude): 33.31638, -80.54635
Time: 2022-12-08 15:19:23 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.65	square miles
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	8.1	inches
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	1.31	percent
PCTREG1	Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley	0	percent
PCTREG2	Percentage of drainage area located in Region 2 - Blue Ridge	0	percent
PCTREG3	Percentage of drainage area located in Region 3 - Sandhills	0	percent
PCTREG4	Percentage of drainage area located in Region 4 - Coastal Plains	100	percent
PCTREG5	Percentage of drainage area located in Region 5 - Lower Tifton Uplands	0	percent

General Disclaimers

Upstream regulation was checked for this watershed.

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Southeast US over 1 sqmi 2009 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.65	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Flow Report [Peak Southeast US over 1 sqmi 2009 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	ASEp
50-percent AEP flood	83.4	ft^3/s	47.9	145	34.5
20-percent AEP flood	168	ft^3/s	97.1	291	34
10-percent AEP flood	237	ft^3/s	135	417	35.1
4-percent AEP flood	333	ft^3/s	183	607	37.5
2-percent AEP flood	417	ft^3/s	222	785	39.6
1-percent AEP flood	512	ft^3/s	263	997	41.9
0.5-percent AEP flood	600	ft^3/s	297	1210	44.3
0.2-percent AEP flood	736	ft^3/s	347	1560	47.7

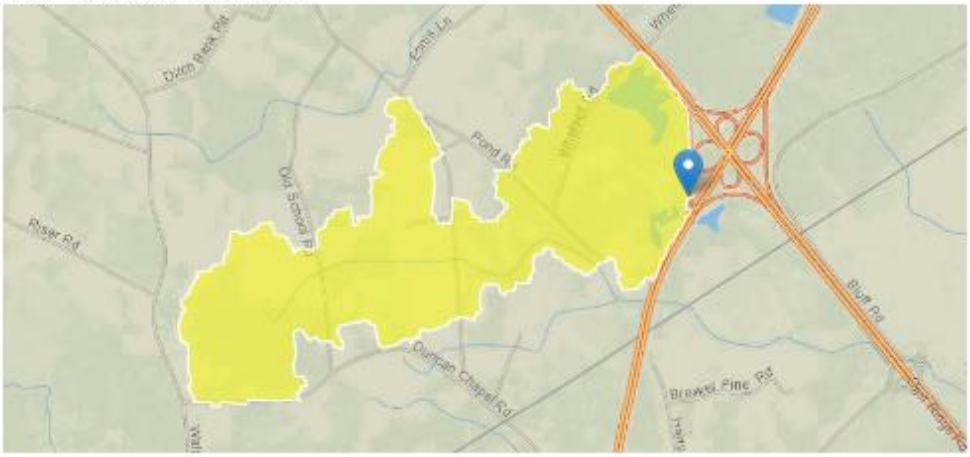
Peak-Flow Statistics Citations

Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina: U.S. Geological Survey Scientific Investigations Report 2009-5156, 226 p. (http://pubs.usgs.gov/sir/2009/5156/)

Application Version: 4.11.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

3.1.3 BC-3 – 6'x6' RCBC @ I-95 STA 6022+50

Region ID: SC
Workspace ID: SC20221208194824071000
Clicked Point (Latitude, Longitude): 33.31568, -80.55096
Time: 2022-12-08 14:48:44 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.51	square miles
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	8.1	inches
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	0.34	percent
PCTREG1	Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley	0	percent
PCTREG2	Percentage of drainage area located in Region 2 - Blue Ridge	0	percent
PCTREG3	Percentage of drainage area located in Region 3 - Sandhills	0	percent
PCTREG4	Percentage of drainage area located in Region 4 - Coastal Plains	100	percent
PCTREG5	Percentage of drainage area located in Region 5 - Lower Tifton Uplands	0	percent

General Disclaimers

Upstream regulation was checked for this watershed.

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Southeast US over 1 sqmi 2009 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.51	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Flow Report [Peak Southeast US over 1 sqmi 2009 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other – see report)

Statistic	Value	Unit	PII	PIu	ASEp
50-percent AEP flood	78.7	ft^3/s	45.2	137	34.5
20-percent AEP flood	159	ft^3/s	91.9	275	34
10-percent AEP flood	224	ft^3/s	127	394	35.1
4-percent AEP flood	315	ft^3/s	173	574	37.5
2-percent AEP flood	396	ft^3/s	210	746	39.6
1-percent AEP flood	486	ft^3/s	250	947	41.9
0.5-percent AEP flood	569	ft^3/s	282	1150	44.3
0.2-percent AEP flood	699	ft^3/s	330	1480	47.7

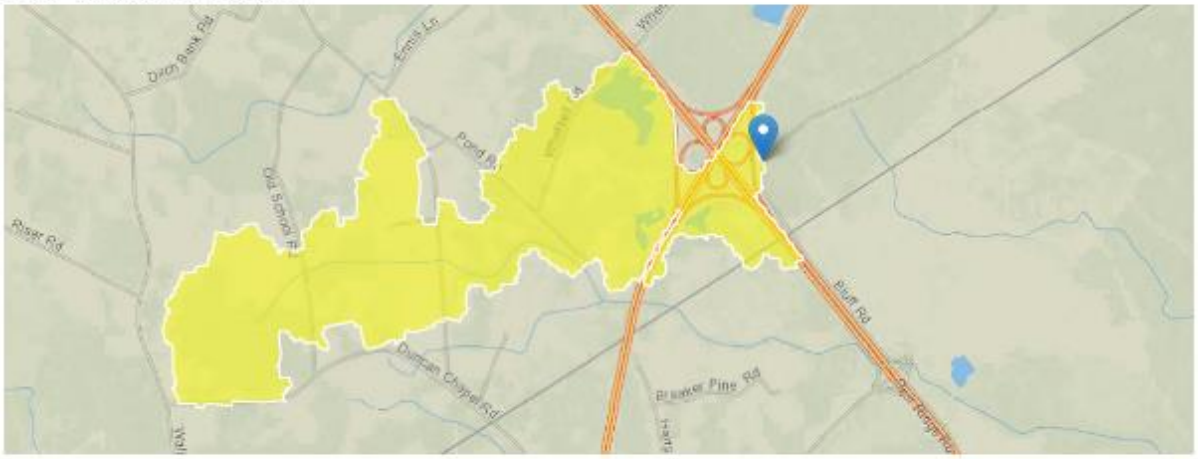
Peak-Flow Statistics Citations

Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina: U.S. Geological Survey Scientific Investigations Report 2009-5156, 226 p. (http://pubs.usgs.gov/sir/2009/5156/)

Application Version: 4.11.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

3.1.4 BC-4 – 6'x6' RCBC @ Bluff Rd STA 119+25

Region ID: SC
Workspace ID: SC20221212171731654000
Clicked Point (Latitude, Longitude): 33.31805, -80.54427
Time: 2022-12-12 12:17:53 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.71	square miles
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	8.1	inches
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	2.05	percent
PCTREG1	Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley	0	percent
PCTREG2	Percentage of drainage area located in Region 2 - Blue Ridge	0	percent
PCTREG3	Percentage of drainage area located in Region 3 - Sandhills	0	percent
PCTREG4	Percentage of drainage area located in Region 4 - Coastal Plains	100	percent
PCTREG5	Percentage of drainage area located in Region 5 - Lower Tifton Uplands	0	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Southeast US over 1 sqmi 2009 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.71	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Flow Report [Peak Southeast US over 1 sqmi 2009 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other – see report)

Statistic	Value	Unit	PII	PIu	ASEp
50-percent AEP flood	85.4	ft^3/s	49	149	34.5
20-percent AEP flood	172	ft^3/s	99.4	298	34
10-percent AEP flood	242	ft^3/s	138	426	35.1
4-percent AEP flood	340	ft^3/s	187	620	37.5
2-percent AEP flood	426	ft^3/s	226	802	39.6
1-percent AEP flood	523	ft^3/s	269	1020	41.9
0.5-percent AEP flood	613	ft^3/s	304	1240	44.3
0.2-percent AEP flood	751	ft^3/s	355	1590	47.7

Peak-Flow Statistics Citations

Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina: U.S. Geological Survey Scientific Investigations Report 2009-5156, 226 p. (http://pubs.usgs.gov/sir/2009/5156/)

Application Version: 4.11.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

3.2 SCS WinTR-55 Method

The SCS Method was utilized for pipe culvert EP-34, which possesses a drainage area between the limits for Rational Method and Regression Equation calculations. The USGS program Hydrologic Toolbox was used to create the outputs, attached below.

WinTR-55 Current Data Description

--- Identification Data ---

User: ENR
Project: I-26/I-95
SubTitle: DA to 48' RCP
State: South Carolina
County: Orangeburg NOAA-14
Filename: C:\Temp\I-26_I-95 Int\SCS Analysis\R29938-48-in RCP.w55

Date: 1/11/2023
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
DA-1		Outlet	427.77	73	3.245

Total area: 427.77 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.71	4.77	5.67	6.98	8.09	9.3	3.06

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: Peak Factor 100

ENR I-26/I-95
DA to 48' RCP
Orangeburg NOAA-14 County, South Carolina

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.71	4.77	5.67	6.98	8.09	9.3	3.06

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: Peak Factor 100

ENR I-26/I-95
DA to 48' RCP
Orangeburg NOAA-14 County, South Carolina

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)	1-Yr (cfs)
SUBAREAS							
DA-1	30.76	49.50	66.82	93.68	117.45	143.98	20.52
REACHES							
OUTLET	30.76	49.50	66.82	93.68	117.45	143.98	20.52

ENR I-26/I-95
DA to 48' RCP
Orangeburg NOAA-14 County, South Carolina

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	5-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS							
DA-1	30.76	49.50	66.82	93.68	117.45	143.98	20.52
	17.12	16.59	16.35	16.33	16.13	15.96	17.37
REACHES							
OUTLET	30.76	49.50	66.82	93.68	117.45	143.98	20.52

ENR I-26/I-95
DA to 48' RCP
Orangeburg NOAA-14 County, South Carolina

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
DA-1	427.77	3.245	73	Outlet	

Total Area: 427.77 (ac)

ENR I-26/I-95
DA to 48' RCP
Orangeburg NOAA-14 County, South Carolina

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
DA-1							
SHEET	80	0.0050	0.400				0.484
SHALLOW	3620	0.0015	0.050				1.609
SHALLOW	3138	0.0022	0.050				1.152
						Time of Concentration	3.245

ENR I-26/I-95
DA to 48' RCP
Orangeburg NOAA-14 County, South Carolina

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
DA-1	Paved parking lots, roofs, driveways		C	2.15	98
	Residential districts (2 acre)		C	13.64	77
	Legume/Rot. Meadow Straight row	(good)	B	125.9	72
	Legume/Rot. Meadow Straight row	(good)	C	87.81	81
	Pasture, grassland or range	(poor)	C	15.35	86
	Woods	(fair)	B	59.8	60
	Woods	(fair)	C	112.09	73
	Farmsteads		C	11.03	82
	Total Area / Weighted Curve Number			427.77	73

3.3 Rational Method

Seven cross-lines at the interchange possess drainage areas below 100 acres, the threshold for use of the Rational Method. The associated time of concentration (Tc) and flow rate (Q) calculations are displayed in **Figure 3.1** and **Figure 3.2**.

Figure 3.1: Time of concentration (Tc) Calculations

CDM Smith
1441 Main Street, Suite 1000
Columbia, SC 29201

JOB: I-95/I-26 Interchange
SUBJECT: Time of Concentration Calculations
CALC'D BY: ERP DATE: 17-Jan-23
CHEK'D BY: CM DATE: 17-Jan-23

TIME OF CONCENTRATION

WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.
ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft		ft/s	hr	To	From	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
EP-22e	0.001	100	0.40	3.8	1.09	0.003	3300	u	0.88	1.04												127.6	127.6
EP-19	0.020	100	0.40	3.8	0.33	0.002	936	u	0.72	0.36												41.3	41.3
EP-12	0.010	100	0.40	3.8	0.43	0.004	576	u	1.02	0.16												35.4	35.4
EP-11					0.00	0.001	347	u	0.51	0.19												11.3	11.3
EP-3	0.030	100	0.40	3.8	0.28	0.004	1408	u	1.02	0.38												39.8	39.8
EP-27	0.005	100	0.40	3.8	0.57	0.002	2057	u	0.72	0.79												81.8	81.8
EP-36	0.001	100	0.40	3.8	1.09	0.013	560	u	1.84	0.08												70.4	70.4

Slope in ft/ft.
Length in feet.
n is TR55 method for Sheet and Shallow concentrated flow, Mannings method for open channel flow.
(P)aved refers to paved or unpaved velocity.
V is velocity in ft/s.
Tt is TR55 travel time in hours.
Tc is TR55 time of concentration in minutes.

Figure 3.2: Flow (Q) Calculations

CDM Smith

CDM Smith
1441 Main Street, Suite 100
Columbia, SC 29201

JOB: I-95/I-26 Interchange
SUBJECT: Runoff Discharge Calculations
CALC'D BY: ERP DATE: 17-Jan-23
CHEK'D BY: CM DATE: 17-Jan-23

Rational Method

Culvert ID	Area Post	Tc (min)	C_{value}	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)
EP-22e	57.60	128.0	0.10	6.0	7.5	9.2	12.4	15.9	19.2
EP-19	17.60	41.0	0.10	4.2	4.9	5.7	7.3	9.0	10.3
EP-12	2.00	35.0	0.10	0.5	0.6	0.7	0.9	1.1	1.3
EP-11	0.80	11.0	0.10	0.4	0.4	0.5	0.6	0.7	0.8
EP-3	30.30	40.0	0.10	7.3	8.5	10.0	12.7	15.6	18.0
EP-27	27.00	82.0	0.10	3.9	4.8	5.8	7.6	9.5	11.3
EP-36	2.70	70.0	0.10	0.4	0.5	0.6	0.8	1.0	1.2

Orangeburg, SC i=a/(b+tc)^c Q=C*I*A*Cf
Rainfall Intensity

freq	a	b	c	i(tc=5)	i(tc=10)	factor Cf
2	65.73000	11.50000	0.83900	5.44	4.82	1
5	54.95000	9.97200	0.75930	6.42	5.66	1
10	49.59000	8.48600	0.69830	7.12	6.25	1
25	42.52000	6.69600	0.62780	8.16	7.14	1.1
50	39.71000	5.70300	0.58180	9.03	7.86	1.2
100	35.32000	4.21500	0.52940	9.88	8.57	1.25

3.4 HY-8 Analysis

The HY-8 outputs for all seven cross-lines and five culverts are presented in **Sections 3.4.1-3.4.12**, arranged in increasing order of stationing. The box culvert on Bluff Road, a frontage road adjacent to the interchange, is placed last. Pertinent information for these culverts and cross-lines is summarized in **Table 3.1**.

Table 3.1: Existing Culverts and Cross-Lines with Proposed Flow Rates

Existing Culverts and Cross-Lines with Proposed Flow Rates																				
Culvert Data									Hydrology Data		50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	HW/D	Over-topping	Q (cfs)	HW Elevation (ft)	HW/D	Over-topping			
EP-22e	3123+00	I-26	RCP	48	48	272	91.91	91.75	57.6	Rational	128	15.9	93.72	0.45	N	19.2	93.91	0.50	N	Good condition. Some minor debris. Fence 50' away. Ditch approximately rectangular.	Meets design criteria. Headwaters within ROW	None
EP-19	3137+00	I-26	RCP	24	24	264	96.41	96.07	17.6	Rational	41	9.0	98.14	0.87	N	10.3	98.31	0.95	N	Good condition. 3" of sediment in pipe, wings damaged on north side	Meets design criteria. Headwaters within ROW	None
BC-1	3145+00	I-26	RCBC	8x6	72	365	93.74	93.22	1414.4	Regression	-	497.0	102.98	1.54	N	609.0	105.13	1.90	Y	Good condition. Minor debris, 3" drop at slab, fence at outlet. Equipment blockage DS side.	Does not meet HW/D = 1.2. Headwaters within ROW	Replace with (2) 7'x6' RCBC
EP-12	3184+00	I-26	RCP	18/24	18	300	96.18	95.88	2.0	Rational	35	1.1	96.80	0.41	N	1.3	96.86	0.45	N	25% full of stagnant water. Ground level 4" higher than inlet.	Meets design criteria. Headwaters within ROW	Alt 1: Extend L & R sides Alt 2: Extend L Side Alt 3: Extend L Side
EP-11	3186+00	I-26	RCP	18	18	291	96.83	96.59	0.8	Rational	11	0.7	97.26	0.29	N	0.8	97.29	0.31	N	Almost entirely filled with debris on south end. Pipe very steep.	Meets design criteria. Headwaters within ROW	Clean. Extend for all alternative plans
BC-2	3214+28	I-95 NB to I-26 EB Ramp	RCBC	6x6	72	1038	91.75	90.28	1056.0	Regression	-	417.0	100.46	1.45	Y	512.0	100.73	1.50	Y	Erosion behind wingwalls. Moderate debris and sediment deposits US/DS.	Does not meet HW/D = 1.2. Headwaters exceed ROW	Replace with (1) 9'x6' RCBC
EP-3	3243+50	I-26	RCP	24	24	211	92.3	91.80	30.3	Rational	40	15.6	94.75	1.23	N	18.0	95.3	1.50	N	North side buried by tree debris. South side in good condition and well-drained.	Meets design criteria. Headwaters within ROW	Alt 1: Extend R side Alt 2: Extend R side Alt 3: Extend L & R sides
EP-27	5989+00	I-95	RCP	24	24	334	92.29	92.00	27.0	Rational	82	9.5	94.19	0.95	N	11.3	94.47	1.09	N	Upstream filled 50% with sediment. Ground level is 6" higher than invert.	Meets design criteria. Headwaters within ROW	Clean. Extend for all alternative plans
BC-3	6022+50	I-26 EB to I-95 SB Ramp	RCBC	6x6	72	412	92.78	92.46	966.4	Regression	-	396.0	102.74	1.66	N	486.0	105.07	2.05	N	Heavy debris blocking DS opening. US opening 50% blocked horizontally.	Does not meet HW/D = 1.2. Headwaters exceed ROW	Replace with (1) 9'x6' RCBC
EP-34	6047+30	I-95	RCP	48	48	283	94.58	94.19	427.8	SCS	195	117.0	101.90	1.83	Y	144.0	104.17	2.40	Y	Heavy debris blocking DS opening. No blockage or damage on US side.	Does not meet HW/D = 1.2. Headwaters exceed ROW	Replace with (3) 48" RCP
EP-36	6060+00	I-95	RCP	42	42	219	96.04	95.83	2.7	Rational	70	1.0	96.50	0.13	N	1.2	96.54	0.14	N	25% blockage of debris on DS side	Meets design criteria. Headwaters within ROW	Alt 2: Extend R side Alt 3: Extend R side
BC-4	119+25	Bluff Rd	RCBC	6x6	72	52	90.6	90.59	1094.4	Regression	-	*340.0	98.47	1.31	Y	523.0	100.54	1.66	Y	Good condition. Well-defined channel that bends to DS left. Vines hanging at US inlet.	Does not meet HW/D = 1.2. Headwaters exceed ROW	Replace with (1) 9'x6' RCBC

**Bluff Rd has a 25-yr design storm*

3.4.1 EP-22e – I-26 STA 3123+00 – 48" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

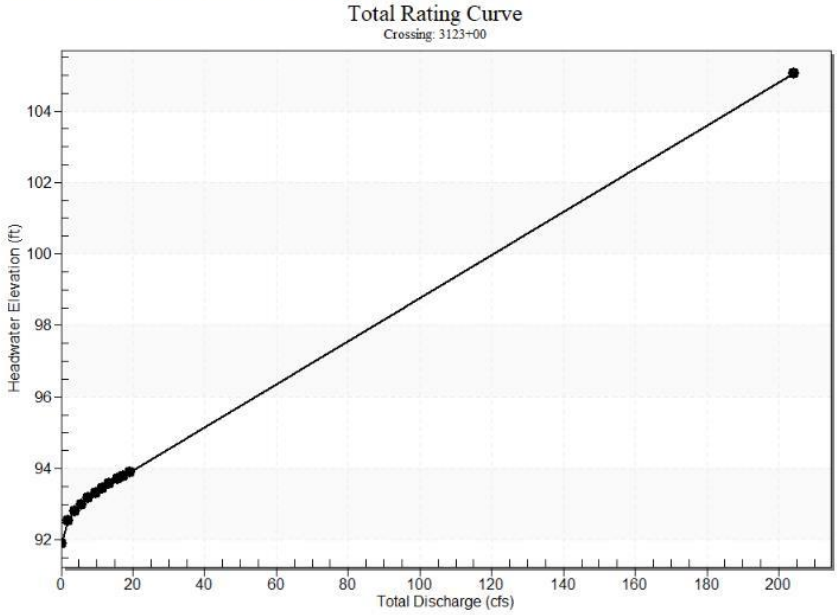
Design Flow: 15.90 cfs

Maximum Flow: 19.20 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3123+00

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
91.91	0.00	0.00	0.00	1
92.55	1.92	1.92	0.00	1
92.81	3.84	3.84	0.00	1
93.00	5.76	5.76	0.00	1
93.17	7.68	7.68	0.00	1
93.31	9.60	9.60	0.00	1
93.45	11.52	11.52	0.00	1
93.57	13.44	13.44	0.00	1
93.72	15.90	15.90	0.00	1
93.80	17.28	17.28	0.00	1
93.91	19.20	19.20	0.00	1
105.00	200.82	200.82	0.00	Overtopping

Rating Curve Plot for Crossing: 3123+00



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	91.91	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.92 cfs	1.92 cfs	92.55	0.53	0.643	2-M2c	0.61	0.40	0.40	0.28	2.96	1.25
3.84 cfs	3.84 cfs	92.81	0.76	0.896	2-M2c	0.86	0.57	0.57	0.43	3.54	1.60
5.76 cfs	5.76 cfs	93.00	0.94	1.091	2-M2c	1.05	0.69	0.69	0.54	3.94	1.84
7.68	7.68	93.17	1.09	1.25	2-	1.22	0.80	0.8	0.64	4.26	2.02

cfs	cfs			6	M2 c			0			
9.60 cfs	9.60 cfs	93.31	1.22	1.40 3	2- M2 c	1.37	0.90	0.9 0	0.73	4.52	2.17
11.52 cfs	11.52 cfs	93.45	1.34	1.53 7	2- M2 c	1.51	0.99	0.9 9	0.81	4.75	2.30
13.44 cfs	13.44 cfs	93.57	1.45	1.66 2	2- M2 c	1.65	1.07	1.0 7	0.88	4.96	2.41
15.90 cfs	15.90 cfs	93.72	1.59	1.81 0	2- M2 c	1.81	1.17	1.1 7	0.97	5.20	2.54
17.28 cfs	17.28 cfs	93.80	1.66	1.89 0	2- M2 c	1.90	1.22	1.2 2	1.02	5.33	2.61
19.20 cfs	19.20 cfs	93.91	1.76	1.99 6	2- M2 c	2.02	1.29	1.2 9	1.08	5.49	2.69

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

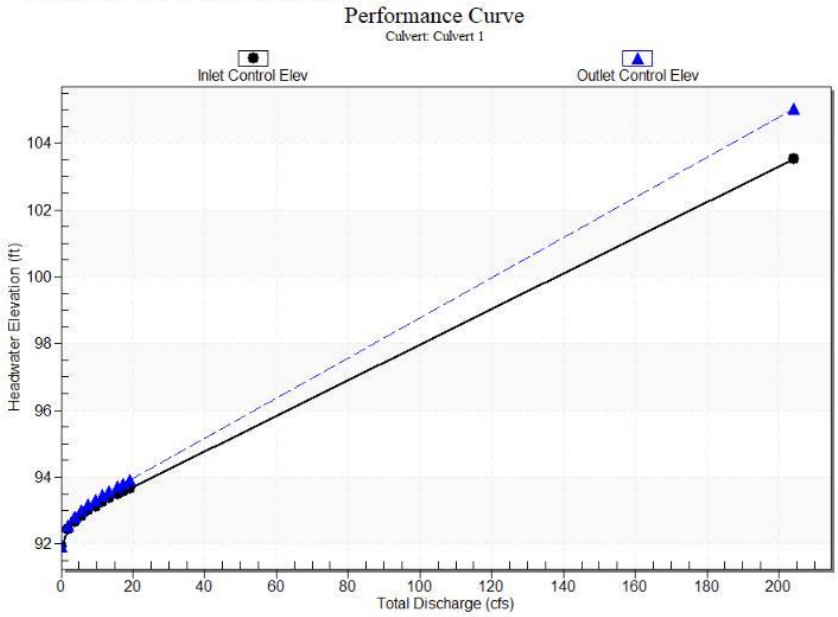
Inlet Elevation (invert): 91.91 ft,

Outlet Elevation (invert): 91.75 ft

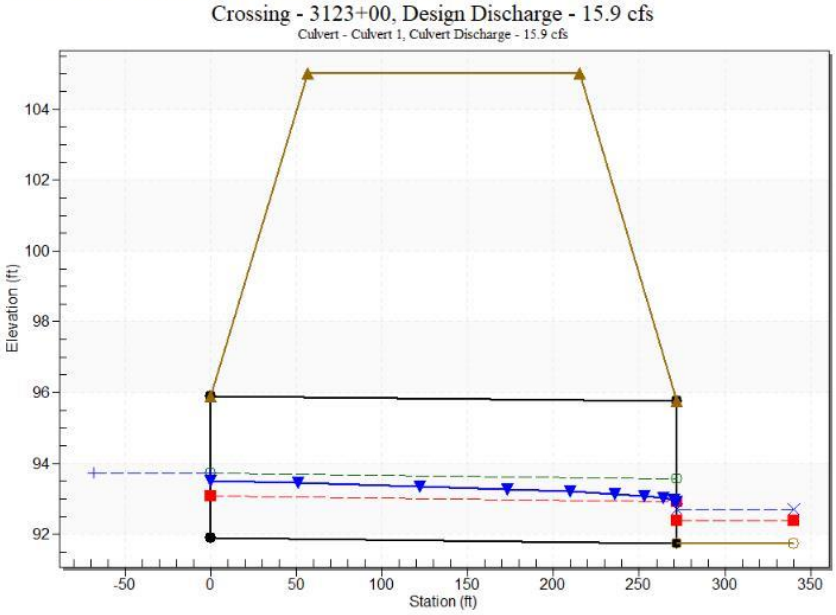
Culvert Length: 272.00 ft,

Culvert Slope: 0.0006

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 91.91 ft

Outlet Station: 272.00 ft

Outlet Elevation: 91.75 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1) (Ke=0.2)

Inlet Depression: None

Tailwater Data for Crossing: 3123+00

Table 3 - Downstream Channel Rating Curve (Crossing: 3123+00)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	91.75	0.00	0.00	0.00	0.00
1.92	92.03	0.28	1.25	0.10	0.43
3.84	92.18	0.43	1.60	0.14	0.46
5.76	92.29	0.54	1.84	0.18	0.47
7.68	92.39	0.64	2.02	0.22	0.48
9.60	92.48	0.73	2.17	0.24	0.49
11.52	92.56	0.81	2.30	0.27	0.49
13.44	92.63	0.88	2.41	0.30	0.50
15.90	92.72	0.97	2.54	0.33	0.50
17.28	92.77	1.02	2.61	0.34	0.51
19.20	92.83	1.08	2.69	0.36	0.51

Tailwater Channel Data - 3123+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0054

Channel Manning's n: 0.0350

Channel Invert Elevation: 91.75 ft

Roadway Data for Crossing: 3123+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 159.00 ft

3.4.2 EP-19 – I-26 STA 3137+00 – 24" Concrete Crossline

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

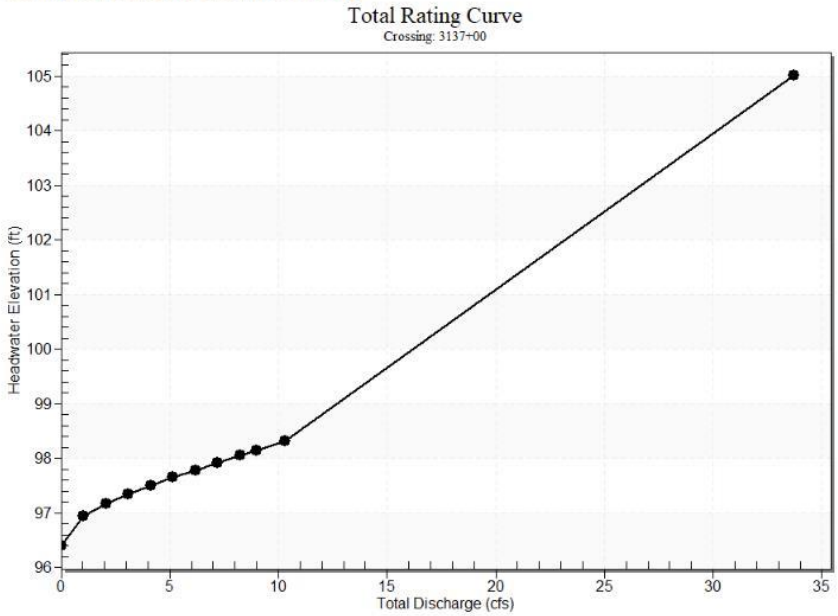
Design Flow: 9.00 cfs

Maximum Flow: 10.30 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3137+00

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
96.41	0.00	0.00	0.00	1
96.94	1.03	1.03	0.00	1
97.16	2.06	2.06	0.00	1
97.35	3.09	3.09	0.00	1
97.50	4.12	4.12	0.00	1
97.65	5.15	5.15	0.00	1
97.79	6.18	6.18	0.00	1
97.92	7.21	7.21	0.00	1
98.05	8.24	8.24	0.00	1
98.14	9.00	9.00	0.00	1
98.31	10.30	10.30	0.00	1
105.00	33.36	33.36	0.00	Overtopping

Rating Curve Plot for Crossing: 3137+00



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	96.41	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.03 cfs	1.03 cfs	96.94	0.47	0.527	2-M2c	0.46	0.35	0.35	0.13	2.80	1.29
2.06 cfs	2.06 cfs	97.16	0.67	0.753	2-M2c	0.66	0.50	0.50	0.20	3.37	1.68
3.09 cfs	3.09 cfs	97.35	0.84	0.935	2-M2c	0.82	0.61	0.61	0.25	3.78	1.95
4.12	4.12	97.50	0.97	1.09	2-	0.96	0.71	0.7	0.30	4.11	2.17

cfs	cfs			4	M2 c			1			
5.15 cfs	5.15 cfs	97.65	1.12	1.240	2-M2 c	1.10	0.80	0.80	0.34	4.39	2.35
6.18 cfs	6.18 cfs	97.79	1.25	1.377	2-M2 c	1.23	0.88	0.88	0.38	4.65	2.51
7.21 cfs	7.21 cfs	97.92	1.37	1.510	2-M2 c	1.38	0.95	0.95	0.41	4.88	2.65
8.24 cfs	8.24 cfs	98.05	1.48	1.640	2-M2 c	1.53	1.02	1.02	0.45	5.10	2.78
9.00 cfs	9.00 cfs	98.14	1.55	1.734	2-M2 c	1.68	1.07	1.07	0.47	5.26	2.86
10.30 cfs	10.30 cfs	98.31	1.68	1.901	2-M2 c	2.00	1.15	1.15	0.51	5.51	3.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

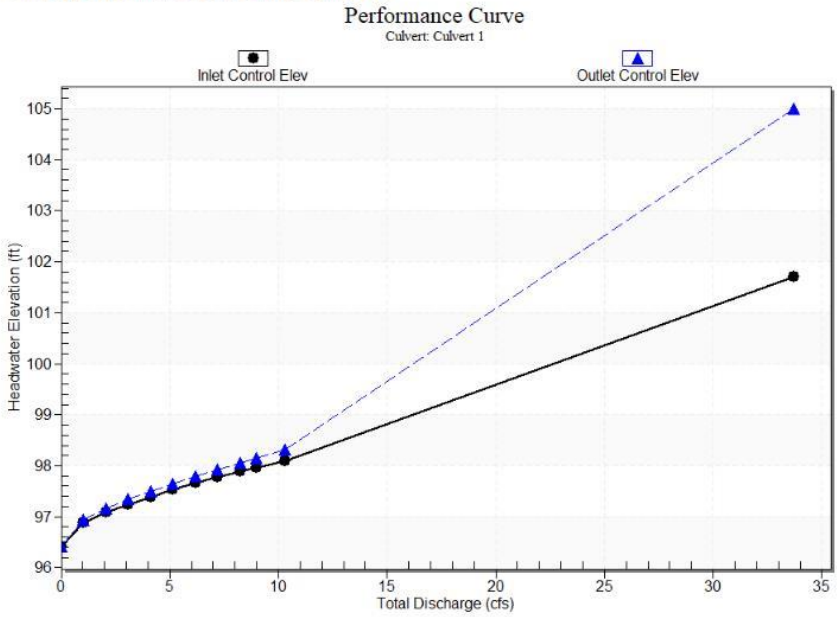
Inlet Elevation (invert): 96.41 ft,

Outlet Elevation (invert): 96.07 ft

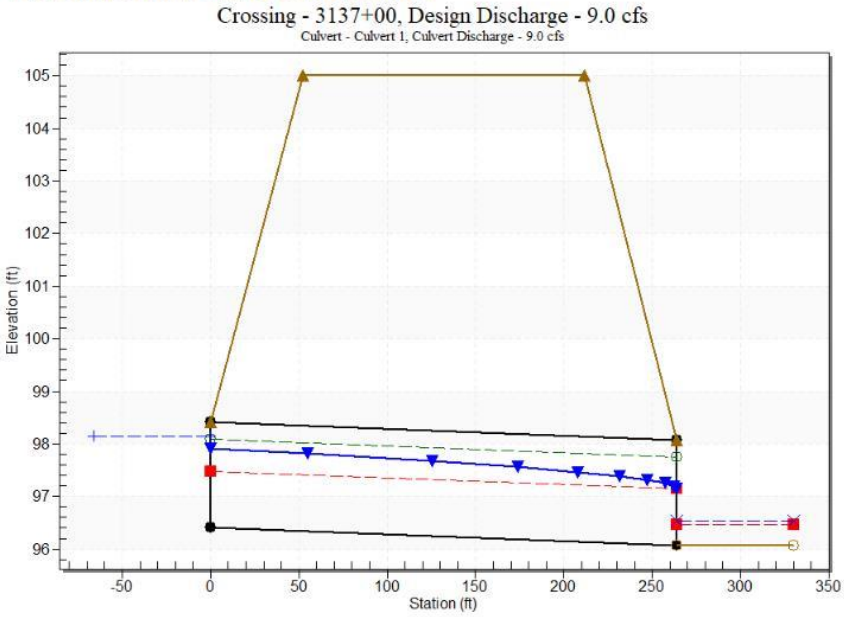
Culvert Length: 264.00 ft,

Culvert Slope: 0.0013

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 96.41 ft

Outlet Station: 264.00 ft

Outlet Elevation: 96.07 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1)

Inlet Depression: None

Tailwater Data for Crossing: 3137+00

Table 3 - Downstream Channel Rating Curve (Crossing: 3137+00)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	96.07	0.00	0.00	0.00	0.00
1.03	96.20	0.13	1.29	0.12	0.64
2.06	96.27	0.20	1.68	0.18	0.68
3.09	96.32	0.25	1.95	0.23	0.71
4.12	96.37	0.30	2.17	0.28	0.73
5.15	96.41	0.34	2.35	0.32	0.74
6.18	96.45	0.38	2.51	0.35	0.75
7.21	96.48	0.41	2.65	0.38	0.76
8.24	96.52	0.45	2.78	0.42	0.77
9.00	96.54	0.47	2.86	0.44	0.77
10.30	96.58	0.51	3.00	0.48	0.78

Tailwater Channel Data - 3137+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 6.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0150

Channel Manning's n: 0.0350

Channel Invert Elevation: 96.07 ft

Roadway Data for Crossing: 3137+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 159.00 ft

3.4.3 BC-1 – I-26 STA 3145+00 – 8'x6' Concrete Box Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 283.00 cfs

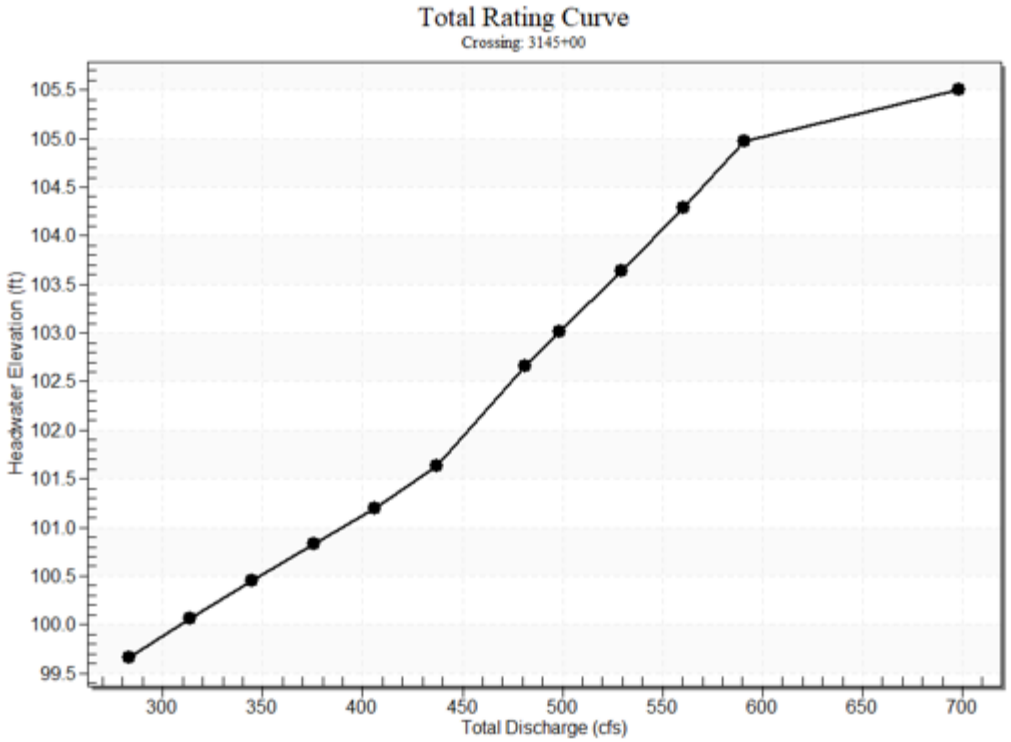
Design Flow: 481.00 cfs

Maximum Flow: 591.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3145+00

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
99.66	283.00	283.00	0.00	1
100.07	313.80	313.80	0.00	1
100.45	344.60	344.60	0.00	1
100.83	375.40	375.40	0.00	1
101.20	406.20	406.20	0.00	1
101.63	437.00	437.00	0.00	1
102.66	481.00	481.00	0.00	1
103.01	498.60	498.60	0.00	1
103.64	529.40	529.40	0.00	1
104.29	560.20	560.20	0.00	1
104.97	591.00	591.00	0.00	1
105.00	592.47	592.47	0.00	Overtopping

Rating Curve Plot for Crossing: 3145+00



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
283.00 cfs	283.00 cfs	99.66	5.24	5.924	3-M1t	4.56	3.39	4.75	4.75	7.45	3.41
313.80 cfs	313.80 cfs	100.07	5.64	6.326	7-M1t	4.94	3.63	4.99	4.99	7.86	3.50
344.60 cfs	344.60 cfs	100.45	6.03	6.715	3-M2t	5.31	3.86	5.21	5.21	8.26	3.59
375.40 cfs	375.40 cfs	100.83	6.44	7.091	3-M2t	5.67	4.09	5.43	5.43	8.64	3.67

406.20 cfs	406.20 cfs	101.20	6.85	7.458	3-M2t	6.00	4.31	5.63	5.63	9.01	3.74
437.00 cfs	437.00 cfs	101.63	7.29	7.889	7-M2t	6.00	4.53	5.83	5.83	9.37	3.81
481.00 cfs	481.00 cfs	102.66	7.95	8.917	4-FFf	6.00	4.82	6.00	6.10	10.02	3.91
498.60 cfs	498.60 cfs	103.01	8.22	9.268	4-FFf	6.00	4.94	6.00	6.20	10.39	3.94
529.40 cfs	529.40 cfs	103.64	8.73	9.900	4-FFf	6.00	5.14	6.00	6.37	11.03	4.01
560.20 cfs	560.20 cfs	104.29	9.27	10.552	4-FFf	6.00	5.34	6.00	6.54	11.67	4.06
591.00 cfs	591.00 cfs	104.97	9.84	11.227	4-FFf	6.00	5.53	6.00	6.70	12.31	4.12

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

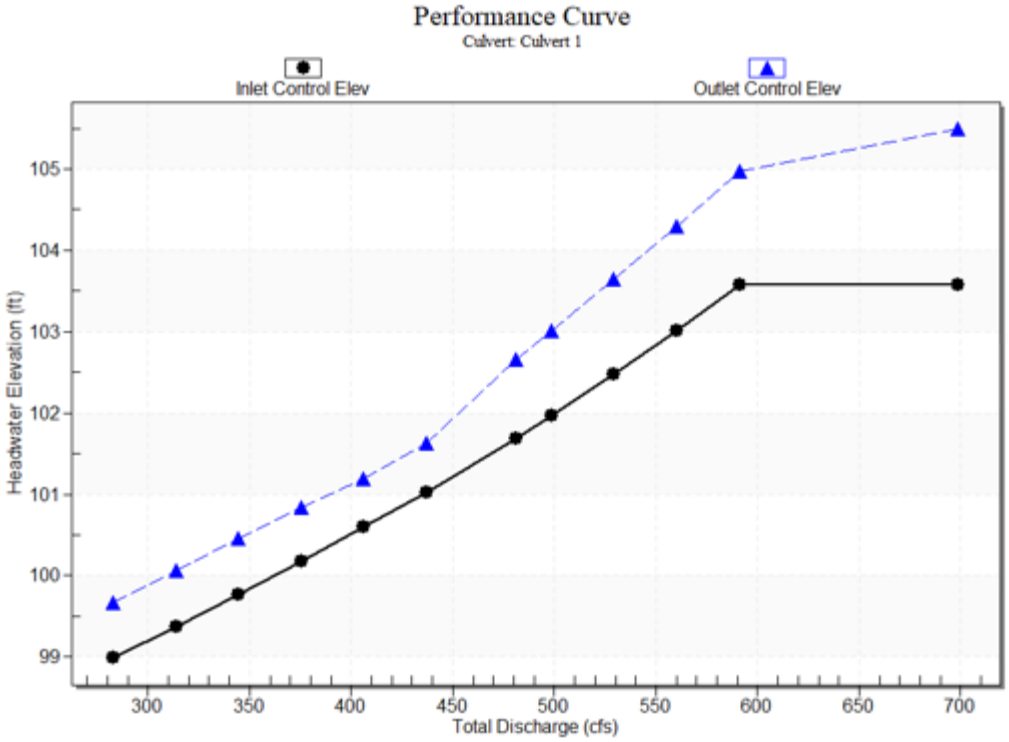
Inlet Elevation (invert): 93.74 ft,

Outlet Elevation (invert): 93.22 ft

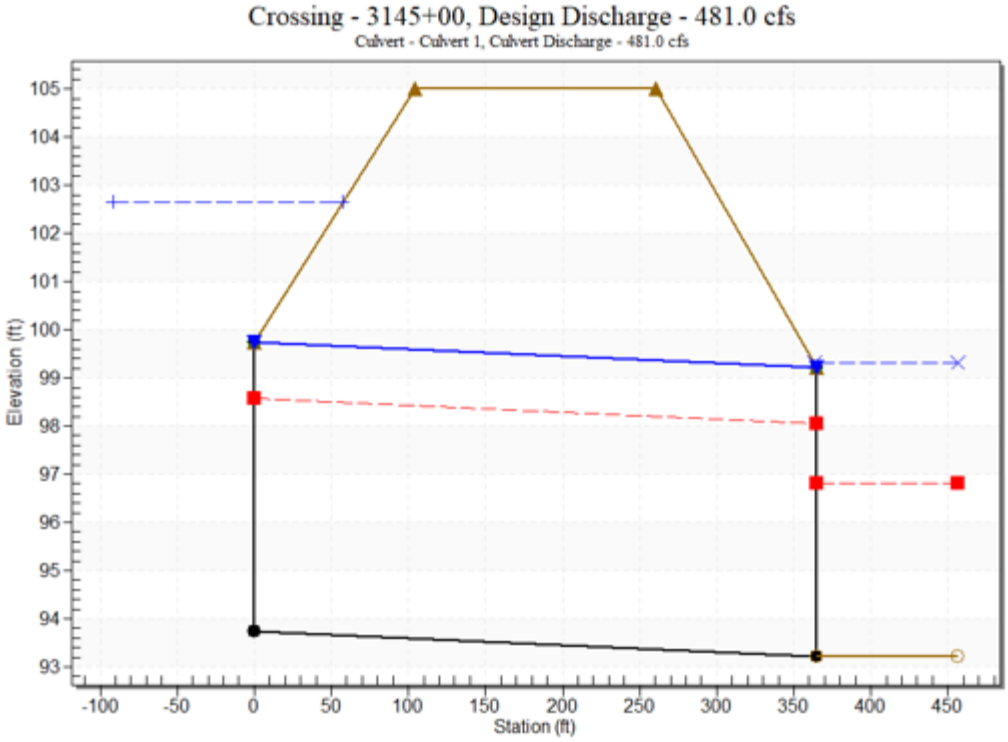
Culvert Length: 365.00 ft,

Culvert Slope: 0.0014

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 93.74 ft

Outlet Station: 365.00 ft

Outlet Elevation: 93.22 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall (Ke=0.4)

Inlet Depression: None

Tailwater Data for Crossing: 3145+00

Table 3 - Downstream Channel Rating Curve (Crossing: 3145+00)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
283.00	97.97	4.75	3.41	0.47	0.34
313.80	98.21	4.99	3.50	0.50	0.34
344.60	98.43	5.21	3.59	0.52	0.35
375.40	98.65	5.43	3.67	0.54	0.35
406.20	98.85	5.63	3.74	0.56	0.35
437.00	99.05	5.83	3.81	0.58	0.35
481.00	99.32	6.10	3.91	0.61	0.35
498.60	99.42	6.20	3.94	0.62	0.35
529.40	99.59	6.37	4.01	0.64	0.36
560.20	99.76	6.54	4.06	0.65	0.36
591.00	99.92	6.70	4.12	0.67	0.36

Tailwater Channel Data - 3145+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 8.00 ft

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0016

Channel Manning's n: 0.0350

Channel Invert Elevation: 93.22 ft

Roadway Data for Crossing: 3145+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 157.00 ft

3.4.4 EP-12 – I-26 STA 3184+00 – 18" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

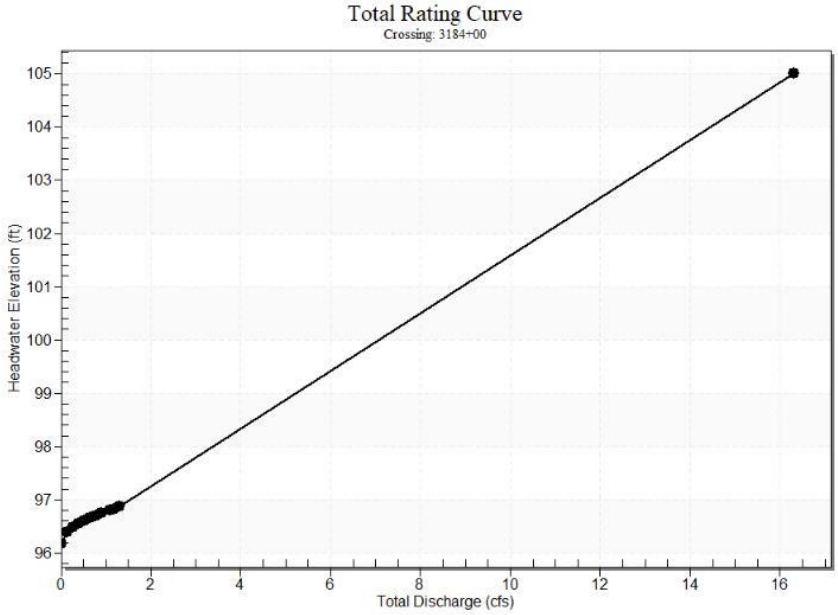
Design Flow: 1.10 cfs

Maximum Flow: 1.30 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3184+00

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
96.18	0.00	0.00	0.00	1
96.39	0.13	0.13	0.00	1
96.48	0.26	0.26	0.00	1
96.55	0.39	0.39	0.00	1
96.60	0.52	0.52	0.00	1
96.65	0.65	0.65	0.00	1
96.70	0.78	0.78	0.00	1
96.75	0.91	0.91	0.00	1
96.80	1.10	1.10	0.00	1
96.83	1.17	1.17	0.00	1
96.86	1.30	1.30	0.00	1
105.00	16.24	16.24	0.00	Overtopping

Rating Curve Plot for Crossing: 3184+00



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	96.18	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.13 cfs	0.13 cfs	96.39	0.18	0.213	2-M2c	0.19	0.13	0.13	0.04	1.70	0.62
0.26 cfs	0.26 cfs	96.48	0.25	0.298	2-M2c	0.27	0.19	0.19	0.06	2.04	0.81
0.39 cfs	0.39 cfs	96.55	0.31	0.366	2-M2c	0.33	0.23	0.23	0.08	2.26	0.95
0.52	0.52	96.60	0.36	0.42	2-	0.38	0.27	0.2	0.10	2.44	1.06

cfs	cfs			4	M2 c			7			
0.65 cfs	0.65 cfs	96.65	0.40	0.474	2-M2 c	0.43	0.30	0.30	0.11	2.59	1.15
0.78 cfs	0.78 cfs	96.70	0.44	0.521	2-M2 c	0.47	0.33	0.33	0.12	2.73	1.24
0.91 cfs	0.91 cfs	96.75	0.48	0.565	2-M2 c	0.51	0.36	0.36	0.13	2.84	1.31
1.10 cfs	1.10 cfs	96.80	0.53	0.625	2-M2 c	0.57	0.39	0.39	0.15	3.00	1.41
1.17 cfs	1.17 cfs	96.83	0.55	0.646	2-M2 c	0.59	0.40	0.40	0.16	3.05	1.44
1.30 cfs	1.30 cfs	96.86	0.58	0.683	2-M2 c	0.62	0.43	0.43	0.17	3.14	1.50

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

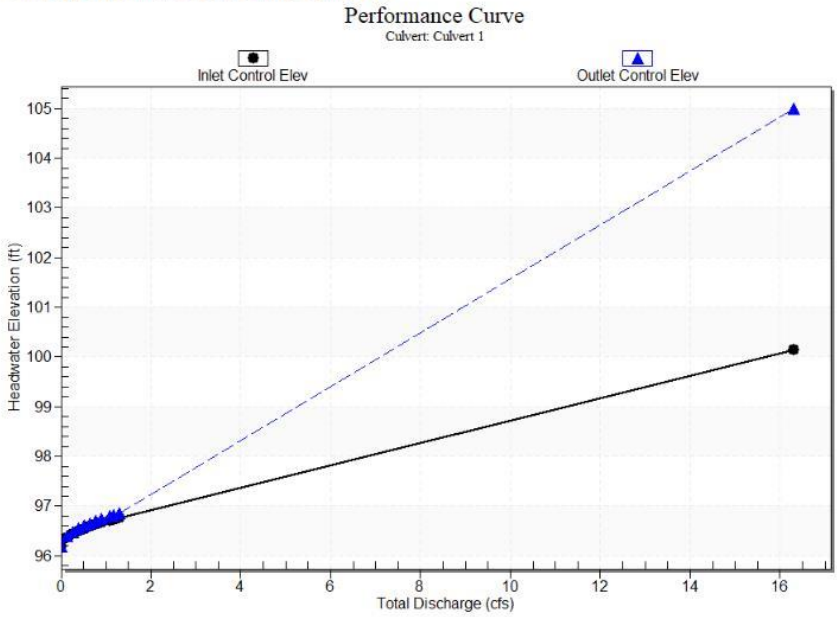
Inlet Elevation (invert): 96.18 ft,

Outlet Elevation (invert): 95.88 ft

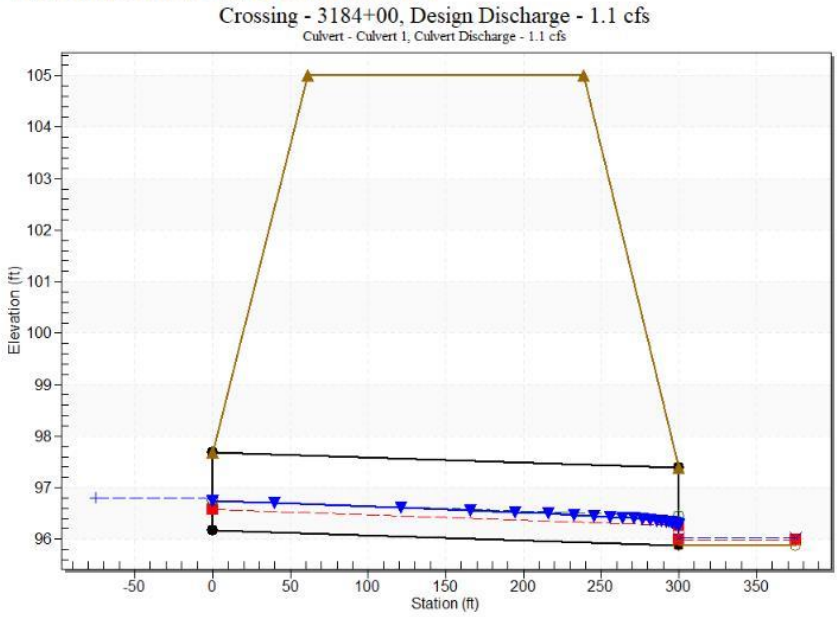
Culvert Length: 300.00 ft,

Culvert Slope: 0.0010

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 96.18 ft

Outlet Station: 300.00 ft

Outlet Elevation: 95.88 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1) (Ke=0.2)

Inlet Depression: None

Tailwater Data for Crossing: 3184+00

Table 3 - Downstream Channel Rating Curve (Crossing: 3184+00)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	95.88	0.00	0.00	0.00	0.00
0.13	95.92	0.04	0.62	0.04	0.54
0.26	95.94	0.06	0.81	0.06	0.57
0.39	95.96	0.08	0.95	0.08	0.60
0.52	95.98	0.10	1.06	0.09	0.61
0.65	95.99	0.11	1.15	0.10	0.62
0.78	96.00	0.12	1.24	0.11	0.64
0.91	96.01	0.13	1.31	0.12	0.65
1.10	96.03	0.15	1.41	0.14	0.66
1.17	96.04	0.16	1.44	0.15	0.66
1.30	96.05	0.17	1.50	0.15	0.67

Tailwater Channel Data - 3184+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0150

Channel Manning's n: 0.0350

Channel Invert Elevation: 95.88 ft

Roadway Data for Crossing: 3184+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 178.00 ft

3.4.5 EP-11 – I-26 STA 3186+80 – 18" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

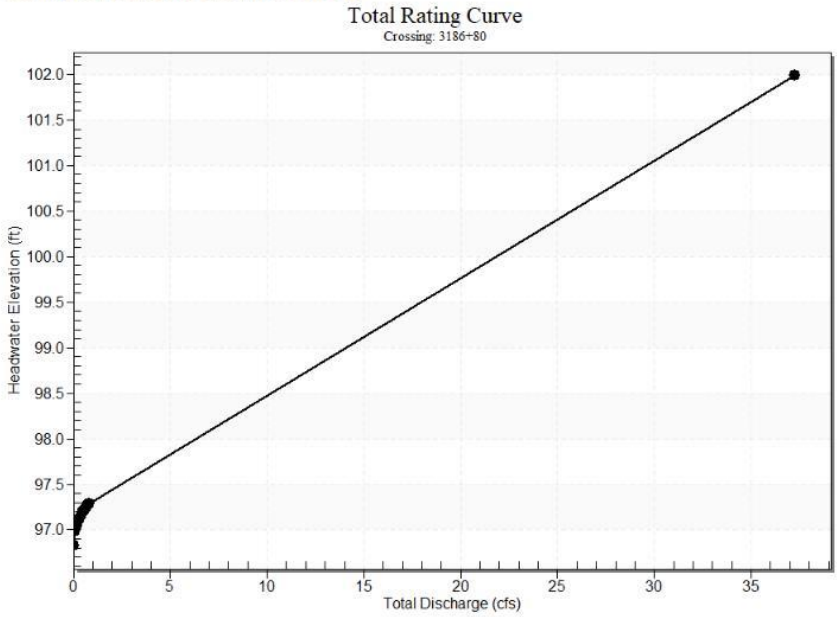
Design Flow: 0.70 cfs

Maximum Flow: 0.80 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3186+80

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
96.83	0.00	0.00	0.00	1
96.98	0.08	0.08	0.00	1
97.04	0.16	0.16	0.00	1
97.09	0.24	0.24	0.00	1
97.12	0.32	0.32	0.00	1
97.16	0.40	0.40	0.00	1
97.19	0.48	0.48	0.00	1
97.22	0.56	0.56	0.00	1
97.24	0.64	0.64	0.00	1
97.26	0.70	0.70	0.00	1
97.29	0.80	0.80	0.00	1
105.00	51.68	51.68	0.00	Overtopping

Rating Curve Plot for Crossing: 3186+80



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	96.83	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.08 cfs	0.08 cfs	96.98	0.12	0.149	2-M2c	0.14	0.09	0.09	0.04	1.40	0.45
0.16 cfs	0.16 cfs	97.04	0.17	0.211	2-M2c	0.20	0.13	0.13	0.05	1.67	0.59
0.24 cfs	0.24 cfs	97.09	0.21	0.255	2-M2c	0.24	0.16	0.16	0.07	1.85	0.69
0.32	0.32	97.12	0.24	0.29	2-	0.27	0.18	0.1	0.08	1.99	0.78

cfs	cfs			4	M2 c			8			
0.40 cfs	0.40 cfs	97.16	0.27	0.32 8	2- M2 c	0.30	0.20	0.2 0	0.09	2.11	0.84
0.48 cfs	0.48 cfs	97.19	0.30	0.35 9	2- M2 c	0.33	0.22	0.2 2	0.10	2.21	0.91
0.56 cfs	0.56 cfs	97.22	0.32	0.38 7	2- M2 c	0.36	0.24	0.2 4	0.11	2.30	0.96
0.64 cfs	0.64 cfs	97.24	0.35	0.41 4	2- M2 c	0.38	0.26	0.2 6	0.12	2.38	1.01
0.70 cfs	0.70 cfs	97.26	0.36	0.43 3	2- M2 c	0.40	0.27	0.2 7	0.13	2.44	1.05
0.80 cfs	0.80 cfs	97.29	0.39	0.46 1	2- M2 c	0.42	0.29	0.2 9	0.14	2.53	1.10

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

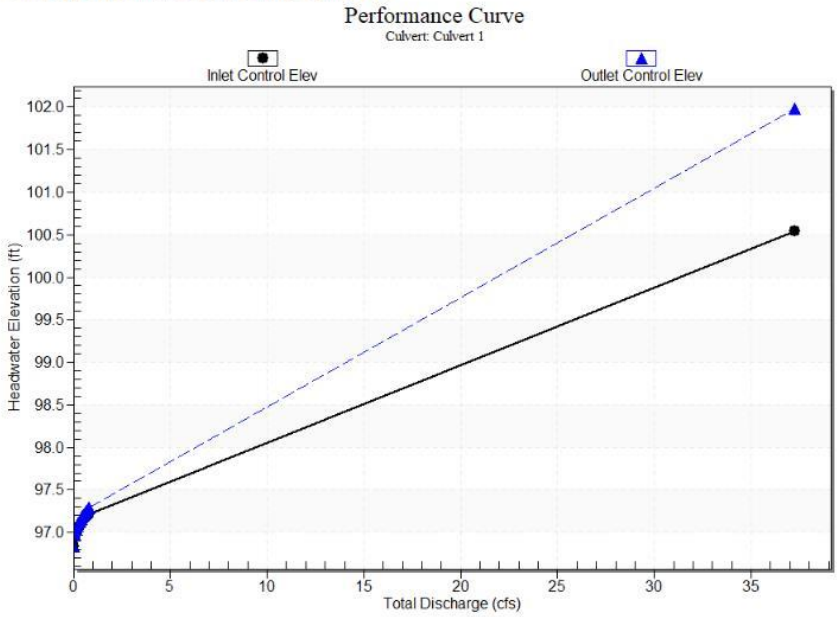
Inlet Elevation (invert): 96.83 ft,

Outlet Elevation (invert): 96.59 ft

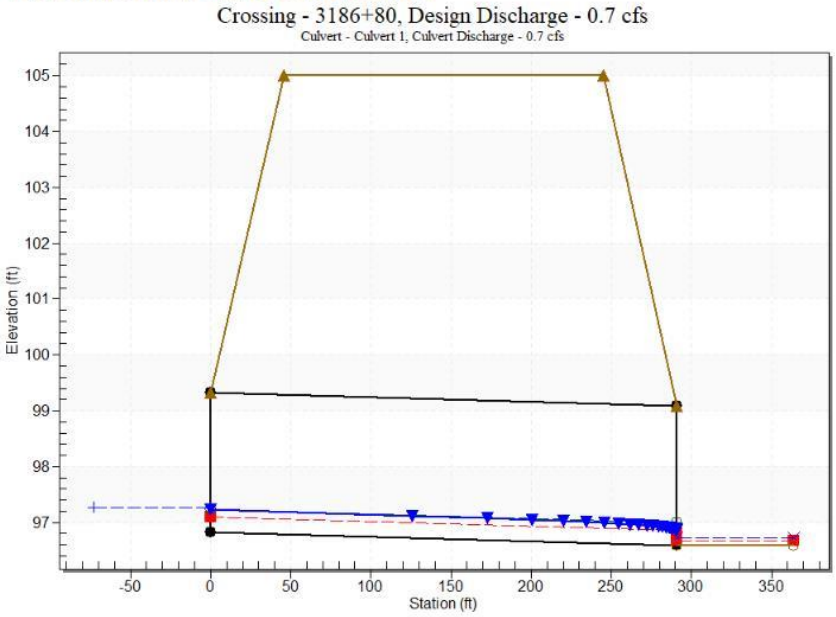
Culvert Length: 291.00 ft,

Culvert Slope: 0.0008

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 96.83 ft

Outlet Station: 291.00 ft

Outlet Elevation: 96.59 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1) (Ke=0.2)

Inlet Depression: None

Tailwater Data for Crossing: 3186+80

Table 3 - Downstream Channel Rating Curve (Crossing: 3186+80)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	96.59	0.00	0.00	0.00	0.00
0.08	96.63	0.04	0.45	0.02	0.43
0.16	96.64	0.05	0.59	0.03	0.46
0.24	96.66	0.07	0.69	0.04	0.47
0.32	96.67	0.08	0.78	0.05	0.49
0.40	96.68	0.09	0.84	0.06	0.50
0.48	96.69	0.10	0.91	0.06	0.51
0.56	96.70	0.11	0.96	0.07	0.51
0.64	96.71	0.12	1.01	0.08	0.52
0.70	96.72	0.13	1.05	0.08	0.52
0.80	96.73	0.14	1.10	0.09	0.53

Tailwater Channel Data - 3186+80

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 96.59 ft

Roadway Data for Crossing: 3186+80

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 200.00 ft

3.4.6 BC-2 – I-95 NB to I-26 EB Ramp STA 3214+28 – 6'x6' Concrete Box Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 237.00 cfs

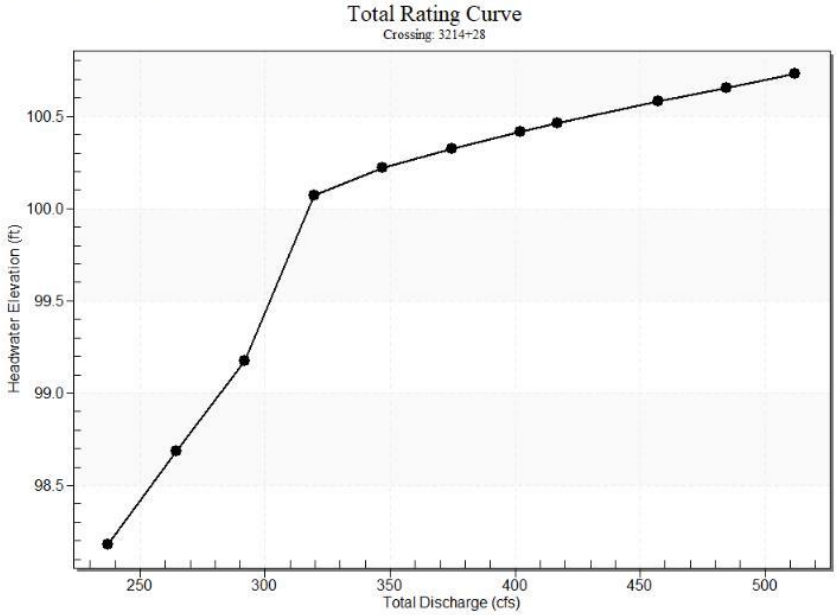
Design Flow: 417.00 cfs

Maximum Flow: 512.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3214+28

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
98.18	237.00	237.00	0.00	1
98.69	264.50	264.50	0.00	1
99.17	292.00	292.00	0.00	1
100.07	319.50	313.94	5.41	6
100.22	347.00	316.92	29.83	7
100.32	374.50	319.85	54.29	5
100.41	402.00	321.73	80.06	5
100.46	417.00	322.57	94.07	4
100.58	457.00	323.87	133.00	5
100.65	484.50	324.08	160.16	4
100.73	512.00	323.52	188.28	4
100.00	311.56	311.56	0.00	Overtopping

Rating Curve Plot for Crossing: 3214+28



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
237.00 cfs	237.00 cfs	98.18	5.66	6.432	7-M2c	5.45	3.65	3.65	3.50	10.83	2.89
264.50 cfs	264.50 cfs	98.69	6.14	6.937	7-M2c	6.00	3.92	3.92	3.73	11.24	2.99
292.00 cfs	292.00 cfs	99.17	6.62	7.425	7-M2c	6.00	4.19	4.19	3.95	11.62	3.08
319.50 cfs	313.94 cfs	100.07	7.03	8.321	7-M2c	6.00	4.40	4.40	4.17	11.90	3.17

347.00 cfs	316.92 cfs	100.22	7.08	8.473	7-M2c	6.00	4.43	4.43	4.37	11.94	3.26
374.50 cfs	319.85 cfs	100.32	7.14	8.571	7-M2t	6.00	4.45	4.57	4.57	11.66	3.33
402.00 cfs	321.73 cfs	100.41	7.17	8.664	7-M2t	6.00	4.47	4.77	4.77	11.25	3.41
417.00 cfs	322.57 cfs	100.46	7.19	8.710	7-M2t	6.00	4.48	4.87	4.87	11.04	3.44
457.00 cfs	323.87 cfs	100.58	7.21	8.829	7-M2t	6.00	4.49	5.13	5.13	10.52	3.54
484.50 cfs	324.08 cfs	100.65	7.22	8.904	7-M2t	6.00	4.49	5.31	5.31	10.17	3.61
512.00 cfs	323.52 cfs	100.73	7.21	8.979	7-M2t	6.00	4.49	5.48	5.48	9.84	3.67

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

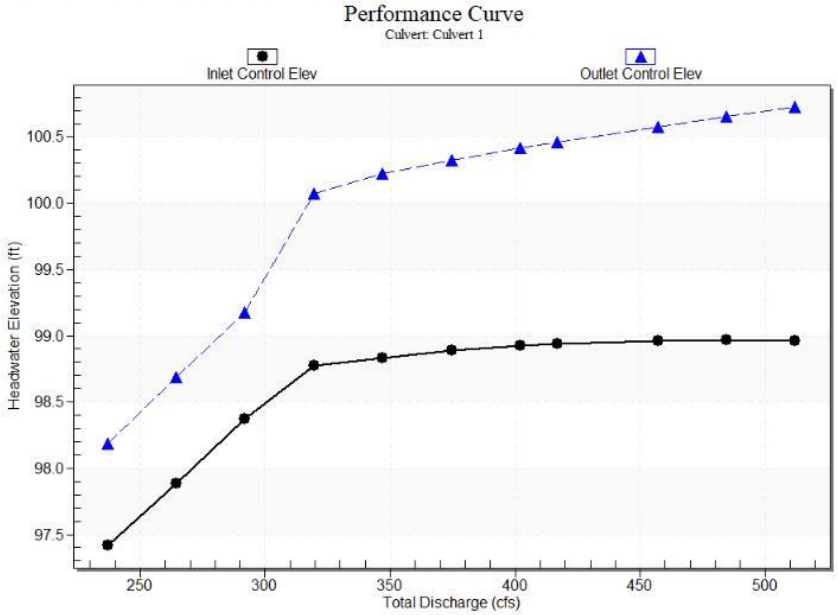
Inlet Elevation (invert): 91.75 ft,

Outlet Elevation (invert): 90.28 ft

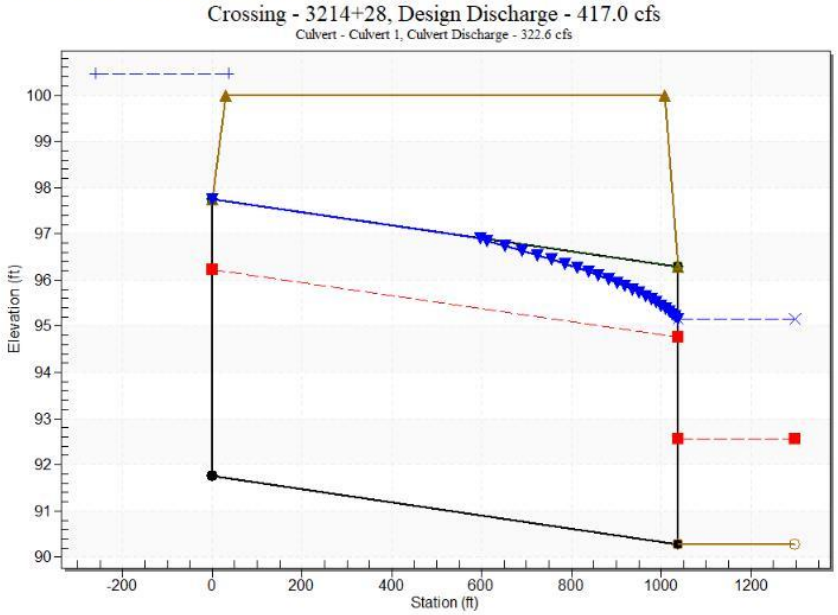
Culvert Length: 1038.00 ft,

Culvert Slope: 0.0014

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 91.75 ft

Outlet Station: 1038.00 ft

Outlet Elevation: 90.28 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall

Inlet Depression: None

Tailwater Data for Crossing: 3214+28

Table 3 - Downstream Channel Rating Curve (Crossing: 3214+28)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
237.00	93.78	3.50	2.89	0.26	0.29
264.50	94.01	3.73	2.99	0.28	0.29
292.00	94.23	3.95	3.08	0.30	0.30
319.50	94.45	4.17	3.17	0.31	0.30
347.00	94.65	4.37	3.26	0.33	0.30
374.50	94.85	4.57	3.33	0.34	0.30
402.00	95.05	4.77	3.41	0.36	0.30
417.00	95.15	4.87	3.44	0.36	0.30
457.00	95.41	5.13	3.54	0.38	0.30
484.50	95.59	5.31	3.61	0.40	0.30
512.00	95.76	5.48	3.67	0.41	0.30

Tailwater Channel Data - 3214+28

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 20.00 ft

Side Slope (H:V): 1.00 (_:1)

Channel Slope: 0.0012

Channel Manning's n: 0.0350

Channel Invert Elevation: 90.28 ft

Roadway Data for Crossing: 3214+28

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 100.00 ft

Roadway Surface: Paved

Roadway Top Width: 976.00 ft

3.4.7 EP-3 – I-26 STA 3243+50 – 24" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

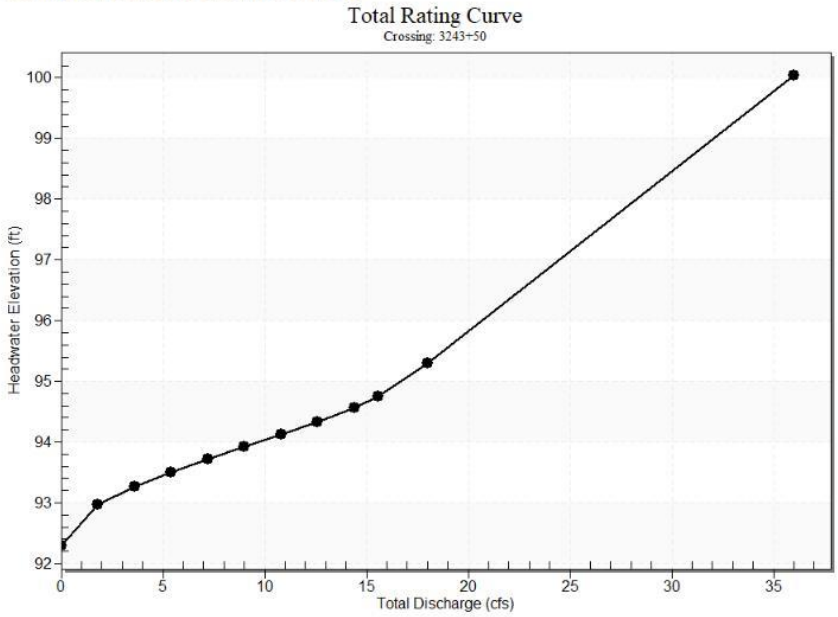
Design Flow: 15.60 cfs

Maximum Flow: 18.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: 3243+50

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
92.30	0.00	0.00	0.00	1
92.96	1.80	1.80	0.00	1
93.26	3.60	3.60	0.00	1
93.50	5.40	5.40	0.00	1
93.71	7.20	7.20	0.00	1
93.92	9.00	9.00	0.00	1
94.12	10.80	10.80	0.00	1
94.33	12.60	12.60	0.00	1
94.56	14.40	14.40	0.00	1
94.75	15.60	15.60	0.00	1
95.30	18.00	18.00	0.00	1
100.00	34.04	34.04	0.00	Overtopping

Rating Curve Plot for Crossing: 3243+50



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	92.30	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.80 cfs	1.80 cfs	92.96	0.63	0.664	2-M2c	0.52	0.46	0.46	0.23	3.25	1.49
3.60 cfs	3.60 cfs	93.26	0.91	0.959	2-M2c	0.75	0.66	0.66	0.34	3.95	1.91
5.40 cfs	5.40 cfs	93.50	1.15	1.199	2-M2c	0.94	0.82	0.82	0.43	4.45	2.20
7.20	7.20	93.71	1.36	1.41	2-	1.12	0.95	0.9	0.51	4.88	2.43

cfs	cfs			4	M2 c			5			
9.00 cfs	9.00 cfs	93.92	1.55	1.618	2-M2 c	1.30	1.07	1.07	0.59	5.26	2.62
10.80 cfs	10.80 cfs	94.12	1.73	1.819	2-M2 c	1.49	1.18	1.18	0.65	5.61	2.78
12.60 cfs	12.60 cfs	94.33	1.90	2.027	7-M2 c	1.76	1.28	1.28	0.71	5.95	2.92
14.40 cfs	14.40 cfs	94.56	2.09	2.257	7-M2 c	2.00	1.37	1.37	0.77	6.29	3.05
15.60 cfs	15.60 cfs	94.75	2.22	2.449	7-M2 c	2.00	1.42	1.42	0.80	6.52	3.13
18.00 cfs	18.00 cfs	95.30	2.51	3.000	7-M2 c	2.00	1.53	1.53	0.87	6.99	3.27

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

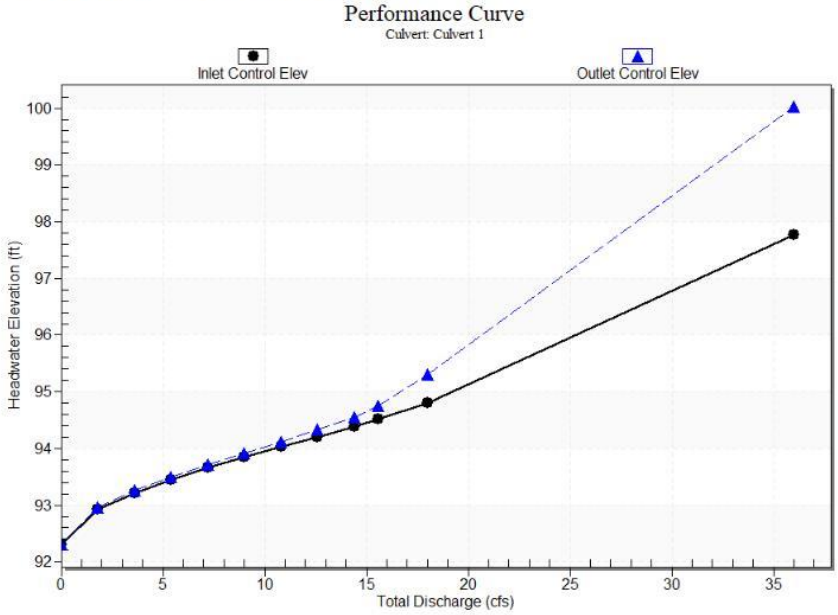
Inlet Elevation (invert): 92.30 ft,

Outlet Elevation (invert): 91.80 ft

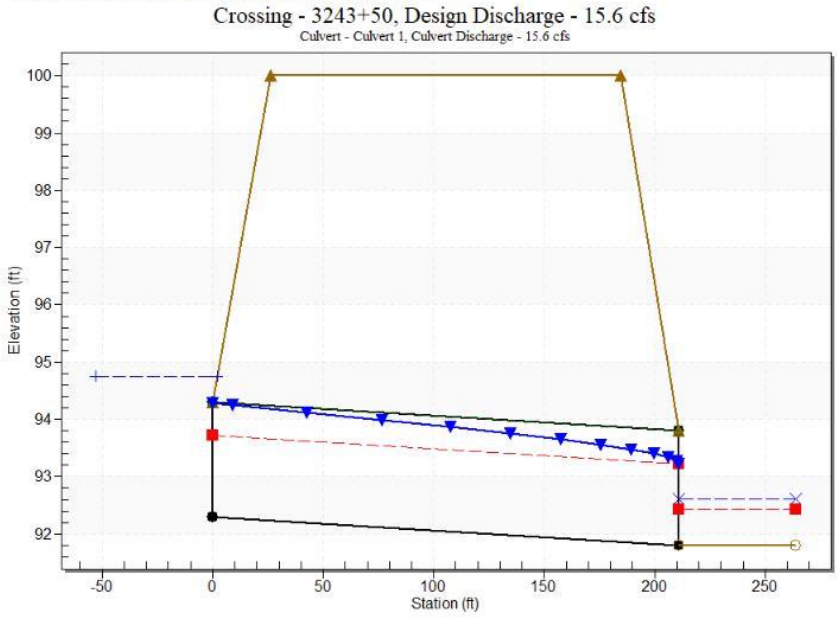
Culvert Length: 211.00 ft,

Culvert Slope: 0.0024

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 92.30 ft

Outlet Station: 211.00 ft

Outlet Elevation: 91.80 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1)

Inlet Depression: None

Tailwater Data for Crossing: 3243+50

Table 3 - Downstream Channel Rating Curve (Crossing: 3243+50)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	91.80	0.00	0.00	0.00	0.00
1.80	92.03	0.23	1.49	0.14	0.57
3.60	92.14	0.34	1.91	0.21	0.60
5.40	92.23	0.43	2.20	0.27	0.62
7.20	92.31	0.51	2.43	0.32	0.64
9.00	92.39	0.59	2.62	0.37	0.65
10.80	92.45	0.65	2.78	0.41	0.65
12.60	92.51	0.71	2.92	0.44	0.66
14.40	92.57	0.77	3.05	0.48	0.67
15.60	92.60	0.80	3.13	0.50	0.67
18.00	92.67	0.87	3.27	0.54	0.68

Tailwater Channel Data - 3243+50

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 91.80 ft

Roadway Data for Crossing: 3243+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 100.00 ft

Roadway Surface: Paved

Roadway Top Width: 158.00 ft

3.4.8 EP-27 – I-95 STA 5989+00 – 24" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

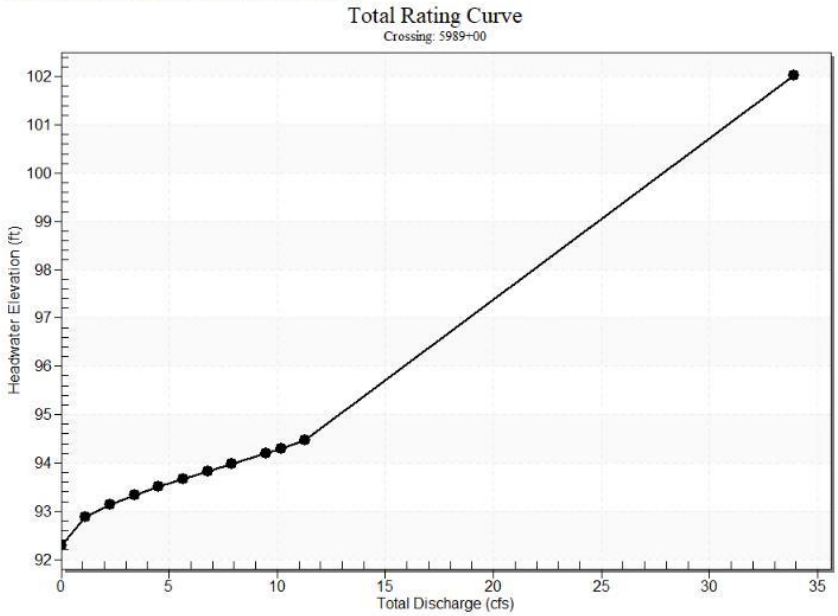
Design Flow: 9.50 cfs

Maximum Flow: 11.30 cfs

Table 1 - Summary of Culvert Flows at Crossing: 5989+00

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
92.29	0.00	0.00	0.00	1
92.87	1.13	1.13	0.00	1
93.12	2.26	2.26	0.00	1
93.33	3.39	3.39	0.00	1
93.50	4.52	4.52	0.00	1
93.67	5.65	5.65	0.00	1
93.82	6.78	6.78	0.00	1
93.98	7.91	7.91	0.00	1
94.19	9.50	9.50	0.00	1
94.29	10.17	10.17	0.00	1
94.47	11.30	11.30	0.00	1
102.00	32.91	32.91	0.00	Overtopping

Rating Curve Plot for Crossing: 5989+00



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	92.29	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.13 cfs	1.13 cfs	92.87	0.49	0.584	2-M2c	0.53	0.37	0.37	0.21	2.87	1.01
2.26 cfs	2.26 cfs	93.12	0.71	0.835	2-M2c	0.77	0.52	0.52	0.32	3.46	1.30
3.39 cfs	3.39 cfs	93.33	0.88	1.035	2-M2c	0.96	0.64	0.64	0.40	3.88	1.49
4.52	4.52	93.50	1.03	1.21	2-	1.15	0.75	0.7	0.48	4.22	1.65

cfs	cfs			2	M2c			5			
5.65 cfs	5.65 cfs	93.67	1.18	1.376	2-M2c	1.33	0.84	0.84	0.55	4.52	1.78
6.78 cfs	6.78 cfs	93.82	1.32	1.533	2-M2c	1.54	0.92	0.92	0.61	4.78	1.89
7.91 cfs	7.91 cfs	93.98	1.44	1.686	2-M2c	2.00	1.00	1.00	0.66	5.03	1.99
9.50 cfs	9.50 cfs	94.19	1.60	1.904	2-M2c	2.00	1.10	1.10	0.74	5.36	2.11
10.17 cfs	10.17 cfs	94.29	1.67	2.000	7-M2c	2.00	1.14	1.14	0.77	5.49	2.15
11.30 cfs	11.30 cfs	94.47	1.78	2.178	7-M2c	2.00	1.21	1.21	0.82	5.71	2.23

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

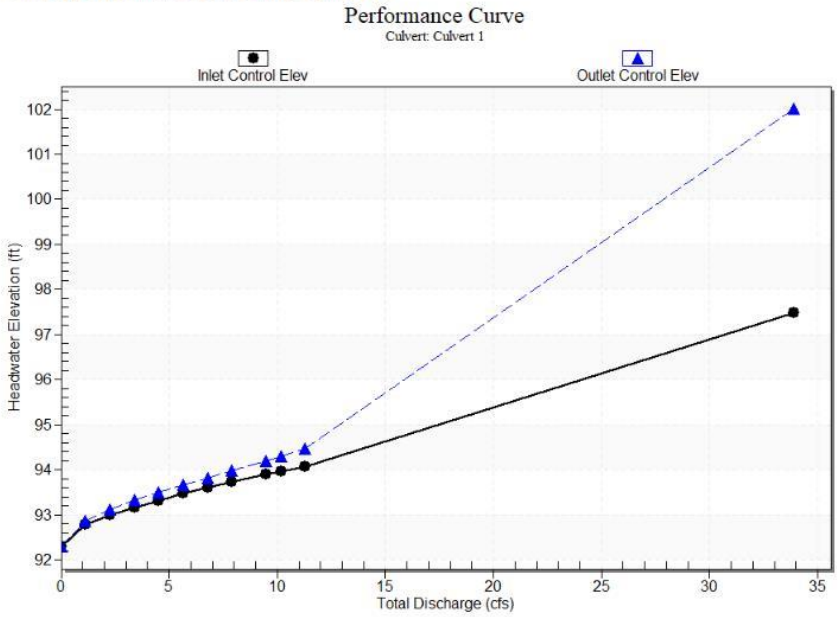
Inlet Elevation (invert): 92.29 ft,

Outlet Elevation (invert): 92.00 ft

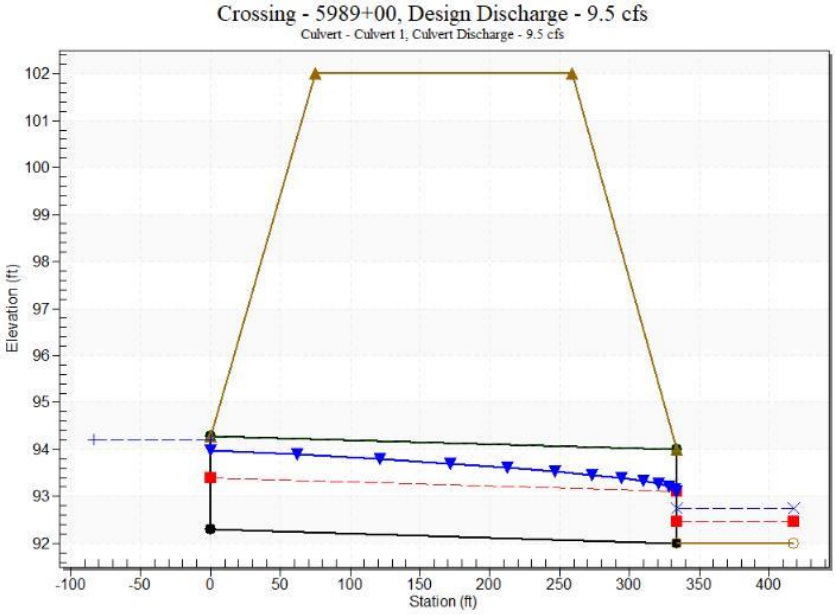
Culvert Length: 334.00 ft,

Culvert Slope: 0.0009

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 92.29 ft

Outlet Station: 334.00 ft

Outlet Elevation: 92.00 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1) (Ke=0.2)

Inlet Depression: None

Tailwater Data for Crossing: 5989+00

Table 3 - Downstream Channel Rating Curve (Crossing: 5989+00)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	92.00	0.00	0.00	0.00	0.00
1.13	92.21	0.21	1.01	0.07	0.40
2.26	92.32	0.32	1.30	0.10	0.42
3.39	92.40	0.40	1.49	0.13	0.44
4.52	92.48	0.48	1.65	0.15	0.45
5.65	92.55	0.55	1.78	0.17	0.45
6.78	92.61	0.61	1.89	0.19	0.46
7.91	92.66	0.66	1.99	0.21	0.46
9.50	92.74	0.74	2.11	0.23	0.47
10.17	92.77	0.77	2.15	0.24	0.47
11.30	92.82	0.82	2.23	0.25	0.48

Tailwater Channel Data - 5989+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0050

Channel Manning's n: 0.0350

Channel Invert Elevation: 92.00 ft

Roadway Data for Crossing: 5989+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 102.00 ft

Roadway Surface: Paved

Roadway Top Width: 184.00 ft

3.4.9 BC-3 – I-26 EB to I-95 SB Ramp STA 6022+50 – 6'x6' Concrete Box Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 224.00 cfs

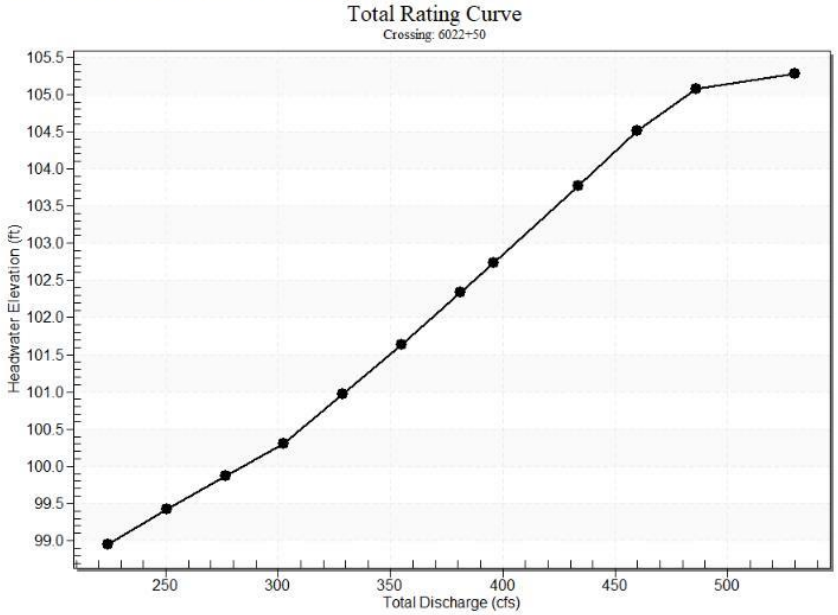
Design Flow: 396.00 cfs

Maximum Flow: 486.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: 6022+50

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
98.95	224.00	224.00	0.00	1
99.42	250.20	250.20	0.00	1
99.87	276.40	276.40	0.00	1
100.31	302.60	302.60	0.00	1
100.97	328.80	328.80	0.00	1
101.64	355.00	355.00	0.00	1
102.34	381.20	381.20	0.00	1
102.74	396.00	396.00	0.00	1
103.77	433.60	433.60	0.00	1
104.51	459.80	459.80	0.00	1
105.07	486.00	479.78	5.97	11
105.00	477.14	477.14	0.00	Overtopping

Rating Curve Plot for Crossing: 6022+50



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
224.00 cfs	224.00 cfs	98.95	5.45	6.172	7-M2c	6.00	3.51	3.51	2.63	10.63	2.37
250.20 cfs	250.20 cfs	99.42	5.89	6.640	7-M2c	6.00	3.78	3.78	2.76	11.03	2.44
276.40 cfs	276.40 cfs	99.87	6.35	7.091	7-M2c	6.00	4.04	4.04	2.89	11.40	2.50
302.60 cfs	302.60 cfs	100.31	6.82	7.528	7-M2c	6.00	4.29	4.29	3.02	11.75	2.56

328.80 cfs	328.80 cfs	100.97	7.31	8.188	7-M2c	6.00	4.53	4.53	3.13	12.08	2.62
355.00 cfs	355.00 cfs	101.64	7.83	8.857	7-M2c	6.00	4.77	4.77	3.24	12.40	2.67
381.20 cfs	381.20 cfs	102.34	8.38	9.555	7-M2c	6.00	5.00	5.00	3.35	12.69	2.72
396.00 cfs	396.00 cfs	102.74	8.71	9.959	7-M2c	6.00	5.13	5.13	3.41	12.86	2.75
433.60 cfs	433.60 cfs	103.77	9.60	10.991	7-M2c	6.00	5.45	5.45	3.55	13.25	2.81
459.80 cfs	459.80 cfs	104.51	10.26	11.727	7-M2c	6.00	5.67	5.67	3.64	13.51	2.86
486.00 cfs	479.78 cfs	105.07	10.80	12.295	7-M2c	6.00	5.83	5.83	3.74	13.71	2.90

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

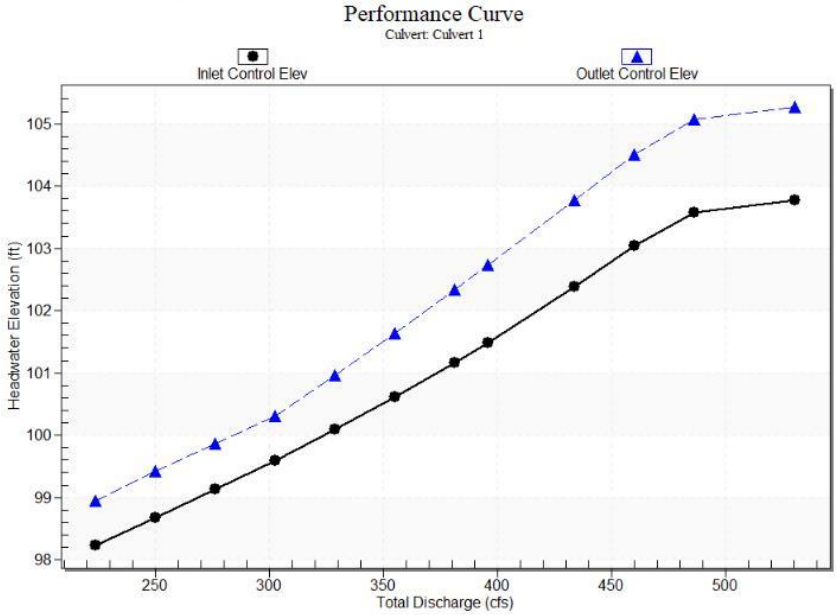
Inlet Elevation (invert): 92.78 ft,

Outlet Elevation (invert): 92.46 ft

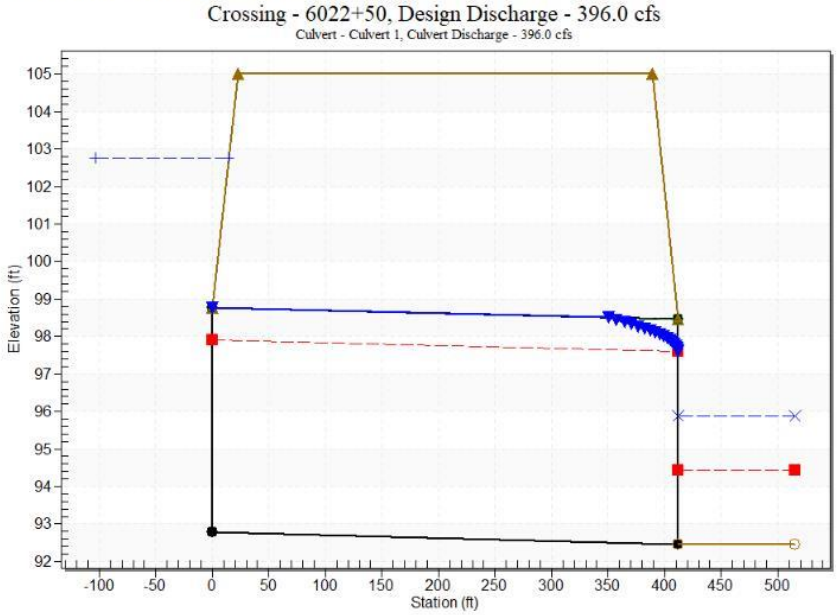
Culvert Length: 412.00 ft,

Culvert Slope: 0.0008

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 92.78 ft

Outlet Station: 412.00 ft

Outlet Elevation: 92.46 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall

Inlet Depression: None

Tailwater Data for Crossing: 6022+50

Table 3 - Downstream Channel Rating Curve (Crossing: 6022+50)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
224.00	95.09	2.63	2.37	0.26	0.32
250.20	95.22	2.76	2.44	0.28	0.33
276.40	95.35	2.89	2.50	0.29	0.33
302.60	95.48	3.02	2.56	0.30	0.33
328.80	95.59	3.13	2.62	0.31	0.33
355.00	95.70	3.24	2.67	0.32	0.33
381.20	95.81	3.35	2.72	0.33	0.34
396.00	95.87	3.41	2.75	0.34	0.34
433.60	96.01	3.55	2.81	0.35	0.34
459.80	96.10	3.64	2.86	0.36	0.34
486.00	96.20	3.74	2.90	0.37	0.34

Tailwater Channel Data - 6022+50

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 15.00 ft

Side Slope (H:V): 8.00 (_:1)

Channel Slope: 0.0016

Channel Manning's n: 0.0350

Channel Invert Elevation: 92.46 ft

Roadway Data for Crossing: 6022+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 367.00 ft

3.4.10 EP-34 – I-95 STA 6047+30 – 48" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 68.00 cfs

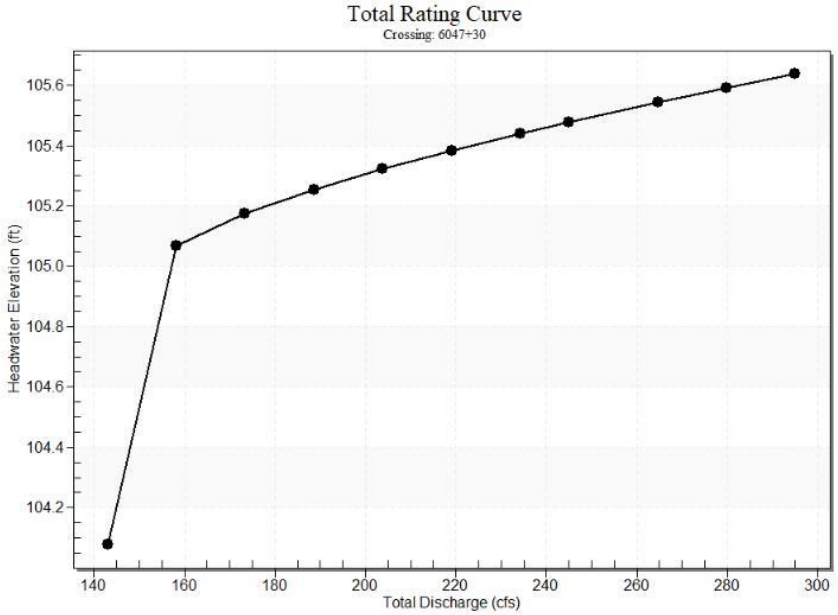
Design Flow: 117.00 cfs

Maximum Flow: 144.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: 6047+30

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
98.81	68.00	68.00	0.00	1
99.16	75.60	75.60	0.00	1
99.54	83.20	83.20	0.00	1
100.02	90.80	90.80	0.00	1
100.54	98.40	98.40	0.00	1
101.07	106.00	106.00	0.00	1
101.90	117.00	117.00	0.00	1
102.23	121.20	121.20	0.00	1
102.85	128.80	128.80	0.00	1
103.50	136.40	136.40	0.00	1
104.17	144.00	144.00	0.00	1
105.00	152.99	152.99	0.00	Overtopping

Rating Curve Plot for Crossing: 6047+30



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
143.00 cfs	143.00 cfs	104.08	7.79	9.498	4-FFf	4.00	3.54	4.00	4.02	11.38	3.95
158.20 cfs	152.96 cfs	105.07	8.53	10.489	4-FFf	4.00	3.62	4.00	4.23	12.17	4.05
173.40 cfs	151.76 cfs	105.17	8.44	10.594	4-FFf	4.00	3.61	4.00	4.43	12.08	4.15
188.60 cfs	150.35 cfs	105.25	8.33	10.674	4-FFf	4.00	3.60	4.00	4.62	11.96	4.24
203.80 cfs	148.90 cfs	105.32	8.22	10.743	4-FFf	4.00	3.59	4.00	4.81	11.85	4.32
219.00 cfs	147.42 cfs	105.38	8.11	10.804	4-FFf	4.00	3.57	4.00	4.98	11.73	4.40

234.20 cfs	145.97 cfs	105.44	8.00	10.861	4-FFf	4.00	3.56	4.00	5.15	11.62	4.48
245.00 cfs	144.96 cfs	105.48	7.93	10.899	4-FFf	4.00	3.55	4.00	5.27	11.54	4.53
264.60 cfs	143.13 cfs	105.54	7.79	10.964	4-FFf	4.00	3.54	4.00	5.47	11.39	4.62
279.80 cfs	141.74 cfs	105.59	7.70	11.012	4-FFf	4.00	3.53	4.00	5.62	11.28	4.68
295.00 cfs	140.38 cfs	105.64	7.60	11.058	4-FFf	4.00	3.51	4.00	5.77	11.17	4.75

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

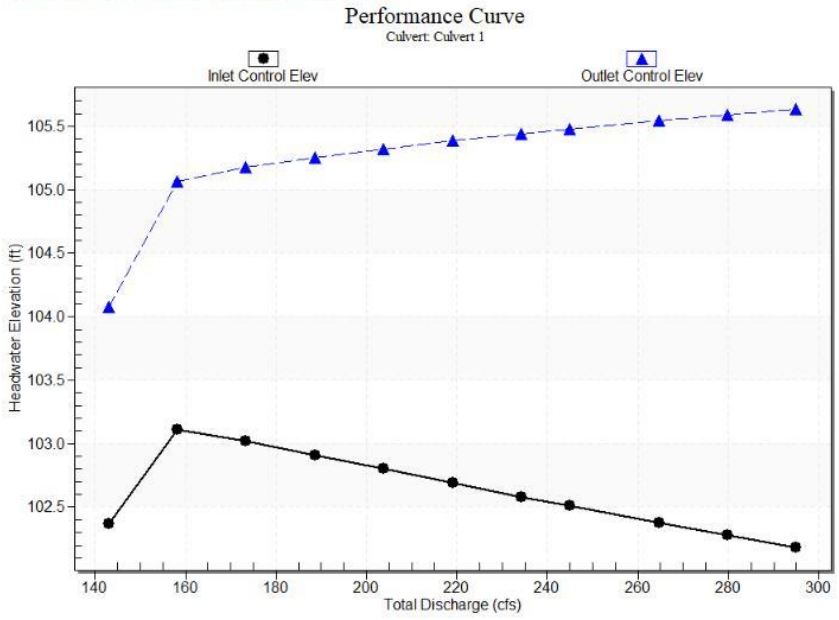
Inlet Elevation (invert): 94.58 ft,

Outlet Elevation (invert): 94.19 ft

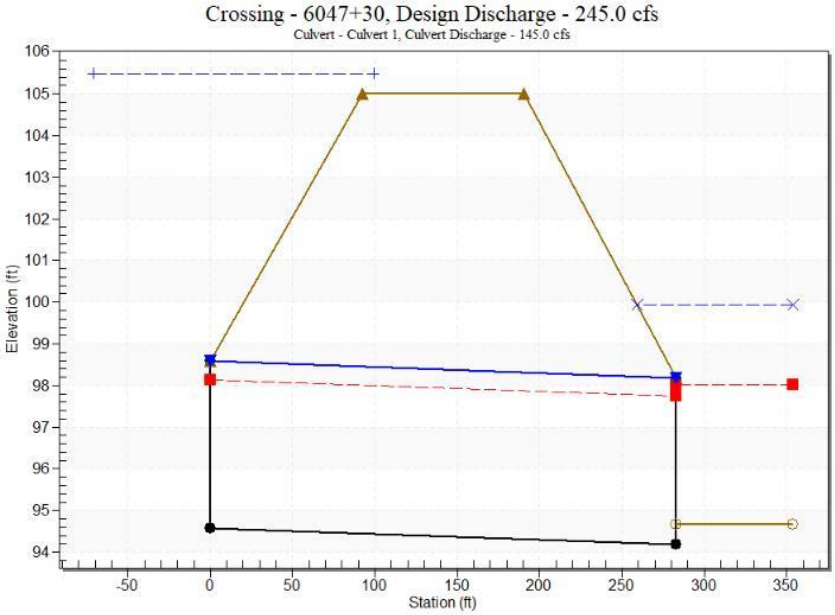
Culvert Length: 283.00 ft,

Culvert Slope: 0.0014

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 94.58 ft

Outlet Station: 283.00 ft

Outlet Elevation: 94.19 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: 6047+30

Table 3 - Downstream Channel Rating Curve (Crossing: 6047+30)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
143.00	98.69	4.02	3.95	0.75	0.42
158.20	98.90	4.23	4.05	0.79	0.42
173.40	99.10	4.43	4.15	0.83	0.42
188.60	99.29	4.62	4.24	0.87	0.42
203.80	99.48	4.81	4.32	0.90	0.42
219.00	99.65	4.98	4.40	0.93	0.43
234.20	99.82	5.15	4.48	0.96	0.43
245.00	99.94	5.27	4.53	0.99	0.43
264.60	100.14	5.47	4.62	1.02	0.43
279.80	100.29	5.62	4.68	1.05	0.43
295.00	100.44	5.77	4.75	1.08	0.43

Tailwater Channel Data - 6047+30

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.00 (_:1)

Channel Slope: 0.0030

Channel Manning's n: 0.0350

Channel Invert Elevation: 94.67 ft

Roadway Data for Crossing: 6047+30

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 98.00 ft

3.4.11 EP-36 – I-95 STA 6060+00 – 42" Concrete Pipe Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

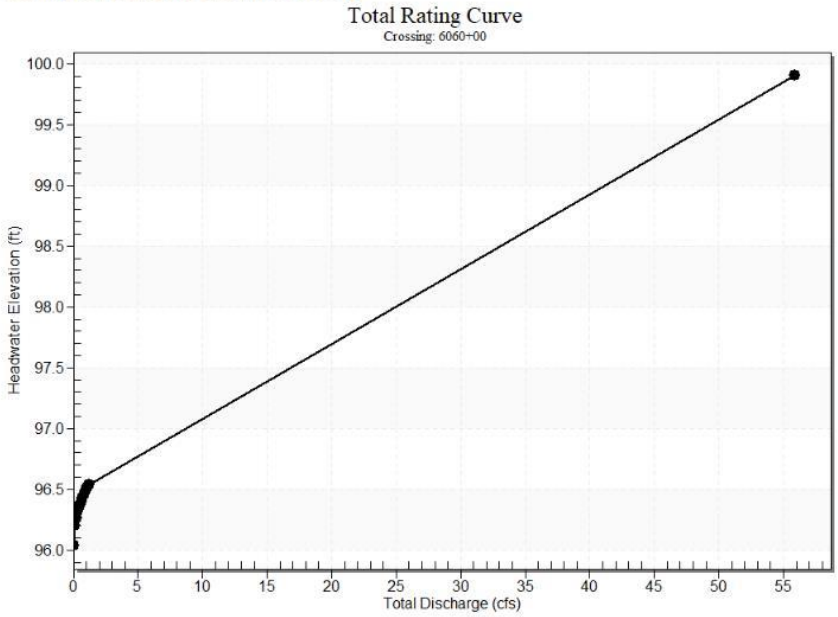
Design Flow: 1.00 cfs

Maximum Flow: 1.20 cfs

Table 1 - Summary of Culvert Flows at Crossing: 6060+00

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
96.04	0.00	0.00	0.00	1
96.20	0.12	0.12	0.00	1
96.27	0.24	0.24	0.00	1
96.32	0.36	0.36	0.00	1
96.36	0.48	0.48	0.00	1
96.40	0.60	0.60	0.00	1
96.43	0.72	0.72	0.00	1
96.46	0.84	0.84	0.00	1
96.50	1.00	1.00	0.00	1
96.52	1.08	1.08	0.00	1
96.54	1.20	1.20	0.00	1
105.00	122.35	122.35	0.00	Overtopping

Rating Curve Plot for Crossing: 6060+00



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
0.00 cfs	0.00 cfs	96.04	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.12 cfs	0.12 cfs	96.20	0.13	0.159	2-M2c	0.14	0.10	0.10	0.06	1.49	0.43
0.24 cfs	0.24 cfs	96.27	0.19	0.226	2-M2c	0.21	0.14	0.14	0.08	1.77	0.56
0.36 cfs	0.36 cfs	96.32	0.24	0.277	2-M2c	0.25	0.18	0.18	0.11	1.96	0.66
0.48	0.48	96.36	0.27	0.31	2-	0.29	0.20	0.2	0.13	2.11	0.73

cfs	cfs			9	M2 c			0			
0.60 cfs	0.60 cfs	96.40	0.30	0.35 5	2- M2 c	0.32	0.23	0.2 3	0.14	2.23	0.80
0.72 cfs	0.72 cfs	96.43	0.34	0.39 0	2- M2 c	0.35	0.25	0.2 5	0.16	2.34	0.85
0.84 cfs	0.84 cfs	96.46	0.36	0.42 0	2- M2 c	0.38	0.27	0.2 7	0.18	2.44	0.90
1.00 cfs	1.00 cfs	96.50	0.40	0.45 7	2- M2 c	0.41	0.30	0.3 0	0.20	2.55	0.96
1.08 cfs	1.08 cfs	96.52	0.41	0.47 5	2- M2 c	0.43	0.31	0.3 1	0.21	2.60	0.99
1.20 cfs	1.20 cfs	96.54	0.43	0.50 0	2- M2 c	0.45	0.33	0.3 3	0.22	2.67	1.03

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

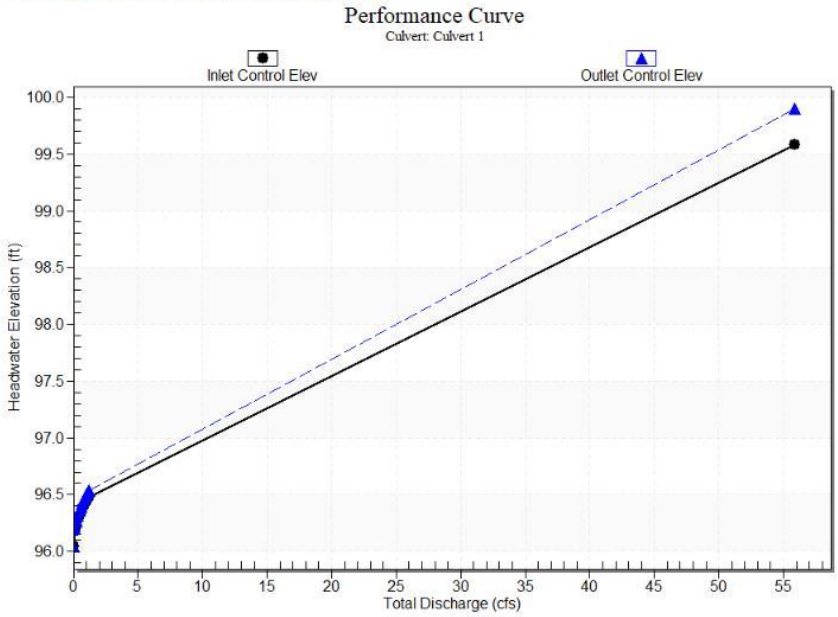
Inlet Elevation (invert): 96.04 ft,

Outlet Elevation (invert): 95.83 ft

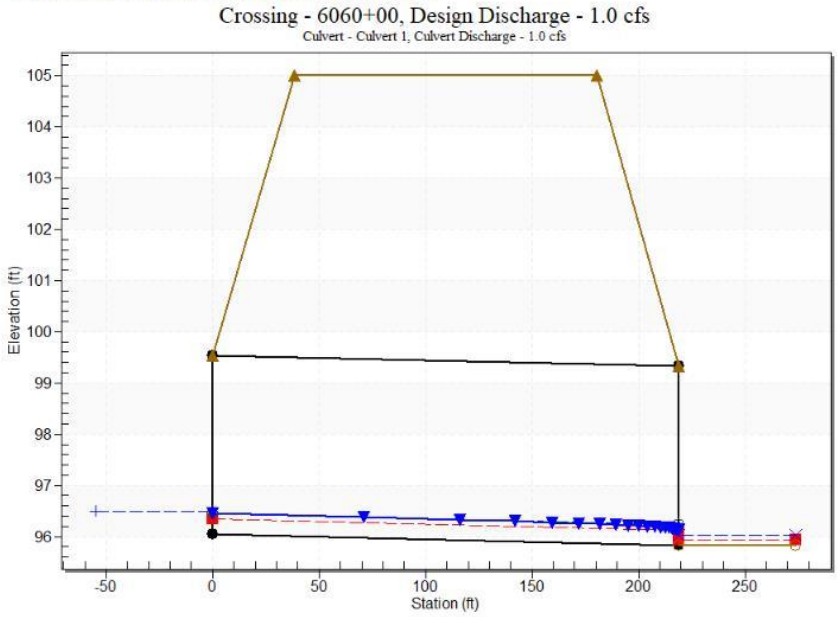
Culvert Length: 219.00 ft,

Culvert Slope: 0.0010

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 96.04 ft

Outlet Station: 219.00 ft

Outlet Elevation: 95.83 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1:1)

Inlet Depression: None

Tailwater Data for Crossing: 6060+00

Table 3 - Downstream Channel Rating Curve (Crossing: 6060+00)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	95.83	0.00	0.00	0.00	0.00
0.12	95.89	0.06	0.43	0.02	0.32
0.24	95.91	0.08	0.56	0.03	0.35
0.36	95.94	0.11	0.66	0.03	0.36
0.48	95.96	0.13	0.73	0.04	0.37
0.60	95.97	0.14	0.80	0.05	0.38
0.72	95.99	0.16	0.85	0.05	0.38
0.84	96.01	0.18	0.90	0.06	0.39
1.00	96.03	0.20	0.96	0.06	0.39
1.08	96.04	0.21	0.99	0.06	0.40
1.20	96.05	0.22	1.03	0.07	0.40

Tailwater Channel Data - 6060+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0050

Channel Manning's n: 0.0350

Channel Invert Elevation: 95.83 ft

Roadway Data for Crossing: 6060+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 105.00 ft

Roadway Surface: Paved

Roadway Top Width: 142.00 ft

3.4.12 BC-4 – Bluff Rd STA 119+25 – 6'x6' Concrete Box Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 242.00 cfs

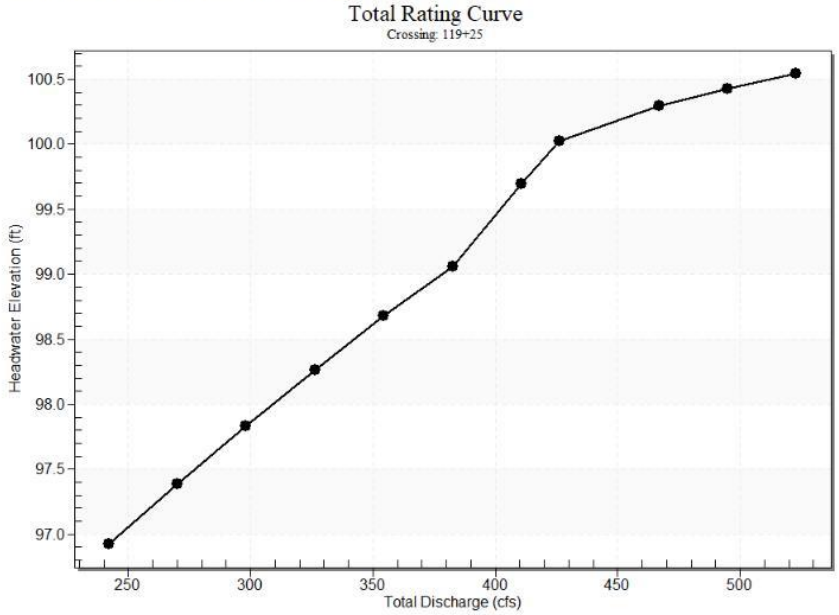
Design Flow: 426.00 cfs

Maximum Flow: 523.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: 119+25

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
96.93	242.00	242.00	0.00	1
97.39	270.10	270.10	0.00	1
97.83	298.20	298.20	0.00	1
98.26	326.30	326.30	0.00	1
98.68	354.40	354.40	0.00	1
99.06	382.50	382.50	0.00	1
99.69	410.60	410.60	0.00	1
100.02	426.00	424.84	0.93	13
100.30	466.80	423.66	42.76	6
100.43	494.90	419.65	75.11	6
100.54	523.00	414.73	107.96	5
100.00	424.12	424.12	0.00	Overtopping

Rating Curve Plot for Crossing: 119+25



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

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)
242.00 cfs	242.00 cfs	96.93	5.75	6.327	7-H2t	-1.00	3.70	4.57	4.57	8.83	2.81
270.10 cfs	270.10 cfs	97.39	6.24	6.786	7-H2t	-1.00	3.98	4.84	4.84	9.30	2.90
298.20 cfs	298.20 cfs	97.83	6.74	7.230	7-H2t	-1.00	4.25	5.10	5.10	9.74	2.97
326.30 cfs	326.30 cfs	98.26	7.26	7.661	7-H2t	-1.00	4.51	5.35	5.35	10.17	3.05

354.40 cfs	354.40 cfs	98.68	7.82	8.080	7-H2t	-1.00	4.77	5.58	5.58	10.59	3.12
382.50 cfs	382.50 cfs	99.06	8.41	8.456	7-H2t	-1.00	5.02	5.80	5.80	10.98	3.18
410.60 cfs	410.60 cfs	99.69	9.05	9.093	4-FFf	-1.00	5.26	6.00	6.02	11.41	3.24
426.00 cfs	424.84 cfs	100.02	9.38	9.425	4-FFf	-1.00	5.38	6.00	6.13	11.80	3.28
466.80 cfs	423.66 cfs	100.30	9.36	9.699	4-FFf	-1.00	5.37	6.00	6.43	11.77	3.36
494.90 cfs	419.65 cfs	100.43	9.26	9.830	4-FFf	-1.00	5.34	6.00	6.62	11.66	3.41
523.00 cfs	414.73 cfs	100.54	9.14	9.942	4-FFf	-1.00	5.29	6.00	6.81	11.52	3.46

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

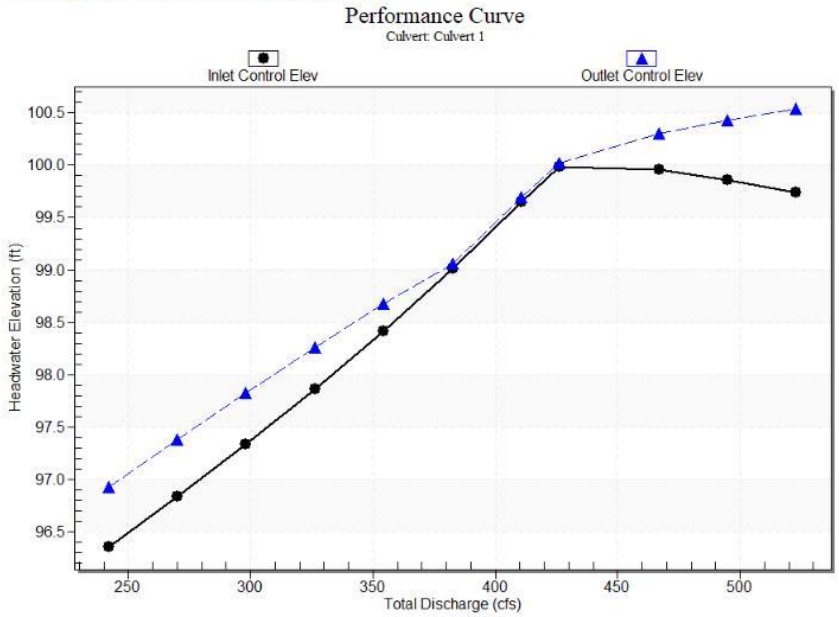
Inlet Elevation (invert): 90.60 ft,

Outlet Elevation (invert): 90.59 ft

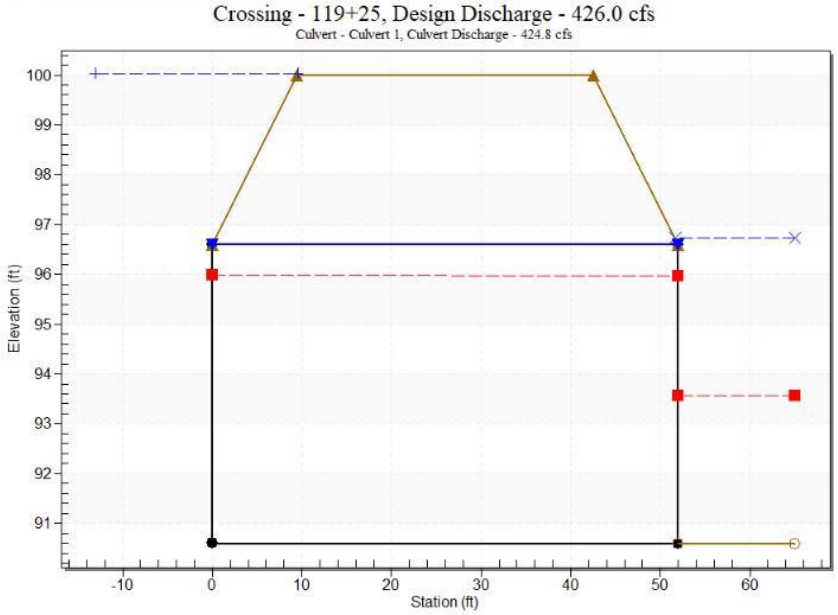
Culvert Length: 52.00 ft,

Culvert Slope: 0.0002

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 90.60 ft

Outlet Station: 52.00 ft

Outlet Elevation: 90.59 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall

Inlet Depression: None

Tailwater Data for Crossing: 119+25

Table 3 - Downstream Channel Rating Curve (Crossing: 119+25)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
242.00	95.16	4.57	2.81	0.29	0.27
270.10	95.43	4.84	2.90	0.30	0.27
298.20	95.69	5.10	2.97	0.32	0.27
326.30	95.94	5.35	3.05	0.33	0.28
354.40	96.17	5.58	3.12	0.35	0.28
382.50	96.39	5.80	3.18	0.36	0.28
410.60	96.61	6.02	3.24	0.38	0.28
426.00	96.72	6.13	3.28	0.38	0.28
466.80	97.02	6.43	3.36	0.40	0.28
494.90	97.21	6.62	3.41	0.41	0.28
523.00	97.40	6.81	3.46	0.42	0.28

Tailwater Channel Data - 119+25

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 12.00 ft

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0010

Channel Manning's n: 0.0350

Channel Invert Elevation: 90.59 ft

Roadway Data for Crossing: 119+25

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 100.00 ft

Roadway Surface: Gravel

Roadway Top Width: 33.00 ft

3.5 Assessment of Alternatives

There are three Alternatives proposed for the I-26/I-95 interchange improvements. A summary of the impact(s) to each of the culverts is described in **Table 3.22**. **Sections 3.5.1-3.5.3** provide more detail for each Alternative.

Table 3.2: Impacts of Alternatives on Existing Culverts

Culvert	Station	Alignment	Description	Alternative 1	Alternative 2	Alternative 3
BC-1	3145+00	I-26	8'x6' RC Box	No Impacts	No Impacts	No Impacts
BC-2	3214+28	I-95 NB to I-26 EB Ramp	6'x6' RC Box	Extend inlet to accommodate new ramps: I-95 NB to I-26 WB, I-95 SB to I-26 EB	Extend inlet to accommodate new ramps: I-95 NB to I-26 WB, I-95 SB to I-26 EB, I-26 EB to I-95 NB. Extend outlet to accommodate new ramps: I-26 WB to I-95 NB and SB	Extend inlet to accommodate new ramps: I-95 NB to I-26 WB, I-95 SB to I-26 EB, I-26 EB to I-95 NB. Extend outlet to accommodate new ramps: I-26 WB to I-95 NB and SB, and Bluff Rd realignment
BC-3	6022+50	I-26 EB to I-95 SB Ramp	6'x6' RC Box	Extend inlet to accommodate new ramp I-26 EB to I-95 SB. Extend outlet to accommodate new ramps: I-95 NB to I-26 WB, I-95 SB to I-26 EB	No Impacts	No Impacts
EP-34	6047+30	I-95	48" RC Pipe	No Impacts	No Impacts	No Impacts
BC-4	119+25	Bluff Rd	6'x6' RC Box	No Impacts	Extend Outlet	New RCBC with potential channel realignment

Each alternative interchange design will also require the addition of new culverts and/or alteration of existing culverts to maintain existing drainage patterns due to new alignments. These additional recommendations are summarized in **Table 3.33** below.

Table 3.3: New Culvert Crossings by Proposed Alternative

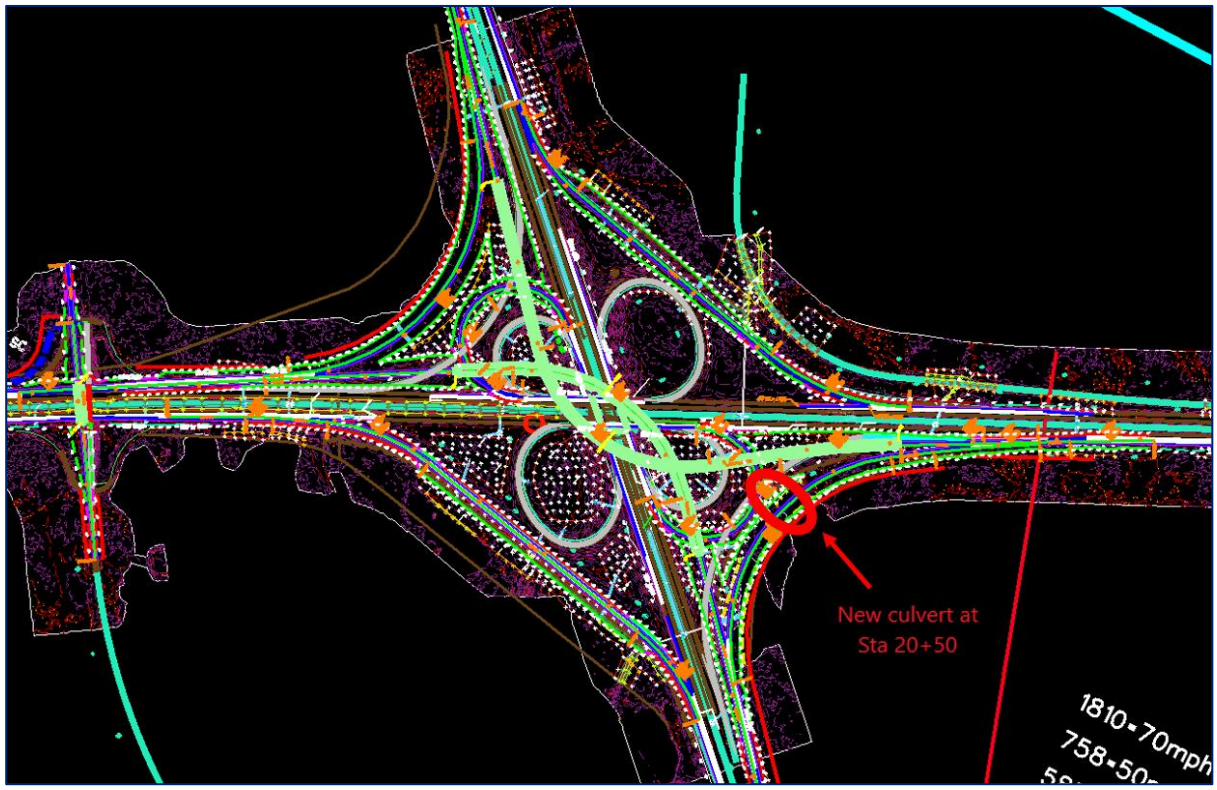
Alignment	Alternative 1	Alternative 2	Alternative 3
I-26 EB to I-95 SB	N/A	New RCBC at STA 41+90	New RCBC at STA 41+90
I-26 WB to I-95 SB	N/A	N/A	New RCBC at STA 24+90
I-26 WB to I-95 NB	N/A	Extend RCBC STA 25+50	New RCBC at STA 27+50
I-95 NB to I-26 EB	New RCBC at STA 20+50	New RCBC at STA 42+00	New RCBC at STA 42+00
I-95 NB to I-26 WB	N/A	New RCBC at STA 38+50	New RCBC at STA 38+50

3.5.1 Alternative 1

The proposed Alternative 1 has several new ramps on a new alignment that will impact the existing ditch either by obstructing or completely filling in the existing channels that drain to the culverts. These channels will need to be relocated to ensure hydraulic conductivity throughout the project.

To see the additional culvert(s) required for this alternative, please reference **Table 3.33** and **Figure 33**.

Figure 3.3: Alternative 1 New Culvert Location



The following channels will need to be constructed due to the Alternative 1 Ditch Impacts:

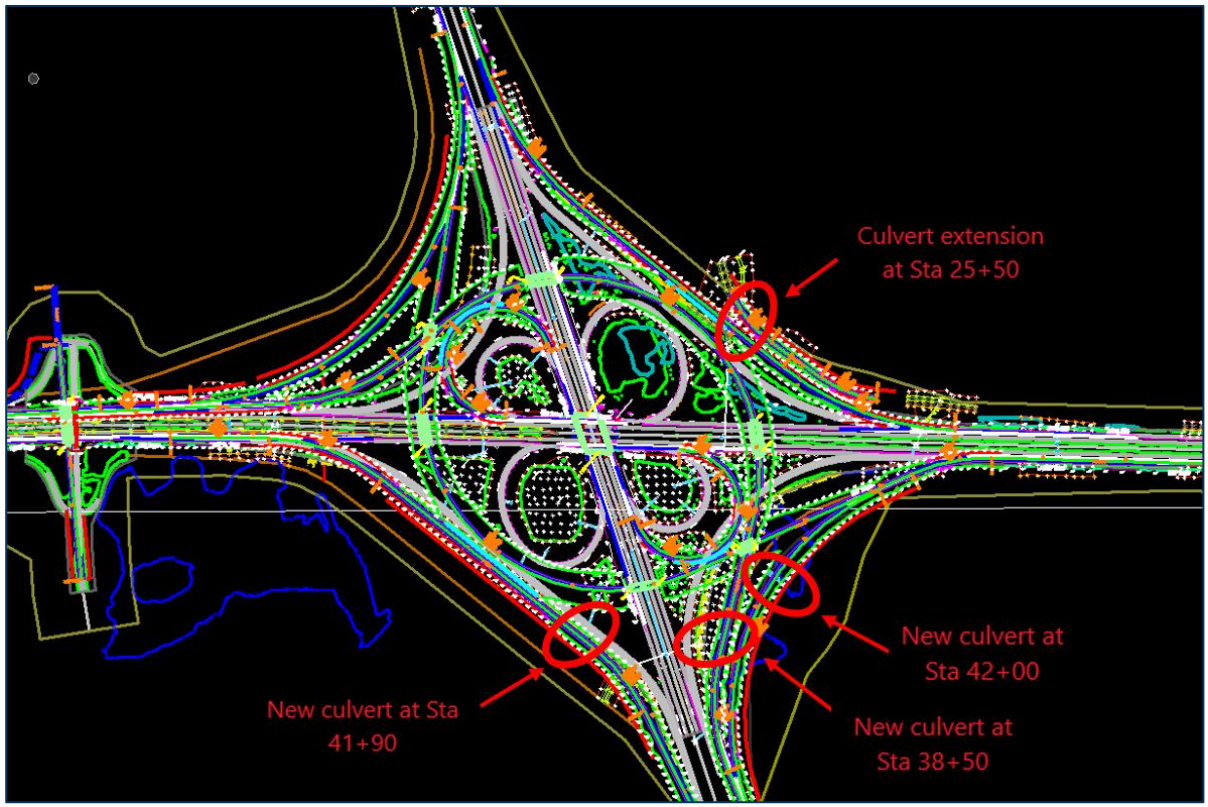
- I-26 EB to I-95 SB: Trapezoid channel on the right side from ramp Sta 24+00 to Sta 43+00
- I-95 NB to I-26 EB: Trapezoid channel on the right side from ramp Sta 12+00 to Sta 28+00

3.5.2 Alternative 2

The proposed Alternative 2 has several new ramps on a new alignment that will impact the existing ditches either by obstructing or completely filling in the existing channels that drain to the culverts. These channels will need to be relocated to ensure hydraulic conductivity throughout the project.

To see the additional culvert(s) required for this alternative, please reference **Table 3.33** and **Figure 34**.

Figure 3.4: Alternative 2 New Culvert Location



The following channels will need to be constructed due to the Alternative 2 Ditch Impacts:

- I-26 EB to I-95 SB: Trapezoid channel on the right side from ramp Sta 21+00 to Sta 42+80
- I-95 NB to I-26 EB: Trapezoid channel on the right side from ramp Sta 35+00 to Sta 49+00
- I-95 NB to I-26 EB: Channel from proposed culvert at Sta 42+10 to the I-95 NB to I-26 WB right side channel

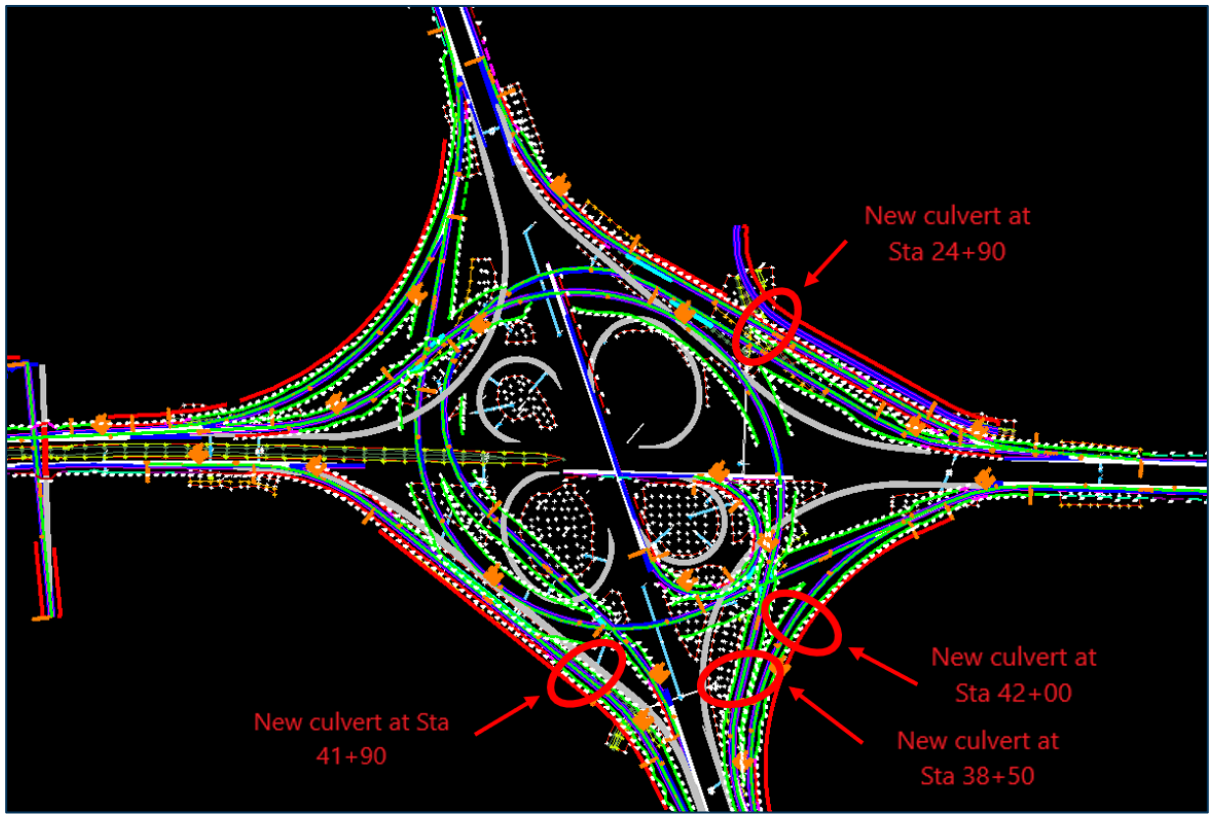
- I-95 NB to I-26 WB: Channel from existing culvert to proposed culvert at Sta 38+50
- I-95 NB to I-26 WB: Trapezoid channel on the right side from ramp Sta 38+70 to Sta 43+30

3.5.3 Alternative 3

The proposed Alternative 2 has several new ramps on a new alignment that will impact the existing ditches either by obstructing or completely filling in the existing channels that drain to the culverts. These channels will need to be relocated to ensure hydraulic conductivity throughout the project.

To see the additional culvert(s) required for this alternative, please reference **Table 3.33** and **Figure 35**.

Figure 3.5: Alternative 3 New Culvert Location



The following channels will need to be constructed due to the Alternative 3 Ditch Impacts:

- I-26 EB to I-95 SB: Trapezoid channel on the right side from ramp Sta 21+00 to Sta 42+80
- I-95 NB to I-26 EB: Trapezoid channel on the right side from ramp Sta 35+00 to Sta 49+00
- I-95 NB to I-26 EB: Channel from proposed culvert at Sta 42+10 to the I-95 NB to I-26 WB right side channel

- I-95 NB to I-26 WB: Channel from existing culvert to proposed culvert at Sta 38+50
- I-95 NB to I-26 WB: Trapezoid channel on the right side from ramp Sta 38+70 to Sta 43+30

4. HALF-LINE PIPE ASSESSMENT

Several half-line pipes draining under both I-26 and I-95 from the median drop inlets will need to be extended due to the proposed fill limits on the new ramp and roadway alignments. As noted in **Section 1.1**, the current tree removal project has caused damage to some of the existing pipe outlets that will need to be repaired. A summary table containing information pertaining to these half-lines is presented below in **Table 4.1**. This summary table includes recommendations for cleaning and extending the pipes based on project alternatives.

Table 4.1: Existing Half-Line Pipes with Proposed Flow Rates

Existing Half-Line Pipes with Proposed Flow Rates																					
Culvert Data									Hydrology Data			50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?			
EP-1	3262+96.56	I-26	RCP	-	18	100.02	89.55	89.47	2.01	Rational	5	7.13	91.34	No	Yes	7.67	91.47	No	Yes	No inspection notes available.	Insufficient Capacity	Clean; Increase size
EP-2	3251+97.06	I-26	RCP	-	24	81.17	92.77	92.55	2.48	Rational	5	8.69	94.27	No	No	9.36	94.34	No	N	24" pipe culvert dammed with a straw dam. Trees recently, cleared, 2' drop to ditch. Top has been damaged by equipment. [Bluff Road] 24" wide concrete pipe with straw dam. Trees recently cleared.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-5	3233+98.64	I-26	RCP	-	24	82.62	93.13	92.91	1.22	Rational	5	4.25	94.13	No	No	4.57	94.17	No	N	[South] 24" wide concrete pipe. Half full of water, slowly draining. No debris. [North] Severely buried by tree clearing debris on north end and damaged by equipment. Almost 100% blockage.	Hydraulic Grade Line retained in Pipe	Clean; Extend for Alternates 2 and 3
EP-6	3233+97.90	I-26	RCP	-	24	99.84	92.87	92.55	1.21	Rational	5	4.14	93.85	No	No	4.46	93.89	No	N	[South] 24" wide concrete pipe. Half full of water, slowly draining. No debris. [North] Severely buried by tree clearing debris on north end and damaged by equipment. Almost 100% blockage.	Hydraulic Grade Line retained in Pipe	Clean; Extend for Alternate 1
EP-14	3178+09.28	I-26	RCP	-	12	112.40	97.63	96.92	1.92	Rational	5	6.72	102.46	No	Yes	7.24	103.19	No	Yes	Could not find, possibly buried. Heavy debris from tree clearing but undamaged.	Insufficient Capacity	Clean; Increase size

Existing Half-Line Pipes with Proposed Flow Rates

Culvert Data									Hydrology Data			50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?			
EP-15	3171+51.43	I-26	RCP	-	18	90.26	96.84	95.98	2.58	Rational	5	9.31	98.63	No	No	10.02	98.72	No	N	18" concrete pipe almost completely buried. Ground elev. ~6" higher all around.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-16	3158+01.95	I-26	RCP	-	24	109.22	97.40	96.63	1.85	Rational	5	6.47	98.65	No	No	6.97	98.70	No	N	24" concrete pipe w/ debris at exit. Another 15" concrete pipe 10' away is half full of sediment. Only goes to median. North side has heavy debris from tree clearing but remains undamaged.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-17	3158+02.20	I-26	RCP	-	24	106.28	97.43	96.94	1.74	Rational	5	6.07	98.63	No	No	6.53	98.68	No	No	24" concrete pipe w/ debris at exit. Another 15" concrete pipe 10' away is half full of sediment. Only goes to median. North side has heavy debris from tree clearing but remains undamaged.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-18	3152+02.45	I-26	RCP	-	18	98.85	97.18	95.83	2.07	Rational	5	7.26	98.70	No	No	7.82	98.77	No	No	18" concrete pipe.	Hydraulic Grade Line retained in Pipe	Retain
EP-21	3130+77.99	I-26	RCP	-	18	92.27	97.47	96.48	1.58	Rational	5	5.60	98.77	No	No	6.03	98.83	No	No	18" concrete pipe. 40% filled with debris. Ground level is 3" higher than invert. Another 18" concrete pipe located 10' away 5% full of stagnant water and ground level is 3" higher than invert.	Hydraulic Grade Line retained in Pipe	Clean; Retain

Existing Half-Line Pipes with Proposed Flow Rates

Culvert Data									Hydrology Data			50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?			
EP-23	5958+01.36	I-95	RCP	-	24	154.84	88.86	88.54	6.66	Rational	5	9.85	90.53	No	No	10.61	90.61	No	No	24" pipe culvert. 5% full of sediment, damaged and last segment has fallen off.	Hydraulic Grade Line retained in Pipe	Clean; Repair to designed specifications, or replace
EP-24	5958+02.95	I-95	RCP	-	24	159.24	88.89	88.30	6.74	Rational	5	11.28	90.61	No	No	12.15	90.70	No	No	24" pipe culvert. 40% full of sediment, damaged and last segment has fallen off. Does not appear to facilitate flow	Hydraulic Grade Line retained in Pipe	Clean; Repair to designed specifications, or replace
EP-26	5979+11.56	I-95	RCP	-	18	149.05	92.89	91.33	3.18	Rational	5	8.30	94.54	No	No	8.94	94.63	No	No	No inspection notes available.	Hydraulic Grade Line retained in Pipe	Retain
EP-30	6027+95.99	I-95	RCP	-	15	162.42	95.53	95.09	3.22	Rational	5	13.19	103.97	Yes*	Yes	14.20	105.19	Yes*	Yes	15" concrete pipe, half full of water/ sediment. Ground elev. 3" higher at outlet.	Insufficient Capacity, HGL is above roadway shoulder elevation, however the median ditch provides sufficient storage volume to limit the HW elevation to below the incipient overtopping elevation.	Increase size
EP-31	6033+94.75	I-95	RCP	-	18	139.00	97.02	96.31	1.15	Rational	5	5.11	98.25	No	No	5.50	98.30	No	No	18" concrete pipe notched between two trees. Half full of water but draining.	Hydraulic Grade Line retained in Pipe	Extend for Alternates 1 and 2
EP-32	6040+61.81	I-95	RCP	-	15	144.59	95.23	95.20	1.11	Rational	5	3.58	96.67	No	Yes	3.86	96.78	No	Yes	15" concrete pipe 100% filled with water. Channel full and <1' deep, 20' wide.	Insufficient Capacity	Increase size

Existing Half-Line Pipes with Proposed Flow Rates																					
Culvert Data									Hydrology Data			50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?			
EP-33	6044+46.68	I-95	RCP	-	18	135.86	97.17	96.30	1.21	Rational	5	3.57	98.17	No	No	3.85	98.21	No	No	18" concrete pipe, half buried with standing water in pipe. Ground elev. ~ 4" higher than invert.	Hydraulic Grade Line retained in Pipe	Clean; Extend for Alternates 1 and 2
EP-35	6048+97.53	I-95	RCP	-	18	141.57	95.59	95.23	1.70	Rational	5	5.06	96.88	No	No	5.45	96.95	No	No	18" pipe almost completely full of sediment. Ground elev. ~6" higher than invert.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-38	5996+94.80	Line 1	RCP	-	18	200.33	93.52	93.28	4.51	Rational	5	14.34	98.98	No	Yes	15.45	99.66	No	Yes	On I-95 SB to I-26 WB ramp. Drop inlet on south side. 18" concrete pipe on north side w/ wingwalls, low flow but no sediment blockage.	Insufficient Capacity	Replace for all Alternates
EP-42	6017+96.21	Line 3	RCP	-	18	250.55	93.72	93.33	N/A	Rational	5	8.08	96.19	No	Yes	8.62	96.44	No	Yes	On I-26 EB to I-95 SB ramp. 18" concrete pipe, half full of stagnant water. Heavy debris. Has drop inlet on N side, maybe same one as connects to Sta 6013+00.	Insufficient Capacity	Replace for all Alternates
EP-46	5995+73.94	Line 8	RCP	-	18	42.75	98.76	98.55	0.33	Rational	5	1.82	99.45	No	No	1.96	99.48	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Replace for all Alternates
EP-47	5998+97.70	Line 2	RCP	-	18	64.36	102.33	98.81	0.37	Rational	5	2.00	103.06	No	No	2.15	103.09	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Replace for all Alternates
EP-52	6021+17.32	Line 6	RCP	-	18	40.20	97.59	97.06	0.38	Rational	5	1.81	98.28	No	No	1.95	98.31	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Replace for all Alternates
EP-54	6014+12.36	Line 4	RCP	-	15	126.28	115.34	105.01	0.41	Rational	5	2.18	116.16	No	No	2.35	116.19	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Replace for all Alternates
EP-55	6018+65.15	Line 4	RCP	-	18	60.77	102.16	98.92	0.45	Rational	5	2.57	103.00	No	No	2.77	103.03	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Replace for all Alternates

Existing Half-Line Pipes with Proposed Flow Rates

Culvert Data									Hydrology Data			50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?			
EP-56	6023+04.69	Line 4	RCP	-	18	38.32	96.83	93.85	0.44	Rational	5	2.45	97.64	No	No	2.63	97.68	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Replace for all Alternates
EP-22a	3123+32.49	I-26	RCP	-	18	34.09	93.43	92.11	1.58	Rational	5	5.63	95.00	No	No	6.07	95.16	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Retain
EP-22b	3122+60.82	I-26	RCP	-	18	33.57	93.63	92.11	2.18	Rational	5	7.87	95.23	No	No	8.48	95.42	No	No	Could Not Inspect due to traffic.	Hydraulic Grade Line retained in Pipe	Retain
EP-22c	3122+91.55	I-26	RCP	-	48	48.51	91.87	91.75	0.84	Rational	5	30.35	93.89	No	No	32.62	93.97	No	No	48" concrete pipe. Good condition. Some debris. Fence 50 away. Ditch approx. rectangular. Has drop inlet on N side.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-22d	3122+59.02	I-26	RCP	-	15	33.06	93.43	91.87	0.32	Rational	5	1.28	94.04	No	No	1.38	94.07	No	No	Could Not Inspect	Hydraulic Grade Line retained in Pipe	Increase size
EP-22e	3122+98.80	I-26	RCP	-	48	108.00	92.38	92.11	1.34	Rational	5	4.89	94.76	No	No	5.26	94.88	No	No	48" concrete pipe. Good condition. Some debris. Fence 50 away. Ditch approx. rectangular. Has drop inlet on N side.	Hydraulic Grade Line retained in Pipe	Clean; Retain
EP-22f	3122+93.90	I-26	RCP	-	48	108.12	92.11	91.87	N/A	Rational	5	26.05	94.75	No	No	27.99	94.87	No	No	48" concrete pipe. Good condition. Some debris. Fence 50 away. Ditch approx. rectangular. Has drop inlet on N side.	Hydraulic Grade Line retained in Pipe	Clean; Retain

Existing Half-Line Pipes with Proposed Flow Rates																					
Culvert Data									Hydrology Data			50-Year Storm				100-Year Storm				Field Notes	50-Year Hydraulic Analysis Notes	Recommendation
ID	Station	Alignment	Type	Size (ft)	Height US/DS (in)	Length (ft)	Inlet El.	Outlet El.	DA (ac)	Method	Tc (min)	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?	Q (cfs)	HW Elevation (ft)	Over-topping	Exceeds Capacity?			
EP-25a	5972+16.41	I-95	RCP	-	24	162.76	90.03	88.85	4.76	Rational	5	4.95	91.14	No	No	4.95	91.14	No	No	[East] 24" concrete pipe. 5% full of sediment, damaged and last segment fell off. [West] 24" concrete pipe. Broken with last segment fallen off. No flow and 40% full of sediment.	Hydraulic Grade Line retained in Pipe	Increase size
EP-25b	5972+16.41	I-95	RCP	-	24	170.43	89.93	88.73	N/A	Rational	5	4.95	91.04	No	N	4.95	91.04	No	No	[East] 24" concrete pipe. 5% full of sediment, damaged and last segment fell off. [West] 24" concrete pipe. Broken with last segment fallen off. No flow and 40% full of sediment.	Hydraulic Grade Line retained in Pipe	Increase size

5. OUTFALL ANALYSIS

As previously mentioned in **Section 1.5 Proposed Stormwater Management**, preliminary analysis of the post construction discharges based on the three Alternatives does not require Stormwater Management. The watersheds for Four Holes Swamp that flows through the project site are larger than 1 square mile. Even though the project alternatives include additional impervious area from the pavement added for longer access ramps, the change in land use is insignificant compared to the larger drainage area upstream of the project.

Under this scenario, detention within the project site could have an adverse impact downstream if the timing of the peak is delayed to coincide with the timing of the peak for the total watershed.

Should design reveal an increase in peak flow from the project site, infield and gore areas within the project limits can be used for detention volume.

6. SITE PHOTOS

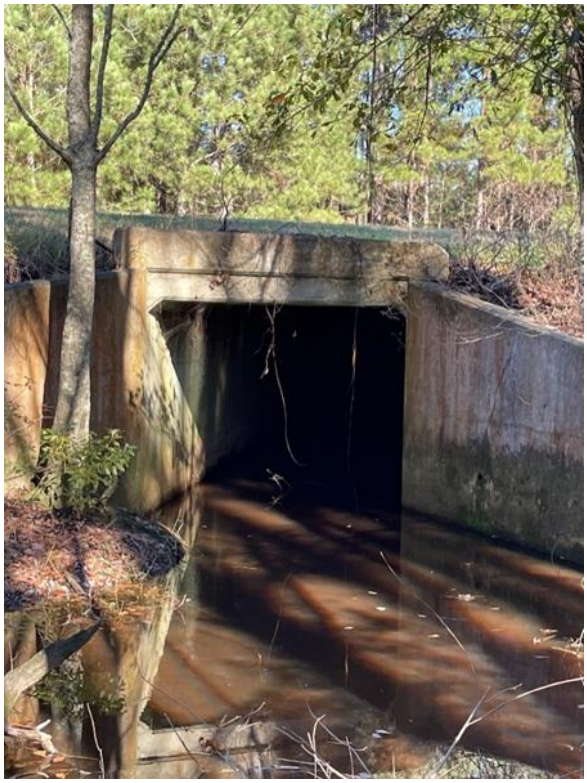
Culvert 1 (Sta 3145+00) US Inlet

Culvert 1 (Sta 3145+00) US Inlet

Culvert 1 (Sta 3145+00) DS blocked by equipment

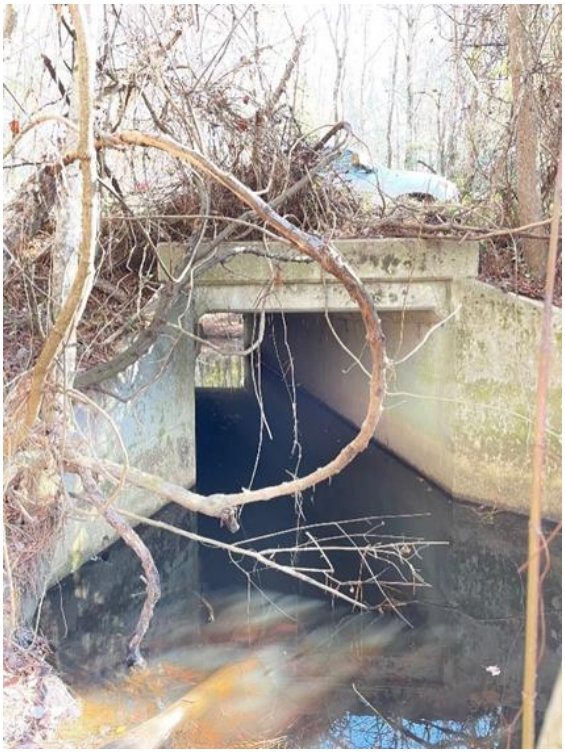
Culvert 2 (Sta 6022+50) US Inlet

Culvert 2 (Sta 6022+50) DS Outlet



Culvert 3 (Sta 3214+28) US Inlet

Culvert 3 (Sta 3214+28) US erosion behind wingwalls



Culvert 4 (Sta 119+25) US Inlet

Culvert 4 (Sta 119+25) DS Outlet

Culvert 5 (Sta 6047+30) US Inlet

Culvert 5 (Sta 6047+30) DS Outlet

Damaged pipe Sta 6018+25 US end

Damaged pipe Sta 6018+25 DS end

Damaged pipe Sta 3252+00

Damaged pipe Sta 3234+00

Damaged pipe Sta 5958+00 (I-95 SBL)

Damaged pipe Sta 5958+00 (I-95 NBL)