HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN

FOR:

I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER
AT CAMP HALL COMMERCE PARK

PREPARED FOR:
BERKELEY COUNTY
ECONOMIC DEVELOPMENT

MAY 17, 2016
REVISED: JUNE 10, 2016

JOB NUMBER: 25644.0006

Prepared by:

THOMAS & HUTTON

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Ramp 1 Sta. 110+00

Ramp 2 Sta. 216+00

Ramp 1/2 Sta. 144+79 / 219+00

Ramp 3 Sta. 312+18

Ramp 3 Sta. 318+38

Ramp 4 Sta. 421+50

Ramp 4 Sta. 500+72

Median Drainage HY-8 Hydraulic Calculations .....F

I-26 EB Sta. 669+25

I-26 EB Sta. 674+00

I-26 EB Sta. 679+72

I-26 EB Sta. 695+02

I-26 EB Sta. 707+63

I-26 EB Sta. 713+61

I-26 EB Sta. 718+97

I-26 EB Sta. 727+95

I-26 EB Sta. 751+97

I-26 WB Sta. 882+00

I-26 WB Sta. 890+10

I-26 WB Sta. 899+11

I-26 WB Sta. 901+62

I-26 WB Sta. 922+85

I-26 WB Sta. 936+70

I-26 WB Sta. 952+07

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I-26 EB Sta. 714+79 – Sta. 716+86 RT

I-26 EB Sta. 719+74 – Sta. 722+54 RT

I-26 EB Sta. 914+50 – Sta. 921+50 LT (including median drainage

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Existing Conditions ICPR Network Layout
Existing Conditions ICPR Node Maximum Output
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Post-Project Conditions ICPR Network Layout
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BACKGROUND AND INTRODUCTION

This report has been prepared to serve as the hydrologic and hydraulic (H&H) basis of design (BOD) for the proposed Interstate 26 (I-26) and Volvo Cars Drive (formerly known as Centerline Road) Interchange (I-26 Exit 189). This report provides a description of existing runoff patterns and a description of existing stormwater management infrastructure. This report also describes the preliminary design of stormwater management infrastructure in and around the proposed interchange. Finally, this report includes a description of existing and/or planned future stormwater management infrastructure improvements in the vicinity of the proposed interchange associated with other development activities that may affect the overall final design of stormwater management infrastructure for this proposed interchange.

The proposed I-26 Exit 189 Interchange will connect I-26 with Volvo Cars Drive and the future Volvo manufacturing facility approximately 0,9 miles northeast of I-26. The proposed Volvo manufacturing facility is located on an approximately 600 acres tract on the east side of Volvo Cars Drive. Volvo Cars Drive is currently a private dirt timber road extending from I-26 to Lake Moultrie. As part of the infrastructure improvements in the area to support the Volvo manufacturing facility (and other anticipated associated development), Berkeley County is improving Volvo Cars Drive from approximately 3,000 feet northeast of I-26 to SC Highway 176 (approximately 4.8 miles of improved road). The proposed Volvo Cars Drive right-of-way is 150 feet. At the proposed connection to the I-26 Exit 189 Interchange, the proposed Volvo Cars Drive includes four (4) 12-foot travel lanes, a 15-foot paved center/turn lane, and two 2-foot paved shoulders (for a total paved section of 67-feet. The proposed Volvo Cars Drive improvements includes improvements at Fish Road and SC Highway 176.

The I-26 Exit 189 Interchange concept is proposed to be a directional, three-leg interchange. The three legs will be made up of east and west bound I-26 and Volvo Cars Drive (north bound). The interchange includes no provision to exit I-26 headed south.

WATERSHED AND RECEIVING STREAM

The proposed Exit 189 Interchange lies almost entirely within the Timothy Creek Watershed. Timothy Creek is a tributary of Four Hole Swamp, with the confluence being located approximately 2.3 miles south of US Highway 78 in Dorchester County. Four Hole Swamp is a tributary of the Edisto River. A very small portion or the Exit 189 Interchange project site (far southeaster end) drains to the Thompson Creek Watershed. Thompson Creek is a tributary of Cypress Swamp, with the confluence being just upstream of I-26 in Berkeley County. Cypress Swamp is a tributary of the Ashley River.

The existing land uses within the Timothy Creek Watershed mainly consist of wetlands and wooded areas, with some areas of brush and open space. Most of the Timothy Creek Watershed, particularly the area north (upstream) of I-26, has been managed for pine silviculture. Some residential, commercial, and farm development has occurred within the watershed, mainly south of I-26 along SC Highway 27 and US Highway 78.

In the area of the proposed Exit 189 Interchange, the Timothy Creek Watershed consists of the main Timothy Creek and a smaller, unnamed tributary. Timothy Creek crosses I-26 west of the project site, approximately 0.8 miles east of SC Highway 27 (Exit 187). The existing contributing area to the crossing is approximately 7,160 acres. At this location, Timothy Creek crosses under I-26 in a dual 10' x 6' concrete box culvert (CBC). The existing drainage area upstream of this culvert encompasses most of the former Camp Hall Tract. This tract was managed for pine silviculture. The watershed contributing to this culvert has been heavily modified by the construction of a network of drainage ditches.

The unnamed tributary to Timothy Creek crosses I-26 west of the project site approximately 1.2 miles east of SC Highway 27 (Exit 187). The existing contributing area to the crossing is approximately 610 acres. At this location, the unnamed tributary crosses under I-26 in a dual 10' x 6' CBC. Both the Timothy Creek and unnamed tributary culverts are outside the proposed Exit 189 Interchange project site.

Based on information contained in the original 1959 I-26 construction plans, and information from the USGS Quadrangle Maps, it appears as if the ditching within the original Camp Hall Tract has significantly altered the contributing drainage basins for the I-26 Timothy Creek and unnamed tributary culverts. It appears that the original (historical) contributing areas to the two culverts under I-26 were nearly equivalent in size, resulting in the matching culvert structures (dual 10' x 6' CBC). Refer to Figure 3 for the historical Timothy Creek drainage basins.

The timber haul roads and large parallel drainage ditches in the former Camp Hall Tract have divided and re-routed a large portion of the unnamed tributary sub-watershed away from the I-26 culvert. This modification has routed a large portion of the historic unnamed tributary sub-watershed to the main Timothy Creek channel upstream of I-26. Refer to Figure 2 for the existing sub-watersheds.

As part of the overall improvements for the future Volvo manufacturing facility, supplemental improved outfall ditches are being constructed. A majority of these supplemental outfall ditches are being constructed as part of the Volvo Cars Drive and Lower Westvaco Road projects. The final portion of the supplemental outfall ditch (to the unnamed tributary) will be constructed as part of the Volvo Training Center project. The Volvo Training Center is planned for the northwest corner of the Exit 189 Interchange. This supplemental improved outfall ditch will "re-divert" a portion of existing Timothy Creek sub-watershed (contributing to the Timothy Creek I-26 culvert crossing) to the unnamed tributary sub-water (contributing to the unnamed tributary I-26 culvert crossing). Refer to Figure 4 for the future sub-watersheds within the Timothy Creek watershed. Refer to Appendix A for selected sheets from the original 1959 South Carolina Department of Transportation design plans.

EXISTING OFF-SITE DRAINAGE

Culvert and off-site drainage areas are illustrated in Exhibit 1. The proposed interchange project site includes only one large culvert crossing. This large culvert crossing is on the Volvo Cars Drive alignment, near the northern end of the interchange project site. The culvert crossing is located approximately 2,300 LF south of the first Volvo Plant entrance on Volvo Cars Drive. This culvert crossing is for a large timber ditch that will ultimately serve as the outfall for the southern portion of the Volvo manufacturing facility. When the Volvo Cars Drive project is complete, this culvert will drain approximately 1,300+/- acres of wetlands, wooded uplands, and portions of the Volvo manufacturing facility. This culvert crossing has been designed for and will be constructed as part of the Volvo Cars Drive project. Refer to Appendix B for the Volvo Cars Drive plans and the design calculations for the culvert (dual 9'x6' CBC).

This culvert, the associated ditch along the west side of Volvo Cars Drive, and the proposed future ditch through the proposed future Volvo training site are an integral part of the overall stormwater management system for the Volvo manufacturing facility site. The design of these facilities have been undertaken in consideration of many factors not documented as part of this report and thus any modifications to these facilities must provide comparable hydraulic capacities and operation.

In addition to the large culvert crossing discussed above, the design of the proposed interchange site shall address other culvert and off-site drainage areas.

EXISTING ROADWAY DRAINAGE

Existing roadway drainage infrastructure and basins are illustrated in Exhibits 2A (I-26 alignment) and 2B (Volvo Cars Drive alignment). Existing drainage patterns within the I-26 alignment generally included sheet flow from the centerline/crown of the pavement section to the outer edge of the road section. However, the existing road pavement is super-elevated in the area of the Volvo Cars Drive and drainage sheet flows across the entire two-lane pavement to the inside for the westbound lanes and to the outside for the eastbound lanes (see Exhibit 2A).

Drainage collecting in the center of I-26 (between the travel lanes) is directed to either a grate inlet with a 18" RCP pipe draining to the outside of the travel lanes, or to 18" RCP pipe ends draining to the outside of the travel lanes. Exhibit 2A includes an estimate drainage area to each interior catch basin or pipe end.

FEMA FLOOD HAZARD ZONES

Figure 5 illustrates the Federal Emergency Management Agency (FEMA) flood hazard zones in the immediate vicinity of the proposed interchange site. The proposed interchange site does not cross or otherwise impact any flood hazard zones identified on the effective FEMA Flood Insurance Rate Maps (FIRMs).

SCDHEC WATER QUALITY MONITORING STATIONS

The South Carolina Department of Health and Environmental Control (SCDHEC) maintains a network of water quality monitoring stations throughout the state. The stations in the immediate vicinity of the proposed interchange site include CSTL–078, CSTL–063, E–100 and E-015A (refer to Figure 6). No stations are located within the Timothy Creek Watershed.

As discussed above, Timothy Creek discharges to Four Hole Swamp. Monitoring Station E-015A is the most immediate downstream station on Four Hole Swamp from the Timothy Creek confluence. Station E-015A is not on the current (2014) Section 303(d) List of Impaired Waters. However, station E–100 is located approximately 2.3 miles upstream of the confluence with Timothy Creek. Station E–100 is listed on the current 303(d) list as not meeting standards for recreational use for Escherichia coli (E. coli).

As discussed above, the very southern portion of the proposed interchange site may drain to Thompson Creek. There are no monitoring stations located on Thompson Creek. Thompson Creek is a tributary of Cypress Swamp. Station CSTL-078 is the most immediate downstream station on Cypress Creek from the Thompson Creek confluence. Station CSTL-078 is not on the current 303(d) list. However, station CSTL-063 is located approximately 5.1 miles upstream of the confluence with Cypress Creek. Station CSTL-063 is listed on the current 303(d) list as not meeting standards for recreational use for Escherichia coli (E. coli).

PROPOSED STORMWATER MANAGEMENT PLAN DESIGN

A proposed drainage plan has been developed for the proposed I-26/Volvo Cars Drive Interchange. Refer to exhibits DP01 through DP04 for an illustration of the proposed drainage plan. All culvert and roadway drainage has been designed for the 50-year storm event per the SCDOT *Requirements for Hydraulic Design Studies* (May 26, 2009). The culvert and roadway drainage calculations also considered the 100-year storm event for overtopping.

All facilities with a drainage area less than 100 acres was designed utilizing the rational method for flow determination. For facilities with drainage areas greater than 100 acres, the SCS (or TR-55) method was used for flow determination.

For drainage within the I-26 corridor, the proposed drainage design has accounted for the following future build out conditions:

1. The existing super-elevation through the slight curve in the area of the intersection will be removed. The east and west bound lanes will have a normal crown between the two existing travel lanes.
2. The ultimate future expansion of I-26 will include four lanes in each direction. The future two lanes (in each direction) will be added in the existing median. The future two lanes (in each direction) will continue the same cross slope (towards the median) as the existing

I-26 lanes (or as the lanes will have after this project – see no. 1 above). The proposed drainage associated with this project accounts for these additional lanes.

The design documentation of the proposed drainage plan is included in the following appendices:

- Appendix C – Rational Method Discharge Calculations
- Appendix D – SCS Method Discharge Calculations
- Appendix E – Culvert HY-8 Hydraulic Calculations
- Appendix F – Median Drainage HY-8 Hydraulic Calculations
- Appendix G – Road Drainage GEOPAK Hydraulic Calculations
- Appendix H – Ditch Hydraulic Calculations
- Appendix I – Hydraulic Data Sheets

OFFSITE PEAK DISCHARGE ANALYSIS

An analysis was performed to compare pre-development and post-development peak discharge rates from the outfalls identified for the project. The analysis was conducted using the Advanced Interconnected Channel and Pond Routing (ICPR) computer program developed by Streamline Technologies. The program is used to model rainfall and stormwater runoff and to perform hydraulic routing through a storm drainage system. The ICPR program is a FEMA–approved model that has undergone extensive testing and application. ICPR has the ability to analyze complex interconnected drainage systems dynamically over extended time periods. Pre- and post-development curve number and time of concentration calculations and model networks, inputs, and outputs are provided in Appendix J. Exhibits illustrating the pre- and post-development ICPR network of links and nodes are provided following this report.

As shown in Table 1 below, peak discharges are not being increased between pre- and post-development conditions. Refer to Exhibits 3A and 3B for the analysis points. The reduction in peak discharges for outfall EB1 and WB1 (which combines pre-development outfalls WB1 and WB2 in post-development conditions) is a result of storage that is being provided by the interchange ramps, which will be constructed on fill, and will be significantly higher than the existing roadway and adjacent wetlands. Under existing conditions, the dirt haul roads adjacent to I-26 are low-lying with undersized drainage infrastructure. The existing roads experience frequent overtopping during smaller storm events resulting in the higher peak discharges.

Table 1: Comparison of Peak Discharges

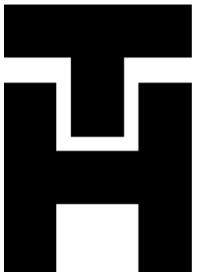
Outfall	Storm	Pre (cfs)	Post (cfs)
CLLT	2-yr	1	1
	10-yr	2	2
	25-yr	2	3
	50-yr	3	3
	100-yr	3	3
CLRT	2-yr	13	13
	10-yr	27	27
	25-yr	35	35
	50-yr	43	42
	100-yr	50	50
EB1	2-yr	166	156
	10-yr	334	308
	25-yr	438	399
	50-yr	528	477
	100-yr	626	562
EB2	2-yr	4	4
	10-yr	8	8
	25-yr	10	10
	50-yr	12	12
	100-yr	14	14
MED	2-yr	6	6
	10-yr	11	11
	25-yr	14	14
	50-yr	16	17
	100-yr	19	19
WB1*	2-yr	65	31
	10-yr	130	59
	25-yr	169	76
	50-yr	203	90
	100-yr	241	106
WB3	2-yr	35	35
	10-yr	73	73
	25-yr	96	96
	50-yr	116	116
	100-yr	138	138

*Post-development outfall WB1 combines pre-development outfalls WB1 and WB2.

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

FIGURES

J – 25644.0006



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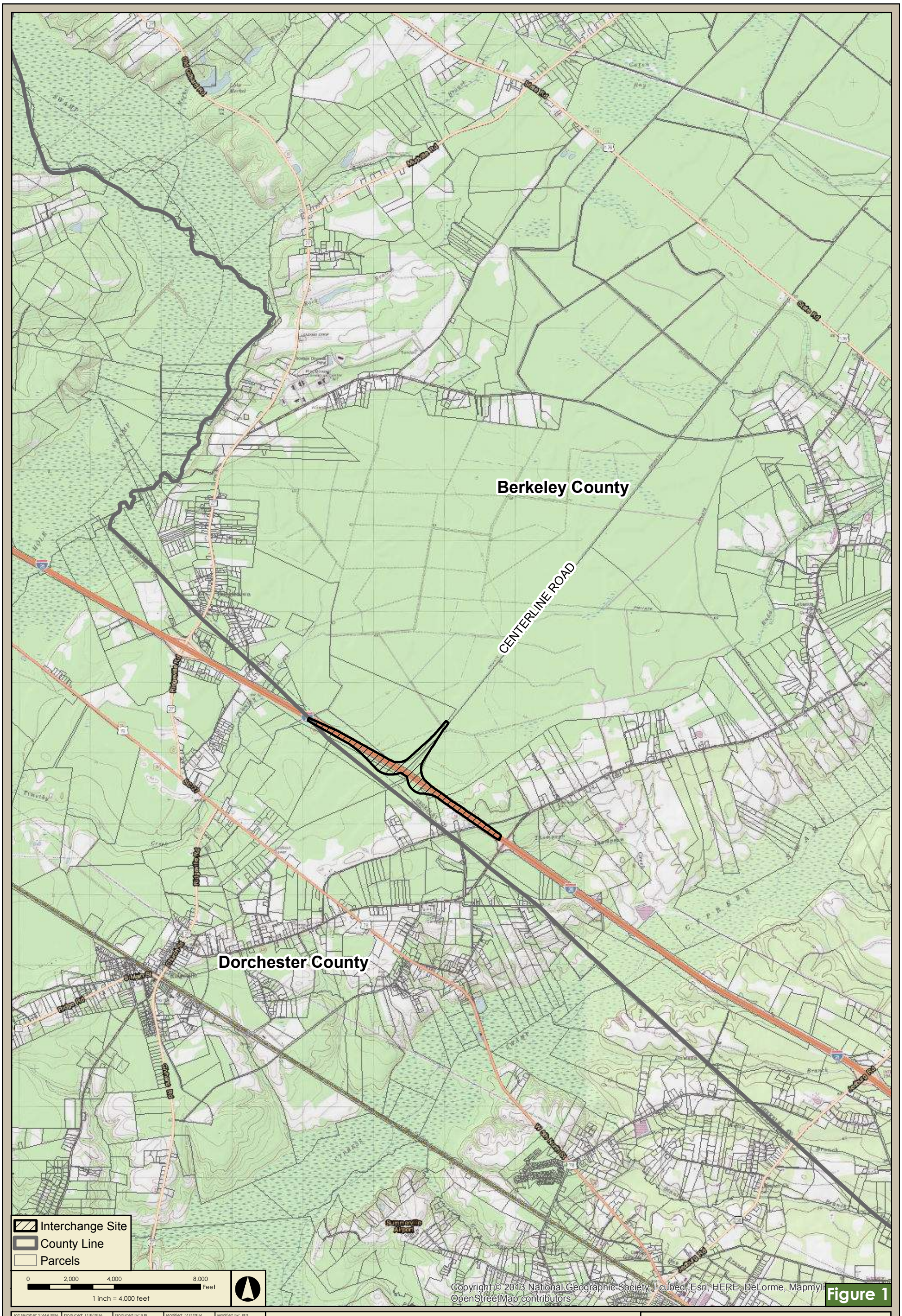

Figure 1

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Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Project Boundary	T&H	2016
Parcels	Berkeley County	2010
Basemap	USGS	varies

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I-26/CENTERLINE RD. INTERCHANGE (EXIT 189)

Berkeley County, SC

Location Map

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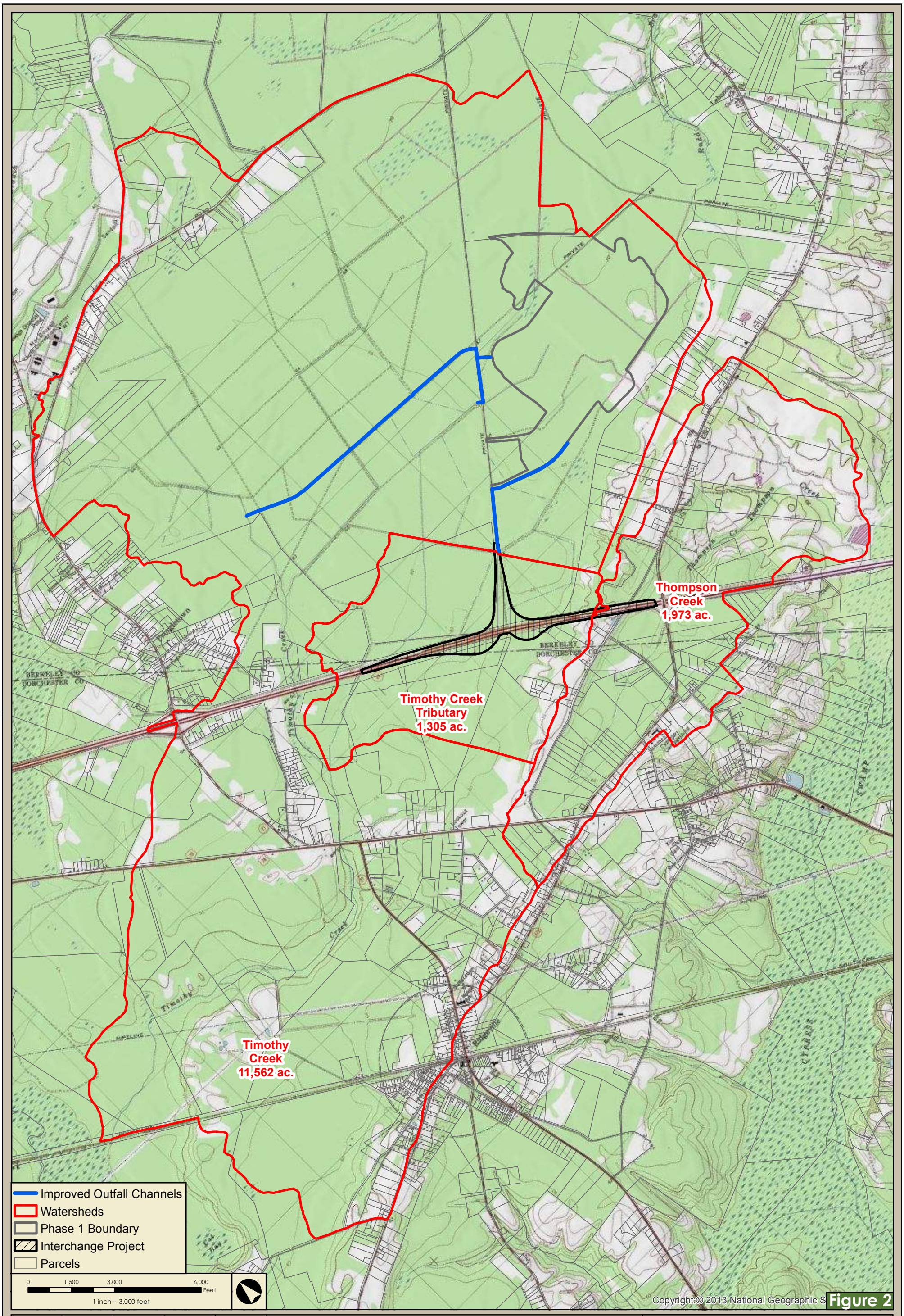

Figure 2

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Watershed	T&H	2016
Project Boundary	T&H	2016
Rivers and Streams	USGS	2010
Parcels	Berkeley County	2015

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Existing Watersheds

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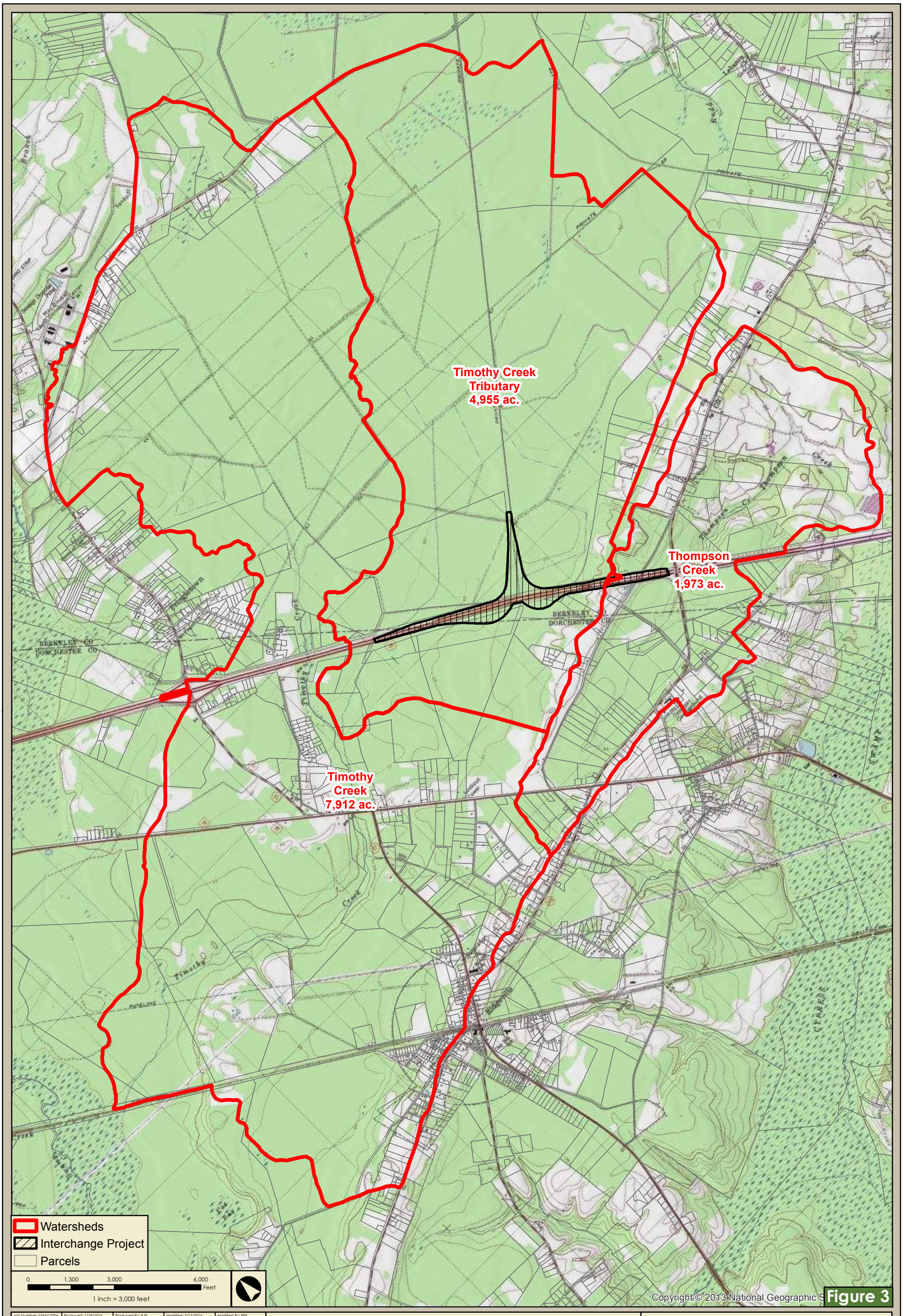

Figure 3

Job Number: 25644.0006	Produced: 1/18/2016	Produced By: BJB	Modified: 5/13/2016	Modified By: RPK
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Watershed	T&H	2016
Project Boundary	T&H	2016
Rivers and Streams	USGS	2010
Parcels	Berkeley County	2015

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I-26/CENTERLINE RD. INTERCHANGE (EXIT 189)

Berkeley County, SC

Historic Watersheds

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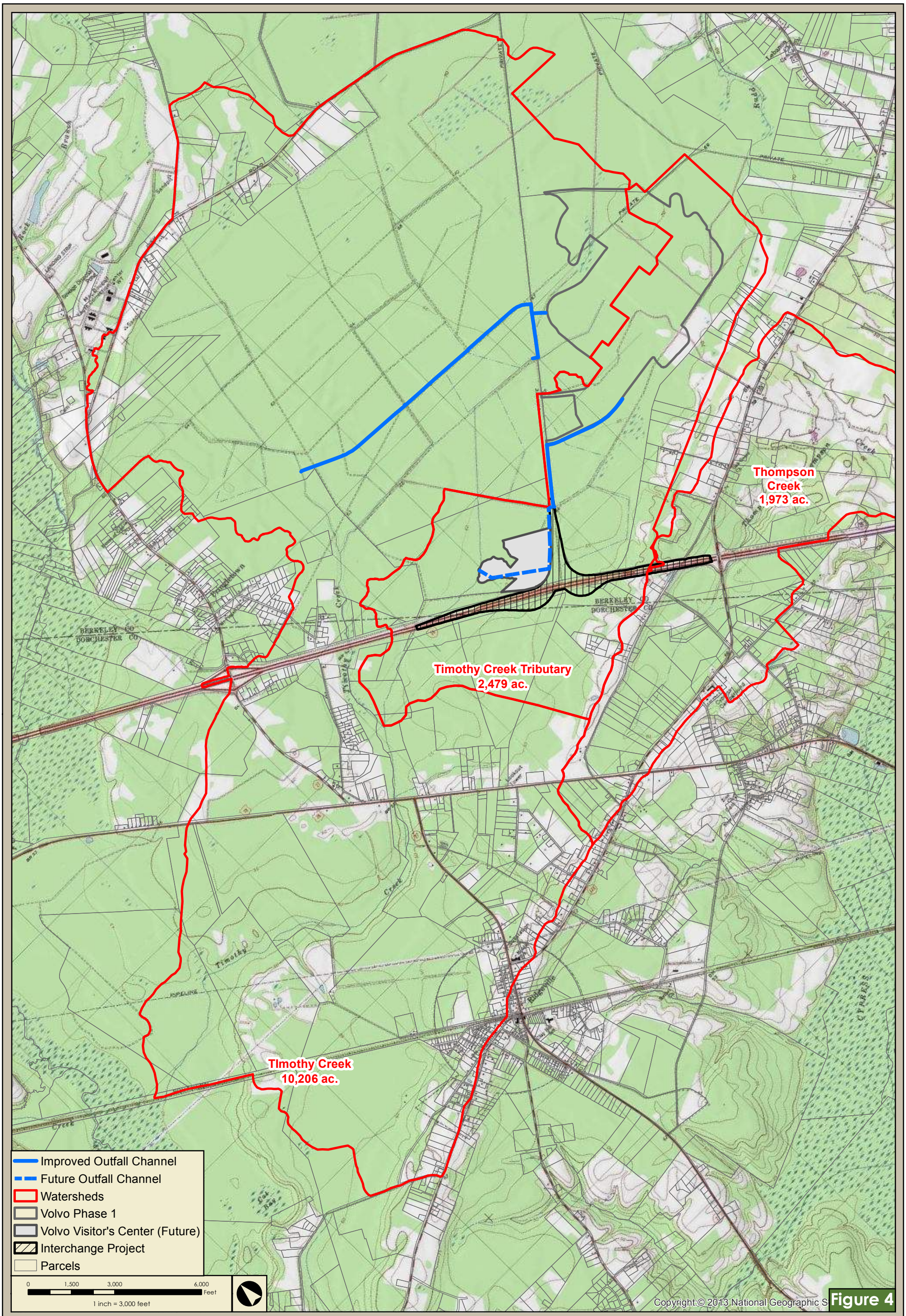

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Project Boundary	T&H	2016
Rivers and Streams	USGS	2010
Parcels	Berkeley County	2015

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I-26/CENTERLINE RD. INTERCHANGE (EXIT 189)

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Future Watersheds

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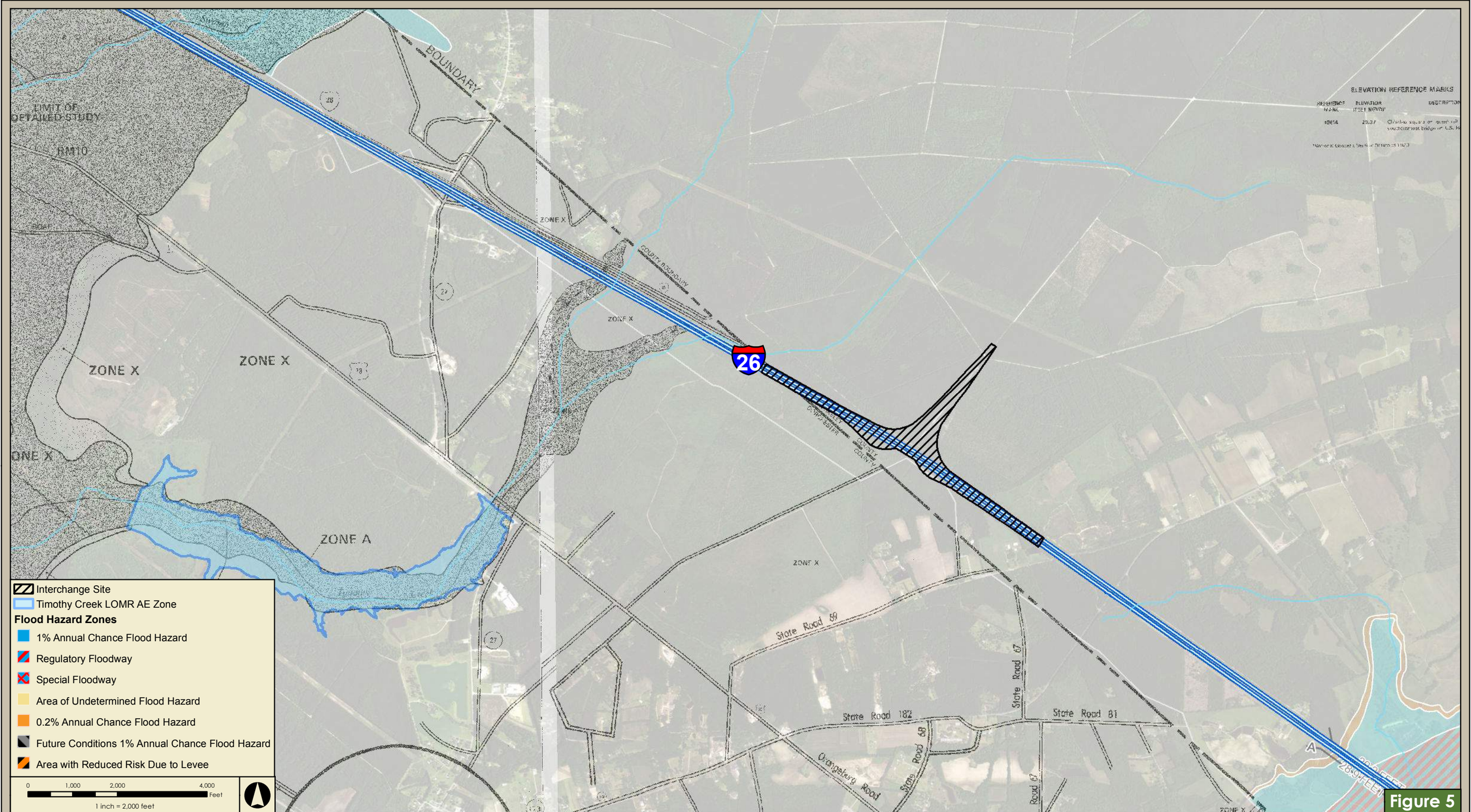

Figure 5

Job Number: 25644.0006	Produced: 1/12/2016	Produced By: BJB	Modified:	Modified By:
File: Z:\25644\25644.0006\GIS\Mxd\FEMA Map.mxd				Vertical Datum:

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Site Boundary	T&H	2015
Rivers and Streams	USGS	2010
Flood Hazard Zones	FEMA	varies

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I-26/Centerline Road Interchange (Exit 189)

Berkeley County, South Carolina

FEMA Flood Hazard Zones

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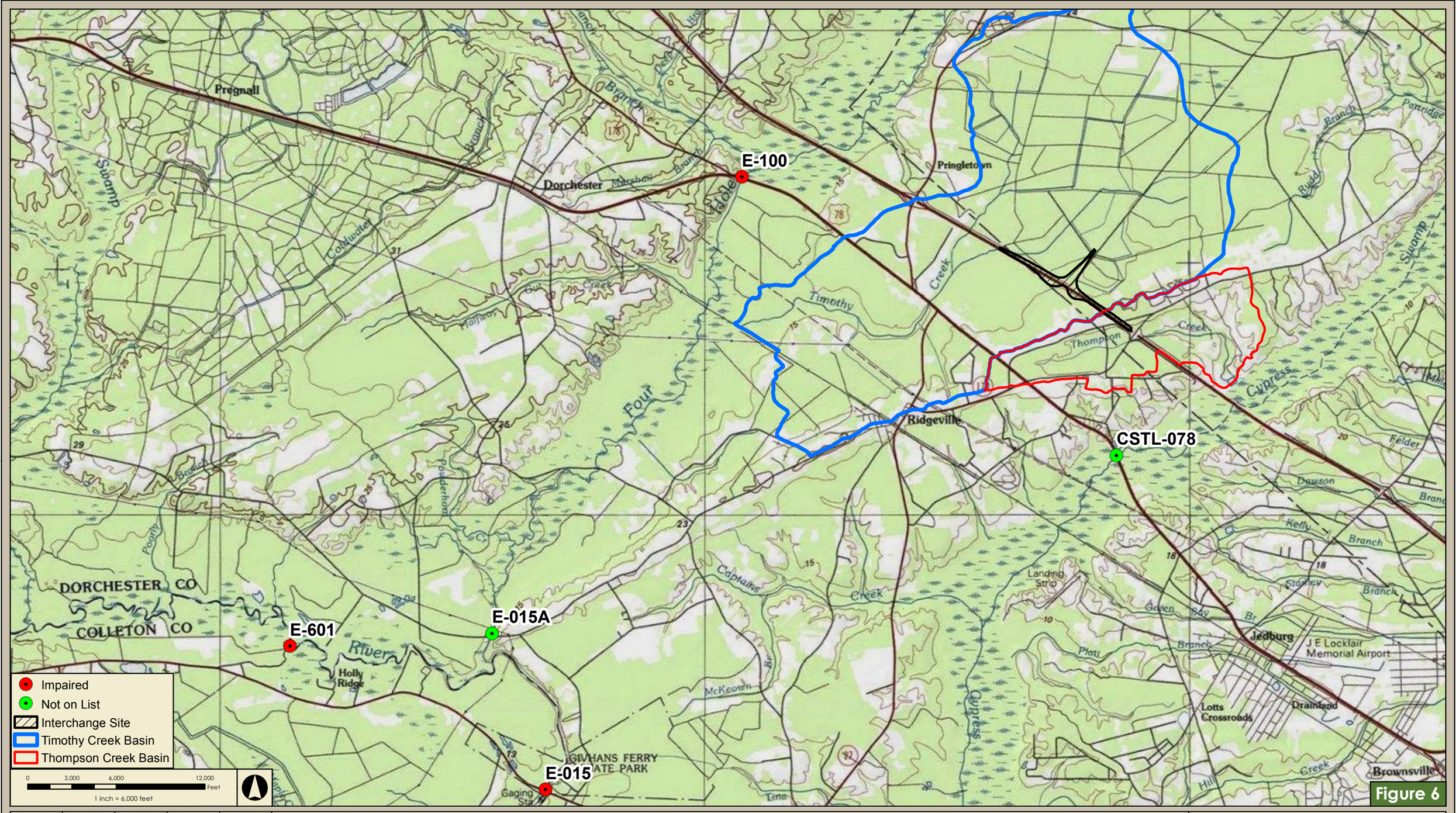

Figure 6

Job Number	Produced: 1/9/2016	Produced By: RPK	Modified: 5/13/2016	Modified By: RPK
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Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Site Boundary	T&H	2016
Timothy Creek Watershed	T&H	2016
Thmpson Creek Watershed	T&H	2016
Rivers and Streams	USGS	2010
Water Quality Monitoring Stations	SCDHEC	2014

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SCDHEC Water Quality Monitoring Stations

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HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX A

HISTORIC SCDOT PLANS FOR I-26

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FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	BERKELEY	8.350	I-26-1(6)	I-26	45	280

PLAN — SURVEYED / PLOTTED / ALIGNMENT CHECKED / PROFILE CHECKED / B. M.'s NOTED / STRUCTURE NOTATIONS CHKD — BY — DATE — NOTE BOOK — NO.

PROFILE — SURVEYED / PLOTTED / GRADES CHECKED / B. M.'s NOTED / STRUCTURE NOTATIONS CHKD — BY — DATE — NOTE BOOK — NO.

(35) S. JOE SAMPSON EST. BY: HEIRS D-6-15-59

(36) J. T. RILEY D-6-9-59

Begin Frontage Road on Lt. Sta. 4232+80

P.O.T.=4232+40± 21" 8 oak 24" 8 oak 36" 8 oak

180'R/W

P.O.T.=4237+24.1

℄ Frontage Rd.

Fowl House 8'×10'

60' Chicken Wire

Chicken Yard 50'×11'

Moving Item No. 5

12' WIDE ENT. 100

S 60° 39' E

15" R.C. Pipe #1500' CO. ROAD

To Sta. 79

Place 88'-18" R.C. Pipe

see Sheet No. 171 for R/W & Channel Change

Construct Double 10'x6'x40' R.C. Box Culvert as shown on sheet No. 155

Construct double 10'x6'x68' R.C. box culvert as shown on sheet No. 156

Construct Double 10'x6'x68' R.C. box Culvert as shown on sheet No. 157.

2 STRAND BARB WIRE

Timothy Creek Crossing
Sta. 4243+70 - Double 10x6

4230 4231 4232 4233 4234 4235 4236 7 8 9 4240 1 2 3 4 4245

B.M.#413 - NAIL IN BASE OF GUY POLE 495' Lt. Sta. 4232+25 El.=60.01

B.M.#414 - NAIL IN BASE 10" PINE 160' Lt. Sta. 4243+15 El.=57.05

EXC.	3745	EMB.	30372
STRIPPING	1020	B-FILL	2915
MUCK	1955	SUB	11650
BOR.	41192	STRIPPING	1020
		WASTE	1955
TOT.	47912	TOT.	47912

OVERHAUL = 164,768 C.Y.H.M.

-0.10%

High Water 59.00

Finished Grade

-0.10% SECTION 3 SWALE DITCH GRADE ON LEFT & RIGHT.

Strip 6"±

-0.14% SWALE DITCH GRADE LT. & RT.

DA: 4.750 A

SWALE DITCH ELEV.'S LT. & RT.

SWALE DITCH ELEVATIONS ON LEFT & RIGHT

Remove Unstable Material and Backfill with Suitable Material From Sta. 4220+00 To 4234+50

Remove Unstable Material and Backfill with Suitable Material From Sta. 4243+00 To 4257+00

Place 160 Tons of Rip Rap on Slopes of Fill at Ends of Culverts

Berkeley + Charleston Counties I-26

Sheet 32 of 32

PLATE 1 - PLAN - PROFILE O.P.R.&R.E. STANDARD
KEUFFEL & ESSER CO., NEW YORK.

SCDOT Plans Online: Not For Distribution

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	BERKELEY	8.350	726-41A	I-26	46	280

18" Oak
6.62'
18.21'
Gum 4"
P.O.T.=4225+04.6
180' R/W

P.O.T.=4252+18.1
6.79'
3.50'
4" Pine
4" Gum

(36)
J. T. RILEY
D-6-9-59

Place 40'-18" R.C. Pipe
℄ Frontage Rd.
Place 76'-18" R.C. Pipe
Place 80'-18" R.C. Pipe
4245
4250
4255
4260
150'
120'
TIMOTHY CREEK
159
S 60° 39' E
135°
180°
90°
100'
pond
Ditch
180' R/W

3 STRAND BARB WIRE
10+ℓ
OLD WELL
F.P.
±20 Woods End
(5)

(36)
J. T. RILEY
D-6-9-59

B.M.#415 NAIL IN BASE 10" PINE
160' LT. STA. 4253+90 EL. 59.58

E/C	8	ENB	28,491
Stripping	510	B-Fill	6630
Muck	6120	Stripping	12,234
BOR:	47,013	Waste	510
TOT.	54,051	TOT	6120
			54,051

OVERHAUL = 221,261 C.Y.H.M.

600' V. C.
−0.10%
+0.14%
+0.11%
P.I.: 4249+75
El.: 62.50
℄ Finished Grade
P.I.: 4260+00
El.: 67.01
High Water 59.00
Strip 6"±
600' V. C.
Ditch
Remove Unstable Material and Backfill with Suitable Material from Sta. 4243+00 to Sta. 4239+00

62.72 62.88 62.80 62.78 62.76 62.75 62.77 62.81 62.84 62.96 63.06 63.19 62.96 63.50 63.71 63.22 63.93 64.37 64.81 65.25 65.67 65.90 66.07 66.22 66.33 66.42 66.48

4245 6 7 8 9 4250 1 2 3 4 5 6 7 8 9 4260

PLAN
NOTE BOOK
NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
PROFILE CHECKED
B. M.'s NOTED
STRUCTURE NOTATIONS CHKD.
BY
DATE

PROFILE
NOTE BOOK
NO.
SURVEYED
PLOTTED
GRADES CHECKED
B. M.'s NOTED
STRUCTURE NOTATIONS CHKD.
BY
DATE

Berkeley Co.
Rt. 1-26

(33 of 41)

PLATE 1 - PLAN - PROFILE O. P. R. & R. E. STANDARD
KEUFFEL & ESSER CO., NEW YORK.

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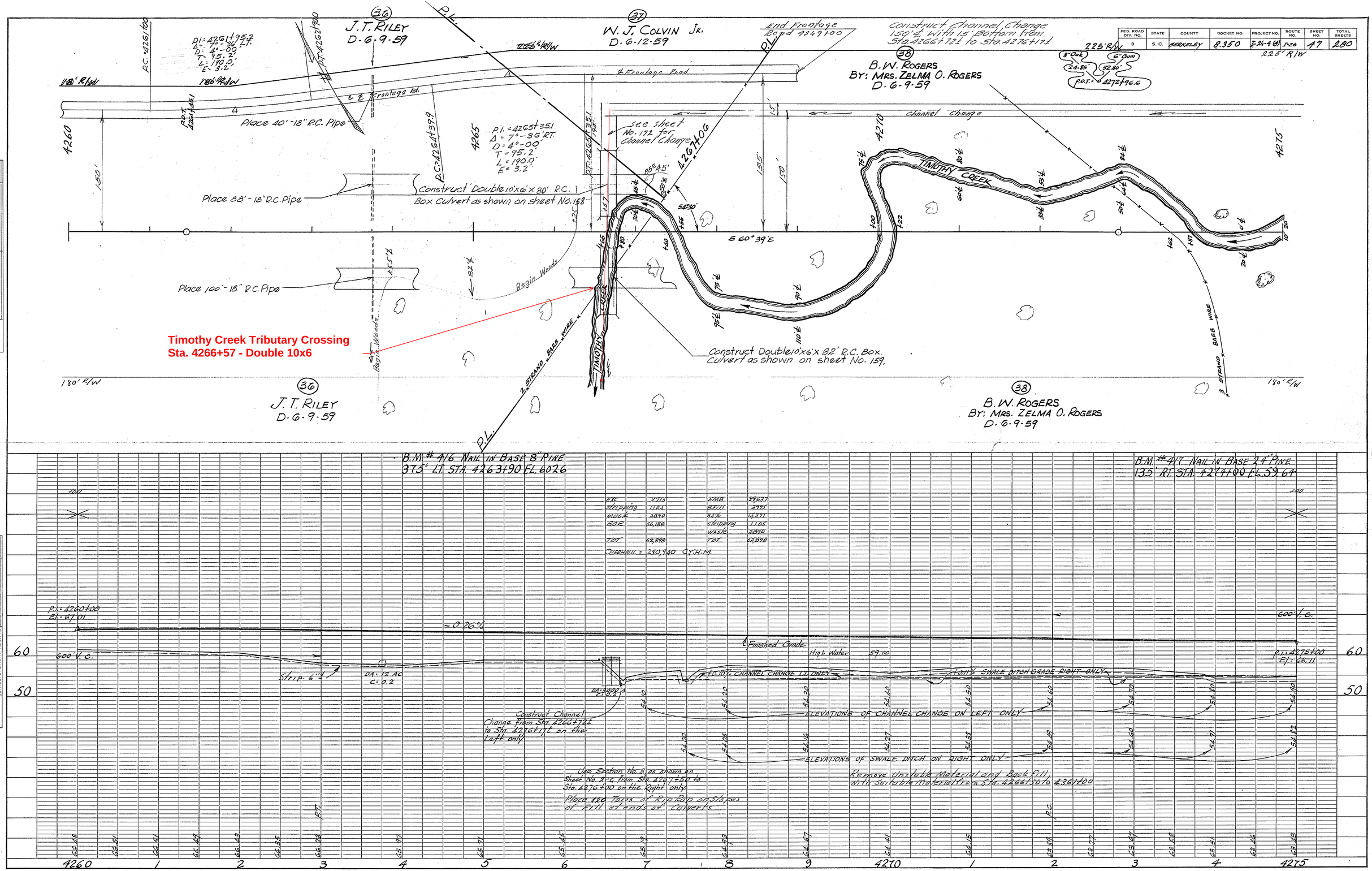


PLATE 1 - PLAN - PROFILE O.P.R. & R.E. STANDARD
KEUFFEL & ESSER CO., NEW YORK.

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
B.M. NOTED
STRUCTURE NOTATNS CH'KD
NOTE BOOK
NO.
BY
DATE

Berkeley Co.
Pt. 1-26

SCDOT Plans Online: Not For Distribution

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	BERKELEY	8.350	7.36-40	I-26	48	250

CONSTRUCT CHANNEL CHANGE
150' ± WITH 15' BOTTOM FROM
STA. 4266+50 TO 4276+17.5

225' R/W

18" Pine

Pine 20.21

P.O.T.=4277+04.2

30.18

18" Pine

(38)
B.W. ROGERS
BY: MRS. ZELMA O. ROGERS
D. 6-9-59

188' ± R/W

180' ± R/W

P.O.T.=4289+10.20

Pine 12.77 — Ins Stump

41.49

18" Pine

channel change

15'

120'±

100'±

TIMOTHY CREEK

4275

4280

4285

4290

Place 84'-18" R.C. Pipe

Place 112'-18" R.C. Pipe on 45° skew

163'

DRAIN

45°00'

Place 76'-18" R.C. Pipe

S 60° 39' E

140' R/W

(38)
B.W. ROGERS
BY: MRS. ZELMA O. ROGERS
D. 6-9-59

180' ± R/W

B.M.#418 NAIL IN BASE 8" PINE
125' RT. STA. 4284+15 EL. 59.01

EXC	4080	EMB	29979
Stripping	—	Fill	3100
MUCK	3100	35%	11928
BOR	41427	Stripping	—
		WASTE	3100
TOT	51107	TOT	51107

OVERHAUL = 139757 C.Y.H.M.

600' V.C.

+0.16%

+0.10% CHANNEL CHANGE

+0.11% SWALE DITCH

+0.11% SECTION #3 SWALE DITCH GRADES RT. & LT. TO EQUALIZER

HIGH WATER EL.=59.00

Dis.=4275.00
El.=63.11

Use Section #3, As Shown on Sheet #2-C, from Sta. 4276+00 to Sta. 4338+00± on Rt. & Lt.

Remove Unstable Material and Backfill with Suitable Material From Sta. 4266+50 to 4341+00

ELEVATIONS OF CHANNEL CHANGE ON LT. ONLY

ELEVATIONS OF SWALE DITCH RT. ONLY

ELEVATIONS OF SWALE DITCH ON LT. & RT.

60
50

4275 6 7 8 9 4280 1 2 3 4 5 6 7 8 9 4290

PLAN / PROFILE
SURVEYED
PLOTTED
ALIGNMENT CHECKED
R/T OF WAY CHECKED
NOTE BOOK
NO.
BY
DATE
BY: M.H. NOTED
STRUCTURE NOTATN'S CH'K'D

Berkeley Co.
Pt. 1-26

(35 of 41)

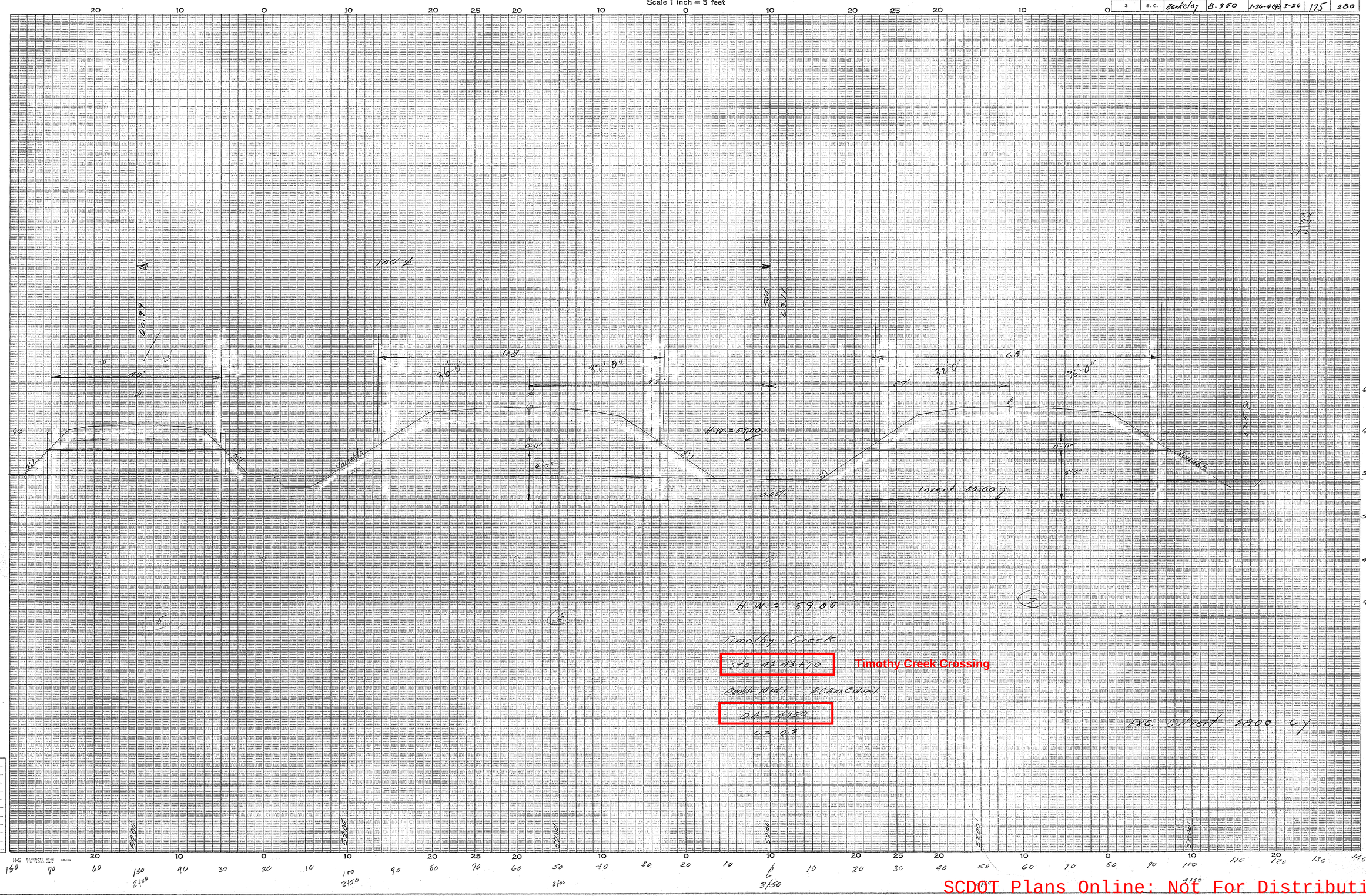
PLATE 1 - PLAN - PROFILE O.P.R. & R.E. STANDARD
KEUFFEL & ESSER CO., NEW YORK.

SCDOT Plans Online: Not For Distribution

CROSS SECTIONS

Scale 1 inch = 5 feet

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	Berkeley	B.350	I-26-4(4)	I-26	175	280



I-26
Culvert Foundation
Sta. 4243+70

Ground Surface Platted by
" " Checked by
Template Sections Platted by
" " Checked by
Areas by
" Checked by
Template Sections Revised by
" " Checked by
Final Areas by
" " Checked by
Quantities Transferred and Inked by

SCDOT Plans Online: Not For Distribution

CROSS SECTIONS

Scale 1 inch = 5 feet

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	Berkeley	8.350	I-26-4(4)	I-26	176	280

I-26
Culvert Foundation
Sta. 4266+57

Ground Surface Platted by........
" " Checked by........
Template Sections Platted by........
" " Checked by........
Areas by........
" Checked by........
Template Sections Revised by........
" " Checked by........
Final Areas by........
" " Checked by........
Quantities Transferred and Inked by........

K+E BANKNOTE 174S

SCDOT Plans Online: Not For Distribution

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX B

VOLVO CARS DRIVE
DESIGN PLANS
AND CULVERT CALCULATIONS

J – 25644.0006

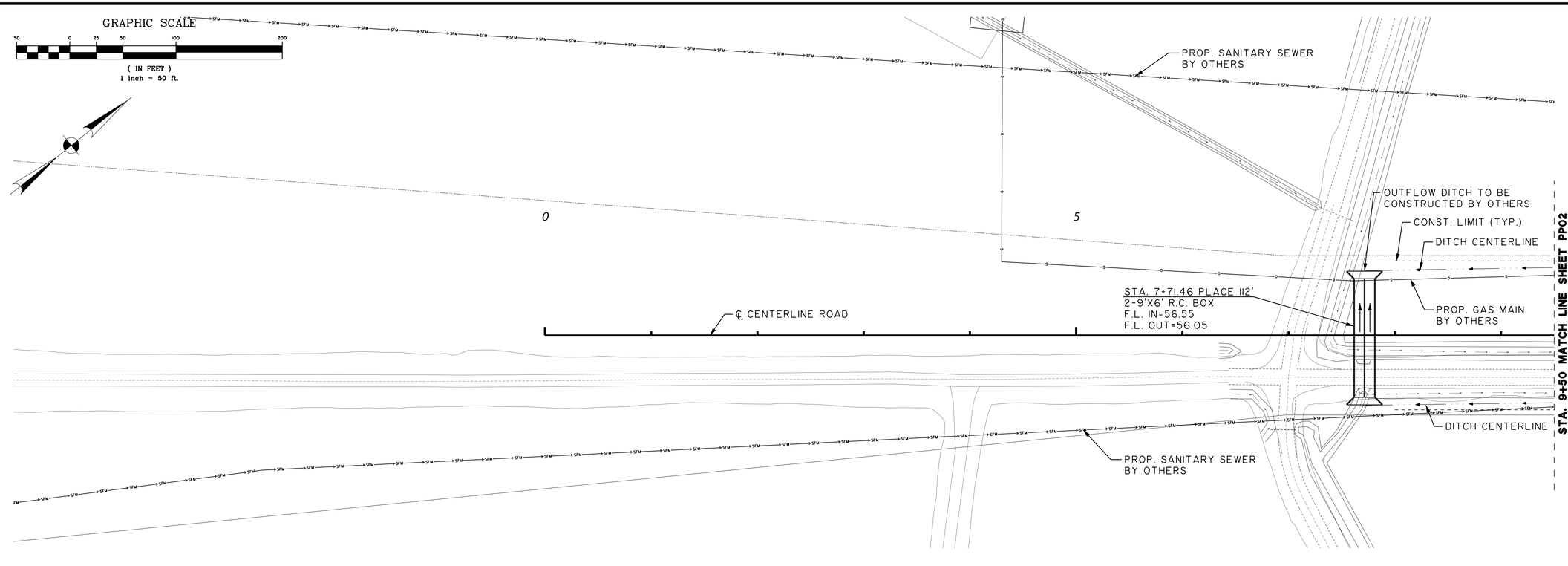
Prepared by:

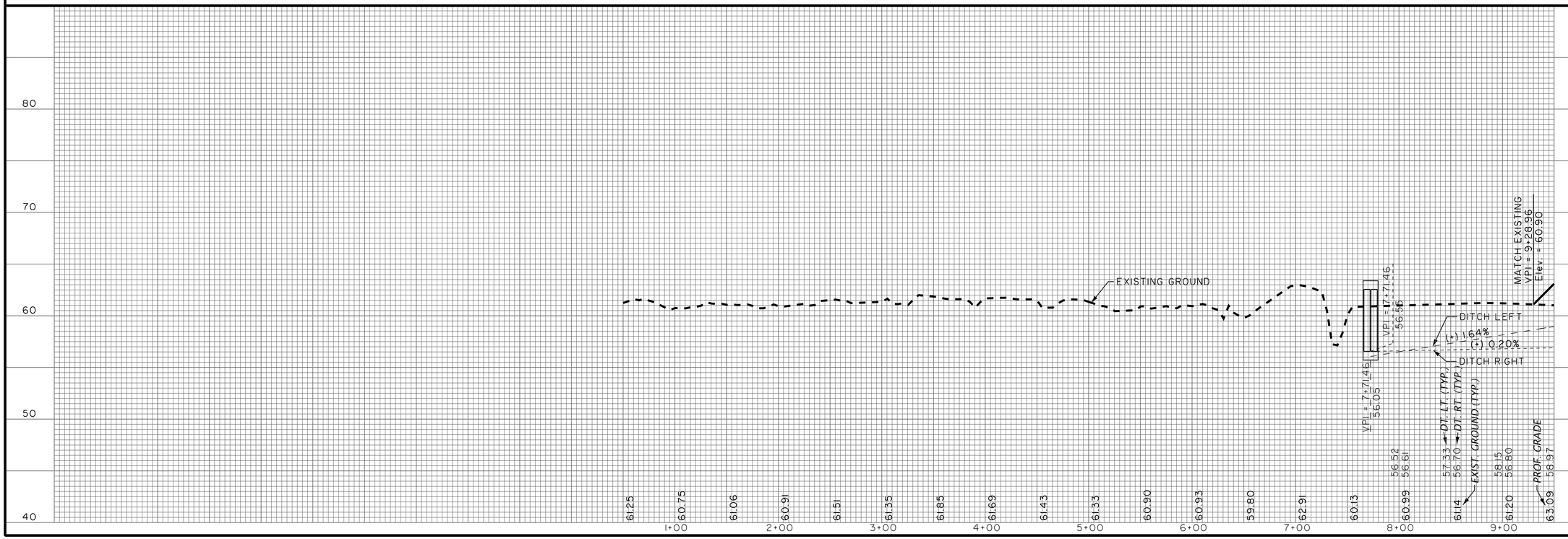
THOMAS & HUTTON

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.





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NO.	REVISIONS	BY	DATE

BERKELEY COUNTY
BERKELEY COUNTY, S.C.

CENTERLINE ROAD

PLAN AND PROFILE

JOB NO:	J-25644.1005
DATE:	
DRAWN:	
DESIGNED:	
REVIEWED:	
APPROVED:	
SCALE:	AS NOTED

PP01

SOUTH CAROLINA PROFESSIONAL ENGINEER No. [illegible] DOYLE D. KELLEY, JR. REGISTERED

SOUTH CAROLINA THOMAS & HUTTON ENGINEERING CO. No. C00285 CERTIFICATE OF AUTHORIZATION

NO.	REVISIONS	BY	DATE

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50 Park of Commerce Way
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BERKELEY COUNTY
BERKELEY COUNTY, S.C.

CENTERLINE ROAD

PLAN AND PROFILE

JOB NO: J-25644.1005
DATE:
DRAWN:
DESIGNED:
REVIEWED:
APPROVED:
SCALE: AS NOTED

PP02

GRAPHIC SCALE

(IN FEET)
1 inch = 50 ft.

PROP. SANITARY SEWER BY OTHERS

PROP. SANITARY SEWER BY OTHERS

ASPH. 40.00'
MATCH ENTRANCE
BY OTHERS- 83.50' LT

STA 29+87.00
CENTERLINE DRIVE=
SOUTH ENTRANCE

STA 29+00.00
PLACE 101'-36" R.C. PIPE
WITH BEVELED END SECTIONS
F.L. IN = 59.69
F.L. OUT = 57.93

STA 29+18.67
83.50' LT
50.0' R

PLACE 86'-36" R.C. PIPE
W/ BEVELED END SECTIONS
F.L. IN = 59.76
F.L. OUT = 59.72

STA 30+58.67
83.50' LT
50.0' R

PROP. WATER MAIN
BY OTHERS

PROP. GAS MAIN
BY OTHERS

DITCH CENTERLINE

BEGIN TAPER
STA 37+40.00
33.50' LT

25

30

35

EXIST. R/W

CONST. LIMIT (TYP.)

℄ CENTERLINE ROAD

2'
12'
12'
12'
12'
2'

STA. 23+00 MATCH LINE SHEET PP02

STA. 37+50 MATCH LINE SHEET PP04

EXIST. R/W

PROP. SANITARY SEWER BY OTHERS

CONSTRUCT 6'X10'X4" SIDEWALK W/ 2' WIDE DETECTABLE WARNING STRIP (TYP.)

STA 29+03.50
83.50' RT
50.0' R

END W-BEAM GUARDRAIL
INSTALL TYPE-B
END SECTION
STA 29+45.50

ASPH. 67.00'
MATCH ENTRANCE
BY OTHERS- 83.50' RT

STA 30+70.50
83.50' RT
50.0' R

PLACE 130'-42" R.C. PIPE
WITH BEVELED END SECTIONS
F.L. IN = 59.23
F.L. OUT = 58.89

DITCH CENTERLINE

℄ DRIVE

PROFILE GRADE

EXISTING GROUND

DITCH LEFT

DITCH RIGHT

(-) 0.01%

(+) 0.04%

(+) 0.05%

(+) 5.00%

(+) 0.05%

(+) 0.10%

VPI = 29+01.44
Elev. = 57.93

VPI = 29+00.00
Elev. = 59.69

VPI = 29+25.00
Elev. = 59.11

	23+00	24+00	25+00	26+00	27+00	28+00	29+00	30+00	31+00	32+00	33+00	34+00	35+00	36+00	37+00
PROF. GRADE (TYP.)	57.61	59.51	59.53	59.54	59.56	59.58	59.60	59.62	59.64	59.66	59.67	59.69	59.72	59.75	59.77
DIT. LT. (TYP.)	59.49	57.67	57.69	57.72	57.74	57.77	57.80	57.82	57.85	57.88	57.90	57.93	59.13	59.18	59.23
DIT. RT. (TYP.)	57.64	66.42	66.42	66.42	66.41	66.41	66.41	66.41	66.40	66.40	66.40	66.40	66.39	66.39	66.39
EXIST. GROUND (TYP.)	62.82	62.69	62.55	62.42	62.55	62.59	62.52	62.45	62.43	62.51	62.63	62.76	62.70	62.63	62.56

	23+00	24+00	25+00	26+00	27+00	28+00	29+00	30+00	31+00	32+00	33+00	34+00	35+00	36+00	37+00
PROF. GRADE (TYP.)	57.77	59.75	59.77	59.80	59.83	59.86	59.88	59.91	59.94	59.97	59.99	60.02	60.05	60.08	60.10
DIT. LT. (TYP.)	59.69	59.28	59.33	59.38	59.42	59.47	59.52	59.57	59.62	59.67	59.72	59.76	59.81	59.86	59.91
DIT. RT. (TYP.)	57.80	66.39	66.39	66.38	66.38	66.38	66.37	66.37	66.37	66.37	66.36	66.36	66.36	66.36	66.35
EXIST. GROUND (TYP.)	62.28	62.37	62.56	62.31	62.27	62.18	62.24	62.30	62.28	62.16	62.17	62.19	62.29	62.40	62.46

NO.	REVISIONS	BY	DATE

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BERKELEY COUNTY
BERKELEY COUNTY, S.C.

CENTERLINE ROAD

PLAN AND PROFILE

JOB NO:	J-25644.1005
DATE:	
DRAWN:	
DESIGNED:	
REVIEWED:	
APPROVED:	
SCALE:	AS NOTED

PP03

This spreadsheet computes the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows for an ungaged site in Georgia, South Carolina, and North Carolina. The spreasheet also includes the 95-percent prediction intervals, the minus and plus standard error of prediction intervals, and the average standard error of prediction. To use the spreadsheet, enter requested information in the yellow cells below.

Enter a site-description name: Centerline Road Sta 7+70 (TC1_403)

Enter the explanatory variables:

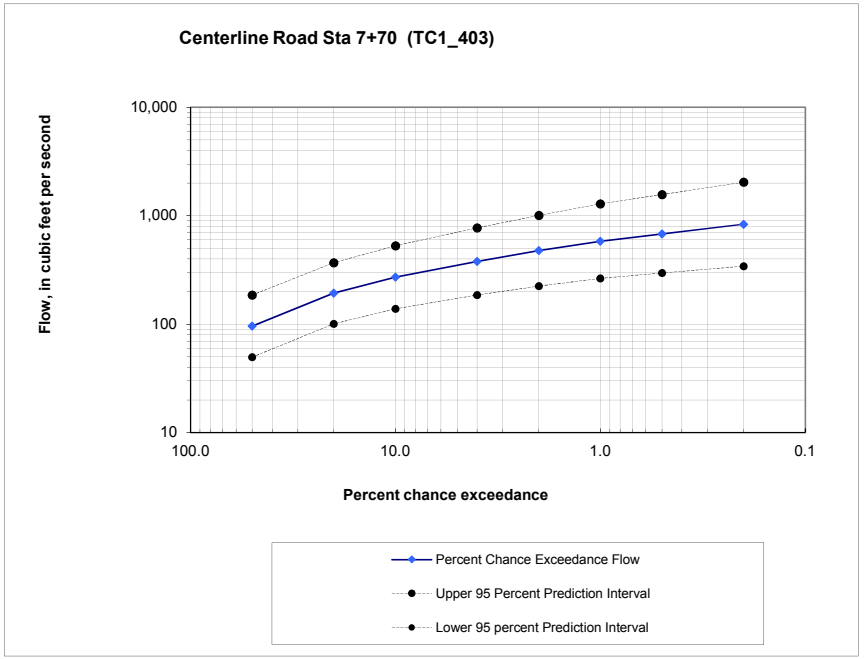
Drainage area, in square miles	2.052
Percent of basin in Hydrologic Region 1	0
Percent of basin in Hydrologic Region 2	0
Percent of basin in Hydrologic Region 3	0
Percent of basin in Hydrologic Region 4	100
Percent of basin in Hydrologic Region 5	0

Applicable range of draingage area is 1 to 9,000 square miles.
Hydrologic Region 1 corresponds to the USEPA Level III Ridge and Valley and Piedmont ecoregions
Hydrologic Region 2 corresponds to the USEPA Level III Blue Ridge ecoregion
Hydrologic Region 3 corresponds to the USEPA Level IV Sand Hills ecoregion
Hydrologic Region 4 corresponds to the USEPA Level III Southeastern, Middle Atlantic Coastal, and Southern Coastal Plain ecoregions
Hydrologic Region 5 corresponds to the lower portion of the USEPA Level IV Tifton Uplands ecoregion.

Sum of region percentages	100

Drainage area check
DRAINAGE AREA WITHIN APPLICABLE LIMITS.

Percent chance exceedance	Percent chance exceedance flow, in ft^3/s	Lower 95 percent prediction interval flow, in ft^3/s	Upper 95 percent prediction interval flow, in ft^3/s	$-S_{P,i}$ (percent)	$+S_{P,i}$ (percent)	Average $S_{p,i}$ (percent)
50	96	50	186	-28.5	40.0	34.6
20	193	101	370	-28.2	39.4	34.1
10	271	139	530	-29.0	40.8	35.2
4	379	186	773	-30.5	43.9	37.6
2	476	225	1,010	-31.8	46.7	39.8
1	583	264	1,290	-33.2	49.7	42.1
0.5	682	296	1,570	-34.6	53.0	44.5
0.2	836	343	2,040	-36.5	57.6	47.9



HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: B13-SOUTH_OUT

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
63.38	50-yr	475.00	475.00	0.00	1
63.63	100-yr	582.00	582.00	0.00	1
67.00	Overtopping	1381.45	1381.45	0.00	Overtopping

Rating Curve Plot for Crossing: B13-SOUTH_OUT

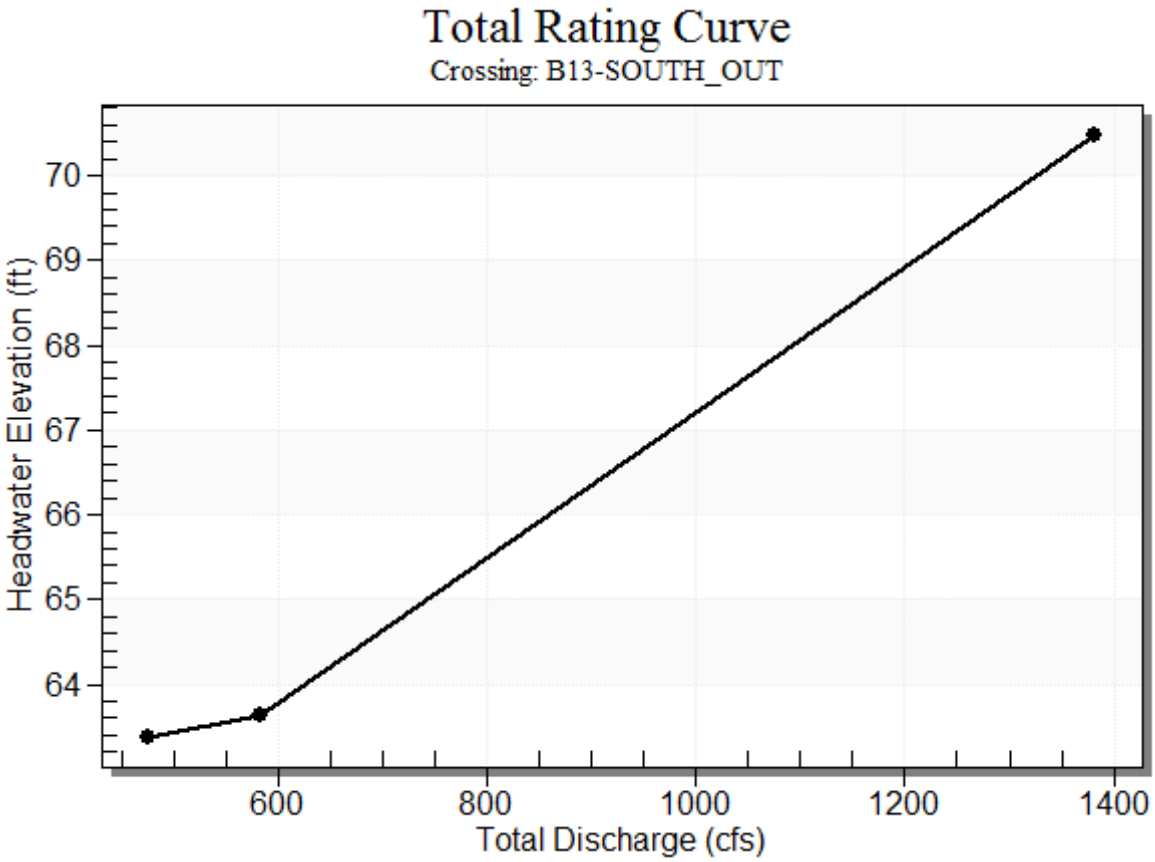


Table 2 - Culvert Summary Table: Culvert 1

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	475.00	475.00	63.38	4.294	6.835	4-FFf	2.105	2.786	6.000	6.850	4.398
100-yr	582.00	582.00	63.63	4.922	7.078	4-FFf	2.426	3.190	6.000	6.850	5.389

****

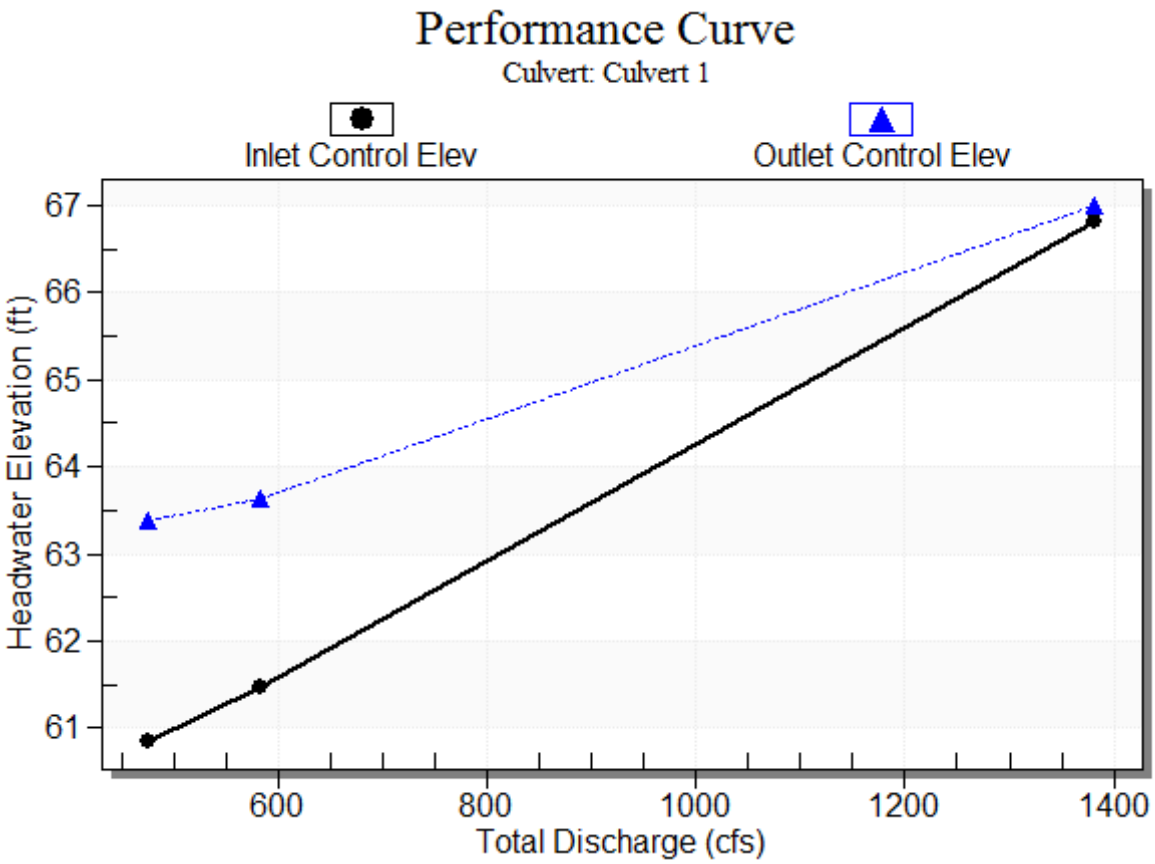
Straight Culvert

Inlet Elevation (invert): 56.55 ft, Outlet Elevation (invert): 56.05 ft

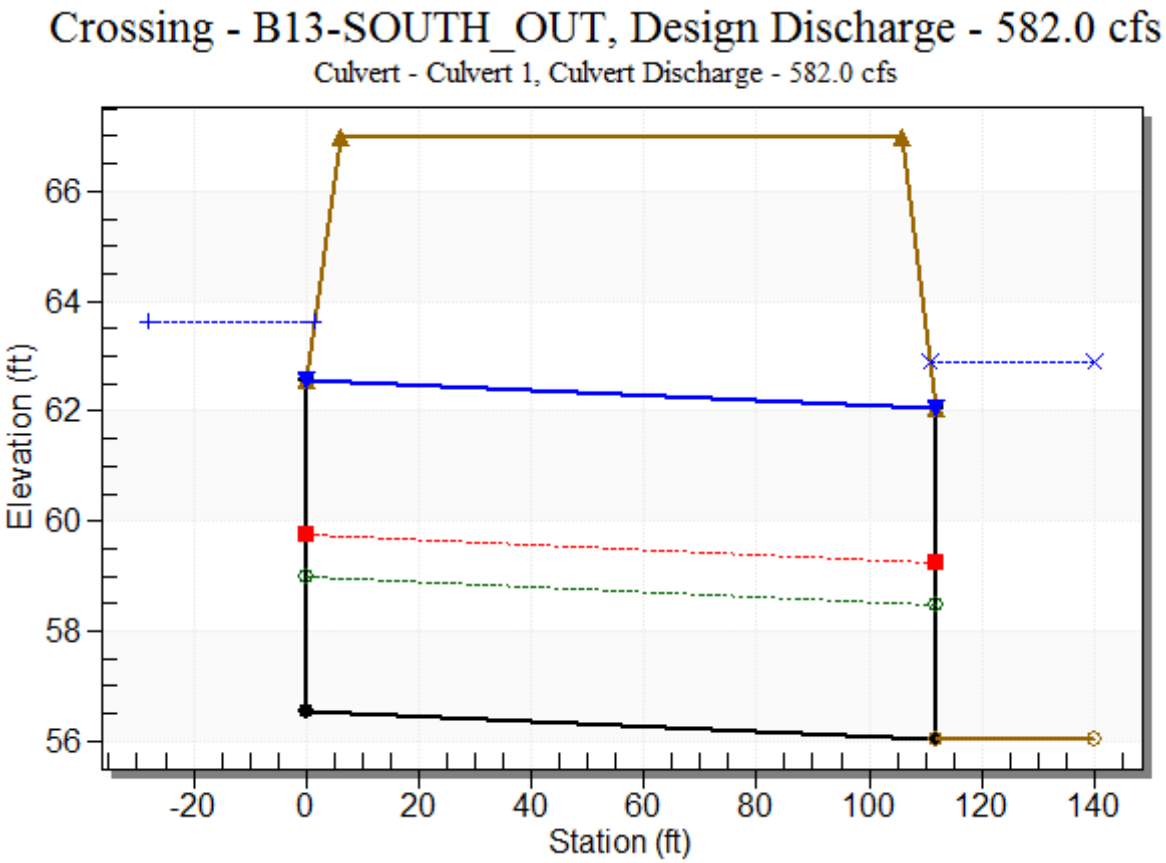
Culvert Length: 112.00 ft, Culvert Slope: 0.0045

****

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: 56.55 ft

Outlet Station: 112.00 ft

Outlet Elevation: 56.05 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 9.00 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

Table 3 - Downstream Channel Rating Curve (Crossing: B13-SOUTH_OUT)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
475.00	62.90	6.85
582.00	62.90	6.85

Tailwater Channel Data - B13-SOUTH_OUT

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 62.90 ft

Roadway Data for Crossing: B13-SOUTH_OUT

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 67.00 ft

Roadway Surface: Paved

Roadway Top Width: 100.00 ft

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/13/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer — Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over — Unnamed Tributary to Timothy Creek (B13-SOUTH_OUT)

County: BERKELEY **Rd/Rte:** Centerline

Const. Pin: n/a

Culvert Dimensions: Span: 9 ft. Rise: 6 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 112 ft.

No. of Barrels: 2 Material Type: Concrete

Centerline Station: 59+10 Skew Angle: 90 °

Inlet Invert Elev: 56.55 ft. Outlet Invert Elev.: 56.05 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 63.4 ft.

For all roads provide 100-yr high water elevation: 63.6 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 1,313.3 acres sq. mi. (or acres)

Q_{Design} = 475 cfs

$Vel._{Design}$ = 4.40 ft. / sec.

Design Headwater Elevation = 63.4 ft.

Q_{100} = 582 cfs

Vel_{100} = 5.39 ft. / sec.

100 Year Headwater Elev. = 63.6 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX C

RATIONAL METHOD DISCHARGE CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

RATIONAL METHOD
DISCHARGE CALCULATIONS

CULVERTS

25644.0006

THOMAS & HUTTON

					C=0.9	C=0.3			10-Y discharge calculation			25-Y discharge calculation			50-Y discharge calculation			100-Y discharge calculation		
TYPE	LOCATION	SIDE	STA.NO	total AREA (acre)	paved area (Acre)	unimproved area (Acre)	A*C	T (min)	I	Cf	Q	I	Cf	Q	I	Cf	Q	I	Cf	Q
CULVERT	RAMP2	XS	216+00	6.93	0.34	6.59	2.29	20.00	5.13	1.00	11.72	5.78	1.10	14.53	6.29	1.20	17.24	6.85	1.25	19.56
CULVERT	RAMP 2 AND 1	XS	219+00/144+79	88.08	9.35	78.72	18.70	82.98	2.28	1.00	42.71	2.55	1.10	52.43	2.75	1.20	61.74	2.99	1.25	69.96
CULVERT	RAMP3	XS	312+18	96.43	11.58	84.85	22.54	82.98	2.28	1.00	51.49	2.55	1.10	63.19	2.75	1.20	74.42	2.99	1.25	84.33
CULVERT	RAMP 3	LT	318+50	10.64	3.05	7.58	5.02	16.00	5.57	1.00	27.96	6.29	1.10	34.73	6.85	1.20	41.27	7.41	1.25	46.52
CULVERT	RAMP 4	XS	421+50	95.49	11.38	84.11	22.14	82.98	2.28	1.00	50.57	2.55	1.10	62.07	2.75	1.20	73.09	2.99	1.25	82.82
CULVERT	RAMP 4	XS	443+00	43.36	1.44	41.92	5.49	62.00	2.80	1.00	15.38	3.13	1.10	18.90	3.38	1.20	22.28	3.63	1.25	24.91

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HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

RATIONAL METHOD
DISCHARGE CALCULATIONS

ROADSIDE DRAINAGE

25644.0006

THOMAS & HUTTON

					C=0.9	C=0.3			10-Y discharge calculation			25-Y discharge calculation			50-Y discharge calculation			100-Y discharge calculation		
TYPE	LOCATION	SIDE	STA.NO	total AREA (acre)	paved area (Acre)	unimproved area (Acre)	A*C	T (min)	I	Cf	Q	I	Cf	Q	I	Cf	Q	I	Cf	Q
ROADSIDE DRAIN	EB	XS	669+30	0.99	0.80	0.19	0.78	5.00	7.28	1.00	5.65	8.29	1.10	7.07	9.09	1.20	8.46	9.90	1.25	9.60
ROADSIDE DRAIN	EB	XS	674+00	1.58	1.28	0.30	1.24	5.00	7.28	1.00	9.02	8.29	1.10	11.30	9.09	1.20	13.52	9.90	1.25	15.34
ROADSIDE DRAIN	EB	XS	679+72	0.84	0.68	0.16	0.66	5.00	7.28	1.00	4.80	8.29	1.10	6.02	9.09	1.20	7.20	9.90	1.25	8.17
ROADSIDE DRAIN	EB	XS	695+02	1.61	1.30	0.31	1.26	5.00	7.28	1.00	9.19	8.29	1.10	11.51	9.09	1.20	13.77	9.90	1.25	15.63
ROADSIDE DRAIN	EB	XS	707+63	0.52	0.42	0.10	0.41	5.00	7.28	1.00	2.97	8.29	1.10	3.72	9.09	1.20	4.45	9.90	1.25	5.05
ROADSIDE DRAIN	EB	XS	713+63	1.61	1.30	0.31	1.26	5.00	7.28	1.00	9.18	8.29	1.10	11.51	9.09	1.20	13.76	9.90	1.25	15.62
ROADSIDE DRAIN	EB	RT	714+79-716+86	80.23	7.81	72.42	15.71	66.18	2.68	1.00	42.12	2.99	1.10	51.74	3.23	1.20	60.97	3.52	1.25	69.08
ROADSIDE DRAIN	EB	XS	718+99	0.89	0.72	0.17	0.70	5.00	7.28	1.00	5.08	8.29	1.10	6.37	9.09	1.20	7.62	9.90	1.25	8.64
ROADSIDE DRAIN	EB	RT	719+74-722+54	55.22	6.27	48.95	11.94	77.00	2.41	1.00	28.80	2.69	1.10	35.35	2.91	1.20	41.64	3.16	1.25	47.18
ROADSIDE DRAIN	EB	XS	726+96	2.87	2.31	0.56	2.25	17.00	5.45	1.00	12.26	6.15	1.10	15.22	6.70	1.20	18.07	7.24	1.25	20.36
ROADSIDE DRAIN	EB	XS	751+97	2.94	0.50	2.44	1.18	5.00	7.28	1.00	8.60	8.29	1.10	10.78	9.09	1.20	12.89	9.90	1.25	14.63
ROADSIDE DRAIN	WB	XS	882+00	1.95	1.58	0.37	0.77	5.00	7.28	1.00	11.14	8.29	1.10	13.95	9.09	1.20	16.69	9.90	1.25	18.94
ROADSIDE DRAIN	WB	XS	890+10	0.98	0.79	0.19	0.77	5.00	7.28	1.00	5.60	8.29	1.10	7.01	9.09	1.20	8.39	9.90	1.25	9.52
ROADSIDE DRAIN	WB	XS	899+12	0.62	0.99	-0.37	0.78	5.00	7.28	1.00	5.68	8.29	1.10	7.11	9.09	1.20	8.51	9.90	1.25	9.66
ROADSIDE DRAIN	WB	XS	901+62	1.74	1.40	0.34	1.36	5.00	7.28	1.00	9.93	8.29	1.10	12.44	9.09	1.20	14.88	9.90	1.25	16.89
ROADSIDE DRAIN	WB	LT	916+73-919+02	1.55	0.25	1.30	0.61	5.00	7.28	1.00	4.46	8.29	1.10	5.58	9.09	1.20	6.68	9.90	1.25	7.58
ROADSIDE DRAIN	WB	XS	919+03	0.89	0.72	0.17	0.70	5.00	7.28	1.00	5.08	8.29	1.10	6.37	9.09	1.20	7.62	9.90	1.25	19.40
ROADSIDE DRAIN	WB	LT	921+10-921+51	2.90	1.11	1.79	1.54	5.00	7.28	1.00	11.17	8.29	1.10	14.00	9.09	1.20	16.74	9.90	1.25	19.00
ROADSIDE DRAIN	WB	XS	922+82	0.35	0.28	0.07	0.27	5.00	7.28	1.00	2.00	8.29	1.10	2.51	9.09	1.20	3.00	9.90	1.25	8.64
ROADSIDE DRAIN	WB	XS	936+70	4.30	3.47	0.83	3.37	15.00	5.69	1.00	19.19	6.43	1.10	23.85	7.00	1.20	28.35	7.58	1.25	31.97
ROADSIDE DRAIN	WB	XS	952+06	4.09	1.43	2.66	2.08	5.00	7.28	1.00	15.15	8.29	1.10	18.98	9.09	1.20	22.71	9.90	1.25	25.76

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HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

RATIONAL METHOD
DISCHARGE CALCULATIONS

DITCHES

25644.0006

THOMAS & HUTTON

					C=0.9	C=0.3			10-Y discharge calculation			25-Y discharge calculation			50-Y discharge calculation			100-Y discharge calculation		
TYPE	LOCATION	SIDE	STA.NO	total AREA (acre)	paved area (Acre)	unimproved area (Acre)	A*C	T (min)	I	Cf	Q	I	Cf	Q	I	Cf	Q	I	Cf	Q
DITCHES	RAMP 1	LT	143+30	95.49	11.38	84.11	22.14	82.98	2.28	1.00	50.57	2.55	1.10	62.07	2.75	1.20	73.09	2.99	1.25	82.82
DITCHES	RAMP 1	RT	161+50	27.30	0.78	26.52	8.66	144.00	1.48	1.00	12.85	1.65	1.10	15.76	1.79	1.20	18.55	1.91	1.25	20.71
DITCHES	RAMP 2	RT	219+00	88.08	9.35	78.72	18.70	82.98	2.28	1.00	42.71	2.55	1.10	52.43	2.75	1.20	61.74	2.99	1.25	69.96
DITCHES	RAMP3	RT	312+18	96.43	11.58	84.85	22.54	82.98	2.28	1.00	51.49	2.55	1.10	63.19	2.75	1.20	74.42	2.99	1.25	84.33
DITCHES	RAMP3	RT	318+50	10.64	3.05	7.58	5.02	16.00	5.57	1.00	27.96	6.29	1.10	34.73	6.85	1.20	41.27	7.41	1.25	46.52
DITCHES	RAMP4	LT	403+04	1.24	0.44	0.80	0.63	5.00	7.28	1.00	4.61	8.29	1.10	5.77	9.09	1.20	6.91	9.90	1.25	7.84
DITCHES	RAMP4	RT	443+00	43.36	1.44	41.92	5.49	62.00	2.80	1.00	15.38	3.13	1.10	18.90	3.38	1.20	22.28	3.63	1.25	24.91
DITCHES	EB	XS	716+86	0.84	0.68	0.16	0.66	5.00	7.28	1.00	4.80	8.29	1.10	6.02	9.09	1.20	7.20	9.90	1.25	8.17
DITCHES	EB	RT	722+54	80.23	7.81	72.42	15.71	66.18	2.68	1.00	42.12	2.99	1.10	51.74	3.23	1.20	60.97	3.52	1.25	69.08
DITCHES	EB	RT	771+50	3.76	1.87	1.89	2.25	5.00	7.28	1.00	16.38	8.29	1.10	20.52	9.09	1.20	24.54	9.90	1.25	27.85
DITCHES	WB	LT	971+50	71.89	1.56	70.33	22.50	59.28	2.89	1.00	64.98	3.23	1.10	79.87	3.49	1.20	94.16	3.74	1.25	105.30

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HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX D

SCS METHOD
DISCHARGE CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

SCS METHOD
DISCHARGE CALCULATIONS

CULVERTS

25644.0006

THOMAS & HUTTON

WinTR-55 Current Data Description

--- Identification Data ---

User: Ling
Project:
SubTitle:
State: South Carolina
County: Berkeley_NOAA_C
Filename: C:\Users\LY\Desktop\25644.0006\25644.0006drainage calculation\R1 RT 110.w55

Date: 6/10/2016
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
R1 RT 110		Outlet	100.03	73	1.279

Total area: 100.03 (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)
4.06	5.2	6.2	7.5	8.6	9.8	3.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: PRF_100

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Berkeley_NOAA_C 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)
4.06	5.2	6.2	7.5	8.6	9.8	3.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: PRF_100

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Berkeley_NOAA_C 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							
R1 RT 110	17.04	27.20	36.85	50.11	61.73	74.68	13.30
REACHES							
OUTLET	17.04	27.20	36.85	50.11	61.73	74.68	13.30

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Berkeley_NOAA_C 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	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	1-Yr
	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)
SUBAREAS							
R1 RT 110	17.04 14.12	27.20 13.85	36.85 13.82	50.11 13.68	61.73 13.60	74.68 13.54	13.30 14.23
REACHES							
OUTLET	17.04	27.20	36.85	50.11	61.73	74.68	13.30

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Berkeley_NOAA_C County, South Carolina

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
R1 RT 110	100.03	1.279	73	Outlet	

Total Area: 100.03 (ac)

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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)
R1 RT 110							
SHEET	100	0.0100	0.800				0.730
SHALLOW	1625	0.0100	0.050				0.280
CHANNEL	1000					3.000	0.093
CHANNEL	1900					3.000	0.176
					Time of Concentration		1.279

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
R1 RT 110	Paved; open ditches (w/right-of-way)	C	15.286	92
	Woods (good)	C	84.74	70
	Total Area / Weighted Curve Number		100.03	73

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HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

SCS METHOD
DISCHARGE CALCULATIONS

DITCHES

25644.0006

THOMAS & HUTTON

WinTR-55 Current Data Description

--- Identification Data ---

User: Ling
Project:
SubTitle:
State: South Carolina
County: Berkeley_NOAA_C
Filename: Z:\25644\25644.1005\Exchange - External\Incoming\Consultant\Stantec\2016-04-04\pdf\WITH EL\ca

Date: 5/16/2016
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
EB RT 667		Outlet	501.17	71	4.357

Total area: 501.17 (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)
4.06	5.2	6.2	7.5	8.6	9.8	3.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: PRF_100

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Berkeley_NOAA_C 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)
4.06	5.2	6.2	7.5	8.6	9.8	3.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: PRF_100

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Berkeley_NOAA_C 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							
EB RT 667	31.08	49.55	67.22	91.70	113.16	137.22	24.30
REACHES							
OUTLET	31.08	49.55	67.22	91.70	113.16	137.22	24.30

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Berkeley_NOAA_C 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	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	1-Yr
	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)	(cfs) (hr)
SUBAREAS							
EB RT 667	31.08 18.37	49.55 18.00	67.22 17.90	91.70 17.68	113.16 17.67	137.22 17.10	24.30 18.80
REACHES							
OUTLET	31.08	49.55	67.22	91.70	113.16	137.22	24.30

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Berkeley_NOAA_C County, South Carolina

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
EB RT 667	501.17	4.357	71	Outlet	

Total Area: 501.17 (ac)

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Berkeley_NOAA_C 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)
EB RT 667							
SHEET	100	0.0100	0.800				0.730
SHALLOW	200	0.0100	0.050				0.034
SHALLOW	5532	0.0008	0.050				3.367
CHANNEL	2439					3.000	0.226
					Time of Concentration		4.357

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Berkeley_NOAA_C 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
EB RT 667	Paved; open ditches (w/right-of-way)	C	20.45	92
	Woods (good)	C	480.72	70
	Total Area / Weighted Curve Number		501.17	71

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WinTR-55 Current Data Description

--- Identification Data ---

User: Ling
Project:
SubTitle:
State: South Carolina
County: Berkeley_NOAA_C
Filename: C:\Users\LY\Desktop\wb lt 886.w55

Date: 6/6/2016
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
WB LT 886		Outlet	122.51	74	1.688

Total area: 122.51 (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)
4.06	5.2	6.2	7.5	8.6	9.8	3.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: PRF_100

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Berkeley_NOAA_C 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)
4.06	5.2	6.2	7.5	8.6	9.8	3.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: PRF_100

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Berkeley_NOAA_C 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							
WB LT 886	17.93	28.16	37.83	51.04	62.65	75.54	14.14
REACHES							
OUTLET	17.93	28.16	37.83	51.04	62.65	75.54	14.14

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Berkeley_NOAA_C 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														
WB LT 886	17.93	14.84	28.16	14.56	37.83	14.28	51.04	14.35	62.65	14.21	75.54	14.08	14.14	14.85
REACHES														
OUTLET	17.93		28.16		37.83		51.04		62.65		75.54		14.14	

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Ling

Berkeley_NOAA_C County, South Carolina

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
WB LT 886	122.51	1.688	74	Outlet	

Total Area: 122.51 (ac)

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Ling

Berkeley_NOAA_C 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)
WB LT 886							
SHEET	100	0.0150	0.800				0.621
SHALLOW	750	0.0130	0.050				0.113
SHALLOW	857	0.0023	0.050				0.308
CHANNEL	1226					1.000	0.341
CHANNEL	3290					3.000	0.305
					Time of Concentration		1.688

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Ling

Berkeley_NOAA_C 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
WB LT 886	Paved; open ditches (w/right-of-way)	C	25.03	92
	Woods (good)	C	97.48	70
	Total Area / Weighted Curve Number		122.51	74

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HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX E

CULVERT HY-8
HYDRAULIC CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

								Overtop		50-Y					100-Y	
TYPE	LOCATION	SIDE	STA.NO	Shape	Diameter (ft)	No. of Barrel	Slope	Discharge (cfs)	Headwater Elevation (ft)	Discharge (cfs)	Headwater Elevation (ft)	Headwater Depth (ft)	Hw/D (<1.2)	Velocity (fps) >3	Discharge (cfs)	Headwater Elevation (ft)
CULVERT	RAMP 1	XS	110+00	Circle	3.5	1	0.27%	140.91	65.87	61.73	59.92	3.88	1.11	7.48	74.68	60.53
CULVERT	RAMP2	XS	216+00	Circle	2	1	1.06%	60.52	76.52	17.24	63.11	2.31	1.16	5.49	19.56	63.35
CULVERT	RAMP 2 AND 1	XS	219+00/144+79	Circle	3	2	0.07%	267.00	77.54	61.74	62.32	3.32	1.11	4.61	69.96	62.58
CULVERT	RAMP3	XS	312+18	Circle	3	2	0.07%	205.71	67.78	74.42	61.85	3.35	1.12	6.14	84.33	62.13
CULVERT	RAMP 3	LT	318+50	Circle	3	1	0.21%	102.20	66.74	41.27	61.52	3.32	1.11	7.10	46.52	61.81
CULVERT	RAMP 4	XS	421+50	Circle	3	2	0.07%	235.38	70.28	73.09	61.85	3.25	1.08	6.28	82.82	62.12
CULVERT	RAMP 4	XS	443+00	Circle	2.5	1	0.23%	52.06	66.70	22.28	63.68	2.48	0.99	6.70	24.91	63.87

								Overtop		50-Y					100-Y	
TYPE	LOCATION	SIDE	STA.NO	Shape	Diameter	No. of Barrel	Slope	Discharge (cfs)	Headwater Elevation (ft)	Discharge (cfs)	Headwater Elevation (ft)	Headwater Depth (ft)	Hw/D (<1.2)	Velocity (fps) >3	Discharge (cfs)	Headwater Elevation (ft)
CULVERT	EB	XS	669+30	Circle	1.5	1	0.77%	22.31	65.34	8.46	56.49	1.74	1.16	4.92	9.60	56.68
CULVERT	EB	XS	674+00	Circle	2	1	2.76%	37.32	62.55	13.52	58.30	1.97	0.99	4.30	15.34	58.49
CULVERT	EB	XS	679+72	Circle	1.5	1	2.16%	20.92	63.19	7.20	57.69	1.54	1.03	4.07	8.17	57.84
CULVERT	EB	XS	695+02	Circle	2	1	4.19%	36.98	65.63	13.77	62.44	1.94	0.97	11.21	15.63	62.60
CULVERT	EB	XS	707+63	Circle	1.5	1	3.76%	21.47	67.26	4.45	63.35	1.14	0.76	8.08	5.05	63.44
CULVERT	EB	XS	713+63	Circle	2	1	4.67%	35.07	67.97	13.76	65.14	1.91	0.96	11.40	15.62	65.31
CULVERT	EB	XS	718+99	Circle	2	1	2.19%	42.63	68.38	7.62	63.38	1.38	0.69	2.46	8.64	63.48
CULVERT	EB	XS	726+96	Circle	2	1	2.53%	41.35	68.96	18.07	65.28	2.38	1.19	10.10	20.36	65.53
CULVERT	EB	XS	751+97	Circle	2	1	2.71%	38.44	80.52	12.89	76.97	1.88	0.94	9.45	14.63	77.13
CULVERT	WB	XS	882+00	Circle	2	1	3.54%	32.93	63.40	16.69	60.55	2.31	1.16	10.96	18.94	60.84
CULVERT	WB	XS	890+10	Circle	1.5	1	1.79%	19.97	64.91	8.39	59.84	1.75	1.17	4.75	9.52	60.12
CULVERT	WB	XS	899+12	Circle	1.5	1	3.07%	22.02	66.25	8.51	62.16	1.73	1.15	4.82	9.66	66.35
CULVERT	WB	XS	901+62	Circle	2	1	4.88%	35.11	66.58	14.88	63.84	2.04	1.02	11.68	16.89	64.04
CULVERT	WB	XS	922+82	Circle	1.5	1	1.71%	18.90	68.79	3.00	64.92	0.91	0.61	6.68	3.40	64.99
CULVERT	WB	XS	936+70	Circle	2.5	1	0.68%	71.19	70.29	28.35	64.16	2.76	1.10	7.23	31.97	64.42
CULVERT	WB	XS	952+06	Circle	2.5	1	0.63%	72.47	80.62	22.71	73.88	2.38	0.95	6.65	25.76	74.09

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 110+00 RAMP 1 (XS): 42" CULVERT

25644.0006

THOMAS & HUTTON

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: RAMP 1 110+00

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	RAMP 1 110+00 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
59.92	50-yr	61.73	61.73	0.00	1
60.53	100-yr	74.68	74.68	0.00	1
65.87	Overtopping	140.91	140.91	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 1 110+00

Table 2 - Culvert Summary Table: RAMP 1 110+00

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	61.73	61.73	59.92	3.807	3.878	3-M2t	3.500	2.460	2.800	2.800	7.481
100-yr	74.68	74.68	60.53	4.483	4.420	3-M2t	3.500	2.702	2.800	2.800	9.051

****

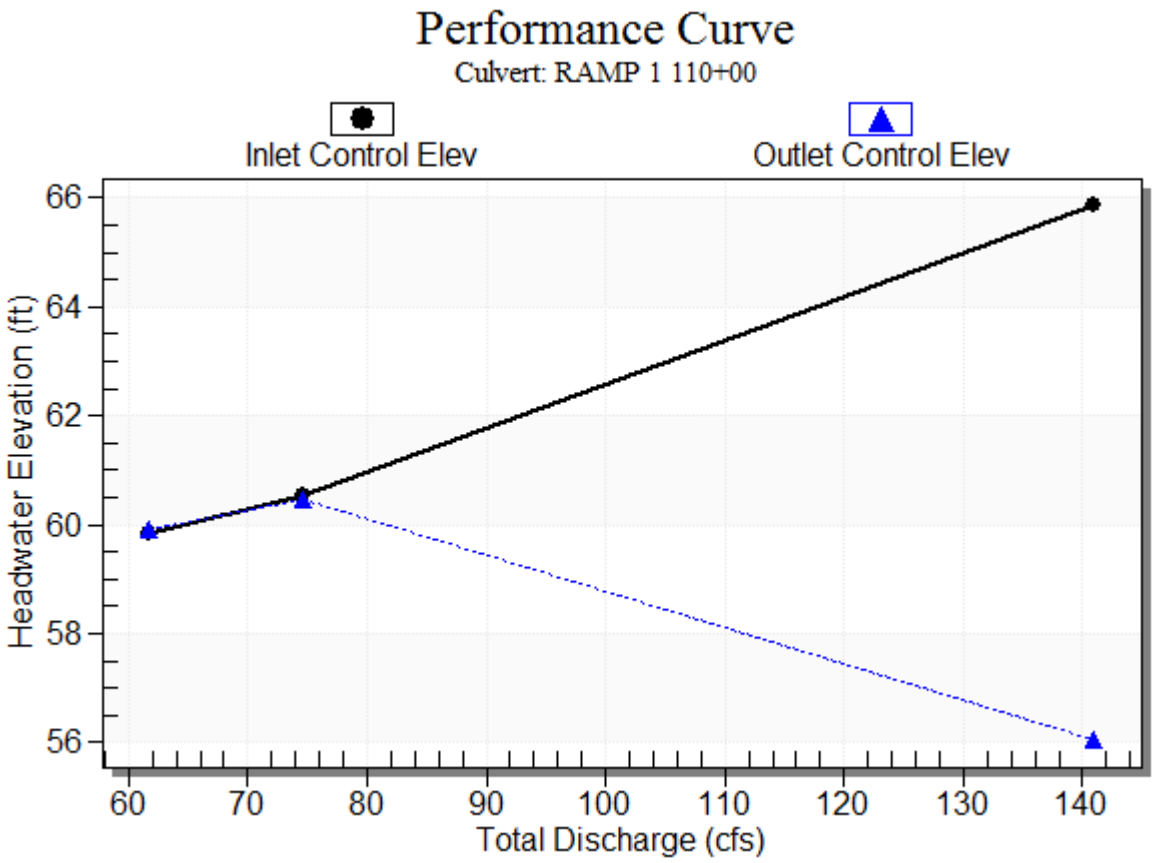
Straight Culvert

Inlet Elevation (invert): 56.05 ft, Outlet Elevation (invert): 55.80 ft

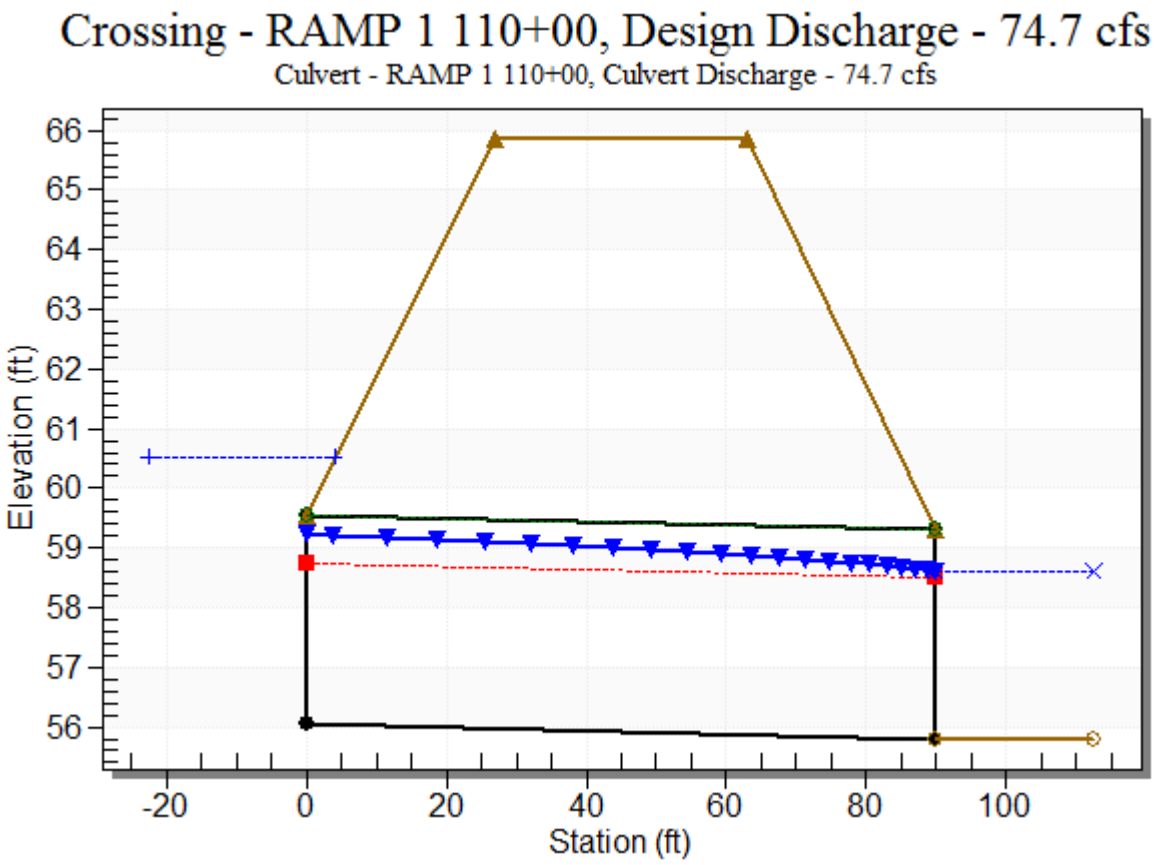
Culvert Length: 90.00 ft, Culvert Slope: 0.0027

****

Culvert Performance Curve Plot: RAMP 1 110+00



Water Surface Profile Plot for Culvert: RAMP 1 110+00



Site Data - RAMP 1 110+00

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 56.05 ft

Outlet Station: 90.00 ft

Outlet Elevation: 55.80 ft

Number of Barrels: 1

Culvert Data Summary - RAMP 1 110+00

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

Table 3 - Downstream Channel Rating Curve (Crossing: RAMP 1 110+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
61.73	58.60	2.80
74.68	58.60	2.80

Tailwater Channel Data - RAMP 1 110+00

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 58.60 ft

Roadway Data for Crossing: RAMP 1 110+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 65.87 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 216+00 RAMP 2 (XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: RAMP 2 XS 216

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
63.11	50-yr	17.24	17.24	0.00	1
63.35	100-yr	19.56	19.56	0.00	1
76.52	Overtopping	60.52	60.52	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 2 XS 216

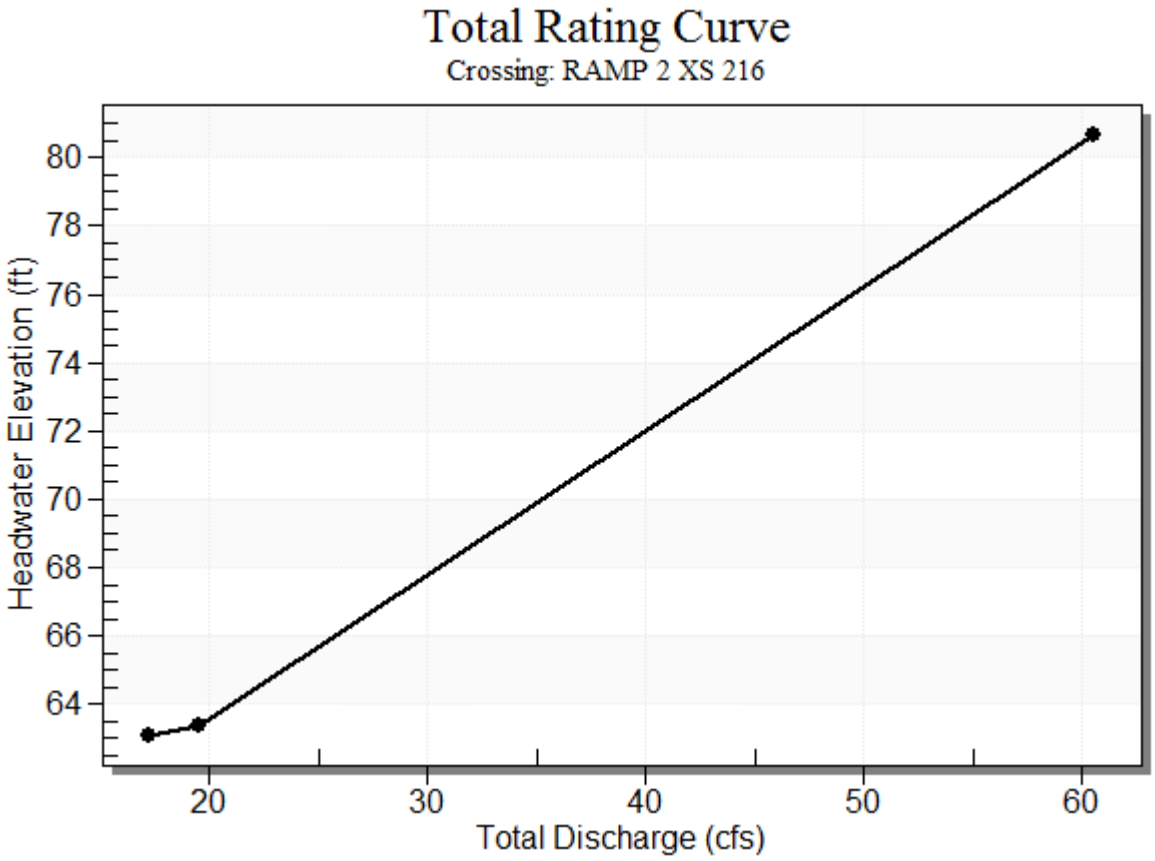


Table 2 - Culvert Summary Table: Culvert 1

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	17.24	17.24	63.11	2.306	2.011	5-JS1f	1.077	1.495	2.000	2.200	5.488
100-yr	19.56	19.56	63.35	2.552	2.358	5-JS1f	1.177	1.588	2.000	2.200	6.226

****

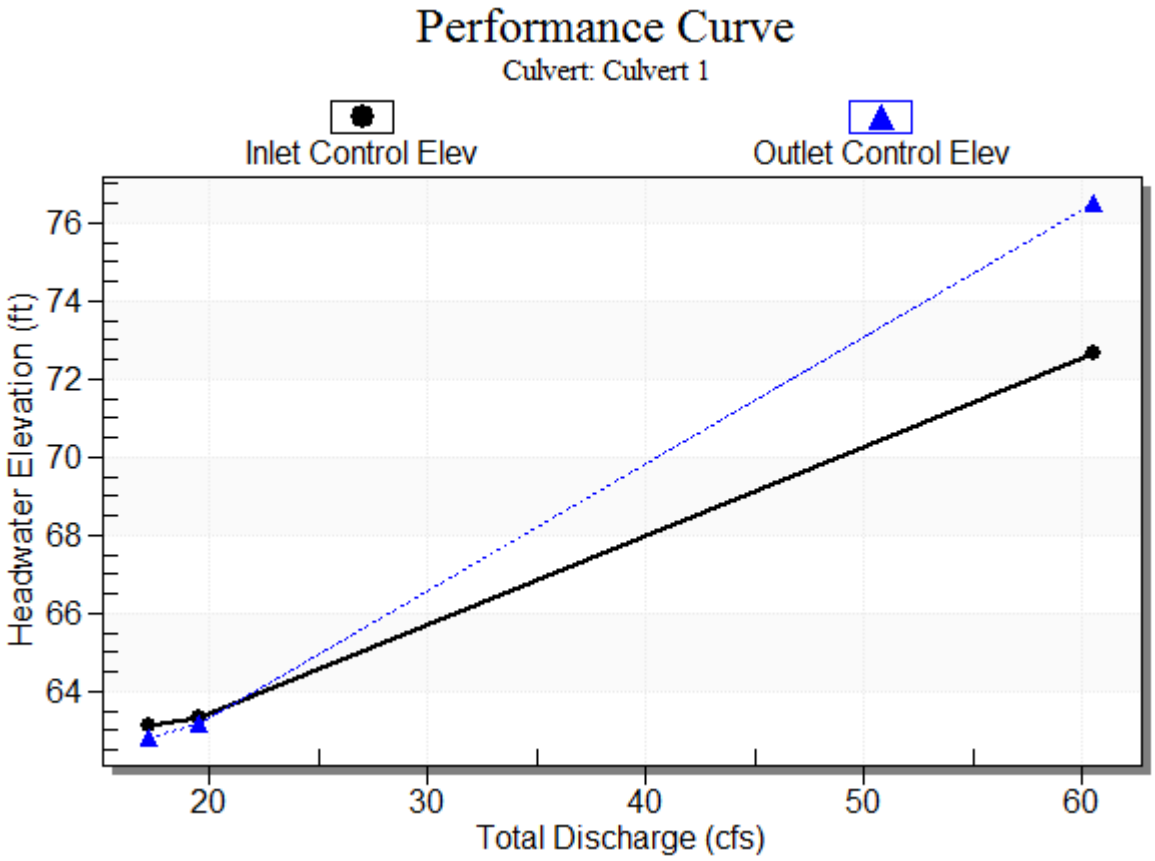
Straight Culvert

Inlet Elevation (invert): 60.80 ft, Outlet Elevation (invert): 59.40 ft

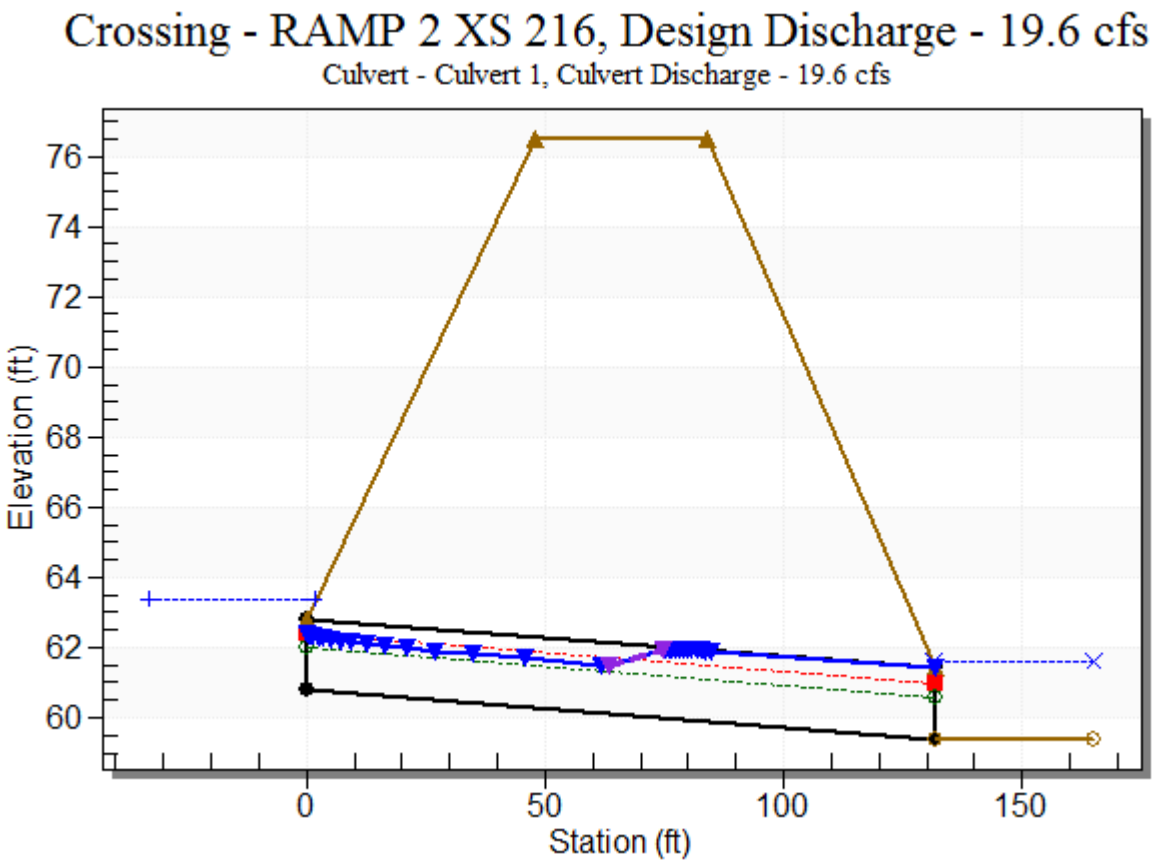
Culvert Length: 132.01 ft, Culvert Slope: 0.0106

****

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: 60.80 ft

Outlet Station: 132.00 ft

Outlet Elevation: 59.40 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 (1.5:1)

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: RAMP 2 XS 216)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
17.24	61.60	2.20
19.56	61.60	2.20

Tailwater Channel Data - RAMP 2 XS 216

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 61.60 ft

Roadway Data for Crossing: RAMP 2 XS 216

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 76.52 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 219+00/144+79 RAMP 2/1 (XS): DUAL 36" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 4 - Summary of Culvert Flows at Crossing: RAMP 2 XS 219

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
62.32	50-yr	61.74	61.74	0.00	1
62.58	100-yr	69.96	69.96	0.00	1
77.54	Overtopping	266.97	266.97	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 2 XS 219

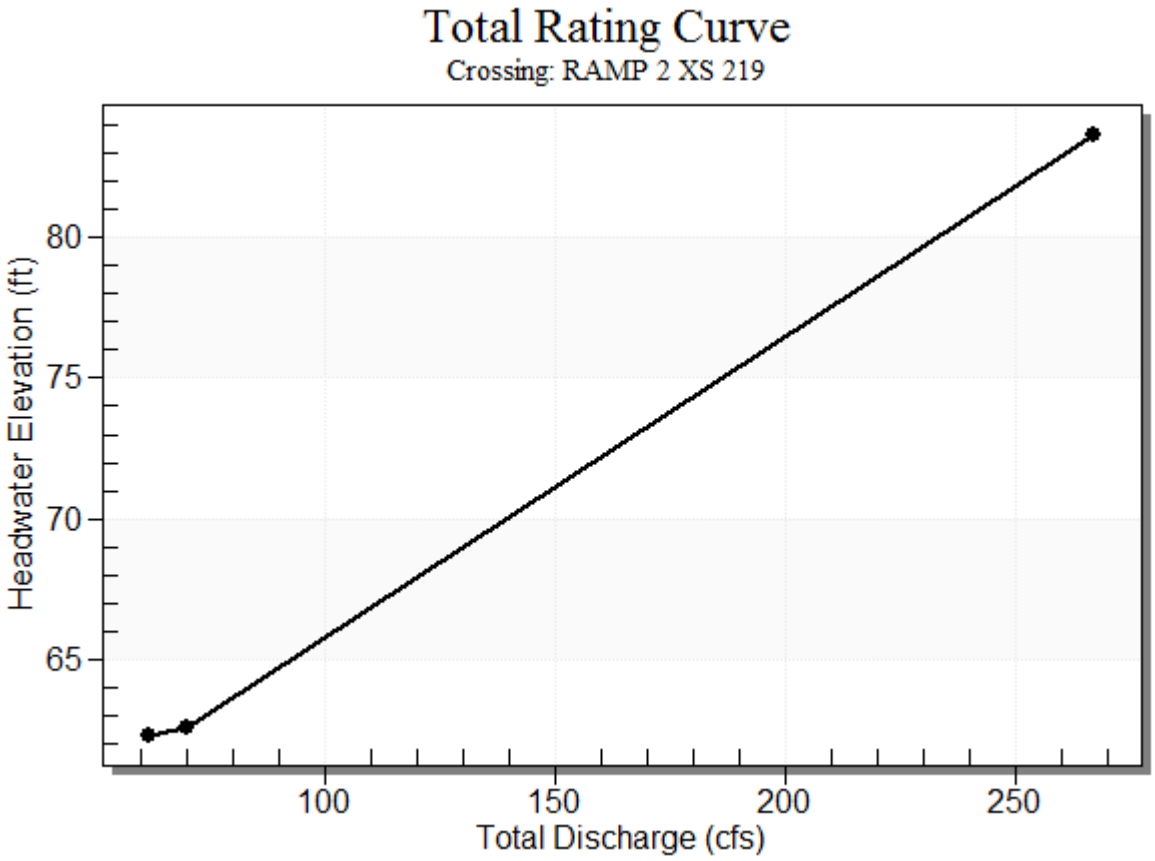


Table 5 - Culvert Summary Table: Culvert 1

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	61.74	61.74	62.32	2.622	3.317	3-M2t	3.000	1.795	2.700	2.700	4.607
100-yr	69.96	69.96	62.58	2.827	3.581	7-M2t	3.000	1.918	2.700	2.700	5.220

****

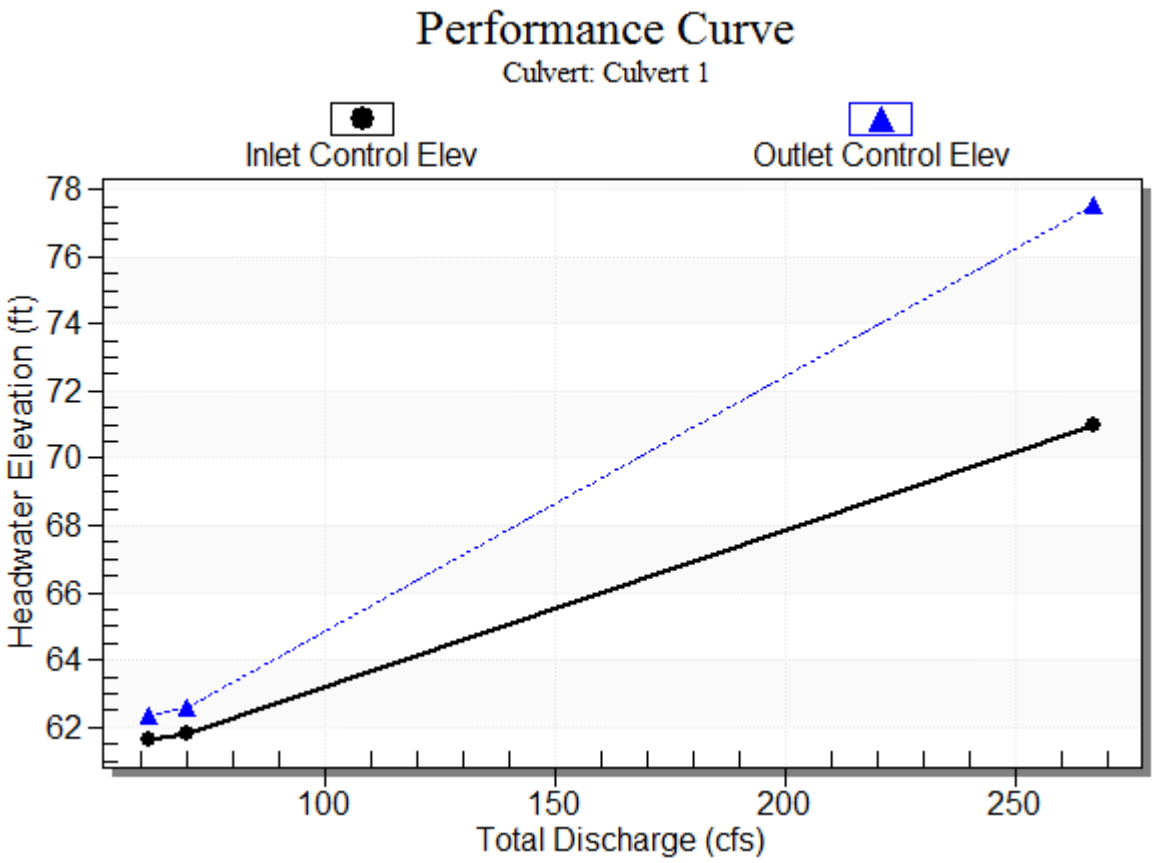
Straight Culvert

Inlet Elevation (invert): 59.00 ft, Outlet Elevation (invert): 58.80 ft

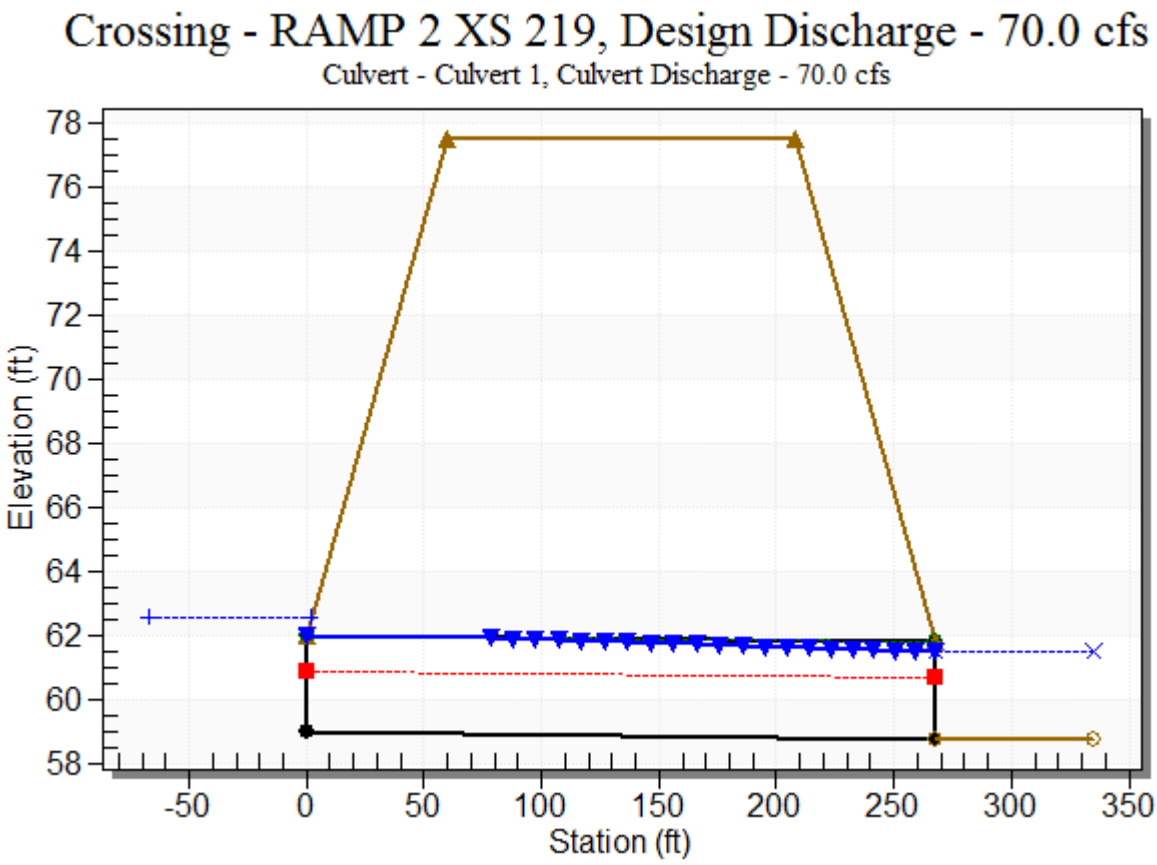
Culvert Length: 268.00 ft, Culvert Slope: 0.0007

****

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: 59.00 ft

Outlet Station: 268.00 ft

Outlet Elevation: 58.80 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1.5:1)

Inlet Depression: NONE

Table 6 - Downstream Channel Rating Curve (Crossing: RAMP 2 XS 219)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
61.74	61.50	2.70
69.96	61.50	2.70

Tailwater Channel Data - RAMP 2 XS 219

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 61.50 ft

Roadway Data for Crossing: RAMP 2 XS 219

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 77.54 ft

Roadway Surface: Paved

Roadway Top Width: 149.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 312+18 RAMP 3 (XS): DUAL 30" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 10 - Summary of Culvert Flows at Crossing: RAMP 3 XS 312+18

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
61.85	50-yr	74.42	74.42	0.00	1
62.13	100-yr	84.33	84.33	0.00	1
67.78	Overtopping	205.71	205.71	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 3 XS 312+18

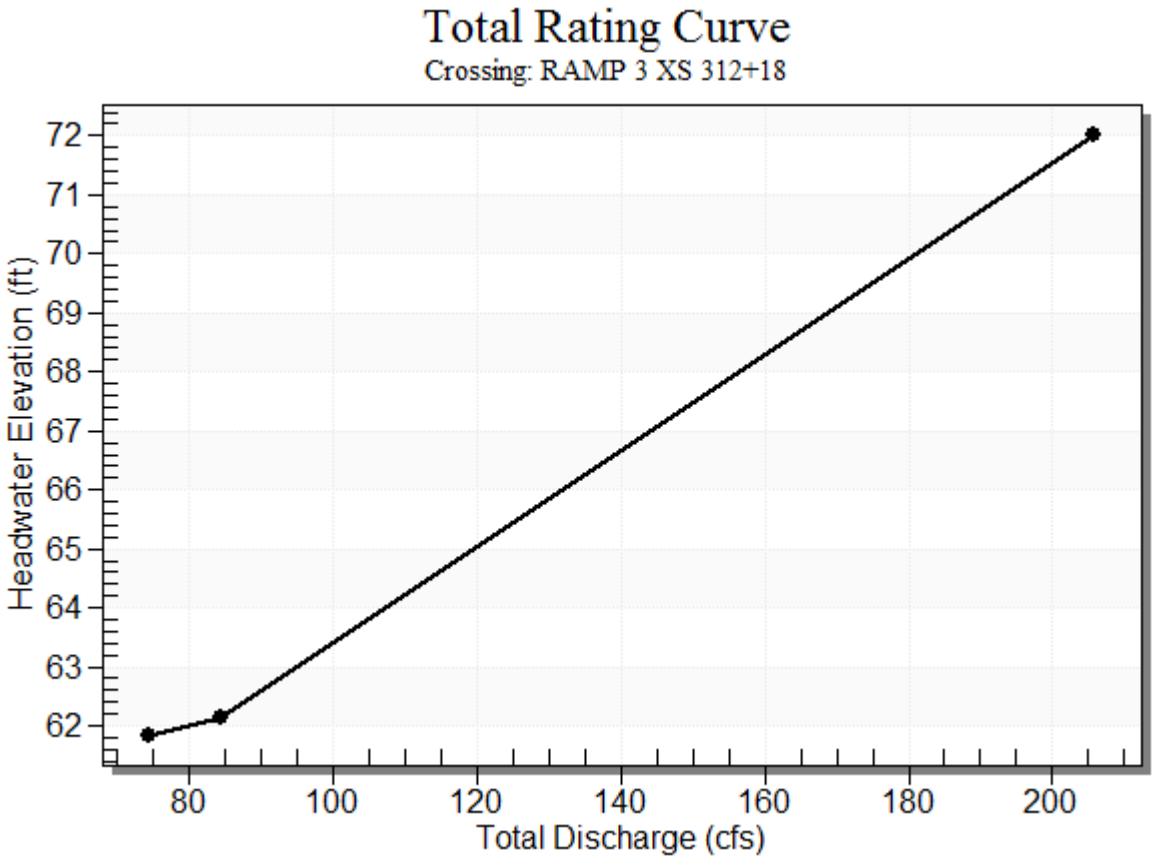


Table 11 - Culvert Summary Table: proposed

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	74.42	74.42	61.85	2.938	3.350	3-M2t	3.000	1.980	2.400	2.400	6.138
100-yr	84.33	84.33	62.13	3.189	3.634	3-M2t	3.000	2.113	2.400	2.400	6.955

****

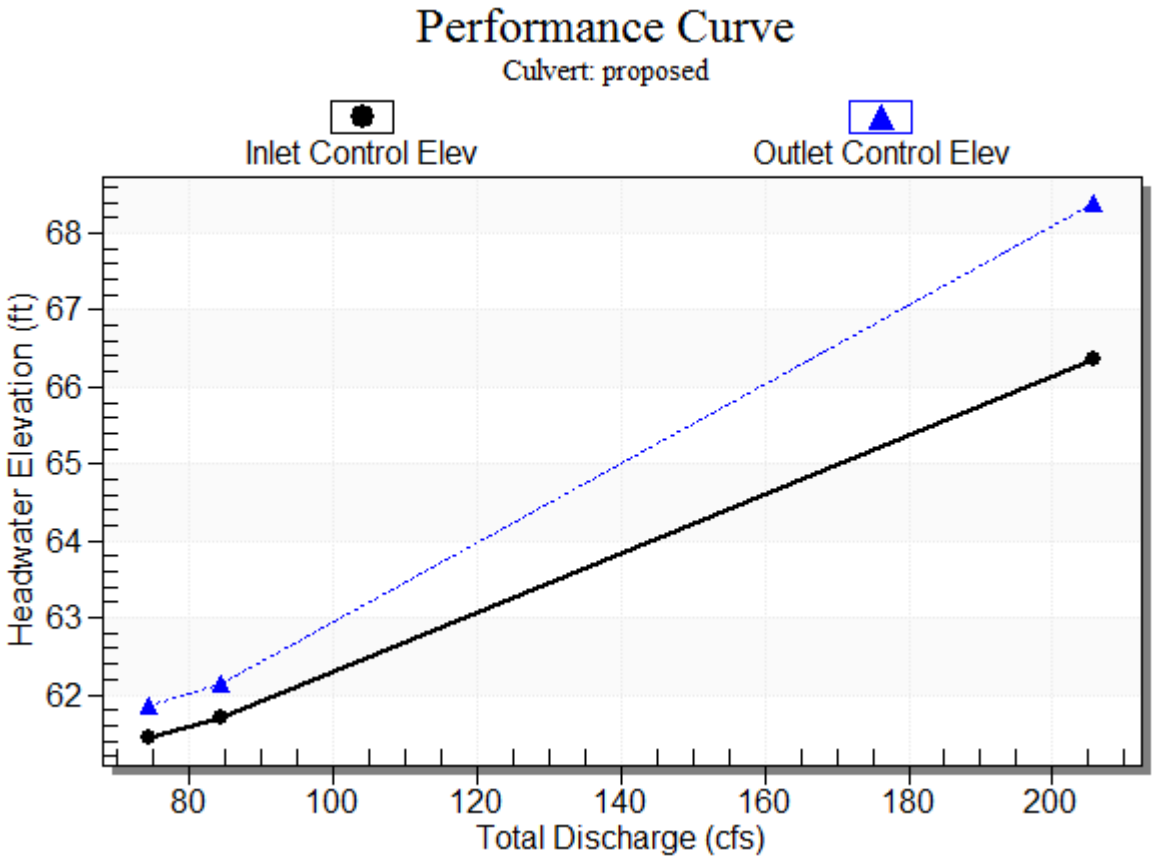
Straight Culvert

Inlet Elevation (invert): 58.50 ft, Outlet Elevation (invert): 58.40 ft

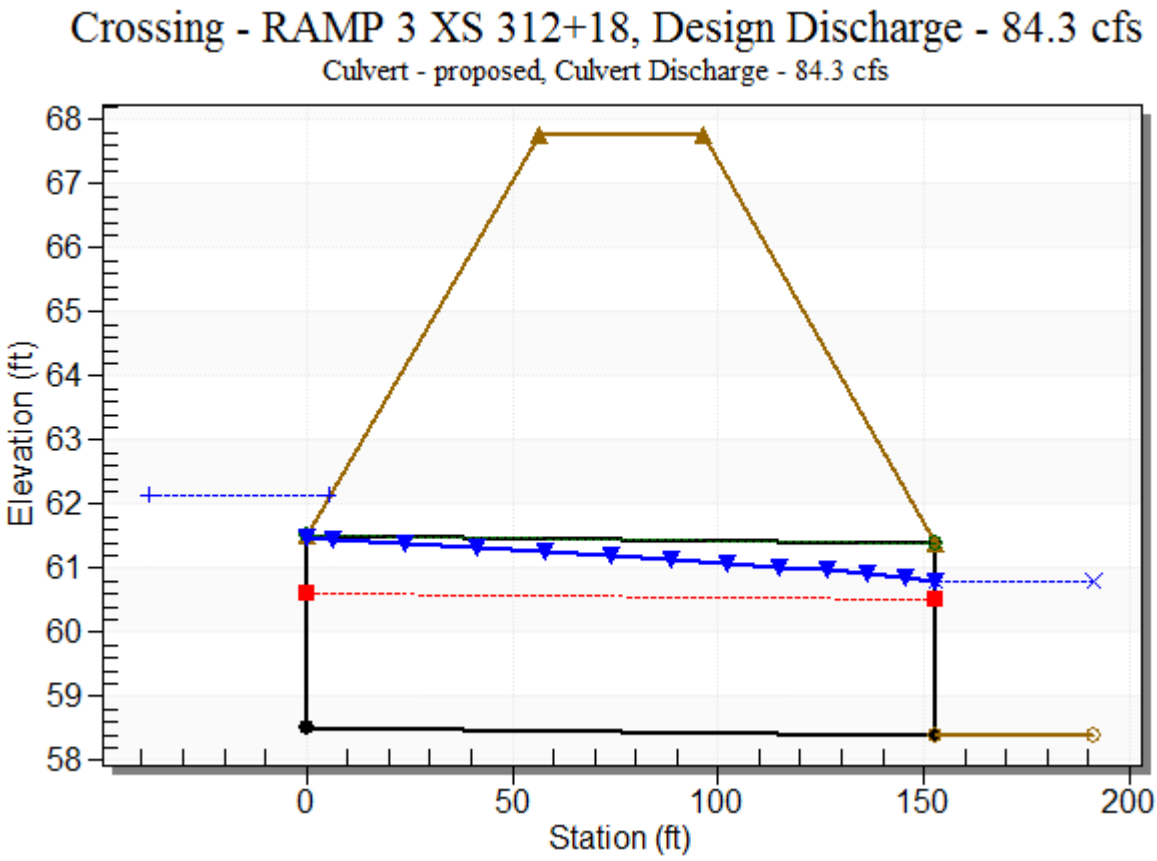
Culvert Length: 153.00 ft, Culvert Slope: 0.0007

****

Culvert Performance Curve Plot: proposed



Water Surface Profile Plot for Culvert: proposed



Site Data - proposed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 58.50 ft

Outlet Station: 153.00 ft

Outlet Elevation: 58.40 ft

Number of Barrels: 2

Culvert Data Summary - proposed

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1.5:1)

Inlet Depression: NONE

Table 12 - Downstream Channel Rating Curve (Crossing: RAMP 3 XS 312+18)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
74.42	60.80	2.40
84.33	60.80	2.40

Tailwater Channel Data - RAMP 3 XS 312+18

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 60.80 ft

Roadway Data for Crossing: RAMP 3 XS 312+18

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 67.78 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 318+50 RAMP 3 (XS): 36" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 7 - Summary of Culvert Flows at Crossing: RAMP 3 XS 318+50

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
61.52	50-yr	41.27	41.27	0.00	1
61.81	100-yr	46.52	46.52	0.00	1
66.74	Overtopping	102.20	102.20	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 3 XS 318+50

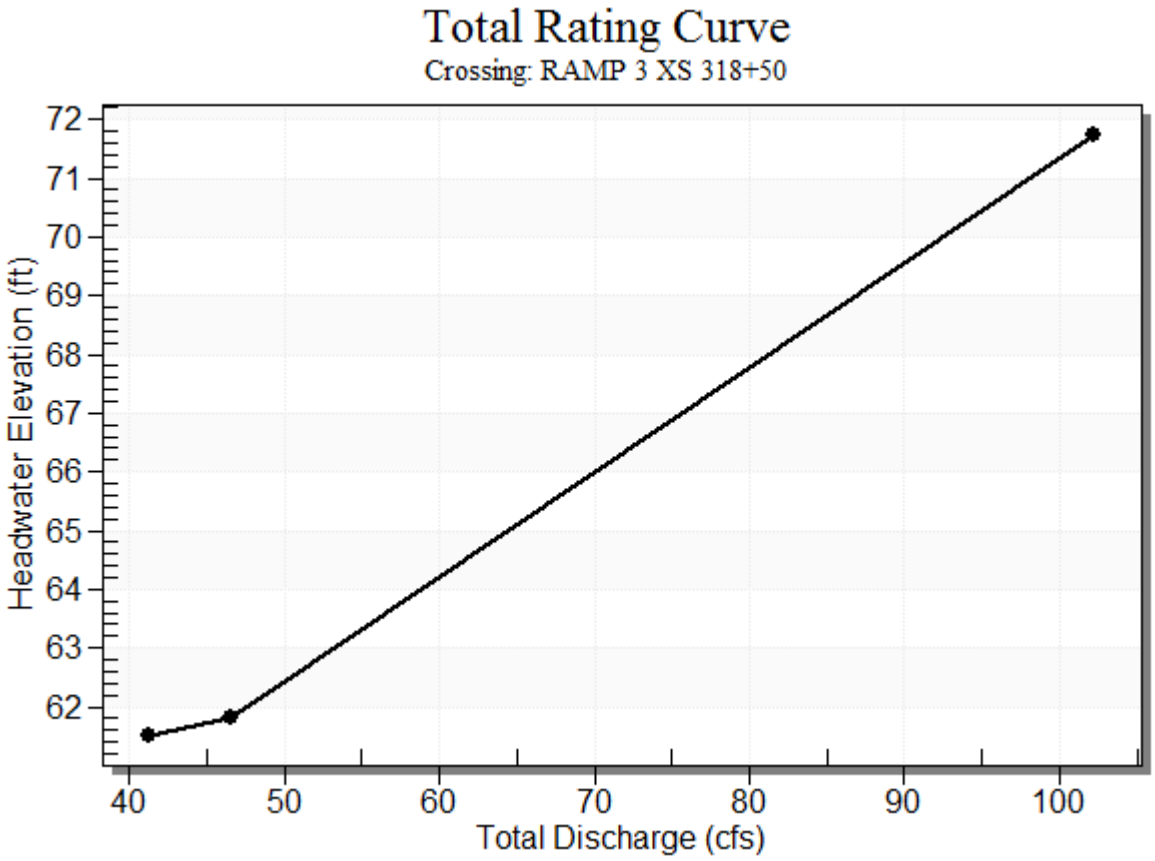


Table 8 - Culvert Summary Table: Culvert 1

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	41.27	41.27	61.52	3.141	3.323	3-M2t	3.000	2.090	2.300	2.300	7.097
100-yr	46.52	46.52	61.81	3.418	3.610	3-M2t	3.000	2.219	2.300	2.300	8.000

****

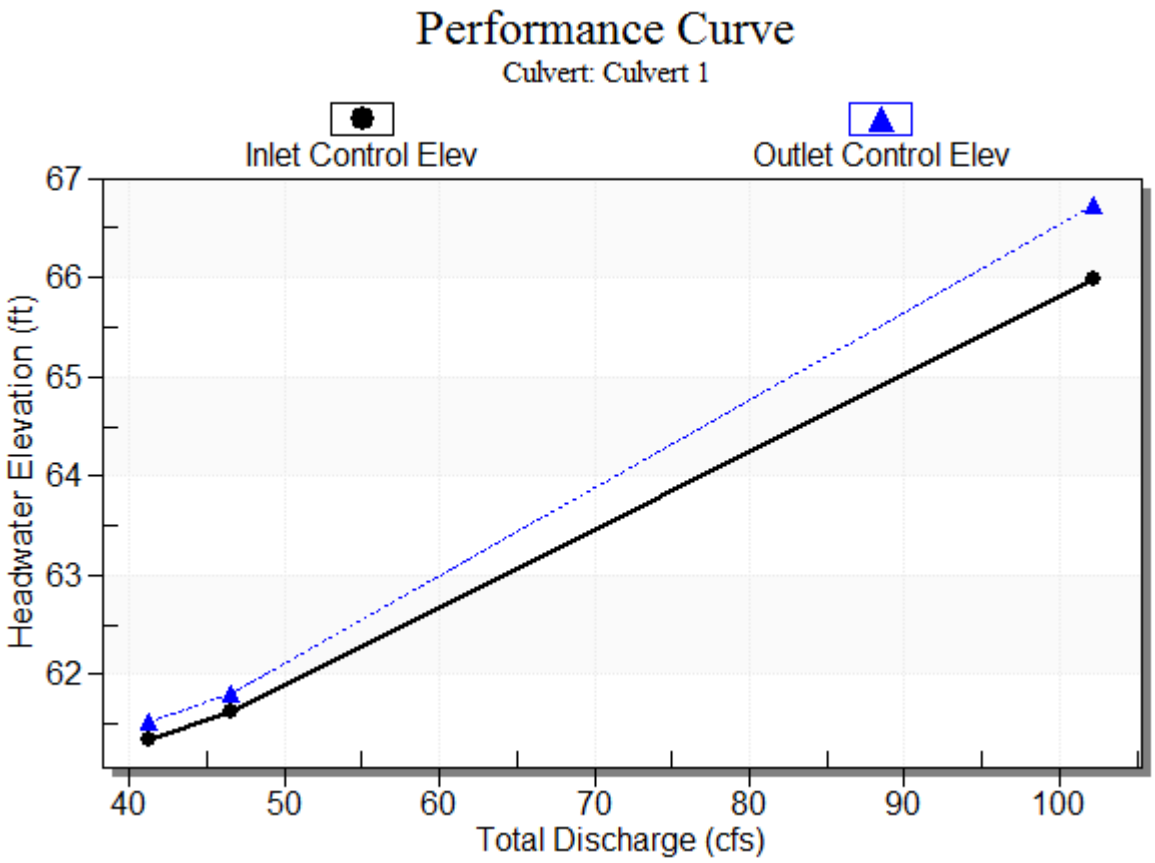
Straight Culvert

Inlet Elevation (invert): 58.20 ft, Outlet Elevation (invert): 58.00 ft

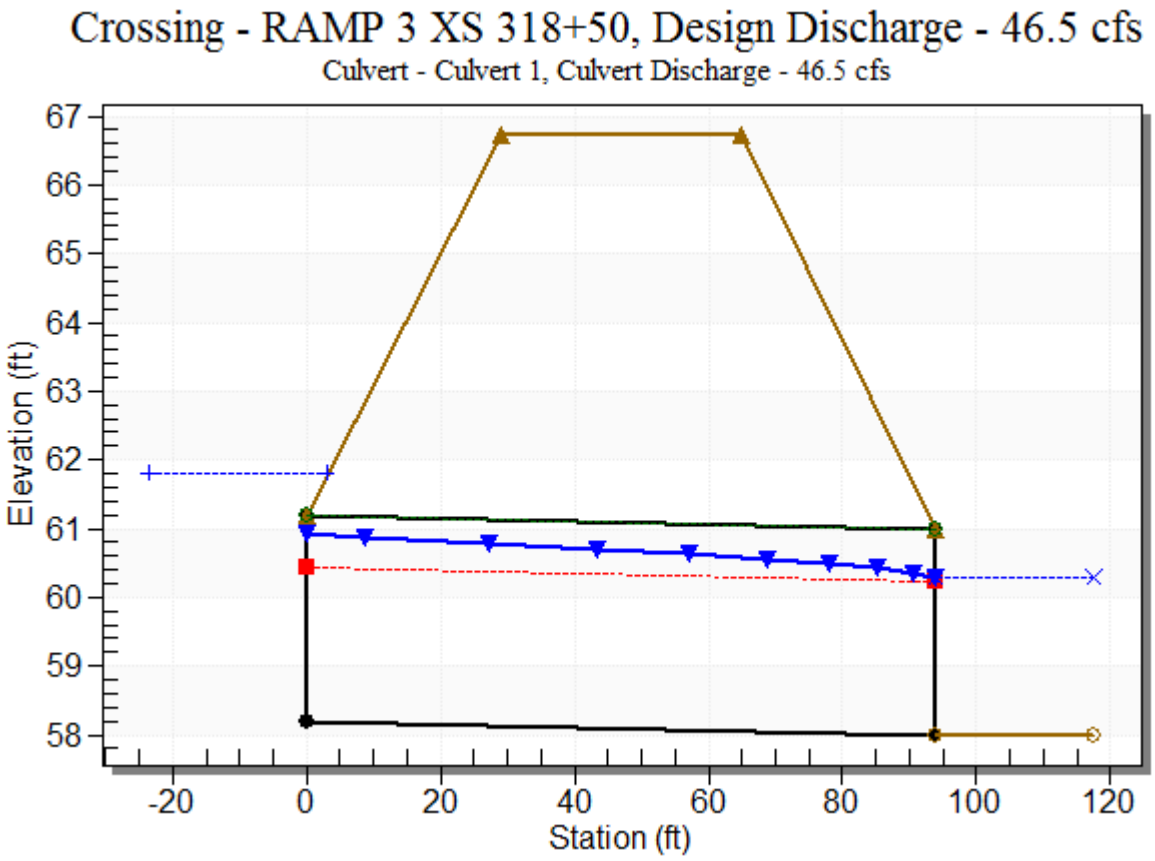
Culvert Length: 94.00 ft, Culvert Slope: 0.0021

****

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: 58.20 ft

Outlet Station: 94.00 ft

Outlet Elevation: 58.00 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1.5:1)

Inlet Depression: NONE

Table 9 - Downstream Channel Rating Curve (Crossing: RAMP 3 XS 318+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
41.27	60.30	2.30
46.52	60.30	2.30

Tailwater Channel Data - RAMP 3 XS 318+50

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 60.30 ft

Roadway Data for Crossing: RAMP 3 XS 318+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 66.74 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 421+50 RAMP 4 (XS): DUAL 36" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 13 - Summary of Culvert Flows at Crossing: RAMP 4 XS 421+50

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
61.85	50-yr	73.09	73.09	0.00	1
62.12	100-yr	82.82	82.82	0.00	1
70.28	Overtopping	235.38	235.38	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 4 XS 421+50

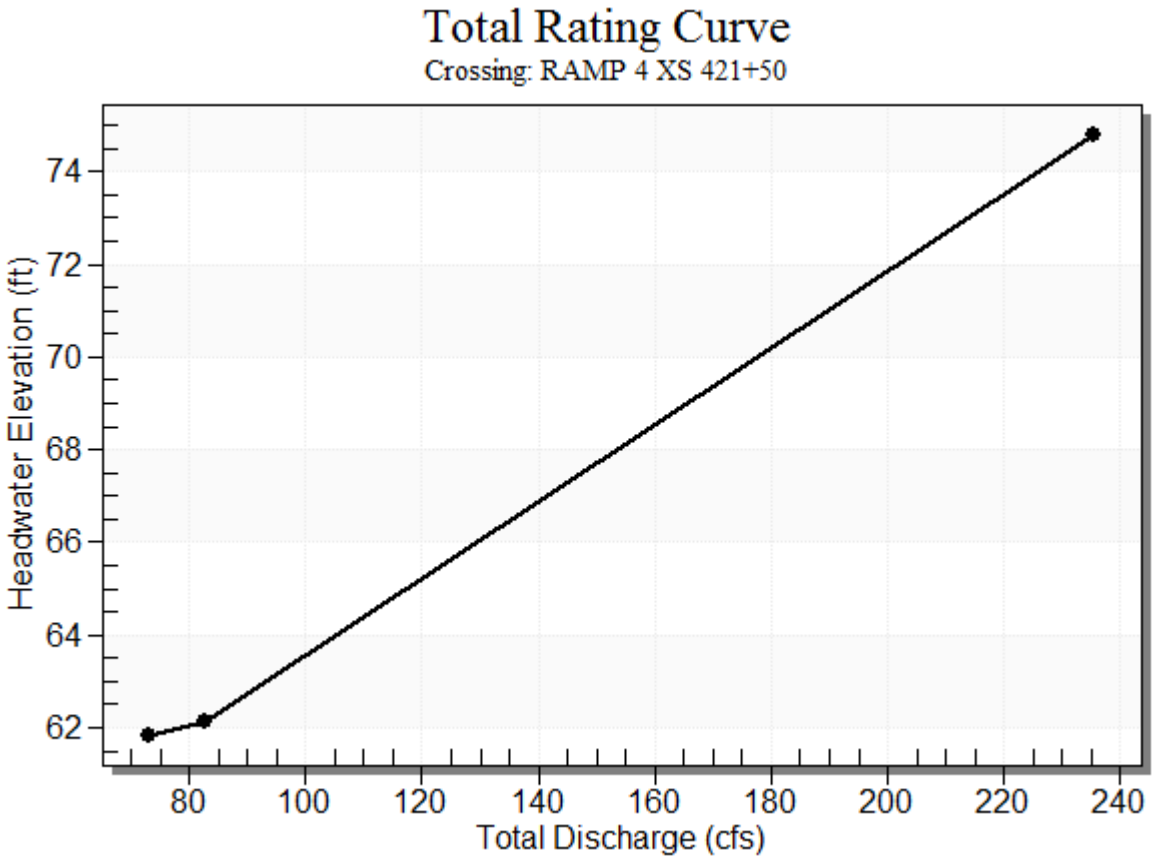


Table 14 - Culvert Summary Table: proposed

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	73.09	73.09	61.85	2.904	3.247	3-M2t	3.000	1.962	2.300	2.300	6.285
100-yr	82.82	82.82	62.12	3.150	3.516	3-M2t	3.000	2.094	2.300	2.300	7.121

****

Straight Culvert

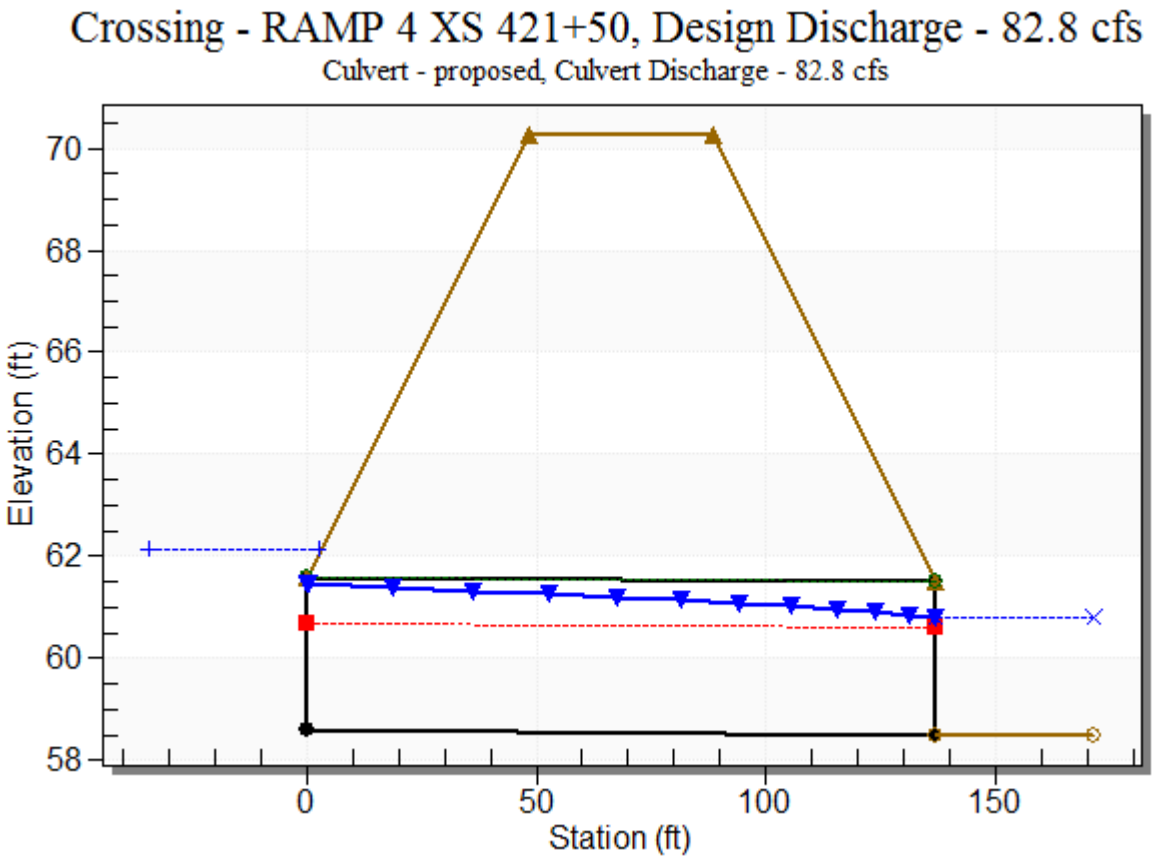
Inlet Elevation (invert): 58.60 ft, Outlet Elevation (invert): 58.50 ft

Culvert Length: 137.00 ft, Culvert Slope: 0.0007

****

Culvert Performance Curve Plot: proposed

Water Surface Profile Plot for Culvert: proposed



Site Data - proposed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 58.60 ft

Outlet Station: 137.00 ft

Outlet Elevation: 58.50 ft

Number of Barrels: 2

Culvert Data Summary - proposed

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Beveled Edge (1.5:1)

Inlet Depression: NONE

Table 15 - Downstream Channel Rating Curve (Crossing: RAMP 4 XS 421+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
73.09	60.80	2.30
82.82	60.80	2.30

Tailwater Channel Data - RAMP 4 XS 421+50

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 60.80 ft

Roadway Data for Crossing: RAMP 4 XS 421+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 70.28 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 CULVERT CALCULATION SUMMARY

STA: 443+00 RAMP 4 (XS): 30" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 4 - Summary of Culvert Flows at Crossing: RAMP 4 RT 443+00

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	RAMP 4 443+00 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
63.68	50-yr	22.28	22.28	0.00	1
63.87	100-yr	24.91	24.91	0.00	1
66.70	Overtopping	52.06	52.06	0.00	Overtopping

Rating Curve Plot for Crossing: RAMP 4 RT 443+00

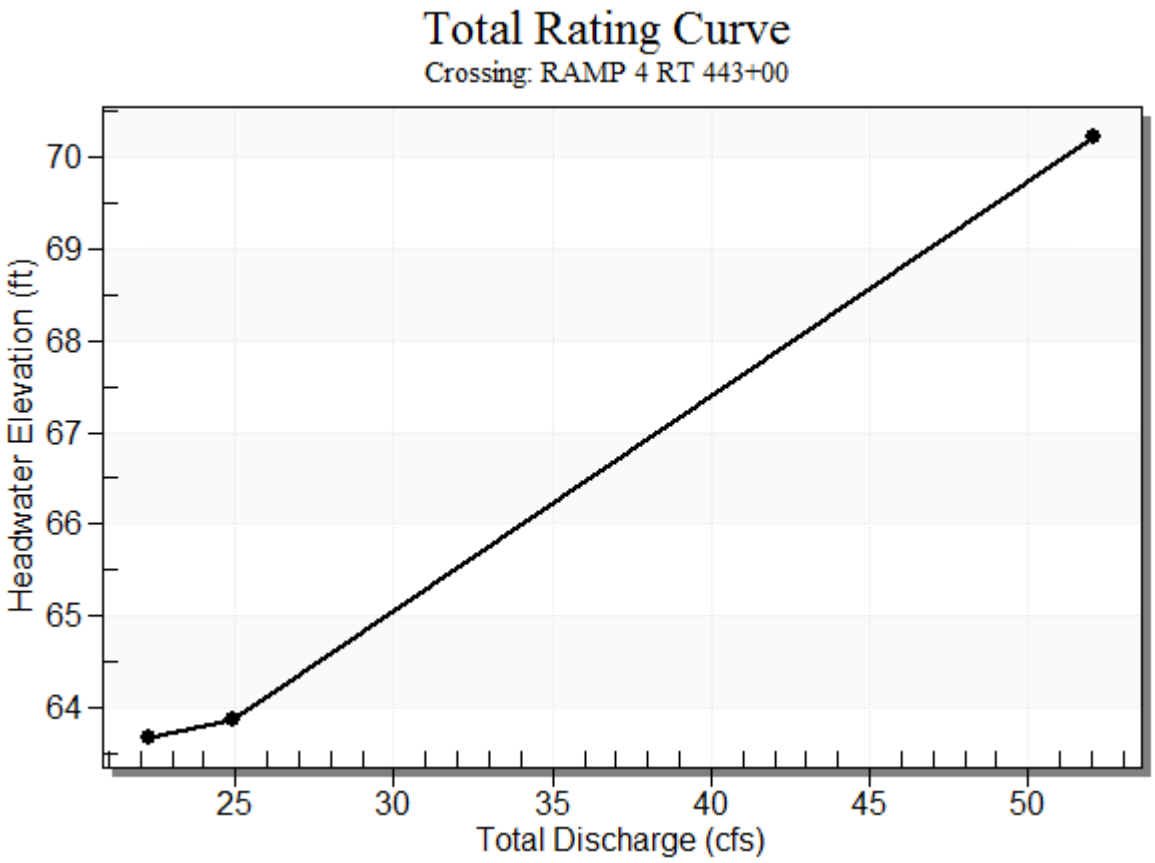


Table 5 - Culvert Summary Table: RAMP 4 443+00

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	22.28	22.28	63.68	2.360	2.479	2-M2c	2.500	1.602	1.602	1.200	6.704
100-yr	24.91	24.91	63.87	2.533	2.671	7-M2c	2.500	1.696	1.696	1.200	7.027

****

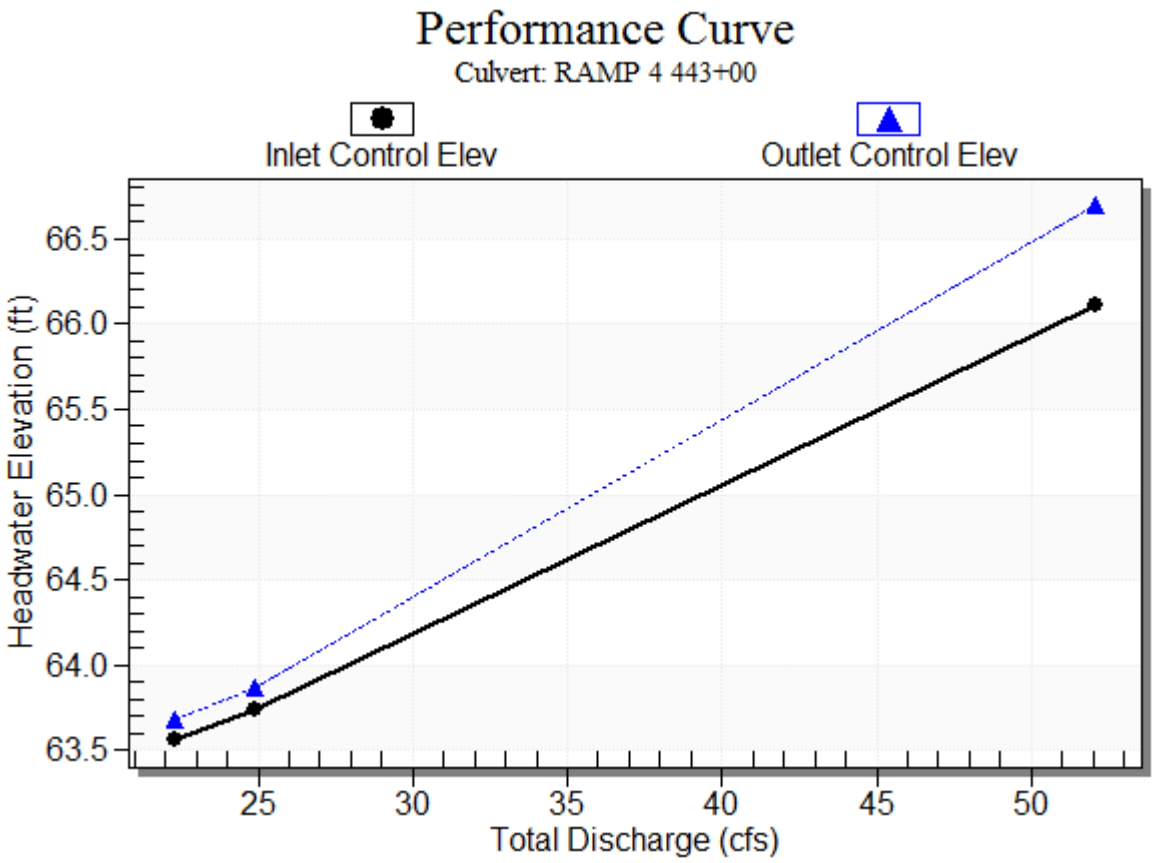
Straight Culvert

Inlet Elevation (invert): 61.20 ft, Outlet Elevation (invert): 61.00 ft

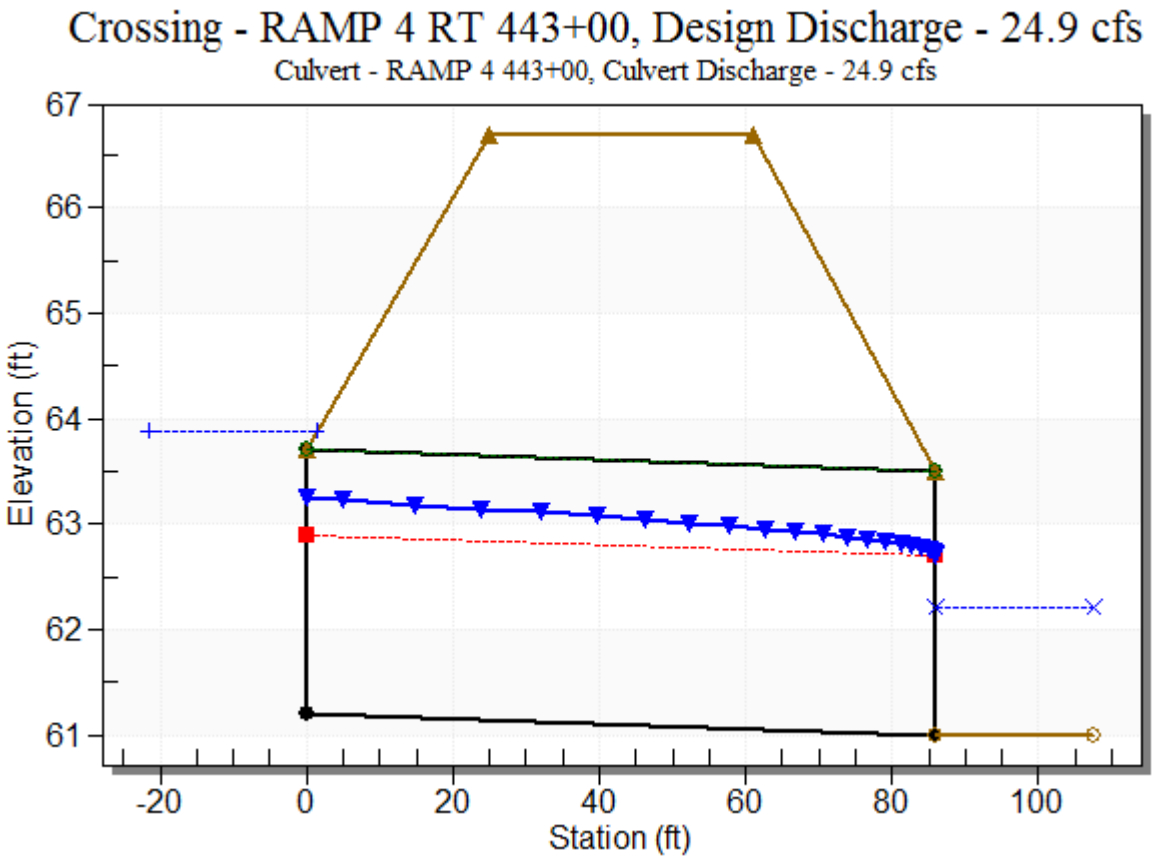
Culvert Length: 86.00 ft, Culvert Slope: 0.0023

****

Culvert Performance Curve Plot: RAMP 4 443+00



Water Surface Profile Plot for Culvert: RAMP 4 443+00



Site Data - RAMP 4 443+00

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 61.20 ft

Outlet Station: 86.00 ft

Outlet Elevation: 61.00 ft

Number of Barrels: 1

Culvert Data Summary - RAMP 4 443+00

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 (1.5:1)

Inlet Depression: NONE

Table 6 - Downstream Channel Rating Curve (Crossing: RAMP 4 RT 443+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
22.28	62.20	1.20
24.91	62.20	1.20

Tailwater Channel Data - RAMP 4 RT 443+00

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 62.20 ft

Roadway Data for Crossing: RAMP 4 RT 443+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 2.00 ft

Crest Elevation: 66.70 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX F

MEDIAN DRAINAGE HY-8
HYDRAULIC CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 669+30 EB (XS): 18" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 22 - Summary of Culvert Flows at Crossing: EB 669+30

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
56.49	50-yr	8.46	8.46	0.00	1
56.68	100-yr	9.60	9.60	0.00	1
63.34	Overtopping	22.31	22.31	0.00	Overtopping

Rating Curve Plot for Crossing: EB 669+30

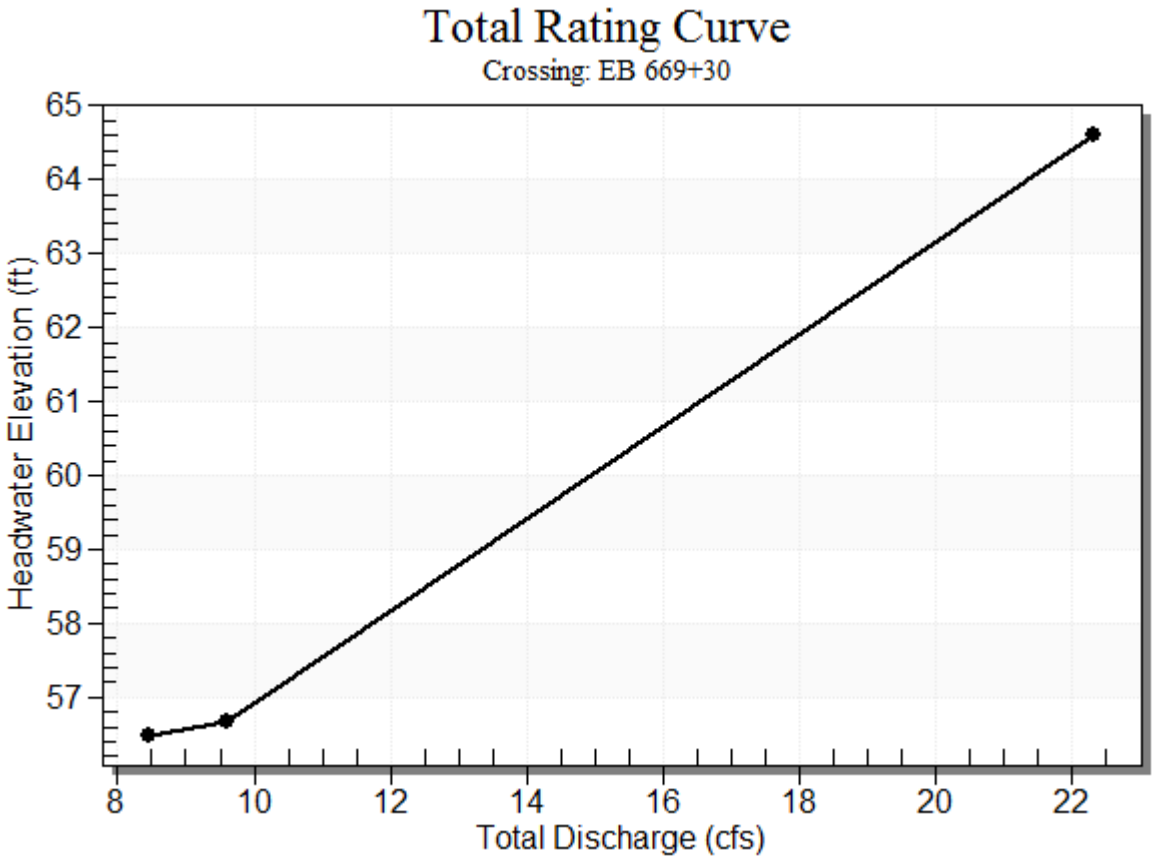


Table 23 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	8.46	8.46	56.49	1.742	1.399	5-JS1t	0.944	1.122	1.270	2.710	4.922
100-yr	9.60	9.60	56.68	1.928	1.735	5-JS1t	1.057	1.195	1.270	2.710	5.586

****

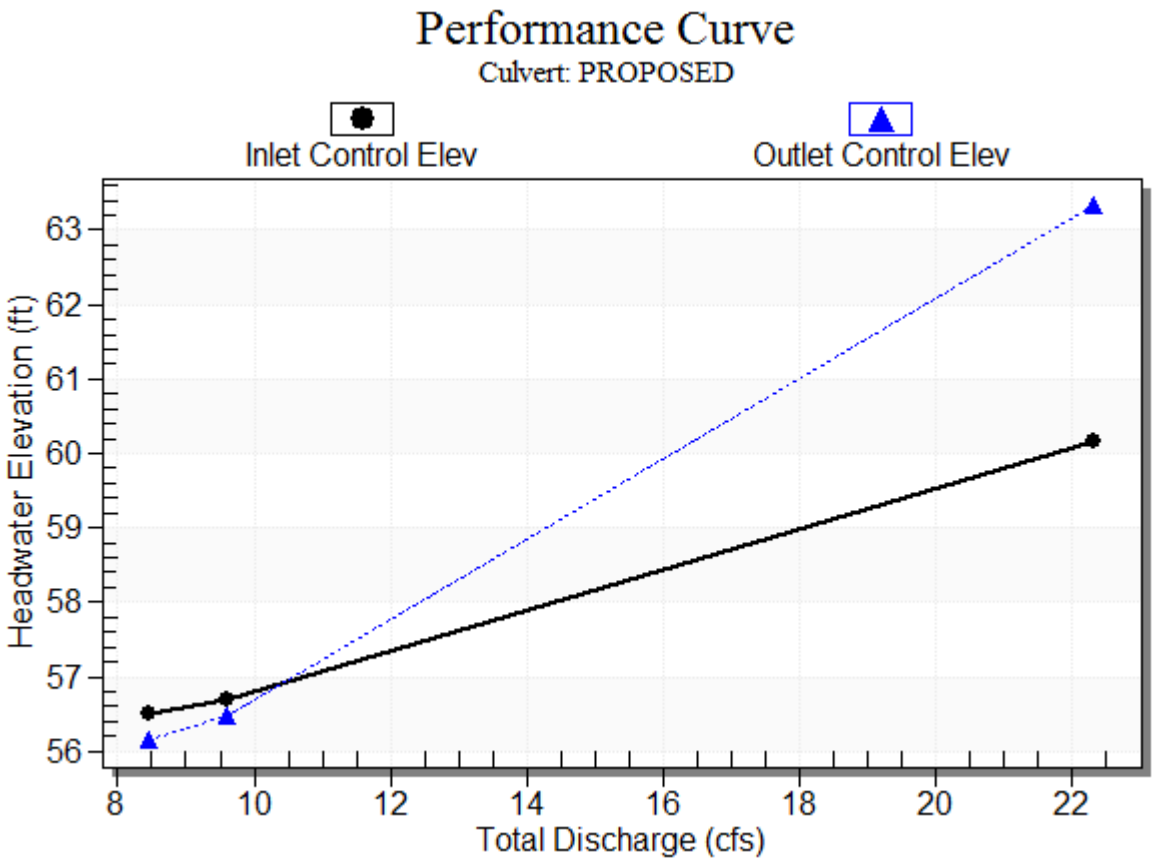
Straight Culvert

Inlet Elevation (invert): 54.75 ft, Outlet Elevation (invert): 53.71 ft

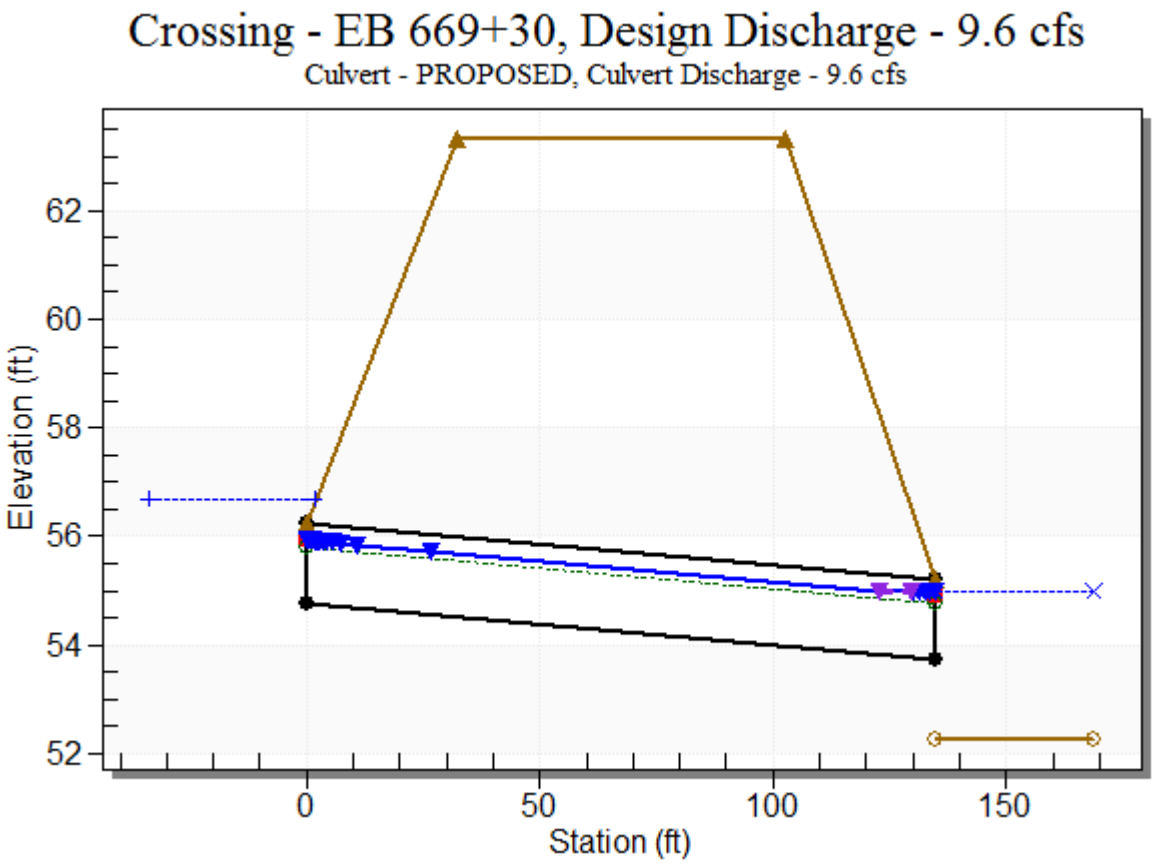
Culvert Length: 135.00 ft, Culvert Slope: 0.0077

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 54.75 ft

Outlet Station: 135.00 ft

Outlet Elevation: 53.71 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 24 - Downstream Channel Rating Curve (Crossing: EB 669+30)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
8.46	54.98	2.71
9.60	54.98	2.71

Tailwater Channel Data - EB 669+30

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 54.98 ft

Roadway Data for Crossing: EB 669+30

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 63.34 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 674+00 EB (XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 25 - Summary of Culvert Flows at Crossing: EB 674+00

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	propsed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
58.30	50-yr	13.52	13.52	0.00	1
58.49	100-yr	15.34	15.34	0.00	1
62.55	Overtopping	37.32	37.32	0.00	Overtopping

Rating Curve Plot for Crossing: EB 674+00

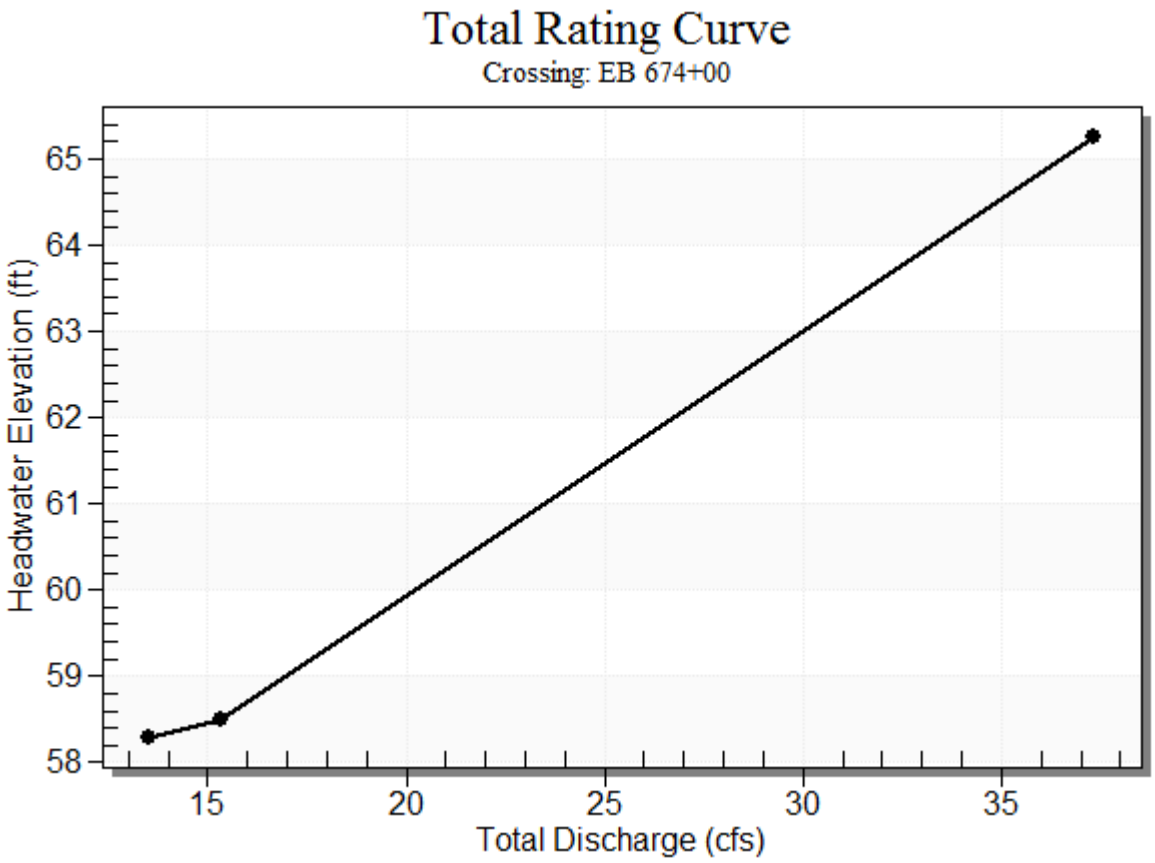


Table 26 - Culvert Summary Table: propsed

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	13.52	13.52	58.30	1.969	0.0*	1-JS1f	0.702	1.321	2.000	2.710	4.304
100-yr	15.34	15.34	58.49	2.162	0.158	5-JS1f	0.751	1.407	2.000	2.710	4.883

* Full Flow Headwater elevation is below inlet invert.

****

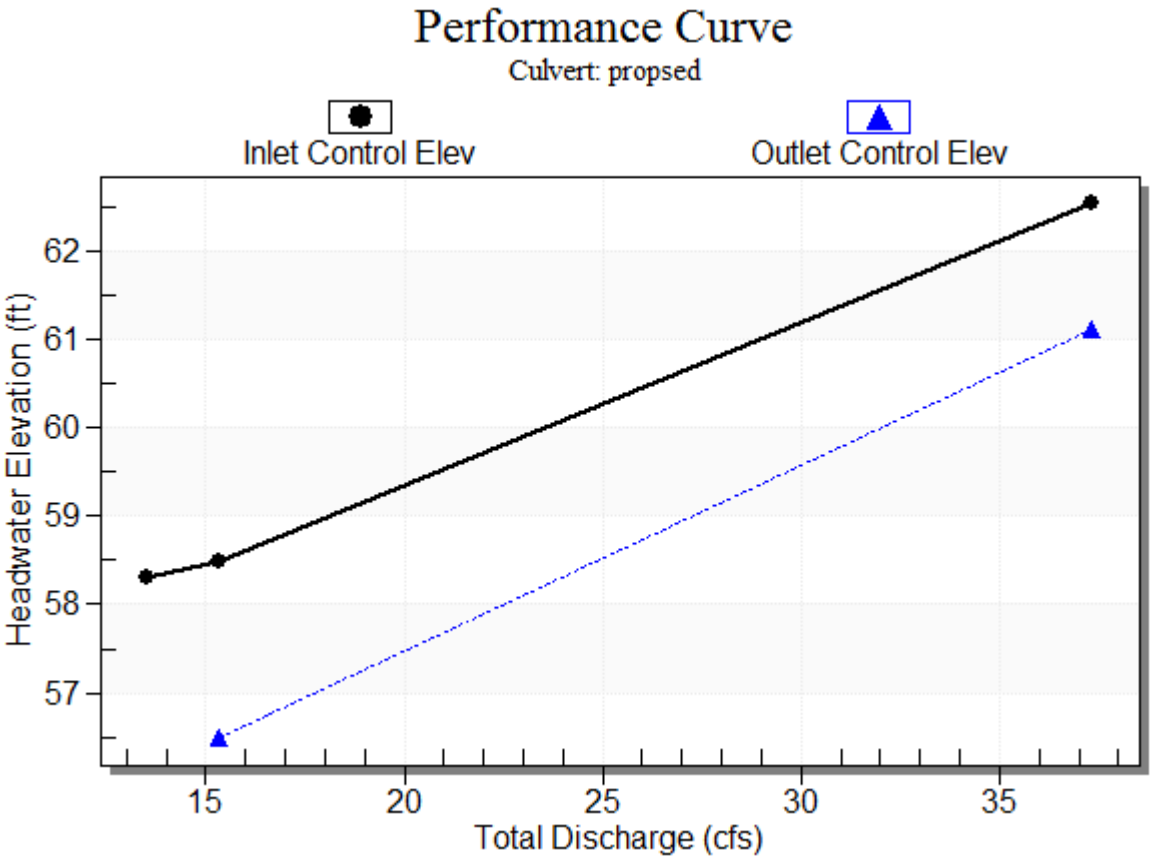
Straight Culvert

Inlet Elevation (invert): 56.33 ft, Outlet Elevation (invert): 52.82 ft

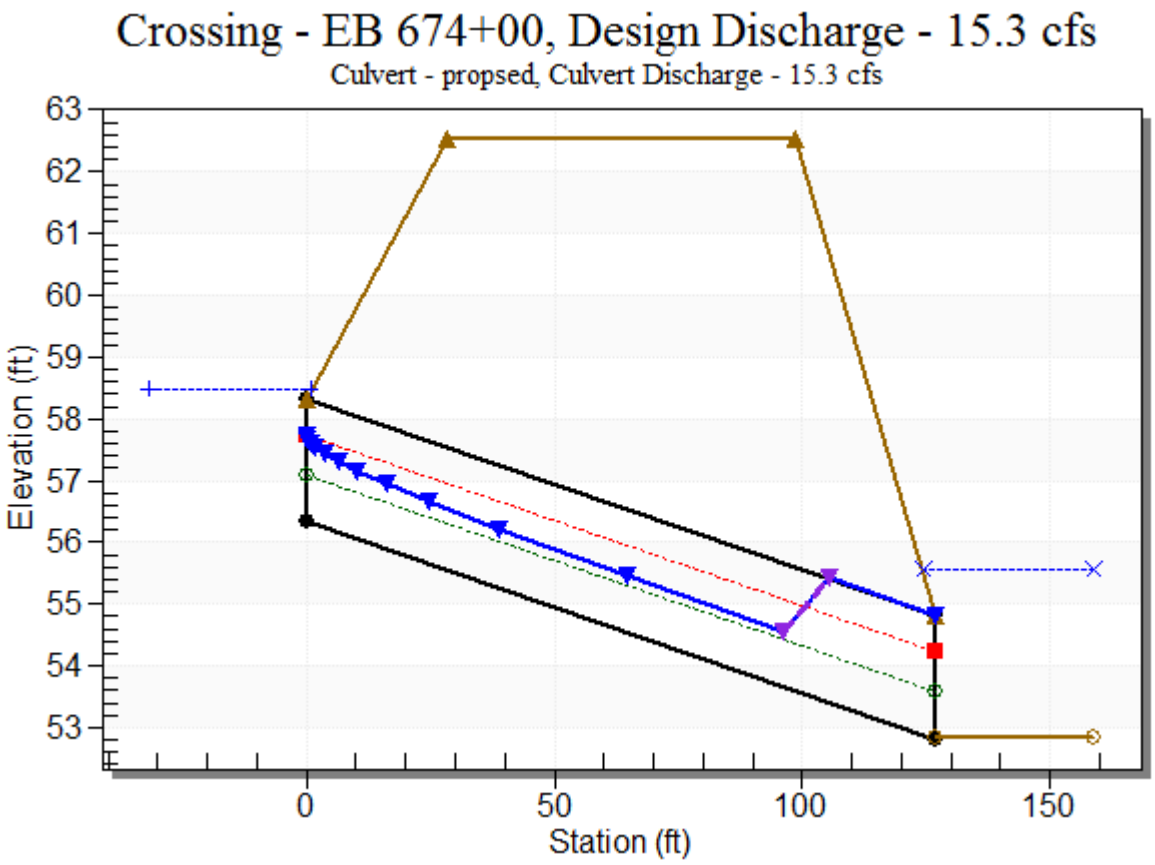
Culvert Length: 127.05 ft, Culvert Slope: 0.0276

****

Culvert Performance Curve Plot: propsed



Water Surface Profile Plot for Culvert: propsed



Site Data - propsed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 56.33 ft

Outlet Station: 127.00 ft

Outlet Elevation: 52.82 ft

Number of Barrels: 1

Culvert Data Summary - propsed

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

Table 27 - Downstream Channel Rating Curve (Crossing: EB 674+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
13.52	55.55	2.71
15.34	55.55	2.71

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 679+72 EB(XS): 18" CULVERT

25644.0006

THOMAS & HUTTON

Tailwater Channel Data - EB 674+00

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 55.55 ft

Roadway Data for Crossing: EB 674+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 62.55 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 28 - Summary of Culvert Flows at Crossing: EB 679+72

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
57.69	50-yr	7.20	7.20	0.00	1
57.84	100-yr	8.17	8.17	0.00	1
63.19	Overtopping	20.92	20.92	0.00	Overtopping

Rating Curve Plot for Crossing: EB 679+72

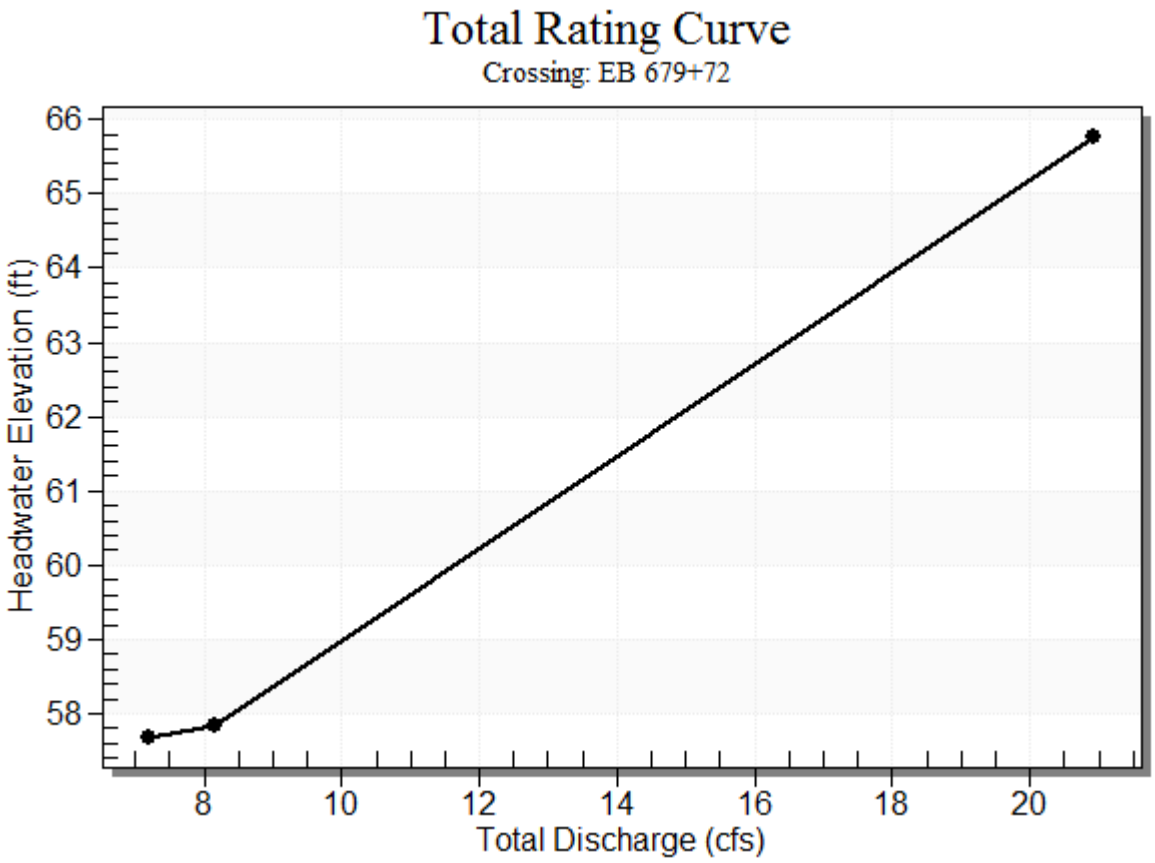


Table 29 - Culvert Summary Table: PROPSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	7.20	7.20	57.69	1.542	0.912	5-JS1f	0.609	1.036	1.500	2.710	4.074
100-yr	8.17	8.17	57.84	1.686	1.149	5-JS1f	0.657	1.103	1.500	2.710	4.623

****

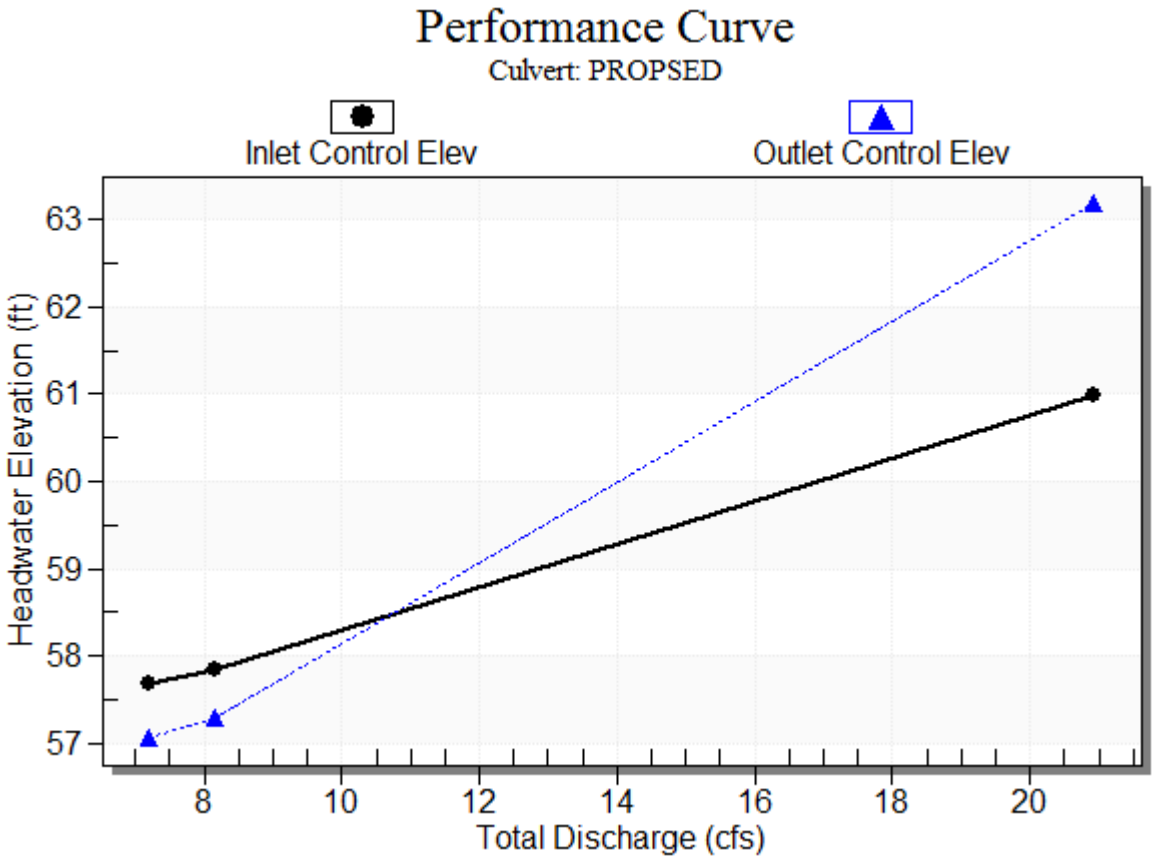
Straight Culvert

Inlet Elevation (invert): 56.15 ft, Outlet Elevation (invert): 53.37 ft

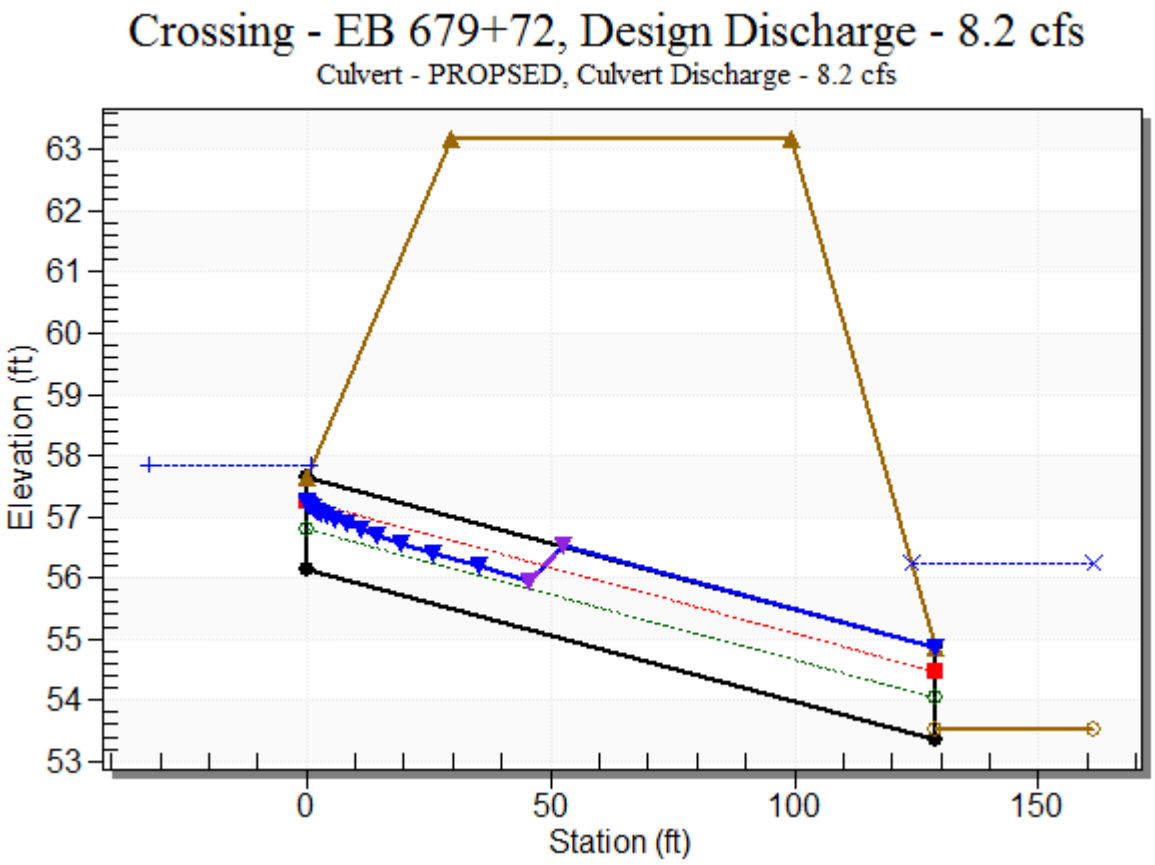
Culvert Length: 129.03 ft, Culvert Slope: 0.0216

****

Culvert Performance Curve Plot: PROPSED



Water Surface Profile Plot for Culvert: PROPSED



Site Data - PROPSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 56.15 ft

Outlet Station: 129.00 ft

Outlet Elevation: 53.37 ft

Number of Barrels: 1

Culvert Data Summary - PROPSED

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 (1.5:1)

Inlet Depression: NONE

Table 30 - Downstream Channel Rating Curve (Crossing: EB 679+72)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
7.20	56.24	2.71
8.17	56.24	2.71

Tailwater Channel Data - EB 679+72

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 56.24 ft

Roadway Data for Crossing: EB 679+72

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 63.19 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 695+02 EB (XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 19 - Summary of Culvert Flows at Crossing: EB 695+2

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	CULVERT 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
62.44	50-yr	13.77	13.77	0.00	1
62.62	100-yr	15.63	15.63	0.00	1
65.63	Overtopping	36.98	36.98	0.00	Overtopping

Rating Curve Plot for Crossing: EB 695+2

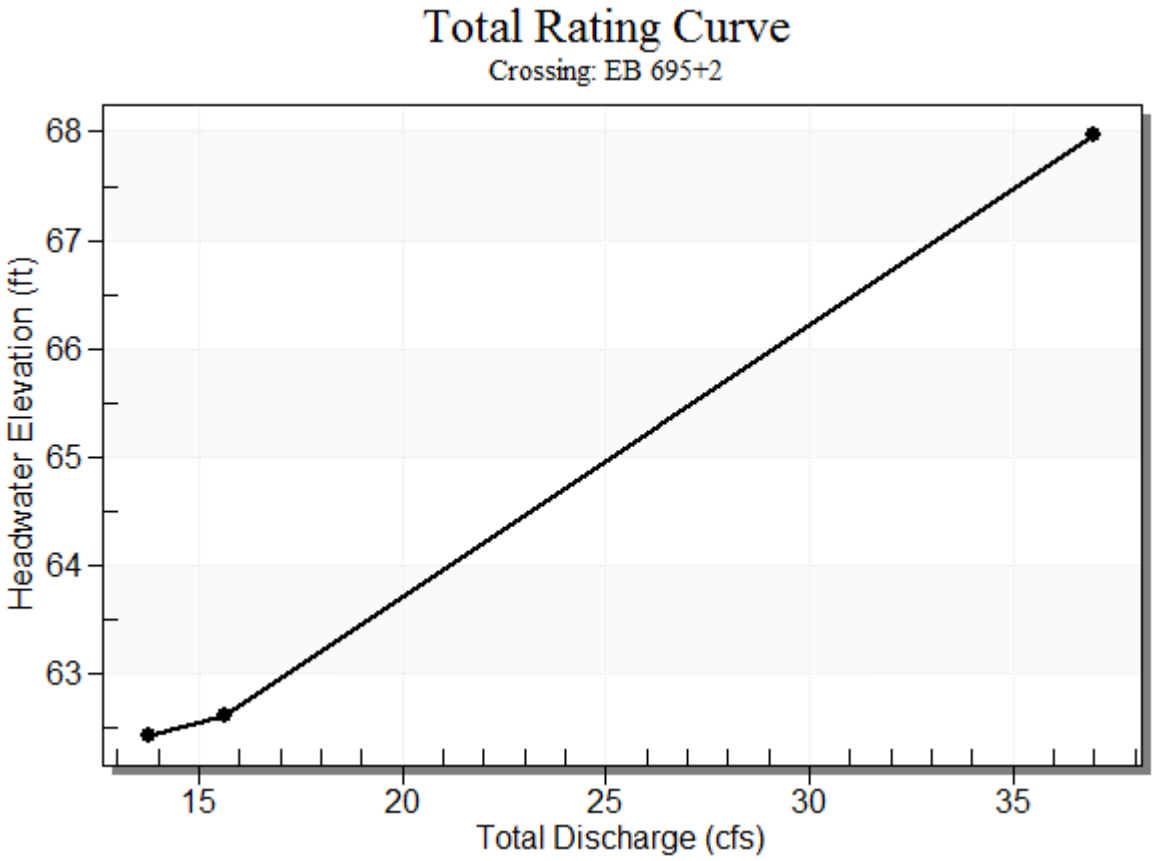


Table 20 - Culvert Summary Table: CULVERT 1

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	13.77	13.77	62.44	1.942	0.0*	1-S2n	0.632	1.333	0.735	2.020	11.212
100-yr	15.63	15.63	62.62	2.116	0.0*	5-S2n	0.680	1.421	0.798	2.020	11.426

* Full Flow Headwater elevation is below inlet invert.

****

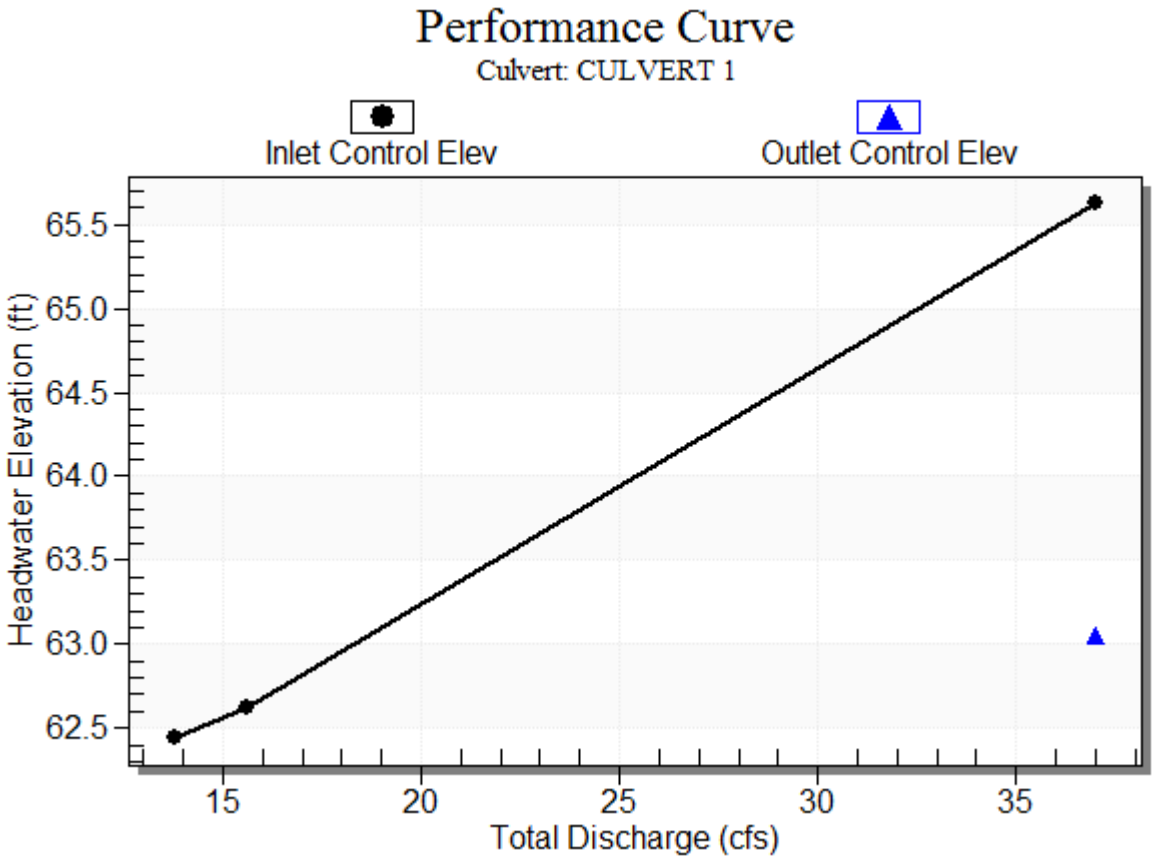
Straight Culvert

Inlet Elevation (invert): 60.50 ft, Outlet Elevation (invert): 56.06 ft

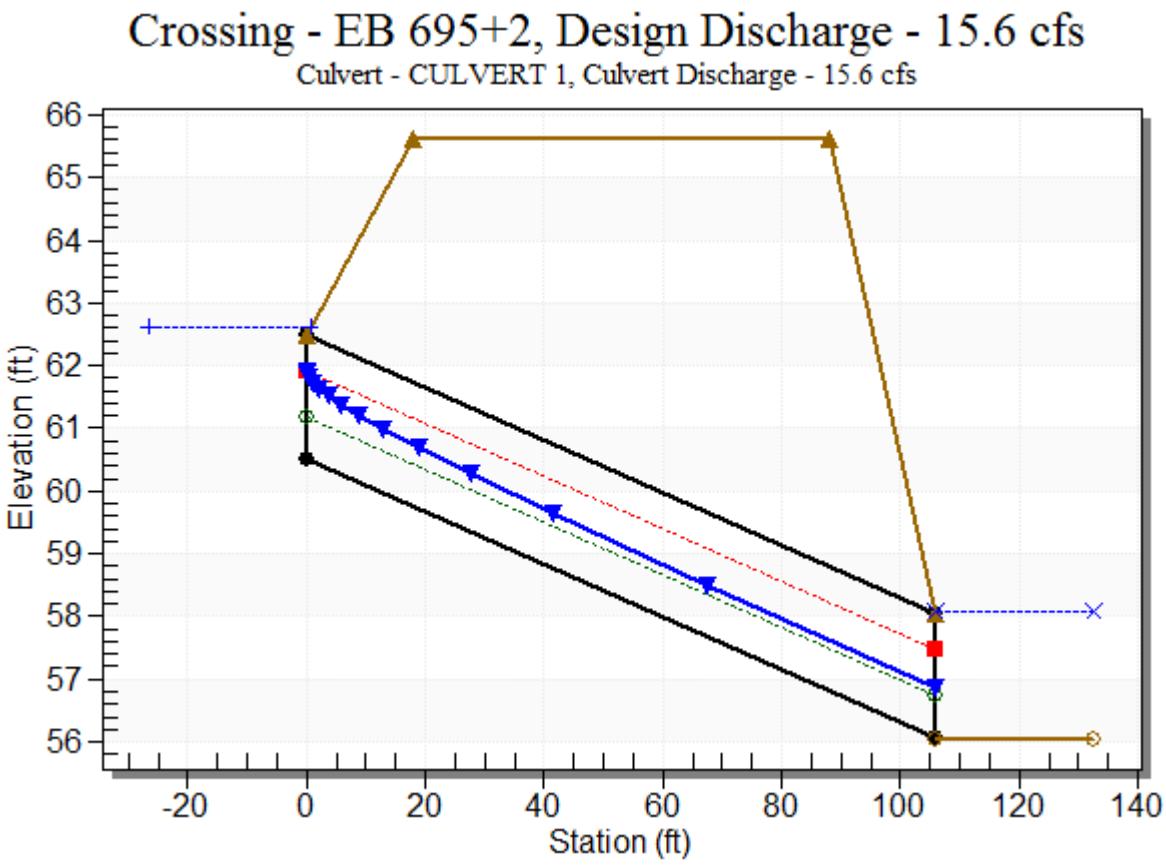
Culvert Length: 106.09 ft, Culvert Slope: 0.0419

****

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: 60.50 ft

Outlet Station: 106.00 ft

Outlet Elevation: 56.06 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 (1.5:1)

Inlet Depression: NONE

Table 21 - Downstream Channel Rating Curve (Crossing: EB 695+2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
13.77	58.07	2.02
15.63	58.07	2.02

Tailwater Channel Data - EB 695+2

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 58.07 ft

Roadway Data for Crossing: EB 695+2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 65.63 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 707+63 EB(XS): 18" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 40 - Summary of Culvert Flows at Crossing: EB 707+63

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
63.35	50-YR	4.45	4.45	0.00	1
63.44	100-YR	5.05	5.05	0.00	1
67.26	Overtopping	21.47	21.47	0.00	Overtopping

Rating Curve Plot for Crossing: EB 707+63

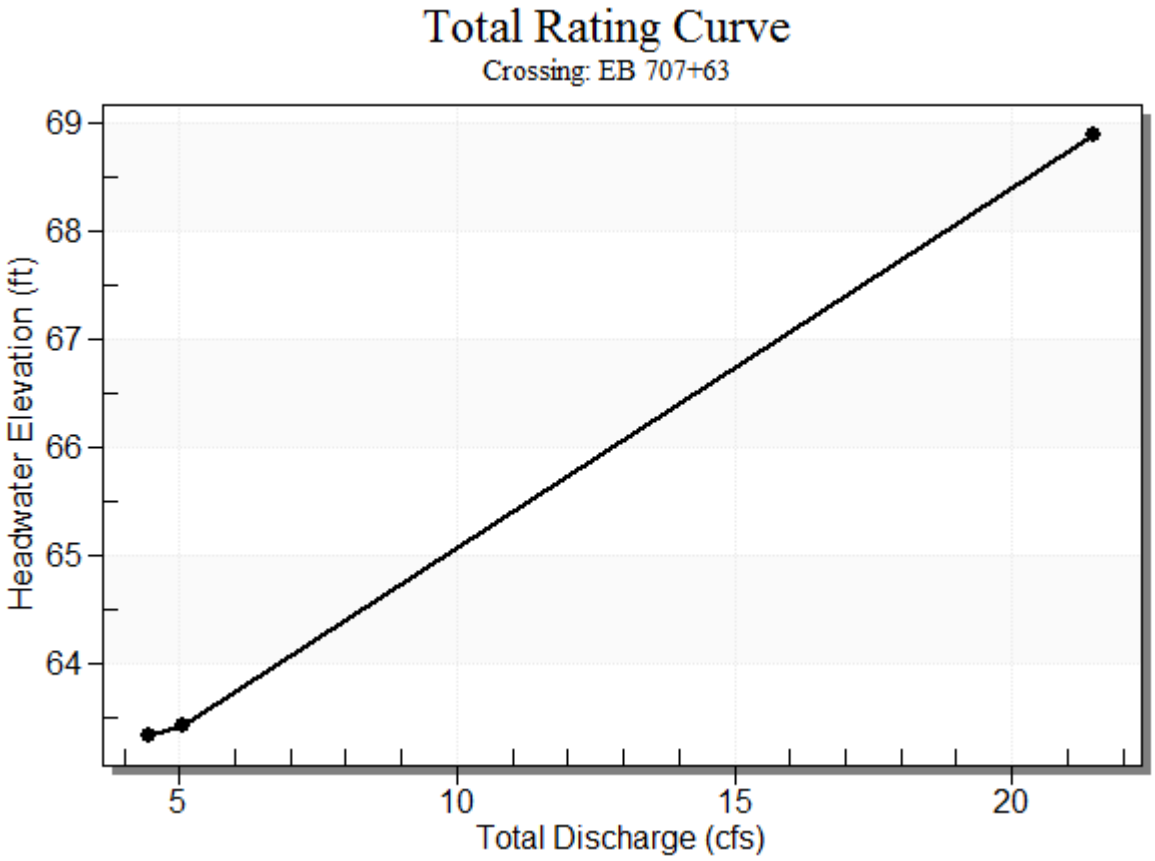


Table 41 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	4.45	4.45	63.35	1.137	0.0*	1-S2n	0.399	0.808	0.465	2.020	8.076
100-YR	5.05	5.05	63.44	1.225	0.0*	1-S2n	0.427	0.860	0.497	2.020	8.406

* Full Flow Headwater elevation is below inlet invert.

****

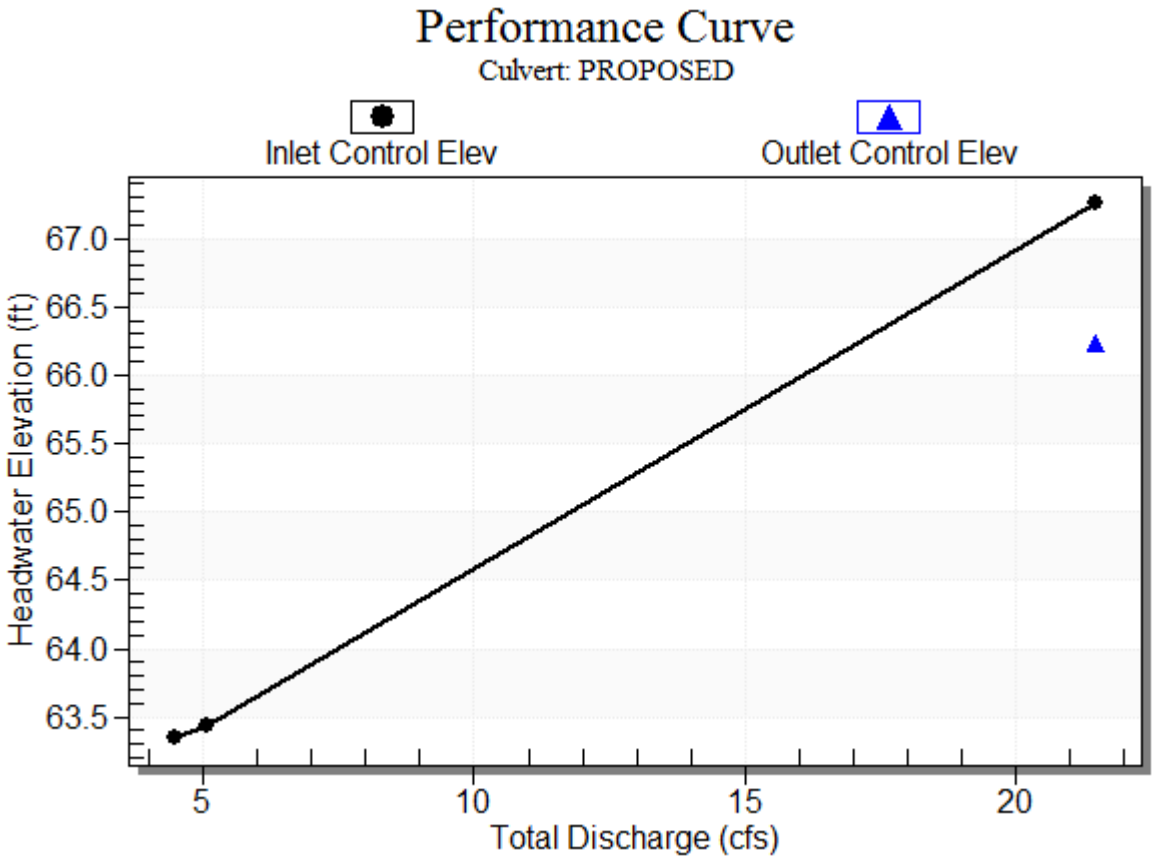
Straight Culvert

Inlet Elevation (invert): 62.21 ft, Outlet Elevation (invert): 58.07 ft

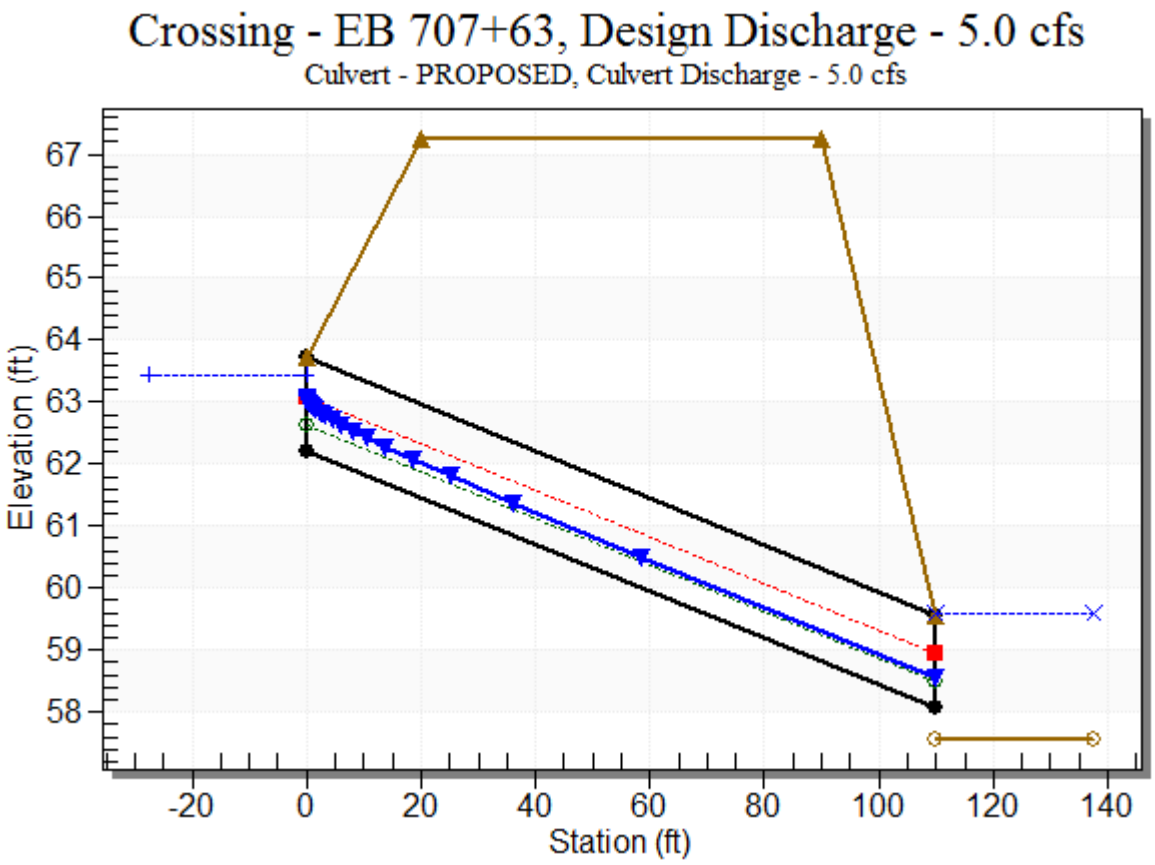
Culvert Length: 110.08 ft, Culvert Slope: 0.0376

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 62.21 ft

Outlet Station: 110.00 ft

Outlet Elevation: 58.07 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 42 - Downstream Channel Rating Curve (Crossing: EB 707+63)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
4.45	59.59	2.02
5.05	59.59	2.02

Tailwater Channel Data - EB 707+63

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 59.59 ft

Roadway Data for Crossing: EB 707+63

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 67.26 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 713+61 EB(XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: EB 713+61

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
65.14	50-YR	13.76	13.76	0.00	1
65.31	100-YR	15.62	15.62	0.00	1
67.97	Overtopping	35.07	35.07	0.00	Overtopping

Rating Curve Plot for Crossing: EB 713+61

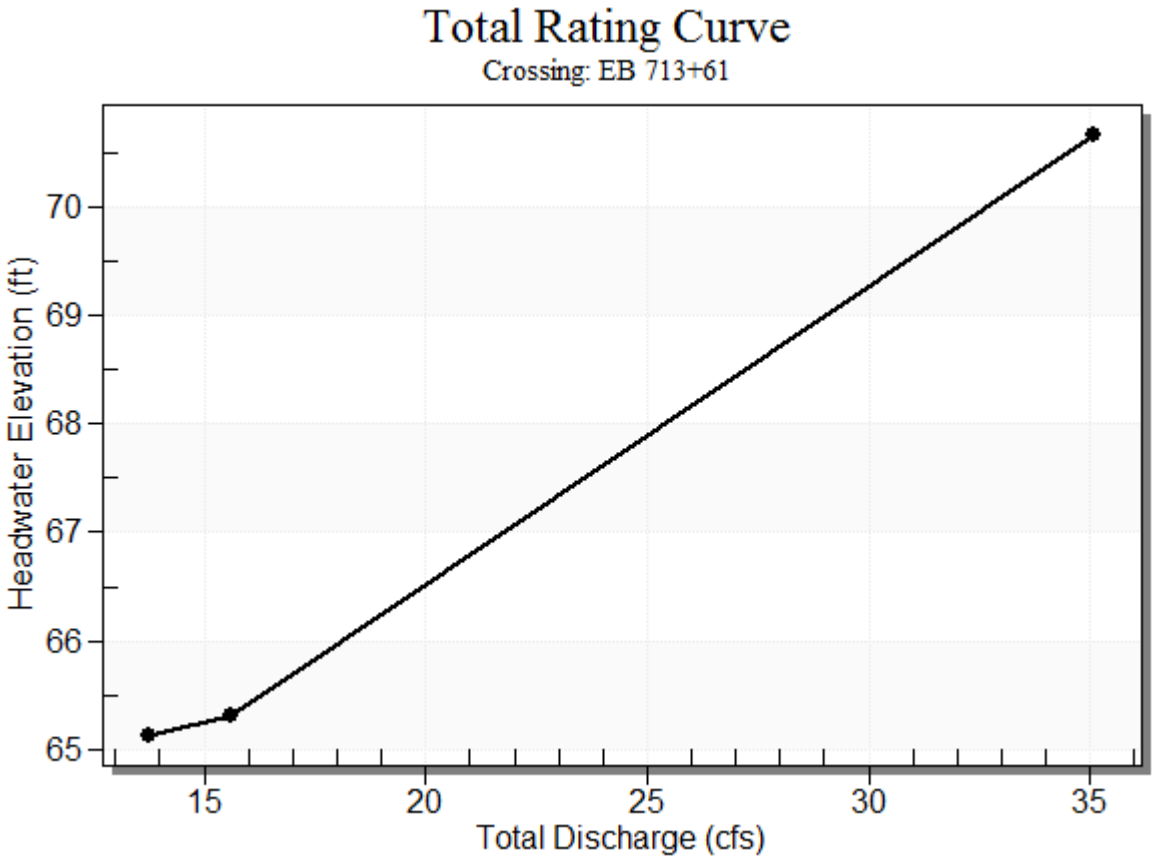


Table 2 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	13.76	13.76	65.14	1.936	0.0*	1-S2n	0.612	1.332	0.726	2.020	11.399
100-YR	15.62	15.62	65.31	2.111	0.0*	5-S2n	0.660	1.420	0.770	2.020	11.966

* Full Flow Headwater elevation is below inlet invert.

****

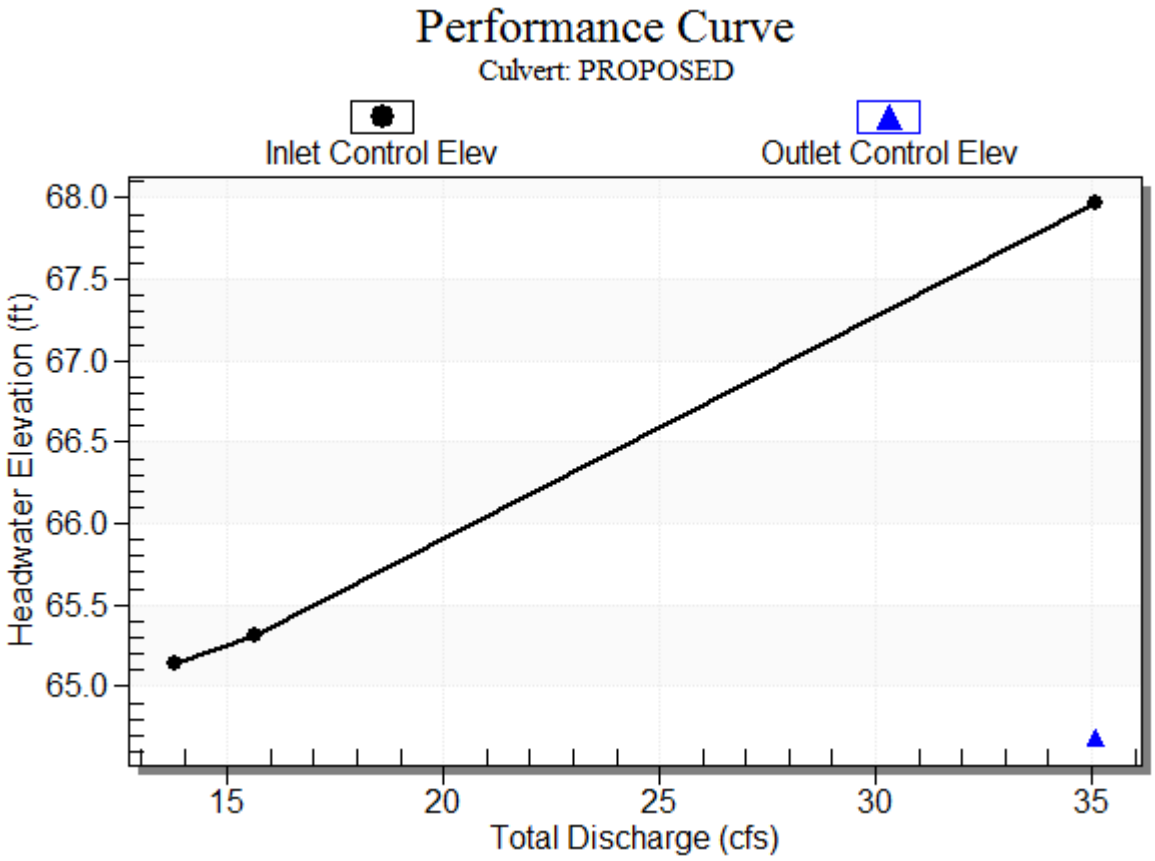
Straight Culvert

Inlet Elevation (invert): 63.20 ft, Outlet Elevation (invert): 58.30 ft

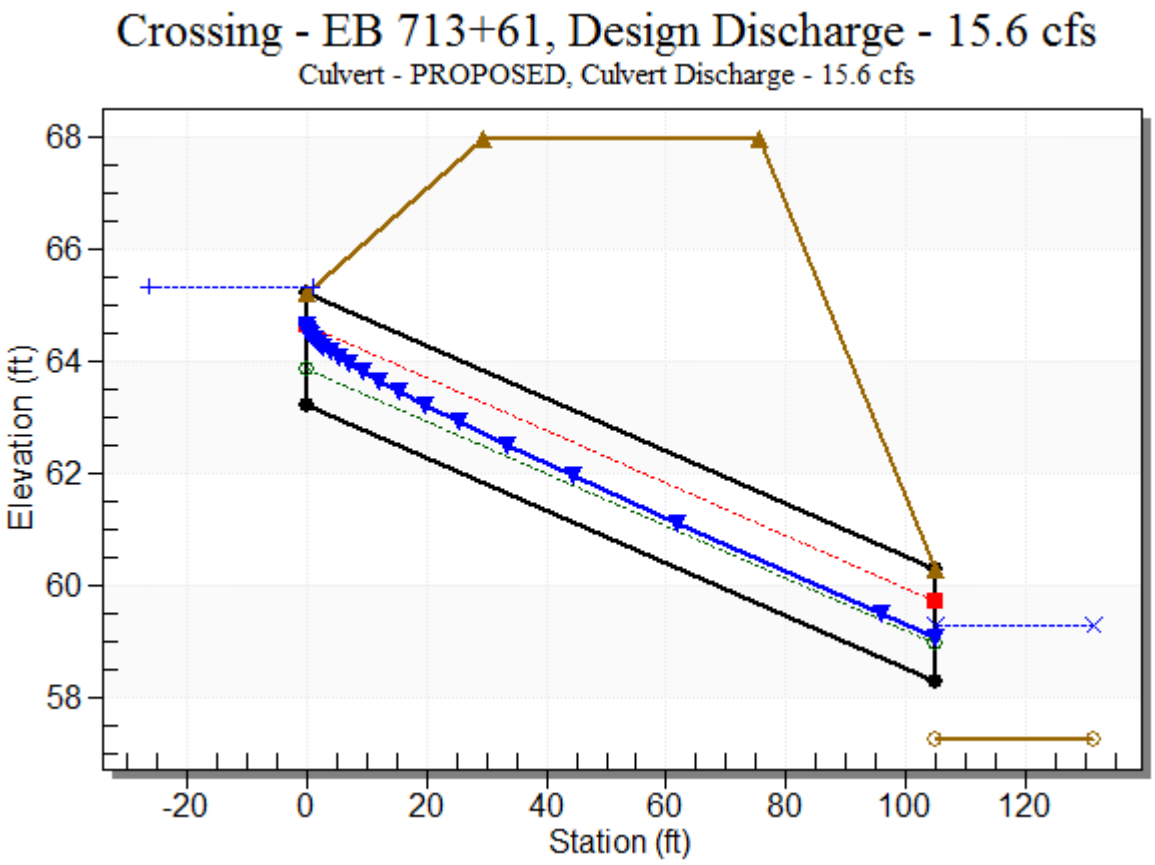
Culvert Length: 105.11 ft, Culvert Slope: 0.0467

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 63.20 ft

Outlet Station: 105.00 ft

Outlet Elevation: 58.30 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: EB 713+61)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
13.76	59.30	2.02
15.62	59.30	2.02

Tailwater Channel Data - EB 713+61

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 59.30 ft

Roadway Data for Crossing: EB 713+61

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 67.97 ft

Roadway Surface: Paved

Roadway Top Width: 46.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 718+99 EB(XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 46 - Summary of Culvert Flows at Crossing: EB 718+99

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
63.38	50-YR	7.62	7.62	0.00	1
63.48	100-YR	8.64	8.64	0.00	1
68.38	Overtopping	42.63	42.63	0.00	Overtopping

Rating Curve Plot for Crossing: EB 718+99

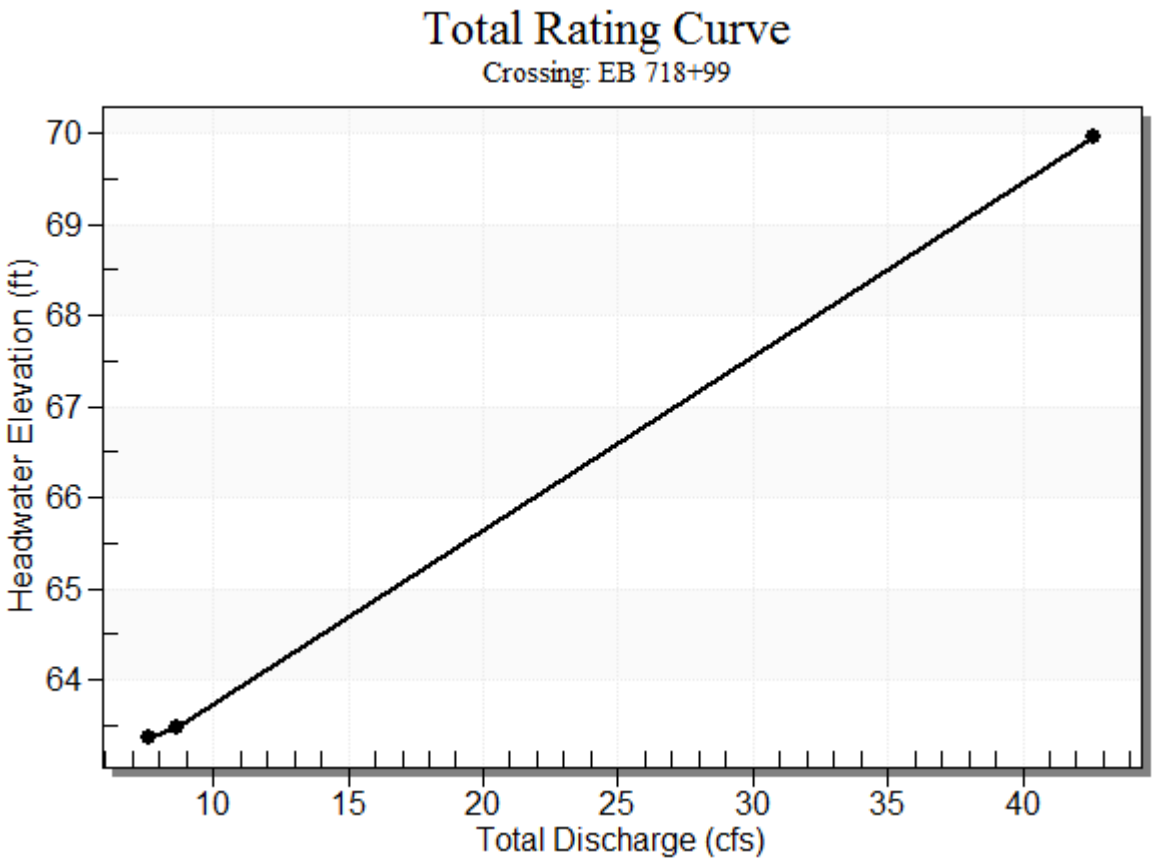


Table 47 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	7.62	7.62	63.38	1.376	0.0*	1-JS1t	0.544	0.982	1.740	2.330	2.456
100-YR	8.64	8.64	63.48	1.482	0.0*	1-S2n	0.582	1.047	0.675	2.330	7.909

* Full Flow Headwater elevation is below inlet invert.

****

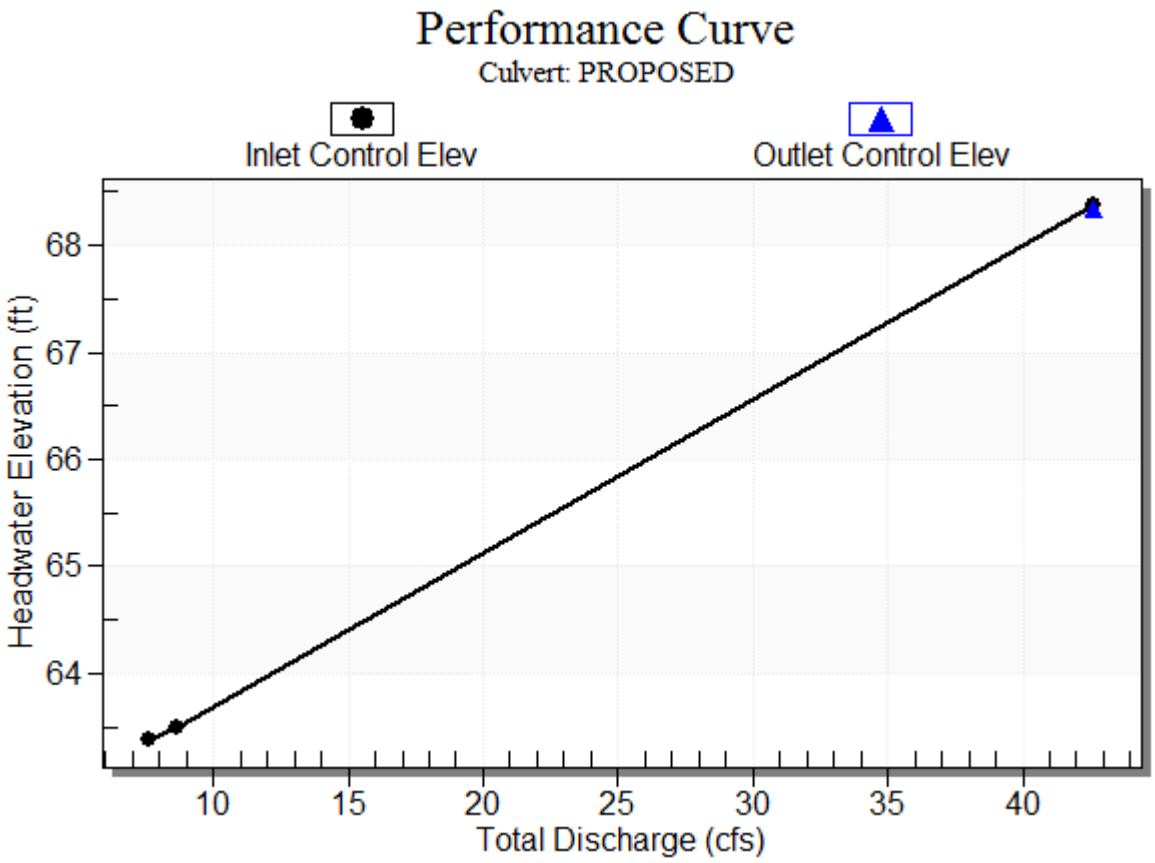
Straight Culvert

Inlet Elevation (invert): 62.00 ft, Outlet Elevation (invert): 59.59 ft

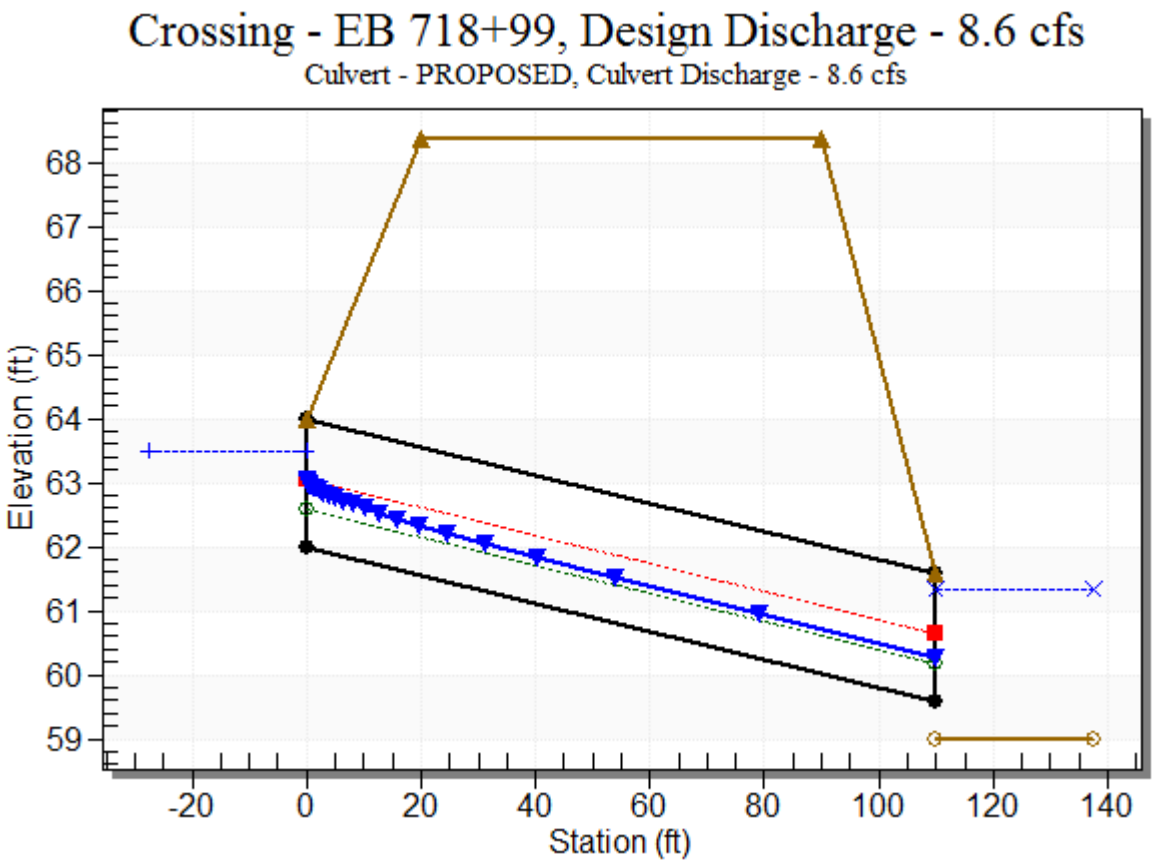
Culvert Length: 110.03 ft, Culvert Slope: 0.0219

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 62.00 ft

Outlet Station: 110.00 ft

Outlet Elevation: 59.59 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 48 - Downstream Channel Rating Curve (Crossing: EB 718+99)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
7.62	61.33	2.33
8.64	61.33	2.33

Tailwater Channel Data - EB 718+99

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 61.33 ft

Roadway Data for Crossing: EB 718+99

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 68.38 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 726+96 EB(XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 52 - Summary of Culvert Flows at Crossing: EB 726+96

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
65.28	50-YR	18.07	18.07	0.00	1
65.53	100-YR	20.36	20.36	0.00	1
68.96	Overtopping	41.35	41.35	0.00	Overtopping

Rating Curve Plot for Crossing: EB 726+96

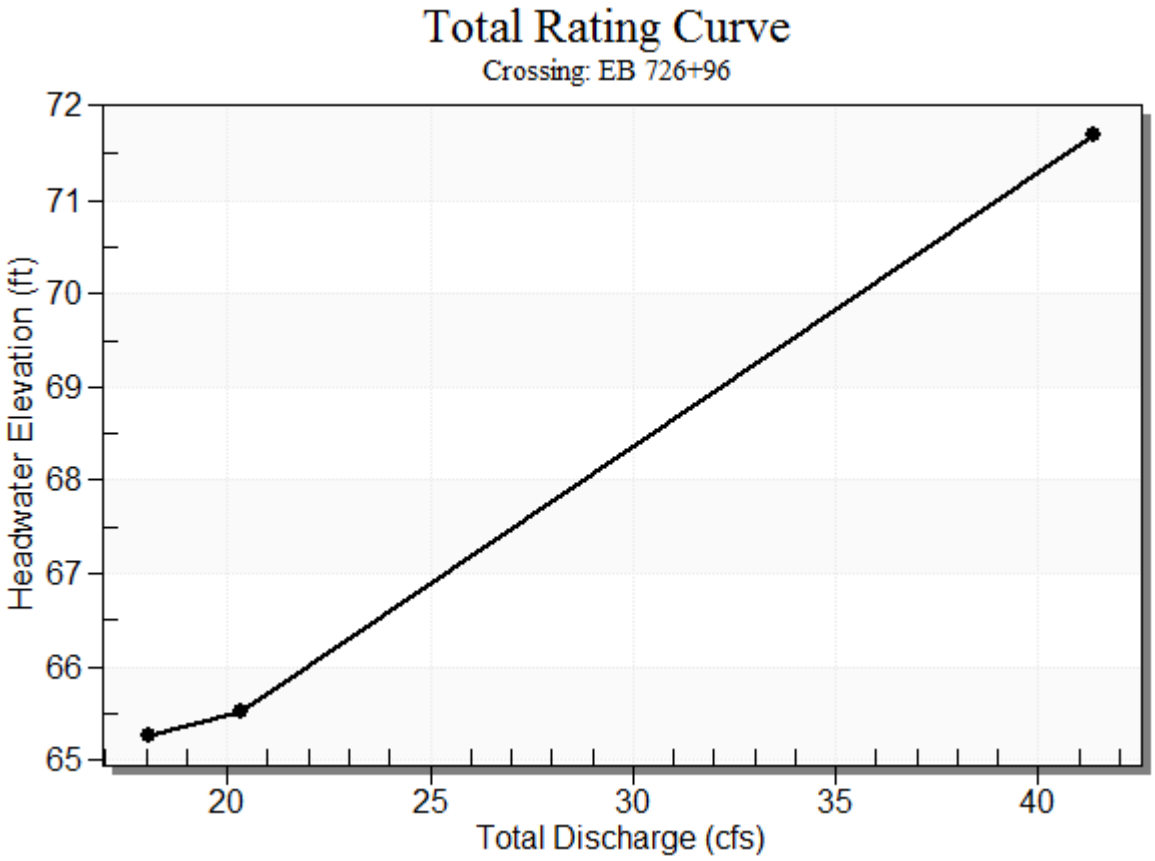


Table 53 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	18.07	18.07	65.28	2.377	0.156	5-S2n	0.847	1.529	0.987	1.710	10.101
100-YR	20.36	20.36	65.53	2.627	0.481	5-S2n	0.911	1.617	1.065	1.710	10.378

****

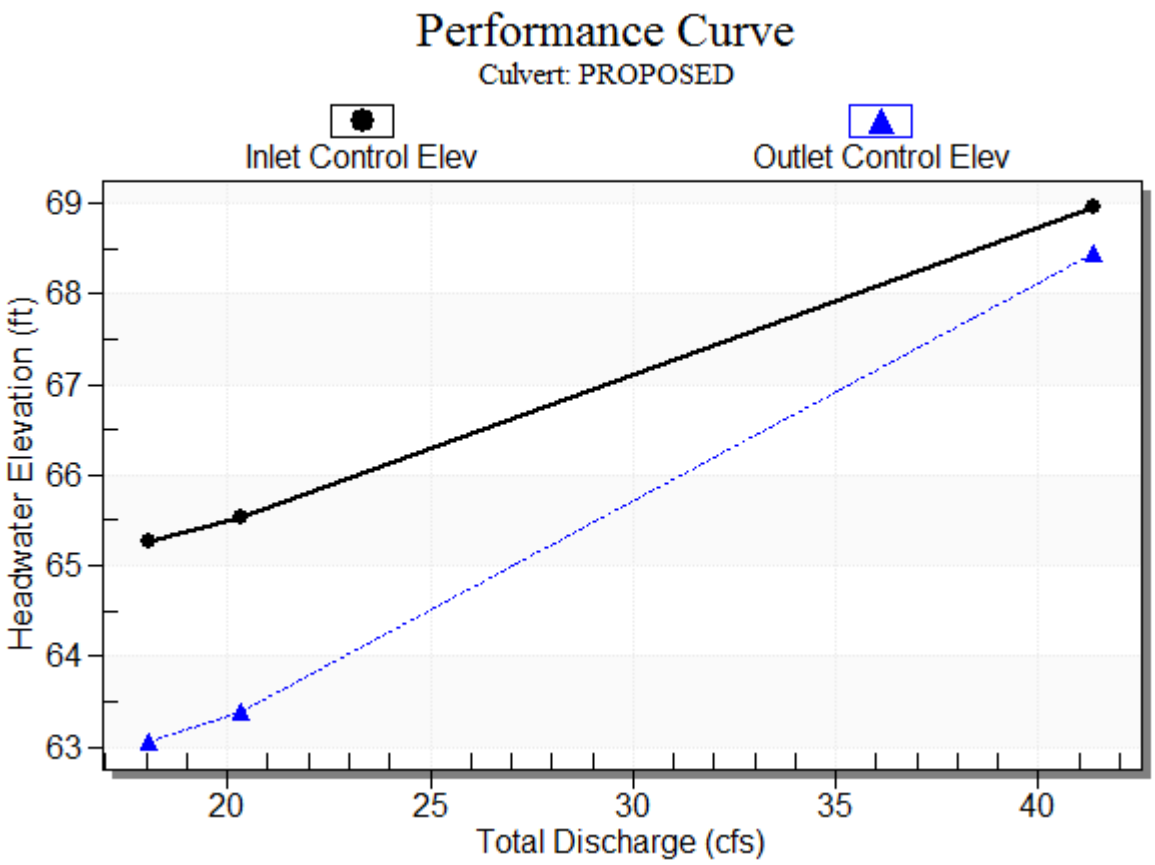
Straight Culvert

Inlet Elevation (invert): 62.90 ft, Outlet Elevation (invert): 60.14 ft

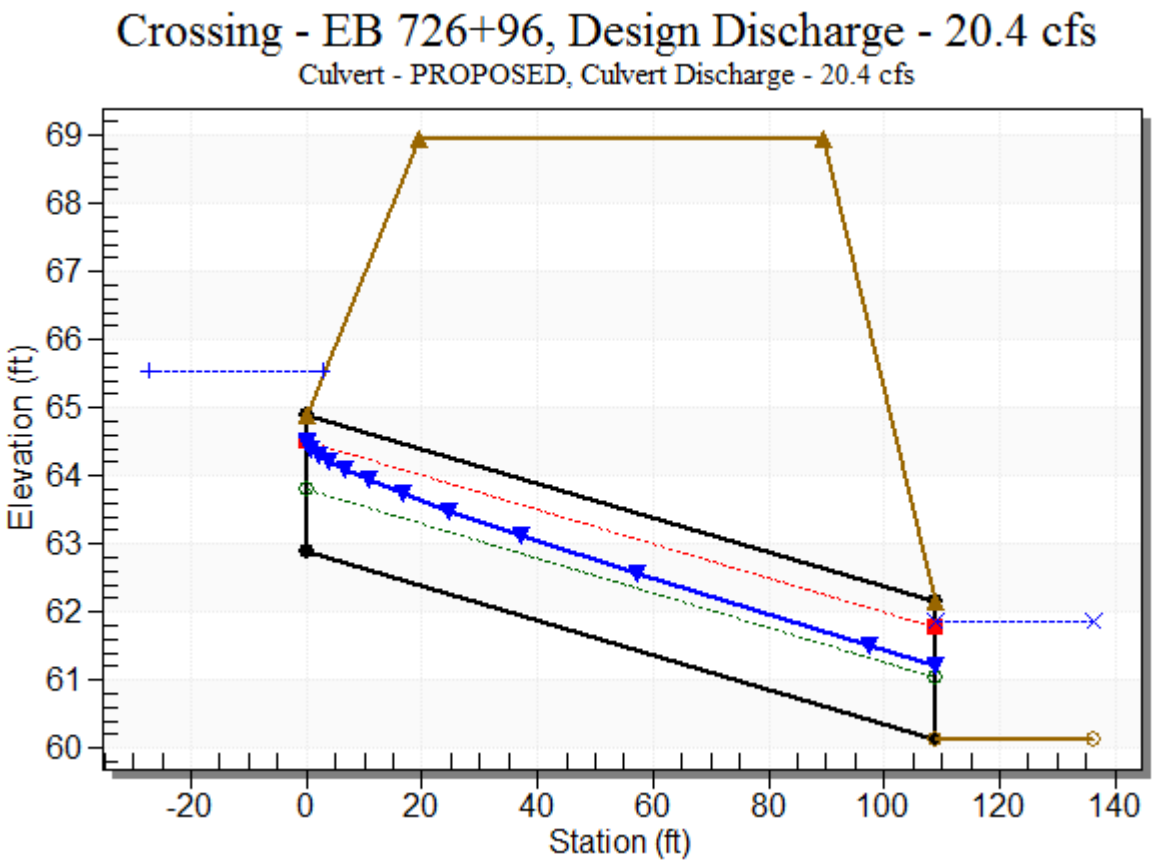
Culvert Length: 109.03 ft, Culvert Slope: 0.0253

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 62.90 ft

Outlet Station: 109.00 ft

Outlet Elevation: 60.14 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 54 - Downstream Channel Rating Curve (Crossing: EB 726+96)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
18.07	61.85	1.71
20.36	61.85	1.71

Tailwater Channel Data - EB 726+96

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 61.85 ft

Roadway Data for Crossing: EB 726+96

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 68.96 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 751+97 EB (XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 61 - Summary of Culvert Flows at Crossing: EB 751+97

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
76.97	50-YR	12.89	12.89	0.00	1
77.13	100-YR	14.63	14.63	0.00	1
80.52	Overtopping	38.44	38.44	0.00	Overtopping

Rating Curve Plot for Crossing: EB 751+97

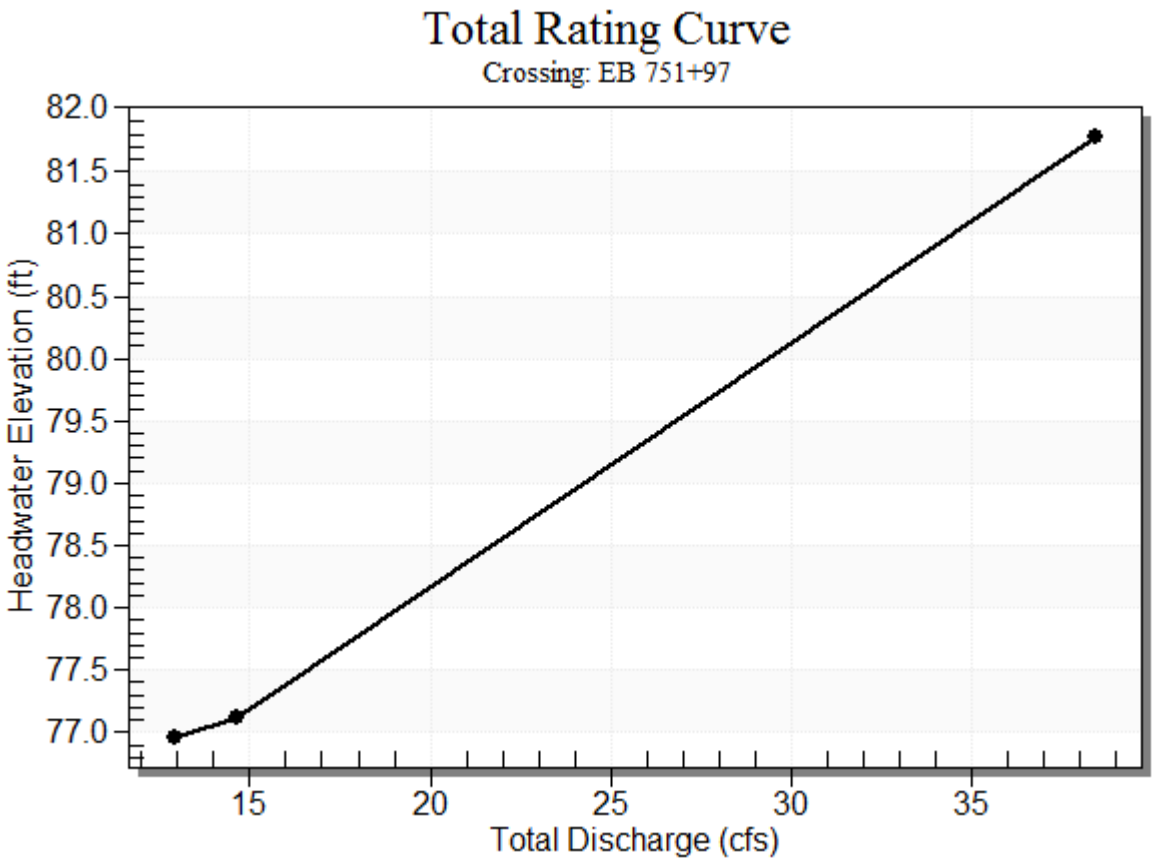


Table 62 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	12.89	12.89	76.97	1.876	0.0*	1-S2n	0.688	1.289	0.796	2.380	9.454
100-YR	14.63	14.63	77.13	2.036	0.0*	5-S2n	0.736	1.374	0.863	2.380	9.675

* Full Flow Headwater elevation is below inlet invert.

****

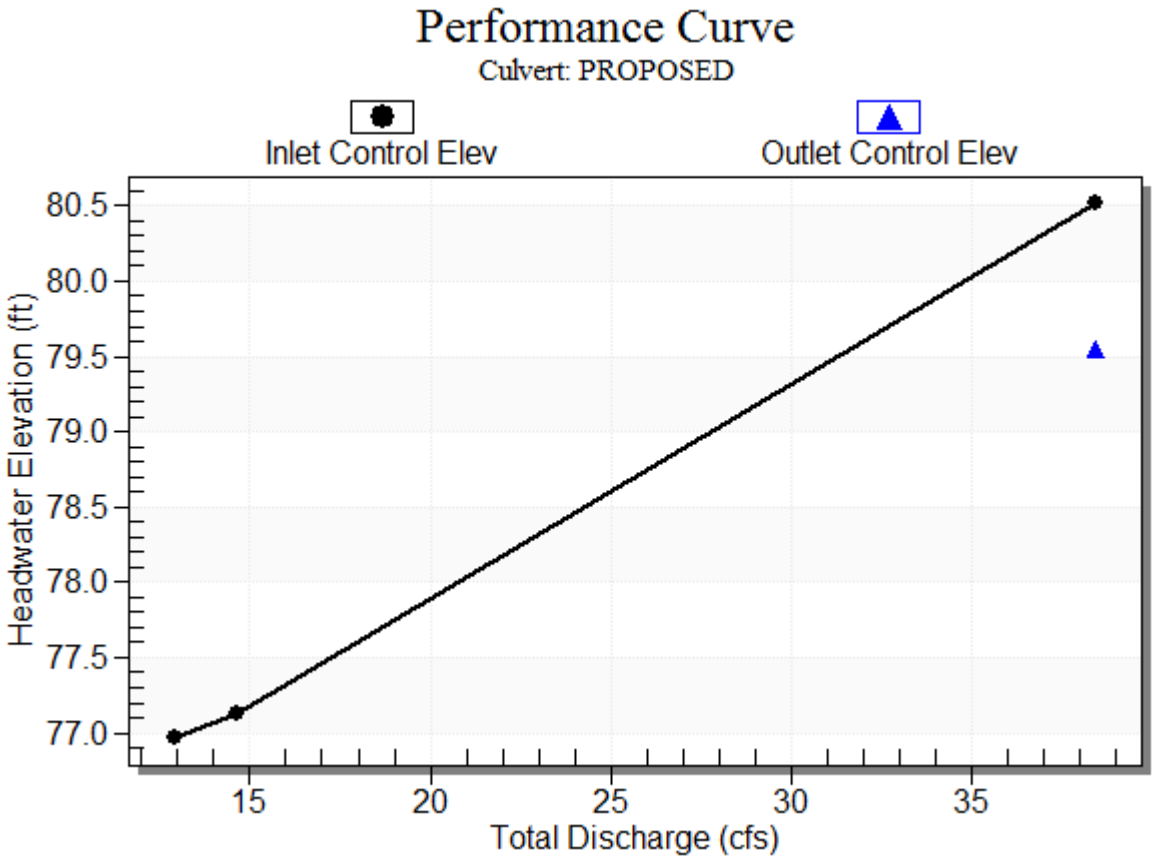
Straight Culvert

Inlet Elevation (invert): 75.09 ft, Outlet Elevation (invert): 72.00 ft

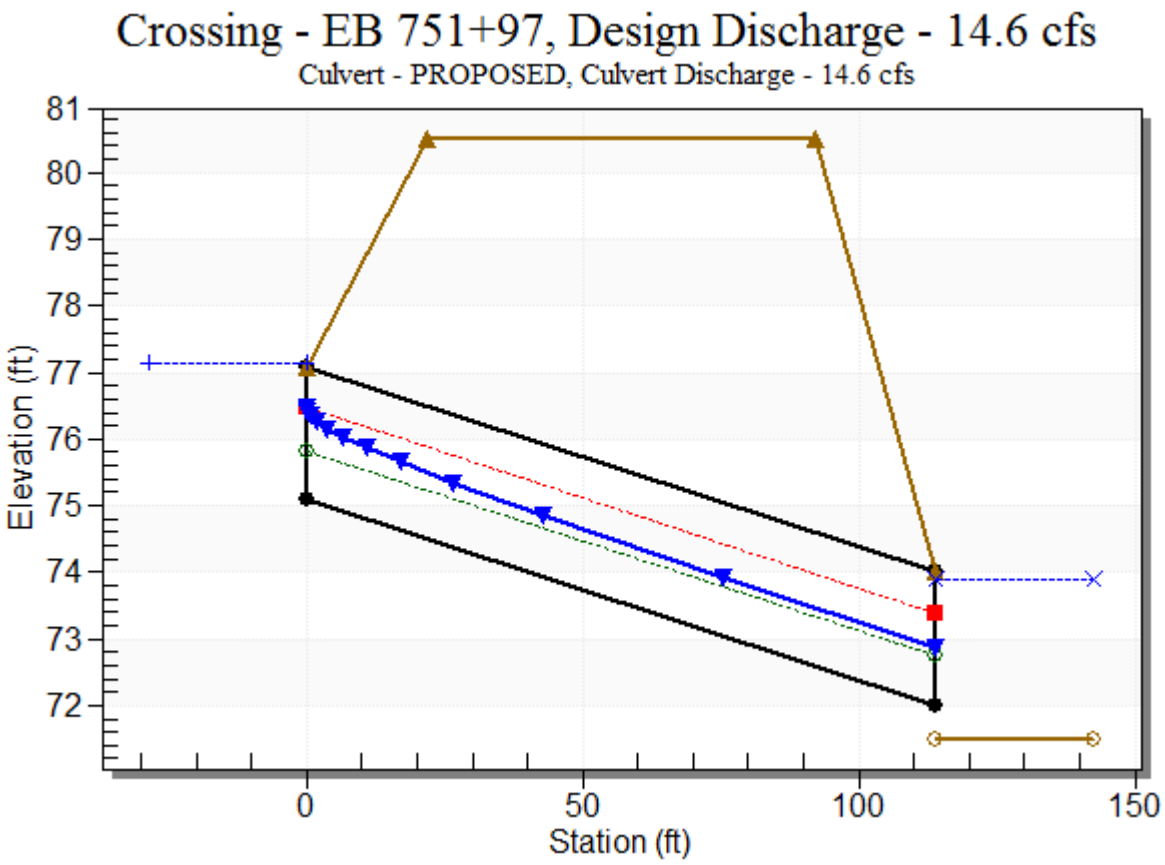
Culvert Length: 114.04 ft, Culvert Slope: 0.0271

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 75.09 ft

Outlet Station: 114.00 ft

Outlet Elevation: 72.00 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 63 - Downstream Channel Rating Curve (Crossing: EB 751+97)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
12.89	73.88	2.38
14.63	73.88	2.38

Tailwater Channel Data - EB 751+97

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 73.88 ft

Roadway Data for Crossing: EB 751+97

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 80.52 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 882+00 WB(XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 4 - Summary of Culvert Flows at Crossing: WB 882+00 (proposed)

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
60.55	50-yr	16.69	16.69	0.00	1
60.84	100-yr	18.94	18.94	0.00	1
63.40	Overtopping	32.93	32.93	0.00	Overtopping

Rating Curve Plot for Crossing: WB 882+00 (proposed)

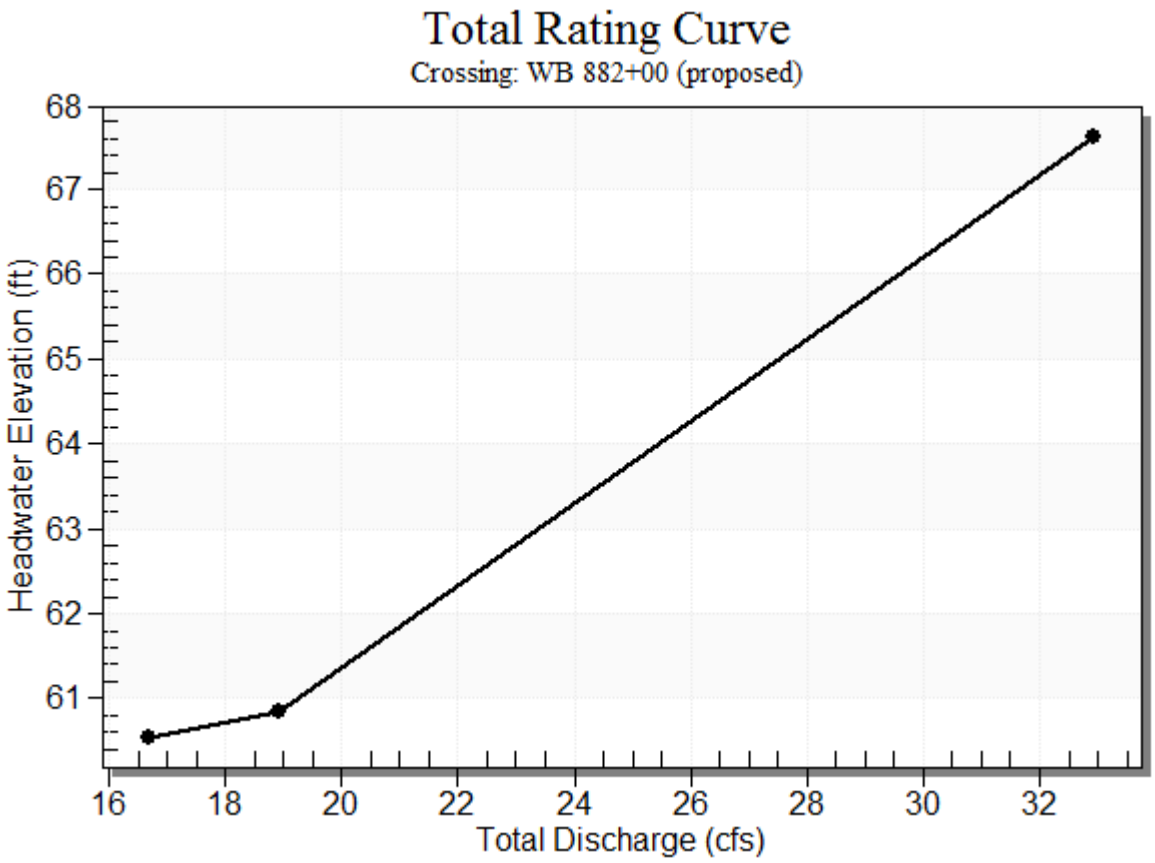


Table 5 - Culvert Summary Table: proposed

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	16.69	16.69	60.55	2.310	0.0*	5-S2n	0.736	1.471	0.867	2.080	10.961
100-yr	18.94	18.94	60.84	2.597	0.0*	5-S2n	0.789	1.564	0.933	2.080	11.341

* Full Flow Headwater elevation is below inlet invert.

****

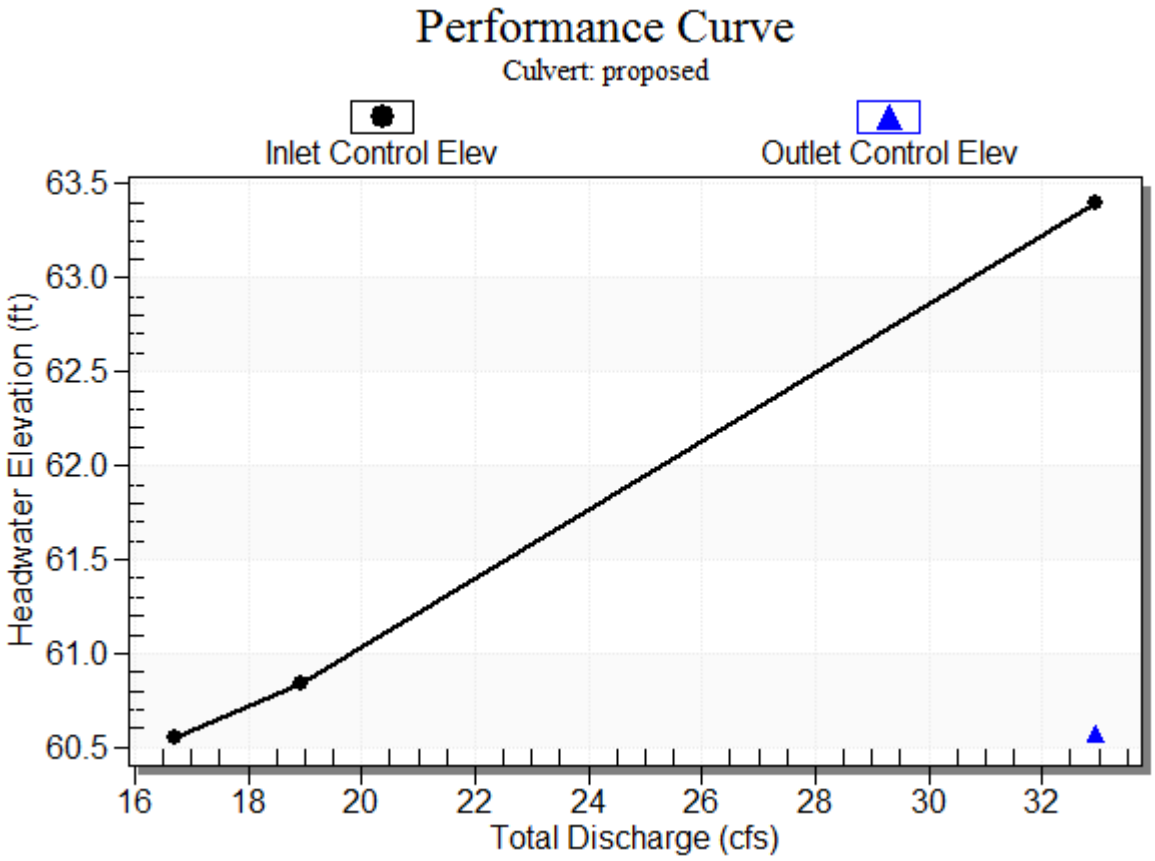
Straight Culvert

Inlet Elevation (invert): 58.24 ft, Outlet Elevation (invert): 54.60 ft

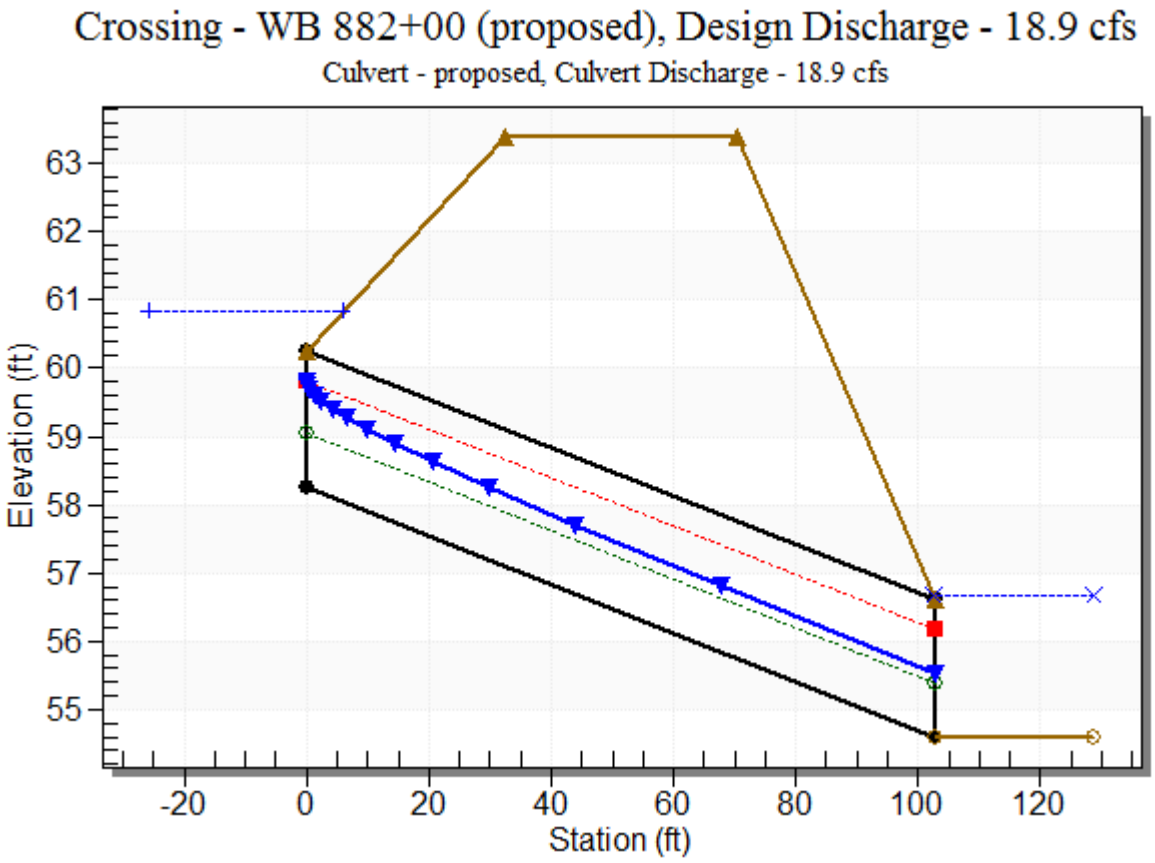
Culvert Length: 103.00 ft, Culvert Slope: 0.0354

****

Culvert Performance Curve Plot: proposed



Water Surface Profile Plot for Culvert: proposed



Site Data - proposed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 58.24 ft

Outlet Station: 102.94 ft

Outlet Elevation: 54.60 ft

Number of Barrels: 1

Culvert Data Summary - proposed

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

Table 6 - Downstream Channel Rating Curve (Crossing: WB 882+00 (proposed))

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
16.69	56.68	2.08
18.94	56.68	2.08

Tailwater Channel Data - WB 882+00 (proposed)

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 56.68 ft

Roadway Data for Crossing: WB 882+00 (proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 63.40 ft

Roadway Surface: Paved

Roadway Top Width: 38.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 890+10 WB(XS): 18" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 31 - Summary of Culvert Flows at Crossing: WB 890+10

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
59.84	50-yr	8.39	8.39	0.00	1
60.12	100-yr	9.52	9.52	0.00	1
64.91	Overtopping	19.97	19.97	0.00	Overtopping

Rating Curve Plot for Crossing: WB 890+10

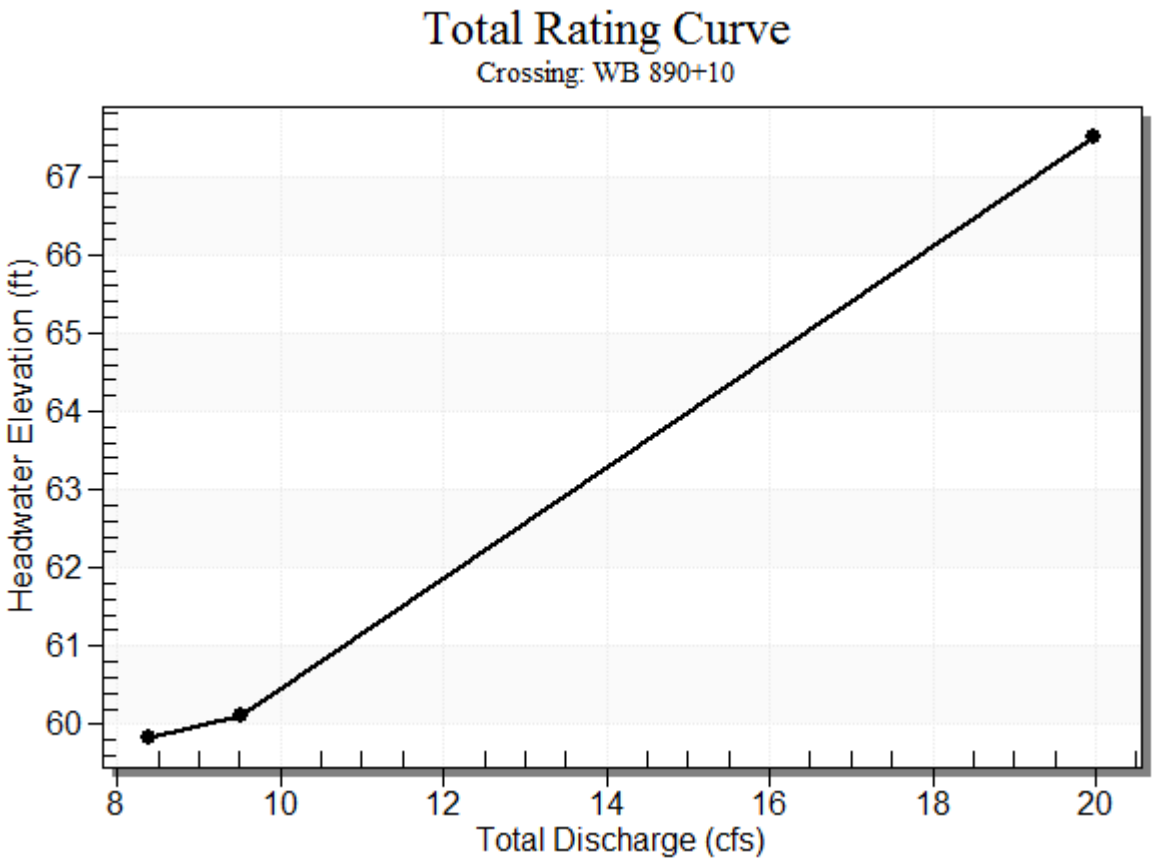


Table 32 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	8.39	8.39	59.84	1.723	1.675	5-JS1f	0.705	1.118	1.500	2.900	4.748
100-yr	9.52	9.52	60.12	1.907	1.996	1-S1f	0.763	1.190	1.500	2.900	5.387

****

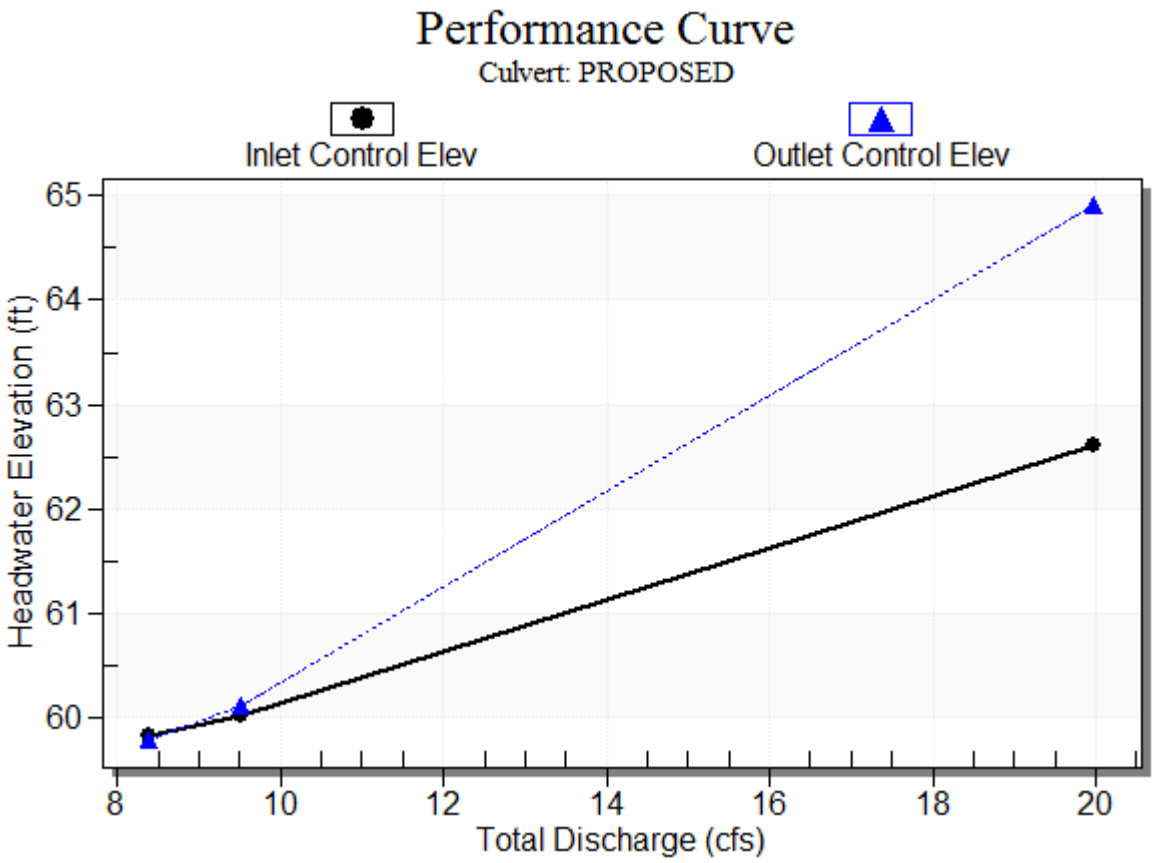
Straight Culvert

Inlet Elevation (invert): 58.12 ft, Outlet Elevation (invert): 55.88 ft

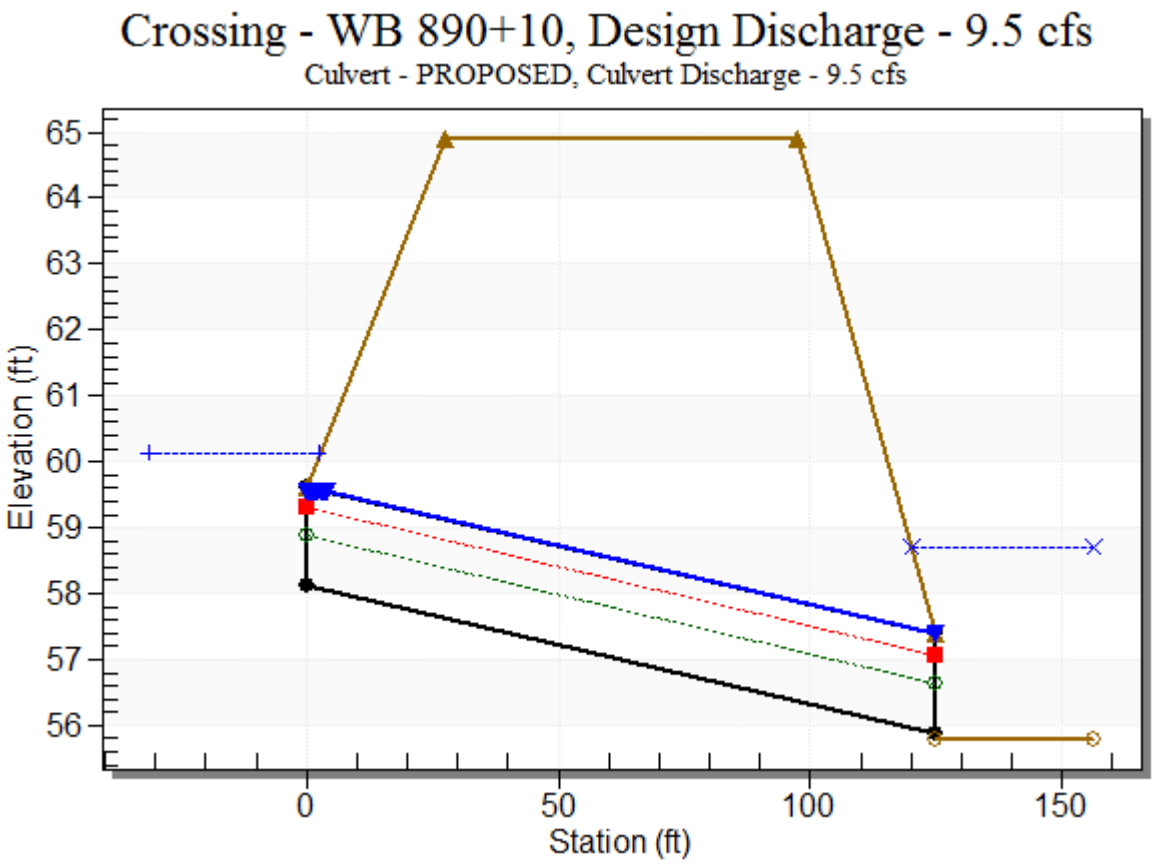
Culvert Length: 125.02 ft, Culvert Slope: 0.0179

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 58.12 ft

Outlet Station: 125.00 ft

Outlet Elevation: 55.88 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 33 - Downstream Channel Rating Curve (Crossing: WB 890+10)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
8.39	58.70	2.90
9.52	58.70	2.90

Tailwater Channel Data - WB 890+10

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 58.70 ft

Roadway Data for Crossing: WB 890+10

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 64.91 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 899+12 WB(XS): 18" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 34 - Summary of Culvert Flows at Crossing: WB 899+12

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
62.16	50-yr	8.51	8.51	0.00	1
62.35	100-yr	9.66	9.66	0.00	1
66.25	Overtopping	22.02	22.02	0.00	Overtopping

Rating Curve Plot for Crossing: WB 899+12

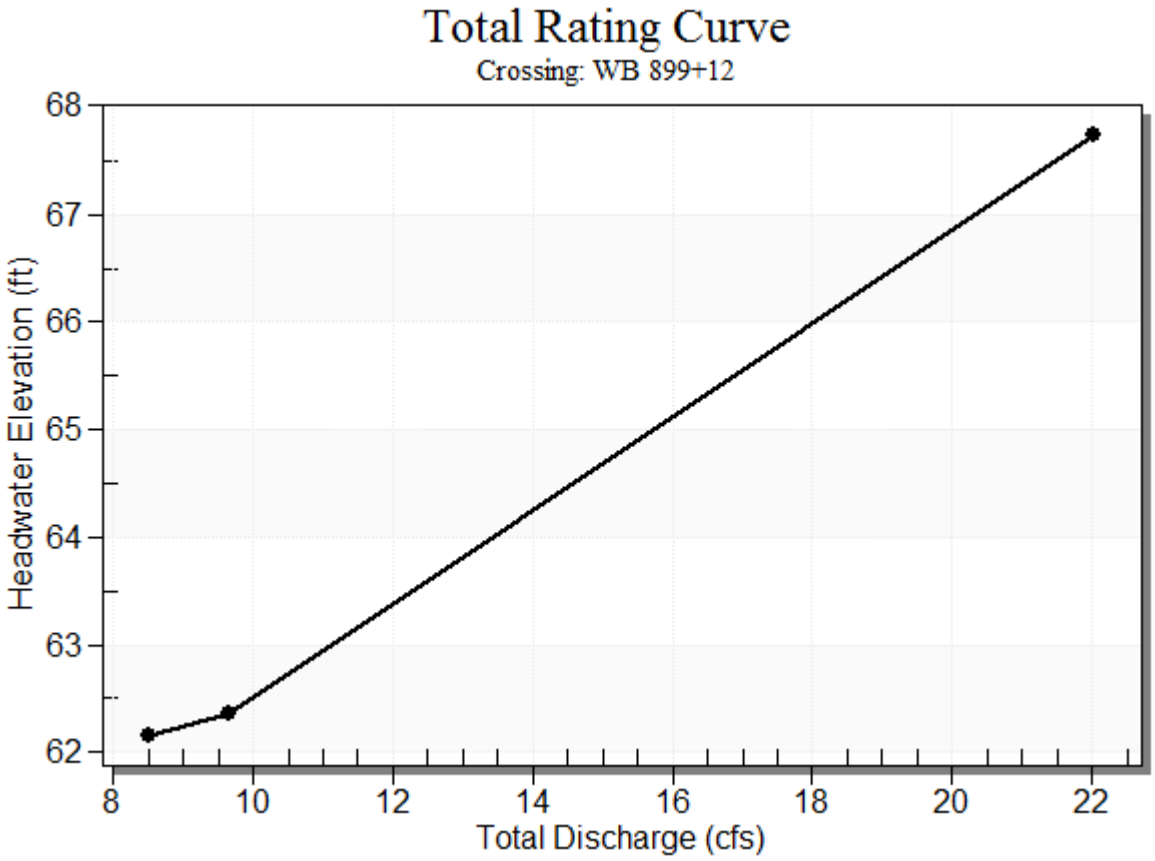


Table 35 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-yr	8.51	8.51	62.16	1.732	0.0*	5-JS1f	0.605	1.125	1.500	2.360	4.816
100-yr	9.66	9.66	62.35	1.921	0.0*	5-S2n	0.653	1.199	0.653	2.360	11.229

* Full Flow Headwater elevation is below inlet invert.

****

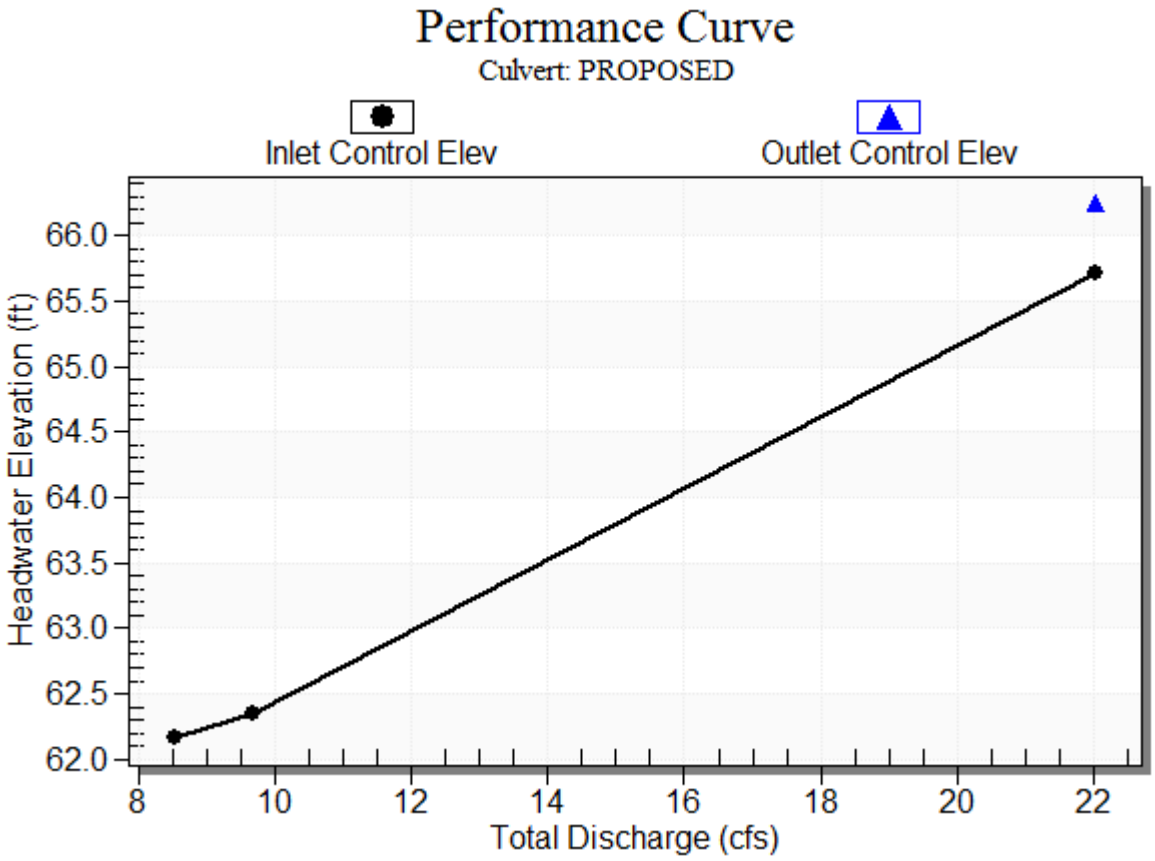
Straight Culvert

Inlet Elevation (invert): 60.43 ft, Outlet Elevation (invert): 56.71 ft

Culvert Length: 121.06 ft, Culvert Slope: 0.0307

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED

Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 60.43 ft

Outlet Station: 121.00 ft

Outlet Elevation: 56.71 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 36 - Downstream Channel Rating Curve (Crossing: WB 899+12)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
8.51	58.85	2.36
9.66	58.85	2.36

Tailwater Channel Data - WB 899+12

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 58.85 ft

Roadway Data for Crossing: WB 899+12

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 66.25 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 901+63 WB(XS): 24" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 37 - Summary of Culvert Flows at Crossing: WB 901+63

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
63.84	50-YR	14.88	14.88	0.00	1
64.04	100-YR	16.89	16.89	0.00	1
66.58	Overtopping	35.11	35.11	0.00	Overtopping

Rating Curve Plot for Crossing: WB 901+63

Table 38 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	14.88	14.88	63.84	2.042	0.0*	5-S2n	0.649	1.386	0.756	2.344	11.677
100-YR	16.89	16.89	64.04	2.237	0.0*	5-S2n	0.695	1.480	0.816	2.344	11.984

* Full Flow Headwater elevation is below inlet invert.

****

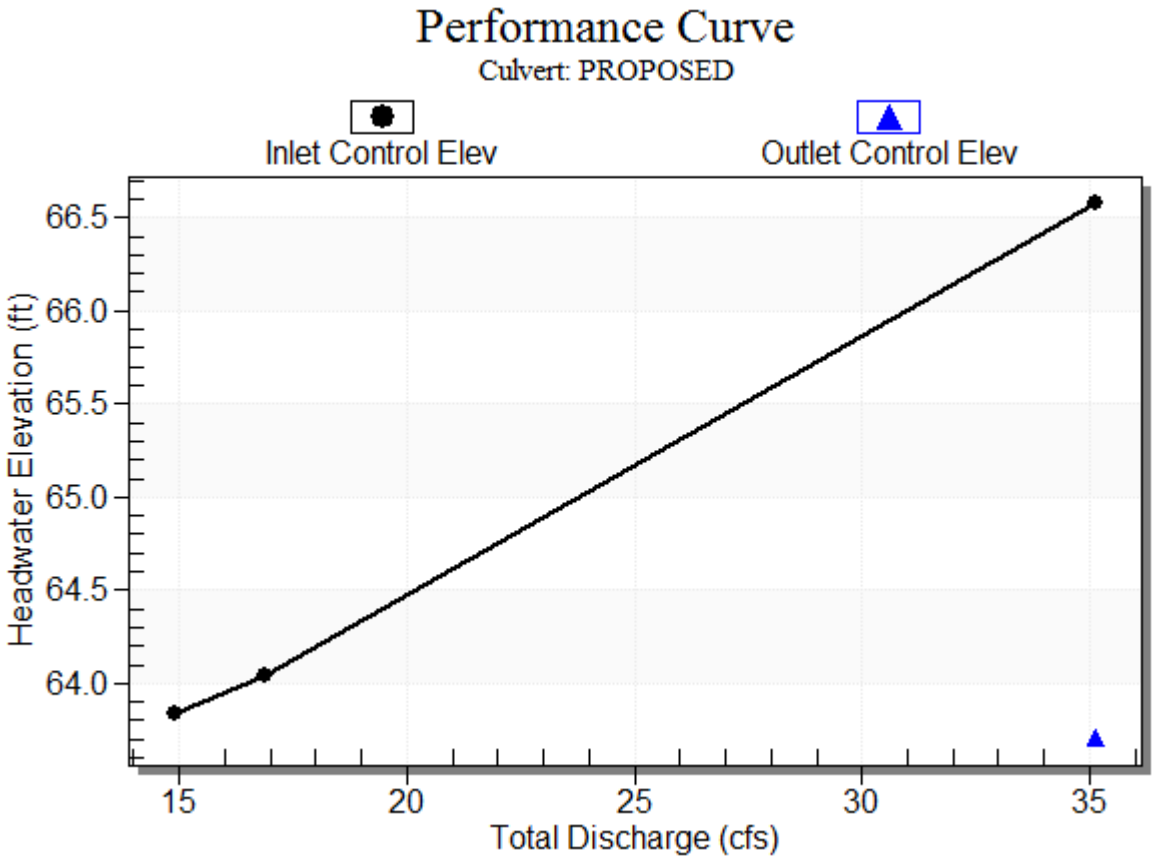
Straight Culvert

Inlet Elevation (invert): 61.80 ft, Outlet Elevation (invert): 56.60 ft

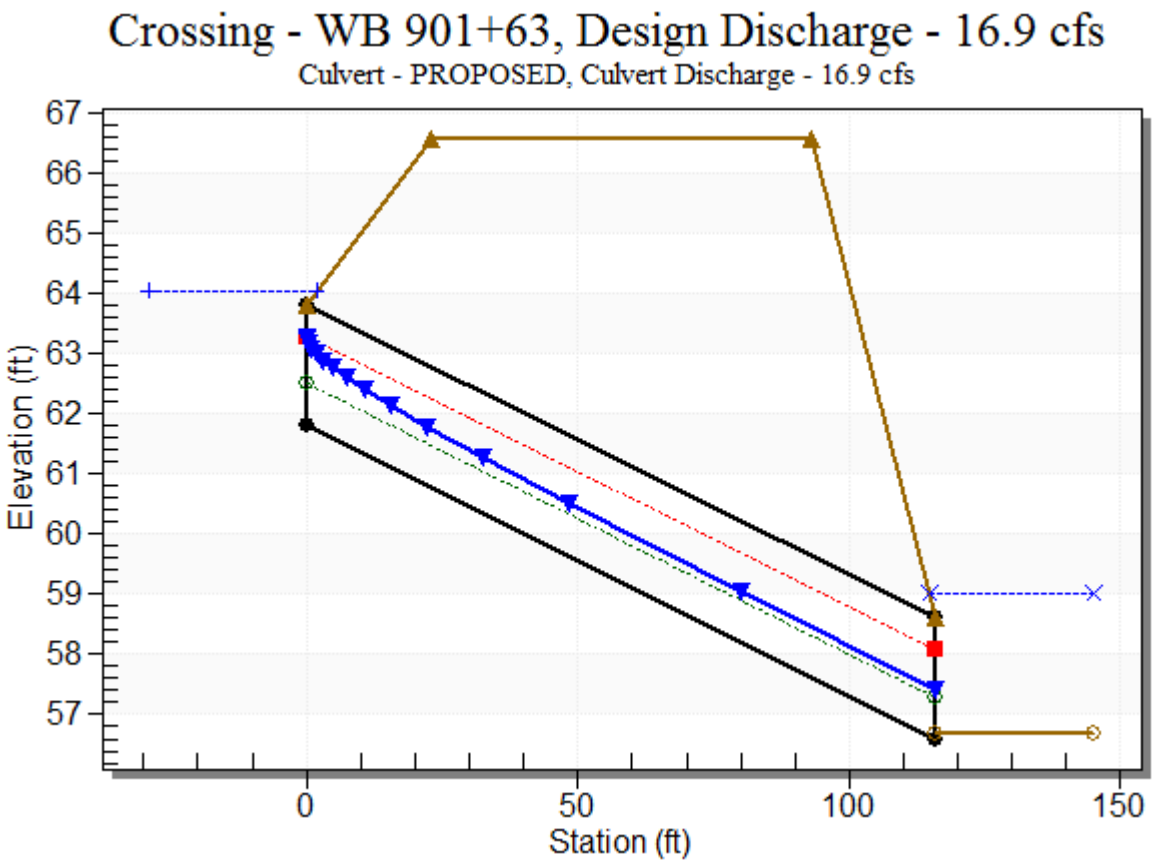
Culvert Length: 116.12 ft, Culvert Slope: 0.0448

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 61.80 ft

Outlet Station: 116.00 ft

Outlet Elevation: 56.60 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 39 - Downstream Channel Rating Curve (Crossing: WB 901+63)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
14.88	59.01	2.34
16.89	59.01	2.34

Tailwater Channel Data - WB 901+63

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 59.01 ft

Roadway Data for Crossing: WB 901+63

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 66.58 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 922+82 WB(XS): 18" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 49 - Summary of Culvert Flows at Crossing: WB 922+82

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
64.92	50-YR	3.00	3.00	0.00	1
64.99	100-YR	3.40	3.40	0.00	1
68.79	Overtopping	18.90	18.90	0.00	Overtopping

Rating Curve Plot for Crossing: WB 922+82

Table 50 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	3.00	3.00	64.92	0.911	0.0*	1-S2n	0.400	0.658	0.400	-0.320	6.685
100-YR	3.40	3.40	64.99	0.983	0.0*	1-S2n	0.427	0.703	0.427	-0.320	6.913

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

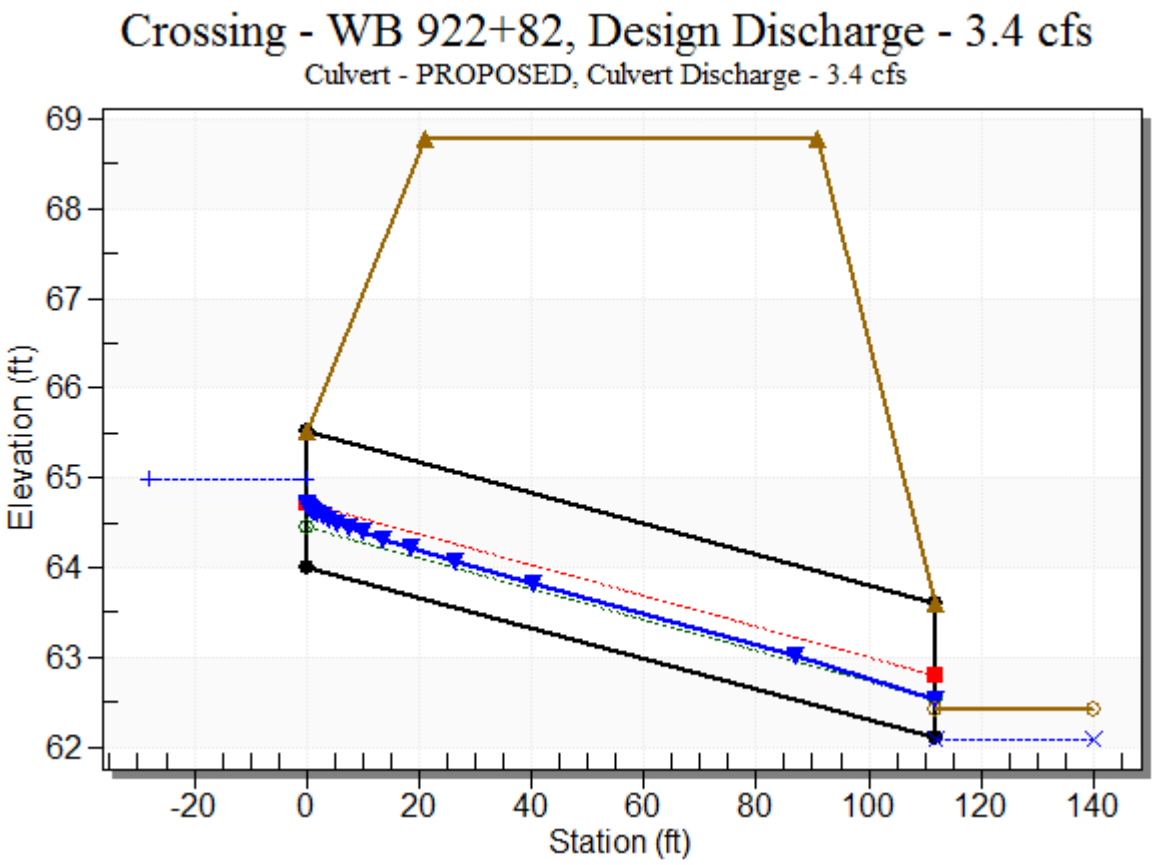
Inlet Elevation (invert): 64.01 ft, Outlet Elevation (invert): 62.10 ft

Culvert Length: 112.02 ft, Culvert Slope: 0.0171

****

Culvert Performance Curve Plot: PROPOSED

Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 64.01 ft

Outlet Station: 112.00 ft

Outlet Elevation: 62.10 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 51 - Downstream Channel Rating Curve (Crossing: WB 922+82)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
3.00	62.09	-0.32
3.40	62.09	-0.32

Tailwater Channel Data - WB 922+82

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 62.09 ft

Roadway Data for Crossing: WB 922+82

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 68.79 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 936+70 WB (XS): 30" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 55 - Summary of Culvert Flows at Crossing: WB 936+70

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
64.16	50-YR	28.35	28.35	0.00	1
64.42	100-YR	31.97	31.97	0.00	1
70.29	Overtopping	71.19	71.19	0.00	Overtopping

Rating Curve Plot for Crossing: WB 936+70

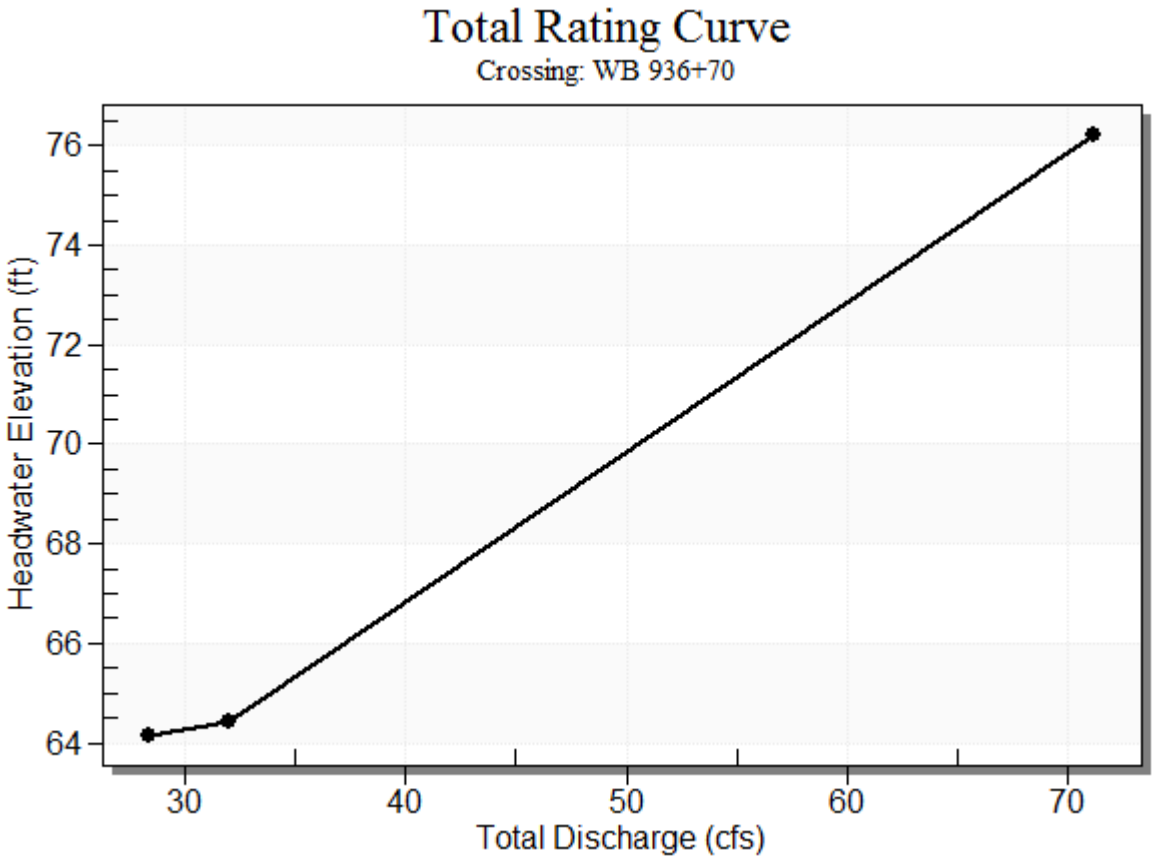


Table 56 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	28.35	28.35	64.16	2.762	2.071	5-S2n	1.470	1.813	1.656	0.859	7.232
100-YR	31.97	31.97	64.42	3.025	2.783	5-S2n	1.609	1.923	1.807	0.859	7.512

****

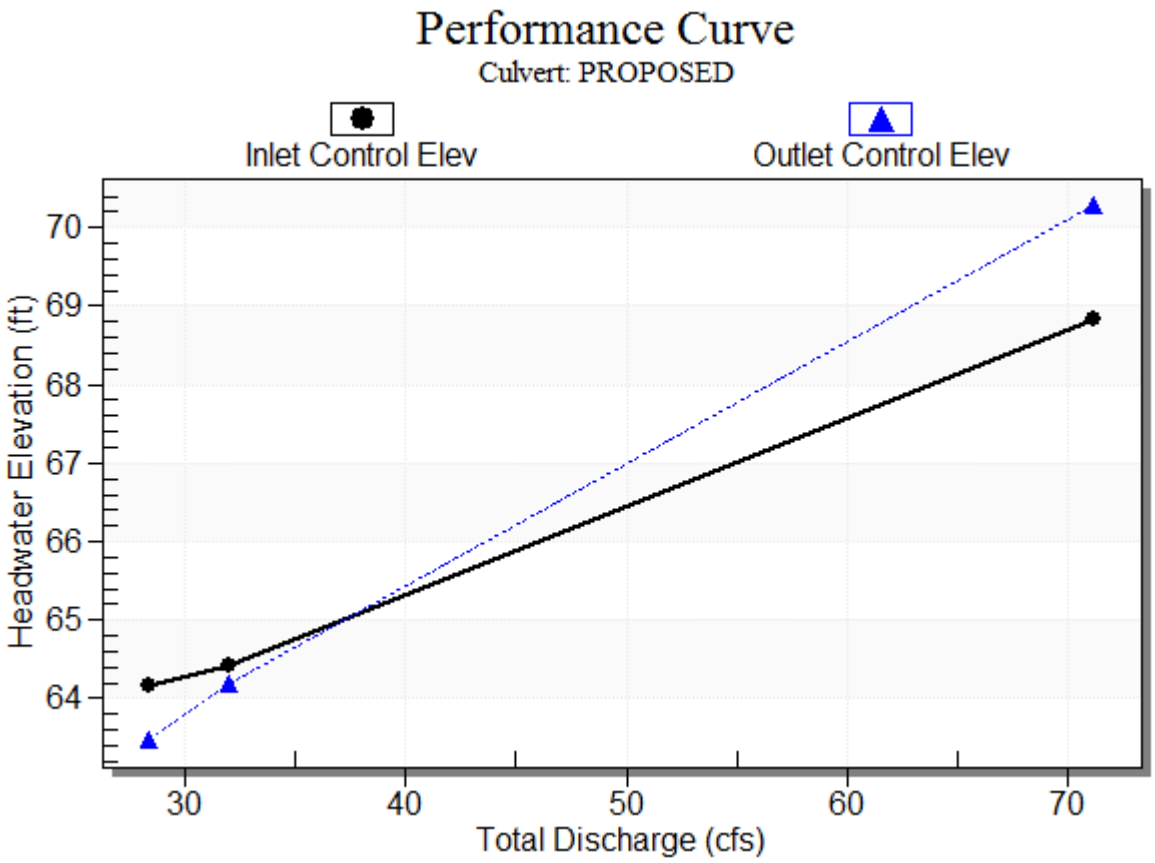
Straight Culvert

Inlet Elevation (invert): 61.40 ft, Outlet Elevation (invert): 60.50 ft

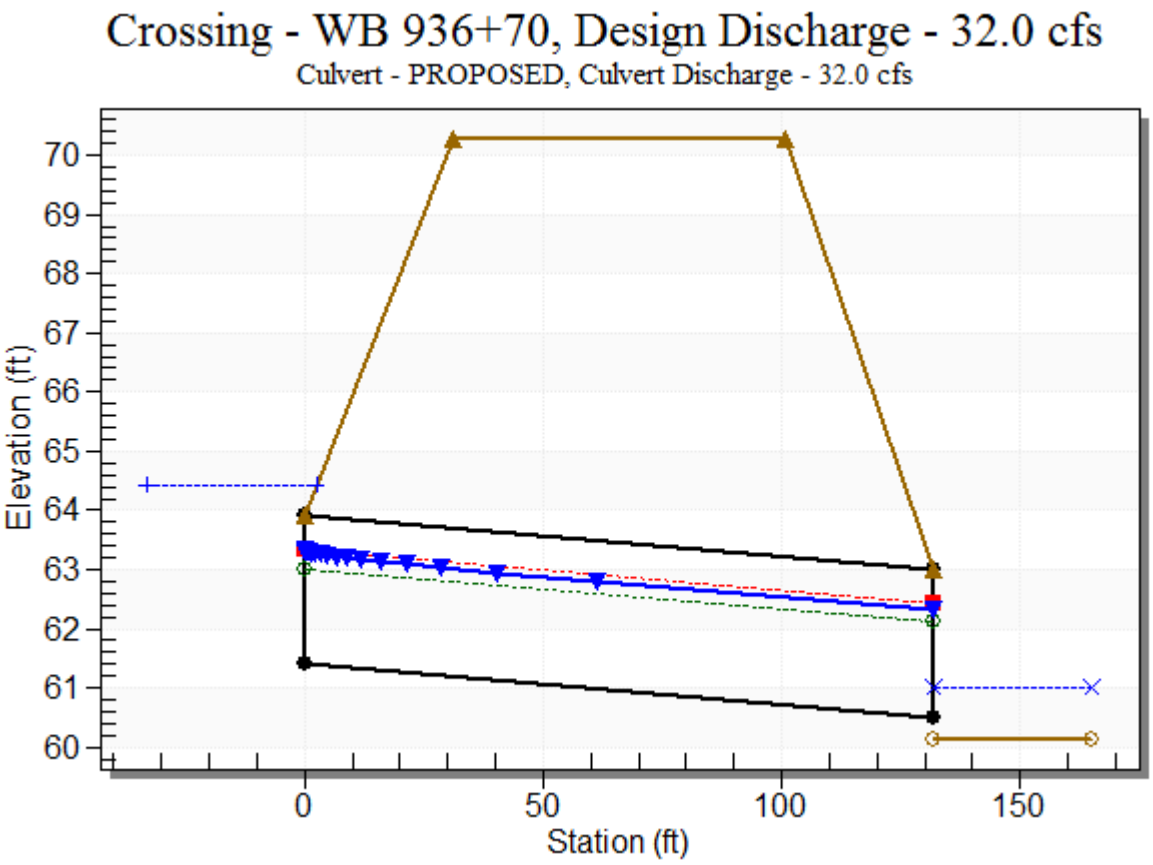
Culvert Length: 132.00 ft, Culvert Slope: 0.0068

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 61.40 ft

Outlet Station: 132.00 ft

Outlet Elevation: 60.50 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 57 - Downstream Channel Rating Curve (Crossing: WB 936+70)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
28.35	61.00	0.86
31.97	61.00	0.86

Tailwater Channel Data - WB 936+70

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 61.00 ft

Roadway Data for Crossing: WB 936+70

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 70.29 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HY-8 ROAD DRAINAGE CALCULATION SUMMARY

STA: 952+06 WB (XS): 30" CULVERT

25644.0006

THOMAS & HUTTON

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 58 - Summary of Culvert Flows at Crossing: WB 952+06

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	PROPOSED Discharge (cfs)	Roadway Discharge (cfs)	Iterations
73.88	50-YR	22.71	22.71	0.00	1
74.09	100-YR	25.76	25.76	0.00	1
80.62	Overtopping	72.47	72.47	0.00	Overtopping

Rating Curve Plot for Crossing: WB 952+06

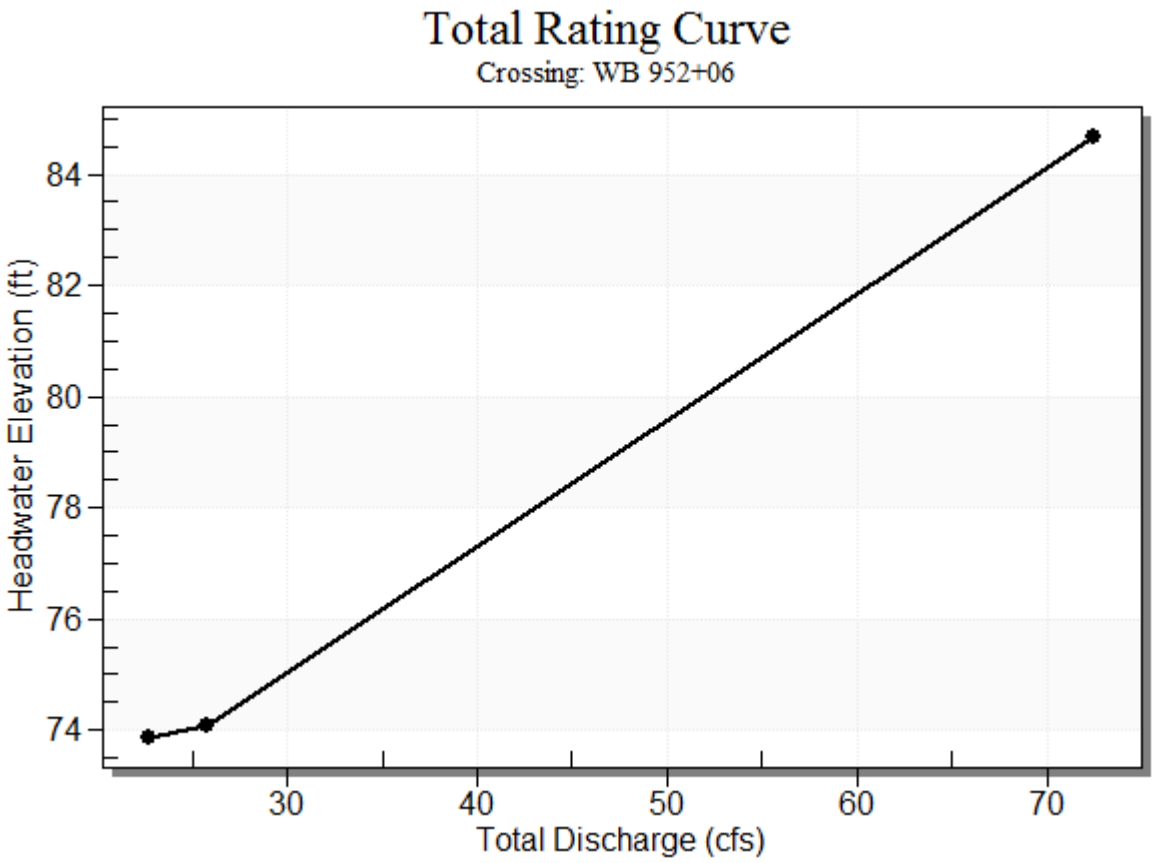


Table 59 - Culvert Summary Table: PROPOSED

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
50-YR	22.71	22.71	73.88	2.383	1.547	1-S2n	1.296	1.618	1.461	1.530	6.650
100-YR	25.76	25.76	74.09	2.585	1.862	5-S2n	1.409	1.725	1.589	1.530	6.875

****

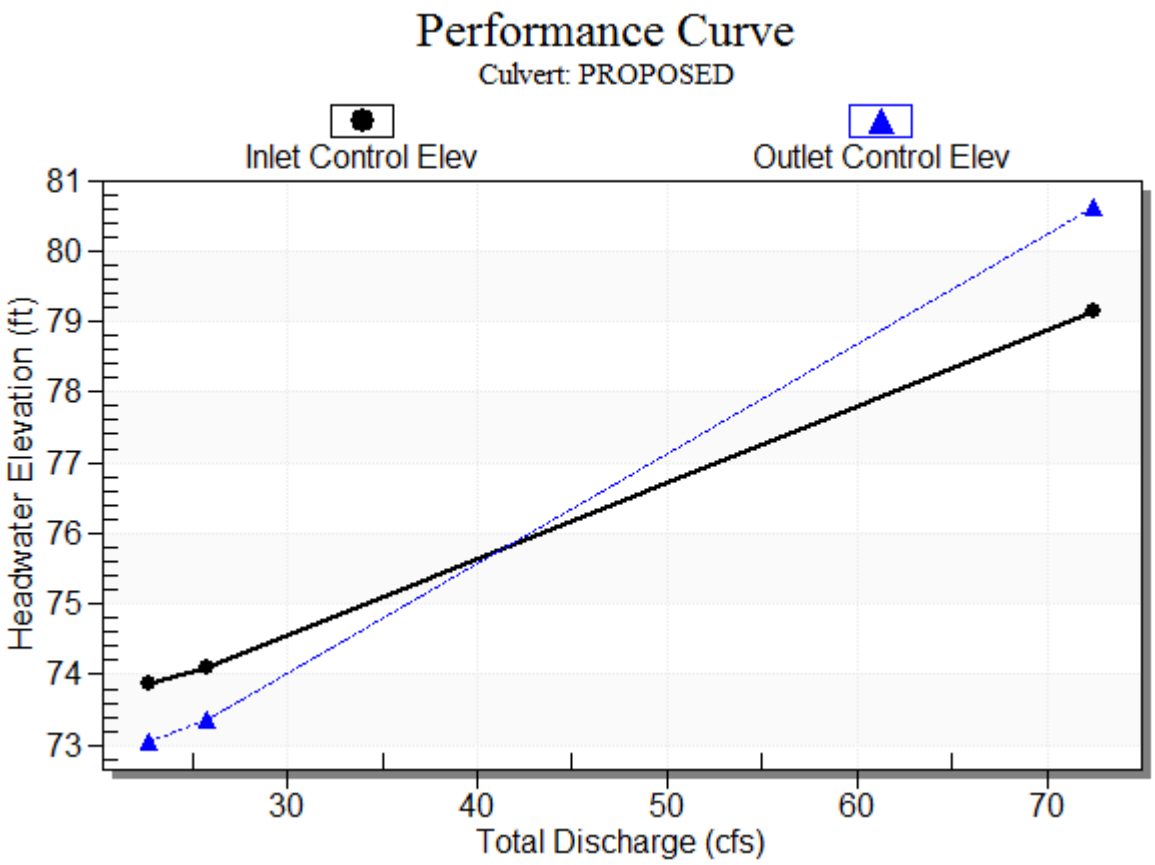
Straight Culvert

Inlet Elevation (invert): 71.50 ft, Outlet Elevation (invert): 70.70 ft

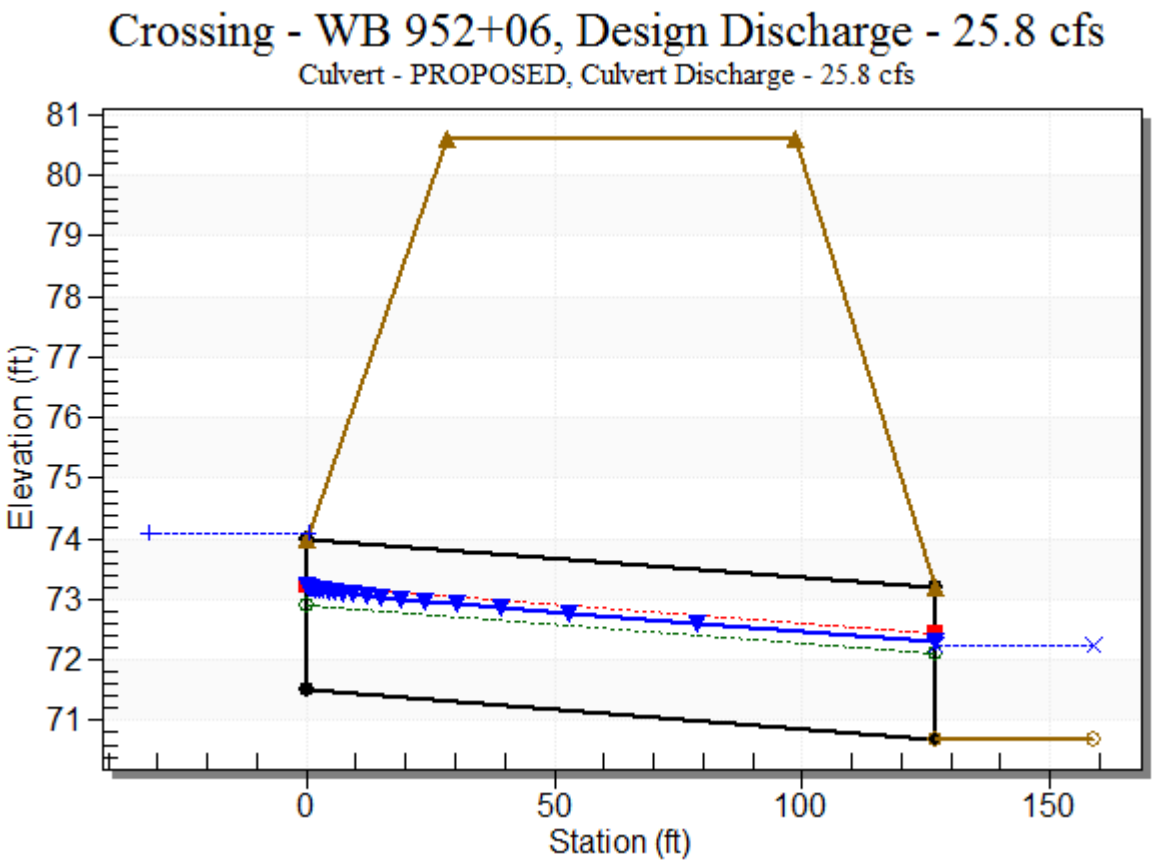
Culvert Length: 127.00 ft, Culvert Slope: 0.0063

****

Culvert Performance Curve Plot: PROPOSED



Water Surface Profile Plot for Culvert: PROPOSED



Site Data - PROPOSED

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 71.50 ft

Outlet Station: 127.00 ft

Outlet Elevation: 70.70 ft

Number of Barrels: 1

Culvert Data Summary - PROPOSED

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 (1.5:1)

Inlet Depression: NONE

Table 60 - Downstream Channel Rating Curve (Crossing: WB 952+06)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
22.71	72.23	1.53
25.76	72.23	1.53

Tailwater Channel Data - WB 952+06

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 72.23 ft

Roadway Data for Crossing: WB 952+06

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 4.00 ft

Crest Elevation: 80.62 ft

Roadway Surface: Paved

Roadway Top Width: 70.00 ft

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX G

ROAD DRAINAGE GEOPAK
HYDRAULIC CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

ROAD DRAINAGE GEOPAK HYDRAULIC CALCULATION SUMMARY

I-26 EB STA. 713+87 - STA. 717+08 (RT)

25644.0006

THOMAS & HUTTON

BERKELEY COUNTY I26
I26 RAODSIDE DRAIN (25-yr)

LINK DATA

Link - ID	US Node	DS Node	Shape	Material	# Barrels	Rise	Actual Length	Slope	Q (cfs)	Capacity	Uniform Depth	Uniform Velocity	US Soffit	US HGL	DS Soffit	DS HGL	US Invert	DS Invert	Actual Vel. US	Actual Vel DS	Actual Depth US	Actual Depth DS
NP-I1	CB-I3	CB-I1	Circular	Concrete	2.000	3.000	29.583	0.101	51.740	49.504	2.816	3.755	61.830	61.849	61.800	61.809	58.830	58.800	3.660	3.660	3.000	3.000
NP-I2	CB-I1	CB-I2	Circular	Concrete	2.000	3.000	288.520	0.111	51.740	51.771	2.816	3.755	61.800	61.809	61.480	61.379	58.800	58.480	3.660	3.698	3.000	2.899
NP-I3	CB-I2	CB-I4	Circular	Concrete	2.000	3.000	30.027	0.100	51.740	49.136	3.000	3.755	61.480	61.379	61.450	61.200	58.480	58.450	3.698	3.812	2.899	2.750

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BERKELEY COUNTY I26
I26 ROADSIDE DRAIN (25-yr)

LINK DATA for ROAD DESIGN

Link - ID	Link-Type	Type	Material	Shape	US Node	DS Node	Actual Length	Slope	Rise	Pay Item	US Invert	DS Invert
NP-I1	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-I3	CB-I1	29.583	0.101	3	7143636	58.83	58.8
NP-I2	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-I1	CB-I2	288.52	0.111	3	7143636	58.8	58.48
NP-I3	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-I2	CB-I4	30.027	0.1	3	7143636	58.48	58.45

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BERKELEY COUNTY I26
I26 RAODSIDE DRAIN (25-yr)

NODE DATA

Node - ID	Description	Node Type	Node Library Item Name	Node Reference PGL	Station	Offset	Reference Elevation	Node Elevation	Node Depth	Junction Loss	Tc Used	Cumulative Tc	Cumulative Discharge	Cumulative Area	Cumulative C Value	Cumulative Intensity
CB-I1		Junction	JUNCT BOX	EB	716+90.57	36.057	64.905	64.905	6.105	0.109	0.000	0.140	51.740	0.000	0.000	0.000
CB-I2		Junction	JUNCT BOX	EB	713+98.14	36.930	64.454	64.454	5.974	0.143	0.000	1.439	51.740	0.000	0.000	0.000
CB-I3		Headwall	36" BEV. END-CL 3	EB	717+08.46	59.026	58.830	58.830	0.000	0.000	0.000	0.000	51.740	0.000	0.000	0.000
CB-I4		Outlet	36" BEV. END-CL 3	EB	713+86.65	64.598	58.450	58.450	0.000	0.056	0.000	1.581	0.000	0.000	0.000	0.000

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BERKELEY COUNTY I26
I26 ROADSIDE DRAIN (25-yr)

NODE DATA for ROAD DESIGN

Node - ID	Node Library Item Name	Reference PGL	Station	Offset	Node Elevation	Node Depth	Pay Item
CB-I1	JUNCT BOX	EB	716+90.57	36.057	64.905	6.105	719228F
CB-I2	JUNCT BOX	EB	713+98.14	36.93	64.454	5.974	719228F
CB-I3	36" BEV. END-CL 3	EB	717+08.46	59.026	58.830	0.000	7142516
CB-I4	36" BEV. END-CL 3	EB	713+86.65	64.598	58.450	0.000	7142516

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HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

ROAD DRAINAGE GEOPAK HYDRAULIC CALCULATION SUMMARY

I-26 EB STA. 719+67 - STA. 722+57 (RT)

25644.0006

THOMAS & HUTTON

BERKELEY COUNTY I26
I26 RAODSIDE DRAIN (25-yr)

LINK DATA

Link - ID	US Node	DS Node	Shape	Material	# Barrels	Rise	Actual Length	Slope	Q (cfs)	Capacity	Uniform Depth	Uniform Velocity	US Soffit	US HGL	DS Soffit	DS HGL	US Invert	DS Invert	Actual Vel. US	Actual Vel DS	Actual Depth US	Actual Depth DS
NP-J1	CB-J2	CB-J1	Circular	Concrete	2.000	3.000	17.808	0.112	35.350	52.096	1.936	3.664	62.320	61.880	62.300	61.800	59.320	59.300	2.751	2.808	2.560	2.500
NP-J2	CB-J3	CB-J2	Circular	Concrete	2.000	3.000	249.214	0.132	35.350	56.568	1.760	4.100	62.650	62.083	62.320	61.880	59.650	59.320	2.879	2.751	2.433	2.560
NP-J3	CB-J4	CB-J3	Circular	Concrete	2.000	3.000	40.456	0.124	35.350	54.650	1.848	3.868	62.700	62.106	62.650	62.083	59.700	59.650	2.908	2.879	2.406	2.433

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BERKELEY COUNTY I26
I26 ROADSIDE DRAIN (25-yr)

LINK DATA for ROAD DESIGN

Link - ID	Link-Type	Type	Material	Shape	US Node	DS Node	Actual Length	Slope	Rise	Pay Item	US Invert	DS Invert
NP-J1	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-J2	CB-J1	17.808	0.112	3	7143636	59.32	59.3
NP-J2	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-J3	CB-J2	249.21	0.132	3	7143636	59.65	59.32
NP-J3	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-J4	CB-J3	40.456	0.124	3	7143636	59.7	59.65

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BERKELEY COUNTY I26
I26 RAODSIDE DRAIN (25-yr)

NODE DATA

Node - ID	Description	Node Type	Node Library Item Name	Node Reference PGL	Station	Offset	Reference Elevation	Node Elevation	Node Depth	Junction Loss	Tc Used	Cumulative Tc	Cumulative Discharge	Cumulative Area	Cumulative C Value	Cumulative Intensity
CB-J1		Outlet	36" BEV. END-CL 3	EB	719+66.64	51.151	59.300	59.300	0.000	0.000	0.000	1.302	0.000	0.000	0.000	0.000
CB-J2		Junction	JUNCT BOX	EB	719+78.92	36.984	64.903	64.903	5.583	0.069	0.000	1.212	35.350	0.000	0.000	0.000
CB-J3		Junction	JUNCT BOX	EB	722+31.93	36.819	65.096	65.096	5.446	0.070	0.000	0.183	35.350	0.000	0.000	0.000
CB-J4		Headwall	36" BEV. END-CL 3	EB	722+56.69	68.231	59.700	59.700	0.000	0.000	0.000	0.000	35.350	0.000	0.000	0.000

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BERKELEY COUNTY I26
I26 ROADSIDE DRAIN (25-yr)

NODE DATA for ROAD DESIGN

Node - ID	Node Library Item Name	Reference PGL	Station	Offset	Node Elevation	Node Depth	Pay Item
CB-J1	36" BEV. END-CL 3	EB	719+66.64	51.151	59.300	0.000	7142516
CB-J2	JUNCT BOX	EB	719+78.92	36.984	64.903	5.583	719228F
CB-J3	JUNCT BOX	EB	722+31.93	36.819	65.096	5.446	719228F
CB-J4	36" BEV. END-CL 3	EB	722+56.69	68.231	59.700	0.000	7142516

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HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

ROAD DRAINAGE GEOPAK HYDRAULIC CALCULATION SUMMARY

I-26 WB STA. 919+03+67 - STA. 921+51 (LT)

25644.0006

THOMAS & HUTTON

BERKELEY COUNTY I26
I26 RAODSIDE DRAIN (50-yr)

LINK DATA

Link - ID	US Node	DS Node	Shape	Material	# Barrels	Rise	Actual Length	Slope	Q (cfs)	Capacity	Uniform Depth	Uniform Velocity	US Soffit	US HGL	DS Soffit	DS HGL	US Invert	DS Invert	Actual Vel. US	Actual Vel DS	Actual Depth US	Actual Depth DS
NP-K1	CB-K1	CB-K2	Circular	Concrete	1.000	2.000	83.183	2.224	7.610	39.315	0.620	9.181	63.690	63.133	61.840	60.471	61.690	59.840	3.136	8.956	1.443	0.631
NP-K2	CB-K2	CB-K3	Circular	Concrete	1.000	3.000	384.679	0.182	31.030	33.157	2.464	4.995	62.200	61.914	61.500	60.837	59.200	58.500	4.614	5.252	2.714	2.337
NP-K3	CB-K3	CB-K4	Circular	Concrete	1.000	3.000	69.578	0.158	31.030	30.905	2.816	4.504	61.500	60.837	61.390	60.196	58.500	58.390	5.252	6.979	2.337	1.806
NP-K6	CB-K6	CB-K2	Circular	Concrete	1.000	2.500	204.975	0.390	16.740	29.862	1.393	5.953	63.100	62.235	62.300	61.914	60.600	59.800	4.921	3.782	1.635	2.114
NP-K7	CB-K7	CB-K6	Circular	Concrete	1.000	2.500	44.584	0.224	16.740	22.638	1.687	4.751	63.270	62.847	63.170	62.235	60.770	60.670	3.840	5.176	2.077	1.565
NP-k5	CB-K5	CB-K2	Circular	Concrete	1.000	2.000	22.020	0.454	6.680	17.766	0.880	5.017	62.050	61.927	61.950	61.914	60.050	59.950	2.182	2.135	1.877	1.964

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BERKELEY COUNTY I26
I26 ROADSIDE DRAIN (50-yr)

LINK DATA for ROAD DESIGN

Link - ID	Link-Type	Type	Material	Shape	US Node	DS Node	Actual Length	Slope	Rise	Pay Item	US Invert	DS Invert
NP-K1	24" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-K1	CB-K2	83.183	2.224	2	7143624	61.69	59.84
NP-K2	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-K2	CB-K3	384.68	0.182	3	7143636	59.2	58.5
NP-K3	36" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-K3	CB-K4	69.578	0.158	3	7143636	58.5	58.39
NP-K6	30" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-K6	CB-K2	204.98	0.39	2.5	7143630	60.6	59.8
NP-K7	30" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-K7	CB-K6	44.584	0.224	2.5	7143630	60.77	60.67
NP-k5	24" SMOOTH WALL PIPE	Pipe	Concrete	Circular	CB-K5	CB-K2	22.02	0.454	2	7143624	60.05	59.95

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BERKELEY COUNTY I26
I26 RAODSIDE DRAIN (50-yr)

NODE DATA

Node - ID	Description	Node Type	Node Library Item Name	Node Reference PGL	Station	Offset	Reference Elevation	Node Elevation	Node Depth	Junction Loss	Tc Used	Cumulative Tc	Cumulative Discharge	Cumulative Area	Cumulative C Value	Cumulative Intensity
CB-K1		Headwall	24" BEV. END-CL 3	WB	919+02.53	51.278	61.690	61.690	0.000	0.000	0.000	0.000	7.610	0.000	0.000	0.000
CB-K2		Junction	JUNCT BOX	WB	919+03.67	-31.476	70.221	70.221	11.021	0.290	0.000	0.756	31.030	0.000	0.000	0.000
CB-K3		Junction	JUNCT BOX	WB	915+16.78	-29.464	66.754	66.754	8.254	0.193	0.000	2.053	31.030	0.000	0.000	0.000
CB-K4		Outlet	36" BEV. END-CL 3	WB	914+59.30	-70.981	58.390	58.390	0.000	0.000	0.000	2.317	0.000	0.000	0.000	0.000
CB-K5		Other	24" BEV. END-CL 3	WB	919+05.06	-56.237	60.050	60.050	0.000	0.000	0.000	0.000	6.680	0.000	0.000	0.000
CB-K6		Junction	JUNCT BOX	WB	921+10.07	-31.444	65.860	65.860	5.260	0.152	0.000	0.170	16.740	0.000	0.000	0.000
CB-K7		Other	30" BEV. END-CL 3	WB	921+51.28	-54.511	60.770	60.770	0.000	0.000	0.000	0.000	16.740	0.000	0.000	0.000

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BERKELEY COUNTY I26
I26 ROADSIDE DRAIN (50-yr)

NODE DATA for ROAD DESIGN

Node - ID	Node Library Item Name	Reference PGL	Station	Offset	Node Elevation	Node Depth	Pay Item
CB-K1	24" BEV. END-CL 3	WB	919+02.53	51.278	61.690	0.000	7142514
CB-K2	JUNCT BOX	WB	919+03.67	-31.476	70.221	11.021	7192240
CB-K3	JUNCT BOX	WB	915+16.78	-29.464	66.754	8.254	7192240
CB-K4	36" BEV. END-CL 3	WB	914+59.30	-70.981	58.390	0.000	7142516
CB-K5	24" BEV. END-CL 3	WB	919+05.06	-56.237	60.050	0.000	7142514
CB-K6	JUNCT BOX	WB	921+10.07	-31.444	65.860	5.260	7192225
CB-K7	30" BEV. END-CL 3	WB	921+51.28	-54.511	60.770	0.000	7142515

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HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX H

DITCH HYDRAULIC CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

TYPE	LOCATION	SIDE	STA.NO	25-yr Q (cfs)	Chanel Width (ft)	Longitudinal Slope	Manning's Roughness	Flow Depth (ft)
DITCHES	RAMP 1	LT	110+00	50.11	8	0.0012	0.028	1.891
DITCHES	RAMP 1	LT	143+30	62.07	8	0.0017	0.028	1.931
DITCHES	RAMP 1	RT	161+50	15.76	8	0.001	0.028	1.048
DITCHES	RAMP 2	RT	219+00	52.43	8	0.0007	0.028	2.236
DITCHES	RAMP3	RT	312+18	63.19	8	0.001	0.028	2.246
DITCHES	RAMP3	RT	318+38	34.73	8	0.001	0.028	1.629
DITCHES	RAMP4	RT	403+04	5.77	8	0.001	0.028	0.588
DITCHES	RAMP 1	RT	443+00	18.90	8	0.0015	0.028	1.001
DITCHES	EB	RT	667+00	91.70	8	0.0011	0.028	2.458
DITCHES	EB	RT	716+86	51.74	8	0.001	0.028	1.896
DITCHES	EB	XS	722+54	6.02	8	0.001	0.028	1.557
DITCHES	EB	RT	771+50	20.52	8	0.001	0.028	1.167
DITCHES	WB	LT	886+00	51.04	8	0.0007	0.028	2.062
DITCHES	WB	LT	971+50	79.87	8	0.001	0.028	2.360

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, May 04, 2016

Project Units: U.S. Customary Units

Notes:

Channel Analysis: EB RT 667+00

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0011 ft/ft

Manning's n: 0.0280

Flow: 91.7000 cfs

Result Parameters

Depth: 2.4679 ft

Area of Flow: 38.0143 ft^2

Wetted Perimeter: 23.6937 ft

Hydraulic Radius: 1.6044 ft

Average Velocity: 2.4122 ft/s

Top Width: 22.8073 ft

Froude Number: 0.3293

Critical Depth: 1.3410 ft

Critical Velocity: 5.6873 ft/s

Critical Slope: 0.0119 ft/ft

Critical Top Width: 16.05 ft

Calculated Max Shear Stress: 0.1694 lb/ft^2

Calculated Avg Shear Stress: 0.1101 lb/ft^2

Channel Analysis: EB 716+86 RT

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 51.7400 cfs

Result Parameters

Depth: 1.8961 ft

Area of Flow: 25.9551 ft^2

Wetted Perimeter: 20.0579 ft

Hydraulic Radius: 1.2940 ft

Average Velocity: 1.9934 ft/s

Top Width: 19.3768 ft

Froude Number: 0.3035

Critical Depth: 0.9612 ft

Critical Velocity: 4.9456 ft/s

Critical Slope: 0.0129 ft/ft

Critical Top Width: 13.77 ft

Calculated Max Shear Stress: 0.1183 lb/ft^2

Calculated Avg Shear Stress: 0.0807 lb/ft^2

Channel Analysis: RAMP 2 RT 219+00

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0007 ft/ft

Manning's n: 0.0280

Flow: 52.4300 cfs

Result Parameters

Depth: 2.2361 ft

Area of Flow: 27.8890 ft^2

Wetted Perimeter: 18.0001 ft

Hydraulic Radius: 1.5494 ft

Average Velocity: 1.8800 ft/s

Top Width: 16.9444 ft

Froude Number: 0.2582

Critical Depth: 1.0077 ft

Critical Velocity: 5.1949 ft/s

Critical Slope: 0.0128 ft/ft

Critical Top Width: 12.03 ft

Calculated Max Shear Stress: 0.0977 lb/ft^2

Calculated Avg Shear Stress: 0.0677 lb/ft^2

Channel Analysis: RAMP 1 LT 143+30

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0017 ft/ft

Manning's n: 0.0280

Flow: 62.0700 cfs

Result Parameters

Depth: 1.9314 ft

Area of Flow: 22.9123 ft^2

Wetted Perimeter: 16.6376 ft

Hydraulic Radius: 1.3771 ft

Average Velocity: 2.7090 ft/s

Top Width: 15.7257 ft

Froude Number: 0.3955

Critical Depth: 1.1167 ft

Critical Velocity: 5.4316 ft/s

Critical Slope: 0.0124 ft/ft

Critical Top Width: 12.47 ft

Calculated Max Shear Stress: 0.2049 lb/ft^2

Calculated Avg Shear Stress: 0.1461 lb/ft^2

Channel Analysis: WB LT 886+00

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0007 ft/ft

Manning's n: 0.0280

Flow: 51.0400 cfs

Result Parameters

Depth: 2.0621 ft

Area of Flow: 29.2541 ft^2

Wetted Perimeter: 21.1134 ft

Hydraulic Radius: 1.3856 ft

Average Velocity: 1.7447 ft/s

Top Width: 20.3728 ft

Froude Number: 0.2566

Critical Depth: 0.9535 ft

Critical Velocity: 4.9285 ft/s

Critical Slope: 0.0130 ft/ft

Critical Top Width: 13.72 ft

Calculated Max Shear Stress: 0.0901 lb/ft^2

Calculated Avg Shear Stress: 0.0605 lb/ft^2

Channel Analysis: RAMP3 LT 318+38

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 34.7300 cfs

Result Parameters

Depth: 1.6286 ft

Area of Flow: 18.3341 ft^2

Wetted Perimeter: 15.2835 ft

Hydraulic Radius: 1.1996 ft

Average Velocity: 1.8943 ft/s

Top Width: 14.5146 ft

Froude Number: 0.2970

Critical Depth: 0.7813 ft

Critical Velocity: 4.6487 ft/s

Critical Slope: 0.0136 ft/ft

Critical Top Width: 11.13 ft

Calculated Max Shear Stress: 0.1016 lb/ft^2

Calculated Avg Shear Stress: 0.0749 lb/ft^2

Channel Analysis: RAMP 3 RT 312+00

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 63.1900 cfs

Result Parameters

Depth: 2.2461 ft

Area of Flow: 28.0584 ft^2

Wetted Perimeter: 18.0448 ft

Hydraulic Radius: 1.5549 ft

Average Velocity: 2.2521 ft/s

Top Width: 16.9843 ft

Froude Number: 0.3088

Critical Depth: 1.1290 ft

Critical Velocity: 5.4565 ft/s

Critical Slope: 0.0124 ft/ft

Critical Top Width: 12.52 ft

Calculated Max Shear Stress: 0.1402 lb/ft^2

Calculated Avg Shear Stress: 0.0970 lb/ft^2

Channel Analysis: RAMP 4 RT 403+04

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 5.7700 cfs

Result Parameters

Depth: 0.5882 ft

Area of Flow: 5.3977 ft^2

Wetted Perimeter: 10.6306 ft

Hydraulic Radius: 0.5078 ft

Average Velocity: 1.0690 ft/s

Top Width: 10.3528 ft

Froude Number: 0.2609

Critical Depth: 0.2477 ft

Critical Velocity: 2.7425 ft/s

Critical Slope: 0.0188 ft/ft

Critical Top Width: 8.99 ft

Calculated Max Shear Stress: 0.0367 lb/ft^2

Calculated Avg Shear Stress: 0.0317 lb/ft^2

Channel Analysis: EB 771+50 RT

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 20.5200 cfs

Result Parameters

Depth: 1.1665 ft

Area of Flow: 13.4144 ft^2

Wetted Perimeter: 15.4181 ft

Hydraulic Radius: 0.8700 ft

Average Velocity: 1.5297 ft/s

Top Width: 14.9991 ft

Froude Number: 0.2851

Critical Depth: 0.5483 ft

Critical Velocity: 3.8803 ft/s

Critical Slope: 0.0150 ft/ft

Critical Top Width: 11.29 ft

Calculated Max Shear Stress: 0.0728 lb/ft^2

Calculated Avg Shear Stress: 0.0543 lb/ft^2

Channel Analysis: RAMP 1 RT 161+50

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 15.7300 cfs

Result Parameters

Depth: 1.0480 ft

Area of Flow: 10.5803 ft^2

Wetted Perimeter: 12.6867 ft

Hydraulic Radius: 0.8340 ft

Average Velocity: 1.4867 ft/s

Top Width: 12.1919 ft

Froude Number: 0.2812

Critical Depth: 0.4738 ft

Critical Velocity: 3.7107 ft/s

Critical Slope: 0.0156 ft/ft

Critical Top Width: 9.90 ft

Calculated Max Shear Stress: 0.0654 lb/ft^2

Calculated Avg Shear Stress: 0.0520 lb/ft^2

Channel Analysis: WB 971+50 LT

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 79.8700 cfs

Result Parameters

Depth: 2.3600 ft

Area of Flow: 35.5878 ft^2

Wetted Perimeter: 23.0074 ft

Hydraulic Radius: 1.5468 ft

Average Velocity: 2.2443 ft/s

Top Width: 22.1597 ft

Froude Number: 0.3121

Critical Depth: 1.2389 ft

Critical Velocity: 5.5023 ft/s

Critical Slope: 0.0121 ft/ft

Critical Top Width: 15.43 ft

Calculated Max Shear Stress: 0.1473 lb/ft^2

Calculated Avg Shear Stress: 0.0965 lb/ft^2

Channel Analysis: RAMP 1 LT 110+00

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0012 ft/ft

Manning's n: 0.0280

Flow: 50.1100 cfs

Result Parameters

Depth: 1.8909 ft

Area of Flow: 22.2775 ft^2

Wetted Perimeter: 16.4561 ft

Hydraulic Radius: 1.3537 ft

Average Velocity: 2.2494 ft/s

Top Width: 15.5634 ft

Froude Number: 0.3313

Critical Depth: 0.9800 ft

Critical Velocity: 5.1335 ft/s

Critical Slope: 0.0128 ft/ft

Critical Top Width: 11.92 ft

Calculated Max Shear Stress: 0.1416 lb/ft^2

Calculated Avg Shear Stress: 0.1014 lb/ft^2

Channel Analysis: RAMP 4 RT 443+00

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0015 ft/ft

Manning's n: 0.0280

Flow: 18.9900 cfs

Result Parameters

Depth: 1.0015 ft

Area of Flow: 11.0208 ft^2

Wetted Perimeter: 14.3686 ft

Hydraulic Radius: 0.7670 ft

Average Velocity: 1.7231 ft/s

Top Width: 14.0089 ft

Froude Number: 0.3424

Critical Depth: 0.5224 ft

Critical Velocity: 3.7997 ft/s

Critical Slope: 0.0153 ft/ft

Critical Top Width: 11.13 ft

Calculated Max Shear Stress: 0.0937 lb/ft^2

Calculated Avg Shear Stress: 0.0718 lb/ft^2

Channel Analysis: EB 722+45 RT

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0280

Flow: 35.3500 cfs

Result Parameters

Depth: 1.5573 ft

Area of Flow: 19.7344 ft^2

Wetted Perimeter: 17.9033 ft

Hydraulic Radius: 1.1023 ft

Average Velocity: 1.7913 ft/s

Top Width: 17.3440 ft

Froude Number: 0.2959

Critical Depth: 0.7651 ft

Critical Velocity: 4.4875 ft/s

Critical Slope: 0.0138 ft/ft

Critical Top Width: 12.59 ft

Calculated Max Shear Stress: 0.0972 lb/ft^2

Calculated Avg Shear Stress: 0.0688 lb/ft^2

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX I

HYDRAULIC DATA SHEETS

J – 25644.0006

Prepared by:

THOMAS & HUTTON

HYDROLOGIC AND HYDRAULIC BASIS OF DESIGN

I-26/CENTERLINE ROAD INTERSECTION
EXIT 189 FOR PROJECT SOTER

HYDRAULIC DATA SHEET

CULVERTS

25644.0006

THOMAS & HUTTON

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 1

Const. Pin: n/a

Culvert Dimensions: Span: 3.5 ft. Rise: 3.5 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 90 ft.

No. of Barrels: 1 Material Type: Concrete

Centerline Station: 110+00 Skew Angle: 90 °

Inlet Invert Elev: 56.05 ft. Outlet Invert Elev.: 55.80 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 59.92 ft.

For all roads provide 100-yr high water elevation: 60.53 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 100.03 sq. mi. (or acres)

Q_{Design} = 61.73 cfs

$Vel._{Design}$ = 7.48 ft. / sec.

Design Headwater Elevation = 59.92 ft.

Q_{100} = 60.53 cfs

Vel_{100} = 9.05 ft. / sec.

100 Year Headwater Elev. = 60.53 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 2

Const. Pin: n/a

Culvert Dimensions: Span: 2.0 ft. Rise: 2.0 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 132 ft.

No. of Barrels: 1 Material Type: Concrete

Centerline Station: 216+00 Skew Angle: 90 °

Inlet Invert Elev: 60.80 ft. Outlet Invert Elev.: 59.40 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 63.11 ft.

For all roads provide 100-yr high water elevation: 63.35 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 6.93 sq. mi. (or acres)

Q_{Design} = 17.24 cfs

$Vel._{Design}$ = 5.49 ft. / sec.

Design Headwater Elevation = 63.11 ft.

Q_{100} = 19.56 cfs

Vel_{100} = 6.23 ft. / sec.

100 Year Headwater Elev. = 63.35 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 2

Const. Pin: n/a

Culvert Dimensions: Span: 3 ft. Rise: 3 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 268 ft.

No. of Barrels: 2 Material Type: Concrete

Centerline Station: 219+00 Skew Angle: 90 °

Inlet Invert Elev: 59.00 ft. Outlet Invert Elev.: 58.80 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 62.32 ft.

For all roads provide 100-yr high water elevation: 62.58 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 88.08 sq. mi. (or acres)

Q_{Design} = 61.74 cfs

$Vel._{Design}$ = 4.61 ft. / sec.

Design Headwater Elevation = 62.32 ft.

Q_{100} = 69.96 cfs

Vel_{100} = 5.22 ft. / sec.

100 Year Headwater Elev. = 62.58 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 3

Const. Pin: n/a

Culvert Dimensions: Span: 3.0 ft. Rise: 3.0 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 153 ft.

No. of Barrels: 1 Material Type: Concrete

Centerline Station: 312+18 Skew Angle: 33 °

Inlet Invert Elev: 58.50 ft. Outlet Invert Elev.: 58.40 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 61.85 ft.

For all roads provide 100-yr high water elevation: 62.13 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 96.43 sq. mi. (or acres)

Q_{Design} = 74.42 cfs

$Vel._{Design}$ = 6.14 ft. / sec.

Design Headwater Elevation = 61.85 ft.

Q_{100} = 84.33 cfs

Vel_{100} = 6.96 ft. / sec.

100 Year Headwater Elev. = 62.13 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 3

Const. Pin: n/a

Culvert Dimensions: Span: 3 ft. Rise: 3 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 94 ft.

No. of Barrels: 1 Material Type: Concrete

Centerline Station: 318+50 Skew Angle: 90 °

Inlet Invert Elev: 58.20 ft. Outlet Invert Elev.: 58.00 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 61.52 ft.

For all roads provide 100-yr high water elevation: 61.81 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 10.64 sq. mi. (or acres)

Q_{Design} = 41.27 cfs

$Vel._{Design}$ = 7.10 ft. / sec.

Design Headwater Elevation = 61.52 ft.

Q_{100} = 46.52 cfs

Vel_{100} = 8.00 ft. / sec.

100 Year Headwater Elev. = 61.81 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 4

Const. Pin: n/a

Culvert Dimensions: Span: 3 ft. Rise: 3 ft.

Extension: Right: ft. Left: ft.

Estimated Length: 137 ft.

No. of Barrels: 1 Material Type: Concrete

Centerline Station: 421+50 Skew Angle: 48 °

Inlet Invert Elev: 58.60 ft. Outlet Invert Elev.: 58.50 ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 61.85 ft.

For all roads provide 100-yr high water elevation: 62.12 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 98.38 sq. mi. (or acres)

Q_{Design} = 73.09 cfs

$Vel._{Design}$ = 6.28 ft. / sec.

Design Headwater Elevation = 61.98 ft.

Q_{100} = 82.82 cfs

Vel_{100} = 7.12 ft. / sec.

100 Year Headwater Elev. = 62.12 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

1.5.6 Hydrology Data Sheet for Culverts (< 20' Opening)

MEMORANDUM TO: **Submittal Date:** 05/16/2016

Supersedes Submittal Date:

RPG ROAD DESIGN TEAM LEADER:

RPG STRUCTURAL ENGINEER:

From: Hydraulic Design Squad / Engineer — Richard P. Karkowski, PE

Subject: Hydrology Data for Culvert over — Interstate 26 roadside drainage

County: BERKELEY **Rd/Rte:** Exit 189 Ramp 4

Const. Pin: n/a

Culvert Dimensions:	Span:	2.5 ft.	Rise:	2.5	ft.
Extension:	Right:	ft.	Left:		ft.
Estimated Length:	86 ft.				
No. of Barrels:	1		Material Type:	Concrete	
Centerline Station:	443+00		Skew Angle:	90	°
Inlet Invert Elev:	61.20 ft.		Outlet Invert Elev.:	61.00	ft.

Riprap Required (In Addition to Typical): Yes ☐ No ☑

Comments:

Historic High Water Information: (Show highwater on plans)

Elevation of High Water: n/a ft. Discharge: (if available) n/a ft.

Date of occurrence: / / Source of data: n/a

Page 1 of 2

Design High Water Information: (Show high water elevations on plans)

If 'Secondary Road' provide 25-yr high water elevation: _____ ft.

If 'Primary Road' provide 50-yr high water elevation: 63.68 ft.

For all roads provide 100-yr high water elevation: 63.87 ft.

Hydrology Data for Tidal Culverts: (Only complete this sections if the culvert is tidally influenced) (show on plans)

Mean Higher high tide elevation = _____ ft.

Mean Lower low tide elevation = _____ ft.

10-year tidal surge height = _____ ft. (includes wave height)

100-year stillwater height = _____ ft.

500-year stillwater height = _____ ft.

Maximum vel. within culvert = 100-yr. tidal surge velocity: _____ fps 500-yr. tidal surge velocity: _____ fps

Hydrology Data for Riverine Culverts: (Only complete this sections if the culvert is NOT tidally influenced) (show on plans)

D.A. = 43.36 sq. mi. (or acres)

Q_{Design} = 22.28 cfs

$Vel._{Design}$ = 6.70 ft. / sec.

Design Headwater Elevation = 63.68 ft.

Q_{100} = 24.91 cfs

Vel_{100} = 7.03 ft. / sec.

100 Year Headwater Elev. = 63.87 ft.

cc: Environmental Engineer _____

Note: Probability may be determined by plotting the 2-, 10-, 25-, 50-, 100-, and 500-year discharges on Gumble paper and reading the probability corresponding to the overtopping discharge. For discharges greater than 500-year, the probability should be stated as less than (<) 0.002. A plot of the 100- and 500-year scour lines on a bridge plan and profile sheet must be provided.
Revised 3/16/09

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

APPENDIX J

OFFSITE PEAK DISCHARGE
ANALYSIS DATA

J – 25644.0006

Prepared by:

THOMAS & HUTTON

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

CN CALCULATIONS

J – 25644.0006

Prepared by:

THOMAS P. HUTTON

Existing Conditions Curve Number Calculations

Basin	Area (acres)																			Grand Total
	Brush				Impervious				Open				Row Crops			Woods				Gravel Road	
	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	C	C/D	A/D	B/D	C	C/D	C/D	
CLLT																			1.181474572	0.065723804	1.25
CLRT																			26.8556512	0.775945847	27.63
EB1							0.65963095	6.605302574			2.919479364	25.06401053		34.14846969	6.618282507			44.5147186	381.1422043		501.67
EB2					0.113501526	0.073750999	0.391295087	0.329189923	0.415214786	0.261582995	0.923412558	1.24304765							0.00809065		3.76
MED					0.169769297	0.119209347	0.223249833	0.632217776	0.452475572	0.326553049	0.905784747	1.45726498									4.29
WB1	5.42062E-05	0.637038974	2.168979868	1.435654867	0.146331374	0.062196003	1.507808545	4.067214472	0.384465134	0.243425235	4.533716522	16.25126603							12.73105998	0.422913774	44.59
WB2a												1.078002424							15.28871666	1.014605917	17.38
WB2b	0.286204338	1.068203536	1.874234173	0.424970438															49.28075719	1.26522855	54.20
X1	0.538969702		0.535642913	0.077933088	0.082416794		0.102029434	0.059024008	0.345136564		0.486850273	0.23642825									2.46
X2					0.080782256		0.107217504		0.293618224		0.810430808		0.366315496	0.640510735	0.590917062	0.03098163		0.048990128			2.97
Grand Total	0.828470166	1.70524251	7.287099775	19.71095249	0.722438945	0.353078723	2.991231353	12.26045054	2.546851551	1.357809493	10.57967427	48.01612517	0.366315496	38.45774338	7.209199569	1.810464174	0.741791674	56.32393771	515.283749	3.544417893	732.10

Basin	Area x CN																			Composite CN
	Brush				Impervious				Open				Row Crops			Woods				Gravel Road	
	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	C	C/D	A/D	B/D	C	C/D	C/D	
	77	77	70	77	**98**	**98**	**98**	**98**	80	80	74	80	**89**	**85**	**89**	79	79	73	79	91	
CLLT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93.3364912	5.980866173	79.6
CLRT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2121.596445	70.61107207	79.3
EB1	0	0	0	0	0	0	64.64383307	647.3196522	0	0	216.0414729	2005.120843	0	2902.619923	589.0271431	0	0	3249.574458	30110.23414	0	79.3
EB2	0	0	0	0	11.12314957	7.227597882	38.34691855	32.26061246	33.21718291	20.92663963	68.33252926	99.44381198	0	0	0	0	0	0	0.639161358	0	82.9
MED	0	0	0	0	16.63739109	11.68251596	21.87848359	61.95734209	36.19804575	26.12424394	67.02807131	116.5811984	0	0	0	0	0	0	0	0	83.5
WB1	0.004173881	49.052001	151.8285908	110.5454248	14.34047463	6.095208309	147.7652374	398.5870182	30.75721068	19.47401878	335.4950226	1300.101283	0	0	0	0	0	0	1005.753739	38.48515347	80.9
WB2a	0	0	0	0	0	0	0	0	0	0	0	86.2401939	0	0	0	0	0	0	1207.808616	92.32913847	79.8
WB2b	22.03773404	82.25167227	131.1963921	32.72272372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3893.179818	115.135798	78.9
WB3	0.249627771	0	189.5769975	1368.474346	12.70449436	9.596392734	0	55.61517472	52.47530171	42.0998571	0	214.8884242	0	311.8448516	0	140.579121	58.60154228	858.4967157	2274.867764	0	77.8

Post-Development Curve Number Calculations

Basin	Area (acres)																			Grand Total
	Brush				Impervious				Open				Row Crops			Woods				
	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	C	C/D	A/D	B/D	C	C/D	
CLLT								0.534976922				0.711200608							0.0010241	1.25
CLRT								0.704723068				1.66109686							24.93475083	27.30
EB1a								2.312287802				17.83187183		21.95329774	6.618282507			23.35799461	329.062707	401.14
EB1b								4.23370976				15.54982002								19.78
EB1c								0.735667109				12.95840471		2.475541023				2.349736093	6.488994165	25.01
EB1d							2.67532E-05	3.037487628				8.817372586								11.85
EB1e							1.383447574	0.051015623			2.195651002	2.231918183		9.719630926				18.8069879	8.969021594	43.36
EB2					0.172027987	0.109782707	0.597004877	0.465937991	0.356688326	0.225551287	0.717702025	1.106299582							0.00809065	3.76
MED					0.175930423	0.124086641	0.237852146	0.645880524	0.446314446	0.321675755	0.891182435	1.443374642								4.29
WB1a								4.353301289				11.05028491							0.05115426	15.45
WB1b								2.646868544				7.87312102								10.52
WB1c								0.197188405				0.74302822								0.94
WB1d								2.090123272				5.319140916								7.41
WB1e	0.286250449	1.705241948	4.043155742	1.860623304	0.05387224	0.11409633	1.857165676	3.386555619	0.063518676	0.191524907	3.57294395	13.00978864							51.41332891	81.56
WB3	0.003241919		2.708242821	17.77239434	0.203942488	0.151267156		0.835563629	0.58163648	0.472903433		2.418043455		3.668762963		1.779482544	0.741791675	11.76070521	28.79579448	71.89
Grand Total	0.828466307	1.705241948	7.287041516	19.711089	1.005220756	0.499232834	4.604702605	26.36005503	2.26406974	1.211655382	8.966245361	103.0127562	0.366315496	38.45775189	7.209198813	1.810464174	0.741791675	56.32441725	449.724866	732.09

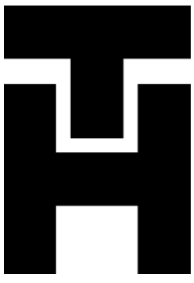
Basin	Area x CN																			Composite CN
	Brush				Impervious				Open				Row Crops			Woods				
	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	B/D	C	C/D	A/D	C	C/D	A/D	B/D	C	C/D	
	77	77	70	77	98	98	98	98	80	80	74	80	89	85	89	79	79	73	79	
CLLT	0	0	0	0	0	0	0	52.42773832	0	0	0	56.89604861	0	0	0	0	0	0	0.080903868	87.7
CLRT	0	0	0	0	0	0	0	69.06286065	0	0	0	132.8877488	0	0	0	0	0	0	1969.845316	79.6
EB1a	0	0	0	0	0	0	0	226.6042046	0	0	0	1426.549746	0	1866.030308	589.0271431	0	0	1705.133606	25995.95385	79.3
EB1b	0	0	0	0	0	0	0	414.9035564	0	0	0	1243.985602	0	0	0	0	0	0	0	83.9
EB1c	0	0	0	0	0	0	0	72.09537673	0	0	0	1036.672377	0	210.420987	0	0	0	171.5307348	512.630539	80.1
EB1d	0	0	0	0	0	0	0.002621816	297.6737876	0	0	0	705.3898069	0	0	0	0	0	0	0	84.6
EB1e	0	0	0	0	0	0	135.5778623	4.999531082	0	0	162.4781741	178.5534547	0	826.1686287	0	0	0	1372.910117	708.5527059	78.2
EB2	0	0	0	0	16.85874271	10.75870532	58.50647792	45.66192311	28.53506606	18.04410296	53.10994984	88.50396659	0	0	0	0	0	0	0.639161356	85.3
MED	0	0	0	0	17.24118147	12.16049084	23.30951026	63.29629138	35.70515566	25.73406038	65.94750017	115.4699714	0	0	0	0	0	0	0	83.7
WB1a	0	0	0	0	0	0	0	426.6235263	0	0	0	884.0227932	0	0	0	0	0	0	4.041186503	85.1
WB1b	0	0	0	0	0	0	0	259.3931174	0	0	0	629.8496816	0	0	0	0	0	0	0	84.5
WB1c	0	0	0	0	0	0	0	19.32446368	0	0	0	59.44225756	0	0	0	0	0	0	0	83.8
WB1d	0	0	0	0	0	0	0	204.8320807	0	0	0	425.5312733	0	0	0	0	0	0	0	85.1
WB1e	22.04128455	131.30363	283.0209019	143.2679944	5.279479507	11.18144036	182.0022363	331.8824507	5.081494065	15.3219926	264.3978523	1040.783091	0	0	0	0	0	0	4061.652984	79.7
WB3	0.24962777	0	189.5769975	1368.474364	19.98636386	14.82418125	0	81.8852356	46.53091843	37.83227463	0	193.4434764	0	311.8448518	0	140.579121	58.60154229	858.5314804	2274.867764	77.9

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

TC CALCULATIONS

J – 25644.0006

Prepared by:



THOMAS & HUTTON

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN EB1 — **DRAINAGE BASIN EB1**

Calculate Pre-Development "Tc" and Composite "CN" — **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 100 ft
P2 = 4.00 in
S = 0.0030 ft/ft
t_1 = 13.5 min

Shallow Concentrated Flow:

t=1/60v
where
l = 2394 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 45.1 min

Pipe & Channel Flow: t=1/60v
l= 6957 ft
v= 2.00 ft/s
t= 58.0 min

Basin EB1: Tc = 117.0 min

DRAINAGE BASIN EB2 — **DRAINAGE BASIN EB2**

Calculate Pre-Development "Tc" and Composite "CN" — **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 44 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 10.0 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1755 ft
v= 2.00 ft/s
t= 14.6 min

Basin EB2: Tc = 25.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN WB1

DRAINAGE BASIN WB1

Calculate Pre-Development "Tc" and Composite "CN" **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 65 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 4.5 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 6724 ft
v= 2.00 ft/s
t= 56.0 min

Basin WB1: Tc = 61.0 min

DRAINAGE BASIN WB2a

DRAINAGE BASIN WB2a

Calculate Pre-Development "Tc" and Composite "CN" **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 26 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 2.2 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 3315 ft
v= 2.00 ft/s
t= 27.6 min

Basin WB2a: Tc = 30.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

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Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN WB2b — **DRAINAGE BASIN WB2b**

Calculate Pre-Development "Tc" and Composite "CN" — **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0080 ft/ft
t_1 = 27.7 min

Shallow Concentrated Flow:

t=1/60v
where
l = 1782 ft
Paved ? No
Slope, S = 0.0080 ft/ft
v = 1.44 ft/s
t_2 = 20.6 min

Pipe & Channel Flow: t=1/60v
l= 1351 ft
v= 2.00 ft/s
t= 11.3 min

Basin WB2b: Tc = 60.0 min

DRAINAGE BASIN WB3 — **DRAINAGE BASIN WB3**

Calculate Pre-Development "Tc" and Composite "CN" — **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0100 ft/ft
t_1 = 25.3 min

Shallow Concentrated Flow:

t=1/60v
where
l = 967 ft
Paved ? No
Slope, S = 0.0100 ft/ft
v = 1.61 ft/s
t_2 = 10.0 min

Pipe & Channel Flow: t=1/60v
l= 3224 ft
v= 2.00 ft/s
t= 26.9 min

Basin WB3: Tc = 62.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

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Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN MED — **DRAINAGE BASIN MED**

Calculate Pre-Development "Tc" and Composite "CN" — **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 40 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 3.0 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1563 ft
v= 2.00 ft/s
t= 13.0 min

Basin MED: Tc = 16.0 min

DRAINAGE BASIN CLLT — **DRAINAGE BASIN CLLT**

Calculate Pre-Development "Tc" and Composite "CN" — **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0040 ft/ft
t_1 = 36.6 min

Shallow Concentrated Flow:

t=1/60v
where
l = 383 ft
Paved ? No
Slope, S = 0.0040 ft/ft
v = 1.02 ft/s
t_2 = 6.3 min

Pipe & Channel Flow: t=1/60v
l= 74 ft
v= 2.00 ft/s
t= 0.6 min

Basin CLLT: Tc = 43.0 min

STORMWATER DESIGN CONSIDERATIONS

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PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

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DRAINAGE BASIN CLRT **DRAINAGE BASIN** CLRT

Calculate Pre-Development "Tc" and Composite "CN" **"Pre"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0020 ft/ft
t_1 = 48.2 min

Shallow Concentrated Flow:

t=1/60v
where
l = 519 ft
Paved ? No
Slope, S = 0.0020 ft/ft
v = 0.72 ft/s
t_2 = 12.0 min

Pipe & Channel Flow: t=1/60v
l= 1085 ft
v= 2.00 ft/s
t= 9.0 min

Basin CLRT: Tc = 69.0 min

STORMWATER DESIGN CONSIDERATIONS

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DRAINAGE BASIN EB1a — **DRAINAGE BASIN EB1a**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 100 ft
P2 = 4.00 in
S = 0.0030 ft/ft
t_1 = 13.5 min

Shallow Concentrated Flow:

t=1/60v
where
l = 2394 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 45.1 min

Pipe & Channel Flow: t=1/60v
l= 6957 ft
v= 2.00 ft/s
t= 58.0 min

Basin EB1a: Tc = 117.0 min

DRAINAGE BASIN EB1b — **DRAINAGE BASIN EB1b**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 58 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 4.1 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 2115 ft
v= 2.00 ft/s
t= 17.6 min

Basin EB1b: Tc = 22.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN EB1c — **DRAINAGE BASIN EB1c**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0100 ft/ft
t_1 = 25.3 min

Shallow Concentrated Flow:

t=1/60v
where
l = 967 ft
Paved ? No
Slope, S = 0.0100 ft/ft
v = 1.61 ft/s
t_2 = 10.0 min

Pipe & Channel Flow: t=1/60v
l= 1751 ft
v= 2.00 ft/s
t= 14.6 min

Basin EB1c: Tc = 50.0 min

DRAINAGE BASIN EB1d — **DRAINAGE BASIN EB1d**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 35 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 2.7 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0100 ft/ft
v = 1.61 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1266 ft
v= 2.00 ft/s
t= 10.6 min

Basin EB1d: Tc = 13.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
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DRAINAGE BASIN EB1e — **DRAINAGE BASIN EB1e**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0120 ft/ft
t_1 = 23.6 min

Shallow Concentrated Flow:

t=1/60v
where
l = 774 ft
Paved ? No
Slope, S = 0.0120 ft/ft
v = 1.77 ft/s
t_2 = 7.3 min

Pipe & Channel Flow: t=1/60v
l= 579 ft
v= 2.00 ft/s
t= 4.8 min

Basin EB1e: Tc = 36.0 min

DRAINAGE BASIN EB2 — **DRAINAGE BASIN EB2**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 44 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 10.0 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1755 ft
v= 2.00 ft/s
t= 14.6 min

Basin EB2: Tc = 25.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN WB1a — **DRAINAGE BASIN WB1a**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 50 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 3.6 min

Shallow Concentrated Flow:

t=1/60v

where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 5127 ft
v= 2.00 ft/s
t= 42.7 min

Basin WB1a: Tc = 46.0 min

DRAINAGE BASIN WB1b — **DRAINAGE BASIN WB1b**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 61 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 4.3 min

Shallow Concentrated Flow:

t=1/60v

where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1524 ft
v= 2.00 ft/s
t= 12.7 min

Basin WB1b: Tc = 17.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN WB1c **DRAINAGE BASIN** WB1c

Calculate Post-Development "Tc" and Composite "CN" **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 40 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 3.0 min

Shallow Concentrated Flow:

t=1/60v

where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 651 ft
v= 2.00 ft/s
t= 5.4 min

Basin WB1c: Tc = 8.0 min

DRAINAGE BASIN WB1d **DRAINAGE BASIN** WB1d

Calculate Post-Development "Tc" and Composite "CN" **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 50 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 3.6 min

Shallow Concentrated Flow:

t=1/60v

where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1578 ft
v= 2.00 ft/s
t= 13.2 min

Basin WB1d: Tc = 17.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN WB1e

DRAINAGE BASIN WB1e

Calculate Post-Development "Tc" and Composite "CN" **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0080 ft/ft
t_1 = 27.7 min

Shallow Concentrated Flow:

t=1/60v
where
l = 1782 ft
Paved ? No
Slope, S = 0.0080 ft/ft
v = 1.44 ft/s
t_2 = 20.6 min

Pipe & Channel Flow: t=1/60v
l= 1360 ft
v= 2.00 ft/s
t= 11.3 min

Basin WB1e: Tc = 60.0 min

DRAINAGE BASIN WB3

DRAINAGE BASIN WB3

Calculate Post-Development "Tc" and Composite "CN" **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0100 ft/ft
t_1 = 25.3 min

Shallow Concentrated Flow:

t=1/60v
where
l = 967 ft
Paved ? No
Slope, S = 0.0100 ft/ft
v = 1.61 ft/s
t_2 = 10.0 min

Pipe & Channel Flow: t=1/60v
l= 3224 ft
v= 2.00 ft/s
t= 26.9 min

Basin WB3: Tc = 62.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN MED — **DRAINAGE BASIN MED**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Pvmt. & Grass Combo (50/50) = 0.100
l = 40 ft
P2 = 4.00 in
S = 0.0200 ft/ft
t_1 = 3.0 min

Shallow Concentrated Flow:

t=1/60v
where
l = 0 ft
Paved ? No
Slope, S = 0.0030 ft/ft
v = 0.88 ft/s
t_2 = 0.0 min

Pipe & Channel Flow: t=1/60v
l= 1563 ft
v= 2.00 ft/s
t= 13.0 min

Basin MED: Tc = 16.0 min

DRAINAGE BASIN CLLT — **DRAINAGE BASIN CLLT**

Calculate Post-Development "Tc" and Composite "CN" — **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0040 ft/ft
t_1 = 36.6 min

Shallow Concentrated Flow:

t=1/60v
where
l = 383 ft
Paved ? No
Slope, S = 0.0040 ft/ft
v = 1.02 ft/s
t_2 = 6.3 min

Pipe & Channel Flow: t=1/60v
l= 74 ft
v= 2.00 ft/s
t= 0.6 min

Basin CLLT: Tc = 43.0 min

STORMWATER DESIGN CONSIDERATIONS

PROJECT: I-26 at Exit 189

PREPARED BY: Thomas & Hutton
PREPARED FOR: Berkeley County

Job: 25644
Date: 6/8/16
Revised:
By: HEH

DRAINAGE BASIN CLRT **DRAINAGE BASIN** CLRT

Calculate Post-Development "Tc" and Composite "CN" **"Post"**

Calculate Time of Concentration:

Use Travel Time Concept:

Overland Sheet Flow:

t = (0.007(nl)^0.8)/((P2^0.5)*(S^0.4))

where: t = Travel time for Overland Flow (min)
n = Manning's coefficient - from TR-55
l = Length of flow (ft)
P2 = 2-yr rainfall depth (in)
S = Hydraulic slope (ft/ft)

n = Woods: Light Underbrush = 0.400
l = 100 ft
P2 = 4.00 in
S = 0.0020 ft/ft
t_1 = 48.2 min

Shallow Concentrated Flow:

t=1/60v
where
l = 519 ft
Paved ? No
Slope, S = 0.0020 ft/ft
v = 0.72 ft/s
t_2 = 12.0 min

Pipe & Channel Flow: t=1/60v
l= 1085 ft
v= 2.00 ft/s
t= 9.0 min

Basin CLRT: Tc = 69.0 min

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

EXISTING CONDITIONS
ICPR INPUT

J – 25644.0006

Prepared by:

THOMAS & HUTTON

```
    Rainfall Amount(in): 0.000                Time of Conc(min): 30.00
              Area(ac): 17.380                  Time Shift(hrs): 0.00
          Curve Number: 79.80               Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00



-------------------------------------------------------------------------------------------------------
         Name: WB2b                     Node: WB2b_up               Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                 Time of Conc(min): 60.00
              Area(ac): 54.200                   Time Shift(hrs): 0.00
          Curve Number: 78.90               Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00



-------------------------------------------------------------------------------------------------------
         Name: WB3                      Node: WB3                   Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                 Time of Conc(min): 62.00
              Area(ac): 71.890                   Time Shift(hrs): 0.00
          Curve Number: 77.80               Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00



=======================================================================================
==== Nodes ============================================================================
=======================================================================================

      Name: CLLT               Base Flow(cfs): 0.000         Init Stage(ft): 58.800
     Group: BASE                                             Warn Stage(ft): 62.400
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          58.800
         999.00          58.800

-------------------------------------------------------------------------------------------------------
      Name: CLRT               Base Flow(cfs): 0.000         Init Stage(ft): 59.400
     Group: BASE                                             Warn Stage(ft): 62.400
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          59.400
         999.00          59.400

-------------------------------------------------------------------------------------------------------
      Name: EB1                Base Flow(cfs): 0.000         Init Stage(ft): 52.000
     Group: BASE                                             Warn Stage(ft): 61.000
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          52.000
         999.00          52.000

-------------------------------------------------------------------------------------------------------
      Name: EB2                Base Flow(cfs): 0.000         Init Stage(ft): 58.200
     Group: BASE                                             Warn Stage(ft): 63.500
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          58.200
         999.00          58.200

-------------------------------------------------------------------------------------------------------
      Name: MED                Base Flow(cfs): 0.000         Init Stage(ft): 60.000
     Group: BASE                                             Warn Stage(ft): 64.200
      Type: Time/Stage
```

```
================================================================================
==== Basins ====================================================================
================================================================================

        Name: CLLT                    Node: CLLT                  Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 43.00
            Area(ac): 1.250                   Time Shift(hrs): 0.00
        Curve Number: 79.60               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: CLRT                    Node: CLRT                  Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 69.00
            Area(ac): 27.630                  Time Shift(hrs): 0.00
        Curve Number: 79.30               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB1                     Node: EB1                   Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 117.00
            Area(ac): 501.670                 Time Shift(hrs): 0.00
        Curve Number: 79.30               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB2                     Node: EB2                   Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 25.00
            Area(ac): 3.760                   Time Shift(hrs): 0.00
        Curve Number: 82.90               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: MED                     Node: MED                   Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 16.00
            Area(ac): 4.290                   Time Shift(hrs): 0.00
        Curve Number: 83.50               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: WB1                     Node: WB1                   Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 61.00
            Area(ac): 44.590                  Time Shift(hrs): 0.00
        Curve Number: 80.90               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: WB2a                    Node: WB2a                  Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
```

Time(hrs)	Stage(ft)
0.00	60.000
999.00	60.000

Name: WB1 Base Flow(cfs): 0.000 Init Stage(ft): 56.500
Group: BASE Warn Stage(ft): 62.000
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	56.500
999.00	56.500

Name: WB2a Base Flow(cfs): 0.000 Init Stage(ft): 55.600
Group: BASE Warn Stage(ft): 61.000
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	55.600
999.00	55.600

Name: WB2b_dn Base Flow(cfs): 0.000 Init Stage(ft): 59.630
Group: BASE Warn Stage(ft): 61.800
Type: Stage/Area

Stage(ft)	Area(ac)

Name: WB2b_up Base Flow(cfs): 0.000 Init Stage(ft): 59.650
Group: BASE Warn Stage(ft): 61.800
Type: Stage/Area

Stage(ft)	Area(ac)

Name: WB3 Base Flow(cfs): 0.000 Init Stage(ft): 56.900
Group: BASE Warn Stage(ft): 64.300
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	56.900
999.00	56.900

==========
==== Pipes ====
==========

Name: WB2 From Node: WB2b_up Length(ft): 32.00
Group: BASE To Node: WB2b_dn Count: 1
Friction Equation: Automatic

	UPSTREAM	DOWNSTREAM	
Geometry:	Circular	Circular	Solution Algorithm: Most Restrictive
Span(in):	15.00	15.00	Flow: Both
Rise(in):	15.00	15.00	Entrance Loss Coef: 0.90
Invert(ft):	59.650	59.630	Exit Loss Coef: 0.50
Manning's N:	0.024000	0.024000	Bend Loss Coef: 0.00
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec: Use dc
			Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular CMP: Projecting

Downstream FHWA Inlet Edge Description:
Circular CMP: Projecting

```
================================================================================
==== Channels ==================================================================
================================================================================

          Name: WB2_Channel         From Node: WB2b_dn            Length(ft): 1520.00
         Group: BASE                  To Node: WB2a                   Count: 1

                UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
      Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
    Invert(ft): 59.630         56.700                               Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                Contraction Coef: 0.100
   Manning's N: 0.035000       0.035000                  Expansion Coef: 0.300
  Top Clip(ft): 0.000          0.000                  Entrance Loss Coef: 0.000
  Bot Clip(ft): 0.000          0.000                      Exit Loss Coef: 0.000
     Main XSec:                                        Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft):                                         Inlet Ctrl Spec: Use dc
     Aux XSec1:                                       Stabilizer Option: None
  AuxElev2(ft):
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft): 5.000          5.000
  LtSdSlp(h/v): 2.00           2.00
  RtSdSlp(h/v): 2.00           2.00



================================================================================
==== Weirs =====================================================================
================================================================================

         Name: WB2_weir            From Node: WB2b_up
        Group: BASE                  To Node: WB2b_dn
         Flow: Both                    Count: 1
         Type: Vertical: Gravel     Geometry: Trapezoidal

            Bottom Width(ft): 25.00
       Left Side Slope(h/v): 200.00
      Right Side Slope(h/v): 200.00
                 Invert(ft): 61.800
      Control Elevation(ft): 61.800
     Struct Opening Dim(ft): 9999.00
                                        TABLE
            Bottom Clip(ft): 0.000
               Top Clip(ft): 0.000
         Weir Discharge Coef: 3.200
     Orifice Discharge Coef: 0.600



================================================================================
==== Hydrology Simulations =====================================================
================================================================================

         Name: 002-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\002.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 4.00

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

------------------------------------------------------------------------------------------------------
         Name: 010-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\010-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 6.20

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

------------------------------------------------------------------------------------------------------
         Name: 025-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\025-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
```

```
    Rainfall Amount(in): 7.50

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

------------------------------------------------------------------------------------------------
         Name: 050-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\050-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 8.60

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

------------------------------------------------------------------------------------------------
         Name: 100-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\100-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 9.80

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

================================================================================================
==== Routing Simulations ======================================================================
================================================================================================

         Name: 002-yr              Hydrology Sim: 002-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\002-yr.I32

      Execute: Yes         Restart: No           Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 1.0000
        Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes


------------------------------------------------------------------------------------------------
         Name: 010-yr              Hydrology Sim: 010-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\010-yr.I32

      Execute: Yes         Restart: No           Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 1.0000
        Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes


------------------------------------------------------------------------------------------------
         Name: 025-yr              Hydrology Sim: 025-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\025-yr.I32

      Execute: Yes         Restart: No           Patch: No
```

```
  Alternative: No

       Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
       Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000               Max Calc Time(sec): 1.0000
       Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes


------------------------------------------------------------------------------------------------------
         Name: 050-yr              Hydrology Sim: 050-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\050-yr.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

       Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
       Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000               Max Calc Time(sec): 1.0000
       Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes


------------------------------------------------------------------------------------------------------
         Name: 100-yr              Hydrology Sim: 100-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Existing\100-yr.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

       Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
       Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000               Max Calc Time(sec): 1.0000
       Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes
```

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

EXISTING CONDITIONS ICPR NETWORK LAYOUT

OFFSITE PEAK DISCHARGE ANALYSIS DATA

J – 25644.0006

Prepared by:

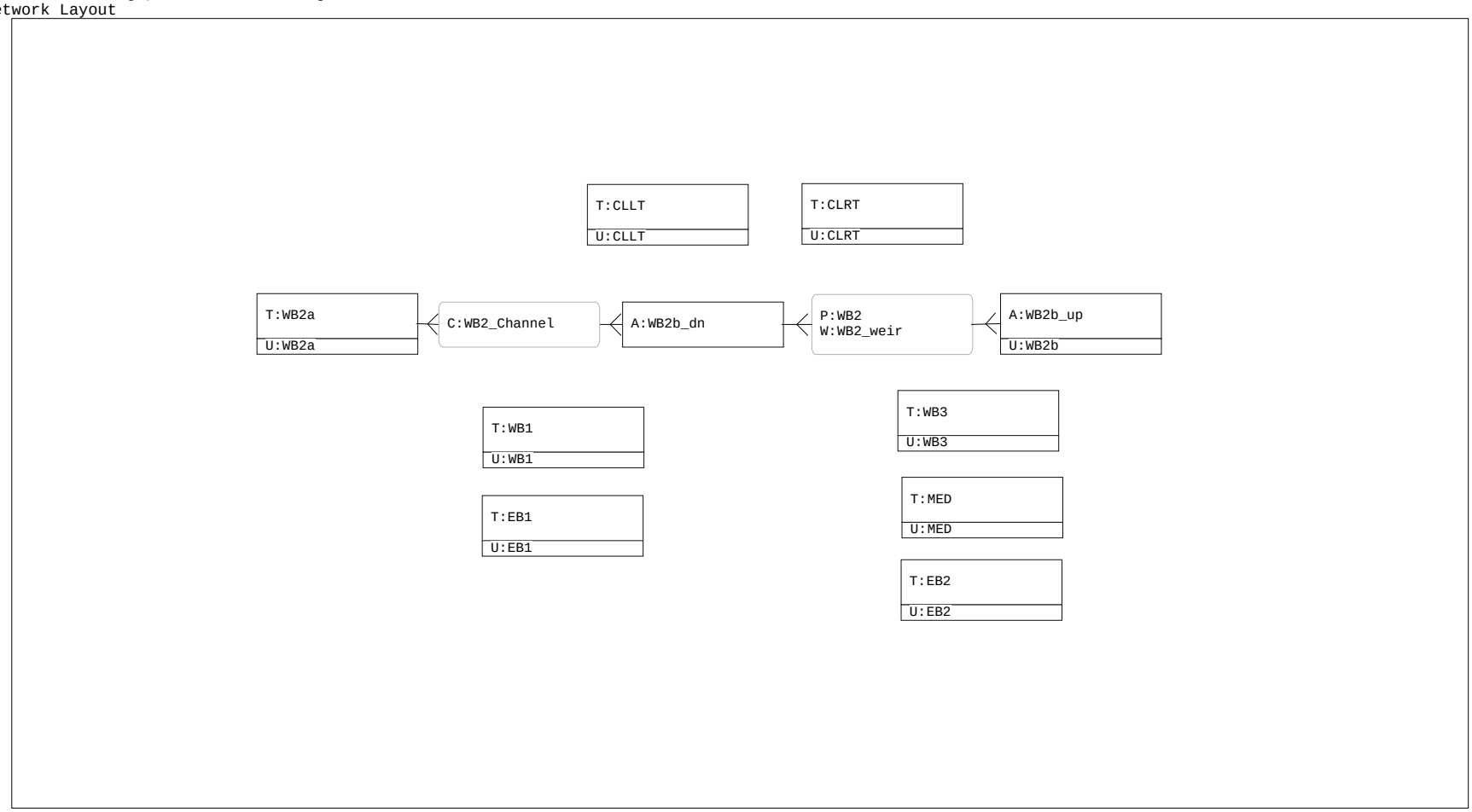
THOMAS & HUTTON

I-26 Volvo Cars Drive Interchange, Exit 189 For Project Soter
Pre-Develpoment Network Layout

Nodes
A Stage/Area
V Stage/Volume
T Time/Stage
M Manhole

Basins
O Overland Flow
U SCS Unit CN
S SBUH CN
Y SCS Unit GA
Z SBUH GA

Links
P Pipe
W Weir
C Channel
D Drop Structure
B Bridge
R Rating Curve
H Breach
E Percolation
F Filter
X Exfil Trench



HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

EXISTING CONDITIONS ICPR NODE MAXIMUM OUTPUT

OFFSITE PEAK DISCHARGE ANALYSIS DATA

J – 25644.0006

Prepared by:

THOMAS & HUTTON

I-26 Volvo Cars Drive Interchange, Exit 189 For Project Soter
Pre-Develpoment Node Maximum Comparison Report

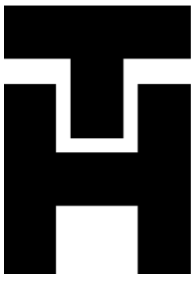
Name	Simulation	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Inflow cfs	Max Outflow cfs
CLLT	002-yr	58.80	62.40	0.0000	0	0.86	0.00
CLLT	010-yr	58.80	62.40	0.0000	0	1.70	0.00
CLLT	025-yr	58.80	62.40	0.0000	0	2.22	0.00
CLLT	050-yr	58.80	62.40	0.0000	0	2.66	0.00
CLLT	100-yr	58.80	62.40	0.0000	0	3.14	0.00
CLRT	002-yr	59.40	62.40	0.0000	0	13.47	0.00
CLRT	010-yr	59.40	62.40	0.0000	0	27.01	0.00
CLRT	025-yr	59.40	62.40	0.0000	0	35.35	0.00
CLRT	050-yr	59.40	62.40	0.0000	0	42.52	0.00
CLRT	100-yr	59.40	62.40	0.0000	0	50.39	0.00
EB1	002-yr	52.00	61.00	0.0000	0	166.03	0.00
EB1	010-yr	52.00	61.00	0.0000	0	334.13	0.00
EB1	025-yr	52.00	61.00	0.0000	0	438.48	0.00
EB1	050-yr	52.00	61.00	0.0000	0	528.03	0.00
EB1	100-yr	52.00	61.00	0.0000	0	626.45	0.00
EB2	002-yr	58.20	63.50	0.0000	0	4.10	0.00
EB2	010-yr	58.20	63.50	0.0000	0	7.61	0.00
EB2	025-yr	58.20	63.50	0.0000	0	9.73	0.00
EB2	050-yr	58.20	63.50	0.0000	0	11.53	0.00
EB2	100-yr	58.20	63.50	0.0000	0	13.50	0.00
MED	002-yr	60.00	64.20	0.0000	0	6.03	0.00
MED	010-yr	60.00	64.20	0.0000	0	11.01	0.00
MED	025-yr	60.00	64.20	0.0000	0	13.98	0.00
MED	050-yr	60.00	64.20	0.0000	0	16.48	0.00
MED	100-yr	60.00	64.20	0.0000	0	19.20	0.00
WB1	002-yr	56.50	62.00	0.0000	0	25.43	0.00
WB1	010-yr	56.50	62.00	0.0000	0	49.66	0.00
WB1	025-yr	56.50	62.00	0.0000	0	64.48	0.00
WB1	050-yr	56.50	62.00	0.0000	0	77.11	0.00
WB1	100-yr	56.50	62.00	0.0000	0	90.93	0.00
WB2a	002-yr	55.60	61.00	0.0000	190	39.57	0.00
WB2a	010-yr	55.60	61.00	0.0000	190	79.81	0.00
WB2a	025-yr	55.60	61.00	0.0000	190	104.71	0.00
WB2a	050-yr	55.60	61.00	0.0000	190	126.07	0.00
WB2a	100-yr	55.60	61.00	0.0000	190	149.51	0.00
WB2b_dn	002-yr	61.51	61.80	0.0006	8870	28.65	28.34
WB2b_dn	010-yr	62.26	61.80	0.0007	10928	71.58	57.39
WB2b_dn	025-yr	62.62	61.80	0.0008	11901	73.69	75.37
WB2b_dn	050-yr	62.88	61.80	0.0008	12631	73.85	90.79
WB2b_dn	100-yr	63.14	61.80	0.0009	13351	73.48	107.71
WB2b_up	002-yr	62.05	61.80	0.0015	114	28.65	28.65
WB2b_up	010-yr	62.28	61.80	-0.0071	114	57.85	71.58
WB2b_up	025-yr	62.55	61.80	-0.0065	114	75.90	73.69
WB2b_up	050-yr	62.67	61.80	-0.0063	114	91.35	73.85
WB2b_up	100-yr	62.72	61.80	-0.0066	114	108.29	73.48
WB3	002-yr	56.90	64.30	0.0000	0	35.31	0.00
WB3	010-yr	56.90	64.30	0.0000	0	72.54	0.00
WB3	025-yr	56.90	64.30	0.0000	0	95.69	0.00
WB3	050-yr	56.90	64.30	0.0000	0	115.66	0.00
WB3	100-yr	56.90	64.30	0.0000	0	137.61	0.00

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

POST-PROJECT CONDITIONS ICPR INPUT

OFFSITE PEAK DISCHARGE ANALYSIS DATA

J – 25644.0006



Prepared by:

THOMAS & HUTTON

```
================================================================================
==== Basins ====================================================================
================================================================================

        Name: CLLT                    Node: CLLT                  Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 43.00
            Area(ac): 1.250                   Time Shift(hrs): 0.00
        Curve Number: 87.70               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: CLRT                    Node: CLRT                  Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 69.00
            Area(ac): 27.300                  Time Shift(hrs): 0.00
        Curve Number: 79.60               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB1a                    Node: EB1a                  Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 117.00
            Area(ac): 401.140                 Time Shift(hrs): 0.00
        Curve Number: 79.30               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB1b                    Node: EB1b_up               Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 22.00
            Area(ac): 19.780                  Time Shift(hrs): 0.00
        Curve Number: 83.90               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB1c                    Node: EB1c_up               Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 50.00
            Area(ac): 25.010                  Time Shift(hrs): 0.00
        Curve Number: 80.10               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB1d                    Node: EB1d_dn               Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000                 Time of Conc(min): 13.00
            Area(ac): 11.850                  Time Shift(hrs): 0.00
        Curve Number: 84.60               Max Allowable Q(cfs): 999999.000
             DCIA(%): 0.00



--------------------------------------------------------------------------------
        Name: EB1e                    Node: EB1e_up               Status: Onsite
       Group: BASE                    Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh256                  Peaking Factor: 256.0
         Rainfall File: Scsiii              Storm Duration(hrs): 0.00
```

```
    Rainfall Amount(in): 0.000                Time of Conc(min): 36.00
                Area(ac): 43.360                Time Shift(hrs): 0.00
           Curve Number: 78.20              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: EB2                      Node: EB2                    Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                Time of Conc(min): 25.00
                Area(ac): 3.760                 Time Shift(hrs): 0.00
           Curve Number: 85.30              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: MED                      Node: MED                    Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                Time of Conc(min): 16.00
                Area(ac): 4.290                 Time Shift(hrs): 0.00
           Curve Number: 83.70              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: WB1a                     Node: WB1a                   Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                Time of Conc(min): 46.00
                Area(ac): 15.450                Time Shift(hrs): 0.00
           Curve Number: 85.10              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: WB1b                     Node: WB1b_up                Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                Time of Conc(min): 17.00
                Area(ac): 10.520                Time Shift(hrs): 0.00
           Curve Number: 84.50              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: WB1c                     Node: WB1c_up                Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                Time of Conc(min): 8.00
                Area(ac): 0.940                 Time Shift(hrs): 0.00
           Curve Number: 83.80              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: WB1d                     Node: WB1d_up                Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                   Peaking Factor: 256.0
          Rainfall File: Scsiii               Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                Time of Conc(min): 17.00
                Area(ac): 7.410                 Time Shift(hrs): 0.00
           Curve Number: 85.10              Max Allowable Q(cfs): 999999.000
                DCIA(%): 0.00



-------------------------------------------------------------------------------------------------
         Name: WB1e                     Node: WB1e_up                Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN
```

```
        Unit Hydrograph: Uh256                  Peaking Factor: 256.0
          Rainfall File: Scsiii              Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                 Time of Conc(min): 60.00
              Area(ac): 81.560                   Time Shift(hrs): 0.00
          Curve Number: 79.70               Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00


-------------------------------------------------------------------------------------------------
         Name: WB3                     Node: WB3                    Status: Onsite
        Group: BASE                    Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                  Peaking Factor: 256.0
          Rainfall File: Scsiii              Storm Duration(hrs): 0.00
    Rainfall Amount(in): 0.000                 Time of Conc(min): 62.00
              Area(ac): 71.890                   Time Shift(hrs): 0.00
          Curve Number: 77.90               Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00


=================================================================================================
==== Nodes ======================================================================================
=================================================================================================

      Name: CLLT               Base Flow(cfs): 0.000          Init Stage(ft): 58.800
     Group: BASE                                             Warn Stage(ft): 62.400
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          58.800
         999.00          58.800

-------------------------------------------------------------------------------------------------
      Name: CLRT               Base Flow(cfs): 0.000          Init Stage(ft): 59.400
     Group: BASE                                             Warn Stage(ft): 62.400
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          59.400
         999.00          59.400

-------------------------------------------------------------------------------------------------
      Name: EB1a               Base Flow(cfs): 0.000          Init Stage(ft): 52.000
     Group: BASE                                             Warn Stage(ft): 61.000
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          52.000
        9999.00          52.000

-------------------------------------------------------------------------------------------------
      Name: EB1b_dn            Base Flow(cfs): 0.000          Init Stage(ft): 55.800
     Group: BASE                                             Warn Stage(ft): 64.000
      Type: Stage/Area


      Stage(ft)        Area(ac)
--------------- ---------------

-------------------------------------------------------------------------------------------------
      Name: EB1b_up            Base Flow(cfs): 0.000          Init Stage(ft): 56.050
     Group: BASE                                             Warn Stage(ft): 63.490
      Type: Stage/Area


      Stage(ft)        Area(ac)
--------------- ---------------
         56.050          0.0100
         63.490          8.0000

-------------------------------------------------------------------------------------------------
      Name: EB1c_dn            Base Flow(cfs): 0.000          Init Stage(ft): 58.450
     Group: BASE                                             Warn Stage(ft): 64.000
      Type: Stage/Area
```

Stage(ft)	Area(ac)

Name: EB1c_up Base Flow(cfs): 0.000 Init Stage(ft): 58.830
Group: BASE Warn Stage(ft): 68.200
Type: Stage/Area

Stage(ft)	Area(ac)
58.830	0.0100
68.200	4.0000

Name: EB1d_dn Base Flow(cfs): 0.000 Init Stage(ft): 59.300
Group: BASE Warn Stage(ft): 64.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: EB1d_up Base Flow(cfs): 0.000 Init Stage(ft): 59.700
Group: BASE Warn Stage(ft): 68.600
Type: Stage/Area

Stage(ft)	Area(ac)
59.700	0.0100
68.600	4.0000

Name: EB1e_dn Base Flow(cfs): 0.000 Init Stage(ft): 61.000
Group: BASE Warn Stage(ft): 67.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: EB1e_up Base Flow(cfs): 0.000 Init Stage(ft): 61.100
Group: BASE Warn Stage(ft): 65.660
Type: Stage/Area

Stage(ft)	Area(ac)
61.100	0.0100
65.660	4.0000

Name: EB2 Base Flow(cfs): 0.000 Init Stage(ft): 58.200
Group: BASE Warn Stage(ft): 63.500
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	58.200
999.00	58.200

Name: MED Base Flow(cfs): 0.000 Init Stage(ft): 60.000
Group: BASE Warn Stage(ft): 64.200
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	60.000
999.00	60.000

Name: WB1a Base Flow(cfs): 0.000 Init Stage(ft): 55.600

Group: BASE Warn Stage(ft): 62.000
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	55.600
999.00	55.600

Name: WB1b_dn Base Flow(cfs): 0.000 Init Stage(ft): 58.000
Group: BASE Warn Stage(ft): 63.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: WB1b_up Base Flow(cfs): 0.000 Init Stage(ft): 58.200
Group: BASE Warn Stage(ft): 66.150
Type: Stage/Area

Stage(ft)	Area(ac)
58.200	0.0100
66.150	1.0000

Name: WB1c_dn Base Flow(cfs): 0.000 Init Stage(ft): 58.400
Group: BASE Warn Stage(ft): 64.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: WB1c_up Base Flow(cfs): 0.000 Init Stage(ft): 58.500
Group: BASE Warn Stage(ft): 66.150
Type: Stage/Area

Stage(ft)	Area(ac)
58.500	0.0100
66.150	1.0000

Name: WB1d_dn Base Flow(cfs): 0.000 Init Stage(ft): 58.500
Group: BASE Warn Stage(ft): 64.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: WB1d_up Base Flow(cfs): 0.000 Init Stage(ft): 58.600
Group: BASE Warn Stage(ft): 65.990
Type: Stage/Area

Stage(ft)	Area(ac)
58.600	0.0100
65.990	3.0000

Name: WB1e_dn Base Flow(cfs): 0.000 Init Stage(ft): 58.800
Group: BASE Warn Stage(ft): 64.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: WB1e_up Base Flow(cfs): 0.000 Init Stage(ft): 59.000

Group: BASE Warn Stage(ft): 66.500
Type: Stage/Area

Stage(ft)	Area(ac)
59.000	0.0100
66.500	20.0000

Name: WB3 Base Flow(cfs): 0.000 Init Stage(ft): 56.900
Group: BASE Warn Stage(ft): 64.300
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	56.900
999.00	56.900

==========
==== Pipes ==========
==========

Name: EB1b_Pipe From Node: EB1b_up Length(ft): 90.00
Group: BASE To Node: EB1b_dn Count: 1
Friction Equation: Automatic

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Solution Algorithm:	Most Restrictive
Span(in):	42.00	42.00	Flow:	Both
Rise(in):	42.00	42.00	Entrance Loss Coef:	0.20
Invert(ft):	56.050	55.800	Exit Loss Coef:	0.50
Manning's N:	0.012000	0.012000	Bend Loss Coef:	0.00
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec:	Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dc
			Stabilizer Option:	None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name: EB1c_Pipe From Node: EB1c_up Length(ft): 349.00
Group: BASE To Node: EB1c_dn Count: 2
Friction Equation: Automatic

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Solution Algorithm:	Most Restrictive
Span(in):	36.00	36.00	Flow:	Both
Rise(in):	36.00	36.00	Entrance Loss Coef:	0.20
Invert(ft):	58.830	58.450	Exit Loss Coef:	0.50
Manning's N:	0.012000	0.012000	Bend Loss Coef:	0.00
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec:	Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dc
			Stabilizer Option:	None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name: EB1d_Pipe From Node: EB1d_up Length(ft): 308.00
Group: BASE To Node: EB1d_dn Count: 2
Friction Equation: Automatic

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Solution Algorithm:	Most Restrictive
Span(in):	36.00	36.00	Flow:	Both
Rise(in):	36.00	36.00	Entrance Loss Coef:	0.20
Invert(ft):	59.700	59.300	Exit Loss Coef:	0.50
Manning's N:	0.012000	0.012000	Bend Loss Coef:	0.00
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec:	Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dc
			Stabilizer Option:	None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name:	EB1e_Pipe	From Node: EB1e_up	Length(ft): 86.00
Group:	BASE	To Node: EB1e_dn	Count: 1
			Friction Equation: Automatic
	UPSTREAM	DOWNSTREAM	Solution Algorithm: Most Restrictive
Geometry:	Circular	Circular	Flow: Both
Span(in):	30.00	30.00	Entrance Loss Coef: 0.20
Rise(in):	30.00	30.00	Exit Loss Coef: 0.50
Invert(ft):	61.100	61.000	Bend Loss Coef: 0.00
Manning's N:	0.012000	0.012000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in):	0.000	0.000	Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name:	WB1b_Pipe	From Node: WB1b_up	Length(ft): 94.00
Group:	BASE	To Node: WB1b_dn	Count: 1
			Friction Equation: Automatic
	UPSTREAM	DOWNSTREAM	Solution Algorithm: Most Restrictive
Geometry:	Circular	Circular	Flow: Both
Span(in):	36.00	36.00	Entrance Loss Coef: 0.20
Rise(in):	36.00	36.00	Exit Loss Coef: 0.50
Invert(ft):	58.200	58.000	Bend Loss Coef: 0.00
Manning's N:	0.012000	0.012000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in):	0.000	0.000	Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name:	WB1c_Pipe	From Node: WB1c_up	Length(ft): 153.00
Group:	BASE	To Node: WB1c_dn	Count: 2
			Friction Equation: Automatic
	UPSTREAM	DOWNSTREAM	Solution Algorithm: Most Restrictive
Geometry:	Circular	Circular	Flow: Both
Span(in):	36.00	36.00	Entrance Loss Coef: 0.20
Rise(in):	36.00	36.00	Exit Loss Coef: 0.50
Invert(ft):	58.500	58.400	Bend Loss Coef: 0.00
Manning's N:	0.012000	0.012000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in):	0.000	0.000	Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name:	WB1d_Pipe	From Node: WB1d_up	Length(ft): 137.00
Group:	BASE	To Node: WB1d_dn	Count: 2
			Friction Equation: Automatic
	UPSTREAM	DOWNSTREAM	Solution Algorithm: Most Restrictive
Geometry:	Circular	Circular	Flow: Both
Span(in):	36.00	36.00	Entrance Loss Coef: 0.20
Rise(in):	36.00	36.00	Exit Loss Coef: 0.50
Invert(ft):	58.600	58.500	Bend Loss Coef: 0.00
Manning's N:	0.012000	0.012000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in):	0.000	0.000	Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name:	WB1e_Pipe	From Node:	WB1e_up	Length(ft):	268.00
Group:	BASE	To Node:	WB1e_dn	Count:	2
				Friction Equation:	Automatic
	UPSTREAM	DOWNSTREAM		Solution Algorithm:	Most Restrictive
Geometry:	Circular	Circular		Flow:	Both
Span(in):	36.00	36.00		Entrance Loss Coef:	0.20
Rise(in):	36.00	36.00		Exit Loss Coef:	0.50
Invert(ft):	59.000	58.800		Bend Loss Coef:	0.00
Manning's N:	0.012000	0.012000		Outlet Ctrl Spec:	Use dc or tw
Top Clip(in):	0.000	0.000		Inlet Ctrl Spec:	Use dc
Bot Clip(in):	0.000	0.000		Stabilizer Option:	None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

==========

Channels

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Name:	EB1a_Channel	From Node:	EB1b_dn	Length(ft):	2924.00
Group:	BASE	To Node:	EB1a	Count:	1
				Friction Equation:	Automatic
	UPSTREAM	DOWNSTREAM		Solution Algorithm:	Automatic
Geometry:	Trapezoidal	Trapezoidal		Flow:	Both
Invert(ft):	55.800	52.000		Contraction Coef:	0.100
TClpInitZ(ft):	9999.000	9999.000		Expansion Coef:	0.300
Manning's N:	0.030000	0.030000		Entrance Loss Coef:	0.000
Top Clip(ft):	0.000	0.000		Exit Loss Coef:	0.000
Bot Clip(ft):	0.000	0.000		Outlet Ctrl Spec:	Use dc or tw
Main XSec:				Inlet Ctrl Spec:	Use dc
AuxElev1(ft):				Stabilizer Option:	None
Aux XSec1:					
AuxElev2(ft):					
Aux XSec2:					
Top Width(ft):					
Depth(ft):					
Bot Width(ft):	8.000	8.000			
LtSdSlp(h/v):	2.00	2.00			
RtSdSlp(h/v):	4.00	4.00			

Name:	EB1b_Channel	From Node:	EB1c_dn	Length(ft):	1897.00
Group:	BASE	To Node:	EB1b_up	Count:	1
				Friction Equation:	Automatic
	UPSTREAM	DOWNSTREAM		Solution Algorithm:	Automatic
Geometry:	Trapezoidal	Trapezoidal		Flow:	Both
Invert(ft):	58.450	56.050		Contraction Coef:	0.100
TClpInitZ(ft):	9999.000	9999.000		Expansion Coef:	0.300
Manning's N:	0.030000	0.030000		Entrance Loss Coef:	0.000
Top Clip(ft):	0.000	0.000		Exit Loss Coef:	0.000
Bot Clip(ft):	0.000	0.000		Outlet Ctrl Spec:	Use dc or tw
Main XSec:				Inlet Ctrl Spec:	Use dc
AuxElev1(ft):				Stabilizer Option:	None
Aux XSec1:					
AuxElev2(ft):					
Aux XSec2:					
Top Width(ft):					
Depth(ft):					
Bot Width(ft):	8.000	8.000			
LtSdSlp(h/v):	2.00	2.00			
RtSdSlp(h/v):	4.00	4.00			

Name:	EB1c_Channel	From Node:	EB1d_dn	Length(ft):	273.00
Group:	BASE	To Node:	EB1c_up	Count:	1

```
               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
   Invert(ft): 59.300         58.830                                 Flow: Both
TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
  Manning's N: 0.030000       0.030000                      Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 8.000          8.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 4.00           4.00


-------------------------------------------------------------------------------------------------
         Name: EB1d_Channel        From Node: EB1e_dn           Length(ft): 1016.00
        Group: BASE                  To Node: EB1d_up                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
   Invert(ft): 61.000         59.700                                 Flow: Both
TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
  Manning's N: 0.030000       0.030000                      Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 8.000          8.000
 LtSdSlp(h/v): 2.00           2.00
 RtSdSlp(h/v): 4.00           4.00


-------------------------------------------------------------------------------------------------
         Name: WB1a_Channela       From Node: WB1b_dn           Length(ft): 3075.00
        Group: BASE                  To Node: WB1a                   Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
   Invert(ft): 58.000         55.600                                 Flow: Both
TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
  Manning's N: 0.030000       0.030000                      Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 8.000          8.000
 LtSdSlp(h/v): 4.00           4.00
 RtSdSlp(h/v): 2.00           2.00


-------------------------------------------------------------------------------------------------
         Name: WB1a_Channelb       From Node: WB1c_dn           Length(ft): 549.00
        Group: BASE                  To Node: WB1b_dn                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
   Invert(ft): 58.400         58.000                                 Flow: Both
TClpInitZ(ft): 9999.000       9999.000                    Contraction Coef: 0.100
  Manning's N: 0.030000       0.030000                      Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 8.000          8.000
 LtSdSlp(h/v): 4.00           4.00
```

```
  RtSdSlp(h/v): 2.00           2.00


-------------------------------------------------------------------------------------------------
         Name: WB1c_Channel        From Node: WB1d_dn            Length(ft): 112.00
        Group: BASE                  To Node: WB1c_up                 Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
   Invert(ft): 58.500         58.500                                 Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                    Contraction Coef: 0.100
  Manning's N: 0.030000       0.030000                      Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 8.000          8.000
 LtSdSlp(h/v): 3.00           3.00
 RtSdSlp(h/v): 3.00           3.00


-------------------------------------------------------------------------------------------------
         Name: WB1e_Channel        From Node: WB1e_dn            Length(ft): 105.00
        Group: BASE                  To Node: WB1d_up                 Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal               Solution Algorithm: Automatic
   Invert(ft): 58.800         58.600                                 Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                    Contraction Coef: 0.100
  Manning's N: 0.030000       0.030000                      Expansion Coef: 0.300
 Top Clip(ft): 0.000          0.000                     Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                         Exit Loss Coef: 0.000
    Main XSec:                                          Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                           Inlet Ctrl Spec: Use dc
    Aux XSec1:                                         Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 8.000          8.000
 LtSdSlp(h/v): 3.00           3.00
 RtSdSlp(h/v): 3.00           3.00


===============================================================================================
==== Weirs ====================================================================================
===============================================================================================

        Name: EB1b_Weir          From Node: EB1b_up
       Group: BASE                 To Node: EB1b_dn
        Flow: Both                   Count: 1
        Type: Vertical: Paved     Geometry: Trapezoidal

           Bottom Width(ft): 100.00
      Left Side Slope(h/v): 200.00
     Right Side Slope(h/v): 200.00
                Invert(ft): 63.490
     Control Elevation(ft): 63.490
    Struct Opening Dim(ft): 9999.00
                                       TABLE
          Bottom Clip(ft): 0.000
             Top Clip(ft): 0.000
       Weir Discharge Coef: 3.200
    Orifice Discharge Coef: 0.600


-------------------------------------------------------------------------------------------------
        Name: EB1c_Weir          From Node: EB1c_up
       Group: BASE                 To Node: EB1c_dn
        Flow: Both                   Count: 1
        Type: Vertical: Paved     Geometry: Trapezoidal

           Bottom Width(ft): 100.00
      Left Side Slope(h/v): 200.00
     Right Side Slope(h/v): 200.00
                Invert(ft): 68.200
     Control Elevation(ft): 68.200
    Struct Opening Dim(ft): 9999.00
                                       TABLE
```

```
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
       Orifice Discharge Coef: 0.600



-------------------------------------------------------------------------------------------------------
         Name: EB1d_Weir           From Node: EB1d_up
        Group: BASE                  To Node: EB1d_dn
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Trapezoidal

            Bottom Width(ft): 100.00
        Left Side Slope(h/v): 200.00
       Right Side Slope(h/v): 200.00
                  Invert(ft): 68.600
       Control Elevation(ft): 68.600
      Struct Opening Dim(ft): 9999.00
                                         TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
       Orifice Discharge Coef: 0.600



-------------------------------------------------------------------------------------------------------
         Name: EB1e_Weir           From Node: EB1e_up
        Group: BASE                  To Node: EB1e_dn
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Trapezoidal

            Bottom Width(ft): 100.00
        Left Side Slope(h/v): 200.00
       Right Side Slope(h/v): 200.00
                  Invert(ft): 65.660
       Control Elevation(ft): 65.660
      Struct Opening Dim(ft): 9999.00
                                         TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
       Orifice Discharge Coef: 0.600



-------------------------------------------------------------------------------------------------------
         Name: WB1b_Weir           From Node: WB1b_up
        Group: BASE                  To Node: WB1b_dn
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Trapezoidal

            Bottom Width(ft): 100.00
        Left Side Slope(h/v): 200.00
       Right Side Slope(h/v): 200.00
                  Invert(ft): 66.150
       Control Elevation(ft): 66.150
      Struct Opening Dim(ft): 9999.00
                                         TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
       Orifice Discharge Coef: 0.600



-------------------------------------------------------------------------------------------------------
         Name: WB1c_Weir           From Node: WB1c_up
        Group: BASE                  To Node: WB1c_dn
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Trapezoidal

            Bottom Width(ft): 100.00
        Left Side Slope(h/v): 200.00
       Right Side Slope(h/v): 200.00
                  Invert(ft): 66.150
       Control Elevation(ft): 66.150
      Struct Opening Dim(ft): 9999.00
                                         TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.200
       Orifice Discharge Coef: 0.600



-------------------------------------------------------------------------------------------------------
```

```
         Name: WB1d_Weir           From Node: WB1d_up
        Group: BASE                  To Node: WB1d_dn
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Trapezoidal

            Bottom Width(ft): 100.00
       Left Side Slope(h/v): 200.00
      Right Side Slope(h/v): 200.00
                 Invert(ft): 65.990
      Control Elevation(ft): 65.990
     Struct Opening Dim(ft): 9999.00
                                        TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
        Weir Discharge Coef: 3.200
     Orifice Discharge Coef: 0.600



-------------------------------------------------------------------------------------------------
         Name: WB1e_Weir           From Node: WB1e_up
        Group: BASE                  To Node: WB1e_dn
         Flow: Both                    Count: 1
         Type: Vertical: Paved      Geometry: Trapezoidal

            Bottom Width(ft): 100.00
       Left Side Slope(h/v): 200.00
      Right Side Slope(h/v): 200.00
                 Invert(ft): 66.500
      Control Elevation(ft): 66.500
     Struct Opening Dim(ft): 9999.00
                                        TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
        Weir Discharge Coef: 3.200
     Orifice Discharge Coef: 0.600



=================================================================================================
==== Hydrology Simulations =====================================================================
=================================================================================================

         Name: 002-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\002-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 4.00

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

-------------------------------------------------------------------------------------------------
         Name: 010-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\010-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 6.20

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

-------------------------------------------------------------------------------------------------
         Name: 025-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\025-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 7.50

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

-------------------------------------------------------------------------------------------------
         Name: 050-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\050-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
```

```
    Rainfall Amount(in): 8.60

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

-------------------------------------------------------------------------------------------------
         Name: 100-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\100-yr.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Scsiii
    Rainfall Amount(in): 9.80

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

=================================================================================
==== Routing Simulations ========================================================
=================================================================================

         Name: 002-yr              Hydrology Sim: 002-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\002-yr.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 1.0000
        Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes


-------------------------------------------------------------------------------------------------
         Name: 010-yr              Hydrology Sim: 010-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\010-yr.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 1.0000
        Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
BASE            Yes


-------------------------------------------------------------------------------------------------
         Name: 025-yr              Hydrology Sim: 025-yr
     Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\025-yr.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 48.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 1.0000
        Boundary Stages:                         Boundary Flows:



Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000
```

Group	Run
BASE	Yes

Name: 050-yr Hydrology Sim: 050-yr
Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\050-yr.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 48.00
Min Calc Time(sec): 0.1000 Max Calc Time(sec): 1.0000
Boundary Stages: Boundary Flows:

Time(hrs)	Print Inc(min)
999.000	15.000

Group	Run
BASE	Yes

Name: 100-yr Hydrology Sim: 100-yr
Filename: Z:\25644\25644.0006\Engineering\Calculations\Storm Water\ICPR\Proposed\100-yr.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 48.00
Min Calc Time(sec): 0.1000 Max Calc Time(sec): 1.0000
Boundary Stages: Boundary Flows:

Time(hrs)	Print Inc(min)
999.000	15.000

Group	Run
BASE	Yes

HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

POST-PROJECT CONDITIONS ICPR NETWORK LAYOUT

OFFSITE PEAK DISCHARGE ANALYSIS DATA

J – 25644.0006

Prepared by:

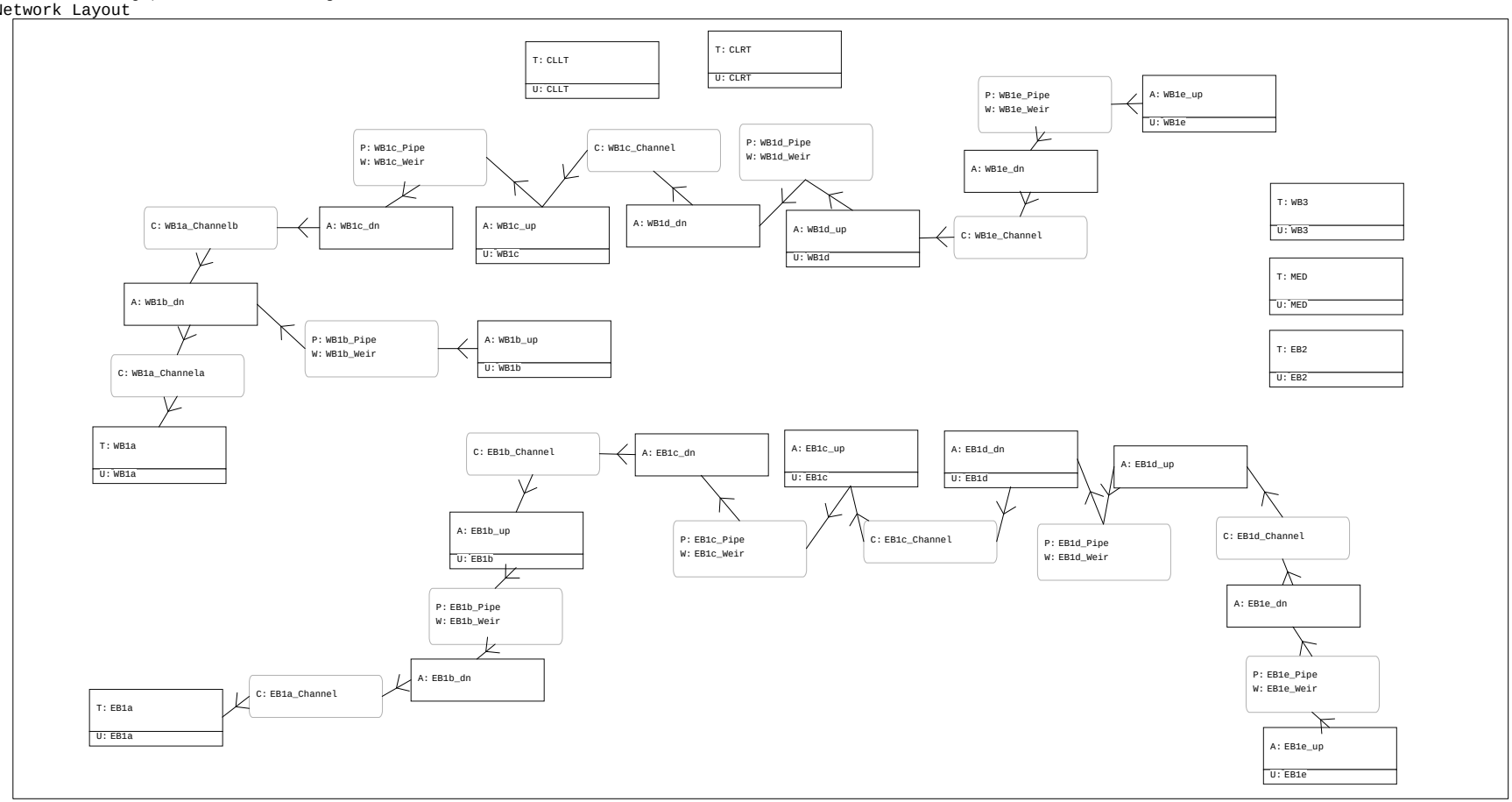
THOMAS & HUTTON

I-26 Volvo Cars Drive Interchange, Exit 189 For Project Soter
Post-Develpoment Network Layout

Nodes
A Stage/Area
V Stage/Volume
T Time/Stage
M Manhole

Basins
O Overland Flow
U SCS Unit CN
S SBUH CN
Y SCS Unit GA
Z SBUH GA

Links
P Pipe
W Weir
C Channel
D Drop Structure
B Bridge
R Rating Curve
H Breach
E Percolation
F Filter
X Exfil Trench

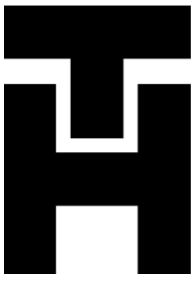


HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

POST-PROJECT CONDITIONS ICPR NODE MAXIMUM OUTPUT

OFFSITE PEAK DISCHARGE ANALYSIS DATA

J – 25644.0006



Prepared by:

THOMAS & HUTTON

I-26 Volvo Cars Drive Interchange, Exit 189 For Project Soter
Post-Develpoment Node Maximum Comparison Report

Name	Simulation	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Inflow cfs	Max Outflow cfs
CLLT	002-yr	58.80	62.40	0.0000	0	1.17	0.00
CLLT	010-yr	58.80	62.40	0.0000	0	2.06	0.00
CLLT	025-yr	58.80	62.40	0.0000	0	2.58	0.00
CLLT	050-yr	58.80	62.40	0.0000	0	3.01	0.00
CLLT	100-yr	58.80	62.40	0.0000	0	3.49	0.00
CLRT	002-yr	59.40	62.40	0.0000	0	13.49	0.00
CLRT	010-yr	59.40	62.40	0.0000	0	26.91	0.00
CLRT	025-yr	59.40	62.40	0.0000	0	35.17	0.00
CLRT	050-yr	59.40	62.40	0.0000	0	42.26	0.00
CLRT	100-yr	59.40	62.40	0.0000	0	50.04	0.00
EB1a	002-yr	52.00	61.00	0.0000	585	155.89	0.00
EB1a	010-yr	52.00	61.00	0.0000	585	307.60	0.00
EB1a	025-yr	52.00	61.00	0.0000	585	399.20	0.00
EB1a	050-yr	52.00	61.00	0.0000	585	477.23	0.00
EB1a	100-yr	52.00	61.00	0.0000	585	562.46	0.00
EB1b_dn	002-yr	57.31	64.00	0.0003	23376	27.78	27.73
EB1b_dn	010-yr	57.81	64.00	0.0003	27218	49.10	49.06
EB1b_dn	025-yr	58.01	64.00	0.0003	28708	59.38	59.34
EB1b_dn	050-yr	58.13	64.00	0.0003	29605	66.51	66.49
EB1b_dn	100-yr	58.24	64.00	0.0003	30416	72.81	72.79
EB1b_up	002-yr	58.38	63.49	0.0004	128863	38.96	27.78
EB1b_up	010-yr	59.42	63.49	0.0005	183043	72.76	49.10
EB1b_up	025-yr	59.93	63.49	0.0005	209088	92.58	59.38
EB1b_up	050-yr	60.29	63.49	0.0006	228034	108.93	66.51
EB1b_up	100-yr	60.67	63.49	0.0006	247665	125.99	72.81
EB1c_dn	002-yr	59.76	64.00	0.0003	17472	28.83	28.53
EB1c_dn	010-yr	60.38	64.00	0.0004	21537	52.73	51.98
EB1c_dn	025-yr	60.68	64.00	0.0004	23447	63.16	62.19
EB1c_dn	050-yr	60.91	64.00	0.0004	24791	71.93	70.62
EB1c_dn	100-yr	61.16	64.00	0.0004	26269	79.80	78.00
EB1c_up	002-yr	60.64	68.20	0.0004	37548	30.07	28.83
EB1c_up	010-yr	61.45	68.20	0.0005	52974	56.33	52.73
EB1c_up	025-yr	61.91	68.20	0.0006	61344	70.85	63.16
EB1c_up	050-yr	62.24	68.20	0.0007	67674	82.30	71.93
EB1c_up	100-yr	62.54	68.20	0.0007	73512	93.51	79.80
EB1d_dn	002-yr	60.71	64.00	0.0005	3359	17.80	17.88
EB1d_dn	010-yr	61.49	64.00	0.0005	3922	33.04	33.22
EB1d_dn	025-yr	61.94	64.00	0.0005	4089	40.08	40.33
EB1d_dn	050-yr	62.26	64.00	0.0006	4004	45.07	45.27
EB1d_dn	100-yr	62.56	64.00	0.0006	4010	49.69	49.84
EB1d_up	002-yr	60.95	68.60	0.0003	33363	15.43	15.54
EB1d_up	010-yr	61.71	68.60	0.0005	50172	28.42	29.58
EB1d_up	025-yr	62.15	68.60	0.0005	59793	33.88	36.17
EB1d_up	050-yr	62.49	68.60	0.0006	67298	37.85	40.62
EB1d_up	100-yr	62.90	68.60	0.0006	76015	41.56	45.78
EB1e_dn	002-yr	61.93	67.00	0.0002	7365	15.45	15.43
EB1e_dn	010-yr	62.40	67.00	0.0003	8904	28.43	28.42
EB1e_dn	025-yr	62.65	67.00	0.0003	9813	33.85	33.88
EB1e_dn	050-yr	62.87	67.00	0.0004	10587	37.75	37.85
EB1e_dn	100-yr	63.16	67.00	0.0004	11553	41.46	41.56
EB1e_up	002-yr	63.12	65.66	0.0005	77530	31.61	15.45
EB1e_up	010-yr	64.11	65.66	0.0006	115123	63.95	28.43
EB1e_up	025-yr	64.67	65.66	0.0007	136377	83.86	33.85
EB1e_up	050-yr	65.13	65.66	0.0007	153949	100.88	37.75
EB1e_up	100-yr	65.61	65.66	0.0008	172428	119.52	41.46
EB2	002-yr	58.20	63.50	0.0000	0	4.46	0.00
EB2	010-yr	58.20	63.50	0.0000	0	8.02	0.00
EB2	025-yr	58.20	63.50	0.0000	0	10.15	0.00
EB2	050-yr	58.20	63.50	0.0000	0	11.95	0.00
EB2	100-yr	58.20	63.50	0.0000	0	13.90	0.00
MED	002-yr	60.00	64.20	0.0000	0	6.07	0.00
MED	010-yr	60.00	64.20	0.0000	0	11.06	0.00
MED	025-yr	60.00	64.20	0.0000	0	14.02	0.00
MED	050-yr	60.00	64.20	0.0000	0	16.52	0.00
MED	100-yr	60.00	64.20	0.0000	0	19.24	0.00
WB1a	002-yr	55.60	62.00	0.0000	615	30.93	0.00
WB1a	010-yr	55.60	62.00	0.0000	615	59.35	0.00
WB1a	025-yr	55.60	62.00	0.0000	615	76.26	0.00
WB1a	050-yr	55.60	62.00	0.0000	615	90.43	0.00
WB1a	100-yr	55.60	62.00	0.0000	615	105.59	0.00
WB1b_dn	002-yr	59.58	63.00	0.0004	29685	24.69	24.60

I-26 Volvo Cars Drive Interchange, Exit 189 For Project Soter
Post-Develpoment Node Maximum Comparison Report

Name	Simulation	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Inflow cfs	Max Outflow cfs
WB1b_dn	010-yr	60.11	63.00	0.0005	34798	44.43	44.35
WB1b_dn	025-yr	60.32	63.00	0.0005	36868	54.34	54.29
WB1b_dn	050-yr	60.46	63.00	0.0005	38172	61.55	61.18
WB1b_dn	100-yr	60.59	63.00	0.0005	39411	71.48	68.56
WB1b_up	002-yr	59.80	66.15	0.0006	9228	14.93	12.90
WB1b_up	010-yr	60.45	66.15	0.0008	12753	26.94	22.86
WB1b_up	025-yr	60.79	66.15	0.0009	14611	34.06	28.49
WB1b_up	050-yr	61.07	66.15	0.0010	16097	40.07	33.08
WB1b_up	100-yr	61.37	66.15	0.0011	17641	46.60	37.91
WB1c_dn	002-yr	59.87	64.00	0.0003	5241	23.23	23.21
WB1c_dn	010-yr	60.41	64.00	0.0004	6078	41.96	41.96
WB1c_dn	025-yr	60.62	64.00	0.0004	6390	51.35	51.34
WB1c_dn	050-yr	60.76	64.00	0.0004	6571	57.82	57.82
WB1c_dn	100-yr	60.85	64.00	0.0004	6670	62.38	62.40
WB1c_up	002-yr	60.17	66.15	0.0003	11309	23.26	23.23
WB1c_up	010-yr	60.83	66.15	0.0003	15174	42.01	41.96
WB1c_up	025-yr	61.12	66.15	0.0004	16877	51.38	51.35
WB1c_up	050-yr	61.32	66.15	0.0004	18014	57.85	57.82
WB1c_up	100-yr	61.48	66.15	0.0004	18816	62.38	62.38
WB1d_dn	002-yr	60.21	64.00	0.0003	1538	23.14	23.14
WB1d_dn	010-yr	60.86	64.00	0.0003	1679	41.81	41.80
WB1d_dn	025-yr	61.16	64.00	0.0004	1686	51.13	51.12
WB1d_dn	050-yr	61.36	64.00	0.0004	1655	57.56	57.56
WB1d_dn	100-yr	61.51	64.00	0.0004	1590	62.08	62.08
WB1d_up	002-yr	60.39	65.99	0.0003	33326	23.57	23.14
WB1d_up	010-yr	61.13	65.99	0.0004	46535	42.62	41.81
WB1d_up	025-yr	61.49	65.99	0.0004	52845	52.12	51.13
WB1d_up	050-yr	61.75	65.99	0.0004	57458	58.66	57.56
WB1d_up	100-yr	61.98	65.99	0.0004	61423	63.21	62.08
WB1e_dn	002-yr	60.42	64.00	0.0003	1857	22.31	22.27
WB1e_dn	010-yr	61.15	64.00	0.0003	1933	40.49	40.44
WB1e_dn	025-yr	61.51	64.00	0.0004	1812	49.48	49.43
WB1e_dn	050-yr	61.77	64.00	0.0004	1612	55.64	55.59
WB1e_dn	100-yr	61.99	64.00	0.0004	1593	59.82	59.80
WB1e_up	002-yr	60.70	66.50	0.0003	198483	44.67	22.31
WB1e_up	010-yr	61.51	66.50	0.0004	291960	89.03	40.49
WB1e_up	025-yr	61.94	66.50	0.0004	342611	116.30	49.48
WB1e_up	050-yr	62.31	66.50	0.0004	385260	139.60	55.64
WB1e_up	100-yr	62.73	66.50	0.0005	433336	165.12	59.82
WB3	002-yr	56.90	64.30	0.0000	0	35.47	0.00
WB3	010-yr	56.90	64.30	0.0000	0	72.75	0.00
WB3	025-yr	56.90	64.30	0.0000	0	95.92	0.00
WB3	050-yr	56.90	64.30	0.0000	0	115.90	0.00
WB3	100-yr	56.90	64.30	0.0000	0	137.85	0.00

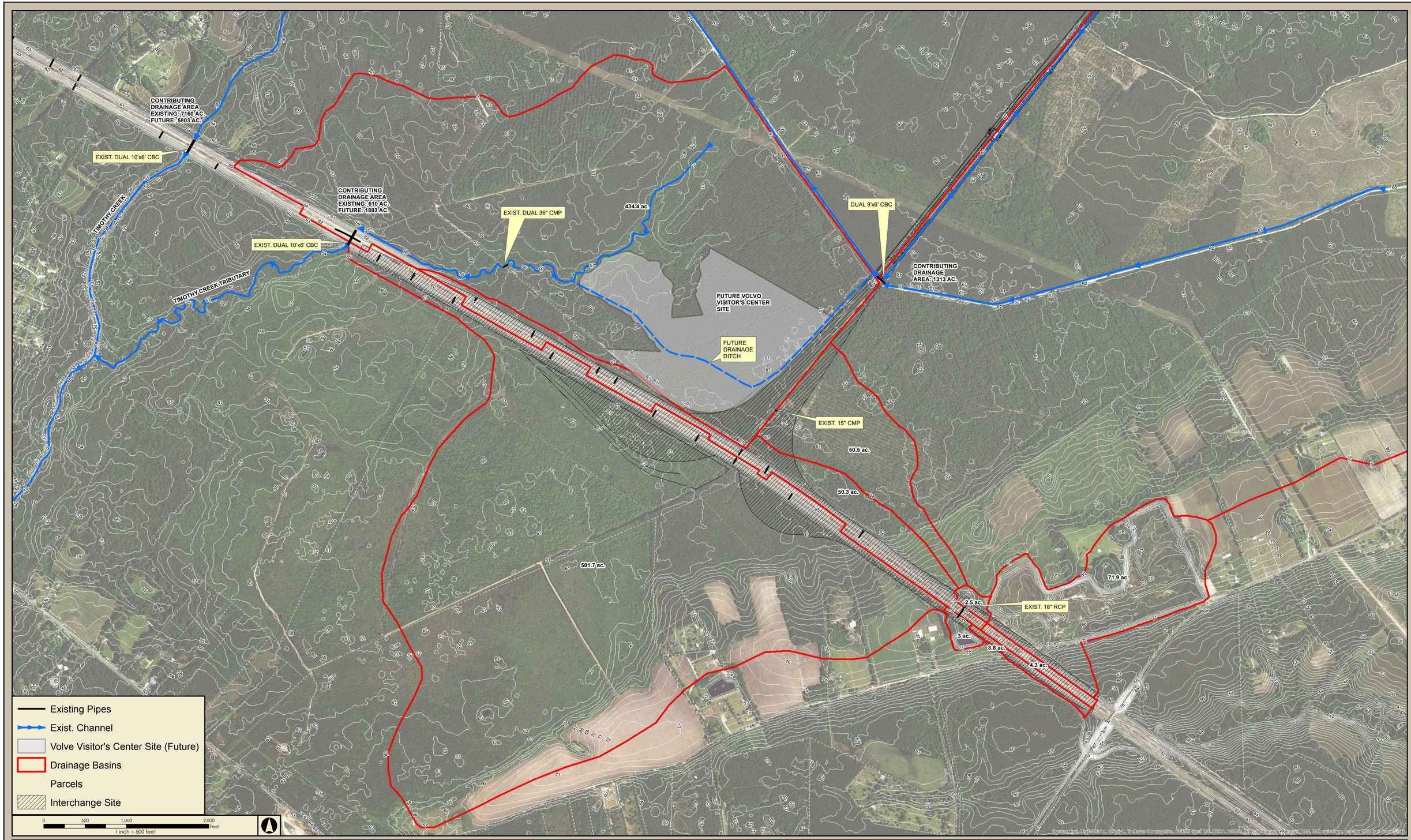
HYDROLOGY AND HYDRAULICS
BASIS OF DESIGN
I-26/VOLVO CARS DRIVE INTERCHANGE
EXIT 189 FOR PROJECT SOTER

EXHIBITS

J – 25644.0006

Prepared by:

THOMAS & HUTTON



Job Number: 25644.0006	Produced: 1/18/16	Produced By: BJB	Modified: 5/12/16
Modified By: BJB			
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Vertical Datum:			

Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Sub Basins	T&H	2016
Project Site	T&H	2016
Channels	T&H	2015
Contours	Berkeley County/Dorchester County	varies
Basemap	ESRI	varies

DISCLAIMER
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I-26 Interchange - Exit 189

Berkeley County, South Carolina

Existing Conditions - Culvert and Off-Site Drainage

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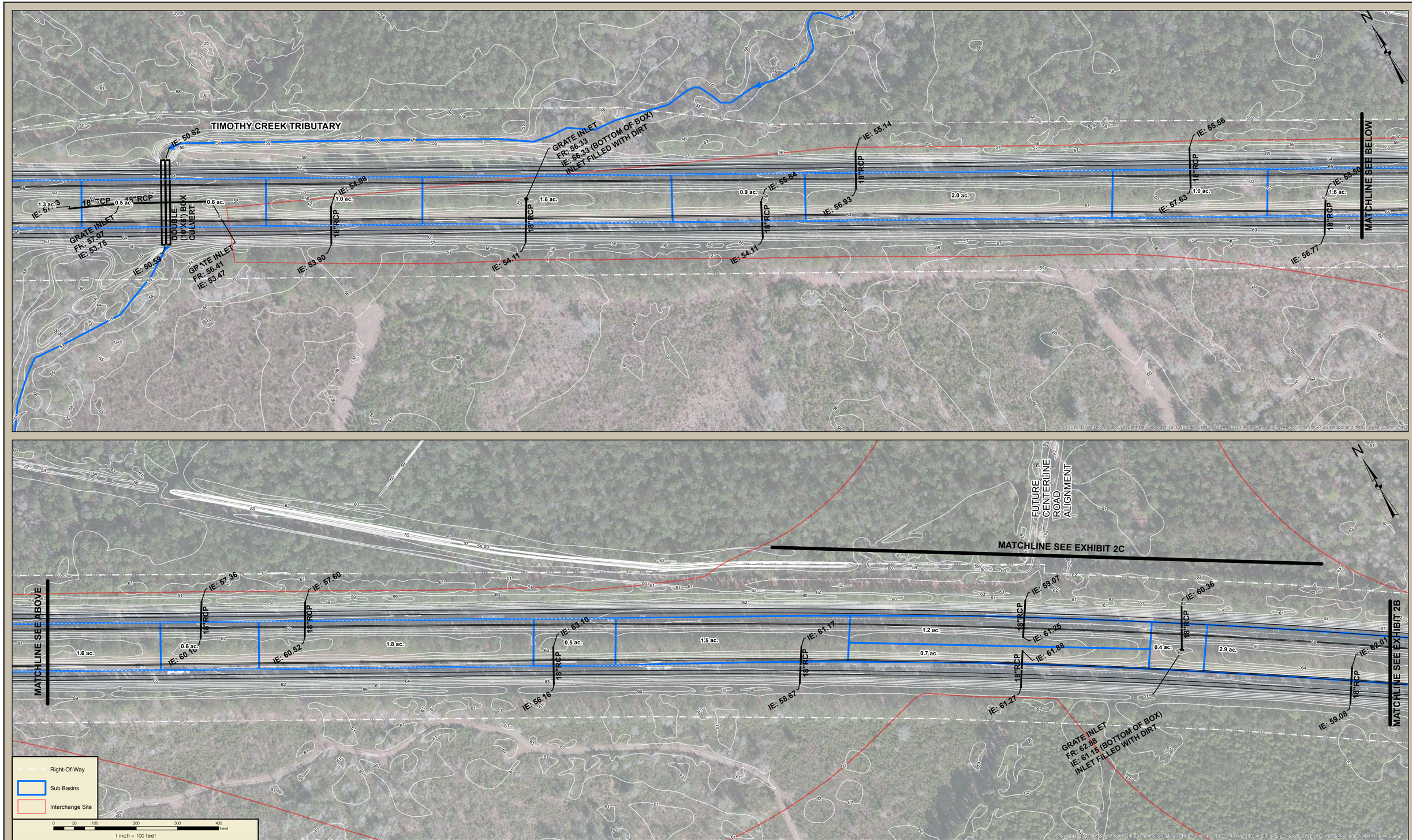
I-26 Interchange - Exit 189 : Existing Conditions

Exhibit 1



Job Number: 25644.0006	Produced: 5/12/16	Produced By: BJB	Modified:	Modified By:
File: T:\25644\25644.0006\GIS\Mxd\Exit 189 Existing Drainage Exhibit 2A.mxd				Vertical Datum:

Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Sub Basins	T&H	2016
Project Site	T&H	2016
Highway/ROW	T&H (Survey)	2015
Contours	T&H (Survey)	2015
Basemap	ESRI	varies

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I-26 Interchange - Exit 189

Berkeley County, South Carolina

Existing Conditions - Roadway Drainage

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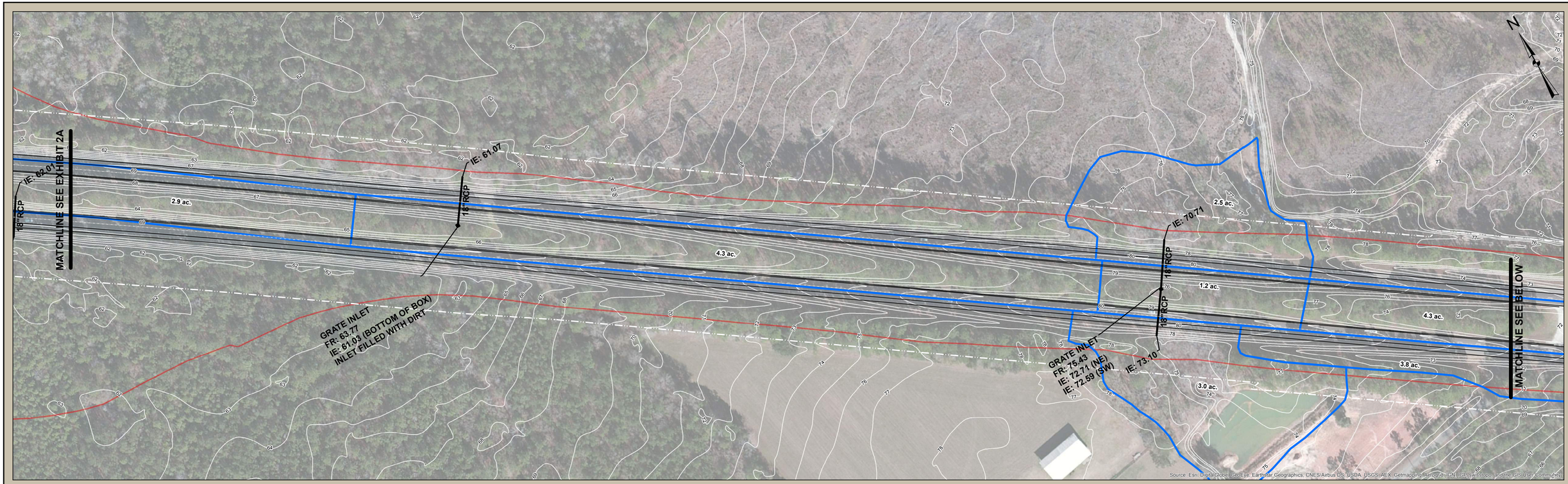
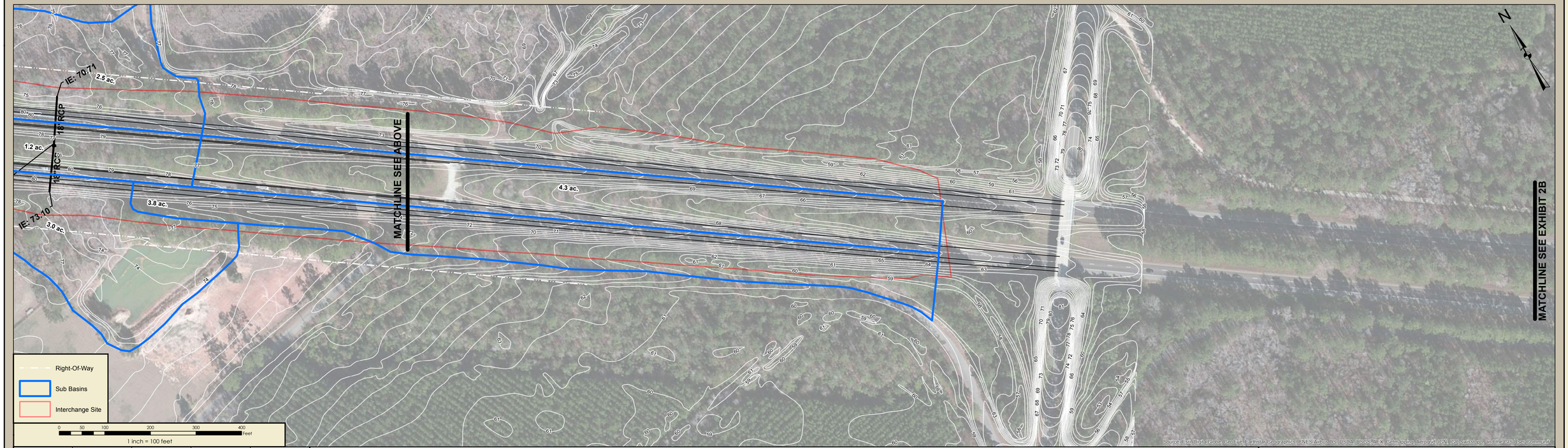
I-26 Interchange - Exit 189 : Existing Conditions - Roadway Drainage

Exhibit 2A





Right-Of-Way

Sub Basins

Interchange Site

0 50 100 200 300 400 Feet

1 inch = 100 feet

Job Number: 25644.0006	Produced: 5/12/16	Produced By: BJB	Modified:	Modified By:
File: T:\25644\25644.0006\GIS\Mxd\Exit 189 Existing Drainage Exhibit 2B.mxd				Vertical Datum:

Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Sub Basins	T&H	2016
Project Site	T&H	2016
Highway/ROW	T&H (Survey)	2015
Contours	T&H (Survey)	2015
Basemap	ESRI	varies

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I-26 Interchange - Exit 189

Berkeley County, South Carolina

Existing Conditions - Roadway Drainage

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I-26 Interchange - Exit 189 : Existing Conditions - Roadway Drainage

Exhibit 2B

Job Number: 25644.0006	Produced: 5/12/16	Produced By: BJB	Modified:	Modified By:
File: T:\25644\25644.0006\GIS\Mxd\Exit 189 Existing Drainage Exhibit 2C.mxd				Vertical Datum:

Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Sub Basins	T&H	2016
Project Site	T&H	2016
Highway/ROW	T&H (Survey)	2015
Contours	T&H (Survey)	2015
Basemap	ESRI	varies

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I-26 Interchange - Exit 189

Berkeley County, South Carolina

Existing Conditions - Roadway Drainage

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I-26 Interchange - Exit 189 : Existing Conditions - Roadway Drainage

Exhibit 2C

Job Number: 25644.0006	Produced: 06/08/16	Produced By: HEH	Modified: 6/8/2016	Modified By:
File: Z:\25644\25644.0006\GIS\Mxd\Existing Conditions ICPR Exhibit.mxd				Vertical Datum:

Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Sub-Basins, Nodes, Links, Tc	T&H	2016
Parcels	Berkeley/Dorchester County	2015/2013
Contours	Berkeley/Dorchester County	2009

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I-26/Volvo Cars Drive Interchange, Exit 189

Berkeley County, SC

Existing Conditions ICPR Exhibit

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I-26/Volvo Cars Drive Interchange, Exit 189: Existing Conditions ICPR Exhibit

Exhibit 3A

I-26/Volvo Cars Drive Interchange, Exit 189 : Post-Development ICPR Exhibit

EB1a
WB1a
WB1a 15.45 ac.
EB1b_up
EB1b_dn
WB1b_dn
WB1b_up
EB1b 19.78 ac.
WB1b 10.52 ac.
EB1c_dn
EB1c_up
EB1d_dn
EB1d_up
EB1c 25.01 ac.
EB1d 11.85 ac.
EB1e_dn
EB1e_up
EB1a 401.14 ac.
EB1e 43.36 ac.
CLLT
CLRT
CLLT 1.25 ac.
CLRT 27.30 ac.
WB1d 7.41 ac.
WB1c 0.94 ac.
WB1c_dn
WB1c_up
WB1d_up
WB1d_dn
WB1e_dn
WB1e_up
WB1e 81.56 ac.
Berkeley County
Dorchester County
WB3 71.89 ac.
X 6.58 ac.
MED 4.29 ac.
EB2 3.76 ac.
WB3
MED
EB2

Nodes
Time of Concentration
Links
Sub-Basins
County Line
Parcels
Contours

DEM

Value

High : 81.6293

Low : 41.8437

0 200 400 800 1,200 1,600 2,000 Feet

1 inch = 400 feet

Job Number: 25644.0006	Produced: 06/08/16	Produced By: HEH	Modified: 6/8/2016	Modified By:
File: Z:\25644\25644.0006\GIS\Mxd\Post-Development ICPR Exhibit.mxd				Vertical Datum:

Thomas & Hutton compiled the map information from the following sources:

Data	Source	Date
Sub-Basins, Nodes, Links, Tc	T&H	2016
Parcels	Berkeley/Dorchester County	2015/2013
Contours	Berkeley/Dorchester County	2009

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I-26/Volvo Cars Drive Interchange, Exit 189

Berkeley County, SC

Post-Development ICPR Exhibit

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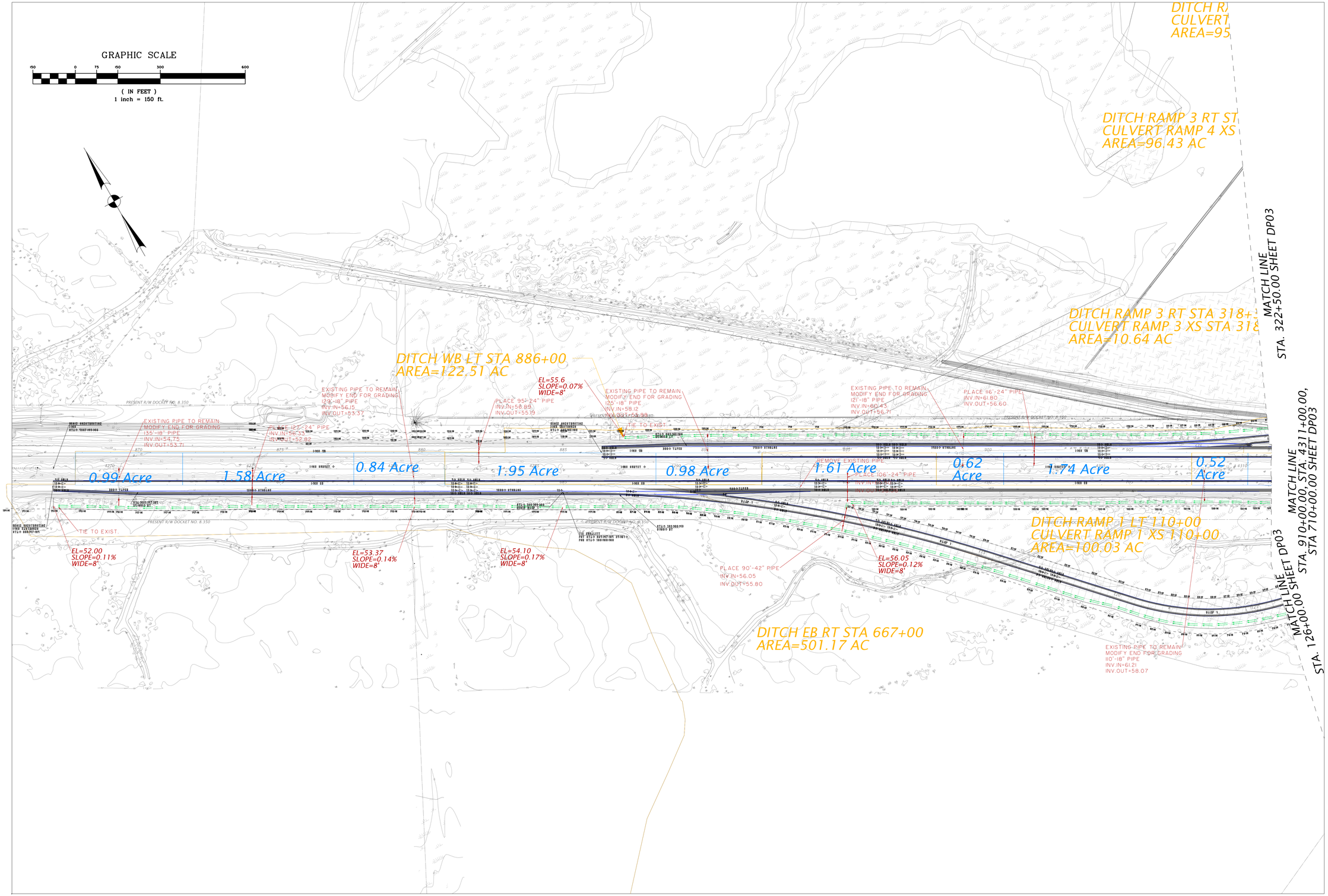
Exhibit 3B



SOUTH CAROLINA PROFESSIONAL ENGINEER REGISTERED NO. 19083 DOYLE D. KELLEY JR.

SOUTH CAROLINA THOMAS & HUTTON ENGINEERING CO. No. C00285 CERTIFICATE OF AUTHORIZATION

NO.	REVISIONS	BY	DATE

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BERKELEY COUNTY
BERKELEY COUNTY, S.C.

I-26 INTERCHANGE-EXIT 189

DRAINAGE PLAN

JOB NO:	J-25644.1005
DATE:	
DRAWN:	
DESIGNED:	
REVIEWED:	
APPROVED:	
SCALE:	AS NOTED

DP01

GRAPHIC SCALE

150 0 75 150 300 600

(IN FEET)

1 inch = 150 ft.

MATCH LINE
STA. 931+00.00, STA. 4332+00.00,
STA 731+00.00 SHEET DP03

9+00
A 219+00

PLACE 132'-30" PIPE
INV.IN=61.40
INV.OUT=60.50

PLACE 127'-30" PIPE
INV.IN=71.50
INV.OUT=70.70

PLACE 114'-24" PIPE
INV.IN=75.09
INV.OUT=72.00

PLACE 86'-30" PIPE
INV.IN=61.20
INV.OUT=61.00

DITCH RAMP4 RT STA 443+00
CULVERT RAMP 4 XS STA 443+00
AREA=43.36AC

EL=61.1
SLOPE=0.15%
WIDE=8'

4.30 Acre

1.15 Acre

2.97 Acre

4.29 Acre

DITCH WB LT STA 971+50
AREA=71.89 AC

DITCH EB RT STA 771+50
AREA=3.76 AC

TIE TO EXIST

TIE TO EXIST

PRESENT R/W

PRESENT R/W DOCKET NO. R-450

PRESENT R/W DOCKET NO. R-330

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NO. 19083

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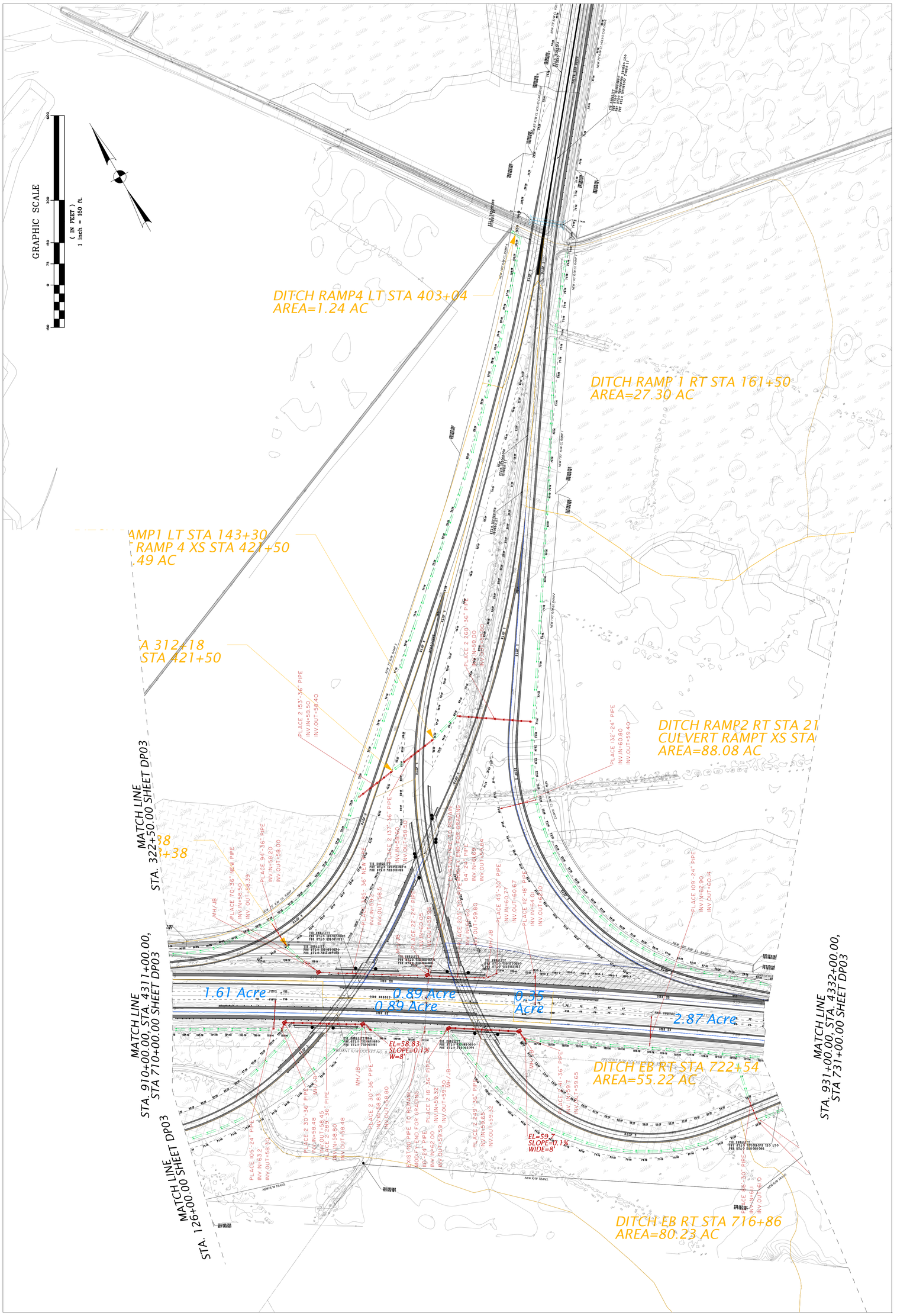
BERKELEY COUNTY
BERKELEY COUNTY, S.C.

I-26 INTERCHANGE-EXIT 189

DRAINAGE PLAN

JOB NO:	J-25644.1005
DATE:	
DRAWN:	
DESIGNED:	
REVIEWED:	
APPROVED:	
SCALE:	AS NOTED

DP02



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BERKELEY COUNTY
BERKELEY COUNTY, S.C.
I-26 INTERCHANGE-EXIT 189
DRAINAGE PLAN

JOB NO: J-25644.005
DATE:
DRAWN:
DESIGNED:
REVIEWED:
APPROVED:
SCALE: AS NOTED

DP03

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER
NO. 19085
JOYCE D. KELLEY, JR.

SOUTH CAROLINA
THOMAS & HUTTON ENGINEERING CO.
CERTIFICATE OF AUTHORIZATION
No. C00285

NO.	REVISIONS	BY	DATE

GRAPHIC SCALE

500 0 250 500 1000 2000

(IN FEET)

1 inch = 500 ft.

DITCH RAMP 4 LT STA 405+00
AREA=1.24 AC

DITCH RAMP 1 RT STA 192+00
AREA=7.30 AC

DITCH RAMP 1 LT STA 141+00
CULVERT RAMP 4 XS STA 141+50
AREA=95.69 AC

DITCH RAMP 3 RT STA 312+75
CULVERT RAMP 4 XS STA 311+50
AREA=56.13 AC

DITCH RAMP 2 RT STA 219+00
CULVERT RAMP 2 XS STA 219+00
AREA=88.08 AC

DITCH RAMP 3 RT STA 318+18
CULVERT RAMP 3 XS STA 315+58
AREA=19.94 AC

DITCH RAMP 2 RT STA 221+00
AREA=2.78 AC

DITCH RAMP 2 RT STA 886+00
AREA=4.77 AC

DITCH RAMP 2 RT STA 221+00
AREA=2.78 AC

DITCH RAMP 2 RT STA 221+00
AREA=55.22 AC

DITCH 18 RT STA 667+00
AREA=60.17 AC

DITCH RAMP 3 RT STA 771+00
AREA=5.79 AC

DITCH RAMP 3 RT STA 771+00
AREA=2.78 AC

DITCH RAMP 3 RT STA 441+50
CULVERT RAMP 4 XS STA 443+50
AREA=5.71 AC

DITCH RAMP 3 RT STA 716+80
AREA=80.78 AC

DITCH RAMP 3 RT STA 771+00
AREA=5.79 AC

SOUTH CAROLINA PROFESSIONAL ENGINEER
NO. 19083
REGISTERED
STEVEN D. KELLY

SOUTH CAROLINA
THOMAS & HUTTON ENGINEERING CO.
No. C00285
CERTIFICATE OF AUTHORIZATION
NO 1X21 80

THOMAS & HUTTON
Engineering | Surveying | Planning | GIS | Consulting
50 Park of Commerce Way
Savannah, GA 31405 • 912.234.5300
www.thomasandhutton.com

NO.	REVISIONS	BY	DATE

BERKELEY COUNTY
BERKELEY COUNTY, S.C.

I-26 INTERCHANGE - EXIT 189

DRAINAGE AREA MAP

JOB NO:	J-25644.1005
DATE:	
DRAWN:	
DESIGNED:	
REVIEWED:	
APPROVED:	
SCALE:	AS NOTED

DAM1