MEMO

TO:	**City of Lee's Summit** Attn: Gene Williams
FROM:	**Olsson** Terry Parsons, PE
RE:	Preliminary RCB Sizing - SE Cape Drive Extension
DATE:	January 15, 2024
PROJECT #:	020-0103

Background

A preliminary hydrologic and hydraulic analysis was performed to determine the culvert sizing for the proposed extension of SE Cape Drive, just south of the East Trails Middle School, in Lee's Summit, MO.

Hydrologic Analysis

Peak flows to the proposed reinforced concrete box culvert (RCB) were determined using HEC-HMS for a 24-Hour SCS Type II rainfall distribution. Calculations were performed to determine curve numbers and times of concentration for the contributing area to the proposed culvert, which were then used to determine peak flows. For this analysis, the drainage area was split at Bailey Drive. A separate hydrologic analysis was previously completed by Olsson for the East Trails Middle School. This area was separated from the current analysis; peak flows from the previous analysis were added to peak flows from the current analysis to determine overall peak flows to the proposed RCB for the entire contributing drainage area. Table 1 contains a summary of the hydrologic parameters. NRCS rainfall depths for Jackson County, MO were used in this analysis (100-year storm depth = 7.7 inches).

Table 1. Hydrologic Parameters.

Drainage Area	Area (acres)	Curve Number	Time of Concentration (minutes)
N of Bailey Drive	79.4	84	17.2
S of Bailey Drive	96.3	78	19.4
East Trails Middle School	30.4	-	-
Total	206.1	-	-

Hydraulic Analysis

SE Cape Drive is classified as a residential road and has an open channel downstream of the proposed culvert. The minimum design storm capacity for this classification is the 25-year storm, with 7-inches or less of overtopping in the 100-year storm per Table 5601-1 of APWA 5600. HY-8 was used to determine a sizing for the proposed culvert. A double 10- foot (span) by 5-foot (rise) RCB, a double 9-foot by 5-foot and a double 8-foot x 5-foot RCB were all tested using the same peak flows, Table 2 summarizes the results from the hydraulic analysis.

Table 2. Hydraulic Analysis Results.

Culvert Size	Headwater El.	Return Interval	Peak Flow (cfs)	RCB Discharge (cfs)	Control Type
Double 10' x 5'	986.10	100-year	1,131.00	1,131.00	Inlet
Double 9' x 5'	986.94	100-year	1,131.00	1,118.76	Inlet
Double 8' x 5'	987.36	100-year	1,131.00	1,035.34	Inlet

*Roadway low point elevation = 986.8 feet

After discussions with the city an additional requirement was added to make sure no water would impede the road's right-of-way. This means that although the 8-foot wide double RCB succeeded in passing the APWA 5600 requirements, it will be an unacceptable design for this project as the projected flooding surpasses the right-of-way line. The 10-foot and 9-foot wide double RCB also meet APWA requirements, but do not encroach the right-of-way line. Both boxes also fully pass the 25-Year storm event through the culvert, therefore, both sizes meet all requirements for this project. The spatial location of the 9-foot-wide box's floodplain can be found in the accompanying topographic work map for this memo.

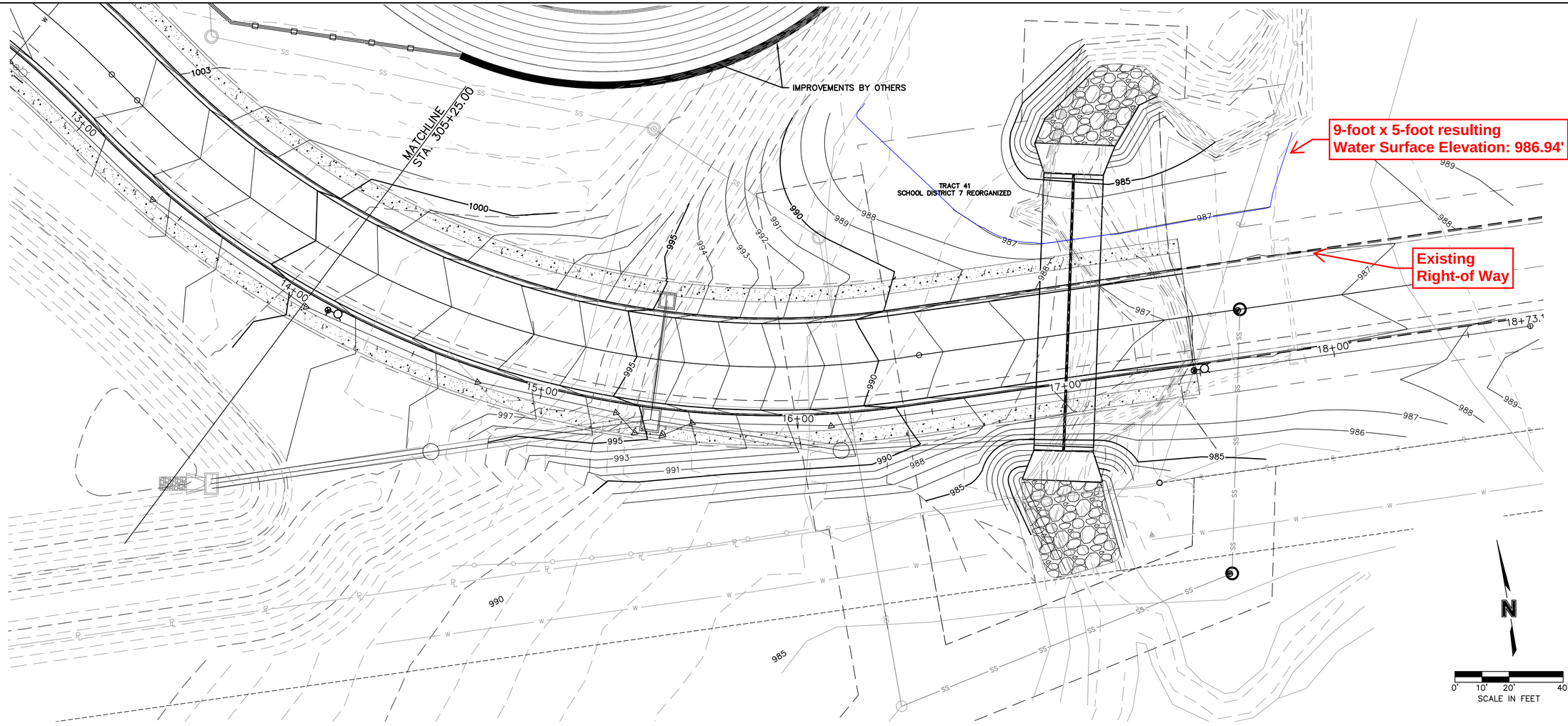
Summary

A preliminary hydrologic and hydraulic analysis was performed to determine a proposed culvert size for the SE Cape Drive Extension project. After this was completed, a final design was determined by testing multiple double RCB sizes in the hydraulic HY-8 model. The results show that a double 10-foot by 5-foot RCB and 9-foot by 5-foot RCB meet all requirements laid out for this project. It is Olsson's recommendation to move forward with the double 9-foot wide RCB for cost reasons, although it does not fully pass the 100-year flows.

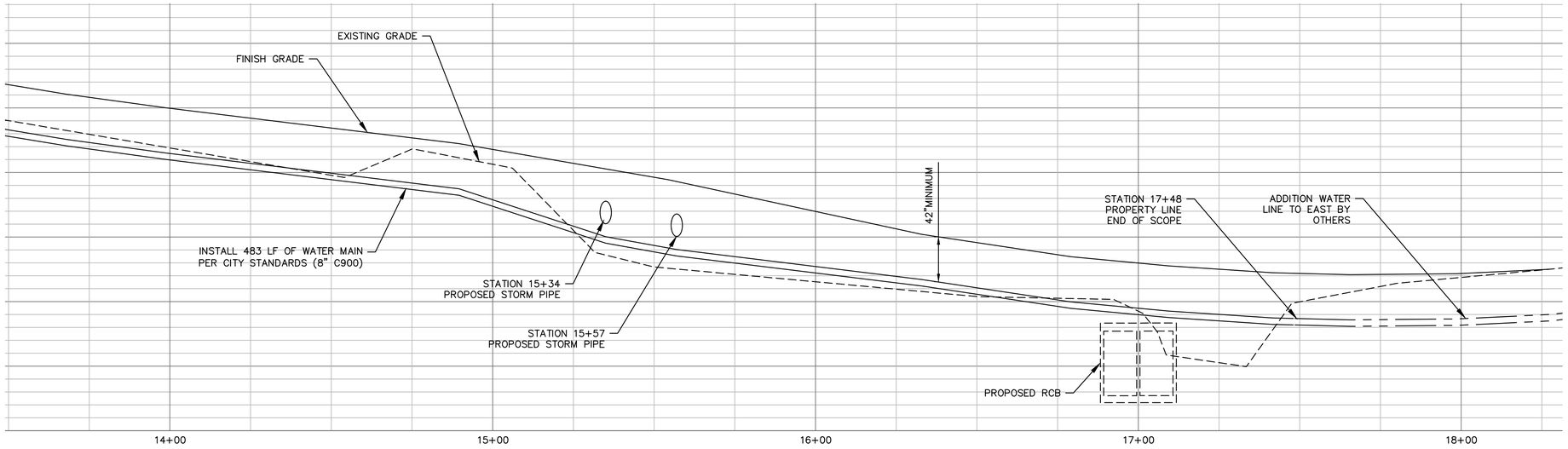
Please feel free to reach out to me with any additional questions at tgillespie@olsson.com or 913.294.7588.

Thanks,

Terry M. Parsons, PE



SE CAPE DRIVE



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REVISIONS

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

WATERMAIN EXTENSION PLAN & PROFILE
SE CAPE DRIVE

LEE'S SUMMIT MIDDLE SCHOOL #4
EXHIBIT A

2022

LEE'S SUMMIT, MISSOURI

C.O.A. NO.: 001592
DRAWN BY: RLK
CHECKED BY: TP
APPROVED BY: TP
QA/QC BY: TP
PROJECT NO.: 020-0103
DRAWING: 20230215_cape_waterC_CAPE_0200103 Exhibit
DATE: 2021-02-01

SHEET
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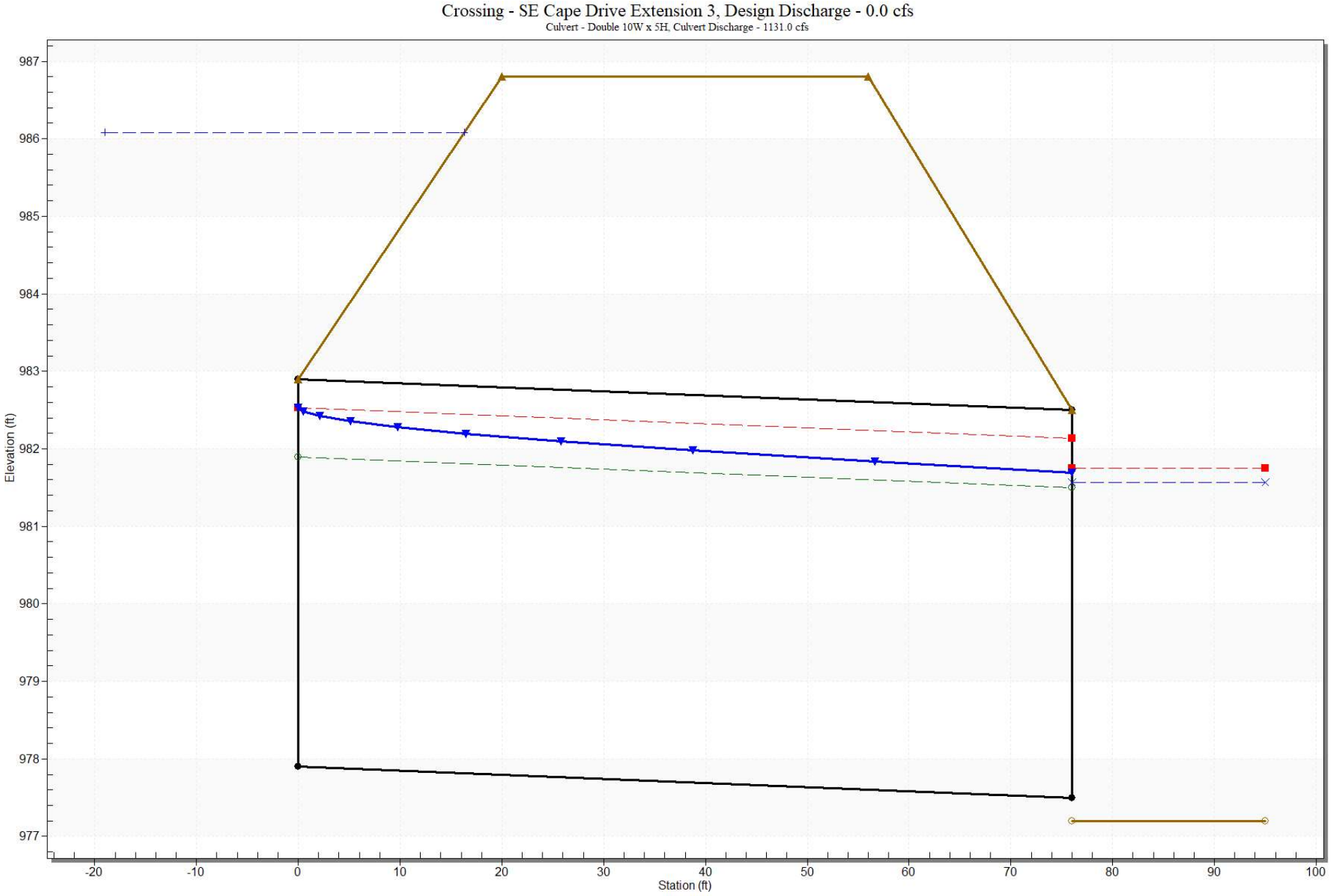
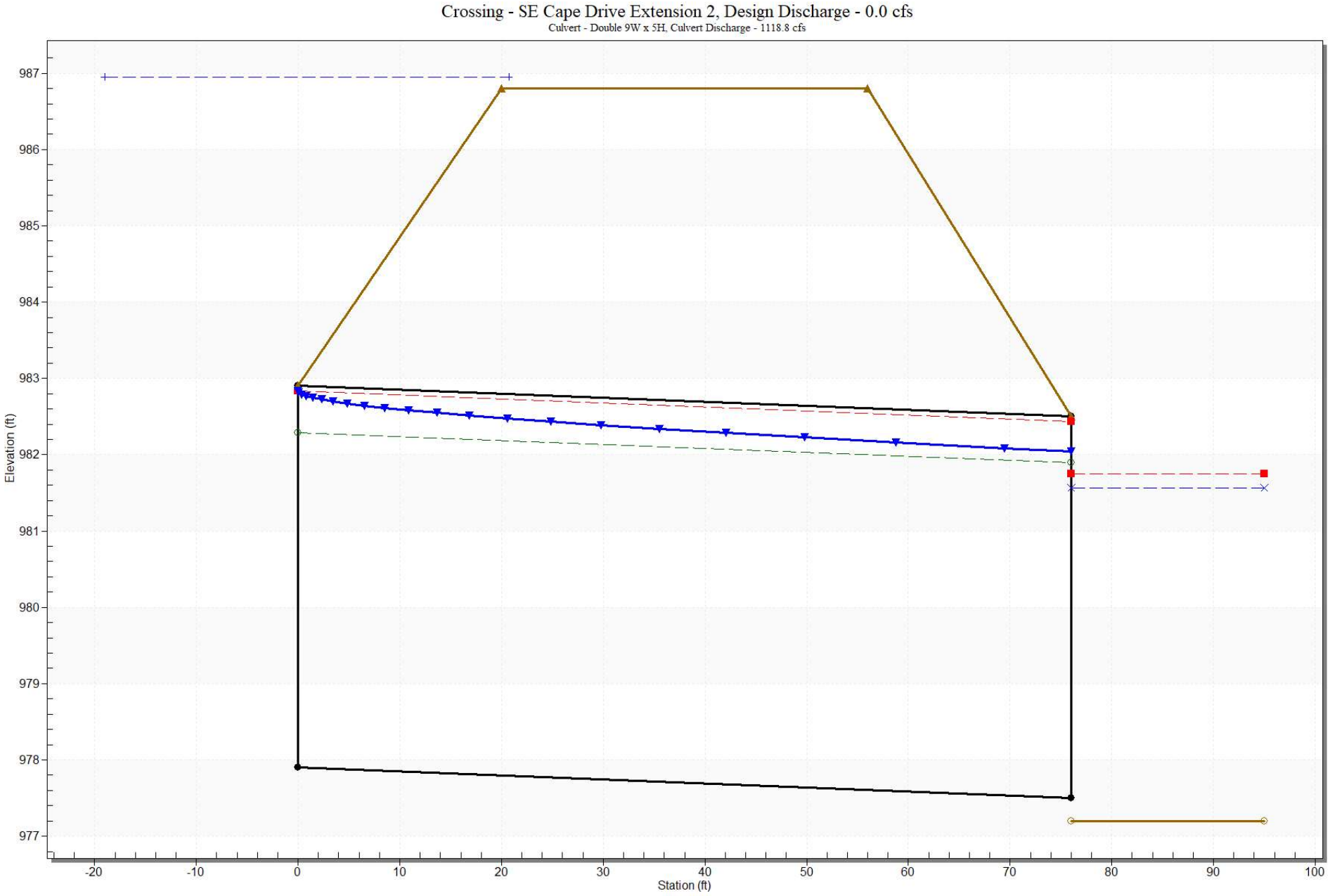
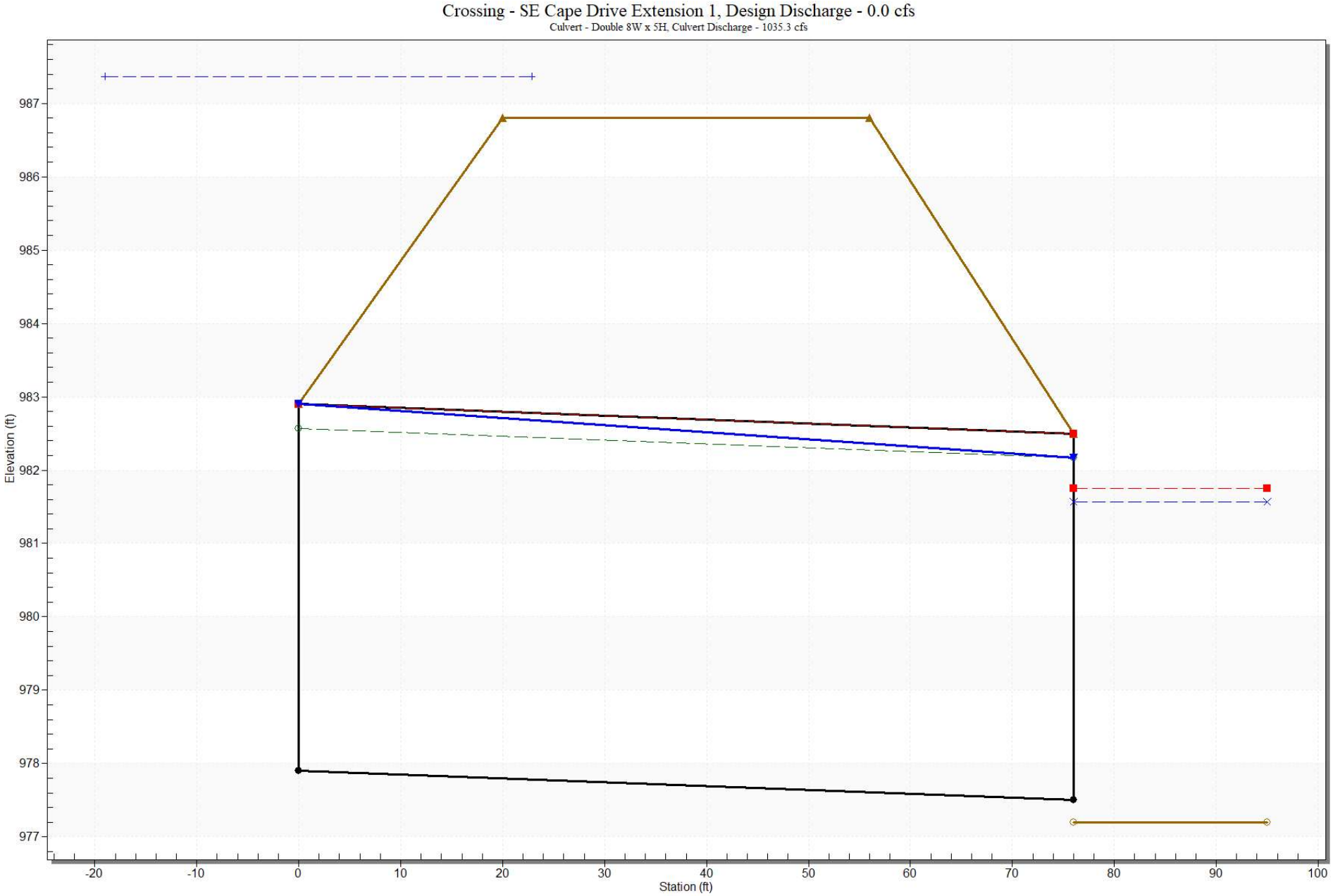
Culvert Crossing: SE Cape Drive Double 9’ x 5’ RCB

Crossing Summary Table

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Double 9W x 5H Discharge (cfs)	Roadway Discharge (cfs)	Iterations
983.58	10 year	677.00	677.00	0.00	1
984.95	25 year	873.40	873.40	0.00	1
986.95	100 year	1131.00	1118.77	12.22	4
986.80	Overtopping	1102.32	1102.32	0.00	Overtopping


Crossing - SE Cape Drive Extension 3, Design Discharge - 0.0 cfs
Culvert - Double 10W x 5H, Culvert Discharge - 1131.0 cfs
Elevation (ft)
987
986
985
984
983
982
981
980
979
978
977
-20
-10
0
10
20
30
40
50
60
70
80
90
100
Station (ft)


Crossing - SE Cape Drive Extension 2, Design Discharge - 0.0 cfs
Culvert - Double 9W x 5H, Culvert Discharge - 1118.8 cfs
Elevation (ft)
987
986
985
984
983
982
981
980
979
978
977
-20
-10
0
10
20
30
40
50
60
70
80
90
100
Station (ft)


Crossing - SE Cape Drive Extension 1, Design Discharge - 0.0 cfs
Culvert - Double 8W x 5H, Culvert Discharge - 1035.3 cfs
Elevation (ft)
987
986
985
984
983
982
981
980
979
978
977
-20
-10
0
10
20
30
40
50
60
70
80
90
100
Station (ft)