DRAINAGE MEMORANDUM
BADGER GULCH PARK
RIDGEGATE EAST FILING NO. 4

DATE: 09/23/2024

TO: JACOB JAMES
CITY OF LONE TREE – PUBLIC WORKS

FROM: CARSON BESGROVE, PE
PROJECT MANAGER
MERRICK & COMPANY

RE: DRAINAGE MEMO FOR BADGER GULCH PARK

Mr. Samson,

The purpose of this memo is to confirm that the proposed Badger Gulch Park Project is in conformance with the previous approved drainage studies. Badger Gulch Park is located in RidgeGate East Filing No. 4, Tracts A and B. The total site area is approximately 3 acres.

The site is bounded by Crossfield Street and Lot 3 to the west, Lot 3 and Ridgegate Parkway (westbound) to the north, and Ridgegate Parkway (eastbound) to the east and south. The site is within the Badger Gulch Drainage Basin, the Badger Gulch 100-year floodplain bisects the project site. Badger Gulch flows from the south end of the project site north towards and under Ridgegate Parkway (westbound).

The proposed project includes trails, passive and active park areas, native riparian areas, and a pedestrian bridge spanning the Badger Gulch 100-year floodplain. A majority of the passive and active park areas will be located on the western portion of the site within Tract A and directly south of Lot 3. The central and eastern half of the site will consist of trails, natural riparian areas, and the pedestrian bridge. Runoff from the passive and active park areas directly south of Lot 3 will be collected by swales, routed to inlets/storm sewer, and discharged to existing Pond 21. Pond 21 provides regional flood detention and water quality. Pond 21 discharges to Badger Gulch downstream of the site. The trails, natural riparian areas, and pedestrian bridge will drain directly to Badger Gulch via overland flow and storm sewer. Calculations for the swales, storm sewer, and inlets are provided in Appendix B.

The Point Precipitation Frequency Estimates from the NOAA Atlas 14 were used to determine the 1-hour point rainfall depth for the different recurrence intervals. Based on the 60-minute duration, the 5-year and 100-year depths for Lone Tree are 1.10 inches and 2.27 inches. The Rational Method was used to determine runoff flow rates for the design and analysis of the inlets and storm sewer. Appendix B presents the hydrologic calculations.

Per Douglas County drainage criteria, the 5-year and 100-year design storm events were used in the design of stormwater conveyance facilities. Storm drainage inlet capacities have been determine using the MHFD "UD-Inlet Version 5.03" Excel spreadsheet. Storm sewer capacities and hydraulic grade line (HGL) calculations have been determined using StormCAD. See Appendix C for inlet, storm sewer and swale calculations.

The proposed storm sewer within Tract A will connect to the storm sewer being constructed by the developer of Lot 3. The flows from Tract A will not negatively impact the Lot 3 storm sewer system.

The main governing document used for drainage design was the *Phase III Drainage Report for RidgeGate East Filing No. 3 and 4*, (Phase III Report) dated January 2024, by Merrick. The Phase III Report Pond 21 design accounted for flood detention and water quality for the western portion of Tract A.

A portion of Tract A (Basin W-1) falls within Basin E190 as identified in the Phase III Report. The CUHP Drainage Map from the Phase III Report is included in Appendix A. The table below presents the imperviousness for Basin E190 and the proposed imperviousness for Basin W-1.

	Imperviousness (%)
Phase III Report, Basin E190	77.6
Proposed Imperviousness, Basin W-1	40.8

The proposed imperviousness will be lower than the Pond 21 design imperviousness for this area. The Site's water quality volume and discharge flow rates are anticipated to be lower than the Pond 21 design and will have no negative impact on the existing detention facility. No pond modifications are required to support the proposed site.

The Project is in general conformance with the Phase III Report and previous approved drainage reports. If you have any questions or need additional information, please let me know.

Sincerely,

MERRICK

Carson Besgrove

Digitally signed by Carson Besgrove
DN: C=US, E=carson.besgrove@merrick.com, O=Merrick, CN=Carson Besgrove
Date: 2024.09.23 13:25:31-06'00'

Carson Besgrove, PE

Project Manager

Appendix A

References

PHASE III DRAINAGE REPORT
RIDGEGATE EAST FILING NO. 3 AND 4
JAN 2024

A304a
A314
A315
E200
E190
E180
A280
A285
A304b

UNPLATTED (RGI)
RIDGEGATE PARKWAY (WEST BOUND)
RIDGEGATE PARKWAY (EASTBOUND)
RHAPSODY ROAD
HIGH NOTE AVE
LOT 1 (RGI)
LOT 2 (RGI)
LOT 3 (RGI)
LOT 4 (RGI)
LOT 5 (RGI)
LOT 6 (RGI)
LOT 7 (RGI)
TRACT A (RGI)
TRACT B (RGI)
POND 21
EX WQ POND E
BADGER GULCH
FLOODPLAIN

N
0 200' 400'

DRAINAGE LEGEND
CUHP BASIN LIMITS
FLOW DIRECTION

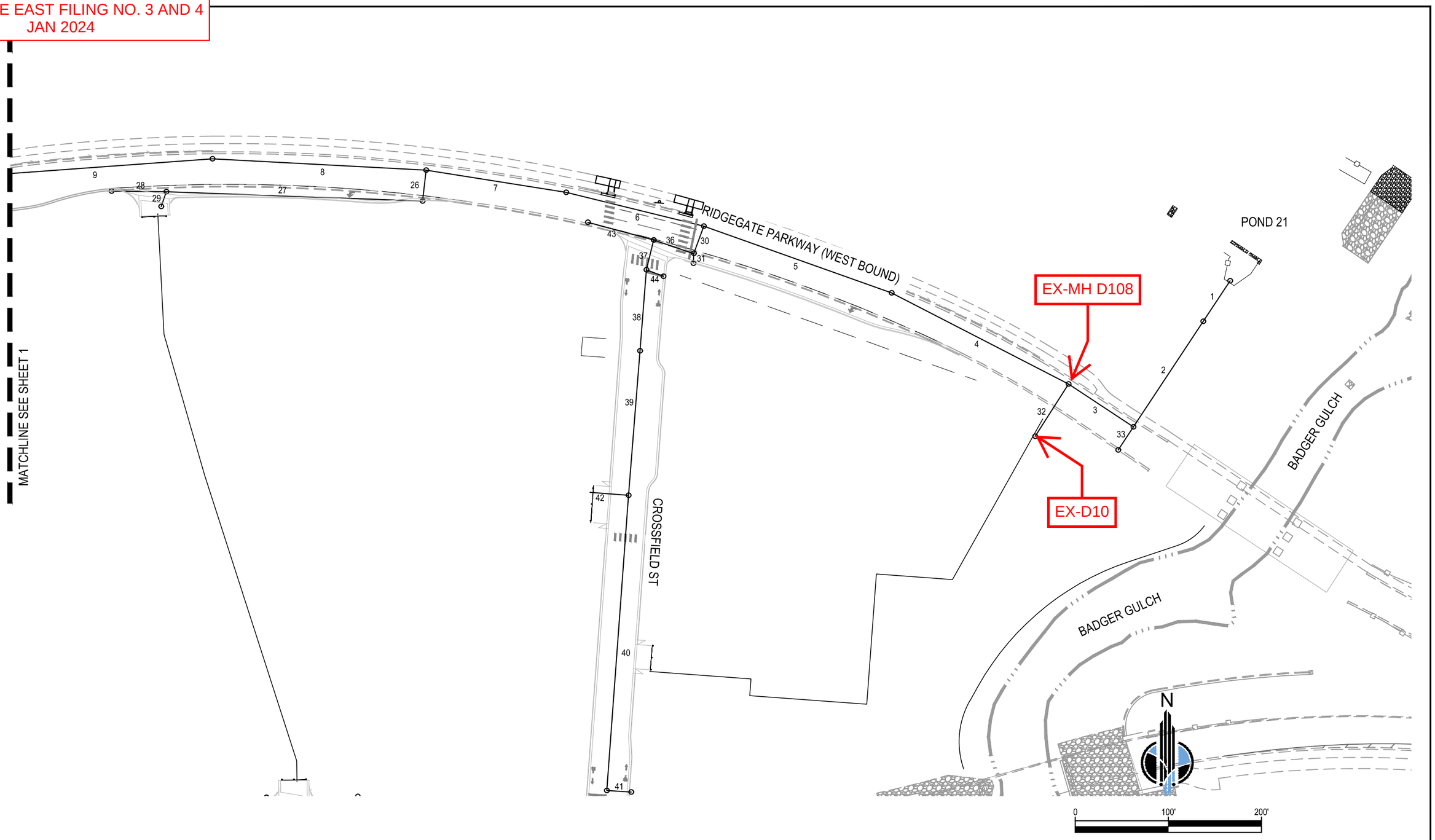
MERRICK®

RIDGEGATE EAST FILING NO. 3
CUHP DRAINAGE MAP

DATE: 3/3/2023
SHEET: 1 OF 1

File Location: O:\DEN\PROJECTS\5087-02-RRMD OVERALL EAST\PROJECTS\1240-COUPLET ROADWAY DESIGN\DESIGN\DRAINAGE\BASIN MAPS\1240-CUHP MAP.DWG PLOT DATE: 3/3/2023 LAST SAVED BY: ACRONIN

PHASE III DRAINAGE REPORT
RIDGEGATE EAST FILING NO. 3 AND 4
JAN 2024



MERRICK®

RIDGEGATE EAST FILING NO. 3 HYDRAFLOW MAP - RGPE-II STORM D	DATE: 12/14/2023 SHEET: 2 OF 3

Report

Line No.	Line ID	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Tc (min)	Flow Rate (cfs)	Line Size (in)	Line Slope (%)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Gnd/Rim El Dn (ft)	HGL Up (ft)	HGL Dn (ft)	Vel Ave (ft/s)
24	Y1	0.00	1.00	0.80	7.8	2.61	30	4.97	6015.84	6014.10	6023.53	6023.83	6016.37 j	6015.06	2.48
25	EX D6	0.00	0.82	0.77	8.7	1.98	24	0.98	6013.08	6012.79	6022.72	6023.43	6013.57	6013.20	3.83
26	EX D10/X4	0.00	0.75	0.77	10.7	21.40	36				1.61	6011.94	6002.79 j	6002.64	5.43
27	X101	0.00	0.00	0.00	9.6	20.55	30				0.34	6011.61	6009.00	6002.82	8.70
28	X1	0.00	0.56	0.78	8.4	1.39	18	2.38	6009.86	6008.46	6021.56	6020.34	6010.30 j	6009.00	2.82
29	X100	0.00	7.68	0.83	7.5	21.07	30	1.79	6007.96	6007.66	6011.58	6020.34	6009.52	6009.00	7.21
30	W1	0.00	0.00	0.00	24.2	6.14	30	1.75	5986.79	5986.23	5996.93	5997.01	5987.61 j	5987.73	3.19
31	W2	0.00	0.17	0.71	5.0	0.45	18	2.47	5988.05	5987.80	5996.91	5996.93	5988.30	5987.97	3.21
32	EX D11	0.00	7.37	0.83	8.4	19.44	36	1.01	5976.01	5975.34	5984.00	5985.00	5977.42	5976.74	5.96
33	EX D13	0.00	1.41	0.78	11.0	3.15	18	7.93	5978.91	5976.53	5983.89	5984.60	5979.59	5976.86	7.49
34	Y101	0.00	0.00	0.00	13.2	36.54	42	0.60	6014.12	6013.30	6025.36	6023.83	6016.00	6015.06	7.25
35	D7-F	0.00	16.60	0.83	12.9	36.86	42	0.60	6014.58	6014.22	6023.57	6025.36	6016.46	6016.00	7.26
36	W3	0.00	0.00	0.00	23.8	5.96	30	2.41	5987.65	5986.54	5996.82	5996.93	5988.46 j	5987.61	3.66
37	W4	0.00	0.00	0.00	23.6	5.42	24	4.00	5989.12	5987.80	5999.63	5996.82	5989.94	5988.46	5.25
38	W5	0.00	0.00	0.00	23.0	4.63	24	6.22	5994.73	5989.32	6003.10	5999.63	5995.49	5989.94	4.91
39	W6	0.00	0.00	0.00	21.9	4.75	24	0.60	5996.71	5995.78	6009.77	6003.10	5997.48	5996.49	4.51
40	W7	0.00	0.00	0.00	7.1	1.08	24	0.59	5998.79	5996.91	6008.72	6009.77	5999.15 j	5997.48	2.15
41	W8	0.00	0.41	0.78	6.0	1.13	24	0.62	5999.14	5998.99	6008.23	6008.72	5999.51	5999.33	3.02
42	W9	0.00	2.39	0.83	5.7	7.14	18	2.00	6002.00	6001.17	6010.75	6009.77	6003.03	6001.90	6.91
43	W10	0.00	0.40	0.71	5.0	1.06	18	3.81	5990.36	5987.80	6002.18	5996.82	5990.74 j	5988.46	2.20
44	W11	0.00	0.54	0.81	5.0	1.63	18	4.11	5990.26	5989.30	5998.39	5999.63	5990.74 j	5989.94	2.81

LINE EX-1 INVERTS

Project File: Storm D-5yr.stm | Number of lines: 44 | Date: 11/10/2023

NOTES: ** Critical depth

Report

Line No.	Line ID	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Tc (min)	Flow Rate (cfs)	Line Size (in)	Line Slope (%)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Gnd/Rim El Dn (ft)	HGL Up (ft)	HGL Dn (ft)	Vel Ave (ft/s)
1	EX D114	0.00	0.00	0.00	26.5	75.11	54	0.50	5953.74	5953.48	5973.34	5958.94	5958.04	5957.98	4.76
2	EX D113	0.00	0.00	0.00	26.1	75.88	54	2.00	5965.23	5962.51	5984.60	5973.34	5967.77	5964.12	11.54
3	EX D112	0.00	0.00	0.00	25.8	74.19	48	1.00	5974.14	5973.31	5985.00	5984.60	5976.74	5975.35	10.03
4	EX D111	0.00	0.00	0.00	25.2	63.62	48	1.43	5977.39	5974.34	5988.89	5985.00	5979.79	5976.74	8.07
5	EX D110	0.00	0.00	0.00	24.5	64.58	48	3.61	5985.31	5977.59	5997.01	5988.89	5987.73	5979.79	8.60
6	EX D109	0.00	0.00	0.00	20.3	64.75	42	4.76	5992.92	5985.67	6004.42	5997.01	5995.44	5987.73	9.85
7	EX D108	0.00	0.00	0.00	19.9	65.40	42	4.59	6000.11	5993.12	6011.94	6004.42	6002.64	5995.44	9.22
8	EX D107	0.00	0.00	0.00	19.2	50.35	42	1.00	6002.60	6000.31	6019.33	6			7.62
9	EX D106	0.00	0.00	0.00	18.5	51.34	42	1.00	6005.11	6002.80	6023.25	6			8.42
10	EX D105	0.00	0.00	0.00	17.8	52.33	42	1.00	6007.61	6005.31	6025.00	6023.25	6009.87	6007.35	8.48
11	EX D104	0.00	0.00	0.00	16.7	17.62	36	1.00	6009.74	6008.11	6024.79	6025.00	6011.08 j	6009.87	4.92
12	EX D103	0.00	0.00	0.00	15.5	18.26	36	1.00	6011.83	6009.94	6023.43	6024.79	6013.20	6011.08	6.61
13	EX D102	0.00	0.00	0.00	14.3	17.35	36	1.00	6013.81	6012.03	6024.93	6023.43	6015.14	6013.20	6.27
14	EX D101	0.00	0.00	0.00	11.7	17.57	36	1.00	6018.01	6014.01	6029.02	6024.93	6019.35	6015.14	6.48
15	EX D100	0.00	0.00	0.00	10.0	15.25	30	1.00	6020.93	6018.51	6031.43	6029.02	6022.25	6019.57	6.78
16	EX PIPE D4/Z100	0.00	0.00	0.00	9.5	15.55	30	2.10	6023.08	6021.13	6033.43	6031.43	6024.41	6022.25	6.59
17	Z2	0.00	0.92	0.81	9.0	14.40	24	2.00	6023.81	6023.28	6033.74	6033.43	6025.18	6024.41	7.08
18	Z1	0.00	4.70	0.83	7.3	13.01	24	1.97	6024.77	6024.01	6034.01	6033.74	6026.07	6025.18	6.44
19	Z3	0.00	0.59	0.80	8.9	1.47	18	0.99	6023.57	6023.28	6033.54	6033.43	6024.02	6024.41	2.14
20	EX D2	0.00	1.48	0.79	11.6	3.28	18	8.00	6023.75	6023.15	6028.75	6029.02	6024.44	6023.49	7.60
21	EX D5	0.00	0.67	0.77	8.8	1.61	18	8.00	6019.89	6019.29	6024.89	6024.93	6020.37	6019.53	6.16
22	EX D8 PIPE/Y100	0.00	0.00	0.00	13.8	39.87	42	1.59	6013.10	6011.49	6023.83	6025.00	6015.06	6012.84	9.43
23	Y2	0.00	0.94	0.81	8.5	2.41	18	5.00	6016.83	6015.10	6023.66	6023.83	6017.42	6015.43	6.16

5-YR TAILWATER CONDITION

Project File: Storm D-5yr.stm | Number of lines: 44 | Date: 11/10/2023

NOTES: ** Critical depth

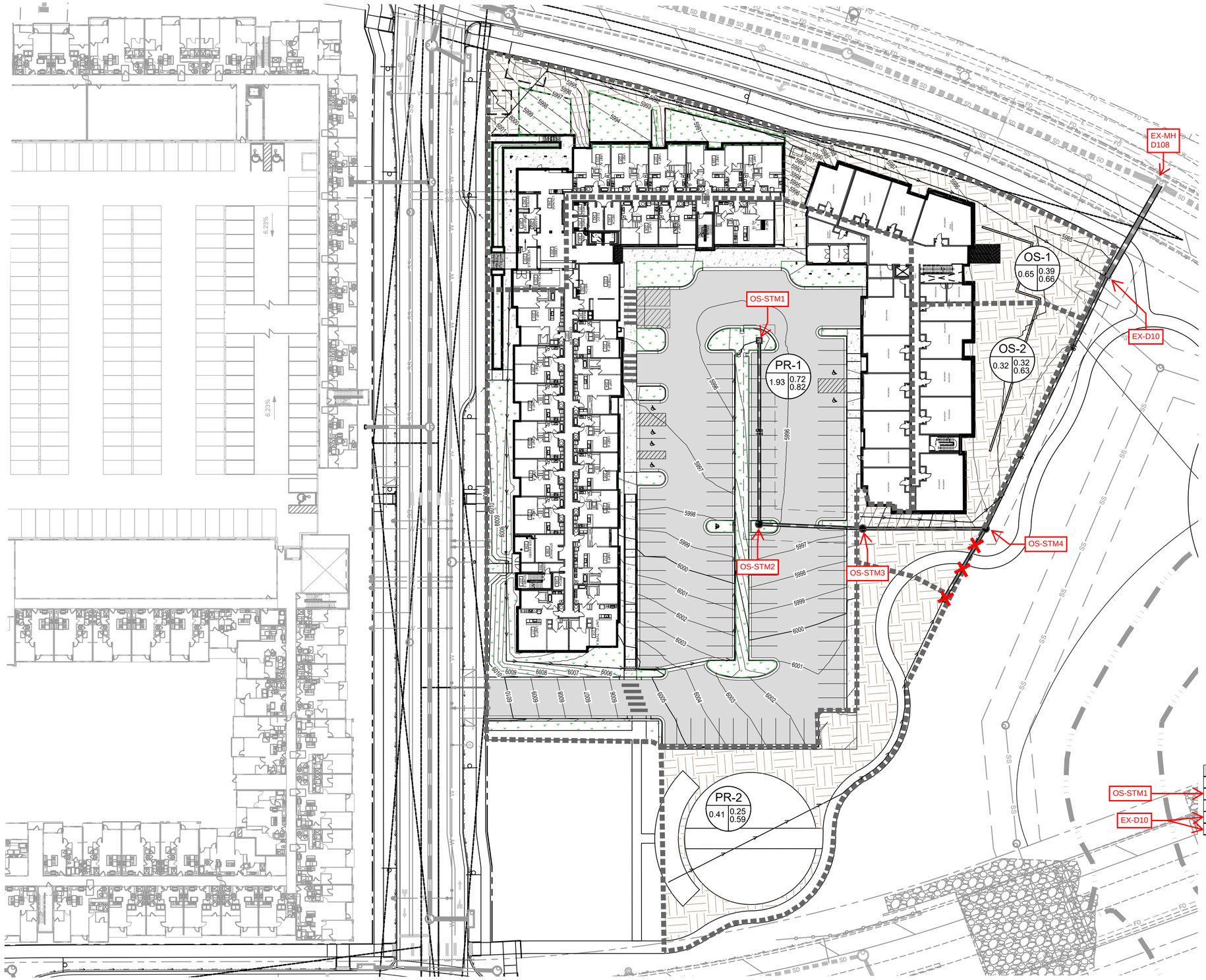
Report

Line No.	Line ID	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Tc (min)	Flow Rate (cfs)	Line Size (in)	Line Slope (%)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Gnd/Rim El Dn (ft)	HGL Up (ft)	HGL Dn (ft)	Vel Ave (ft/s)
1	EX D114	0.00	0.00	0.00	17.0	196.63	54	0.50	5953.74	5953.48	5973.34	5958.94	5958.50	5957.98	12.36
2	EX D113	0.00	0.00	0.00	16.8	197.93	54	2.00	5965.23	5962.51	5984.60	5973.34	5969.25	5965.31	16.10
3	EX D112	0.00	0.00	0.00	16.7	193.19	48	1.00	5974.14	5973.31	5985.00	5984.60	5978.82	5977.31	15.38
4	EX D111	0.00	0.00	0.00	16.3	164.82	48	1.43	5977.39	5974.34	5988.89	5985.00	5983.31	5982.50	13.12
5	EX D110	0.00	0.00	0.00	16.0	166.41	48	3.61	5985.31	5977.59	5997.01	5988.89	5989.02	5985.74	13.47
6	EX D109	0.00	0.00	0.00	15.8	151.55	42	4.76	5992.92	5985.67	6004.42	5997.01	5996.31	5989.02	15.95
7	EX D108	0.00	0.00	0.00	15.6	152.41	42	4.59	6000.11	5993.12	6011.94	6004.42	6003.12	5996.31	16.27
8	EX D107	0.00	0.00	0.00	15.3	116.35	42	1.00	6002.60	6000.31	6019.33	6011.94	6010.37	6003.12	12.09
9	EX D106	0.00	0.00	0.00	14.9	117.61	42	1.00	6005.11	6002.80	6023.25	6019.33	6016.37	6010.37	12.23
10	EX D105	0.00	0.00	0.00	14.6	118.86	42	1.00	6007.61	6005.31	6025.00	6023.25	6013.94	6010.72	12.35
11	EX D104	0.00	0.00	0.00	14.1	39.45	36	1.00	6009.74	6008.11	6024.79	6025.00	6016.88	6016.31	5.58
12	EX D103	0.00	0.00	0.00	13.5	40.21	36	1.00	6011.83	6009.94	6023.43	6024.79	6017.64	6016.95	5.69
13	EX D102	0.00	0.00	0.00	12.9	37.52	36	1.00	6013.81	6012.03	6024.93	6023.43	6018.71	6018.14	5.31
14	EX D101	0.00	0.00	0.00	11.6	36.30	36	1.00	6018.01	6014.01	6029.02	6024.93	6020.23	6019.14	5.81
15	EX D100	0.00	0.00	0.00	9.4	32.17	30	1.00	6020.93	6018.51	6031.43	6029.02	6022.86 j	6020.88	7.30
16	EX PIPE D4/Z100	0.00	0.00	0.00	9.2	32.48	30	2.10	6023.08	6021.13	6033.43	6031.43	6025.02	6022.86	8.45
17	Z2	0.00	0.92	0.81	9.0	29.71	24	2.00	6023.81	6023.28	6033.74	6033.43	6025.67	6025.02	10.00
18	Z1	0.00	4.70	0.83	7.3	26.85	24	1.97	6024.77	6024.01	6034.01	6033.74	6026.57	6025.67	9.32
19	Z3	0.00	0.59	0.80	8.9	3.03	18	0.99	6023.57	6023.28	6033.54	6033.43	6025.04	6025.02	1.72
20	EX D2	0.00	1.48	0.79	11.6	6.76	18	8.00	6023.75	6023.15	6028.75	6029.02	6024.76	6023.64	9.48
21	EX D5	0.00	0.67	0.77	8.8	3.33	18	8.00	6019.89	6019.29	6024.89	6024.93	6020.58	6019.63	7.62
22	EX D8 PIPE/Y100	0.00	0.00	0.00	13.3	83.50	42	1.59	6013.10	6011.49	6023.83	6025.00	6017.01	6016.31	8.68
23	Y2	0.00	0.94	0.81	8.5	4.97	18	5.00	6016.83	6015.10	6023.66	6023.83	6018.18	6018.12	2.89

100-YR TAILWATER CONDITION

Project File: Storm D-100yr.stm | Number of lines: 44 | Date: 11/9/2023

NOTES: ** Critical depth



Proposed Drainage				
Basin	C5	C100	Q5	Q100
PR-1	0.72	0.82	4.86	10.18
PR-2	0.25	0.59	0.38	1.64
OS-1	0.39	0.66	0.90	2.79
OS-2	0.32	0.63	0.39	1.38

DRAINAGE COMPLIANCE LETTER
RIDGEGATE SENIOR HOUSING
JUN 2024

EVstudio
Denver, CO
Evergreen, CO

303.670.7242
design@evstudio.com
inspections@evstudio.com
www.evstudio.com

Contact:
Brian Welch, PE
brian.welch@evstudio.com
303.670.7242 x50

UTILITY NOTIFICATION CENTER
The811.Promise.com
FOR MARKING OF UNDERGROUND MEMBER UTILITIES.

EVSTUDIO ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. THE UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS, HOWEVER, THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.

RIDGEGATE SENIOR HOUSING
LONE TREE, CO

23A037

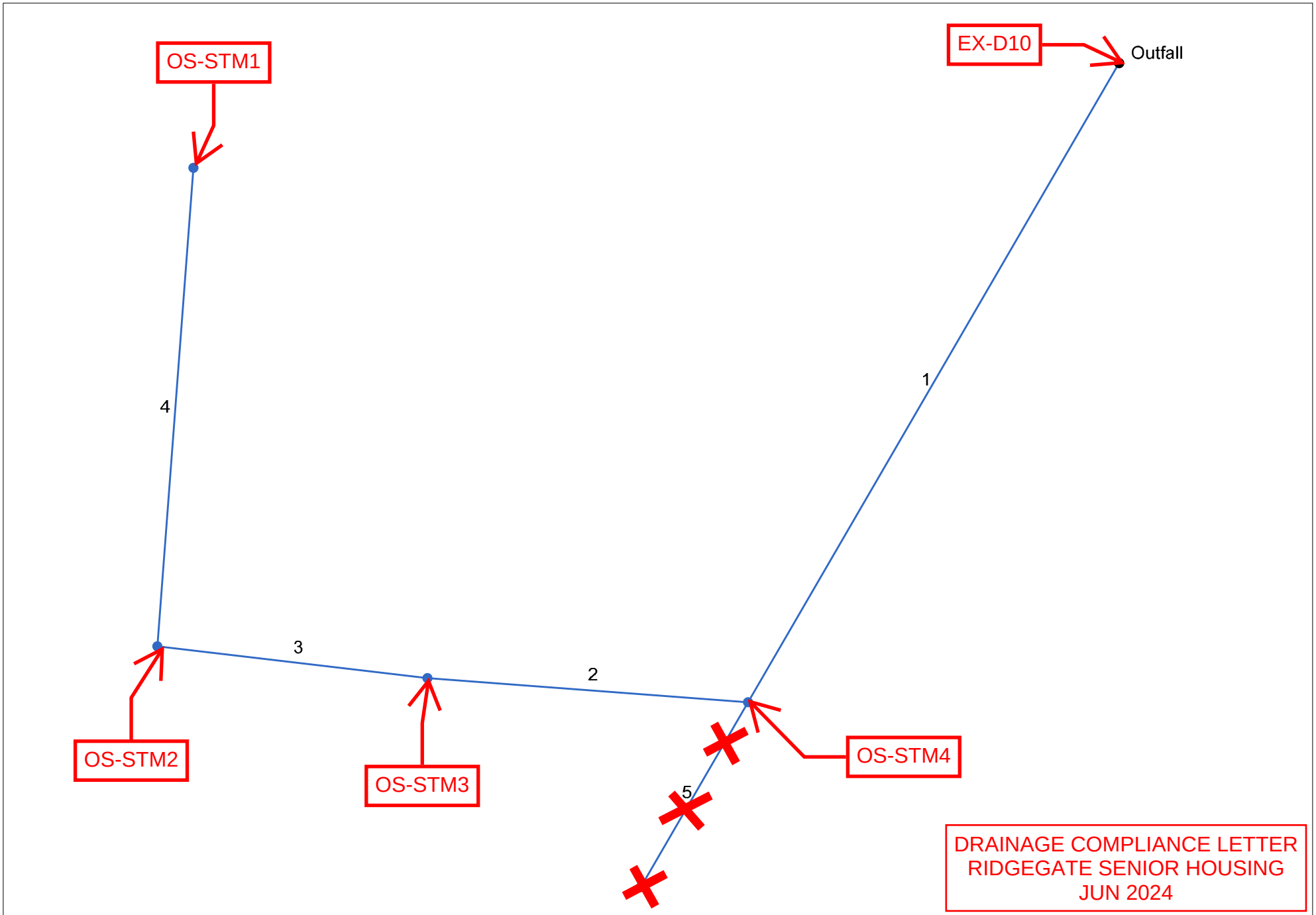
REVISION:

DATE: 6/5/2024
DRAWN BY: TRO
CHECKED BY: BMW

PROPOSED DRAINAGE PLAN

C02

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Ridgegate Senior Storm (100-year).stm	Number of lines: 5	Date: 6/5/2024

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1		11.82	18	Cir	179.697	5978.43	5979.65	0.679	5979.74*	5982.03*	0.64	5982.67	End	Manhole
2		10.18	18	Cir	78.000	5979.85	5987.14	9.346	5982.67	5988.37	n/a	5988.37 j	1	Manhole
3		10.18	18	Cir	65.952	5987.34	5988.00	1.001	5988.53	5989.23	0.67	5989.23	2	Manhole
4		10.18	18	Cir	116.823	5991.16	5992.33	1.001	5992.35	5993.56	0.67	5993.56	3	DropGrate
5		1.64	18	Cir	52.000	5981.35	5986.50	9.904	5982.67	5986.98	n/a	5986.98 j	1	DropGrate

Project File: Ridgegate Senior Storm (100-year).stm | Number of lines: 5 | Run Date: 6/5/2024

NOTES: Known Qs only ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

DRAINAGE COMPLIANCE LETTER
RIDGEGATE SENIOR HOUSING
JUN 2024

Appendix B

Hydrologic Calculations

Job Name: Badger Gulch Park
Job Number: 100610
Date: 9/16/2024
By: MAS

Badger Gulch Park

Composite Runoff Coefficient Calculations

Location: Douglas County
Municipality: UDFCD
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: C/D

Runoff Coefficient (UDFCD Vol 1, Chp 6, Sec. 2.5.1)

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	C=0.84i^1.302	C=0.86i^1.276	C=0.87i^1.232	C=0.84i^1.124	C=0.85i+0.025	C=0.78i+0.110
B	C=0.84i^1.169	C=0.86i^1.088	C=0.81i+0.057	C=0.63i+0.249	C=0.56i+0.328	C=0.47i+0.426
C/D	C=0.83i^1.122	C=0.82i+0.035	C=0.74i+0.132	C=0.56i+0.319	C=0.49i+0.393	C=0.41i+0.484

Basin Design Data

	I (%) =	95%	40%	35%	5%	20%			i (%)	Runoff Coeff's			
Basin Name	Design Point	$A_{drives/conc}$ (sf)	A_{gravel} (sf)	$A_{art.\ turf}$ (sf)	$A_{open\ space}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
W-1	1	6,634	127	10,985	0	14,218	31,965	0.73	40.8%	0.30	0.37	0.43	0.65
E-2	2	843	0	0	17,613	0	18,456	0.42	9.1%	0.06	0.11	0.20	0.52
E-3	3	2,014	356	0	0	7,430	9,800	0.22	36.1%	0.26	0.33	0.40	0.63
E-4	4	0	255	0	0	2,758	3,012	0.07	21.7%	0.15	0.21	0.29	0.57

Merrick & Company
5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Ph: (303) 751-0741

Job Name: Badger Gulch Park
Job Number: 100610
Date: 9/16/2024
By: MAS

Badger Gulch Park

Time of Concentration Calculations

Location: Douglas County
Municipality: UDFCD
Minor Design Storm: 10
Major Design Storm: 100
Soil Type: C/D

$t_i=(0.395(1.1-C_5)(L_i^{0.5}))/(S_o^{0.33})$
$t_t=L_t/(60V_t)$
Urban $t_c=(26-17i)+L_t/(60(14i+9)*(S_O^{.5}))$

Sub-Basin Data					Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON			t_c Final
Basin Name	Design Point	A_{Total} (ac)	i (%)	C5	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	L_t (ft)	S_O (%)	Urban t_c	Min t_c
W-1	1	0.73	40.8%	0.37	210	2.0%	15.4	14	2.5%	Grassed waterway	15	2.4	0.1	15.5	223.5	2.0%	20.8	15.5
E-2	2	0.42	9.1%	0.11	41	33.0%	3.6	200	2.0%	Paved areas & shallow paved swales	20	2.8	1.2	4.8	241.0	3.7%	26.5	5.0
E-3	3	0.22	36.1%	0.33	47	15.0%	3.9	118	4.6%	Paved areas & shallow paved swales	20	4.3	0.5	4.4	165.0	6.6%	20.6	5.0
E-4	4	0.07	21.7%	0.21	31	33.0%	2.8	110	4.3%	Paved areas & shallow paved swales	20	4.1	0.4	3.3	141.0	7.3%	23.0	5.0

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Job Name: Badger Gulch Park
Job Number: 100610
Date: 9/16/2024
By: MAS

Badger Gulch Park

Developed Storm Runoff Calculations

Design Storm : **100 Year**

Point Hour Rainfall (P_1) : **2.60**

$I = (28.5\ P1) / ((10 + TC)^{0.786})$

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time			
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover (Qco)	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Approx. Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)
W-1	1	0.73	0.65	15.5	0.48	5.81	2.8																
E-2	2	0.42	0.52	5.0	0.22	8.82	1.9																
E-3	3	0.22	0.63	5.0	0.14	8.82	1.3																
E-4	4	0.07	0.57	5.0	0.04	8.82	0.3																

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Job Name: Badger Gulch Park
Job Number: 100610
Date: 9/16/2024
By: MAS

Badger Gulch Park

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.43**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time			
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover (Qco)	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Approx. Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)
W-1	1	0.73	0.37	15.5	0.27	3.20	0.9																
E-2	2	0.42	0.11	5.0	0.05	4.85	0.2																
E-3	3	0.22	0.33	5.0	0.07	4.85	0.4																
E-4	4	0.07	0.21	5.0	0.01	4.85	0.1																

Appendix C

Inlet, Storm Sewer and Swale Calculations

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	INL-01	INL-02	INL-03
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	AREA	AREA
Hydraulic Condition	Swale	Swale	Swale
Inlet Type	CDOT Type C	User-Defined	User-Defined

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.9	0.2	0.4
Major Q_{Known} (cfs)	2.8	1.9	1.3

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.9**	**0.2**	**0.4**
Major Total Design Peak Flow, Q (cfs)	**2.8**	**1.9**	**1.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	INL-04
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	AREA
Hydraulic Condition	Swale
Inlet Type	User-Defined

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.1
Major Q_{Known} (cfs)	0.3

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

Major Storm Rainfall Input

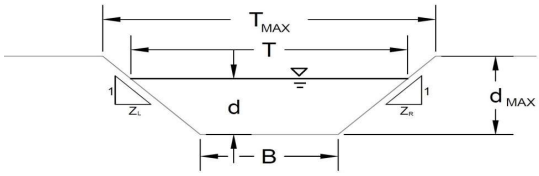
Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.1**
Major Total Design Peak Flow, Q (cfs)	**0.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0

AREA INLET IN A SWALE

INL-01



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0375	ft/ft
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Sloe	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**10.00**	**10.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**34.6**	**34.6**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**1.00**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.9**	**2.8**	**cfs**
Water Depth	d =	**0.16**	**0.30**	**ft**

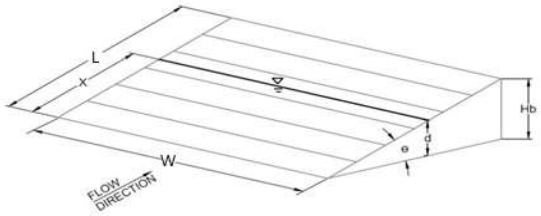
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

AREA INLET IN A SWALE

INL-01

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.96	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	

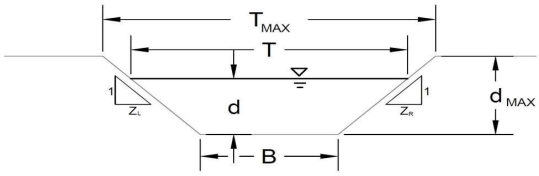


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.16	0.30	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.2**	**3.0**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

AREA INLET IN A SWALE

INL-02



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.016	
Channel Invert Slope	S_O =	0.0050	ft/ft
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	3.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**2.00**	**2.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.33**	**0.33**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**0.6**	**0.6**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.33**	**0.33**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.2**	**1.9**	**cfs**
Warning 05 Water Depth	d =	**0.22**	**0.50**	**ft**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

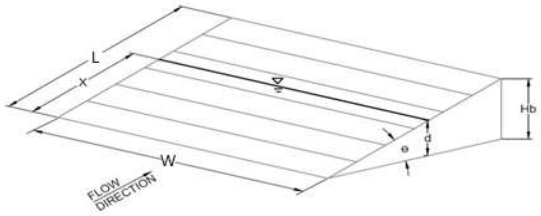
SWALE NOT DESIGNED FOR MAJOR STORM.

AREA INLET IN A SWALE

INL-02

Inlet Design Information (Input)

Type of Inlet	User-Defined	Inlet Type =	User-Defined	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	1.73	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	N/A	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	



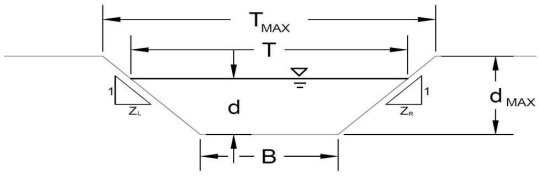
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.22	0.50	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.5**	**5.4**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

TYPE 13 INLET

Warning 04: Froude No. exceeds USDCM Volume I recommendation.
Warning 05: Depth (d) exceeds max allowable depth (dmax).
Warning 06: Top Width (T) exceeds max allowable top width (Tmax).

AREA INLET IN A SWALE

INL-03



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0455	ft/ft
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	3.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**2.00**	**2.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.33**	**0.33**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**0.9**	**0.9**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.33**	**0.33**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.4**	**1.3**	**cfs**
Warning 05 Water Depth	**d =**	**0.25**	**0.39**	**ft**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

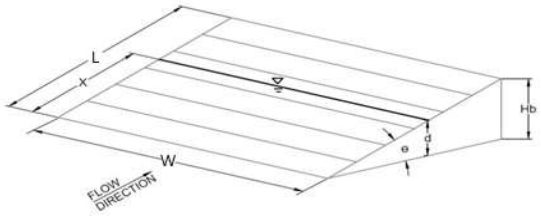
SWALE NOT DESIGNED FOR MAJOR STORM.

AREA INLET IN A SWALE

INL-03

Inlet Design Information (Input)

Type of Inlet	User-Defined	Inlet Type =	User-Defined	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	1.73	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	N/A	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	



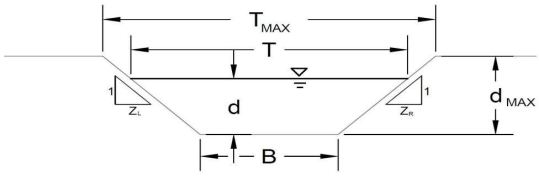
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.25	0.39	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.9**	**3.6**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

TYPE 13 INLET

Warning 04: Froude No. exceeds USDCM Volume I recommendation.
Warning 05: Depth (d) exceeds max allowable depth (dmax).
Warning 06: Top Width (T) exceeds max allowable top width (Tmax).

AREA INLET IN A SWALE

INL-04



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0425	ft/ft
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	3.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ○ **Non-Cohesive**
- ◉ **Cohesive**
- ○ **Paved**

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**2.00**	**2.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.33**	**0.33**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**0.8**	**0.8**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.33**	**0.33**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.1**	**0.3**	**cfs**
Water Depth	d =	**0.15**	**0.23**	**ft**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

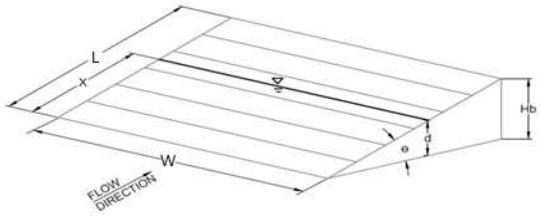
SWALE NOT DESIGNED FOR MAJOR STORM.

AREA INLET IN A SWALE

INL-04

Inlet Design Information (Input)

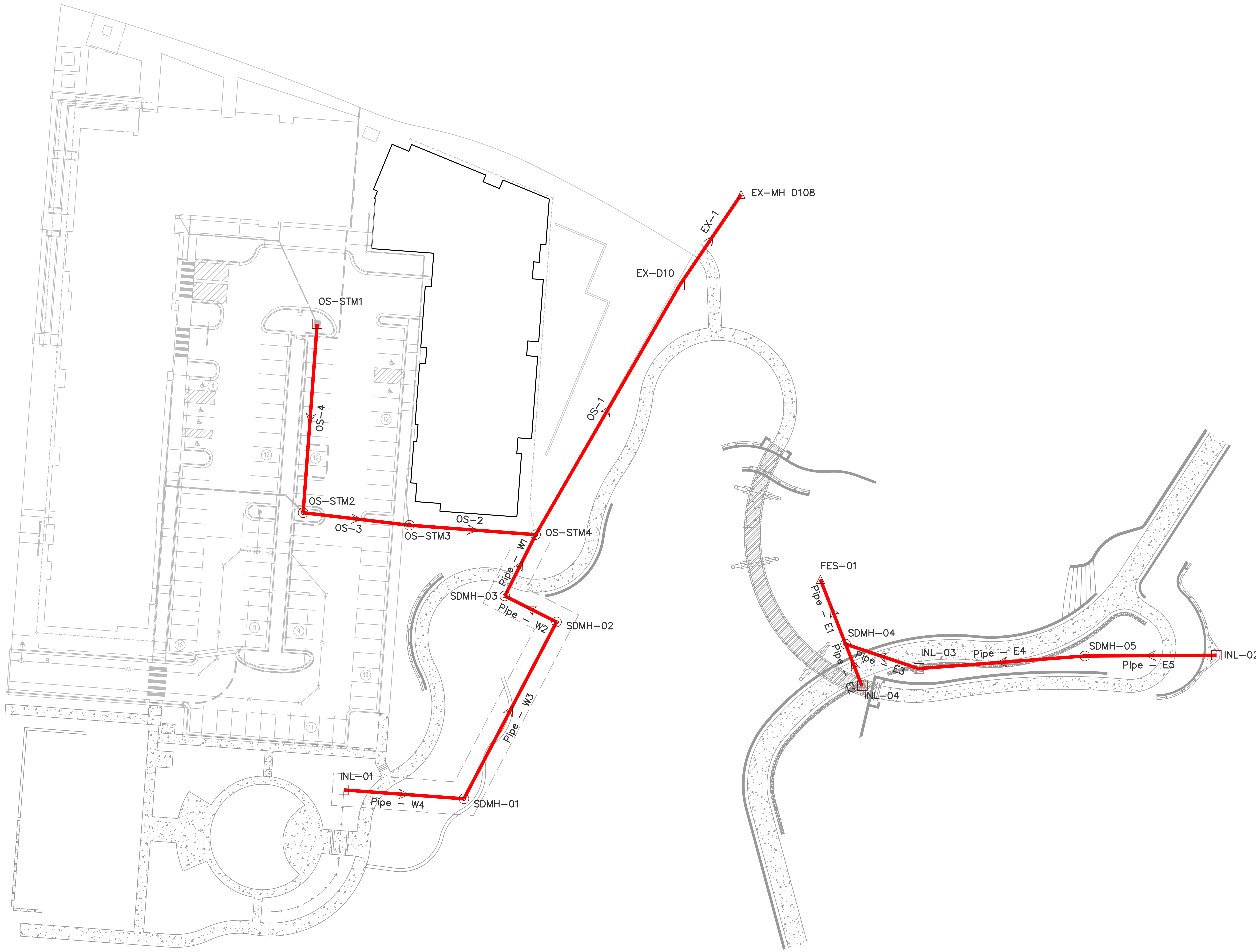
Type of Inlet	User-Defined	Inlet Type =	User-Defined	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	1.73	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	N/A	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.15	0.23	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.9**	**1.6**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

TYPE 13 INLET

Warning 04: Froude No. exceeds USDCM Volume I recommendation.



MERRICK®

BADGER GULCH PARK
STORMCAD MAP

09/18/2024

1 OF 1

File Location:Q:\DEN\Projects\5087-02-RRMD Overall East\Projects\2024-01 BG Park\Design\Drainage\Report\Appendices\Appendix B - Hydraulics\StormCAD Map.dwg Plot Date:9/18/2024 10:31 AM Last Saved By: MADALYNN.SUITER

EXISTING 5-YR

FlexTable: Conduit Table

Label	Start Node	Stop Node	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (%)	Flow (cfs)	Velocity (ft/s)	Manning's n	Is Active?
EX-1	EX-D10	EX-MH D108	36.0	5,976.01	5,975.34	67.4	0.99	6.15	5.88	0.013	True
OS-1	OS-STM4	EX-D10	18.0	5,979.65	5,978.43	177.7	0.69	4.86	5.06	0.013	True
OS-2	OS-STM3	OS-STM4	18.0	5,987.14	5,979.85	78.1	9.34	4.86	13.10	0.013	True
OS-3	OS-STM2	OS-STM3	18.0	5,988.00	5,987.34	66.0	1.00	4.86	5.83	0.013	True
OS-4	OS-STM1	OS-STM2	18.0	5,992.33	5,991.16	116.8	1.00	4.86	5.83	0.013	True
Pipe - E1	SDMH-04	FES-01	12.0	5,952.00	5,951.70	36.3	0.83	(N/A)	(N/A)	0.010	False
Pipe - E2	INL-04	SDMH-04	12.0	5,952.40	5,952.20	27.6	0.72	(N/A)	(N/A)	0.010	False
Pipe - E3	INL-03	SDMH-04	12.0	5,952.50	5,952.20	47.3	0.63	(N/A)	(N/A)	0.010	False
Pipe - E4	SDMH-05	INL-03	12.0	5,958.00	5,954.00	102.9	3.89	(N/A)	(N/A)	0.010	False
Pipe - E5	INL-02	SDMH-05	12.0	5,966.50	5,958.30	81.2	10.10	(N/A)	(N/A)	0.010	False
Pipe - W1	SDMH-03	OS-STM4	12.0	5,981.20	5,980.75	42.3	1.06	(N/A)	(N/A)	0.010	False
Pipe - W2	SDMH-02	SDMH-03	12.0	5,981.70	5,981.50	35.7	0.56	(N/A)	(N/A)	0.010	False
Pipe - W3	SDMH-01	SDMH-02	12.0	5,984.00	5,982.00	123.1	1.62	(N/A)	(N/A)	0.010	False
Pipe - W4	INL-01	SDMH-01	12.0	5,993.00	5,987.00	74.5	8.06	(N/A)	(N/A)	0.010	False

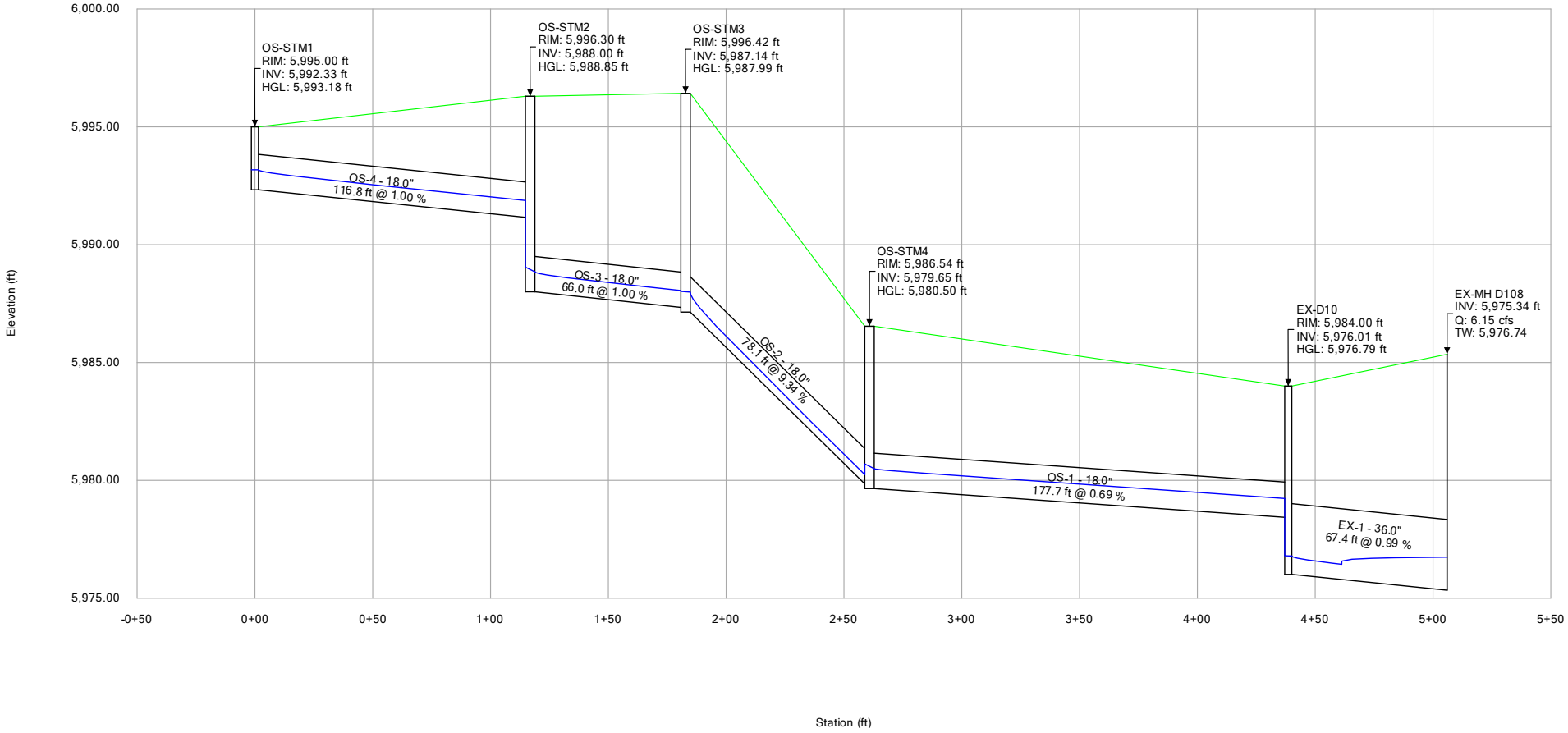
FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
EX-D10	6.15	5,984.00	5,976.01	5,976.80	5,976.79	HEC-22 Energy (Second Edition)	0.01	True
INL-01	(N/A)	5,998.76	5,993.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
INL-02	(N/A)	5,980.61	5,966.50	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
INL-03	(N/A)	5,962.94	5,952.50	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
INL-04	(N/A)	5,963.76	5,952.40	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
OS-STM1	4.86	5,995.00	5,992.33	5,993.18	5,993.18	HEC-22 Energy (Second Edition)	0.00	True

FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
OS-STM2	4.86	5,996.30	5,988.00	5,989.05	5,988.85	HEC-22 Energy (Second Edition)	0.20	True
OS-STM3	4.86	5,996.42	5,987.14	5,988.02	5,987.99	HEC-22 Energy (Second Edition)	0.03	True
OS-STM4	4.86	5,986.54	5,979.65	5,980.70	5,980.50	HEC-22 Energy (Second Edition)	0.20	True
SDMH-01	(N/A)	5,993.37	5,984.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-02	(N/A)	5,987.10	5,981.70	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-03	(N/A)	5,991.33	5,981.20	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-04	(N/A)	5,955.91	5,952.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-05	(N/A)	5,968.75	5,958.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False

Profile Report
Engineering Profile - EX-1 (BG Park StormCAD.stsw)



PROPOSED 5-YR

FlexTable: Conduit Table

Label	Start Node	Stop Node	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (%)	Flow (cfs)	Velocity (ft/s)	Manning's n	Is Active?
EX-1	EX-D10	EX-MH D108	36.0	5,976.01	5,975.34	67.4	0.99	7.05	6.12	0.013	True
OS-1	OS-STM4	EX-D10	18.0	5,979.65	5,978.43	177.7	0.69	5.76	5.26	0.013	True
OS-2	OS-STM3	OS-STM4	18.0	5,987.14	5,979.85	78.1	9.34	4.86	13.10	0.013	True
OS-3	OS-STM2	OS-STM3	18.0	5,988.00	5,987.34	66.0	1.00	4.86	5.83	0.013	True
OS-4	OS-STM1	OS-STM2	18.0	5,992.33	5,991.16	116.8	1.00	4.86	5.83	0.013	True
Pipe - E1	SDMH-04	FES-01	12.0	5,952.00	5,951.70	36.3	0.83	0.70	3.97	0.010	True
Pipe - E2	INL-04	SDMH-04	12.0	5,952.40	5,952.20	27.6	0.72	0.10	2.13	0.010	True
Pipe - E3	INL-03	SDMH-04	12.0	5,952.50	5,952.20	47.3	0.63	0.60	3.46	0.010	True
Pipe - E4	SDMH-05	INL-03	12.0	5,958.00	5,954.00	102.9	3.89	0.20	4.73	0.010	True
Pipe - E5	INL-02	SDMH-05	12.0	5,966.50	5,958.30	81.2	10.10	0.20	6.57	0.010	True
Pipe - W1	SDMH-03	OS-STM4	12.0	5,981.20	5,980.75	42.3	1.06	0.90	4.67	0.010	True
Pipe - W2	SDMH-02	SDMH-03	12.0	5,981.70	5,981.50	35.7	0.56	0.90	3.71	0.010	True
Pipe - W3	SDMH-01	SDMH-02	12.0	5,984.00	5,982.00	123.1	1.62	0.90	5.43	0.010	True
Pipe - W4	INL-01	SDMH-01	12.0	5,993.00	5,987.00	74.5	8.06	0.90	9.58	0.010	True

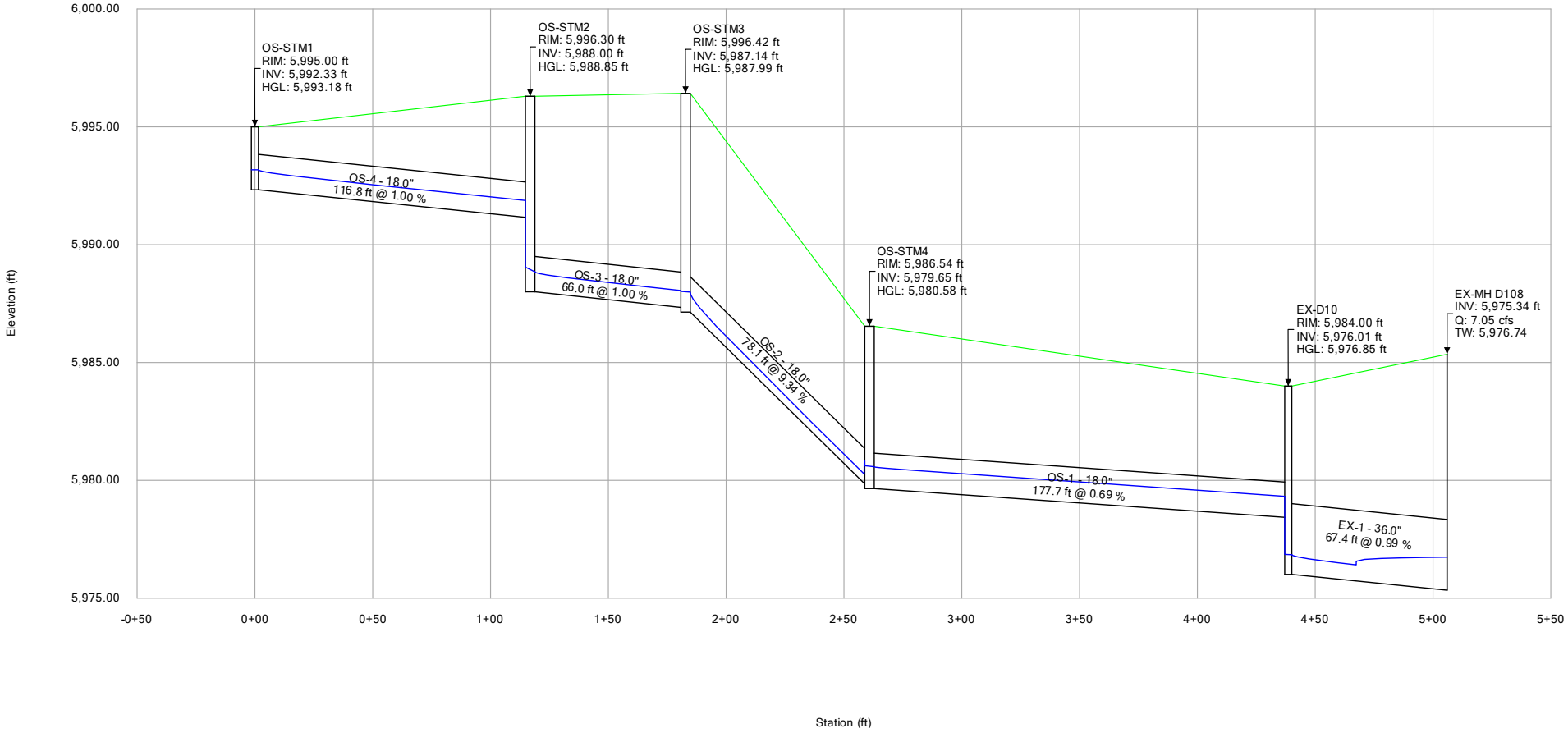
FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
EX-D10	7.05	5,984.00	5,976.01	5,976.86	5,976.85	HEC-22 Energy (Second Edition)	0.01	True
INL-01	0.90	5,998.76	5,993.00	5,993.40	5,993.40	HEC-22 Energy (Second Edition)	0.00	True
INL-02	0.20	5,980.61	5,966.50	5,966.68	5,966.68	HEC-22 Energy (Second Edition)	0.00	True
INL-03	0.60	5,962.94	5,952.50	5,952.84	5,952.82	HEC-22 Energy (Second Edition)	0.02	True
INL-04	0.10	5,963.76	5,952.40	5,952.53	5,952.53	HEC-22 Energy (Second Edition)	0.00	True
OS-STM1	4.86	5,995.00	5,992.33	5,993.18	5,993.18	HEC-22 Energy (Second Edition)	0.00	True

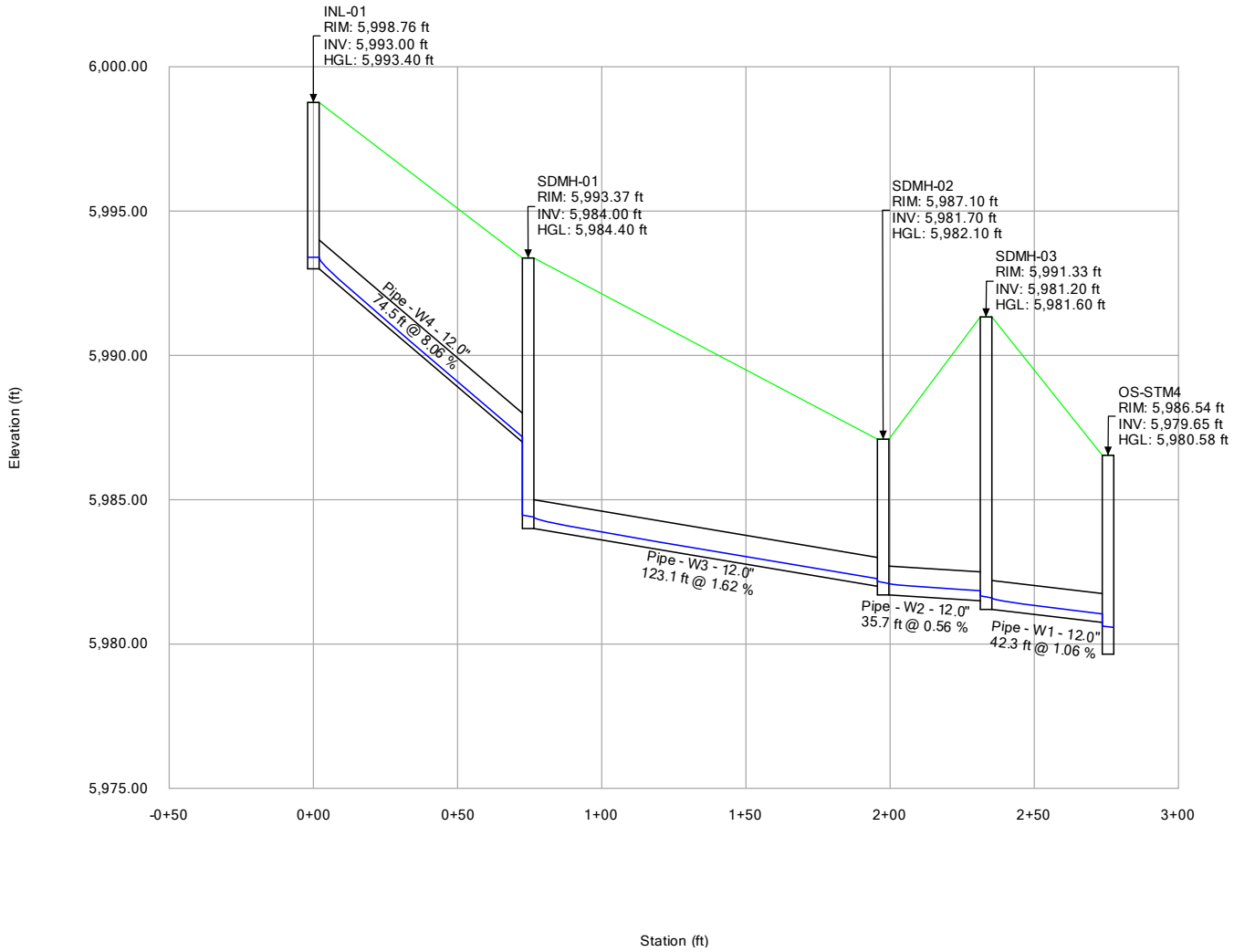
FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
OS-STM2	4.86	5,996.30	5,988.00	5,989.05	5,988.85	HEC-22 Energy (Second Edition)	0.20	True
OS-STM3	4.86	5,996.42	5,987.14	5,988.02	5,987.99	HEC-22 Energy (Second Edition)	0.03	True
OS-STM4	5.76	5,986.54	5,979.65	5,980.62	5,980.58	HEC-22 Energy (Second Edition)	0.04	True
SDMH-01	0.90	5,993.37	5,984.00	5,984.47	5,984.40	HEC-22 Energy (Second Edition)	0.07	True
SDMH-02	0.90	5,987.10	5,981.70	5,982.17	5,982.10	HEC-22 Energy (Second Edition)	0.07	True
SDMH-03	0.90	5,991.33	5,981.20	5,981.67	5,981.60	HEC-22 Energy (Second Edition)	0.07	True
SDMH-04	0.70	5,955.91	5,952.00	5,952.39	5,952.35	HEC-22 Energy (Second Edition)	0.04	True
SDMH-05	0.20	5,968.75	5,958.00	5,958.19	5,958.18	HEC-22 Energy (Second Edition)	0.01	True

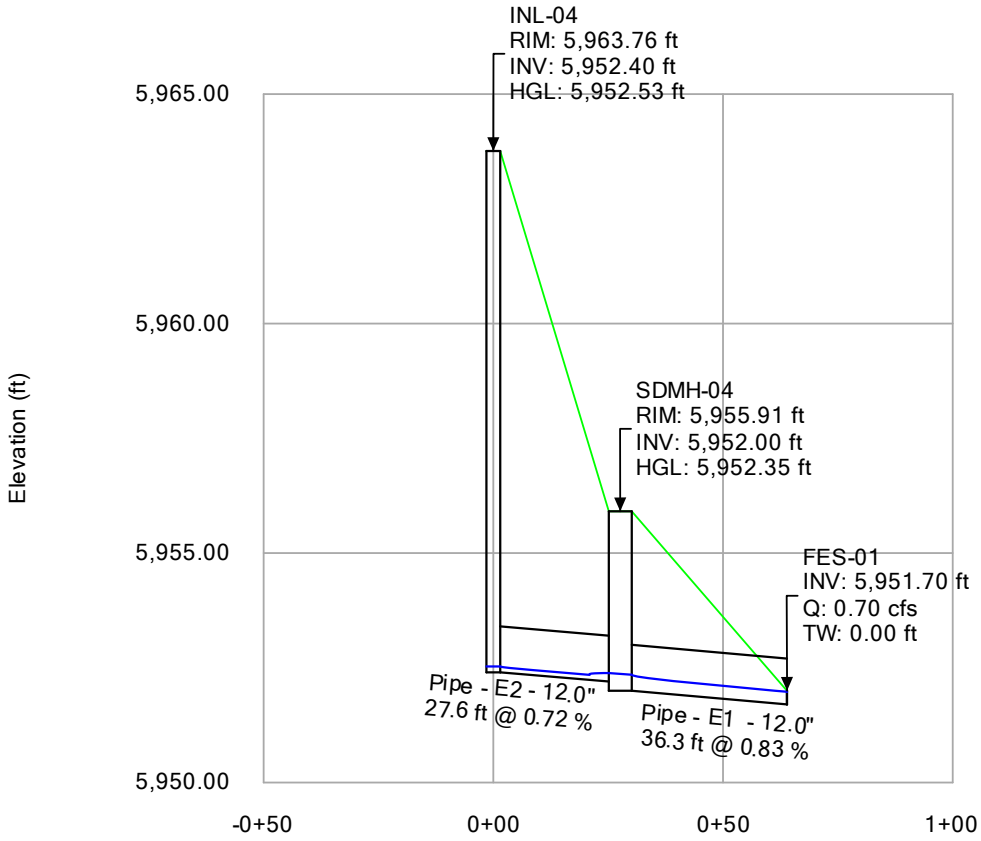
Profile Report
Engineering Profile - EX-1 (BG Park StormCAD.stsw)



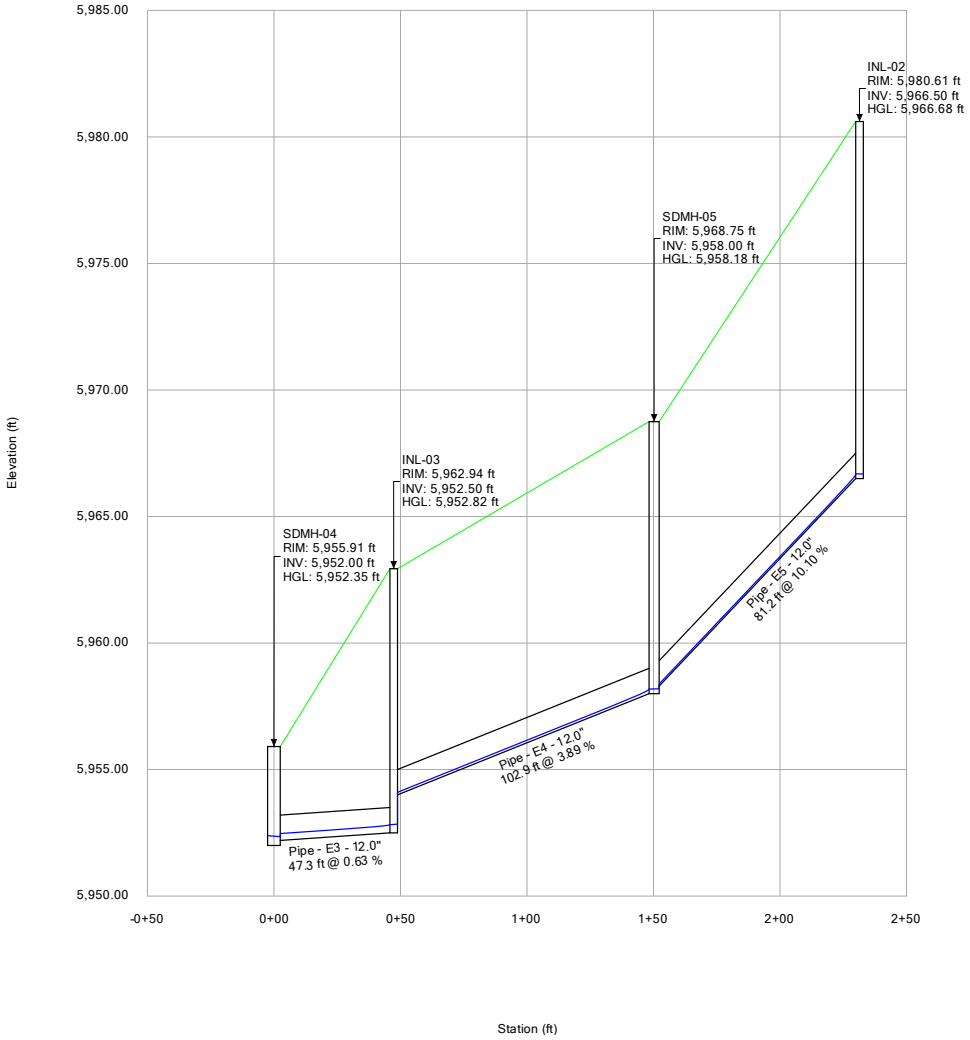
Profile Report
Engineering Profile - ST-1 (BG Park StormCAD.stsw)



Profile Report
Engineering Profile - ST-2 (BG Park StormCAD.stsw)



Profile Report
Engineering Profile - ST-3 (BG Park StormCAD.stsw)



EXISTING 100-YR

FlexTable: Conduit Table

Label	Start Node	Stop Node	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (%)	Flow (cfs)	Velocity (ft/s)	Manning's n	Is Active?
EX-1	EX-D10	EX-MH D108	36.0	5,976.01	5,975.34	67.4	0.99	14.35	7.51	0.013	True
OS-1	OS-STM4	EX-D10	18.0	5,979.65	5,978.43	177.7	0.69	10.18	5.76	0.013	True
OS-2	OS-STM3	OS-STM4	18.0	5,987.14	5,979.85	78.1	9.34	10.18	16.12	0.013	True
OS-3	OS-STM2	OS-STM3	18.0	5,988.00	5,987.34	66.0	1.00	10.18	6.77	0.013	True
OS-4	OS-STM1	OS-STM2	18.0	5,992.33	5,991.16	116.8	1.00	10.18	6.78	0.013	True
Pipe - E1	SDMH-04	FES-01	12.0	5,952.00	5,951.70	36.3	0.83	(N/A)	(N/A)	0.010	False
Pipe - E2	INL-04	SDMH-04	12.0	5,952.40	5,952.20	27.6	0.72	(N/A)	(N/A)	0.010	False
Pipe - E3	INL-03	SDMH-04	12.0	5,952.50	5,952.20	47.3	0.63	(N/A)	(N/A)	0.010	False
Pipe - E4	SDMH-05	INL-03	12.0	5,958.00	5,954.00	102.9	3.89	(N/A)	(N/A)	0.010	False
Pipe - E5	INL-02	SDMH-05	12.0	5,966.50	5,958.30	81.2	10.10	(N/A)	(N/A)	0.010	False
Pipe - W1	SDMH-03	OS-STM4	12.0	5,981.20	5,980.75	42.3	1.06	(N/A)	(N/A)	0.010	False
Pipe - W2	SDMH-02	SDMH-03	12.0	5,981.70	5,981.50	35.7	0.56	(N/A)	(N/A)	0.010	False
Pipe - W3	SDMH-01	SDMH-02	12.0	5,984.00	5,982.00	123.1	1.62	(N/A)	(N/A)	0.010	False
Pipe - W4	INL-01	SDMH-01	12.0	5,993.00	5,987.00	74.5	8.06	(N/A)	(N/A)	0.010	False

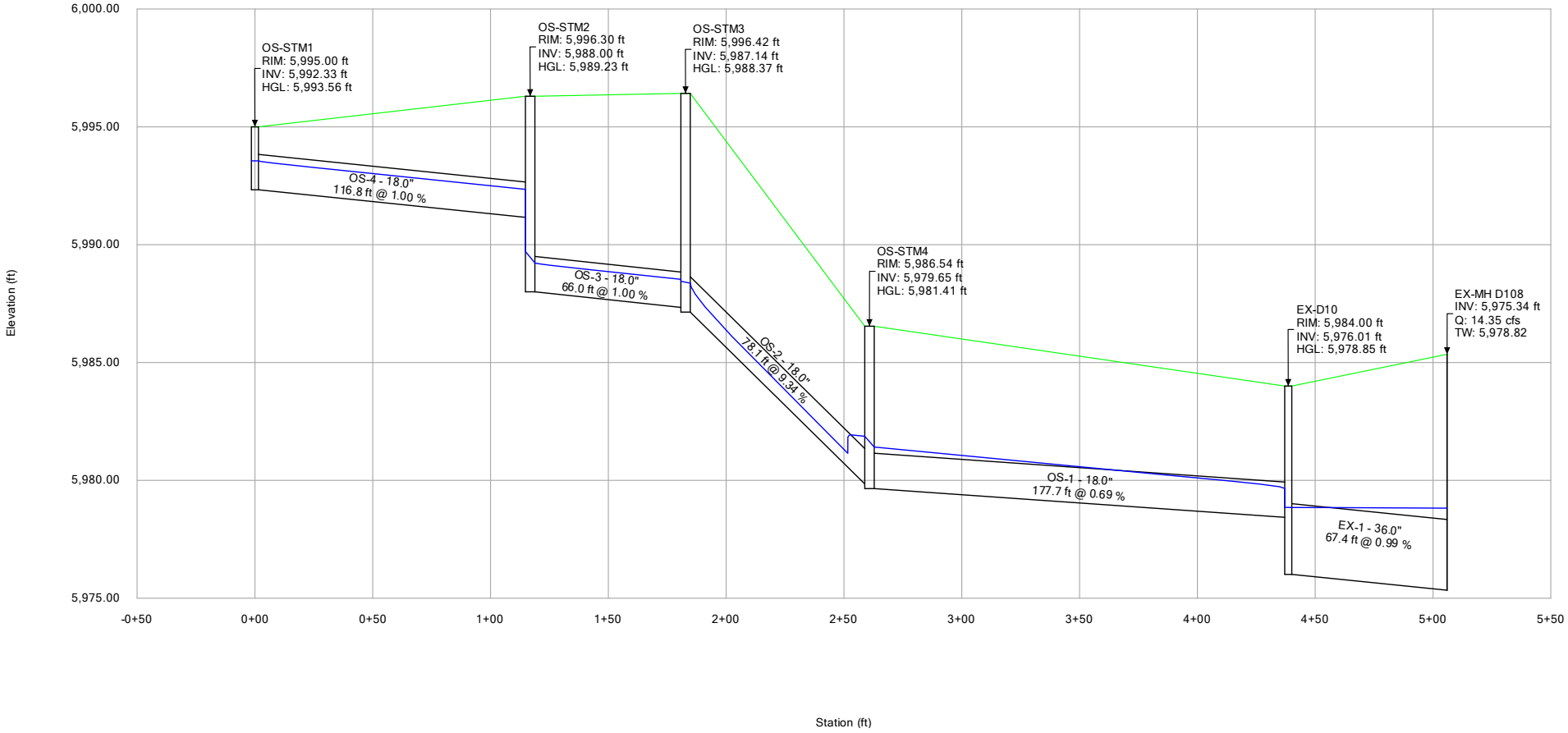
FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
EX-D10	14.35	5,984.00	5,976.01	5,978.85	5,978.85	HEC-22 Energy (Second Edition)	0.01	True
INL-01	(N/A)	5,998.76	5,993.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
INL-02	(N/A)	5,980.61	5,966.50	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
INL-03	(N/A)	5,962.94	5,952.50	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
INL-04	(N/A)	5,963.76	5,952.40	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
OS-STM1	10.18	5,995.00	5,992.33	5,993.56	5,993.56	HEC-22 Energy (Second Edition)	0.00	True

FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
OS-STM2	10.18	5,996.30	5,988.00	5,989.71	5,989.23	HEC-22 Energy (Second Edition)	0.48	True
OS-STM3	10.18	5,996.42	5,987.14	5,988.45	5,988.37	HEC-22 Energy (Second Edition)	0.08	True
OS-STM4	10.18	5,986.54	5,979.65	5,981.87	5,981.41	HEC-22 Energy (Second Edition)	0.46	True
SDMH-01	(N/A)	5,993.37	5,984.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-02	(N/A)	5,987.10	5,981.70	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-03	(N/A)	5,991.33	5,981.20	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-04	(N/A)	5,955.91	5,952.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False
SDMH-05	(N/A)	5,968.75	5,958.00	(N/A)	(N/A)	HEC-22 Energy (Second Edition)	(N/A)	False

Profile Report
Engineering Profile - EX-1 (BG Park StormCAD.stsw)



PROPOSED 100-YR

FlexTable: Conduit Table

Label	Start Node	Stop Node	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (%)	Flow (cfs)	Velocity (ft/s)	Manning's n	Is Active?
EX-1	EX-D10	EX-MH D108	36.0	5,976.01	5,975.34	67.4	0.99	17.15	7.89	0.013	True
OS-1	OS-STM4	EX-D10	18.0	5,979.65	5,978.43	177.7	0.69	12.98	7.35	0.013	True
OS-2	OS-STM3	OS-STM4	18.0	5,987.14	5,979.85	78.1	9.34	10.18	16.12	0.013	True
OS-3	OS-STM2	OS-STM3	18.0	5,988.00	5,987.34	66.0	1.00	10.18	6.77	0.013	True
OS-4	OS-STM1	OS-STM2	18.0	5,992.33	5,991.16	116.8	1.00	10.18	6.78	0.013	True
Pipe - E1	SDMH-04	FES-01	12.0	5,952.00	5,951.70	36.3	0.83	3.50	4.46	0.010	True
Pipe - E2	INL-04	SDMH-04	12.0	5,952.40	5,952.20	27.6	0.72	0.30	0.38	0.010	True
Pipe - E3	INL-03	SDMH-04	12.0	5,952.50	5,952.20	47.3	0.63	3.20	4.07	0.010	True
Pipe - E4	SDMH-05	INL-03	12.0	5,958.00	5,954.00	102.9	3.89	1.90	9.18	0.010	True
Pipe - E5	INL-02	SDMH-05	12.0	5,966.50	5,958.30	81.2	10.10	1.90	12.91	0.010	True
Pipe - W1	SDMH-03	OS-STM4	12.0	5,981.20	5,980.75	42.3	1.06	2.80	3.57	0.010	True
Pipe - W2	SDMH-02	SDMH-03	12.0	5,981.70	5,981.50	35.7	0.56	2.80	3.57	0.010	True
Pipe - W3	SDMH-01	SDMH-02	12.0	5,984.00	5,982.00	123.1	1.62	2.80	7.42	0.010	True
Pipe - W4	INL-01	SDMH-01	12.0	5,993.00	5,987.00	74.5	8.06	2.80	13.30	0.010	True

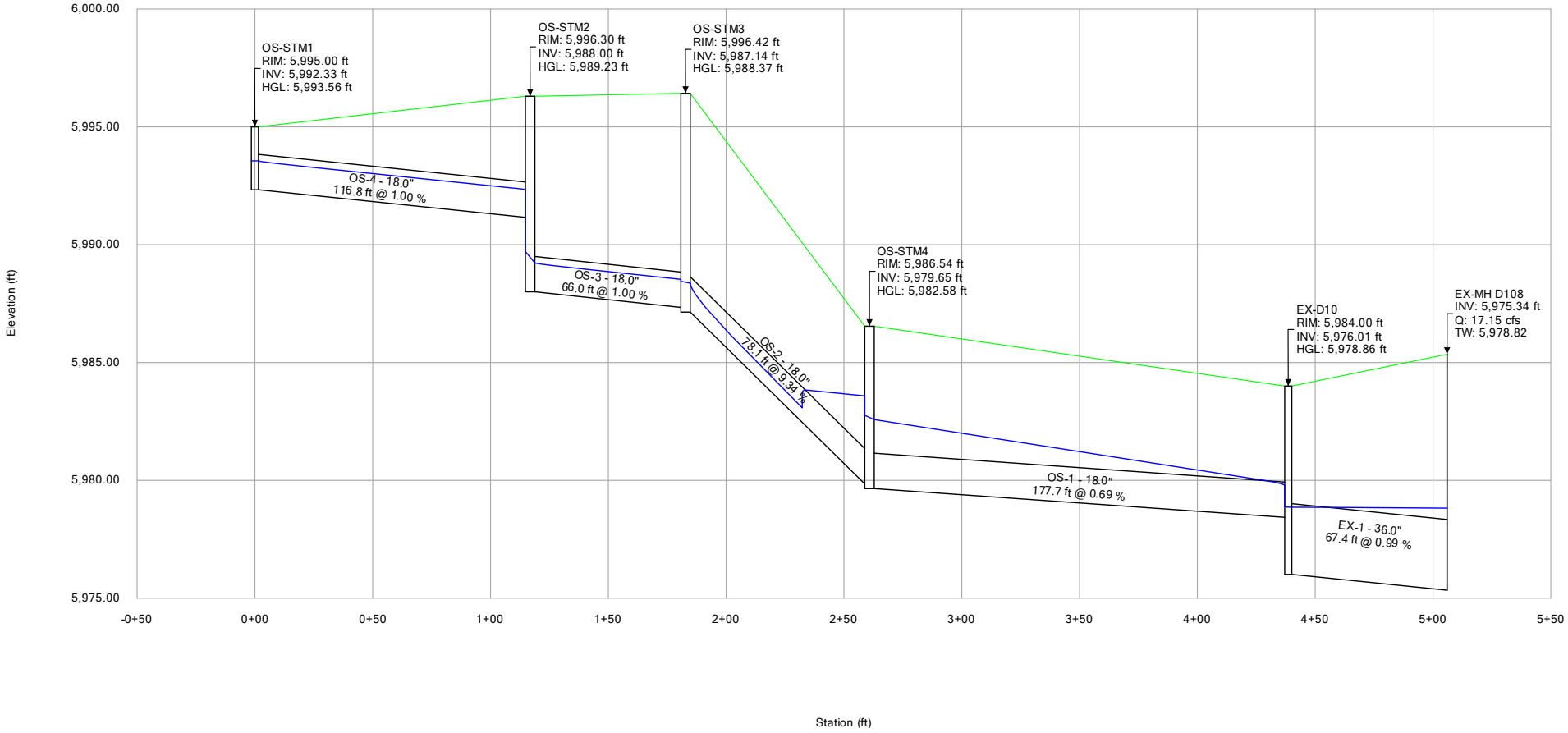
FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
EX-D10	17.15	5,984.00	5,976.01	5,978.87	5,978.86	HEC-22 Energy (Second Edition)	0.01	True
INL-01	2.80	5,998.76	5,993.00	5,993.72	5,993.72	HEC-22 Energy (Second Edition)	0.00	True
INL-02	1.90	5,980.61	5,966.50	5,967.09	5,967.09	HEC-22 Energy (Second Edition)	0.00	True
INL-03	3.20	5,962.94	5,952.50	5,954.87	5,954.72	HEC-22 Energy (Second Edition)	0.16	True
INL-04	0.30	5,963.76	5,952.40	5,954.48	5,954.48	HEC-22 Energy (Second Edition)	0.00	True
OS-STM1	10.18	5,995.00	5,992.33	5,993.56	5,993.56	HEC-22 Energy (Second Edition)	0.00	True

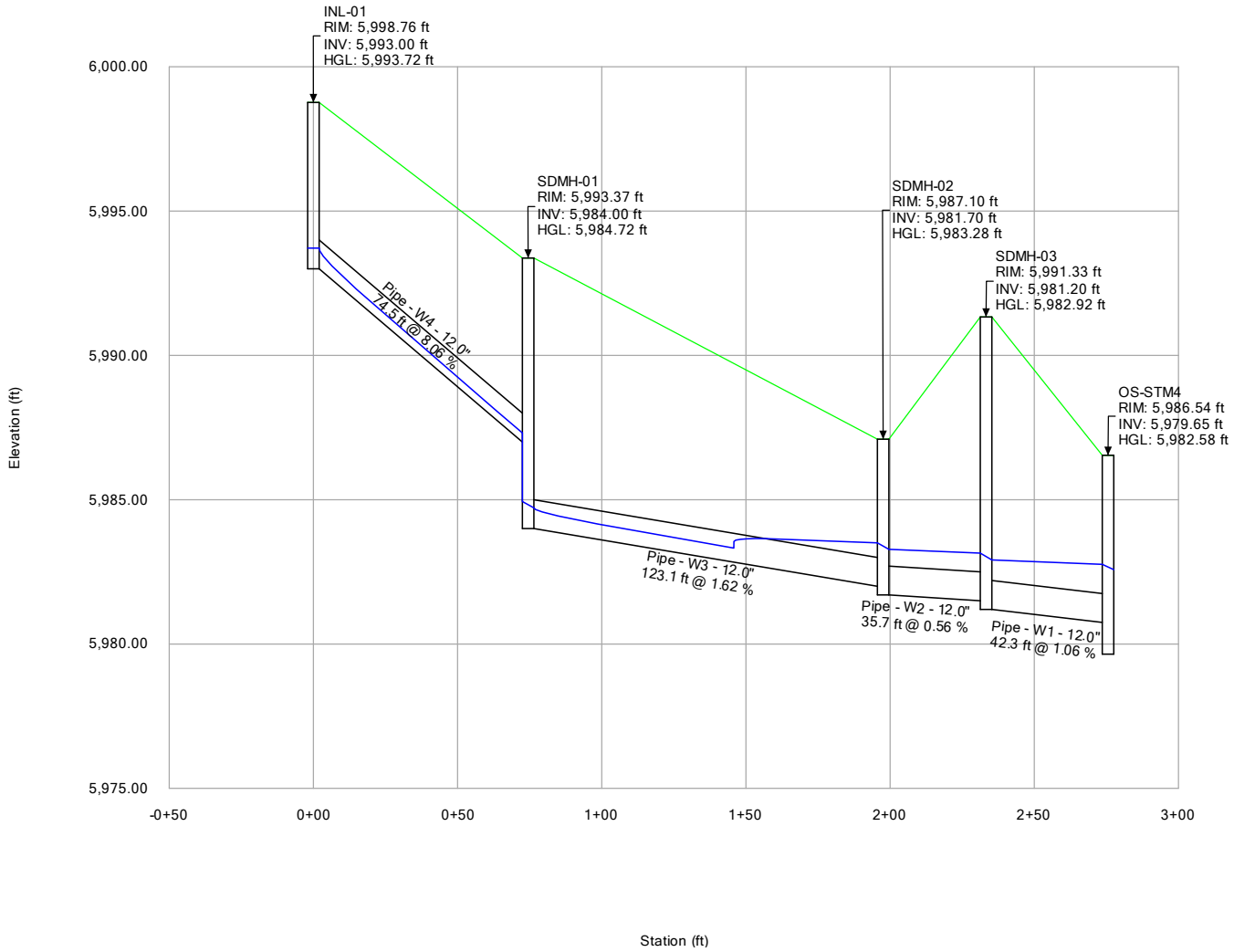
FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss (ft)	Is Active?
OS-STM2	10.18	5,996.30	5,988.00	5,989.71	5,989.23	HEC-22 Energy (Second Edition)	0.48	True
OS-STM3	10.18	5,996.42	5,987.14	5,988.45	5,988.37	HEC-22 Energy (Second Edition)	0.08	True
OS-STM4	12.98	5,986.54	5,979.65	5,982.76	5,982.58	HEC-22 Energy (Second Edition)	0.18	True
SDMH-01	2.80	5,993.37	5,984.00	5,984.94	5,984.72	HEC-22 Energy (Second Edition)	0.22	True
SDMH-02	2.80	5,987.10	5,981.70	5,983.50	5,983.28	HEC-22 Energy (Second Edition)	0.22	True
SDMH-03	2.80	5,991.33	5,981.20	5,983.15	5,982.92	HEC-22 Energy (Second Edition)	0.24	True
SDMH-04	3.50	5,955.91	5,952.00	5,954.48	5,954.21	HEC-22 Energy (Second Edition)	0.27	True
SDMH-05	1.90	5,968.75	5,958.00	5,958.64	5,958.59	HEC-22 Energy (Second Edition)	0.06	True

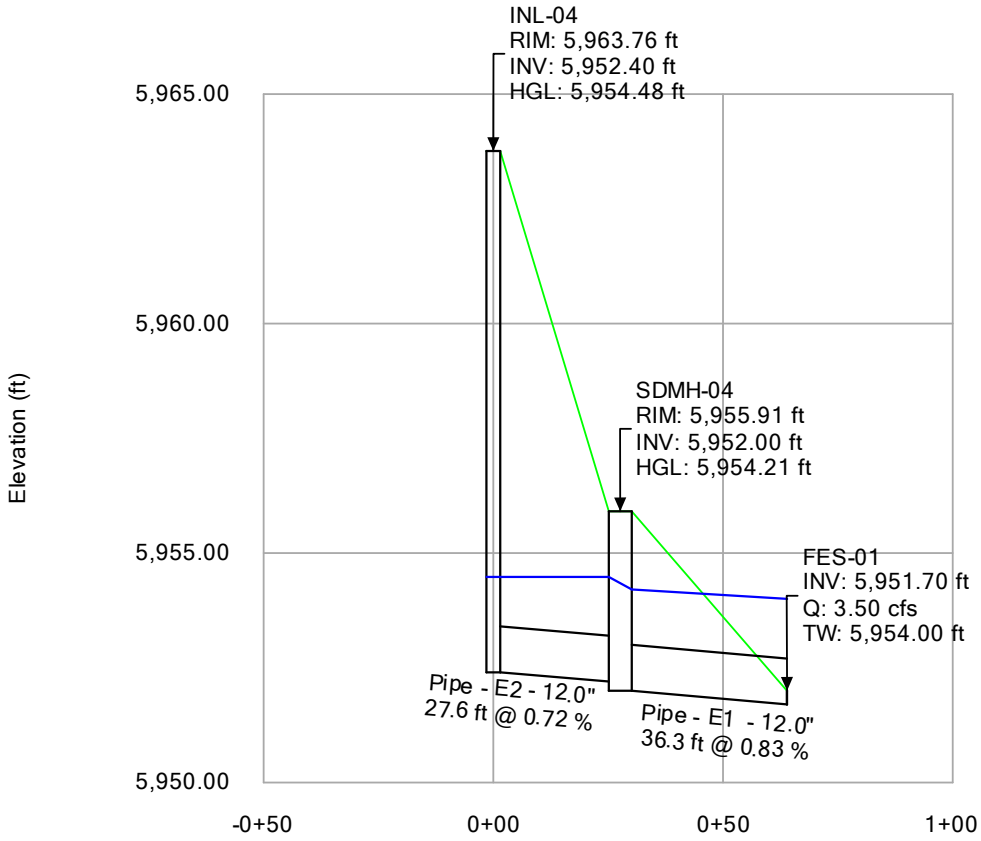
Profile Report
Engineering Profile - EX-1 (BG Park StormCAD.stsw)



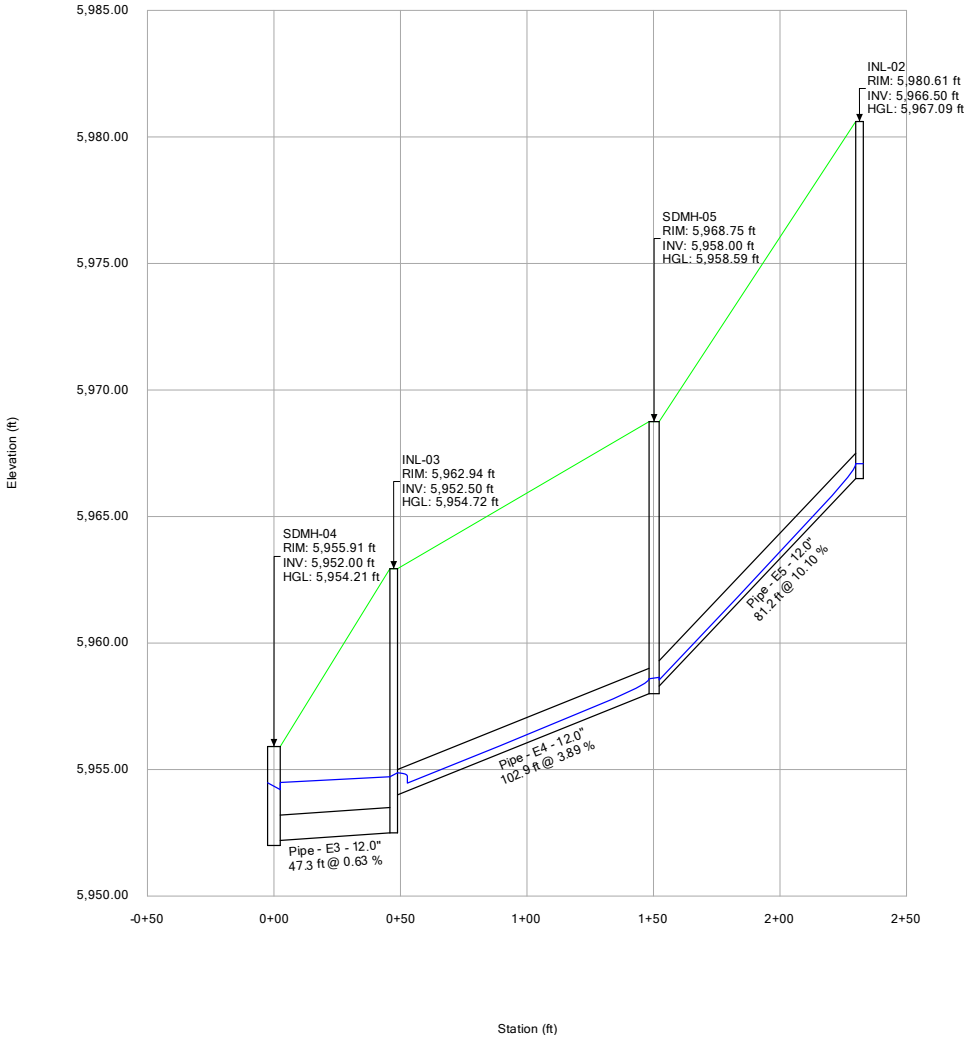
Profile Report
Engineering Profile - ST-1 (BG Park StormCAD.stsw)



Profile Report
Engineering Profile - ST-2 (BG Park StormCAD.stsw)



Profile Report
Engineering Profile - ST-3 (BG Park StormCAD.stsw)



Grass Swale - W-1

Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data		
Roughness Coefficient	0.035	(Grass)
Channel Slope	0.038 ft/ft	
Left Side Slope	4.000 H:V	
Right Side Slope	4.000 H:V	
Bottom Width	1.00 ft	
Discharge	2.80 cfs	(100-yr flow)

Results	
Normal Depth	4.4 in
Flow Area	0.9 ft²
Wetted Perimeter	4.0 ft
Hydraulic Radius	2.7 in
Top Width	3.96 ft
Critical Depth	4.7 in
Critical Slope	0.030 ft/ft
Velocity	3.05 ft/s
Velocity Head	0.14 ft
Specific Energy	0.51 ft
Froude Number	1.119
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.4 in
Critical Depth	4.7 in
Channel Slope	0.038 ft/ft
Critical Slope	0.030 ft/ft

Concrete Swale - E-2

Project Description		
Friction Method	Manning Formula	
Solve For	Discharge	

Input Data		
Roughness Coefficient	0.016	(Concrete)
Channel Slope	0.005 ft/ft	
Normal Depth	4.0 in	(Max. depth)
Left Side Slope	3.000 H:V	
Right Side Slope	3.000 H:V	

Results		
Discharge	0.64 cfs	(50-yr = 0.6 cfs)
Flow Area	0.3 ft²	
Wetted Perimeter	2.1 ft	
Hydraulic Radius	1.9 in	
Top Width	2.00 ft	
Critical Depth	3.7 in	
Critical Slope	0.007 ft/ft	
Velocity	1.92 ft/s	
Velocity Head	0.06 ft	
Specific Energy	0.39 ft	
Froude Number	0.829	
Flow Type	Subcritical	

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.0 in
Critical Depth	3.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.007 ft/ft

Cobble Swale - E-3

Project Description		
Friction Method	Manning Formula	
Solve For	Discharge	

Input Data		
Roughness Coefficient	0.035	(Cobble)
Channel Slope	0.046 ft/ft	
Normal Depth	4.0 in	(Max. depth)
Left Side Slope	3.000 H:V	
Right Side Slope	3.000 H:V	

Results		
Discharge	0.88 cfs	(50-yr = 0.7 cfs)
Flow Area	0.3 ft²	
Wetted Perimeter	2.1 ft	
Hydraulic Radius	1.9 in	
Top Width	2.00 ft	
Critical Depth	4.2 in	
Critical Slope	0.034 ft/ft	
Velocity	2.65 ft/s	
Velocity Head	0.11 ft	
Specific Energy	0.44 ft	
Froude Number	1.143	
Flow Type	Supercritical	

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.0 in
Critical Depth	4.2 in
Channel Slope	0.046 ft/ft
Critical Slope	0.034 ft/ft

Cobble Swale - E-4

Project Description		
Friction Method	Manning Formula	
Solve For	Discharge	

Input Data		
Roughness Coefficient	0.035	(Cobble)
Channel Slope	0.043 ft/ft	
Normal Depth	4.0 in	(Max. depth)
Left Side Slope	3.000 H:V	
Right Side Slope	3.000 H:V	

Results		
Discharge	0.85 cfs	(100-yr = 0.3 cfs)
Flow Area	0.3 ft²	
Wetted Perimeter	2.1 ft	
Hydraulic Radius	1.9 in	
Top Width	2.00 ft	
Critical Depth	4.2 in	
Critical Slope	0.034 ft/ft	
Velocity	2.56 ft/s	
Velocity Head	0.10 ft	
Specific Energy	0.44 ft	
Froude Number	1.105	
Flow Type	Supercritical	

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.0 in
Critical Depth	4.2 in
Channel Slope	0.043 ft/ft
Critical Slope	0.034 ft/ft

Appendix D

Drainage Map

LOT 3
(RGI)

TRACT A
(RRMD)

TRACT B
(RRMD)

UNPLATTED
(RGI)

UNPLATTED
(RGI)

CROSSFIELD ST

RIDGEGATE PKWY (WESTBOUND)

RIDGEGATE PKWY (EASTBOUND)

BADGER GULCH

100-YR FLOODPLAIN

EX TYPE D INLET

EX 18" STORM SEWER
(BY OTHERS)

EX 18" STORM SEWER
(BY OTHERS)

EX 4' MANHOLE
(BY OTHERS)

INL – 01

INL – 02

INL – 03

INL – 04

W-1
0.73 | 40.8%

E-2
0.40 | 9.3%

E-3
0.18 | 36.1%

E-4
0.07 | 21.7%

FLOW SUMMARY TABLE				
BASIN	C10	C100	Q10 (cfs)	Q100 (cfs)
W-1	0.43	0.65	0.9	2.8
E-2	0.20	0.52	0.2	1.9
E-3	0.40	0.63	0.4	1.3
E-4	0.2900	0.57	0.1	0.3

BASIN ID
AC. | %IMP

N

0 30' 60'

SCALE: 1" = 30'

MERRICK®

BADGER GULCH PARK
SUB-BASIN MAP

09/18/2024

1 OF 1