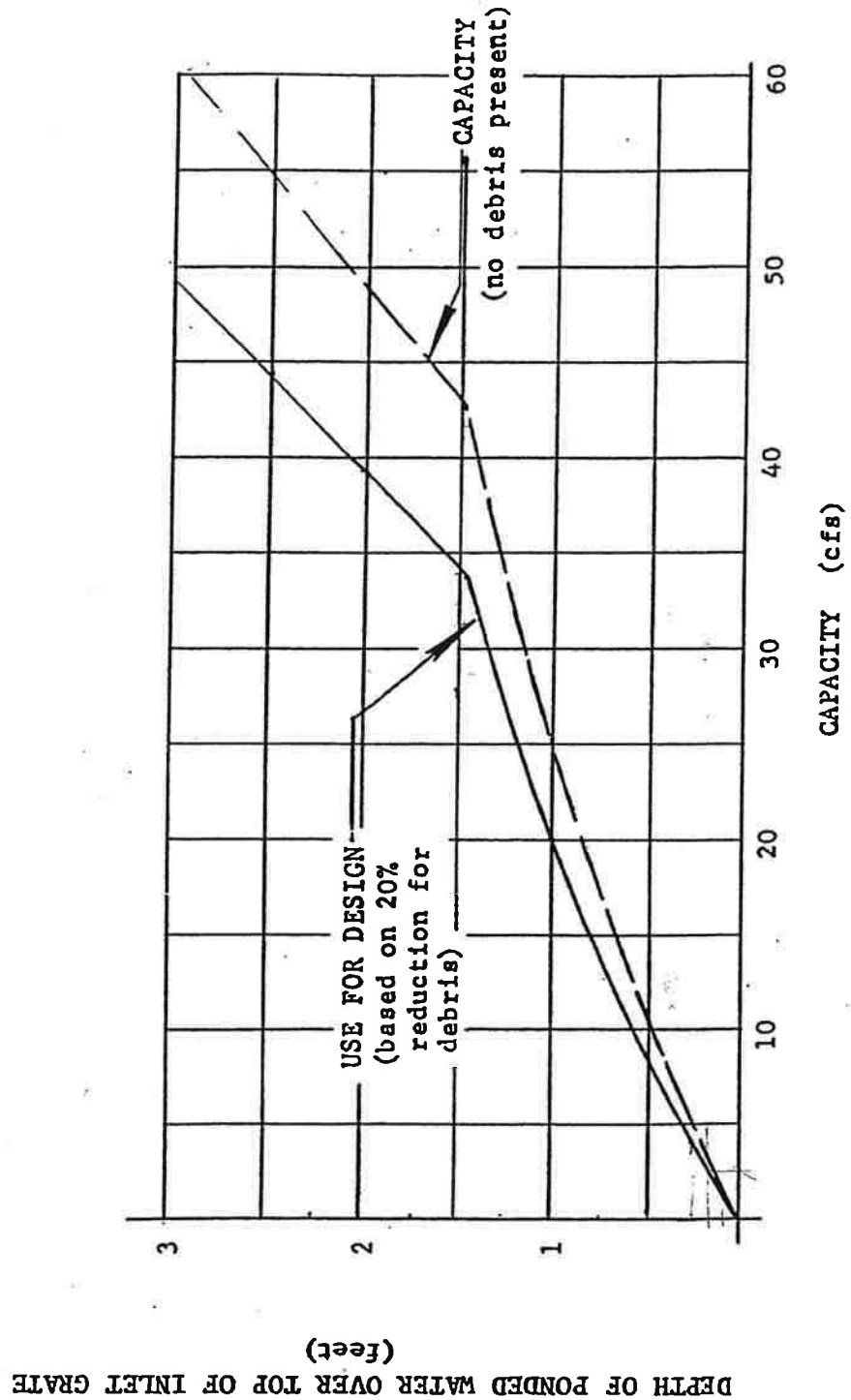


# **SUPPLEMENTAL INFORMATION**

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**TYPE C MEDIAN INLET CAPACITY - for single grate installations**

- for two grate installations multiply single grate discharge by 1.8
- for three grate installations multiply single grate discharge by 2.5
- additional capacity reduction is necessary where heavy debris exists



## 8.5 HORIZONTAL ALIGNMENT

Storm sewer alignment may be curvilinear for pipe with diameters of 48-inches or greater but only when approved in writing by the Planning Engineer. The applicant must demonstrate the need for a curvilinear alignment. The limitations on the radius for pulled-joint pipe are dependent on the pipe length and diameter, and amount of opening permitted in the joint. The maximum allowable joint pull shall be 3/4-inches. The minimum parameters for radius type pipe are shown in Table-801. The radius requirements for pipe bends are dependent upon the manufacturer's specifications.

## 8.6 PIPE SIZE

The minimum allowable pipe size for storm sewers for detention outlets is dependent upon a practical diameter from the maintenance standpoint. The length of the sewer also affects the maintenance and, therefore, the minimum diameter. Table-801 presents the minimum pipe size for storm sewers.

## 8.7 MANHOLES

Manholes or maintenance access ports will be required whenever there is a change in size, direction, elevation, grade, or where there is a junction of two or more sewers. A manhole may be required at the beginning and/or at the end of the curved section of storm sewer. The maximum spacing between manholes for various pipe sizes shall be in accordance with Table-801. The required manhole size shall be as follows:

MANHOLE SIZE	
SEWER DIAMETER	MANHOLE DIAMETER
15" to 18"	4'
21" to 42"	5'
48" to 54"	6'
60" and larger	CDOT M-604-20, Page 3

Larger manhole diameters or a junction structure may be required when sewer alignments are not straight through or more than one sewer line goes through the manhole.

## 8.8 DESIGN EXAMPLE

The following calculation example, including the calculation Table 804, and Figures 804A and 804B, were obtained from Modern Sewer Design, AISI, Washington, D.C., 1980 (Ref. 26) and edited for the calculation of manhole and junction losses in accordance with this Section.

## PIPE CAPACITIES

Assumptions: Full pipe flow, Manning's n = 0.013

Pipe Dia. (inch)	Slope =	Pipe Capacity (cfs)					
		0.5%	1.0%	1.5%	2.0%	2.5%	3.0%
15		5	6	8	9	10	11
18		7	11	13	15	17	18
24		16	23	28	32	36	39
30		29	41	50	58	65	71
36		47	67	82	95	106	116
42		71	101	124	143	160	175
48		102	144	176	204	228	249
54		139	197	241	279	312	342
60		185	261	320	369	413	452
66		238	337	412	476	532	583
72		300	425	520	601	671	736
78		372	526	644	743	831	911
84		453	641	785	906	1013	1109
90		544	770	943	1089	1217	1334
96		647	915	1120	1293	1446	1584
102		760	1075	1317	1520	1700	1862
108		885	1252	1533	1771	1980	2169
114		1023	1446	1771	2045	2287	2505

Assumptions: Full pipe flow, Manning's n = 0.025

Pipe Dia. (inch)	Slope =	Pipe Capacity (cfs)					
		0.5%	1.0%	1.5%	2.0%	2.5%	3.0%
15		2	3	4	5	5	6
18		4	5	7	8	9	9
24		8	12	14	17	19	20
30		15	21	26	30	34	37
36		25	35	43	49	55	60
42		37	52	64	74	83	91
48		53	75	92	106	118	130
54		73	103	126	145	162	178
60		96	136	166	192	215	235
66		124	175	214	248	277	303
72		156	221	270	312	349	382
78		193	273	335	387	432	473
84		236	333	408	471	527	577
90		283	400	490	566	633	693
96		336	476	582	673	752	824
102		395	559	685	791	884	968
108		460	651	797	921	1029	1128
114		532	752	921	1064	1189	1303

## CONCRETE BOX CULVERT

Assumptions: Culvert flowing full, Manning's n = 0.013

Width (ft)	Height (ft)	Slope =	Pipe Capacity (cfs)					
			0.5%	1.0%	1.5%	2.0%	2.5%	3.0%
4	4							
6	4		130	183	225	259	290	318
6	6		220	311	380	439	491	538
8	6		382	541	662	765	855	936
9	5		557	788	965	1114	1246	1365
8	8		500	708	867	1001	1119	1226
10	8		823	1164	1426	1647	1841	2017
			1104	1561	1912	2208	2469	2704

TABLE 3.1 (Cont'd)

[U.S. Customary Units]

DESIGN SPEED	DESIGN ADT	FORESLOPES			BACKSLOPES		
		1V:6H or flatter	1V:5H TO 1V:4H	1V:3H	1V:3H	1V:5H TO 1V:4H	1V:6H or flatter
40 mph or less	UNDER 750	7-10	7-10	**	7-10	7-10	7-10
	750-1500	10-12	12-14	**	10-12	10-12	10-12
	1500-6000	12-14	14-16	**	12-14	12-14	12-14
	OVER 6000	14-16	16-18	**	14-16	14-16	14-16
45-50 mph	UNDER 750	10-12	12-14	**	8-10	8-10	10-12
	750-1500	14-16	16-20	**	10-12	12-14	14-16
	1500-6000	16-18	20-26	**	12-14	14-16	16-18
	OVER 6000	20-22	24-28	**	14-16	18-20	20-22
55 mph	UNDER 750	12-14	14-18	**	8-10	10-12	10-12
	750-1500	16-18	20-24	**	10-12	14-16	16-18
	1500-6000	20-22	24-30	**	14-16	16-18	20-22
	OVER 6000	22-24	26-32 *	**	16-18	20-22	22-24
60 mph	UNDER 750	16-18	20-24	**	10-12	12-14	14-16
	750-1500	20-24	26-32 *	**	12-14	16-18	20-22
	1500-6000	26-30	32-40 *	**	14-18	18-22	24-26
	OVER 6000	30-32 *	36-44 *	**	20-22	24-26	26-28
65-70 mph	UNDER 750	18-20	20-26	**	10-12	14-16	14-16
	750-1500	24-26	28-36 *	**	12-16	18-20	20-22
	1500-6000	28-32 *	34-42 *	**	16-20	22-24	26-28
	OVER 6000	30-34 *	38-46 *	**	22-24	26-30	28-30

\* Where a site specific investigation indicates a high probability of continuing crashes, or such occurrences are indicated by crash history, the designer may provide clear-zone distances greater than the clear-zone shown in Table 3.1. Clear zones may be limited to 30 ft for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

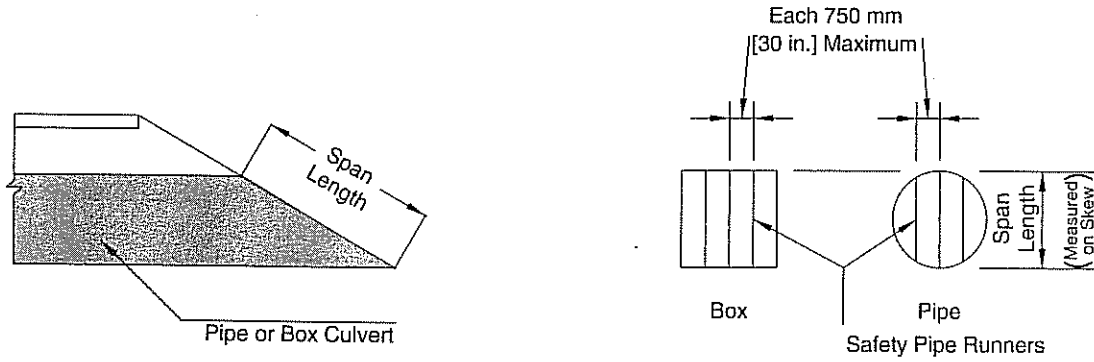
\*\* Since recovery is less likely on the unshielded, traversable 1V:3H slopes, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high-speed vehicles that encroach beyond the edge of the shoulder may be expected to occur beyond the toe of slope. Determination of the width of the recovery area at the toe of slope should take into consideration right-of-way availability, environmental concerns, economic factors, safety needs, and crash histories. Also, the distance between the edge of the through traveled lane and the beginning of the 1V:3H slope should influence the recovery area provided at the toe of slope. While the application may be limited by several factors, the foreslope parameters which may enter into determining a maximum desirable recovery area are illustrated in Figure 3.2.

**SPAN LENGTH**

up to 3.65 m	[12 ft]
3.65–4.90 m	[12–16 ft]
4.90–6.10 m	[16–20 ft]
6.10 m [20 ft] or less with center support	

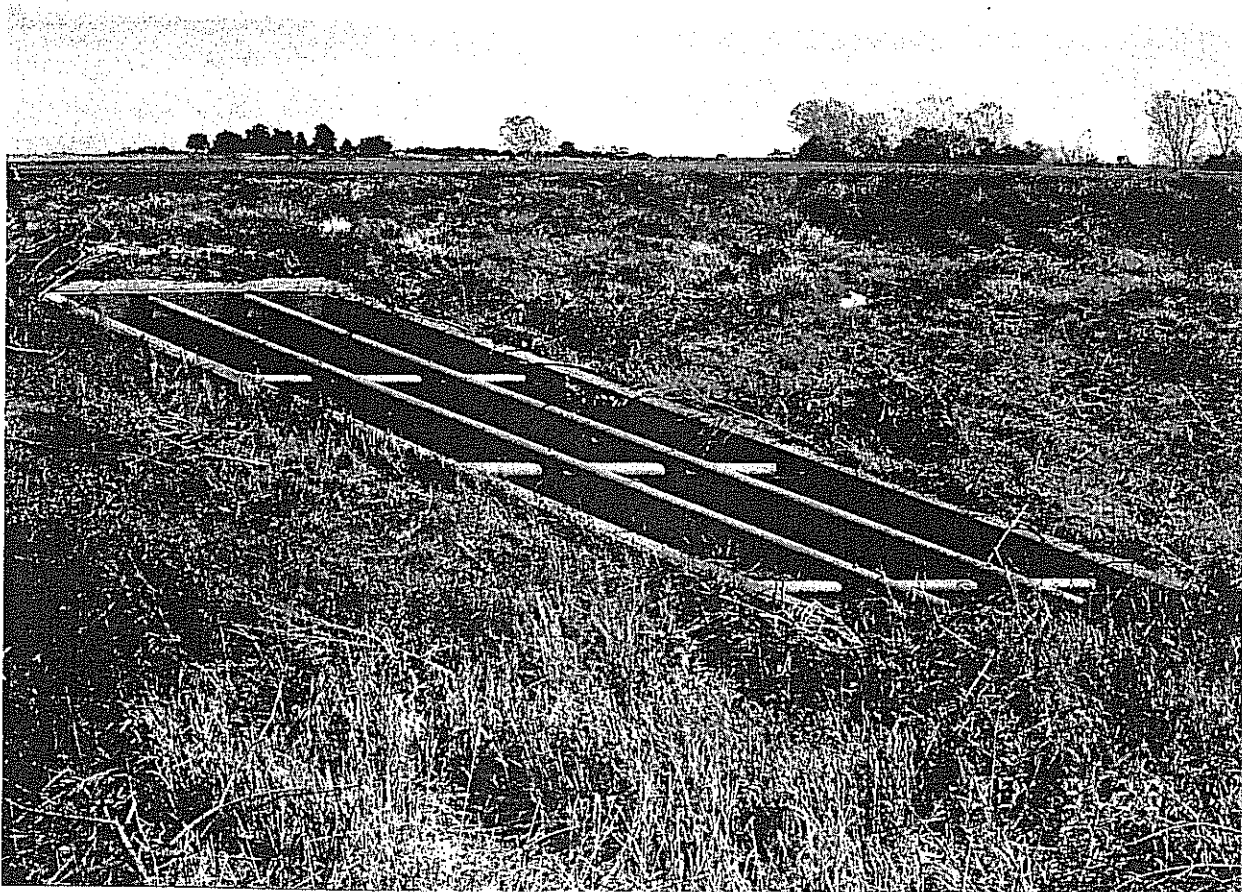
**INSIDE DIAMETER**

75 mm	[3 in.]
87 mm	[3.5 in.]
100 mm	[4 in.]
75 mm	[3 in.]



\*The chart above shows recommended safety pipe runner sizes for various span lengths for cross-drainage structures. The safety pipe runners are Schedule 40 pipes spaced on centers of 750 mm [30 in.] or less.

**FIGURE 3.8** Design criteria for safety treatment of pipes and culverts



**FIGURE 3.9** Safety treatment for cross-drainage culvert

## Erosivity Rating Curve for Typical Ditch US 550

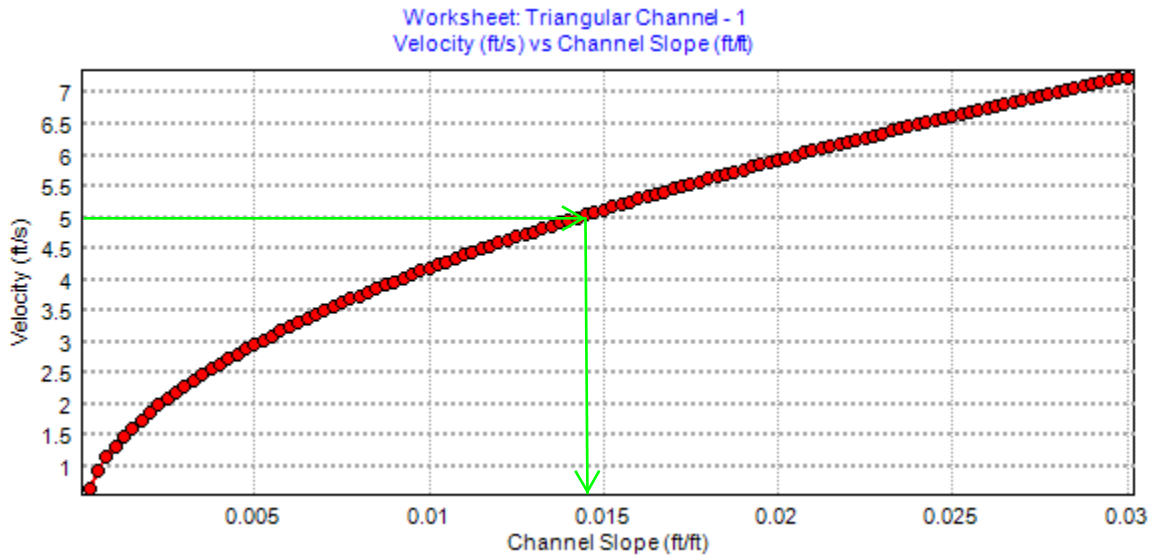
### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Roughness Coefficient	0.035
Channel Slope	0.02000 ft/ft
Normal Depth	2.00 ft
Left Side Slope	6.00 ft/ft (H:V)
Right Side Slope	4.00 ft/ft (H:V)

### Rating Curve Plot



# APPENDIX C

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## Water Quality

- 303(d) list Information for Animas River
- MS4 Summary of Roadway Basins and Treatment
- Pond Sizing Estimator



# Integrated Water Quality Monitoring and Assessment Report

# 2016



*Prepared Pursuant to Section 303(d) and Section 305(b) of the Clean Water Act*



**COLORADO**  
Water Quality Control Division  
Department of Public Health & Environment

AUID	Description	MILES	Use Tiers		Attainment Status for Applicable Uses				Causes of Impairment	IR Category
			AQLtier	RecTier	Ag	AOLife	Rec	WS		
COSJAF04b_A	Mainstem of the Animas River, including wetlands, from a point immediately above the confluence with Deer Park Creek to Bakers Bridge.	28.29	C1	E	F	T	U	F	Zn-D	4a
COSJAF05a_A	Mainstem of the Animas River, including wetlands, from Bakers Bridge to the Southern Ute Indian Reservation boundary.	26.17	C1	E	F	U	F	N	Mn-D	5
COSJAF05b_A	Mainstem of the Animas River, including wetlands, from the Southern Ute Indian Reservation boundary to the Colorado/New Mexico border.	20.23	C1	E	F	F	F	F	None	1
COSJAF06_A	Mainstem of the Animas River from the source to the outlet of Denver Lake. Mainstem, including all tributaries and wetlands of Cinnamon Creek, Grouse Creek, Picayne Gulch, and Minnie Gulch. All tributaries and wetlands to the Animas River from immediately above Maggie Gulch to Elk Park except for those listed under segments 3c, 7, 8 and 9.	28.32	C1	E	F	F	F	F	None	1
COSJAF07_A	Mainstem of Cement Creek, including all tributaries, and wetlands, from the source to the confluence with the Animas River.	12.31	none	E	F	T	X	NA	Al-T, Cd-D, Cu-D, Fe-D, Pb-D	4a
COSJAF08_A	Mainstem of Mineral Creek, including wetlands, from the source to a point immediately above the confluence with South Mineral Creek. All tributaries on the east side of this segment of Mineral Creek including wetlands, except for Big Horn Creek. Mainstem of the Middle Fork of Mineral Creek including all tributaries and wetlands from the source to the confluence with Mineral Creek except for Crystal Lake and its exiting tributary to confluence with Middle Fork of Mineral Creek.	11.19	none	E	F	T	X	NA	Al-T, Cd-D, Cu-D, Fe-D, Pb-D	4a
COSJAF09_A	Mainstem of Mineral Creek, including wetlands, from immediately above the confluence with South Mineral Creek to the confluence with the Animas River.	25.04	C2	E	F	T	X	F	Cu-D, Fe-D, pH, Zn-D	4a
COSJAF10a_A	Mainstem of the Florida River from the boundary of the Weminuche Wilderness Area to the inlet of Lemon Reservoir.	3.30	C1	E	F	F	F	F	None	1

Attainment Status for Applicable Uses: F - Use is fully supported T - TMDL completed N - Use is not attaining B - Category 4b Plan completed NA - Use does not apply  
I - Insufficient data for attainment decision (M&E List) U - Attainment status is unknown X - Use has not been assessed  
Tier for Recreational Uses: E - Existing Primary Contact Use P - Potential Primary Contact Use N - Not Primary Contact Use U - Undetermined Use  
Tier for Aquatic Life Uses: C1 - Cold water, Class 1 C2 - Cold water, Class 2 W1 - Warm water, Class 1 W2 - Warm water, Class 2 None - No tier defined

**US 550 SOUTH CONNECTION - WATER QUALITY  
SUMMARY OF ROADWAY BASINS AND TREATMENT  
MEC PROJ #13-034.01  
June 2, 2016**

Basin Label	Total Basin Area (Ac)	Total Impervious Area (Ac)	TREATED IMP AREA	Project I (%)	Pervious Area (Ac)	C <sub>100</sub>	Q <sub>100</sub> (cfs)	WQCV (WS Inches)	Design Volume (ac-ft)	WQCV <sub>other</sub> * (ac-ft)	Design Volume (ft <sup>3</sup> )	Notes	Treatment Type
960L	2.04	1.22	1.22	61%	0.81	0.59	5.18	0.24	0.049	0.034	1478		
961L	1.85	0.08	0.08	6%	1.77	0.63	3.54	0.05	0.008	0.006	254		
<b>TOTAL</b>	<b>3.89</b>	<b>1.30</b>	<b>1.30</b>	<b>35%</b>	<b>2.58</b>		<b>9.08**</b>	<b>0.166</b>	<b>0.064</b>	<b>0.045</b>	<b>1960</b>	<b>EXTENDED DETENTION BASIN MS4 TREATMENT STA 960+00</b>	<b>40-HR Modified EDB</b>
979L	1.56	0.48	0.48	32%	1.08	0.57	10.66	0.16	0.025	0.017	752		
981L	0.75	0.45	0.45	60%	0.30	0.63	4.44	0.24	0.018	0.012	540		
982L	3.28	1.66	1.66	52%	1.62	0.60	1.83	0.21	0.069	0.048	2097		
982R	1.21	0.48	0.48	41%	0.73	0.58	2.74	0.18	0.022	0.015	669		
983R	6.22	1.08	1.08	19%	5.14	0.55	10.26	0.11	0.069	0.048	2105		
<b>TOTAL</b>	<b>13.02</b>	<b>4.14</b>	<b>4.14</b>	<b>33%</b>	<b>8.88</b>		<b>29.99**</b>	<b>0.161</b>	<b>0.210</b>	<b>0.146</b>	<b>6371</b>	<b>EXTENDED DETENTION BASIN MS4 TREATMENT STA 982+00</b>	<b>40-HR Modified EDB</b>
1000L	1.11	0.67	0.67	61%	0.44	0.63	2.94	0.24	0.027	0.019	808		
1003L	0.27	0.27	0.27	100%	0.00	0.95	1.51	0.50	0.014	0.009	414		
1005L	0.26	0.26	0.26	99%	0.00	0.96	1.46	0.49	0.013	0.009	389		
1005R	12.42	1.62	1.62	15%	10.80	0.54	25.52	0.09	0.115	0.080	3481		
1007L	3.53	0.87	0.87	26%	2.66	0.56	10.66	0.14	0.049	0.034	1491		
1012R	0.38	0.38	0.38	99%	0.00	0.96	2.14	0.49	0.019	0.013	570		
1014L	0.55	0.55	0.55	101%	0.00	0.96	3.13	0.51	0.028	0.019	846		
1014R	0.51	0.51	0.51	100%	0.00	0.96	2.88	0.50	0.025	0.018	767		
<b>TOTAL</b>	<b>19.03</b>	<b>5.13</b>	<b>5.13</b>	<b>28%</b>	<b>13.90</b>		<b>60.53**</b>	<b>0.146</b>	<b>0.279</b>	<b>0.194</b>	<b>8467</b>	<b>EXTENDED DETENTION BASIN MS4 TREATMENT STA 1007+00</b>	<b>40-HR Modified EDB</b>
1033L	0.61	0.60	0.60	98%	0.01	0.93	3.34	0.483	0.029	0.021	895		
1037L	1.25	0.19	0.19	17%	1.06	0.54	4.00	0.102	0.013	0.009	389		
1037R	1.37	0.82	0.82	61%	0.55	0.63	5.08	0.239	0.033	0.023	993		
1039R	0.84	0.81	0.81	96%	0.03	0.90	4.46	0.459	0.039	0.027	1172		
1039L	0.39	0.37	0.37	95%	0.02	0.88	2.02	0.444	0.017	0.012	527		
ROUNDAABOUT	0.61	0.00	0.00	2%	0.61	0.51	3.34	0.015	0.001	0.001	28		
<b>AM-9 (76.0%)</b>	<b>5.07</b>	<b>2.79</b>	<b>2.79</b>	<b>56%</b>	<b>2.28</b>		<b>22.25**</b>	<b>0.223</b>	<b>0.113</b>	<b>0.079</b>	<b>3437</b>	<b>EXTENDED DETENTION BASIN MS4 TREATMENT STA 1039+00</b>	<b>40-HR Modified EDB</b>
<b>Actual treated acres of impervious area =</b>			<b>13.36</b>	<b>Required = 12.35 ac</b>									

\* WQCV<sub>other</sub> used for regions outside of the Denver region [D6 assumed to be 0.30 in for project site]

\*\* Taken from SF-3 (100-year) for the combined basin flowrate

US 550 South Connection - Extended Detention Basins  
SUMMARY OF BASIN DIMENSIONS  
MEC PROJ #13-034.02  
May 27, 2016

Treatment Station	Dimension Ratios	V Needed	V Actual(3)	B (minor)	A (major)	Elliptical Cylinder		Volume of Side Slopes		
						Area of Elipse	Volume with 4 foot Depth (1)	Perimeter	Triangle Area	Volume Side Slopes (2)
Sta 960+00	(a=2b)	1960	1993	17.0	34.0 (x2.0)	1815.84	7263.36	164.70	32.00	5270.50
Sta 982+00	(a=2b)	6371	6421	23.3	46.6 (x2)	3411.08	13644.31	225.74	32.00	7223.69
Sta 1007+00	(a=2b)	8487	9838	25.0	100.0 (x3)	7853.98	23561.94	428.88	32.00	13724.00
Sta 1039+00	(a=3b)	3437	3444	19.4	38.8 (x1.5)	2364.74	9458.96	187.96	32.00	6014.57

V Needed (3) = (1) - (2)

