2013P054

Drainage Report

For

Eastmark DU 8 & 9 - MCFCD Access Road

Mesa, Arizona

Owner/Developer
EM 646, LLC / Terrawest Communities
2222 W. Pinnacle Peak Road, STE. 160
Phoenix, Arizona 85027
Contact: Michael Cronin, V.P.

Project No. 13-016

Prepared: March 2014

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A024.318

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1.0 Introduction

This report analyzes the MCFCD Access Road designed to service the Powerline Floodway Channel on the north side of DU8 and DU9.

This report has been prepared based on standards set forth by the Flood Control District of Maricopa County.

2.0 Access Road Drainage Management

The access road has been designed to drain in such a way that drainage from the access road and site will not overtop into the Powerline Floodway Channel. The 16' access road will slope away from the channel at a minimum of 1% to a 3' wide drainage ditch adjacent to the Parcel 8-1, 8-2, 8-3, and 8-1 lot walls. The drainage will enter the site from the access road via swales and curb cuts.

The drainage ditch will be lined with 3" minus gravel with a maximum slope of 3:1. The Manning's n value used for the gravel is 0.25 per Table 7.6 in the Drainage Design Manual for Maricopa County. Detailed cross sections can be found in the 8-1, 8-2, 8-3, and 9-1 Parcel Plans. See Appendix A for the ditch capacity calculations.

3.0 Calculation Methodology

The Rational Method will be used to calculate peak flows at critical locations in the drainage report. The Rational Method will be applied as outlined in section 806.10 of the City of Mesa Engineering Design Standards. Peak flows will be calculated as follows:

$$Q = C * i * A$$

Where Q is the Peak Discharge, C is the weighted "c" value of the area, i is the rainfall intensity (as defined by the local time of concentration and the site specific IDF curve) in inches per hour, and A is the area in acres.

As required by City of Mesa the time of concentration calculations for the street drainage will be performed using the Papadakis and Kazan equation as follows:

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

Where T_c is the time of concentration (in hours), L is the length of the longest flow path (in miles), K_b is the watershed resistance coefficient, S is the watercourse slope (in feet per mile), and i is the rainfall intensity (in inches per hour).

Intensity will be estimated by linearly interpolating the site specific I-D-F curve that is derived from the NOAA ATLAS 14 data (see Appendix A) at a specific time of concentration.

As can be seen, the time of concentration is a function of the intensity and the intensity is a function of the time of concentration. Therefore the equations will be iterated until both equations can be satisfied. When both equations are satisfied for each sub basin area the resulting values will be applied to that sub basin area and the peak flow at the concentration point will be calculated.

The time of concentration will be calculated from the high point of the sub basin area to the low point of the sub basin area. For the access road, runoff will start in the access road and drain to the swale south of the access road and then the swale will drain to a low point on the site where drainage will be conveyed via streets, catch basins, and pipe to a retention basin. In this circumstance the drainage length "L" will be measured from the high point on the road to the low point in the swale along the flow line. The slope of the watercourse "S" will be calculated by dividing the difference in the high point elevation and the low point elevation by the drainage length "L". A 0 minute time of concentration will be used for the time of concentration in the access road as a conservative estimate.

Drainage in the swale was calculated using the Manning's Equation and using the 100 year storm event flow.

4.0 Conclusions

This report concluded that:

- The 16' Access Road will not pond water.
- 100 year storm event will be contained in the swale. Depth of flow will not exceed depth of swale.
- No drainage from the site or access road will enter the Powerline Floodway Channel.
- This site will create no adverse impacts on any downstream property.

5.0 References

Flood Control District of Maricopa County, 1995
Drainage Design Manual for Maricopa County, AZ. Volume 1, Hydrology

Flood Control District of Maricopa County, 2009 (Draft)
Drainage Design Manual for Maricopa County, AZ. Volume 2, Hydraulics

City of Mesa
City of Mesa Engineering & Design Standards, Chapter 8

Appendix A:
Figures and Calculations

Project Rainfall Data and IDF Curve

Project: Eastmark DU 8 & 9

Prepared By: Kyle Millett **Date:** 3/31/2014

Site Specific Rainfall Data

Duration	Duration	Storm Event Return Period									
		1 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	200 yr	500 yr	1,000 yr
5 min	5 min	0.19	0.25	0.34	0.40	0.50	0.57	0.64	0.71	0.81	0.89
10 min	10 min	0.29	0.38	0.51	0.62	0.76	0.86	0.97	1.09	1.24	1.35
15 min	15 min	0.36	0.47	0.64	0.76	0.94	1.07	1.21	1.35	1.53	1.67
30 min	30 min	0.48	0.63	0.86	1.03	1.26	1.44	1.63	1.81	2.06	2.25
60 min	60 min	0.60	0.78	1.06	1.27	1.56	1.78	2.01	2.24	2.56	2.79
2 hr	120 min	0.69	0.89	1.18	1.41	1.72	1.96	2.20	2.45	2.78	3.04
3 hr	180 min	0.73	0.94	1.23	1.46	1.79	2.04	2.31	2.59	2.98	3.30
6 hr	360 min	0.88	1.12	1.43	1.68	2.01	2.28	2.56	2.84	3.23	3.54
12 hr	720 min	1.00	1.26	1.59	1.86	2.21	2.48	2.76	3.04	3.42	3.71
24 hr	1,440 min	1.21	1.52	1.95	2.29	2.77	3.13	3.52	3.92	4.47	4.91

Site Specific IDF Curve

Time	Time	Storm Event Return Period									
		1 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	200 yr	500 yr	1,000 yr
5 min	5 min	2.28	3.00	4.08	4.80	6.00	6.84	7.68	8.52	9.72	10.68
10 min	10 min	1.74	2.28	3.06	3.72	4.56	5.16	5.82	6.54	7.44	8.10
15 min	15 min	1.44	1.88	2.56	3.04	3.76	4.28	4.84	5.40	6.12	6.68
30 min	30 min	0.96	1.26	1.72	2.06	2.52	2.88	3.26	3.62	4.12	4.50
60 min	60 min	0.60	0.78	1.06	1.27	1.56	1.78	2.01	2.24	2.56	2.79
2 hr	120 min	0.35	0.45	0.59	0.71	0.86	0.98	1.10	1.23	1.39	1.52
3 hr	180 min	0.24	0.31	0.41	0.49	0.60	0.68	0.77	0.86	0.99	1.10
6 hr	360 min	0.15	0.19	0.24	0.28	0.34	0.38	0.43	0.47	0.54	0.59
12 hr	720 min	0.08	0.11	0.13	0.16	0.18	0.21	0.23	0.25	0.29	0.31
24 hr	1,440 min	0.05	0.06	0.08	0.10	0.12	0.13	0.15	0.16	0.19	0.20

Input Parameters for Papadakis and Kazan Equation

Project: Eastmark DU 8 & 9

Prepared By: Kyle Millett **Date:** 3/31/2014

Table 2-2: Watershed Resistance Coefficients

Type	Description	Typical Applications	m	b
A	Minimal roughness: Relatively smooth and/or well-graded and uniform land surfaces. Surfaces runoff is sheet flow.	Commercial/industrial areas Residential area Parks and golf courses	-0.00625	0.04
B	Moderately low roughness: Land surfaces have irregularly spaced roughness elements that protrude from the surface but the overall character of the surface is relatively uniform. Surface runoff is predominately sheet	Agricultural fields Pastures Desert rangelands Undeveloped urban lands	-0.01375	0.08
C	Moderately high roughness: Land surfaces that have significant large to medium-sized roughness elements and/or poorly graded land surfaces that cause the flow to be diverted around the roughness elements. Surface runoff is sheet flow for short distances draining into	Hillslopes Brushy alluvial fans Hilly rangeland Disturbed land, mining, etc. Forests with underbrush	-0.02500	0.15
D	Maximum roughness: Rough land surfaces with torturous flow paths. Surface runoff is concentrated in numerous short flow paths that are often oblique to the main flow direction.	Mountains Some wetlands	-0.03000	0.20

Peak Flow Calculations using and Rational Method and the Papadakis and Kazan Equation

Project: Eastmark DU 8 & 9

Prepared By: Kyle Millett **Date:** 3/31/2014

"C" Value Adjustment	
100-yr	1.00
50-yr	1.00
25-yr	1.00
10-yr	1.00

Sub Basin Area Description													Time of Concentation				Time of Concentation			
													Storm Event: 10 yr				Storm Event: 100 yr			
Concentration Point ID	Local Contributing Areas	Area (ac)	Length (ft)	High Point Elevation	Low Point Elevation	Watercourse slope	Initial Lot Tc (min)	Kb	Type	Roughness Description	m	b	Weighted C	Time of Concentration (min)	Intensity (in/hr)	**Peak Flow (cfs)**	Weighted C	Time of Concentration (min)	Intensity (in/hr)	**Peak Flow (cfs)**
1	100 Feet	0.04	100.00	1429.84	1429.36	0.0048		0.0485	A	Minimal	-0.0063	0.040	0.85	3.95	4.80	**0.18**	0.85	3.30	7.68	**0.28**
2	200 Feet	0.09	200.00	1430.32	1429.36	0.0048	0	0.0466	A	Minimal	-0.0063	0.040	0.85	5.52	4.69	**0.35**	0.85	4.57	7.68	**0.57**
3	300 Feet	0.13	300.00	1430.80	1429.36	0.0048	0	0.0455	A	Minimal	-0.0063	0.040	0.85	6.83	4.40	**0.49**	0.85	5.59	7.46	**0.83**
4	400 Feet	0.17	400.00	1431.28	1429.36	0.0048	0	0.0447	A	Minimal	-0.0063	0.040	0.85	8.00	4.15	**0.62**	0.85	6.52	7.12	**1.06**
5	500 Feet	0.22	500.00	1431.76	1429.36	0.0048	0	0.0441	A	Minimal	-0.0063	0.040	0.85	9.08	3.92	**0.73**	0.85	7.36	6.80	**1.26**
6	600 Feet	0.26	600.00	1432.24	1429.36	0.0048	0	0.0436	A	Minimal	-0.0063	0.040	0.85	10.10	3.71	**0.82**	0.85	8.15	6.51	**1.45**
7	700 Feet	0.31	700.00	1432.72	1429.36	0.0048	0	0.0432	A	Minimal	-0.0063	0.040	0.85	10.99	3.59	**0.93**	0.85	8.91	6.23	**1.62**
8	800 Feet	0.35	800.00	1433.20	1429.36	0.0048	0	0.0429	A	Minimal	-0.0063	0.040	0.85	11.84	3.47	**1.03**	0.85	9.65	5.95	**1.77**
9	900 Feet	0.39	900.00	1433.68	1429.36	0.0048	0	0.0425	A	Minimal	-0.0063	0.040	0.85	12.67	3.36	**1.12**	0.85	10.32	5.76	**1.92**
10	1000 Feet	0.44	1000.00	1434.16	1429.36	0.0048	0	0.0423	A	Minimal	-0.0063	0.040	0.85	13.48	3.25	**1.20**	0.85	10.93	5.64	**2.09**
11	1100 Feet	0.48	1100.00	1434.64	1429.36	0.0048	0	0.0420	A	Minimal	-0.0063	0.040	0.85	14.27	3.14	**1.28**	0.85	11.51	5.52	**2.25**
12	1200 Feet	0.52	1200.00	1435.12	1429.36	0.0048	0	0.0418	A	Minimal	-0.0063	0.040	0.85	15.05	3.04	**1.35**	0.85	12.09	5.41	**2.41**
13	1300 Feet	0.57	1300.00	1435.60	1429.36	0.0048	0	0.0415	A	Minimal	-0.0063	0.040	0.85	15.71	2.99	**1.44**	0.85	12.64	5.30	**2.56**
14	1400 Feet	0.61	1400.00	1436.08	1429.36	0.0048	0	0.0413	A	Minimal	-0.0063	0.040	0.85	16.35	2.95	**1.53**	0.85	13.19	5.20	**2.70**
15	1500 Feet	0.65	1500.00	1436.56	1429.36	0.0048	0	0.0412	A	Minimal	-0.0063	0.040	0.85	16.97	2.91	**1.62**	0.85	13.73	5.09	**2.83**
16	1600 Feet	0.70	1600.00	1437.04	1429.36	0.0048	0	0.0410	A	Minimal	-0.0063	0.040	0.85	17.58	2.87	**1.70**	0.85	14.26	4.99	**2.96**
17	1700 Feet	0.74	1700.00	1437.52	1429.36	0.0048	0	0.0408	A	Minimal	-0.0063	0.040	0.85	18.18	2.83	**1.79**	0.85	14.78	4.88	**3.08**
18	127 Feet	0.06	127.00	1429.90	1429.36	0.0043	0	0.0479	A	Minimal	-0.0063	0.040	0.85	4.59	4.80	**0.23**	0.85	3.84	7.68	**0.36**
Bridge Area	Bridge Area	0.05	62.00	1420.00	1419.84	0.0026	0	0.0482	A	Minimal	-0.0063	0.040	0.85	3.75	4.80	**0.20**	0.85	3.14	7.68	**0.32**

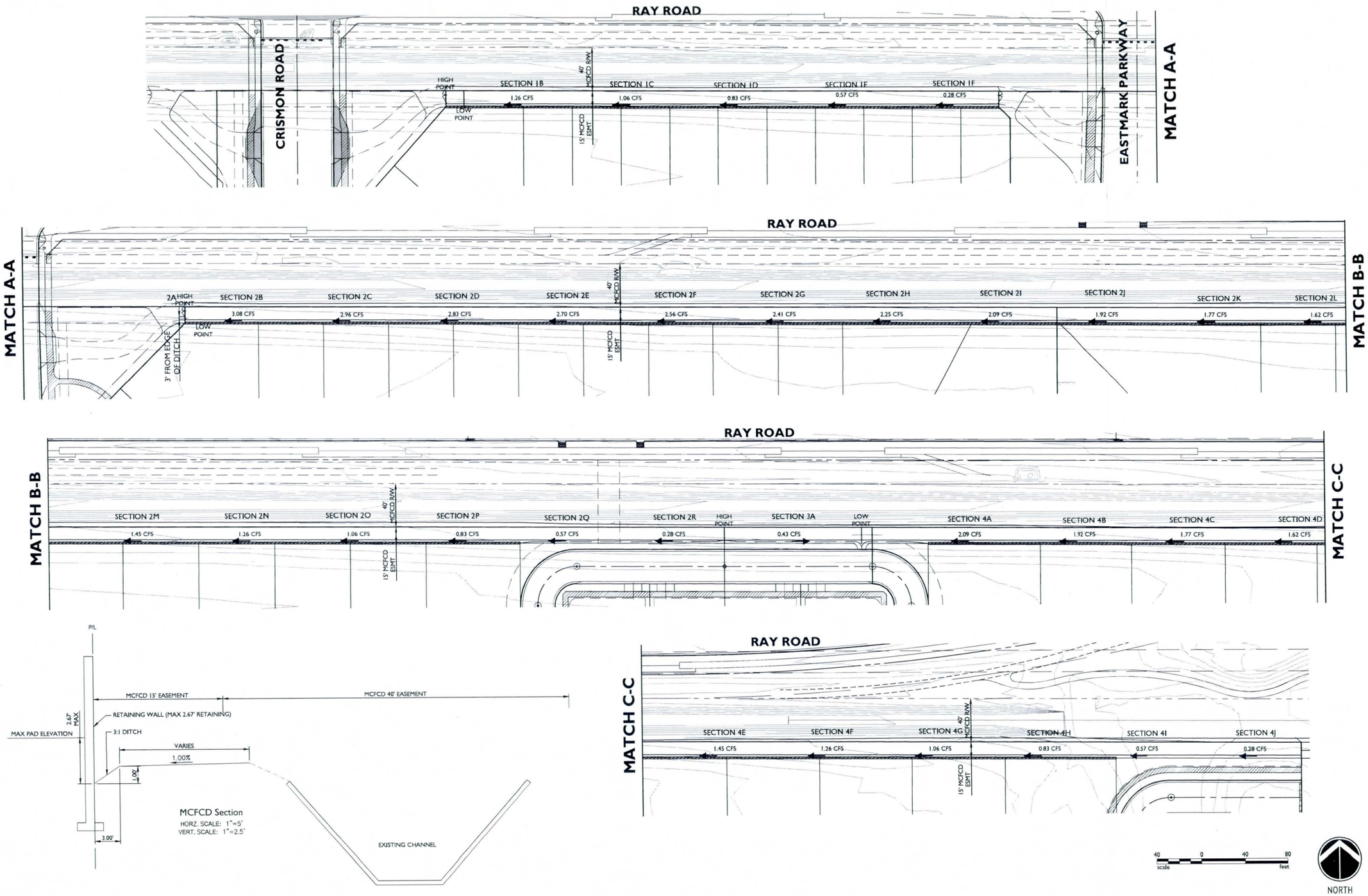
Swale Flow Calculations Using Manning's Equation

Project: Eastmark DU 8&9

Prepared By: Kyle Millett **Date:** 3/31/2014

Section Label	Depth of Swale (ft)	Q (cfs)	v (ft/s)	Manning's n	A (sf)	P (ft)	S	Depth of Flow - d (ft)
1B	0.60	1.26	1.46	0.025	0.86	3.58	0.40%	0.59
1C	0.55	1.06	1.28	0.025	0.83	3.60	0.33%	0.55
1D	0.45	0.83	1.38	0.025	0.60	3.28	0.52%	0.42
1E	0.30	0.57	1.27	0.025	0.45	3.31	0.65%	0.30
1F	0.25	0.28	0.89	0.025	0.31	2.98	0.45%	0.23
2B	1.00	3.08	2.05	0.025	1.50	4.17	0.46%	1.00
2C	1.00	2.96	1.98	0.025	1.50	4.16	0.43%	1.00
2D	1.00	2.83	1.90	0.025	1.49	4.14	0.40%	1.00
2E	0.96	2.70	1.89	0.025	1.43	4.09	0.41%	0.96
2F	0.96	2.56	1.80	0.025	1.43	4.09	0.37%	0.96
2G	0.96	2.41	1.69	0.025	1.42	4.08	0.33%	0.95
2H	0.90	2.25	1.67	0.025	1.34	4.02	0.34%	0.90
2I	0.85	2.09	1.69	0.025	1.24	3.91	0.37%	0.84
2J	0.82	1.92	1.59	0.025	1.21	3.89	0.34%	0.81
2K	0.77	1.77	1.55	0.025	1.14	3.85	0.34%	0.77
2L	0.70	1.62	1.54	0.025	1.05	3.78	0.37%	0.70
2M	0.67	1.45	1.45	0.025	1.00	3.74	0.34%	0.67
2N	0.65	1.26	1.34	0.025	0.94	3.65	0.31%	0.64
2O	0.55	1.06	1.35	0.025	0.78	3.51	0.38%	0.54
2P	0.45	0.83	1.28	0.025	0.65	3.42	0.42%	0.44
2Q	0.30	0.57	1.45	0.025	0.39	2.86	0.83%	0.28
2R	0.25	0.28	0.95	0.025	0.30	2.70	0.48%	0.22
3A	0.41	0.43	0.99	0.025	0.44	2.62	0.30%	0.34
4A	0.90	2.09	1.66	0.025	1.26	3.88	0.35%	0.87
4B	0.75	1.92	1.87	0.025	1.02	3.66	0.54%	0.72
4C	0.75	1.77	1.89	0.025	0.94	3.49	0.58%	0.68
4D	0.72	1.62	1.52	0.025	1.07	3.78	0.35%	0.72
4E	0.56	1.45	1.85	0.025	0.79	3.49	0.70%	0.54
4F	0.56	1.26	1.51	0.025	0.83	3.60	0.45%	0.56
4G	0.40	1.06	1.85	0.025	0.57	3.34	1.02%	0.39
4H	0.30	0.83	2.05	0.025	0.41	3.15	1.81%	0.28
4I	0.50	0.57	0.95	0.025	0.60	2.83	0.20%	0.45
4J	0.25	0.28	0.91	0.025	0.31	2.76	0.43%	0.23
5A	0.50	0.32	0.57	0.025	0.56	6.61	0.25%	0.17
5B	0.50	0.32	0.61	0.025	0.52	6.39	0.30%	0.16
5E	0.22	0.32	1.00	0.025	0.32	4.68	1.00%	0.14
5F	0.22	0.40	1.11	0.025	0.36	4.97	1.00%	0.15

* Depth of flow will not exceed depth of swale



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Project: Eastmark DU 8 & 9
Mesa, AZ

MCFCD DRAINAGE EXHIBIT

Revisions:

Call at least two full working days before you begin excavation.
ARIZONA 811
Arizona Blue Stake, Inc.
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)
In Maricopa County: (602)263-1100

Designer: JCM
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Job No.
13-016

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of 1