

Drainage Reports

ZONING DRAINAGE REPORT

Estates at Jenan

Prepared for:

Camelot Homes, Inc. 6607 North Scottsdale Road, Suite H-100 Scottsdale, AZ 85250

Prepared by:

Kimley-Horn and Associates 291104074 January 2020



ZONING DRAINAGE REPORT

ESTATES AT JENAN

JANUARY 2020

Prepared By:

Kimley »Horn

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INTRODUCTION

SITE LOCATION

This Zoning Drainage Report has been prepared for the proposed Estates at Jenan (the Site). The Site is bound to the east by private properties and North 74th Place, to the west by an existing development and North Scottsdale United Methodist Church, to the north by East Jenan Drive and south by an existing development, Cholla Estates. The area surrounding the Site is developed with primarily single-family homes. The Site is located within Section 23 of Township 3 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. Refer to Figure 1 for the Location Map.

PROJECT SIZE AND TYPE

The Site is a proposed 5.7-acre residential subdivision. The proposed development consists of 10 singlefamily residential units. Currently, the property is developed with single-family lots that are zoned R1-35. This report is being prepared to rezone the property to R1-18. The proposed site is located within the City of Scottsdale (City).

PURPOSE AND OBJECTIVES

This report establishes drainage parameters and criteria for site planning and zoning. This report establishes a general hydrologic and hydraulic plan for the development of the site and will include the following:

- Demonstrate compliance with the City's Design Standards & Polices Manual (DS&PM).
- Quantify offsite runoff being conveyed through the existing property.
- Determine a preliminary hydrologic analysis for onsite and offsite runoff that meets the City's requirements.
- Determine a preliminary hydraulic analysis for onsite and offsite runoff that meets the City's requirements.



DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

EXISTING ONSITE CONDITIONS

The Site consists of three developed single-family home lots zoned R1-35 in existing conditions. The Site slopes from northwest to southeast with an average slope of 0.8%. Offsite flow approaches the Site from the northern boundary and collects in the southeast corner of the Site. There is an existing block wall bordering the Site along the south property line that blocks runoff from exiting the site, causing the offsite runoff to pond against the wall. The recorded plat for the development to the south indicated that wall openings were to be constructed. No wall openings are currently present. Refer to **Figure 3** for the Drainage Conditions Map.

EXISTING OFFSITE DRAINAGE CONDITIONS

The majority of the offsite runoff originates north of the Site from a drainage area developed with single-family homes and zoned R1-35 and R1-18. This offsite runoff is conveyed through the offsite drainage area, to the Site, through side yard swales and across East Jenan Drive at the low point in the road. As offsite runoff enters the Site, it continues to flow southeast to the southeast corner of the Site where it ponds due to the existing block wall on the property line. Refer to **Figure 3** for the Drainage Conditions Map.

CONTEXT RELATIVE TO ADJACENT PROJECTS AND IMPROVEMENTS

Offsite runoff crosses East Jenan Drive by overtopping the existing roadway which has no curb or gutter and dirt shoulders at the low point in the road. Further development within the Site requires East Jenan Drive to be improved for the half street. Improvements to the Site consider the properties upstream of East Jenan Drive and downstream of the Site per City requirements. The existing site experiences ponding in the southeast corner. Improvements associated with the Site improve or do not impact the adjacent properties.

FLOOD HAZARD ZONES ON PROPERTY, FIRM MAPS

The Site is located within Flood Insurance Rate Map (FIRM) panel number 04013C1760L dated October 16, 2013. Refer to **Figure 2** for a FIRMette of Panel 04013C1760L. The Site is in a shaded Zone X flood zone. Shaded Zone X flood zones are classified as "Areas of moderate flood hazard, usually between the limits of the 100-year and 500-year floods."

National Flood Hazard Layer FIRMette



Legend



250

500

1.000

1.500

2,000



PROPOSED DRAINAGE PLAN

PROPOSED ONSITE DRAINAGE PLAN

The proposed development consists of 10 single-family lots rezoned from R1-35 to R1-18. All proposed lots drain from the back of the lot forward to the local streets, which convey the runoff to Retention Basin A in the southeast corner of the Site. All lots will have finished floor elevations a minimum of one foot above the 100-year, 2-hour event water surface elevation of Retention Basin A. Retention Basin A provides storage for onsite and offsite runoff and will drain via dry wells. The overall drainage pattern of the Site maintains the historical drainage pattern from northwest to southeast, and therefore, there is no outfall for offsite runoff to pass through the Site. Refer to **Figure 3** for the Drainage Conditions Map.

PROPOSED HYDROLOGY

Peak discharges are calculated using the Rational Method for the 2-year, 10-year, and 100-year storm events. Proposed onsite drainage areas are delineated from 1-foot contours. The offsite drainage area is delineated based on using City one-foot contours per quarter section mapping. All delineations are shown on the Drainage Conditions Map, **Figure 3**. Weighted "C" values were selected based on proposed zoning classifications per the DS&PM, and a minimum time of concentration of ten minutes was used. A summary of the peak discharges is provided in **Table 1**. Refer to **Appendix A** for the detailed hydrologic calculations.

		-	
Drainage Area	Q ₂ [cfs]	Q ₁₀ [cfs]	Q ₁₀₀ [cfs]
OFF10	13.9	24.2	38.3
ON10	1.8	2.9	4.6
ON20	1.2	1.9	2.9
ON30	0.8	1.3	2.1
ON40	3.9	6.4	10.1
ON50	0.4	0.7	1.1

Table 1. Peak Discharge

PROPOSED HYDRAULICS

Offsite runoff approaches the Site from the north and is mixed with onsite runoff from proposed lots 1-3. There is 6" vertical curb proposed along the south side of East Jenan Drive with a low point at the entry of the Site to allow the runoff to discharge over the road to then be collected by the two MAG 533 Catch Basins 10 and 20. The catch basins discharge to a proposed 36" storm drain that routes the offsite runoff, plus runoff from proposed lots 1-3, to Retention Basin A in the southeast corner of the Site. Runoff has no outfall from the Site until elevation 1378.30, at which point runoff breaks out on to East Jenan Drive. The lowest proposed pad is set to elevation 1378.80, 0.50' above the break out elevation for the Site. At elevation 1378.95, runoff breaks out on East Jenan Drive to the north east, providing the Ultimate Outfall for the Site and surrounding properties.

Onsite runoff will be conveyed in the local street to Catch Basins 30 and 40 to Retention Basin A. Per the DS&PM, the interior street will be designed to convey the peak discharge from the 10-year storm event at or below the top of curb elevation. Additionally, the streets will convey the 100-year runoff within the proposed tracts and maintain a maximum flow depth of eight inches above the gutter flow line. Refer to **Appendix B** for the detailed hydraulic calculations.

DATA ANALYSIS METHODS

HYDROLOGY

The Rational Method is used to determine the 2-year, 10-year, and 100-year peak discharges for offsite and onsite drainage areas. The hydrology in this report uses rainfall depths from National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14). Offsite drainage areas were delineated using City one-foot contours per quarter section mapping provided by the City. Onsite drainage areas are delineated using proposed one-foot contours. A minimum time of concentration of ten minutes was used per the Flood Control District of Maricopa County (FCDMC) Drainage Design Manual, Hydrology (DDMH), dated August 2013. Runoff Coefficients from the Runoff Coefficients – "C" Value Table in section 4-1.504 on the DS&PM were used, specifically, 0.64 and 0.58 per zoning R1-18.

HYDRAULICS

StormCAD is used to model the proposed 18" and 36" storm drains and is sized for the 100-year storm. Tailwater conditions are conservatively set to 1.5' above the bottom of the basin to account for the basin being half full.

FlowMaster CONNECT Edition was used to determine the street capacity and inlet sizing for the Site. Catch Basins 10, 20, and 40 are designed with 17' wings on either side, in sump condition, sized to pass the 100-year runoff from OFF10 and ON10. Catch Basin 30 is designed with a 3' wing on the west, in sump condition, sized to pass the 100-year runoff from ON30.

STORMWATER STORAGE METHOD

The proposed development is designed to retain the 100-year, 2-hour volume for both onsite and offsite runoff due to lack of outfall for the offsite runoff. Retention Basin A meets the City's storage requirement for the onsite 100-year, 2-hour event volume of 0.7 acre-feet (AF) within 1.5' of depth. The basin also stores onsite plus offsite 100-year, 2-hour volume of 1.9 AF in 3.3 feet of depth. In addition to the 100-year, 2-hour volume for onsite and offsite runoff, Retention Basin A will also retain the onsite and offsite runoff volumes for the 100-year, 6-hour and 24-hour storm events within 5.3 feet of depth. In existing conditions, runoff ponds against the existing screen walls located in the southeast corner of the site. In existing conditions if runoff was to pond to a height of 2.3 feet against the existing wall (an elevation of approximately 1378.30) the site provides approximately 2 acre-feet of storage. Basin A will hold 3.5 acre feet of water, an increase of 1.5 acre-ft, when ponding to the same elevation. **Table 2** below

summarizes the volumes for the onsite runoff in proposed conditions while **Table 3** summarizes the volumes for the onsite plus offsite runoff in proposed conditions. Retention basin A will be drained via three dual chamber dry wells that are designed to drain the onsite plus offsite 100-year, 2-hour storm within 36 hours, per the DS&PM.

Storm Event	Proposed Required Onsite Volume (AF)	Proposed Onsite Volume Provided (AF)
100 Yr, 2 Hr*	0.7	1.9

Table 2. Proposed Onsite Volume Summary Table

Table 3. Proposed Onsite and Offsite Volume Summary Table

Storm Event	Proposed Onsite/Offsite Volume Produced (AF)	Proposed Onsite/Offsite Volume Provided (AF)
100 Yr, 2 Hr**	1.9	3.4
100 Yr, 6 Hr**	2.3	3.4
100 Yr, 24 Hr**	3.1	3.4

*Onsite 100-year, 2-hour storage is required per DS&PM.

**Offsite storage is not required per DS&PM.

CONCLUSIONS

- In existing conditions offsite flows approach the site from the north, travel southeast through the site and pond against the block wall on the south property line of the Site. Wall openings included in the Final Plat, for the subdivision to the south, were not constructed. Runoff has no outlet from the Site until elevation 1378.30, at which point runoff breaks out on to East Jenan Drive. This breakout at elevation 1378.95 is the Ultimate Outfall for the Site and surrounding properties.
- Retention Basin A will be used to store onsite and offsite runoff due to the lack of outfall for the Site. Onsite runoff volume generated by the 100-year, 2-hour event will be retained within 1.5' of depth. Onsite plus offsite runoff volume generated by the 100-year, 2-hour event will be retained within 3.3' of depth.
- Runoff volume generated by storms in excess of the 100-year, 2-hour event will be retained within the Site by additional depth above the basin high water elevation and below the finished floor elevations.
- Finished floor elevations will be set at a minimum of one foot above the 100-year, 2-hour water surface elevation and will not be impacted in storm events up to the 100-year, 24-hour. The lowest finished floor elevation is 1379.47, 0.5' above the Ultimate Outfall for the Site on East Jenan Drive(1378.95).

1/28/2020

REFERENCES

City of Scottsdale, Design Standards and Policies Manual, 2018.

Federal Emergency Management Agency, Flood Insurance Rate Map Panel No 04013C1760L, dated October 16, 2013.

City of Scottsdale Topography Quarter Section Maps.

Flood Control District of Maricopa County, Drainage Design Manual, Hydrology, August 2013.

Appendix A Hydrology

- NOAA 14 Rainfall
- Rational Method Calculations
- Storage Calculations

Kimley »Horn Rainfall Information

General Project Information							
Proje	ect	Estates at Jenan					
Projec	t #	291104071					
Designed	by	MML Date 11/5/201					

NOAA 14 Rainfall Depth Data [in]											
		Storm Event [yr]									
Duration	1	2	5	10	25	50	100	200	500	1000	
5-min:	0.19	0.25	0.33	0.40	0.49	0.55	0.63	0.70	0.79	0.86	
10-min:	0.29	0.37	0.50	0.60	0.74	0.84	0.95	1.06	1.21	1.32	
15-min:	0.35	0.46	0.62	0.75	0.92	1.05	1.18	1.31	1.49	1.63	
30-min:	0.48	0.62	0.84	1.01	1.23	1.41	1.59	1.77	2.01	2.20	
60-min:	0.59	0.77	1.04	1.25	1.53	1.74	1.97	2.19	2.49	2.72	
2-hr:	0.69	0.89	1.19	1.41	1.73	1.96	2.20	2.45	2.78	3.03	
3-hr:	0.77	0.99	1.29	1.53	1.86	2.13	2.41	2.70	3.10	3.42	
6-hr:	0.93	1.17	1.50	1.76	2.11	2.38	2.67	2.96	3.36	3.68	
12-hr:	1.03	1.30	1.64	1.90	2.26	2.54	2.82	3.11	3.49	3.79	
24-hr:	1.21	1.53	1.97	2.32	2.80	3.19	3.58	4.00	4.57	5.02	
2-day:	1.29	1.64	2.14	2.54	3.09	3.52	3.98	4.45	5.11	5.63	
3-day:	1.37	1.75	2.30	2.74	3.36	3.86	4.38	4.93	5.71	6.33	
4-day:	1.46	1.87	2.47	2.95	3.64	4.20	4.79	5.42	6.31	7.03	
7-day:	1.65	2.11	2.79	3.34	4.13	4.76	5.43	6.14	7.15	7.97	
10-day:	1.78	2.28	3.01	3.60	4.42	5.08	5.79	6.53	7.57	8.40	
20-day:	2.20	2.83	3.74	4.43	5.36	6.07	6.80	7.54	8.54	9.31	
30-day:	2.57	3.31	4.37	5.18	6.25	7.09	7.94	8.81	9.98	10.90	
45-day:	2.96	3.82	5.04	5.94	7.13	8.02	8.93	9.84	11.00	11.90	
60-day:	3.26	4.22	5.55	6.52	7.78	8.71	9.65	10.60	11.80	12.70	

	NOAA 14 Rainfall Intensity [in/hr]										
	Storm Event										
Duration	1	2	5	10	25	50	100	200	500	1000	
5-min:	2.26	2.94	3.96	4.76	5.83	6.65	7.50	8.35	9.50	10.37	
10-min:	1.72	2.24	3.02	3.62	4.44	5.06	5.71	6.36	7.26	7.92	
15-min:	1.42	1.85	2.49	2.99	3.67	4.20	4.72	5.24	5.96	6.52	
30-min:	0.95	1.25	1.68	2.02	2.46	2.82	3.18	3.54	4.02	4.40	
60-min:	0.59	0.77	1.04	1.25	1.53	1.74	1.97	2.19	2.49	2.72	
2-hr:	0.34	0.45	0.60	0.71	0.87	0.98	1.10	1.23	1.39	1.52	
3-hr:	0.26	0.33	0.43	0.51	0.62	0.71	0.80	0.90	1.03	1.14	
6-hr:	0.15	0.20	0.25	0.29	0.35	0.40	0.45	0.49	0.56	0.61	
12-hr:	0.086	0.108	0.137	0.158	0.188	0.212	0.235	0.259	0.291	0.316	
24-hr:	0.050	0.064	0.082	0.097	0.117	0.133	0.149	0.167	0.190	0.209	
2-day:	0.027	0.034	0.045	0.053	0.064	0.073	0.083	0.093	0.106	0.117	
3-day:	0.019	0.024	0.032	0.038	0.047	0.054	0.061	0.068	0.079	0.088	
4-day:	0.015	0.020	0.026	0.031	0.038	0.044	0.050	0.057	0.066	0.074	
7-day:	0.010	0.013	0.017	0.020	0.025	0.028	0.032	0.037	0.043	0.047	
10-day:	0.007	0.010	0.013	0.015	0.018	0.021	0.024	0.027	0.032	0.035	
20-day:	0.005	0.006	0.008	0.009	0.011	0.013	0.014	0.016	0.018	0.019	
30-day:	0.004	0.005	0.006	0.007	0.009	0.010	0.011	0.012	0.014	0.015	
45-day:	0.003	0.004	0.005	0.006	0.007	0.007	0.008	0.009	0.010	0.011	
60-day:	0.002	0.003	0.004	0.005	0.005	0.006	0.007	0.007	0.008	0.009	

Kimley »Horn Rational Method Calculations

General Project Information							
Project	Estates at Jenan						
Designed by MML		Date	1/9/2020				
[Design Storm Event	2					
	Minimum T _c [min]	10)				

	Hydrology								
Drainage Area	Longitudinal Slope, S _I [ft/ft]	Rational Coefficient ¹	Flowpath Length [ft]	Area [ac]	FCDMC Resistance Coefficient Type	Kb	l [in/hr]	T _c [min]	Q [cfs]
OFF10	0.009	0.40	1,130	10.8	А	0.034	2.1	12.4	9.0
ON10	0.007	0.43	456	1.3	А	0.039	2.2	10.0	1.2
ON20	0.009	0.43	340	0.8	А	0.041	2.2	10.0	0.8
ON30	0.011	0.43	300	0.6	А	0.041	2.2	10.0	0.6
ON40	0.006	0.43	552	2.7	A	0.037	2.2	10.1	2.6
ON50	0.005	0.20	10	0.7	A	0.041	2.2	10.0	0.3

1= Runoff coefficients per Scottsdale DSPM based on zoning category

Kimley »Horn Rational Method Calculations

General Project Information							
Project	Project Estates at Jenan						
Designed by	MML	Date	1/9/2020				
C	Design Storm Event	10					
	Minimum T _c [min]	10)				

	Hydrology								
Drainage Area	Longitudinal Slope, S _I [ft/ft]	Rational Coefficient ¹	Flowpath Length [ft]	Area [ac]	FCDMC Resistance Coefficient Type	Kb	l [in/hr]	T _c [min]	Q [cfs]
OFF10	0.009	0.56	1,130	10.8	А	0.034	3.6	10.1	21.9
ON10	0.007	0.58	456	1.3	А	0.039	3.6	10.0	2.6
ON20	0.009	0.58	340	0.8	А	0.041	3.6	10.0	1.7
ON30	0.011	0.58	300	0.6	А	0.041	3.6	10.0	1.2
ON40	0.006	0.58	552	2.7	A	0.037	3.6	10.0	5.8
ON50	0.005	0.25	10	0.7	A	0.041	3.6	10.0	0.6

1= Runoff coefficients per Scottsdale DSPM based on zoning category

Kimley »Horn Rational Method Calculations

General Project Information						
Project	ŀ	Estates at Jenan				
Designed by	MML	Date	1/9/2020			
C	Design Storm Event	100				
	Minimum T _c [min]	10)			

	Drainage	e Area Informatio	Hydrology						
Drainage Area	Longitudinal Slope, S _I [ft/ft]	Rational Coefficient ¹	Flowpath Length [ft]	Area [ac]	FCDMC Resistance Coefficient Type	Kb	l [in/hr]	T _c [min]	Q [cfs]
OFF10	0.009	0.62	1,130	10.8	А	0.034	5.7	10.0	38.3
ON10	0.007	0.64	456	1.3	А	0.039	5.7	10.0	4.6
ON20	0.009	0.64	340	0.8	А	0.041	5.7	10.0	2.9
ON30	0.011	0.64	300	0.6	A	0.041	5.7	10.0	2.1
ON40	0.006	0.64	552	2.7	A	0.037	5.7	10.0	10.1
ON50	0.005	0.30	10	0.7	A	0.041	5.7	10.0	1.1

1= Runoff coefficients per Scottsdale DSPM based on zoning category

Kimley **»Horn**

General Project Information						
Project Estates at Jenan						
Designed by	MML	Date	1/9/2020			
Design Sto	orm Event [yr]	100				
Rain	fall Depth [in]	2.2	20			

ON-SITE 100YR-2HR REQUIRED STORAGE

			Volume	Basin		Basin			Volume
Storm		Rational	Required [ac-	Bottom	Basin Top	Bottom	Basin Top	Basin Depth	Provided
Duration [hrs]	Area [ac]	Coefficient ¹	ft]	Elev [ft]	Elev [ft]	Area [ft ²]	Area [ft ²]	[ac-ft]	[ac-ft]
2	6.05	0.64	0.7	1,373.0	1,376.3	22,210	27,984	3.30	1.9

1= Runoff coefficient per Scottsdale DSPM based on zoning category

Kimley **»Horn**

General Project Information						
Project	Estates at Jenan					
Designed by	MML	Date	1/9/2020			
Design Sto	orm Event [yr]	100				
Rainfall De	pth (2 Hr)	2.20				
Rainfall De	pth (6 Hr)	2.67				
Rainfall Dep	oth (24 Hr)	3.5	8			

ON/OFF-SITE STORAGE

						Decin						
Storm			Volume	Basin		Basin			Volume	Discharge		Drain
Duration		Rational	Produced	Bottom	Basin Top	Bottom	Basin Top	Basin Depth	Provided	per Dry	No. of Dry	Down
[hrs]	Area [ac] ¹	Coefficient ²	[ac-ft]	Elev [ft]	Elev [ft]	Area [ft ²]	Area [ft ²]	[ac-ft]	[ac-ft]	Well [cfs]	Wells	Time [hrs]
2	16.85	0.40	1.2	1,373.0	1,378.0	22,210	27,984	5.00	3.4	0.30	3.00	17
6	16.85	0.40	1.5	1,373.0	1,378.0	22,210	27,984	5.00	3.4	-	-	-
24	16.85	0.40	2.0	1,373.0	1,378.0	22,210	27,984	5.00	3.4	-	-	-

1=Offsite+onsite area (6.05 & 10.80)

2=Weighted C Value for offsite+onsite drainage area per Scottsdale DSPM based on zoning category (.62 & .64)

Kimley »Horn

General Project Information					
Project	E	Estates at Jenan			
Designed by	MML	Date	1/9/2020		
Design Storm I	Event [yr]	10	00		

ΤΟΤΑΙ	TOTAL VOLUME PROVIDED @ 5.3' DEPTH							
			Volume	Volume				
	Area (sq.		Provided	Provided				
Elevation	ft.)	Area (Ac.)	(cf)	(af)				
1373.0	22210	0.5	-	-				
1373.5	23132	0.5	11,335	0.3				
1374.0	24011	0.6	11,785	0.3				
1374.5	24858	0.6	12,217	0.3				
1375.0	25680	0.6	12,634	0.3				
1375.5	26490	0.6	13,042	0.3				
1376.0	27272	0.6	13,440	0.3				
1376.5	28064	0.6	13,834	0.3				
1377.0	28246	0.6	14,077	0.3				
1377.5	28410	0.7	14,164	0.3				
1378.0	40371	0.9	17,108	0.4				
1378.3	49376	1.1	13,439	0.3				
			Total =	3.4				

VC	VOLUME PROVIDED @ 3.3' DEPTH							
			Volume	Volume				
	Area (sq.		Provided	Provided				
Elevation	ft.)	Area (Ac.)	(cf)	(af)				
1373.0	22210	0.5	-	-				
1373.5	23132	0.5	11,335	0.3				
1374.0	24011	0.6	11,785	0.3				
1374.5	24858	0.6	12,217	0.3				
1375.0	25680	0.6	12,634	0.3				
1375.5	26490	0.6	13,042	0.3				
1376.0	27272	0.6	13,440	0.3				
1376.3	27984	0.6	8,288	0.2				
			Total =	1.9				

Appendix B Hydraulics

- StormCAD Calculations
- Street Capacity
- Inlet Calculations



Jenan.stsw 1/14/2020 Bentley Systems, Inc. Haestad Methods Solution Center 27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 StormCAD CONNECT Edition [10.02.01.04] Page 1 of 1



Station (ft)

Jenan.stsw 1/14/2020 Bentley Systems, Inc. Haestad Methods Solution Center 27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 StormCAD CONNECT Edition [10.02.01.04] Page 1 of 1



Profile Report Engineering Profile - Storm Drain at Entry (OFF10,ON10,ON20) (Jenan.stsw)

Station (ft)

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Profile Report Engineering Profile - Storm Drain at RBA (ON30 and ON40) (Jenan.stsw)



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Conduit FlexTable: Combined Pipe/Node Report

										=				
Label	Start Node	Stop Node	Length (Unified) (ft)	Manning's n	Slope (Calculated) (ft/ft)	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
CO-5	CB-10	MH-4	38.3	0.013	0.003	36.0	23.80	3.37	1,377.84	1,377.61	1,377.66	1,377.61	1,373.14	1,373.02
CO-6	MH-4	CB-20	12.7	0.013	-0.003	36.0	22.10	3.13	1,377.61	1,377.84	1,377.62	1,377.61	1,373.02	1,373.06
CO-1	MH-1	0-1	26.3	0.013	0.003	36.0	45.90	6.49	1,377.69	1,377.00	1,374.96	1,374.61	1,372.47	1,372.40
CO-7	CB-40	0-1	18.8	0.013	0.025	18.0	10.10	9.93	1,376.40	1,377.00	1,374.10	1,373.90	1,372.88	1,372.40
CO-4	MH-4	MH-3	45.7	0.013	0.003	36.0	45.90	6.49	1,377.61	1,377.68	1,377.13	1,376.91	1,373.02	1,372.89
CO-3	MH-3	MH-2	66.3	0.013	0.003	36.0	45.90	6.49	1,377.68	1,378.18	1,376.52	1,376.20	1,372.89	1,372.68
CO-2	MH-2	MH-1	73.7	0.013	0.003	36.0	45.90	6.49	1,378.18	1,377.69	1,375.81	1,375.46	1,372.68	1,372.47
CO-8	CB-40	CB-30	30.2	0.013	-0.030	18.0	2.10	6.85	1,376.40	1,376.03	1,374.33	1,374.10	1,372.88	1,373.78

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FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Hydraulic Grade (ft)
0-1	1,377.00	1,372.40	56.00	User Defined Tailwater	1,374.61

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Project Description		
Solve For	Spread	
Input Data		
Discharge	23.80 cfs	
Gutter Width	1.42 ft	
Gutter Cross Slope	0.030 ft/ft	
Road Cross Slope	0.020 ft/ft	
Curb Opening Length	37.00 ft	
Opening Height	0.50 ft	
Curb Throat Type	Horizontal	
Local Depression	2.0 in	
Local Depression Width	24.0 in	
Throat Incline Angle	90.00 degrees	
Poculte		
Spread	17.91 ft	
Depth	4.5 in	
Gutter Depression	0.2 in	
Total Depression	2.2 in	
Messages		
Notes	Clogging Factor of 20% X 0.50FF10+0 N10 Flow 1.2 (0.5*38.3+4. 6)	

Worksheet for CB10 - 100YR

Project Description		
Solve For	Spread	
Input Data		
Discharge	26.46 cfs	
Gutter Width	1.42 ft	
Gutter Cross Slope	0.030 ft/ft	
Road Cross Slope	0.020 ft/ft	
Curb Opening Length	37.00 ft	
Opening Height	0.50 ft	
Curb Throat Type	Horizontal	
Local Depression	2.0 in	
Local Depression Width	24.0 in	
Throat Incline Angle	90.00 degrees	
Results		
Spread	19 22 ft	
Depth	4.8 in	
Gutter Depression	0.2 in	
Total Depression	2.2 in	
Messages		
	Classica	
	Clogging Eactor of	
	20% X	
Nishaa	0.50FF10+0	
Notes	N20 Flow	
	1.2	
	(0.5*38.3+2.	
	9)	

Worksheet for CB20 - 100YR

Project Description		
Solve For	Curb Opening Length	
Input Data		
Discharge	2.52 cfs	
Spread	13.50 ft	
Gutter Width	1.42 ft	
Gutter Cross Slope	0.030 ft/ft	
Road Cross Slope	0.020 ft/ft	
Opening Height	0.50 ft	
Curb Throat Type	Horizontal	
Local Depression	2.0 in	
Local Depression Width	24.0 in	
Throat Incline Angle	90.00 degrees	
Results		
	4.21.0	
	4.21 π	
Depth	3.4 in	
Gutter Depression	0.2 in	
Total Depression	2.2 in	
Messages		
Notes	Clogging Factor of 20% X ON30 Flow 1.2*2.1	

Worksheet for CB30 - 100YR

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Project Description		
Solve For	Curb Opening Length	
Input Data		
Discharge	12.12.050	
Discillatige	12.12 CIS	
Spread Cuttor Width	1 42 0	
	1.42 IL	
Gutter Cross Slope	0.030 ft/ft	
Road Cross Slope	0.020 π/π	
Opening Height	0.50 π	
Curb Throat Type	Horizontal	
Local Depression	2.0 in	
Local Depression Width	24.0 in	
Throat Incline Angle	90.00 degrees	
Results		
Curb Opening Length	28.80 ft	
Depth	3.4 in	
Gutter Depression	0.2 in	
Total Depression	2.2 in	
Messages		
Notes	Clogging Factor of 20% X ON40	
	Flow	
	1.2*(10.1)	

Worksheet for CB40 - 100YR

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Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Input Data		
Channel Slope	0.005 ft/ft	
Discharge	26.20 cfs	

Worksheet for Street Capacity - Entry at CB10 & CB20 - 10YR

Section Definitions

Station (ft)		Elevation (ft)
	0+00.00	80.30
	0+04.46	80.00
	0+05.31	78.00
	0+10.00	77.87
	0+12.44	77.83
	0+12.94	77.75
	0+32.94	77.70
	0+33.44	78.20
	0+41.44	78.20
	0+41.94	77.70
	0+61.94	77.75
	0+62.44	77.84
	0+64.93	77.87
	0+69.62	78.00
	0+70.38	80.00
	0+74.93	80.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.30)	(0+12.44, 77.83)	0.041
(0+12.44, 77.83)	(0+33.44, 78.20)	0.013
(0+33.44, 78.20)	(0+41.44, 78.20)	0.041
(0+41.44, 78.20)	(0+62.44, 77.84)	0.013
(0+62.44, 77.84)	(0+74.93, 80.60)	0.041

Options		
Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	

Results

Normal Depth

4.0 in

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Results		
Elevation Pango	77.70 to	
Lievation Range	80.60 ft	
Flow Area	14.5 ft ²	
Wetted Perimeter	56.34 ft	
Hydraulic Radius	3.1 in	
Top Width	56.00 ft	
Normal Depth	4.0 in	
Critical Depth	3.1 in	
Critical Slope	0.014 ft/ft	
Velocity	1.80 ft/s	
Velocity Head	0.05 ft	
Specific Energy	0.38 ft	
Froude Number	0.625	
Flow Type	Subcritical	
GVF Input Data		
Downstream Denth	0.0 in	
l ength	0.00 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	3.1 in	
Channel Slope	0.005 ft/ft	
Critical Slope	0.014 ft/ft	
Messages		
Magazaga	Flow is	
messages	divided.	
	10YR	
	Flow=OFF10	
	+ON10+ON2	
Notes	+ON10+ON2 0	
Notes	+ON10+ON2 0 =21.9+2.6+1	

Worksheet for Street Capacity - Entry at CB10 & CB20 - 10YR

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Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	4.0 in
Discharge	20.20 015
	80.50
	▼ − − − − − − − − − − − − − − − − − − −
	80.00
	5 79.50
	të shara ka
	± ^{79.00}
	78.50
	78.00
	77.50
	0+00 0+20 0+40 0+60 Station

Cross Section for Street Capacity - Entry at CB10 & CB20 - 10YR

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Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Input Data		
Channel Slope	0.005 ft/ft	
Discharge	45.80 cfs	

Worksheet for Street Capacity - Entry at CB10 & CB20 - 100YR

Section Definitions

Station (ft)		Elevation (ft)
	0+00.00	80.30
	0+04.46	80.00
	0+05.31	78.00
	0+10.00	77.87
	0+12.44	77.83
	0+12.94	77.75
	0+32.94	77.70
	0+33.44	78.20
	0+41.44	78.20
	0+41.94	77.70
	0+61.94	77.75
	0+62.44	77.84
	0+64.93	77.87
	0+69.62	78.00
	0+70.38	80.00
	0+74.93	80.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.30)	(0+12.44, 77.83)	0.041
(0+12.44, 77.83)	(0+33.44, 78.20)	0.013
(0+33.44, 78.20)	(0+41.44, 78.20)	0.041
(0+41.44, 78.20)	(0+62.44, 77.84)	0.013
(0+62.44, 77.84)	(0+74.93, 80.60)	0.041

Options		
Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	

Results

Normal Depth

5.3 in

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Results		
Elevation Dange	77.70 to	
Elevation Range	80.60 ft	
Flow Area	20.4 ft ²	
Wetted Perimeter	56.87 ft	
Hydraulic Radius	4.3 in	
Top Width	56.30 ft	
Normal Depth	5.3 in	
Critical Depth	4.2 in	
Critical Slope	0.013 ft/ft	
Velocity	2.25 ft/s	
Velocity Head	0.08 ft	
Specific Energy	0.52 ft	
Froude Number	0.658	
Flow Type	Subcritical	
GVF Input Data		
Downstream Denth	0.0 in	
Length	0.00 ft	
Number Of Steps	0.00 10	
	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	5.3 in	
Critical Depth	4.2 in	
Channel Slope	0.005 ft/ft	
Critical Slope	0.013 ft/ft	
Messages		
	Flow is	
Messages	divided.	
	100YR	
	Flow=OFF10	
	+ON10+ON2	
Notes	0	
	-38 3+4 6+2	
	-50.5 + 1 .0+2 .9	

Worksheet for Street Capacity - Entry at CB10 & CB20 - 100YR

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Project Description	
Friction Method Solve For	Manning Formula Normal Depth
Input Data	
Channel Slope Normal Depth Discharge	0.005 ft/ft 5.3 in 45.80 cfs
	80.50 80.00 5 79.50 79.00 78.50 78.00 78.00 78.00 77.50 0+00 0+20 0+40 0+60 5tation

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Worksheet for Street Capacity - Knuckle East of CB30 & CB40 - 10YR

Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Input Data		
Channel Slope	0.005 ft/ft	

Section Definitions

Station (ft)	Elevation (ft)
0+	00.00 78.69
0+	10.00 78.08
0+	16.00 77.99
0+	18.00 77.67
0+	30.00 77.90
0+	42.00 77.66
0+	44.00 77.99
0+	50.00 78.19
0+	60.00 78.53

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 78.69)	(0+16.00, 77.99)	0.041
(0+16.00, 77.99)	(0+44.00, 77.99)	0.013
(0+44.00, 77.99)	(0+60.00, 78.53)	0.041

Options		
Current Roughness Weighted	Pavlovskii's	
Metrica Onen Channel Weightige	Metriou	
Method	Paviovskii s Method	
Closed Channel Weighting	Pavlovskii's	
Method	Method	
Results		
Normal Depth	3.0 in	
Elevation Range	77.66 to 78.69 ft	
Flow Area	3.4 ft ²	
Wetted Perimeter	27.06 ft	
Hydraulic Radius	1.5 in	
Top Width	27.01 ft	
Normal Depth	3.0 in	
Critical Depth	3.0 in	
Critical Slope	0.005 ft/ft	
Velocity	2.04 ft/s	
	Bentley Systems, Inc. Haestad Methods Solution	Flo
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Results		
Velocity Head	0.06 ft	
Specific Energy	0.31 ft	
Froude Number	1.010	
Flow Type	Supercritical	
GVF Input Data		
Downstream Depth	0.0 in	
Length	0.00 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	3.0 in	
Critical Depth	3.0 in	
Channel Slope	0.005 ft/ft	
Critical Slope	0.005 ft/ft	
Messages		
Notes	10YR Flow=ON30+ ON40	
	=1.2+5.8	

Worksheet for Street Capacity - Knuckle East of CB30 & CB40 - 10YR

Cross Section for Street Capacity - Knuckle East of CB30 & CB40 - 10YR



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Worksheet for Street Capacity - Knuckle East of CB30 & CB40 - 100YR

Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Innut Data		
Channel Slope	0.005 ft/ft	

Section Definitions

Station (ft)	Elevation (ft)
0+00.	00 78.69
0+10.	00 78.08
0+16.	00 77.99
0+18.	00 77.67
0+30.	00 77.90
0+42.	00 77.66
0+44.	00 77.99
0+50.	00 78.19
0+60.	00 78.53

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 78.69)	(0+16.00, 77.99)	0.041
(0+16.00, 77.99)	(0+44.00, 77.99)	0.013
(0+44.00, 77.99)	(0+60.00, 78.53)	0.041

Options		
Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	
Results		
Normal Depth	3.6 in	
Elevation Range	77.66 to 78.69 ft	
Flow Area	4.8 ft ²	
Wetted Perimeter	27.70 ft	
Hydraulic Radius	2.1 in	
Top Width	27.64 ft	
Normal Depth	3.6 in	
Critical Depth	3.7 in	
Critical Slope	0.004 ft/ft	
Velocity	2.53 ft/s	
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Results		
Velocity Head	0.10 ft	
Specific Energy	0.40 ft	
Froude Number	1.066	
Flow Type	Supercritical	
GVF Input Data		
Downstream Depth	0.0 in	
Length	0.00 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	3.6 in	
Critical Depth	3.7 in	
Channel Slope	0.005 ft/ft	
Critical Slope	0.004 ft/ft	
Messages		
Notes	100YR Flow=ON30+ ON40	
	=2.1+10.1	

Worksheet for Street Capacity - Knuckle East of CB30 & CB40 - 100YR

Cross Section for Street Capacity - Knuckle East of CB30 & CB40 - 100YR



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Worksheet for Street Capacity - Knuckle West of CB30 & CB40 - 10YR

Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Input Data		
Channel Slope	0.005 ft/ft	

Section Definitions

Elevation (ft)
) 79.00
78.00
) 77.91
) 77.58
) 77.78
) 77.58
) 77.91
78.00
78.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 79.00)	(0+16.00, 77.91)	0.041
(0+16.00, 77.91)	(0+44.00, 77.91)	0.013
(0+44.00, 77.91)	(0+60.00, 78.87)	0.041

Options		
Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	
Results		
Normal Depth	2.8 in	
Elevation Range	77.58 to 79.00 ft	
Flow Area	3.4 ft ²	
Wetted Perimeter	26.82 ft	
Hydraulic Radius	1.5 in	
Top Width	26.78 ft	
Normal Depth	2.8 in	
Critical Depth	2.8 in	
Critical Slope	0.005 ft/ft	
Velocity	2.05 ft/s	
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Results		
Velocity Head	0.07 ft	
Specific Energy	0.29 ft	
Froude Number	1.010	
Flow Type	Supercritical	
GVF Input Data		
Downstream Depth	0.0 in	
Length	0.00 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	2.8 in	
Critical Depth	2.8 in	
Channel Slope	0.005 ft/ft	
Critical Slope	0.005 ft/ft	
Messages		
Notes	10YR Flow=ON30+ ON40	
	=1.2+5.8	

Worksheet for Street Capacity - Knuckle West of CB30 & CB40 - 10YR

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Cross Section for Street Capacity - Knuckle West of CB30 & CB40 - 10YR



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Worksheet for Street Capacity - Knuckle West of CB30 & CB40 - 100YR

Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Input Data		
Channel Slope	0.005 ft/ft	
Discharge	12.20 cfs	

Section Definitions

Station (ft)	Elevation (ft)
0+00.	00 79.00
0+10.	00 78.00
0+16.	00 77.91
0+18.	00 77.58
0+30.	00 77.78
0+42.	00 77.58
0+44.	00 77.91
0+50.	00 78.00
0+60.	00 78.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 79.00)	(0+16.00, 77.91)	0.041
(0+16.00, 77.91)	(0+44.00, 77.91)	0.013
(0+44.00, 77.91)	(0+60.00, 78.87)	0.041

Options		
Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	
Results		
Normal Depth	3.4 in	
Elevation Range	77.58 to 79.00 ft	
Flow Area	4.8 ft ²	
Wetted Perimeter	27.45 ft	
Hydraulic Radius	2.1 in	
Top Width	27.40 ft	
Normal Depth	3.4 in	
Critical Depth	3.5 in	
Critical Slope	0.004 ft/ft	
Velocity	2.53 ft/s	
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Results		
Velocity Head	0.10 ft	
Specific Energy	0.38 ft	
Froude Number	1.066	
Flow Type	Supercritical	
GVF Input Data		
Downstream Depth	0.0 in	
Length	0.00 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	3.4 in	
Critical Depth	3.5 in	
Channel Slope	0.005 ft/ft	
Critical Slope	0.004 ft/ft	
Messages		
Notes	100YR Flow=ON30+ ON40	
	=2.1+10.1	

Worksheet for Street Capacity - Knuckle West of CB30 & CB40 - 100YR

Cross Section for Street Capacity - Knuckle West of CB30 & CB40 - 100YR



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