Preliminary

Hydrology Study

For

5030 College

5030 College Avenue
San Diego, CA 92115

Prepared for
Capstone Development Partners, LLC
162 South Rancho Santa Fe Road, Suite B-80
Encinitas, CA 92024

Prepared by
Nasland Engineering
4740 Ruffner Street
San Diego, Ca. 92111
(858) 292-7770
N.E. Job No. 113-110.1

April 22nd, 2015

4/22/2015

Cory Schrack **R.C.E. 65976** **Date**

Table of Contents

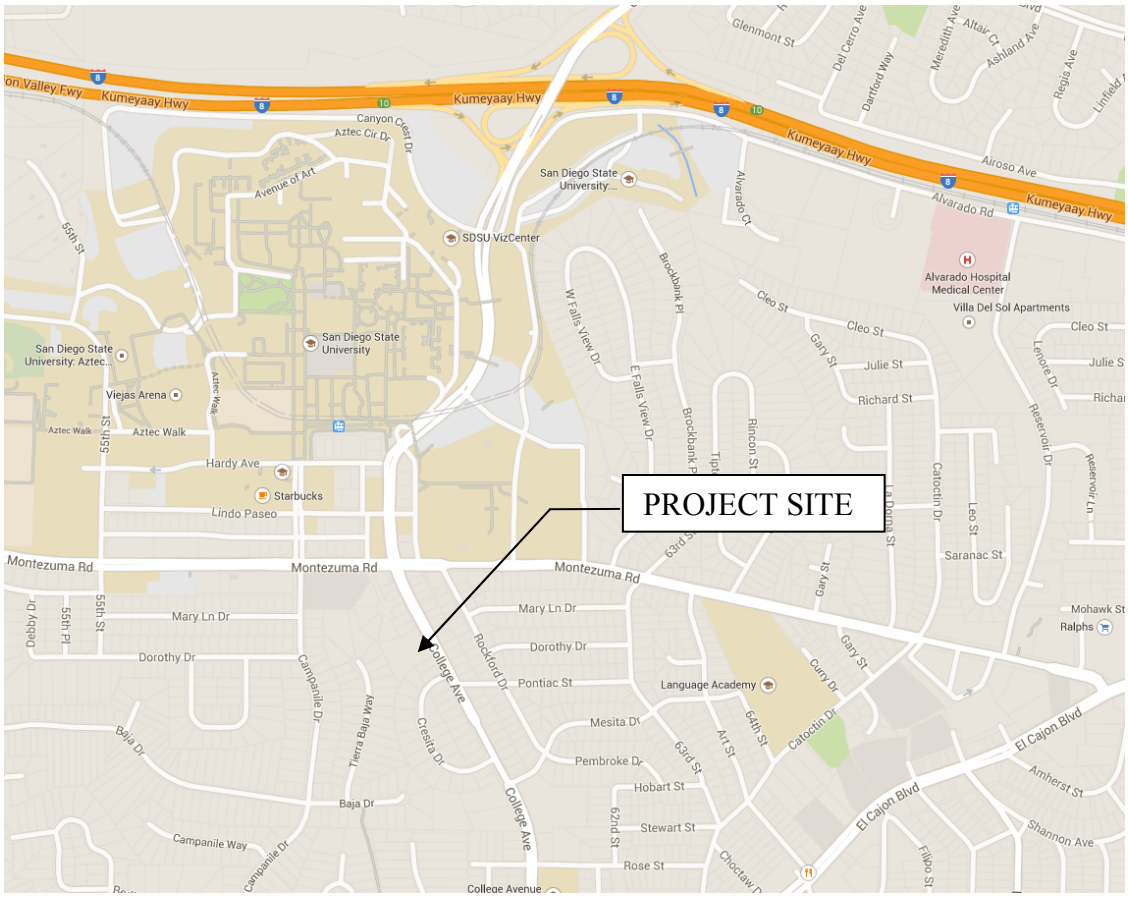
PURPOSE:

The purpose of this hydrology study is to show that the proposed 5030 College project will not negatively impact existing hydrologic conditions. This report will calculate, analyze and compare storm water runoff for both the existing and proposed site conditions in order to ensure that the existing hydrologic regime is not negatively impacted by the project.

DESCRIPTION:

The 5030 College project site is located on the west side of College Avenue approximately 450 feet south of Montezuma Road in the City of San Diego. The proposed project would construct a student housing apartment building over 2 stories of underground parking. The project will be confined to an area encompassing approximately 1.51 acres. The general direction of the storm water flow for this site is shown on the attached hydrology exhibits (Existing Hydrology and Proposed Hydrology Exhibits).

VICINITY MAP



Source: Google Maps

EXISTING DRAINAGE:

The existing site encompasses approximately 1.51 acres of undeveloped land. The existing conditions are considered to be one drainage basin with an average slope of 13% which is considered to be steep. There are two curb inlets located in College Avenue that drains the right-of-way and adjacent neighborhoods. These inlets are connected to the existing storm drain system that currently runs through the proposed site. The existing drainage pattern generally sheet flows to the west and down to Tierra Baja Way through the existing residential development where it eventually makes its way into the existing storm drain system.

See **Appendix A – Existing Hydrologic Conditions Exhibit,** for further information.

PROPOSED DRAINAGE:

The project proposes two buildings with residential apartments, a private drive lane, landscape improvements and storm water management facilities. In order to provide adequate site drainage, as well as meet City of San Diego Storm Water Standard requirements, improvements such as a flow-through planters and private storm drain system are incorporated into the design. The proposed 1.51 acre hydrologic area consists of approximately 77% impervious surface and 23% pervious surfaces such as landscape areas. Storm water from each basin is routed to onsite flow through planters which are sized for both Water Quality and Hydromodification requirements. The project proposes to reroute and upsize the existing storm drain system that runs through the property and tie into the existing 18" storm drain located at the west end of the property. The proposed 30" pipe will collect all runoff from both off site and on site. This area is also considered to be a single drainage basin and will discharge at the same location as the existing condition.

See **Appendix B – Proposed Hydrologic Conditions Exhibit,** for further information.

HYDROLOGY METHODOLOGY/DESIGN CRITERIA:

Storm water runoff for both the existing and proposed site conditions is calculated, analyzed and compared in order to ensure that the proposed conditions do not negatively affect the existing hydrologic regime. Runoff is calculated by utilizing methods outlined in the City of San Diego Drainage Design Manual. Topographical information has been obtained by Nasland Engineering. Hydrologic basin boundaries, landscape areas, and flow path characteristics such as change in elevation and length of flow are obtained from the Existing and Proposed Conditions Maps which are drafted in AutoCAD Civil 3D 2013 software. This information is utilized to determine the basin area, runoff coefficient and inlet time for each basin.

CALCULATIONS:

Calculations have been performed per Rational Method guidelines set forth in the City of San Diego Drainage Design Manual:

- Runoff Coefficients were determined using Table 2. A coefficient of 0.45 for Open Area is used because the existing site is open undeveloped land for basin 1A. A coefficient of 0.55 for Single Family Residence is used for basin 1B and 1C. Runoff Coefficients for the proposed condition has been calculated per Table 2 of the Drainage Design Manual. A coefficient of 0.85 is used for Commercial (80% impervious) Land Use Type.
- Land Use type was used per Table 2 of the City of San Diego Drainage Design Manual – 0.45 (Open Area). Land Use type for the proposed condition was used per Table 2 of the Drainage Design Manual – 0.85 (Commercial).
- Time of Concentration for storm water runoff flowing in a drainage ditch, gutter or storm drain is determined per the "Urban Overland Time of Flow Curves" located on page 86 of the City of San Diego Drainage Design Manual.
- For hydrology calculations refer to the pages following. For attachments and references to the calculations see **Appendix D – Hydrology References**

5030 College - Existing & Proposed Time of Concentrations

Existing Site Conditions							
Basin	Runoff Coefficient	[1]Urban Areas Overland Time					
		High Point	Low Point	ΔE	Length	Avg Slope	$T_{overland}$
	(C)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(min)
1A	0.45	447.0	407.0	40.0	293	0.137	8.4
1B	0.55	454.0	445.0	9.0	85	0.106	5.0
1C	0.55	443.0	437.0	6.0	32	0.188	5.0

Proposed Site Conditions							
Basin	[2]Runoff Coefficient	[1]Urban Areas Overland Time					
		High Point	Low Point	ΔE	Length	Avg Slope	$T_{overland}$
	(C)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(min)
1A	0.70	447.0	426.0	21.0	392	0.054	8.1
1B	0.55	454.0	426.0	28.0	415	0.067	10.7
1C	0.55	443.0	426.0	17.0	305	0.056	9.8

1. Time of concentration for stormwater runoff flowing in a drainage ditch, gutter or storm drain is determined per the "Urban Areas Overland Time" page 86 of the City of San Diego Drainage Design Manual.
2. Runoff coefficients have been determined per the Table 3-1.

5030 College - Existing & Proposed Surface Runoff

Existing Site Conditions										
Basin	Basin Area	Basin Acreage (A)	Pervious Area	Impervious Area	% Pervious	% Impervious	[1]Runoff Coefficient	[2]Tc	[3]Intensity 100-year	Q_{100}
	(sf)	(ac)	(sf)	(sf)	%	%	(C)	(min)	(in/hr)	(cfs)
1A	65,681	1.51	65,681	0	100%	0%	0.45	8.4	3.80	2.58
1B	13,132	0.30	0	13,132	0%	100%	0.55	5.0	4.20	0.69
1C	1,776	0.04	1,776	0	100%	0%	0.55	5.0	4.20	0.09
Total	80,589	1.85	67,457	13,132	84%	16%				3.37

Proposed Site Conditions										
Basin	Basin Area	Basin Acreage (A)	Pervious Area	Impervious Area	% Pervious	% Impervious	[1]Runoff Coefficient	[2]Tc	[3]Intensity 100-year	Q_{100}
	(sf)	(ac)	(sf)	(sf)	%	%	(C)	(min)	(in/hr)	(cfs)
1A	65,681	1.51	26,525	39,156	40%	60%	0.70	8.1	3.60	3.81
1B	13,132	0.30	13,132	0	100%	0%	0.55	10.7	3.10	0.51
1C	1,776	0.04	1,776	0	100%	0%	0.55	9.8	3.10	0.07
Total	80,589	1.85	41,433	39,156	51%	49%				4.38

Change in Site Surface Runoff (CFS) 1.02

1. Runoff coefficients have been determined per Table 3-1 of the City of San Diego Drainage Design Manual.

2. See previous table for time of concentration calculations.

3. Intensity values have been calculated per the "Intensity-Duration Frequency Curves" graph located in Appendix I-B of the City of San Diego Drainage Design Manual.

EXISTING OFF SITE BASIN CONDITIONS AND Q_{50} CALCULATIONS:

The hydraulic capacity of the existing storm drain system located within the project boundary was analyzed using the reference drawings 6184-AB, 11097-D and topographic survey from Nasland Engineering. The upstream drainage basin includes 16.8 acres which are divided into two basins. Using the rational method the two offsite basins discharge a total of 33.06 cfs into two existing curb inlets located in College Avenue. The curb inlets connect to the existing storm drain system which the proposed project ties into. The analysis concludes that the existing storm drain system is unable to contain the 33.06 cfs and that upsizing the onsite system will be needed.

Existing Site Conditions									
Basin	Runoff Coefficient	Gutter and Roadway Discharge - Velocity							
		High Point	Low Point	ΔE	Length	Avg Slope	Velocity[1]	Length/ Velocity	Tc
	(C)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(f/s)	(sec)	(min)
1	0.55	466.0	441.0	25.0	1600	0.016	3.4	470.59	14.8*
2	0.55	460.0	441.0	19.0	621	0.031	4.8	129.38	5.0

1. Value obtained from Gutter and Roadway Discharge - Velocity Chart on page 87 of the San Diego Drainage Design Manual.
* Basin 1 added 7 min for initial time of concentration for leaving initial property.

Basin	Tc	Area	C	I	Q_{50}	I	Q_{100}
1	7.8	14.6	0.55	3.5	28.105	3.8	30.514
2	5.0	2.2	0.55	4.1	4.961	4.2	5.082
				Total	33.066	Total	35.596

*The offsite basin Q_{50} value was obtained using page 87 of the City of San Diego Drainage Design Manual. The runoff coefficient value used for the offsite basin was determined to be 0.55 for single family residential per Table 3-1 of the City of San Diego Drainage Design Manual.

See **Appendix D – Existing Offsite Hydrology Conditions Exhibit,** for further information.

HYDRAULIC CALCULATIONS:

The proposed storm drain system was analyzed using Storm Sewers application in AutoCad 2013. The upstream offsite basin 1 produced 28.10 cfs and was the initial input for the proposed storm drain system. An additional 4.96 cfs from the offsite basin 2 was added to the storm drain system at the next inlet. Lastly the existing site runoff from the combined onsite basins of 3.37 cfs was added into the storm drain system. Through the Storm Sewers application and these quantities it has been shown the proposed systems maximum capacity was not met. Therefore the onsite storm drain system will work with the existing and proposed conditions. The capacity of a 30" pipe was determined to be 62.83 cfs at a 2% slope per manning's calculation which is well over the sum of Q_{50} values for the proposed site.

See **Appendix E – Storm Sewer Calculations,** for further information.

CONCLUSION:

The Surface Runoff Calculation shows that the proposed 5030 College project will increase the peak flow runoff from the existing conditions. The total volume of the existing site run-off was calculated from the equation $V = CP_6A$ using the 100 year 6 hour storm isopluvial map from the Drainage Design Manual. $V_{Existing}$ = (0.45)(0.225)(65,681) = 6,650 cubic feet. $V_{Proposed}$ = (0.70)(0.225)(65,681) = 10,344 cubic feet. This project proposes to detain 3,694 cubic feet of run-off within the site boundary. As discussed in the proposed condition section of this report the onsite storm drain system will be rerouted and increased to a 30" pipe which will collect both the off-site and on-site storm water. The larger pipe size will increase capacity to handle the 50 year storm and for any additional runoff the proposed site may cause. Furthermore by developing this site, the existing sheet flow of storm water draining off-site to the west via surface flow is eliminated by capturing the runoff though the storm drain system.

ENGINEER OF WORK:

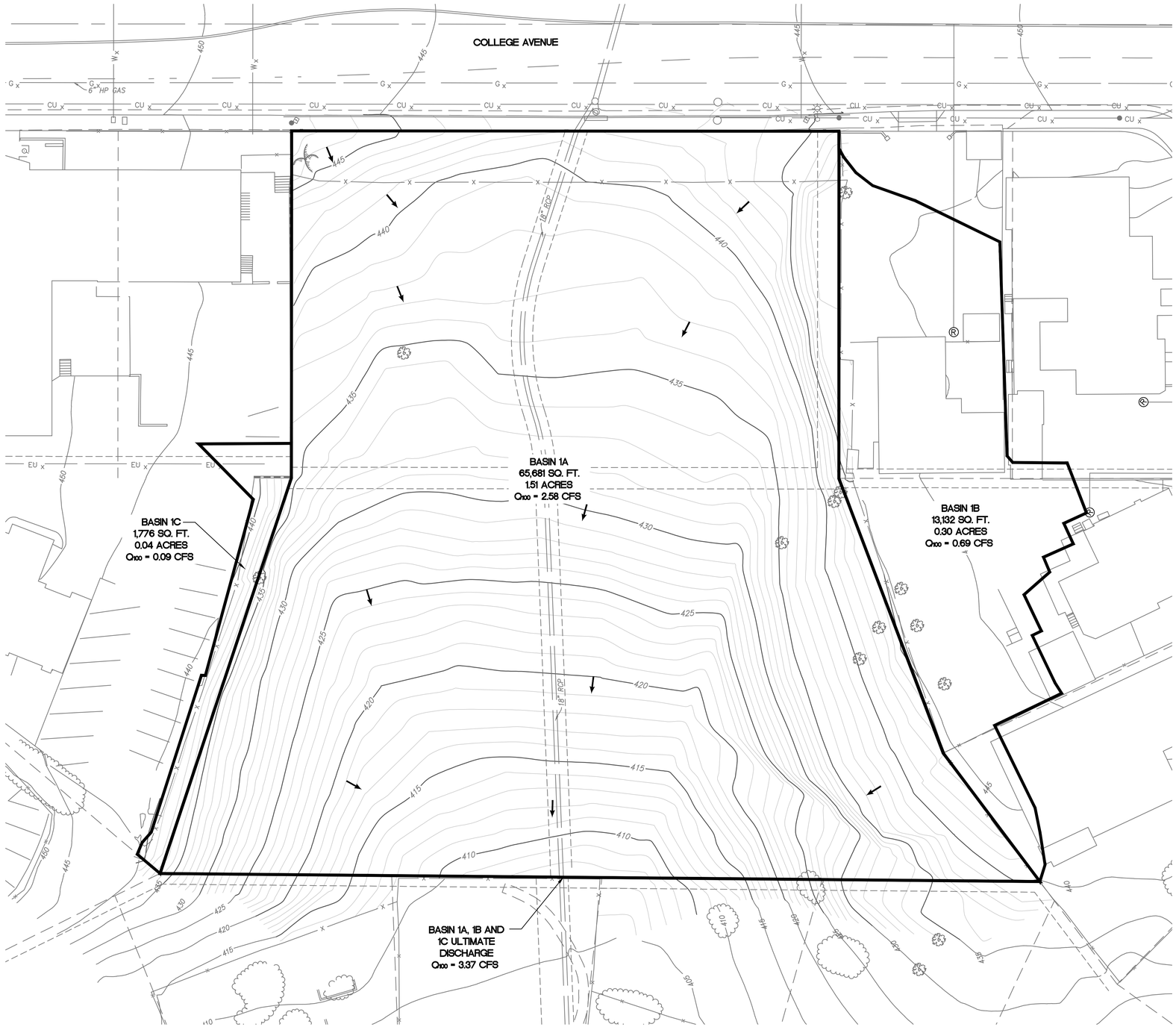
This report was prepared under the supervision of Cory Schrack, PE, Project Manager for Nasland Engineering.

Cory Schrack ● RCE 65976 ● Expires 06-30-16

APPENDICES

APPENDIX A

Existing Hydrologic Conditions



LEGEND

BASIN LIMITS

BASIN DRAINAGE FLOW

20 0 20 40 60 80

SCALE 1" = 20'

N

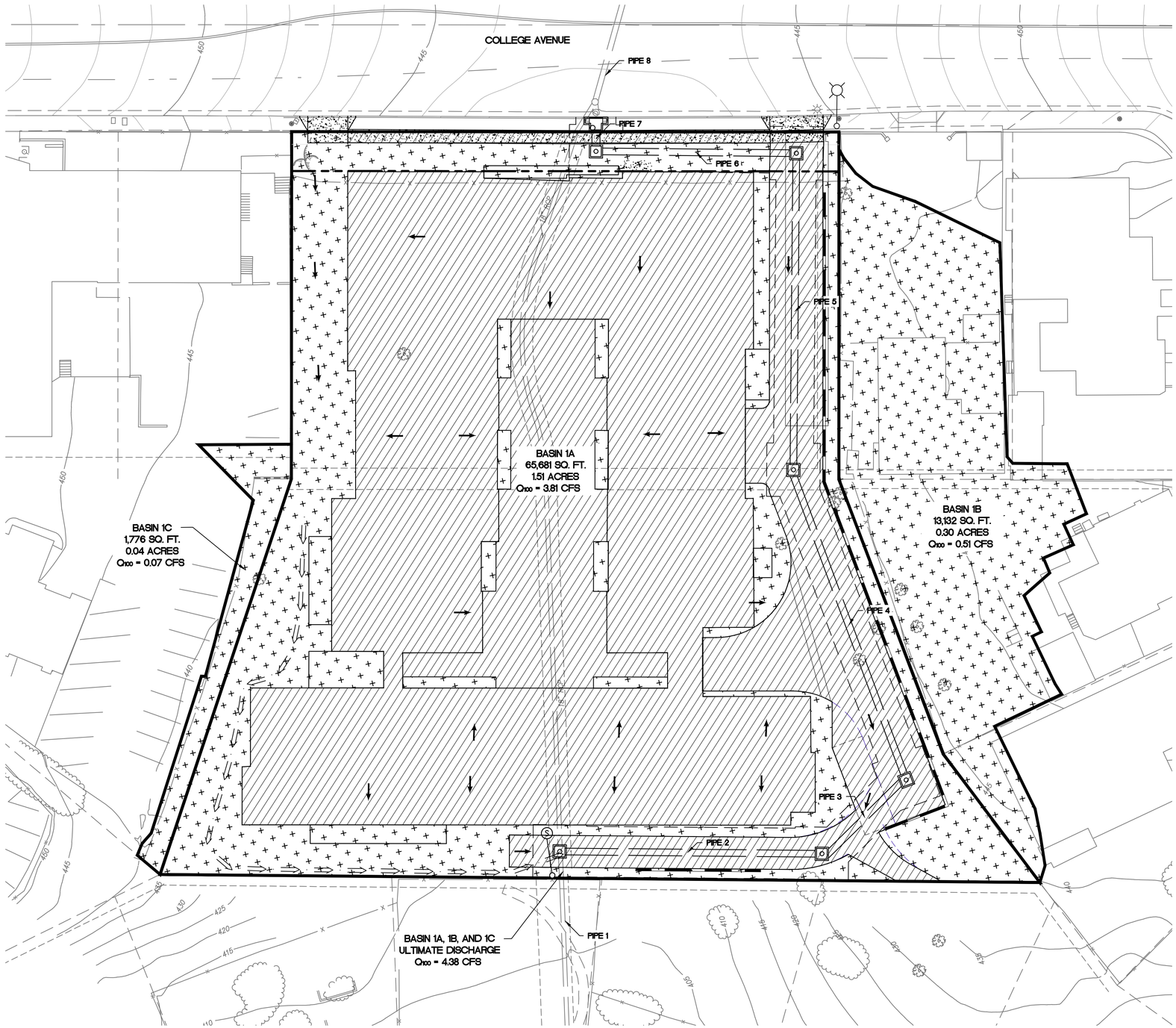
EXISTING HYDROLOGY

5030 COLLEGE AVENUE

Nasland
Civil Engineering
Surveying
Land Planning
T (858) 292-7770
4740 Ruffner Street
San Diego, CA 92111
nasland.com

APPENDIX B

Proposed Hydrologic Conditions



LEGEND

- PERVIOUS AREA (23% ONSITE)
- IMPERVIOUS AREA (77% ONSITE)
- BASIN LIMITS
- BASIN DRAINAGE FLOW

20 0 20 40 60 80

SCALE 1" = 20'

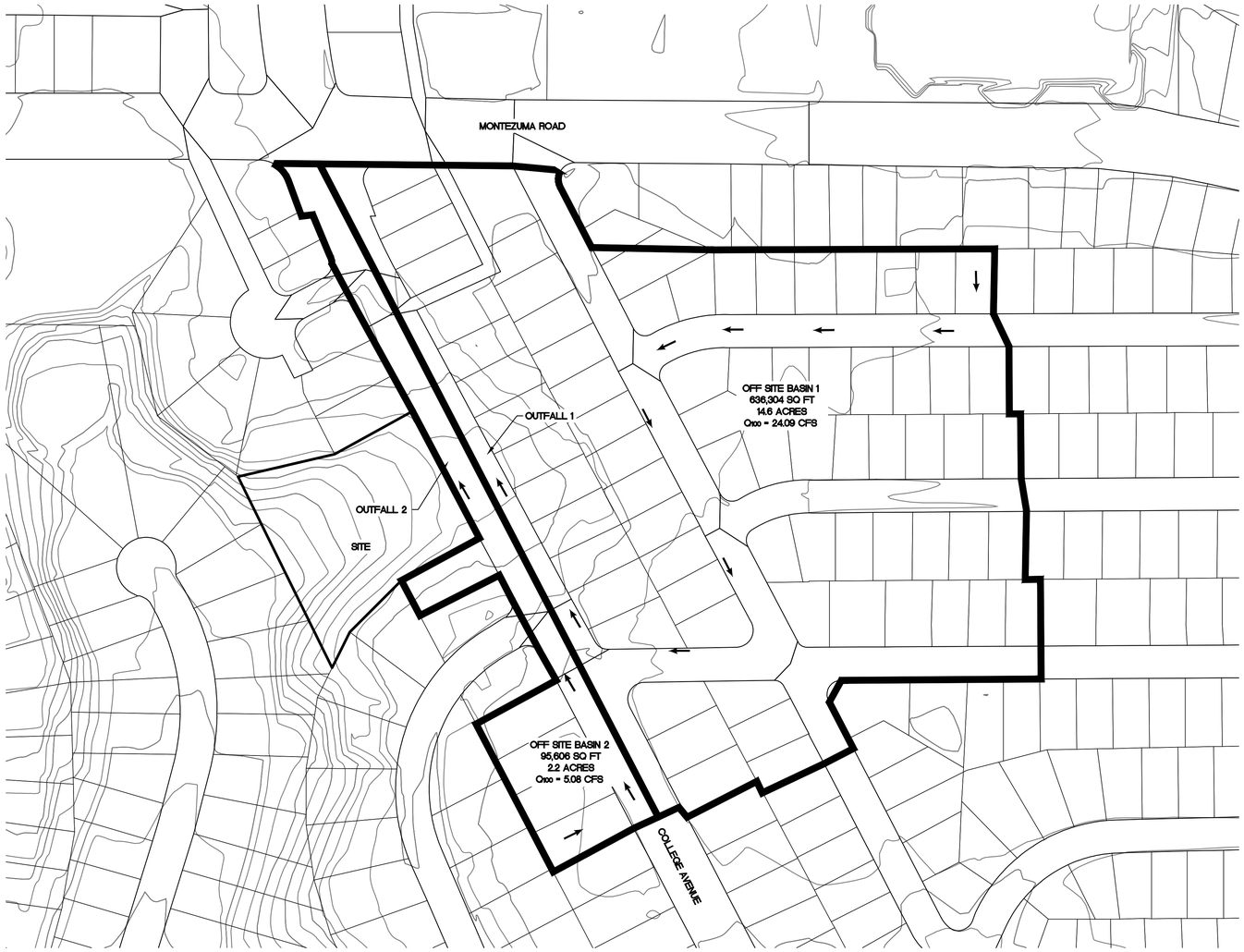
PROPOSED HYDROLOGY

5030 COLLEGE AVENUE

Nasland
Civil Engineering
Surveying
Land Planning
T (858) 292-7770
4740 Ruffner Street
San Diego, CA 92111
nasland.com

APPENDIX C

Existing Offsite Hydrology Exhibit



LEGEND

BASIN LIMITS

BASIN DRAINAGE FLOW

100 0 100 200 300 400

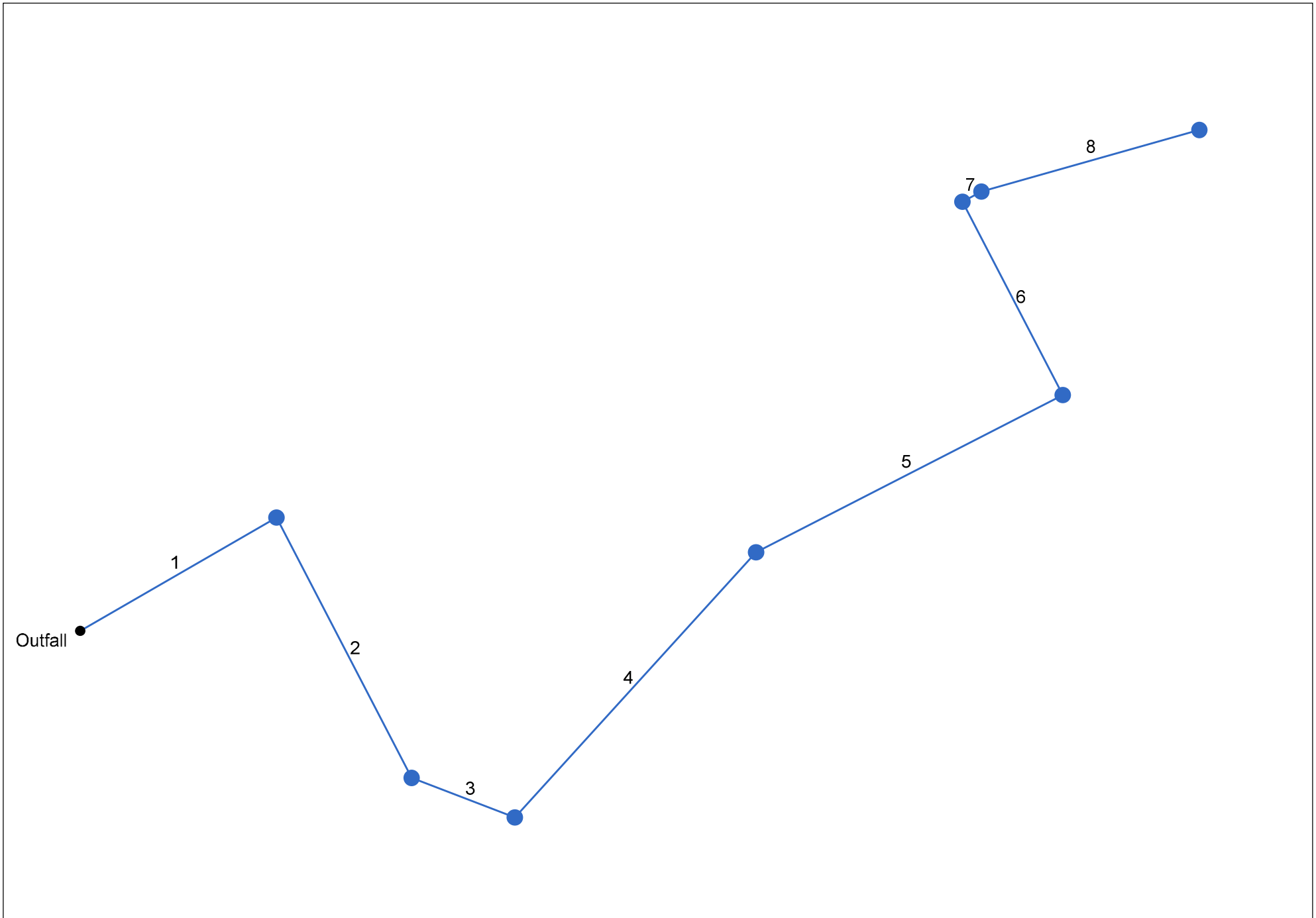
SCALE 1" = 100'

EXISTING OFFSITE HYDROLOGY

5030 COLLEGE AVENUE

Nasland
Civil Engineering
Surveying
Land Planning
T (858) 292-7770
4740 Ruffner Street
San Diego, CA 92111
nasland.com

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2013 Plan



Project File: 30 IN 50 YEAR RIGHT SIDE.stm	Number of lines: 8	Date: 4/22/2015

Storm Sewer Summary Report

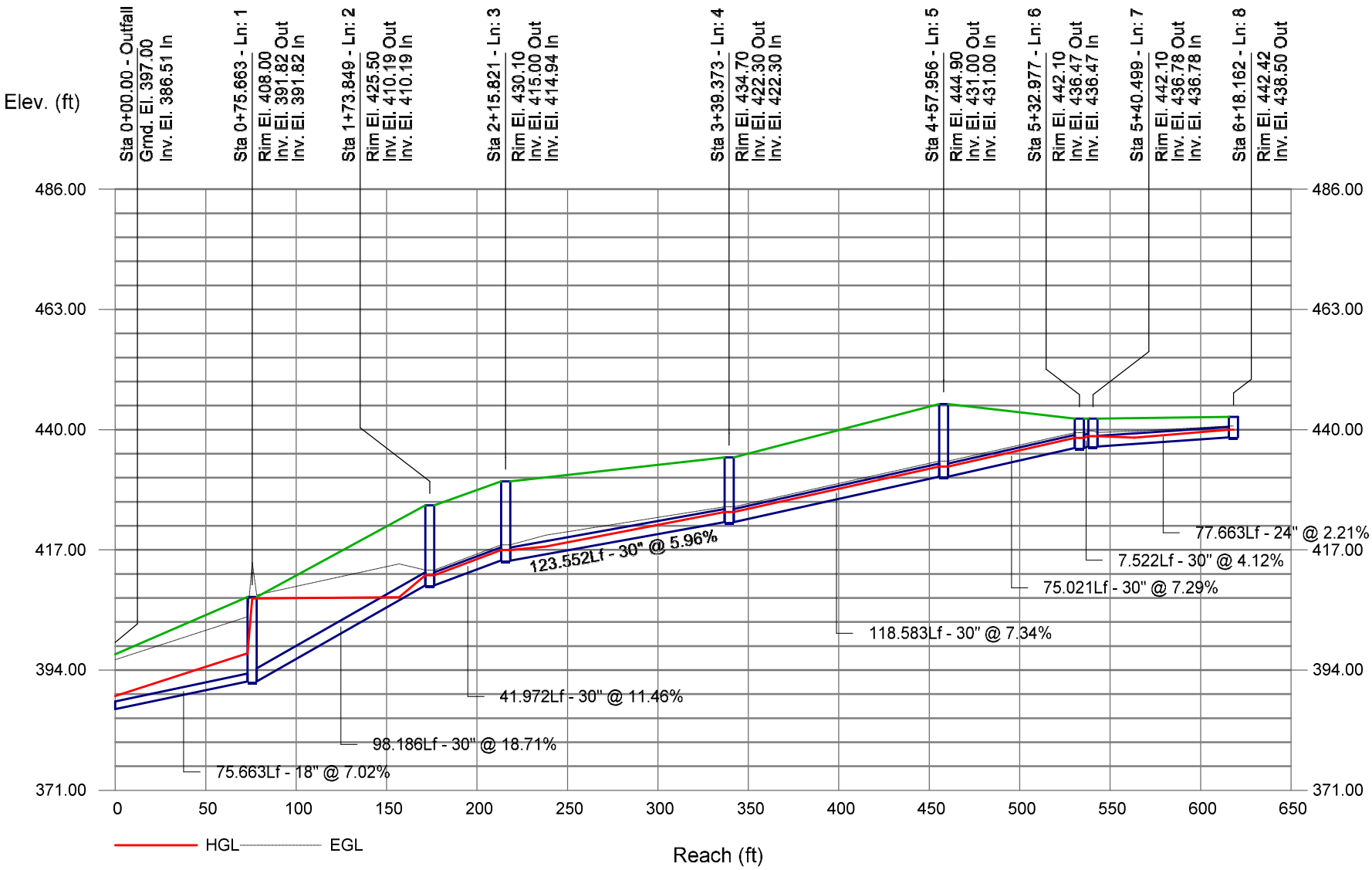
Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - 36	37.44	18	Cir	75.663	386.51	391.82	7.018	389.01*	397.21*	10.47	407.68	End	Curb-
2	Pipe - 35	33.06	30	Cir	98.186	391.82	410.19	18.709	407.68	412.14	n/a	412.14 j	1	Manhole
3	Pipe - 34	33.06	30	Cir	41.972	410.19	415.00	11.460	412.14	416.95	0.94	416.95	2	Manhole
4	Pipe - 33	33.06	30	Cir	123.552	414.94	422.30	5.957	416.95	424.25	n/a	424.25 j	3	Manhole
5	Pipe - 32	33.06	30	Cir	118.583	422.30	431.00	7.337	424.25	432.95	1.00	432.95	4	Manhole
6	Pipe - 31	33.06	30	Cir	75.021	431.00	436.47	7.291	432.95	438.42	1.00	438.42	5	Manhole
7	Pipe - 30	33.06	30	Cir	7.522	436.47	436.78	4.121	438.42	438.73	0.50	438.73	6	Curb-
8	Pipe - 39	17.00	24	Cir	77.663	436.78	438.50	2.215	438.73	439.98	n/a	439.98 j	7	Curb-

Project File: New.stm | Number of lines: 8 | Run Date: 4/22/2015

NOTES: Return period = 50 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Profile

Proj. file: New.stm



APPENDIX D

Hydrology References

TABLE 2

RUNOFF COEFFICIENTS (RATIONAL METHOD)

DEVELOPED AREAS (URBAN)

Land Use	Coefficient, C Soil Type (1)
	D
Residential:	
Single Family	.55
Multi-Units	.70
Mobile Homes	.65
Rural (lots greater than 1/2 acre)	.45
Commercial (2) 80% Impervious	.85
Industrial (2) 90% Impervious	.95

NOTES:

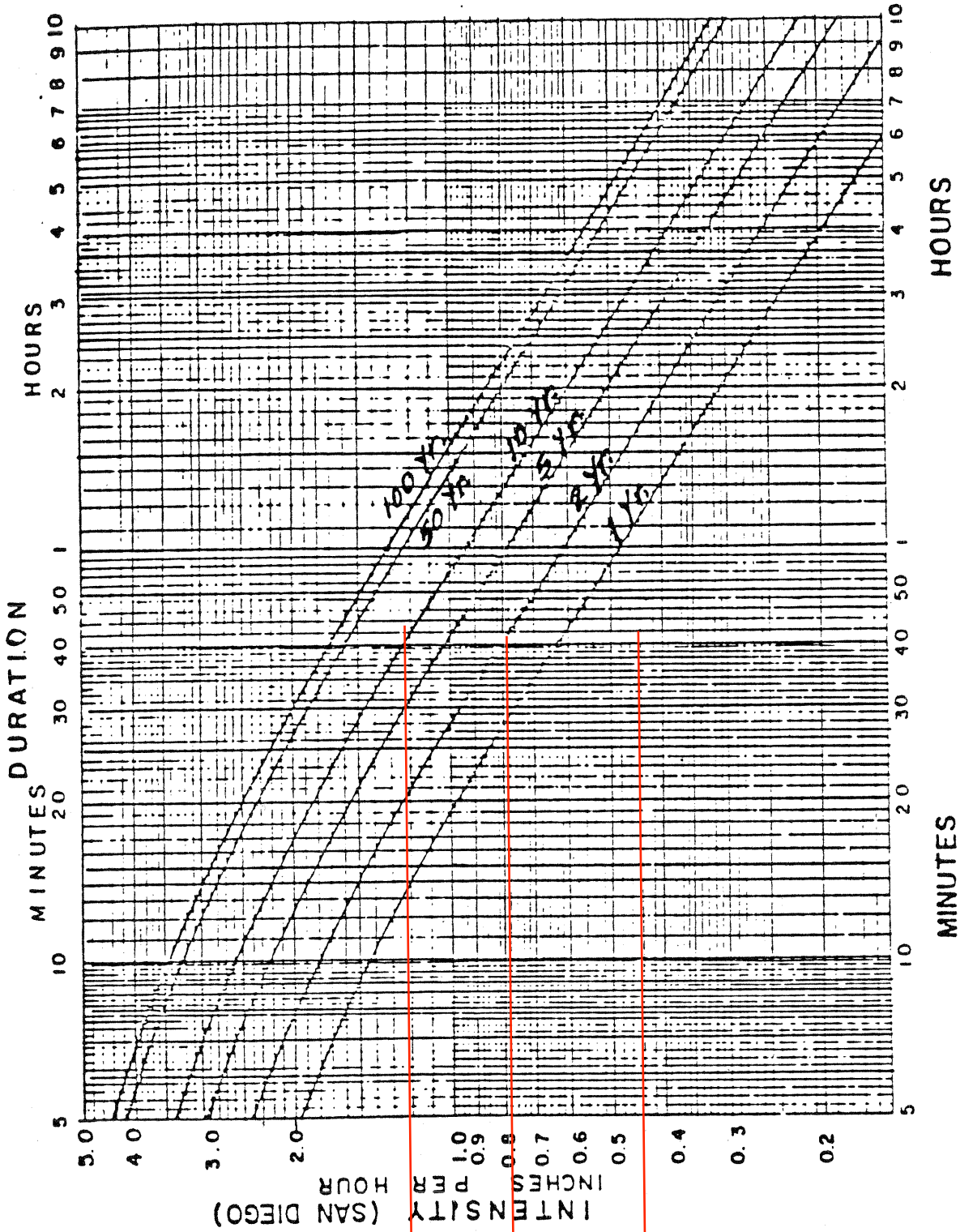
(1) Type D soil to be used for all areas.

(2) Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in no case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil.

Actual imperviousness = 50%

Tabulated imperviousness = 80%

Revised C = $\frac{50}{80}$ x 0.85 = 0.53



RAINFALL

INTENSITY - DURATION - FREQUENCY

CURVES

for

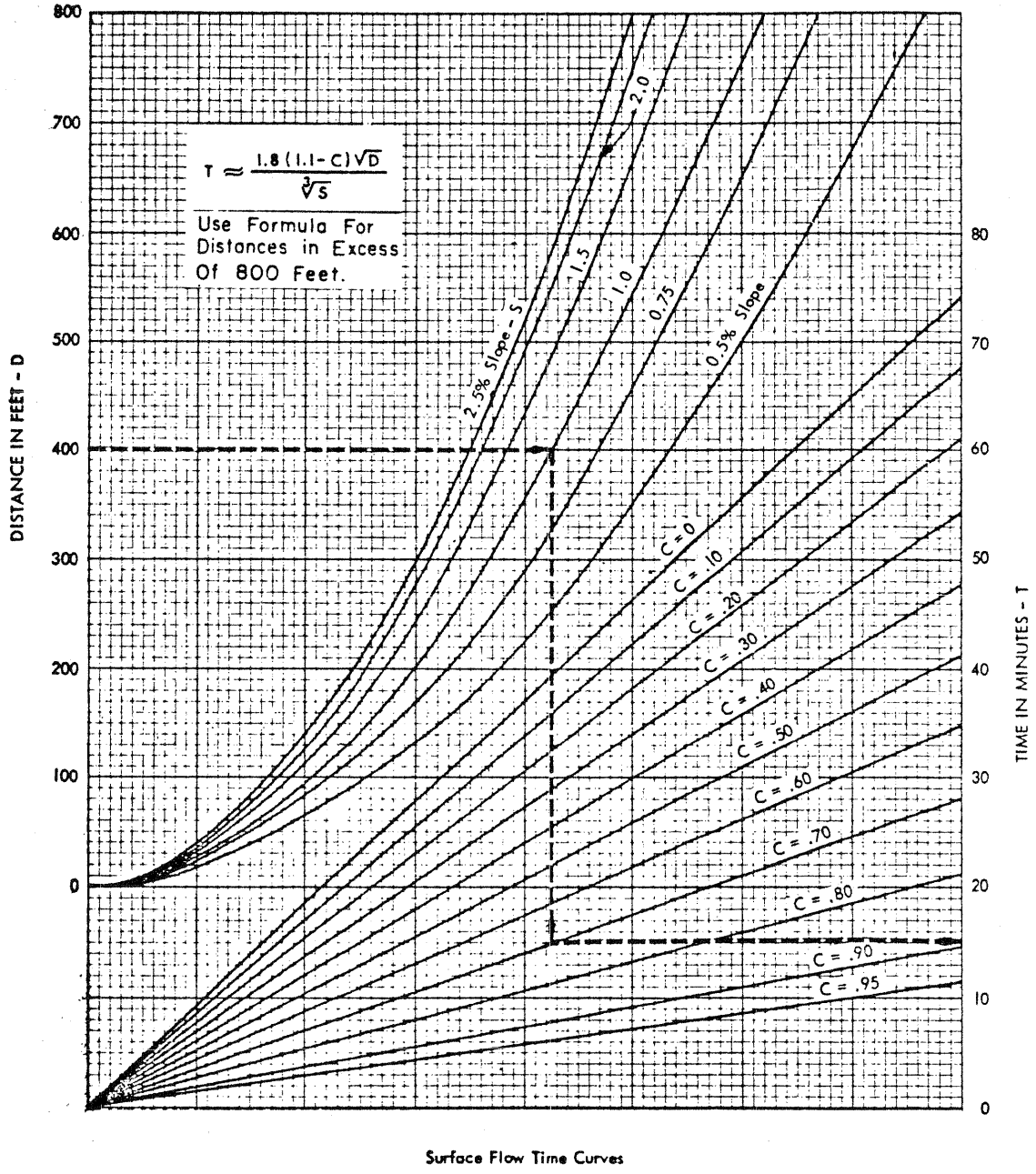
COUNTY OF SAN DIEGO

ELEV.	FACTOR
0-1500	1.00
1500-3000	1.25
3000-4000	1.42
4000-5000	1.60
5000-6000	1.70
DESERT	1.25

To obtain correct intensity, multiply intensity on chart by factor for design elevation.

APPENDIX I-I

URBAN AREAS OVERLAND TIME OF FLOW CURVES



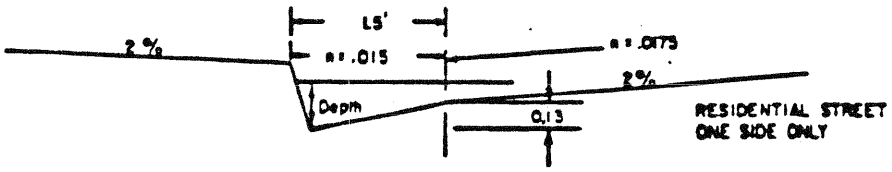
Surface Flow Time Curves

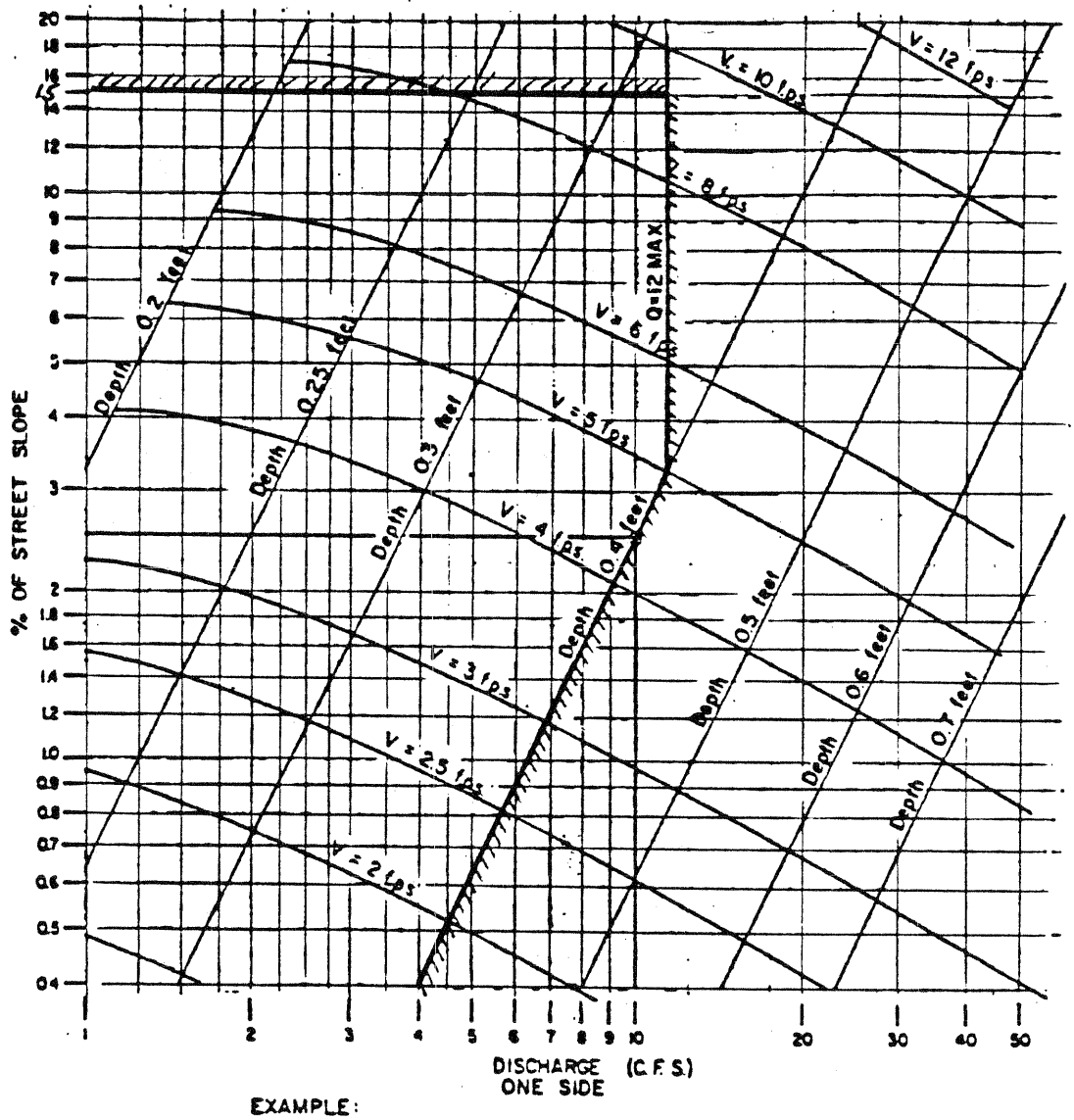
EXAMPLE:

GIVEN: LENGTH OF FLOW = 400 FT.
SLOPE = 1.0 %
COEFFICIENT OF RUNOFF C = .70

READ: OVERLAND FLOWTIME = 15 MINUTES

CHART I-104.12





EXAMPLE:

Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

REV.		CITY OF SAN DIEGO - DESIGN GUIDE	SHT. NO.
		GUTTER AND ROADWAY DISCHARGE - VELOCITY CHART	