PRELIMINARY DRAINAGE STUDY

17 ON VOLTAIRE
4103 / 4111 VOLTAIRE STREET

PTS #: 640598 (VOLTAIRE STREET SDP)

APN: 533-233-19-00

4103 / 4111 Voltaire Street
San Diego, CA 92101

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1. INTRODUCTION

1.1 Project Description

The 0.60 acre site is located west of the intersection of San Clemente Street and Voltaire Street in San Diego, CA. The currently 4-parcel site exists today with single-family residential development on the southern-most parcel, commercial development immediately adjacent, both with parking off the Alley to the west, and non-developed / vacant parcels to the north along Voltaire. The proposed project includes the demolition of the existing buildings along with all on-site improvements and proposes two (2) new multi-family residential buildings with street-level commercial space, a shared access driveway, and covered parking. The project also includes new improvements around the building which include sidewalk, landscaping, new driveway cuts, and other surface improvements typical of this type of development.

The project is designed in accordance with the January 2017 Edition of the Drainage Design Manual, the 2016 San Diego Storm Water Standards Manual and complies with the Regional Water Quality Control Board Region 9 MS4 Permit, Order No. R9-2015-0100. The project does not propose work adjacent to federally regulated waters therefore Sections 401 and 404 of the Federal Clean Water Act (CWA) are not applicable.

1.2 Existing Conditions

The site appears to generally sheet flow storm water runoff from the southeast corner of the site to the northwest corner adjacent to Voltaire Street. From the northwest corner of the site, water is discharged to the street gutter in the public right-of-way and continues northwest toward Catalina Boulevard. The storm water then continues north on Famosa Boulevard until it is collected by a public storm drain inlet located near the intersection of Whittier Street and Famosa Boulevard. It then continues north along Nimitz Boulevard, and ultimately discharges to the San Diego River Flood Control Channel. The peak storm water run-off was calculated using the rational method equation (Q=CiA) as shown in Equation A-1 of the City of San Diego Drainage Design Manual. The 4.4 in/hr intensity was determined from the City of San Diego Drainage Design Manual's Appendix H. using the minimum allowable time of concentration of 5 minutes. This resulted in a peak pre-project run-off for the site at Q = 1.32 CFS using a runoff coefficient of 0.50 based on commercial zoning and land use from Table A-1 in the 2017 Storm Water Standards Manual and the reduction described in Footnote 2 based on the existing site impervious area. Refer to the Appendix of this report for additional information.

1.3 Proposed Conditions

The project proposes the development of a new multi-family residential building and the surface improvements (i.e. asphalt paving and concrete sidewalk) to support the proposed building. The proposed drainage condition will remain unchanged as all water will be collected and routed to the curb and gutter on Voltaire Street adjacent to the northwest corner of the property. The project is a priority development project, therefore pollutant removal and hydromodification management measures are implemented to demonstrate compliance with the Regional MS4 Permit. In addition, site design measures for storm water runoff are proposed where feasible. The proposed project will result in an increase of impervious area and therefore will increase the post project peak runoff. The post project condition has been delineated by three (3) drainage management areas (DMA's) which are tributary to their respective sidewalk underdrain and curb outlet structures discharging to the

public right-of-way. The roof runoff is collected and conveyed to raised planter biofiltration basins located on the side of the proposed structures. The post project flow of 1.86 CFS was calculated using the Rational Method Q=CiA where the intensity was derived from the San Diego Drainage Design Manual assuming a 5-minute time of concentration (Tc) which is the shortest Tc allowable. A table summarizing the pre-project and post-project peak flows is provided at the end of this study.

2. METHODOLOGY

The proposed project has been analyzed to determine the peak runoff flow for 100-year, 6-hour rainfall event using the Rational Method per the City of San Diego Drainage Design Manual (Section 1-102.3). The Runoff Coefficient, C, for the existing and proposed conditions were selected using Table A-1 in the Appendix A of the City of San Diego Drainage Design Manual. The time of concentration for all existing and proposed drainage areas were calculated using the minimum T_C of 5 min, which yields an intensity of 4.4 inches per hour in accordance with the City of San Diego's Intensity-Duration-Frequency Design Chart included as Figure A-1 in the City of San Diego Drainage Design Manual. A copy of this Figure has been added to Appendix 1 of this report as well for reference.

The proposed LID best management practices have been sized and located such that all runoff will be directed to landscape planters or through pervious areas where feasible before ultimately discharging to the downstream storm drain system.

2.1 Rational Method

As mentioned above, runoff from the project site was calculated for the 100-year, 6-hour storm event. Runoff was calculated using the Rational Method which is given by the following equation:

$Q = C \times I \times A$ Equation A-1 of City of SD Drainage Design Manual

Where:

Q = Flow rate in cubic feet per second (cfs)
C = Runoff coefficient (Determined from Table A-1 of City of SD Drainage Design Manual)
I = Rainfall Intensity in inches per hour (in/hr)
A = Drainage basin area in acres, (ac)

Rational Method calculations were performed using the City of San Diego Drainage Design Manual Equation A-1, as shown above.

2.2 Runoff Coefficient

The runoff coefficients for the project were used from Table A-1 from the City of San Diego Drainage Design Manual (January, 2017), using the Revised C Method for commercial use in the pre-developed condition (0.50) and the value shown in Table A-1 for Multi-Units land use for the post-developed project, which is 0.70.

2.3 Rainfall Intensity

Rainfall intensity was determined using the Rainfall Intensity-Duration-Frequency Curves shown in Section A.1.3 of the City of San Diego Drainage Design Manual (January, 2017). Based on a 5-minute time of concentration, an intensity of 4.4 inches per hour is used in accordance with Figure A-1.

2.4 Tributary Areas

Drainage basins are delineated in the Post-Project Hydrology Exhibit in Appendix 2 and graphically portray the tributary area for each drainage basin. Each drainage basin has been defined by the area being conveyed to each curb outlet location discharging from the property. Ultimately, runoff is all conveyed west along Voltaire Street and continues downstream toward Catalina Boulevard.

3. CALCULATIONS / RESULTS

3.1 Pre & Post Development Peak Flow Comparison

Below are a series of tables which summarize the calculations provided in the Appendix of this report.

SITE IMPERVIOUS AREA COMPOSITION					
	TOTAL IMPERVIOUS AREA (ACRES)	TOTAL PERVIOUS AREA (ACRES)	TOTAL PROJECT AREA (ACRES)	% IMPERVIOUS SURFACES	RUNOFF COEFFICIENT "C"
Existing	0.21	0.39	0.60	35.1%	0.50
Proposed	0.49	0.11	0.60	82.1%	0.70

Table 1. Runoff Coefficient "C" Comparison

The table above shows the difference in the runoff coefficient, "C", between the existing and proposed condition. For additional explanation on how each runoff coefficient was calculated, refer to Appendix 1 of this report.

EXISTING DRAINAGE FLOWS			
DRAINAGE AREA	DRAINAGE AREA (ACRES)	Q_{100} (CFS)	I_{100} (IN/HR)
EX-1	0.60	1.32	4.4

Table 2. Existing Condition Peak Drainage Flow Rates

Table 2 above lists the peak flow rates for the project site in the existing condition for the respective rainfall events.

PROPOSED DRAINAGE FLOWS			
DRAINAGE AREA	DRAINAGE AREA (ACRES)	Q_{100} (CFS)	I_{100} (IN/HR)
PR 1-5	0.60	1.86	4.4

Table 3. Proposed Condition Peak Drainage Flow Rates

The table above lists the peak flow rates for the project site for the proposed condition for the 100-year, 6-hour storm event. The table combines the three (3) drainage management areas and peak runoff produced at each discharge location from the property. As in the existing condition, all water discharging to the public right-of-way offsite eventually confluences near the northwest corner of the site and is conveyed west along Voltaire Street toward downstream public storm drain infrastructure.

PEAK DRAINAGE FLOW COMPARISON				
CONDITION	DRAINAGE AREA (ACRES)	Q_{100} (CFS)	V_{100} (CU-FT)	C
Existing	0.60	1.32	2,714	0.50
Proposed	0.60	1.86	3,800	0.70

Table 4. Proposed Condition Peak Drainage Flow Rates

Table 4 above shows a comparison between the peak flow rates and precipitation volume for the proposed condition and the existing condition.

As shown in Table 4, the project increases the peak runoff rate and runoff volume for the design storms analyzed when comparing the pre-project condition to the post-project condition because the proposed development proposes additional impervious surfaces in addition to multi-unit residential land use. The increase in post-developed peak flows is mitigated by the proposed biofiltration basin planters, which are sized to provide detention volume while also complying with the Regional MS4 Permit requirements for hydromodification management. Curb outlet structures are proposed to convey treated and detained runoff from the property, and are adequately sized to handle the peak flows. See Appendix 3 of this report for a summary of the detention / routing analysis completed for the entire site, showing the detained peak runoff.

3.2 Storm Water Quality

The project's runoff will be treated for storm water quality by site design and source control measures where applicable and feasible. The project also proposes biofiltration planter areas. The project is a "Priority" Development project however, low impact design is implemented where feasible in order to comply with storm water quality measures required of all development projects.

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APPENDIX 1

PRE-PROJECT & POST-PROJECT HYDROLOGY

CALCULATIONS AND SUPPORT MATERIAL

17 ON VOLTAIRE
PLSA 3090
6/12/2019

PRE-PROJECT HYDROLOGY

Drainage Area	Area Description	Total Area (Ac)	Total Area (sq-ft)	Total Impervious Area (Sq-Ft)	% Impervious	% Pervious	Weighted Runoff Coefficient	Peak Runoff Q: (CFS)	Peak Runoff Volume: (cu-ft)
EX-1	**Existing Site**	**0.60**	**26059**	**9140**	**35%**	**65%**	0.50	1.33	2714
Totals:		**0.60**	**26059**				**0.50**	**1.33**	**2714**

POST-PROJECT HYDROLOGY

BMP Location	Basin Description	Total Area (Ac)	Total Area (sq-ft)	Total Impervious Area (Sq-Ft)	% Impervious	% Pervious	Weighted Runoff Coefficient	Peak Runoff Q: (CFS)	Peak Runoff Volume: (cu-ft)
PR-1	**OUTLET-1**	**0.3561**	**15510**	-	-	-	**0.70**	1.11	2262
PR-2	**OUTLET-2**	**0.102**	**4445**	-	-	-	**0.70**	0.32	648
PR-3	**OUTLET-3**	**0.072**	**3135**	-	-	-	**0.70**	0.22	457
PR-4	**SELF-TREATING**	**0.041**	**1785**	-	-	-	**0.70**	0.13	260
PR-5	**DE MINIMIS**	**0.0272**	**1184**	-	-	-	**0.70**	0.08	173
Totals:		**0.60**	**26059**				**0.70**	**1.86**	**3800**

100 Yr Storm at 5 Min TC		
Intensity:	4.40	in/hr
Precip:	2.50	in

Runoff Coefficient	
Pre-Project	0.5
Post-Project	0.70

Table A-1. Runoff Coefficients for Rational Method

Land Use	Runoff Coefficient (C)
	Soil Type [1]
Residential:	
Single Family	0.55
Multi-Units	0.70
Mobile Homes	0.65
Rural (lots greater than ½ acre)	0.45
Commercial [2]	
80% Impervious	0.85
Industrial [2]	
90% Impervious	0.95

Note:
[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 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 = (50/80) x 0.85 = 0.53

The values in Table A–1 are typical for urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the City.

A.1.3. Rainfall Intensity

The rainfall intensity (I) is the rainfall in inches per hour (in/hr.) for a duration equal to the T_C for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_C calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration-Frequency Design Chart (Figure A-1).

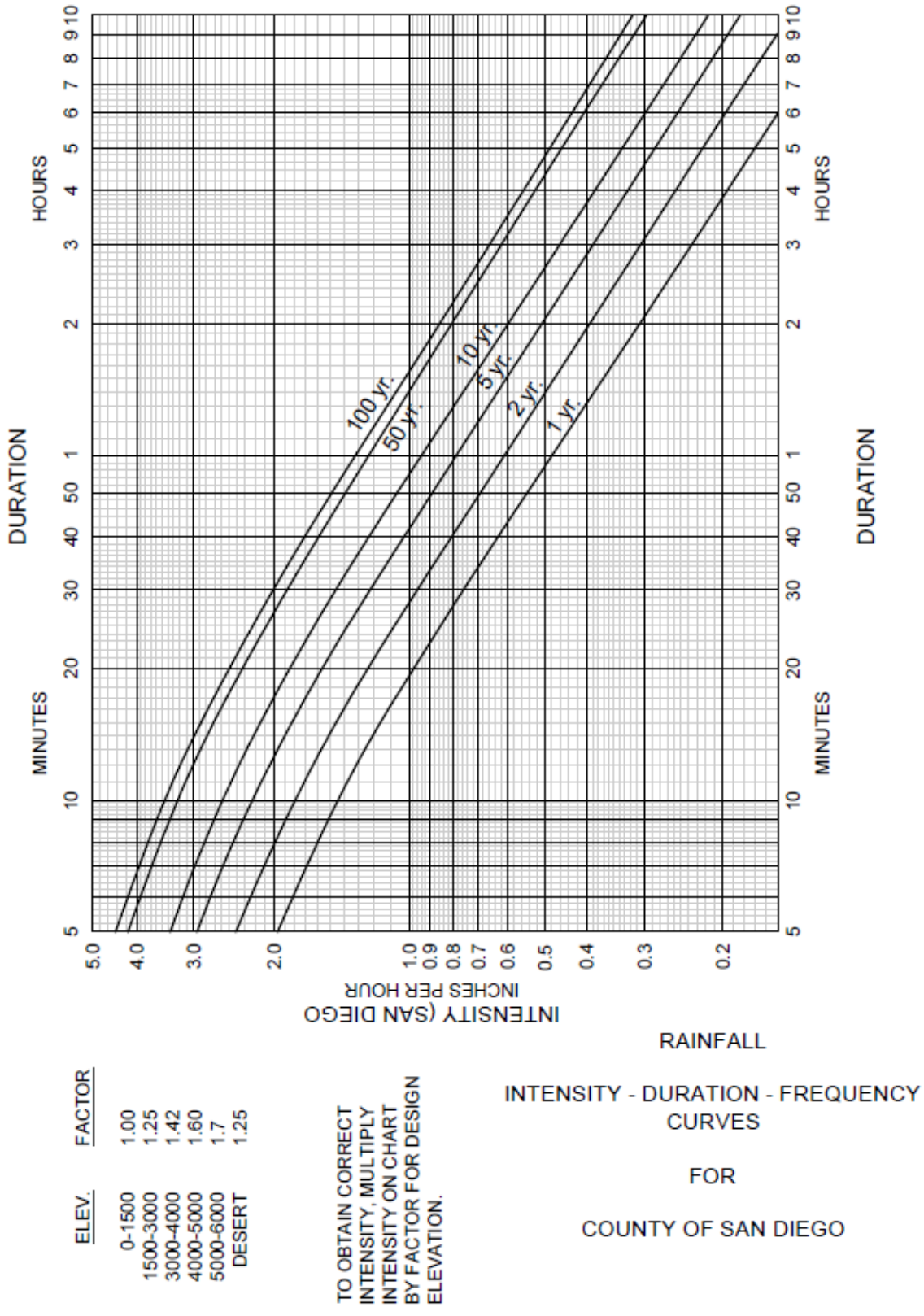

Figure A-1. Intensity-Duration-Frequency Design Chart

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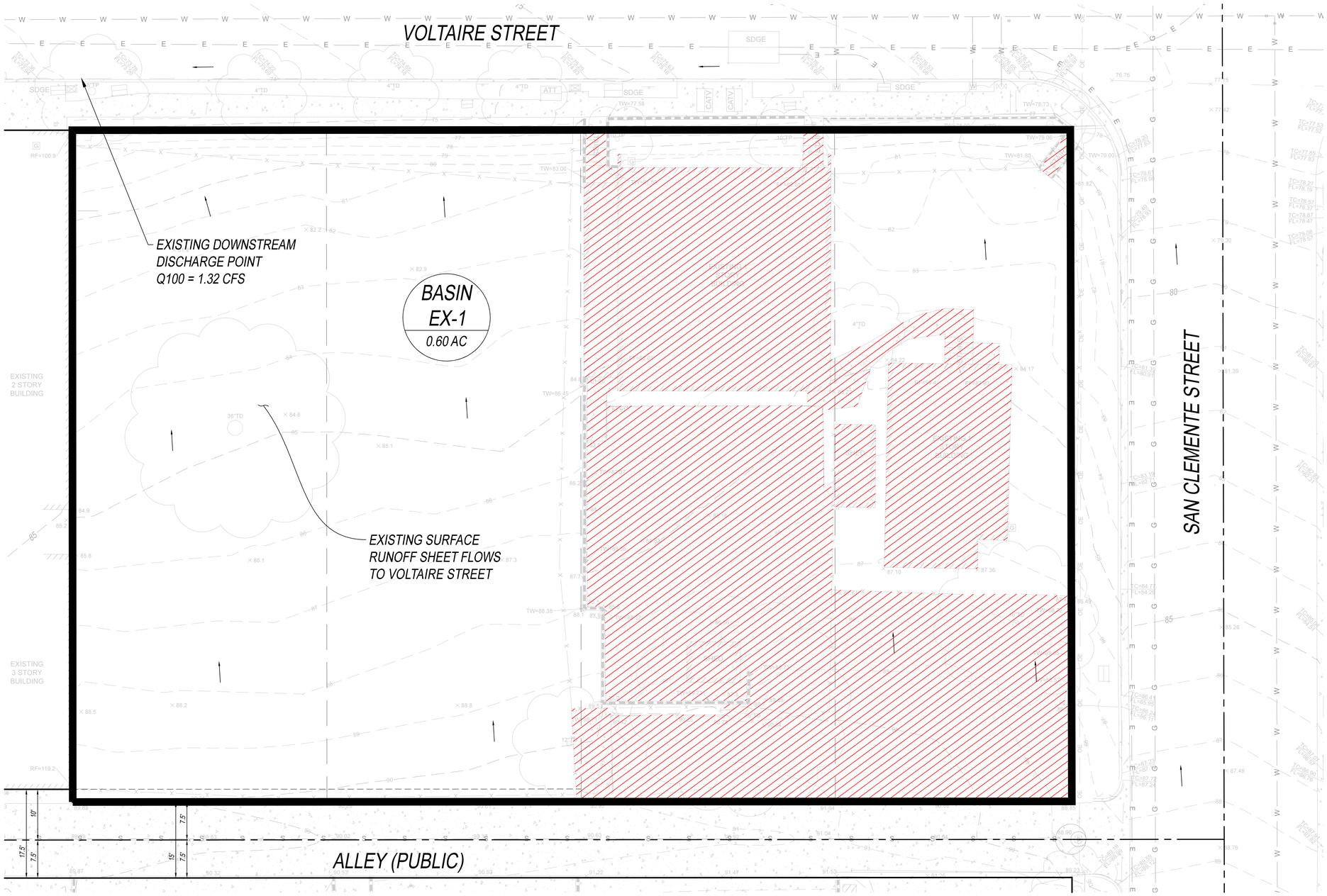
APPENDIX 2

EXISTING & PROPOSED

DRAINAGE EXHIBITS

EXISTING HYDROLOGY EXHIBIT

17 ON VOLTAIRE - 4103 VOLTAIRE STREET



PRE-DEVELOPMENT HYDROLOGY NODE MAP

SCALE: 1" = 10' HORIZONTAL

LEGEND

- SUBJECT PROPERTY / SUBDIVISION BOUNDARY
- EXISTING RIGHT-OF-WAY / ADJACENT LOT LINE
- CENTERLINE OF ROAD
- EXISTING CONTOUR
- EXISTING FLOW DIRECTION
- EXISTING MAJOR DRAINAGE BASIN BOUNDARY
- EXISTING IMPERVIOUS AREA

BASIN A - AREA CALCULATIONS

TOTAL BASIN AREA	26,059 SF (0.598 AC)
BASIN EXISTING IMPERVIOUS AREA	9,140 SF (0.210 AC)
BASIN EXISTING PERVIOUS AREA	16,919 SF (0.388 AC)
% IMPERVIOUS	35.1%
*Cn	0.50

*ASSUME TYPE D SOILS, EXISTING LAND USE IS COMMERCIAL AT 35.1% IMPERVIOUS AREA. RUNOFF COEFFICIENT OF 0.50 USED IN ACCORDANCE WITH THE REVISED C METHOD DESCRIBED IN APPENDIX A OF CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL

GRAPHIC SCALE 1" = 10'

10 0 10 20 30

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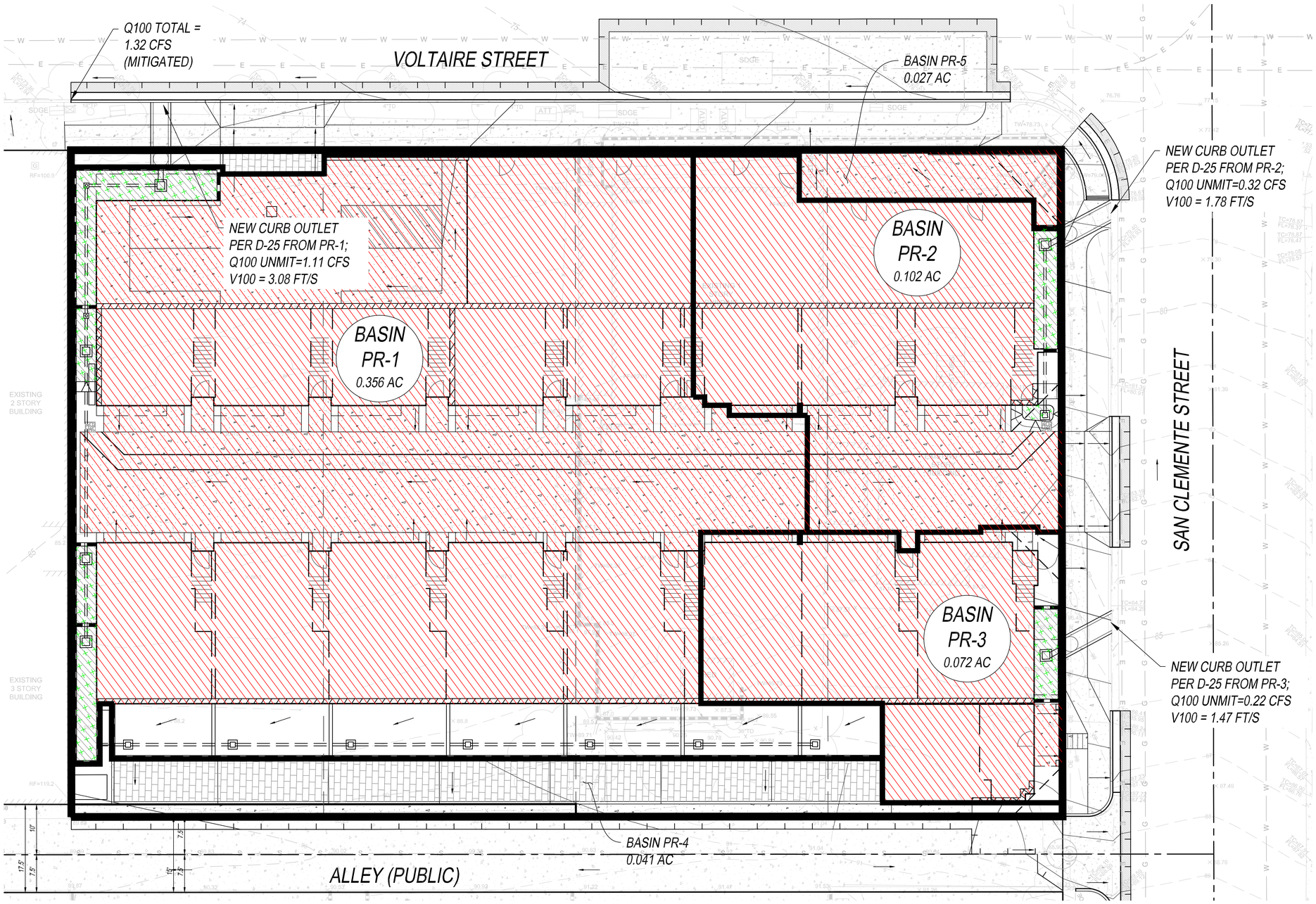
PLSA 2235-02

PROPOSED HYDROLOGY EXHIBIT

4103 - 4111 VOLTAIRE STREET



POST-DEVELOPMENT HYDROLOGY NODE MAP

SCALE: 1" = 10' HORIZONTAL

LEGEND

- SUBJECT PROPERTY / SUBDIVISION BOUNDARY
- EXISTING RIGHT-OF-WAY / ADJACENT LOT LINE
- CENTERLINE OF ROAD
- EXISTING CONTOUR
- PROPOSED PATH OF TRAVEL
- PROPOSED MAJOR DRAINAGE BASIN BOUNDARY
- PROPOSED IMPERVIOUS AREA

BASIN PR-1 - AREA CALCULATIONS

TOTAL BASIN AREA	15,510 SF (0.356 AC)
*Cn	0.70
Q100 UNMITIGATED	= C*I*A
Q100 UNMITIGATED	= (0.70)*(4.40 IN/HR)*(0.356 AC)
	= 1.11 CFS
V100 FROM CURB OUTLET	3.08 FT / S

*ASSUME TYPE D SOILS; EXISTING LAND USE IS MULTI-UNIT RESIDENTIAL. RUNOFF COEFFICIENT OF 0.70 USED IN ACCORDANCE WITH APPENDIX A OF CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL

BASIN PR-2 - AREA CALCULATIONS

TOTAL BASIN AREA	4,445 SF (0.102 AC)
*Cn	0.70
Q100 UNMITIGATED	0.32 CFS
V100 FROM CURB OUTLET	1.78 FT / S

*ASSUME TYPE D SOILS; EXISTING LAND USE IS MULTI-UNIT RESIDENTIAL. RUNOFF COEFFICIENT OF 0.70 USED IN ACCORDANCE WITH APPENDIX A OF CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL

BASIN PR-3 - AREA CALCULATIONS

TOTAL BASIN AREA	3,135 SF (0.072 AC)
*Cn	0.70
Q100 UNMITIGATED	0.22 CFS
V100 FROM CURB OUTLET	1.47 FT / S

*ASSUME TYPE D SOILS; EXISTING LAND USE IS MULTI-UNIT RESIDENTIAL. RUNOFF COEFFICIENT OF 0.70 USED IN ACCORDANCE WITH APPENDIX A OF CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL

GRAPHIC SCALE 1" = 10'

10 0 10 20 30

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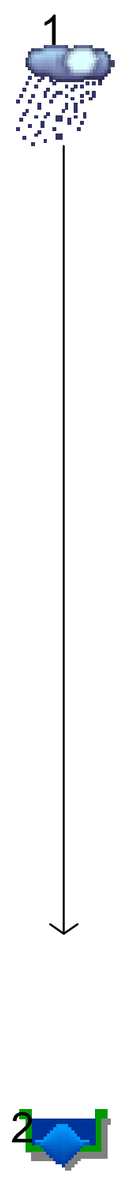
APPENDIX 3

DETENTION AND ROUTING ANALYSIS

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

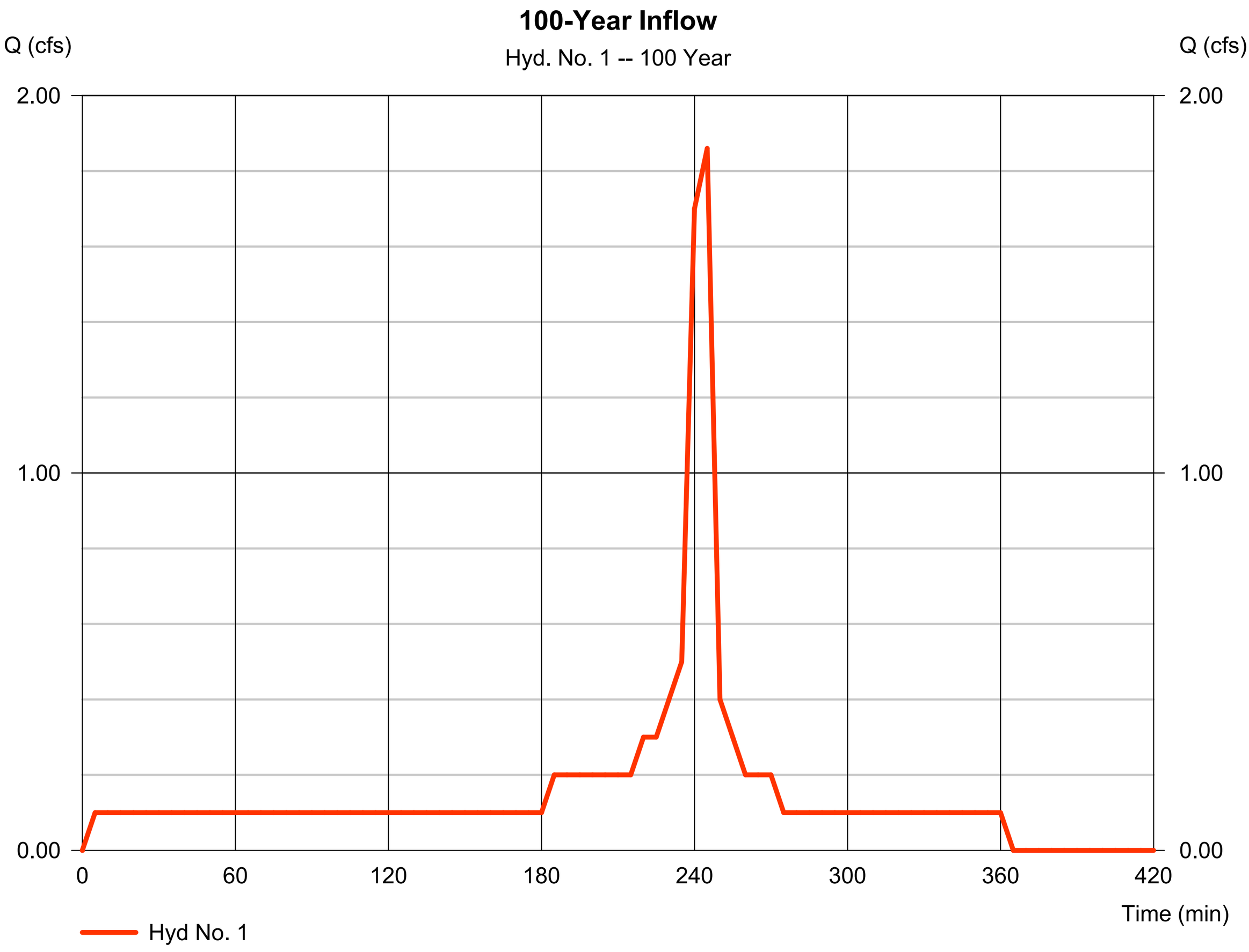
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	1.860	5	245	3,948	------	------	------	100-Year Inflow
2	Reservoir	1.318	5	245	3,892	1	103.93	1,393	<no description>

Hydrograph Report

Hyd. No. 1

100-Year Inflow

Hydrograph type	= Manual	Peak discharge	= 1.860 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 3,948 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 01 / 7 / 2020

Hyd. No. 2

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	1.318 cfs
Storm frequency	=	100 yrs	Time to peak	=	4.08 hrs
Time interval	=	5 min	Hyd. volume	=	3,892 cuft
Inflow hyd. No.	=	1 - 100-Year Inflow	Max. Elevation	=	103.93 ft
Reservoir name	=	All Site BMPs	Max. Storage	=	1,393 cuft

Storage Indication method used.