

Appendix H1 Hydrology Report

Appendices

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HYDROLOGY REPORT

City of Hope Campus Plan

1500 East Duarte Road
Duarte, CA 91010
KPFF Job # 114186

Revised August 16, 2016

CLIENT:

City of Hope
1500 East Duarte Road
Duarte, CA 91010
(626) 757-9018

PREPARED BY:

KPFF Consulting Engineers
6080 Center Drive, Suite 700
Los Angeles, California 90045
(310) 665-2800

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I. INTRODUCTION

In conjunction with the proposed City of Hope Campus Plan, a long-term development plan for City of Hope's approximately 110-acre property ("Campus"), City of Hope retained KPFF to conduct a hydraulic analysis to analyze the existing and proposed conditions at the Campus with regard to stormwater runoff.

The Campus is located at 1500 East Duarte Road, Duarte, CA 91010. Located just northeast of Los Angeles, the Campus is situated at the eastern edge of the City of Duarte and the northwestern edge of the City of Irwindale. The Campus is bounded by Duarte Road to the north, and Cinco Robles Drive, LA County Flood Control Channel, and Buena Vista Street to the west. The undeveloped Santa Fe Flood Control Basin is located to the east and south. The Campus is located approximately 0.4 miles south of the 210 Interstate Freeway and 0.9 miles west of the 605 Interstate Freeway.

The analysis presented herein examines the changes in stormwater runoff for the City of Hope Campus due to the development of the City of Hope Specific Plan ("Project"), which would include the development of additional outpatient, inpatient, research, office, industrial, warehouse, and hospitality uses, as well as a new access roadway. Under an Illustrative Development Scenario presented in the proposed Specific Plan, it is anticipated that approximately fifteen different areas will be developed on the Campus.

Specific Project elements include: expansion and addition of parking lots, parking structures, buildings, roadways, landscaping and pedestrian walkways. Exhibit 1 shows the existing conditions at the Campus and Exhibit 3 shows the proposed areas of development at the Campus.

II. HYDROLOGY

The analysis presented examines the changes in stormwater runoff for the City of Hope Campus due to the development of the Project. It was reasonably assumed that the Campus does not receive off-site run-on because the roads bound the Campus have drainage systems that prevent run-on to the Campus. Thus, off-site drainage was not included.

The ground cover at the Campus is predominately hardscape and structures, with some grass and planter areas. There is also a park and garden space within the Campus, along Duarte Road, which measures about 11 acres of land and is mostly covered with grass. For the purpose of this report the existing hydrology, proposed hydrology and the hydrology of the major storm drain systems will be studied. The 10- and 50-year Los Angeles County storms will be considered, consistent with LA County methodology. Figure 1 shows an aerial view of the Campus.

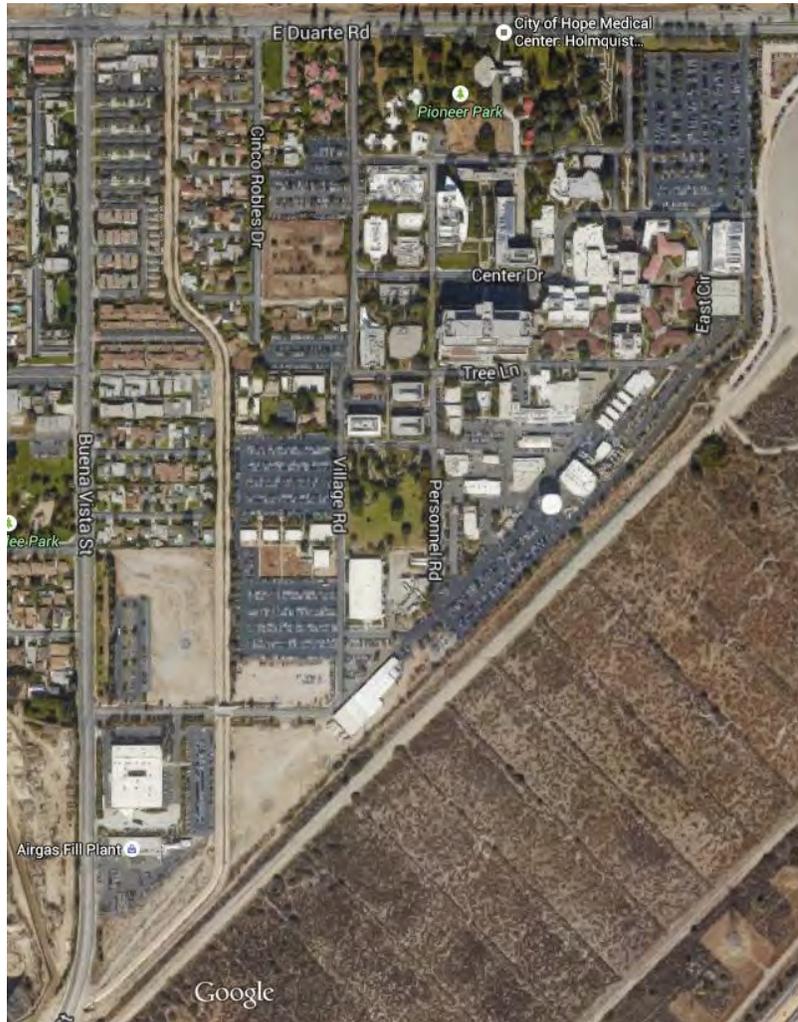


Figure 1: Satellite View of Campus

Although the entire site drains towards the southwest corner, the Campus was subdivided into 3 drainage areas. Exhibit 3 shows the proposed conditions and drainage areas at the Campus. Flow rates and volumes were calculated for each drainage area for existing and proposed conditions.

III. METHODOLOGY

Except where specified elsewhere in this report, the procedures, criteria, and standards as set forth in the Los Angeles County Hydrology Manual were utilized to perform the hydrology study. See Appendix B for the calculation results. Appendix A shows the Los Angeles County 50-year 24-hour Isohyet and Soil Map.

The Los Angeles County HydroCalc software was used to compute the peak runoff at pre-determined design points. The runoff analysis is based on the proposed land use, topographic features and proposed grading for the area. The average land slopes and runoff coefficients were used for computing runoff.

The runoff equation for the Rational Method is as follows:

$$Q = CIA$$

Where:

$$\begin{aligned} Q &= \text{Peak runoff rate (CFS)} \\ C &= \text{Runoff coefficient} \\ I &= \text{Average rainfall intensity (in/hr)} \\ A &= \text{Drainage area (acres)} \end{aligned}$$

IV. EXISTING DRAINAGE AREAS & CHARACTERISTICS

Based on site visits, record drawings, as-builts, and available survey data, the existing site storm water was found to flow from north to south of the Campus. There is an approximate 47 foot elevation difference from the highest point to the lowest point of the Campus. The existing storm drain system consists of inlets and pipes that discharge to the private, on-site storm drain lines; one 30- to 36-inch RCP storm drain main runs from east to west near the center of the Campus, and another 24- to 30-inch RCP storm drain main runs along the south border of the Campus. The existing storm drain network is shown on Exhibit 2, Storm Drain Plan.

Additionally, there is a Los Angeles County Flood Control Channel that runs from north to south and passes through the southern portion of the Campus. The channel is highlighted in Exhibit 1. The existing hydrology is such that all of the storm water on the Campus east of the channel eventually discharges to the channel either by means of sheet flow, or through a pipe network that connects to the 30-inch and 36-inch RCP storm drain lines. The portion of the Campus which is west of the Los Angeles County Flood Control Channel is assumed to sheet flow and discharge to Buena Vista Street.

Under existing conditions, KPFF calculates that the total runoff generated by a 10-year storm and 50-year storm would be 136 cubic feet per second (cfs) and 221 cfs, respectively, for the entire Campus. Hydrology calculations for existing conditions are based on existing building and site plan documents as well as satellite survey information. The percentage impervious used to calculate the runoff was estimated 90% for DA2 and DA3. Based on visual assessment and satellite imagery, the estimation of 90% imperviousness seems to be conservative. The percentage impervious used for DA1 was estimated 85%, 5% less than the other two drainage areas, because of the large grass park situated within the drainage area.

V. PROPOSED DRAINAGE AREAS & CHARACTERISTICS

This hydrology report analyzes the stormwater runoff changes in the overall imperviousness of the entire site and the overall changes in stormwater runoff due to the development of the Project. The LID report examines the new and altered impervious areas on site and shows how the stormwater runoff generated from those newly developed areas will be treated. Under the County of Los Angeles MS4 permit, since less than 50% of the existing impervious surface at the Campus would be altered by Specific Plan development, only the proposed alteration must comply with LID requirements. The four drainage areas shown in the LID report reflects drainage for the areas being developed and treatment provided for those altered areas. For purposes of this hydrology report, the entire existing and proposed Campus development has been divided into 3 main drainage areas: DA1 through DA3. The three main drainage areas are comprised of fifteen smaller development

areas delineated by specific areas of work, and they are divided into four stormwater treatment areas per the LID report by potential phases of development for the Project. As noted above, Exhibit 1 shows the existing conditions and Exhibit 3 shows the proposed conditions and drainage areas.

Relatively little impervious area is being added to each drainage area compared to the entire size of each drainage area. Thus, the percentage impervious used to calculate the runoff for the proposed conditions was estimated to be 5% more impervious than the percentage impervious used in the existing conditions.

The anticipated stormwater runoff was found for the 10-year and 50-year storm to be 141 cfs and 225 cfs respectively. These hydrology calculations for the existing and proposed conditions can be found in Appendix B.

VI. ASSUMPTIONS

The following assumptions are made while preparing this report:

- a. Off-site run-on was not considered.
- b. The area was calculated using provided architectural site plan and topography available from Google Earth.

VII. RESULTS & CONCLUSIONS

The hydrology calculations for the existing and proposed conditions are shown in Appendix B. The anticipated 24-hour stormwater runoff for the proposed development was calculated for 10-year and 50-year storm to be 141 cfs and 225 cfs, respectively. The increase in stormwater runoff due to the development of the Campus for 10- and 50-year storms were calculated to be 5.03 cfs and 3.89 cfs, respectively.

In the existing conditions, all of the stormwater on the Campus east of the Los Angeles County Flood Control Channel ultimately ends up in the channel either by means of sheet flow or a pipe network that connects to the flood control channel at the southern corner of the site. In the proposed conditions, stormwater would be collected in a similar manner and brought to the southern corner of the Campus where the 85th percentile volume will be infiltrated and the remainder of the stormwater will be directed via overflow to the existing 30" RCP which connects to the channel. This is explained in detail in the accompanying Low Impact Development (LID) Study.

In the proposed conditions with a 50-year storm, the majority of the site east of the channel including DA1 and DA2 will generate stormwater runoff rate of 188.46 cfs. Compared to the existing flow rates of DA1 and DA2 combined 185.15 cfs, it is increased by 3.3 cfs. However, the proposed Contech CMP infiltration systems for these areas are designed to treat the 85th percentile runoff rates of 13.4 cfs per the LID report; therefore, the Project will eventually result in reducing the total stormwater runoff rate within DA1 and DA2 by 10.1 cfs. In the same manner, the portion of the Campus west of the channel including DA3 will generate stormwater runoff rate of 36.44 cfs. Compared to the existing flow rate of 35.84 cfs, it is increased by 0.6 cfs. This drainage area is currently drains to Buena Vista Street and will continue to drain out any overflow to the street in the post-development conditions. However, the proposed Contech CMP infiltration system for this drainage area is designed to treat the 85th percentile runoff rate of 1.6 cfs per the LID report; therefore, the Project will further result in reducing the total stormwater runoff rate within DA3 by 1.0 cfs. Table 1 summarizes the changes in runoff rates due to the development of the Campus.

Overall, for the entire site of Campus, the Project is expected to increase stormwater runoff rate by 3.9 cfs but the proposed infiltration systems are designed to accommodate the 85th percentile runoff rate of 15.0 cfs per the LID report; therefore, the Project along with implementation of infiltration as structural BMPs will decrease the total stormwater flow rate by 11.1 cfs. The design flow rates for infiltration systems (Q_{pm}) were taken from the LID Study and the summary of these calculations is included in this report in Appendix B.

Table 1: Change in Runoff Rates Due to Development

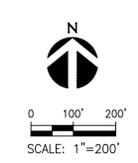
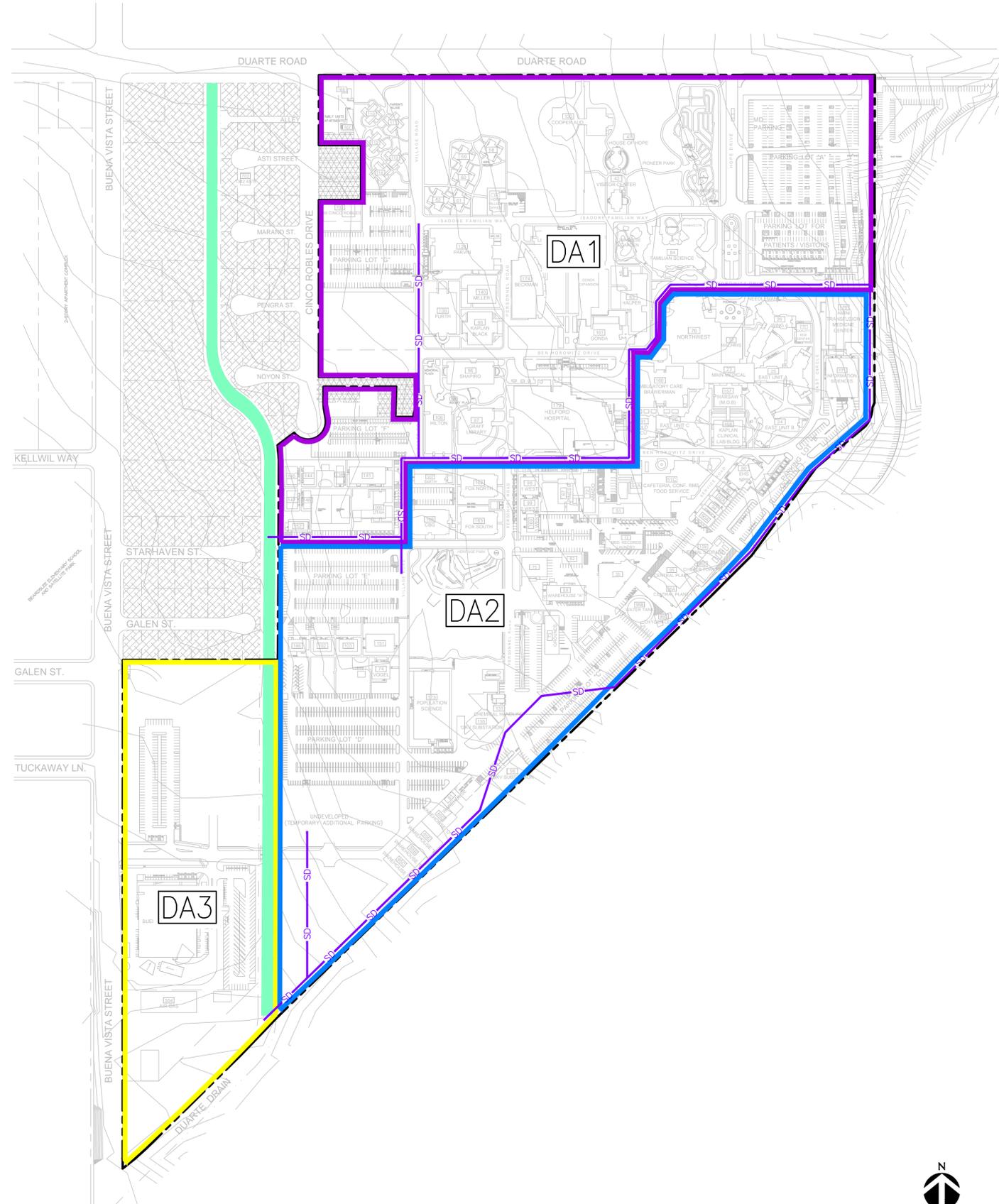
Drainage Area	50-yr Increase in Runoff Flow Rate (cfs)	Runoff Infiltrated (cfs)	Decrease in Overall runoff (cfs)
1 & 2	3.3	13.4	10.1
3	0.6	1.6	1.0
Total			11.1

Exhibit 1

Existing Conditions

LEGEND:

- DRAINAGE AREA 1
- DRAINAGE AREA 2
- DRAINAGE AREA 3
- STORM DRAIN



6080 Center Dr., Suite 700
 Los Angeles, CA 90045
 O: 310.665.2800
 F: 310.665.3075
www.kpff.com

CONSULTANTS

STAMP

REVISIONS

NO.	DESCRIPTION

DATE 07/02/15

PROJECT NUMBER 114186

DESIGNED BY JK

DRAWN BY CJ

CHECKED BY DC

SCALE AS SPECIFIED

KEY MAP

PROJECT DESCRIPTION
 CITY OF HOPE

1500 E. DUARTE ROAD
 DUARTE, CA 91010

DRAWING TITLE
 HYDROLOGY

SHEET NUMBER (EXHIBIT NUMBER)

EXHIBIT 1
EXISTING CONDITIONS

Exhibit 2

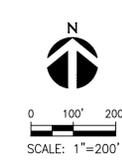
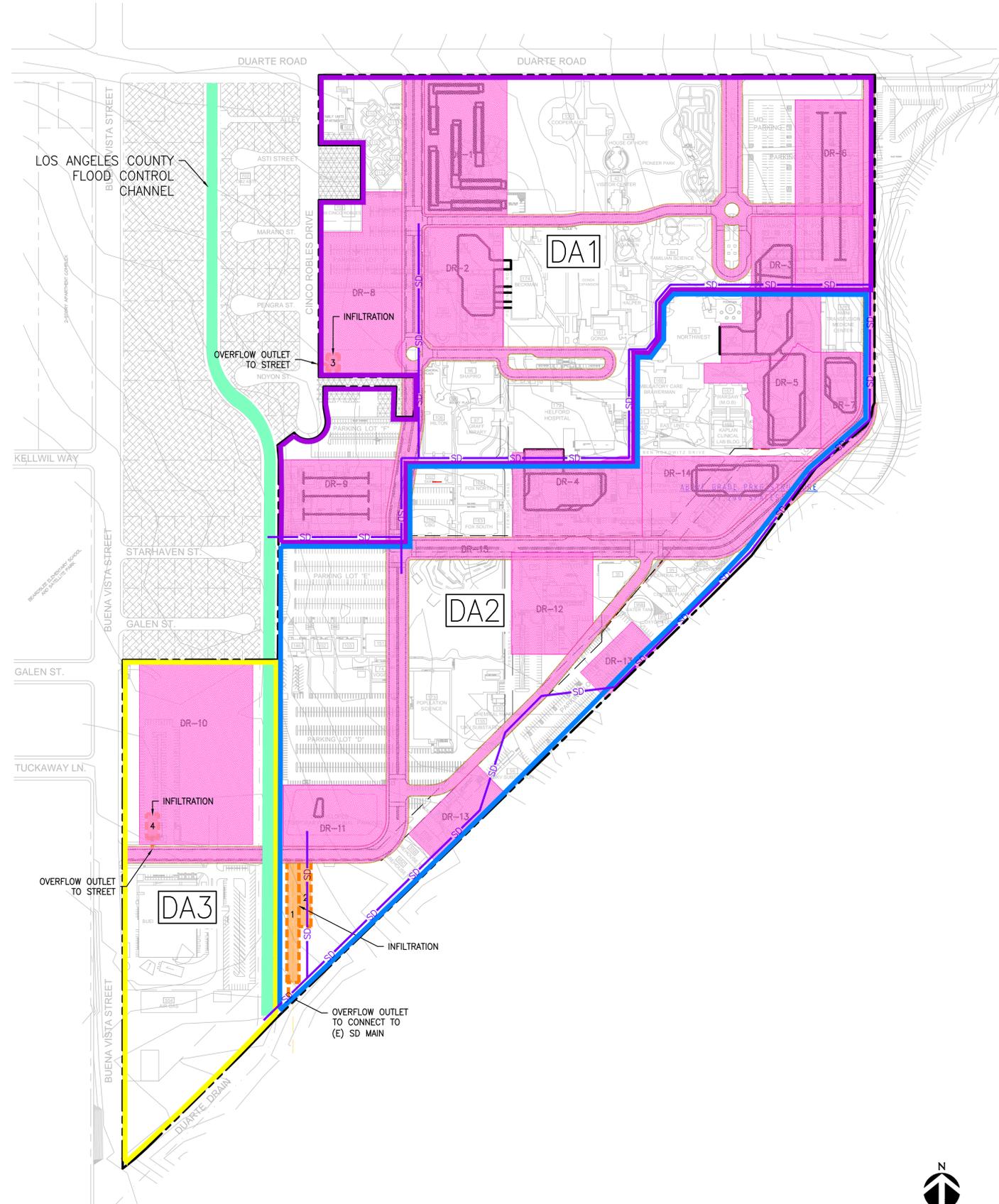
Storm Drain Plan

Exhibit 3

Proposed Conditions and Drainage Areas

LEGEND:

- PROPOSED DEVELOPMENT
- DRAINAGE AREA 1
- DRAINAGE AREA 2
- DRAINAGE AREA 3
- INFILTRATION AREA
- STORM DRAIN



CONSULTANTS

STAMP

REVISIONS

NO.	DESCRIPTION

DATE	07/02/15
PROJECT NUMBER	114186
DESIGNED BY	JK
DRAWN BY	CJ
CHECKED BY	DC
SCALE	AS SPECIFIED
KEY MAP	

PROJECT DESCRIPTION
CITY OF HOPE

1500 E. DUATRE ROAD
DUARTE, CA 91010

DRAWING TITLE
HYDROLOGY

SHEET NUMBER (EXHIBIT NUMBER)

EXHIBIT 3
PROPOSED CONDITIONS

Appendix A

Los Angeles County 50-year 24-hour Isohyet and Soil Map

34° 15' 00"

WATERMAN MOUNTAIN 1-H1.40

-118° 00' 00"

MOUNT WILSON 1-H1.30

GLENDORA 1-H1.32

-117° 52' 30"

BALDWIN PARK 1-H1.21

34° 07' 30"



016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

Soil 007
Rainfall 7.1

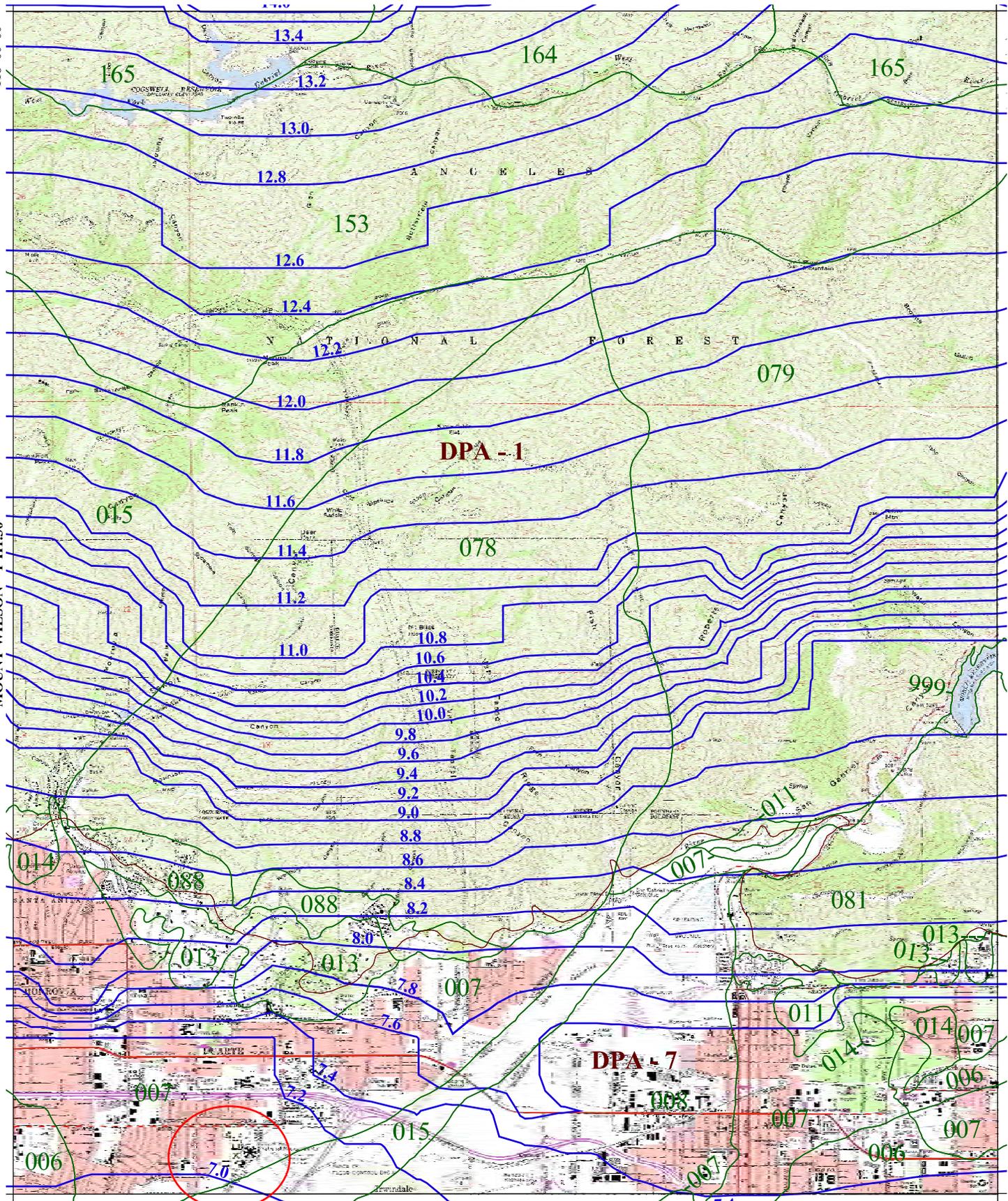


A Z U S A

50-YEAR 24-HOUR ISOHYET

1-H1.31

H1-15

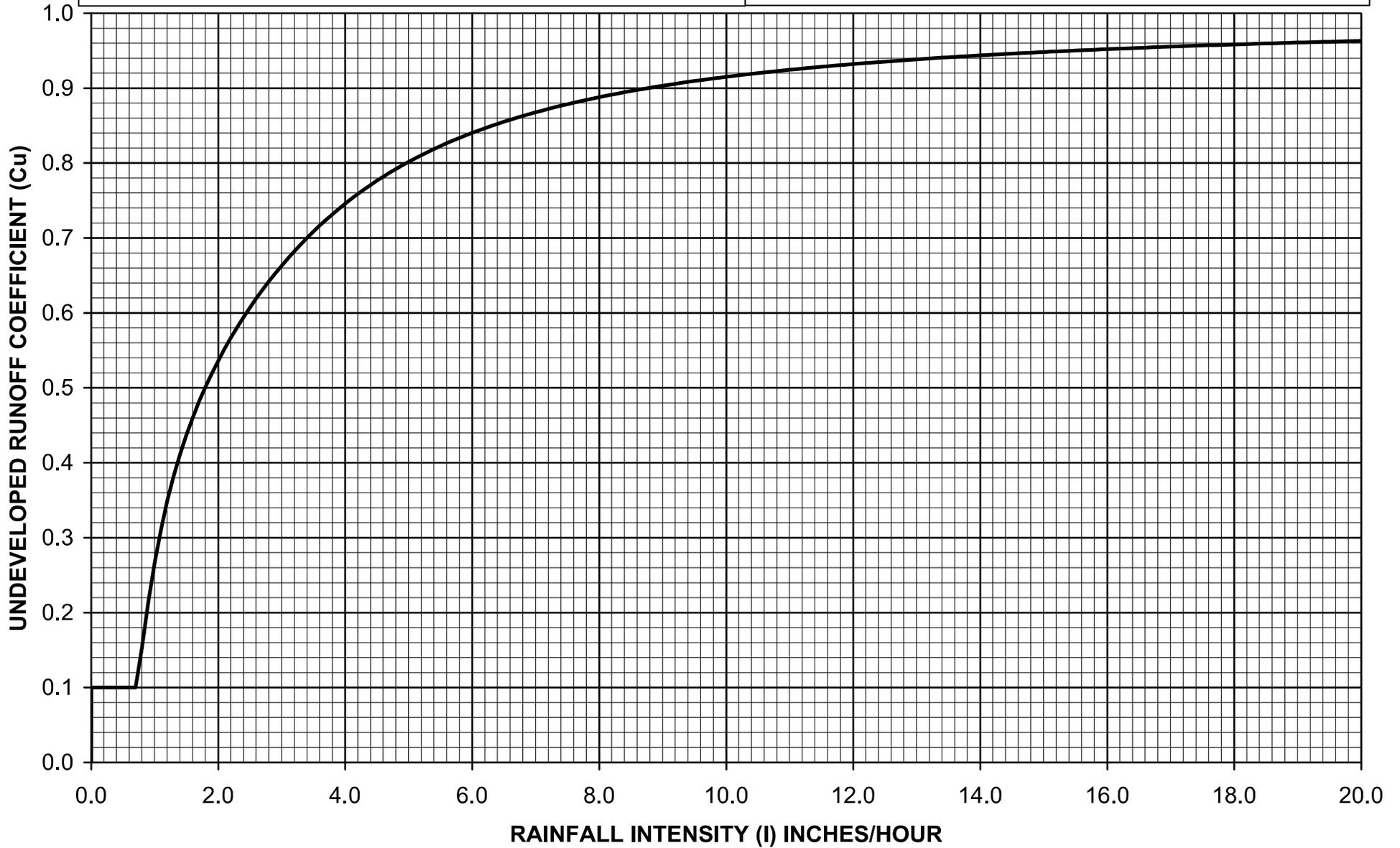


$C_D = (0.9 * IMP) + (1.0 - IMP) * C_U$
 Where: C_D = Developed Runoff Coefficient
 IMP = Proportion Impervious
 C_U = Undeveloped runoff coefficient



Los Angeles County Department of Public Works

**RUNOFF COEFFICIENT CURVE
SOIL TYPE NO. 007**



Appendix B

HydroCalc Hydrology Calculations

Hydrocal Summary

Existing 10 year

project	subarea	area (acres)	length (ft)	slope (vft/hft)	depth (in)	imperviousness	soil	frequency	fire
City of Hope	1	45.06	2327	0.013	7.1	0.8	7	10-yr	0
City of Hope	2	44.58	2630	0.013	7.1	0.9	7	10-yr	0
City of Hope	3	16.28	1601	0.005	7.1	0.9	7	10-yr	0

DrainageArea	Modeled (10-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
1	5.0694	21	56.17	14.09	56.17	1.54	0.45	0.81
2	5.0694	22	57.38	15.38	57.38	1.51	0.44	0.85
3	5.0694	19	22.51	5.62	22.51	1.61	0.46	0.86
			136.06	35.09				

50 year

project	subarea	area (acres)	length (ft)	slope (vft/hft)	depth (in)	imperviousness	soil	frequency	fire
City of Hope	1	45.06	2327	0.013	7.1	0.8	7	50-yr	0
City of Hope	2	44.58	2630	0.013	7.1	0.9	7	50-yr	0
City of Hope	3	16.28	1601	0.005	7.1	0.9	7	50-yr	0

DrainageArea	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
1	7.1	16	92.82	19.86	92.82	2.45	0.60	0.84
2	7.1	17	92.33	21.59	92.33	2.38	0.59	0.87
3	7.1	15	35.84	7.89	35.84	2.53	0.61	0.87
			221.00	49.34				

Proposed 10 year

project	subarea	area (acres)	length (ft)	slope (vft/hft)	depth (in)	imperviousness	soil	frequency	fire
City of Hope	1	45.06	2327	0.013	7.1	0.85	7	10-yr	0
City of Hope	2	44.58	2630	0.013	7.1	0.95	7	10-yr	0
City of Hope	3	16.28	1601	0.005	7.1	0.95	7	10-yr	0

DrainageArea	Modeled (10-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
1	5.0694	21	57.75	14.82	57.75	1.54	0.45	0.83
2	5.0694	21	60.26	16.09	60.26	1.54	0.45	0.88
3	5.0694	19	23.08	5.88	23.08	1.61	0.46	0.88
			141.09	36.79				

50 year

project	subarea	area (acres)	length (ft)	slope (vft/hft)	depth (in)	imperviousness	soil	frequency	fire
City of Hope	1	45.06	2327	0.013	7.1	0.85	7	50-yr	0
City of Hope	2	44.58	2630	0.013	7.1	0.95	7	50-yr	0
City of Hope	3	16.28	1601	0.005	7.1	0.95	7	50-yr	0

DrainageArea	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
1-50yr	7.1	16	94.48	20.84	94.48	2.45	0.60	0.86
2-50yr	7.1	17	93.98	22.57	93.98	2.38	0.59	0.88
3-50yr	7.1	15	36.44	8.24	36.44	2.53	0.61	0.89
			224.89	51.65				

Increase in Runoff Flow Rate (cfs)	
10 Year	5.0
50 Year	3.9

LID Calculations Proposed BMP Design Calculations

BMPs Sizing												
Drainage Area	Bldg. ID	Area (AC)	% Imp	Length of Water Flow (FT)	Slope	Rainfall (Inch)	Soil Type	85th% Rainfall (Inch)	Cu	85th% Qpm (CFS)	85th% Vm (CF)	Req. Infiltration Footprint Area (SF)
DA 1												
1	Hospitality	2.91	96%	500	0.012	7.1	7	1.2	0.1	0.94	10,984	
2	Research	2.36	91%	460	0.013	7.1	7	1.2	0.1	0.73	8,527	
3	Outpatient	2.36	74%	540	0.013	7.1	7	1.2	0.1	0.73	8,525	
4	Inpatient	2.65	74%	500	0.014	7.1	7	1.2	0.1	0.82	9,542	
5	Outpatient	1.87	74%	385	0.014	7.1	7	1.2	0.1	0.58	6,738	
6	PRKG Structure - E	3.19	91%	635	0.011	7.1	7	1.2	0.1	0.99	11,515	
7	Office	0.77	91%	345	0.035	7.1	7	1.2	0.1	0.24	2,795	
9	PRKG Structure - W	2.11	91%	450	0.014	7.1	7	1.2	0.1	0.65	7,593	
11	Research	1.55	91%	385	0.021	7.1	7	1.2	0.1	0.48	5,595	
12	Surface PRKG - SE	1.99	91%	425	0.011	7.1	7	1.2	0.1	0.62	7,191	
13	Support Expansion	1.67	91%	300	0.020	7.1	7	1.2	0.1	0.51	6,006	
14	Office	2.52	91%	590	0.016	7.1	7	1.2	0.1	0.78	9,106	
Σ		26.0								8.06	94,117	40 x 470
DA 2												
15	Fire Access/New Roadway	13.8	91%	500	0.011	7.1	7	1.2	0.1	4.27	49,890	
												40 x 250
DA 3												
8	Surface PRKG - N	3.4	91%	650	0.009	7.1	7	1.2	0.1	1.06	12,395	
												40 x 65
DA 4												
10	Surface PRKG - SW	5.2	91%	700	0.009	7.1	7	1.2	0.1	1.60	18,623	
												40 x 95
	Σ	48.4									Σ	40 x 880

Peak mitigated flow (Qpm) and Mitigated Volume (Vm) are greater based on the 85th Percentile calculations. Thus, the 85th Percentile method governs and the required BMP sizing is based on the 85th Percentile volume and flow.

Percent impervious are based on Los Angeles County Hydrology Manual, Appendix D Proportion Impervious Data

Refer to LID Report for Exhibit of LID Drainage Areas