

# APPENDIX H1

## Preliminary Drainage Report



# PRELIMINARY DRAINAGE REPORT

## FOR

### 4<sup>th</sup> CORNER APARTMENTS

July 15, 2020



A handwritten signature in black ink, appearing to read "Wayne W. Chang".

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Wayne W. Chang, MS, PE 46548

**Chang**Consultants  
Civil Engineering • Hydrology • Hydraulics • Sedimentation

**P.O. Box 9496**  
**Rancho Santa Fe, CA 92067**  
**(858) 692-0760**

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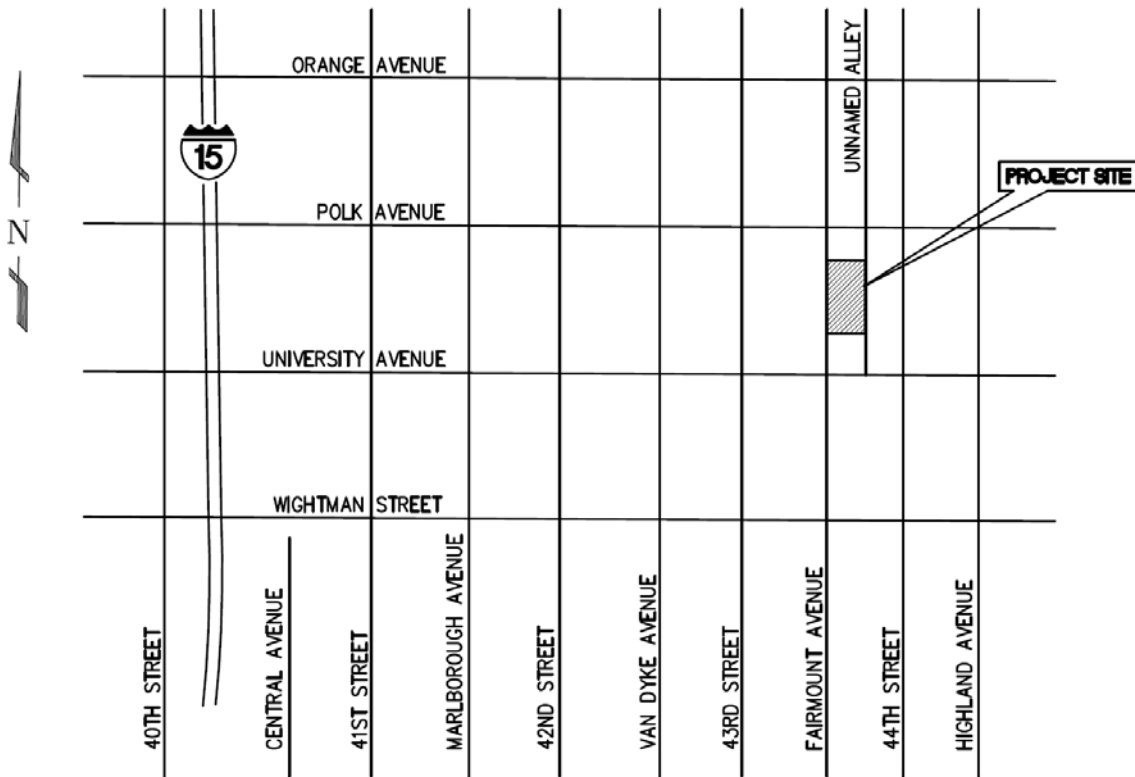
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**APPENDIX**

A. Rational Method Results

## INTRODUCTION

The 4<sup>th</sup> Corner Apartments redevelopment project is located in the City Heights community of the city of San Diego. The site is bounded by Fairmount Avenue to the west, an alley to the east, and is between Polk Avenue and University Avenue (see the Vicinity Map). The project will redevelop the lots at 4021, 4035, 4037, and 4061 Fairmount Avenue and covers 0.87 acres.



**Vicinity Map**

The lots currently contain a commercial building, two parking lots, and two nursery areas, which will be demolished for the redevelopment. The redevelopment project includes a 75-unit apartment building, hardscape, landscape, private utilities, private storm drain, and post-construction BMPs. The project's preliminary plans are being designed by Kettler Leweck Engineering.

The pre-project site drainage surface flows onto the adjacent alley to the east and adjacent Fairmount Avenue to the west. The runoff is conveyed north in the alley and street to an existing curb inlet located on the southeast corner of Polk Avenue and 44th Street (see the Vicinity Map for the streets). The majority of the post-project runoff will be directed to one of three biofiltration planters. The biofiltration planters will be raised to allow the northerly planter to outlet to the alley, while the central and south planters will outlet to Fairmount Avenue. The entire post-project runoff will continue to be directed to the adjacent alley and

street, and ultimately to the existing curb inlet located on the southeast corner of Polk Avenue and 44th. There is no off-site run-on to the site.

This drainage report has been prepared in support of Kettler Leweck Engineering's entitlement plans and calculates the preliminary runoff from the site.

## HYDROLOGIC RESULTS

The overall project site drainage area covers 0.92 acres, so the City of San Diego's 2017, *Drainage Design Manual's* (Manual) rational method procedure was the basis for the existing and proposed condition hydrologic analyses. The Manual states that "the combination of storm drain system capacity and overflow (streets and gutter) will be able to carry the 100-year frequency storm . . . ." Since the project runoff flows onto a street and alley, 100-year analyses have been performed. The rational method input parameters are summarized below and the supporting data is attached:

- Intensity-Duration-Frequency: The City's 100-year Intensity-Duration-Frequency curve from the *Drainage Design Manual* was used.
- Drainage area: The existing and proposed condition drainage subareas are shown on the associated work maps in Appendix A. There is no off-site runoff that will enter the site. Under both conditions, the drainage subareas with rational method nodes starting at 10 (10, 12, etc.) flow to the alley, while drainage subareas with rational method nodes starting at 20 (20, 22, 24, etc.) flow to Fairmount Avenue.

For proposed conditions, the runoff at nodes 22 and 24 will enter separate biofiltration planters before being directed to Fairmount Avenue, while the runoff from node 26 will flow directly onto Fairmount Avenue. The runoff at node 12 will enter a biofiltration basin before being directed to the alley.

The proposed condition work map primarily represents the proposed roof top; therefore, the flows at Nodes 12, 22, and 24 enter roof drains and are then conveyed by interior building drains to three associated biofiltration planters. Consequently, the flow paths from node 10 to 12 and 20 to 22 are from the edge of the roof to a roof drain. Since the flow paths are short, the time of concentration for these subareas is the minimum value of 5 minutes. The time of concentration of the node 24 and 26 subareas are also 5 minutes, so these subareas can merely be added to the node 20 to 22 subarea. An additional 0.38 acre subarea was added along Fairmount Avenue adjacent to the site in order to assess the flow depth in the street.

- Hydrologic soil groups: The soil group within the site is entirely 'D' according to the City criteria.
- Runoff coefficients: Under existing conditions, the site is developed and approximately 72 percent impervious based on the project's topographic mapping. Under proposed

conditions, the site will be approximately 82 percent impervious based on Kettler Leweck Engineering’s drainage management areas. The existing and proposed condition roughness coefficients were calculated using the formula from the *Drainage Design Manual* ( $\text{Pervious Area} \div 80 \times 0.85 = C \text{ value}$ ). The resulting existing and proposed condition C values used in the analyses are 0.77 and 0.87.

These input parameters were entered into the CivilDesign Rational Hydrology Program, which is based on City criteria. The results are included in Appendix A and summarized in Table 1. Table 1 shows that the project will decrease the 100-year flow tributary to the alley by 1.3 cfs and increase the flow tributary to Fairmount Avenue by 1.9 cfs.

Location	Existing Conditions			Proposed Conditions		
	Node	Area, ac	Q <sub>100</sub> , cfs	Node	Area, ac	Q <sub>100</sub> , cfs
To Alley	12	0.70	2.2	12	0.23	0.9
To Fairmount Avenue	22	0.22	0.7	22, 24, 26	0.69	2.6

**Table 1. Comparison of 100-Year Rational Method Results**

A normal depth analysis for Fairmount Avenue was performed to assess the 100-year flow depth in the street along the site. The Proposed Condition Rational Method Work Map delineates an additional 0.38 acre off-site area tributary to Fairmount Avenue along the site. The total 100-year runoff from the off-site area and proposed on-site area is 4.2 cfs. The half street width was modeled in FlowMaster. The longitudinal slope measured from the topographic mapping is 0.25 percent. The FlowMaster normal depth results are included after this report text and show a flow depth of 0.49 feet, which is within the 6-inch curb height. These results conservatively estimate the street flow depth because they do not account for detention provided by the proposed biofiltration basins.

## CONCLUSION

The analyses in this drainage report show that the project will reduce the 100-year flow rate tributary to the alley and increase the 100-year flow rate tributary to Fairmount Avenue. The drainage area tributary to Fairmount Avenue along the site is essentially the half width of Fairmount Avenue along with some adjacent frontage, so the additional flow contribution will not have much impact on Fairmount Avenue. The results indicate that the undetained flows will be within the Fairmount Avenue curb height along the site. Detention resulting from the biofiltration basins can be assessed during final engineering and will show a lower flow depth in the street. The overall flow rate within the project footprint will increase by 0.6 cfs. This increase is rather small, so will have minor impacts. The project proposes three biofiltration basins. As a result, it is anticipated that the increase can be mitigated by the biofiltration basins, if needed.

Storm runoff from the three biofiltration basins will either be conveyed to the alley in a pipe or to Fairmount Avenue in one of two D-25 curb outlets. Normal depth analyses were

performed for the pipe and curb outlets based on the tributary 100-year flow rates. The analyses are attached after this report text. The flow rates and velocities from the pipe and curb outlets are summarized on the Proposed Condition Rational Method Work Map.

The site is currently developed and within a developed area of downtown. There are no waters of the US at or in the immediate vicinity of the site. Therefore, neither a Federal Clean Water Act Section 401 (Regional Water Quality Control Board) nor 404 permit (US Army Corps of Engineers) are required.



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## Worksheet for Street Section - Prop Flow

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### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Channel Slope	0.00250	ft/ft
Discharge	4.20	ft <sup>3</sup> /s

Section Definitions

Station (ft)	Elevation (ft)
0+00	10.00
0+10	9.80
0+10	9.30
0+12	9.43
0+36	10.12

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 10.00)	(0+10, 9.30)	0.030
(0+10, 9.30)	(0+12, 9.43)	0.015
(0+12, 9.43)	(0+36, 10.12)	0.018

### 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	0.49	ft
Elevation Range	9.30 to 10.12	ft
Flow Area	3.01	ft <sup>2</sup>
Wetted Perimeter	14.96	ft
Hydraulic Radius	0.20	ft
Top Width	14.45	ft

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## Worksheet for Street Section - Prop Flow

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### Results

Normal Depth	0.49	ft
Critical Depth	0.40	ft
Critical Slope	0.00931	ft/ft
Velocity	1.40	ft/s
Velocity Head	0.03	ft
Specific Energy	0.53	ft
Froude Number	0.54	
Flow Type	Subcritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	0.40	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.00931	ft/ft

**Cross Section for Street Section - Prop Flow**

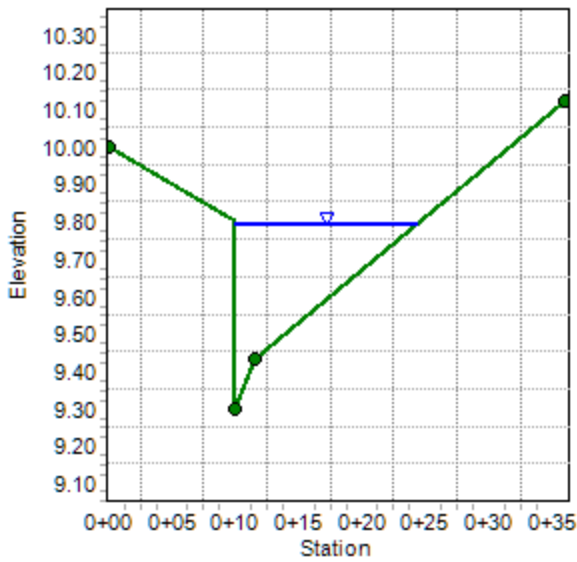
**Project Description**

Friction Method	Manning Formula
Solve For	Normal Depth

**Input Data**

Channel Slope	0.00250	ft/ft
Discharge	4.20	ft <sup>3</sup> /s

**Cross Section Image**



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## Worksheet for 6" PVC Node 12

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### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02600	ft/ft
Diameter	0.50	ft
Discharge	0.90	ft <sup>3</sup> /s

### Results

Normal Depth	0.41	ft
Flow Area	0.17	ft <sup>2</sup>
Wetted Perimeter	1.13	ft
Hydraulic Radius	0.15	ft
Top Width	0.39	ft
Critical Depth	0.46	ft
Percent Full	81.5	%
Critical Slope	0.02232	ft/ft
Velocity	5.25	ft/s
Velocity Head	0.43	ft
Specific Energy	0.84	ft
Froude Number	1.39	
Maximum Discharge	0.97	ft <sup>3</sup> /s
Discharge Full	0.90	ft <sup>3</sup> /s
Slope Full	0.02573	ft/ft
Flow Type	SuperCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	81.50	%
Downstream Velocity	Infinity	ft/s

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## Worksheet for D-25 Curb Outlet Node 22

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### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.015	
Channel Slope	0.02080	ft/ft
Bottom Width	3.00	ft
Discharge	1.00	ft <sup>3</sup> /s

### Results

Normal Depth	0.11	ft
Flow Area	0.32	ft <sup>2</sup>
Wetted Perimeter	3.22	ft
Hydraulic Radius	0.10	ft
Top Width	3.00	ft
Critical Depth	0.15	ft
Critical Slope	0.00700	ft/ft
Velocity	3.09	ft/s
Velocity Head	0.15	ft
Specific Energy	0.26	ft
Froude Number	1.66	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.15	ft
Channel Slope	0.02080	ft/ft
Critical Slope	0.00700	ft/ft

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## Worksheet for D-25 Curb Outlet Node 24

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### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.015	
Channel Slope	0.02080	ft/ft
Bottom Width	3.00	ft
Discharge	1.30	ft <sup>3</sup> /s

### Results

Normal Depth	0.13	ft
Flow Area	0.38	ft <sup>2</sup>
Wetted Perimeter	3.25	ft
Hydraulic Radius	0.12	ft
Top Width	3.00	ft
Critical Depth	0.18	ft
Critical Slope	0.00675	ft/ft
Velocity	3.42	ft/s
Velocity Head	0.18	ft
Specific Energy	0.31	ft
Froude Number	1.69	
Flow Type	Supercritical	

### GVF Input Data

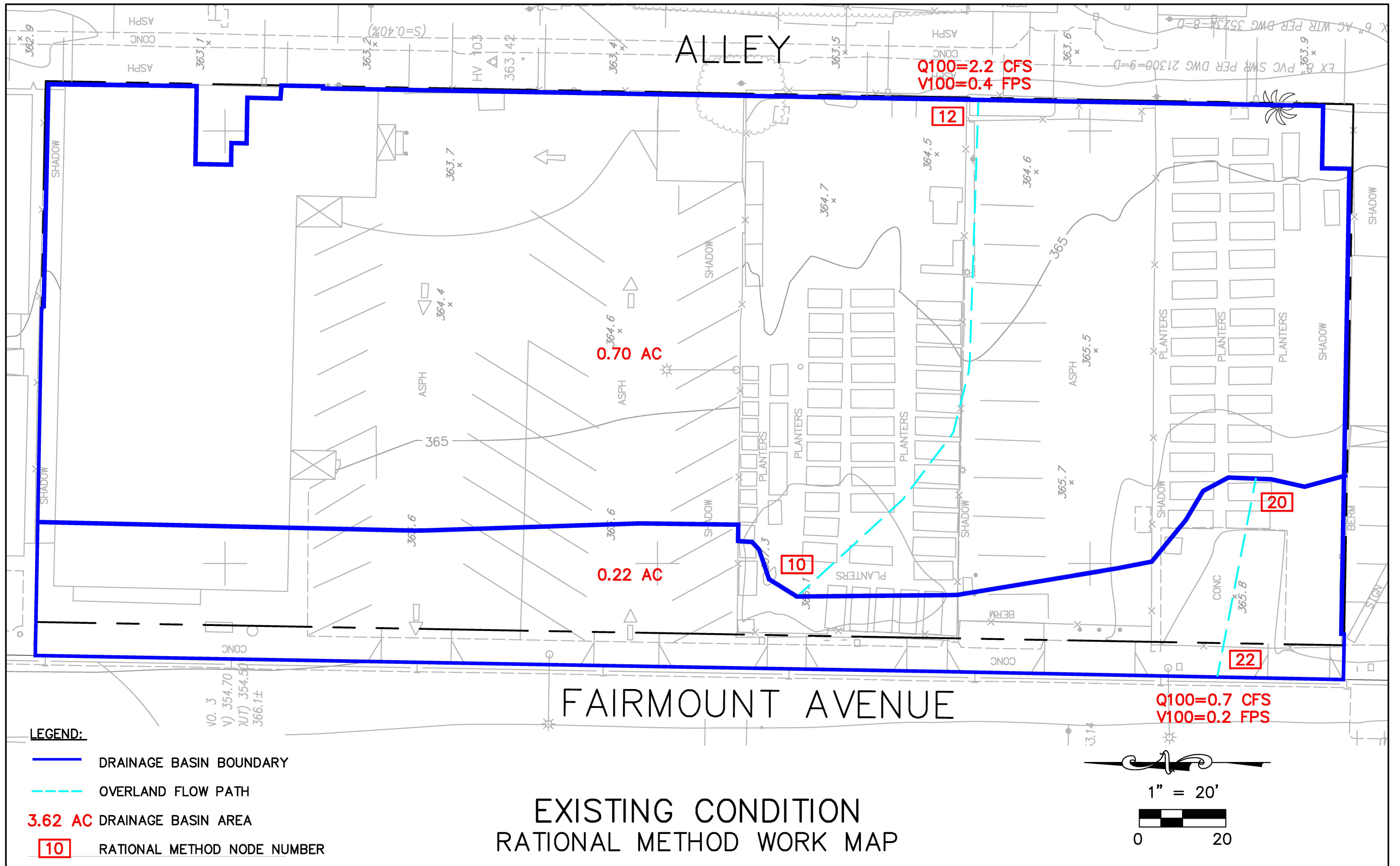
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

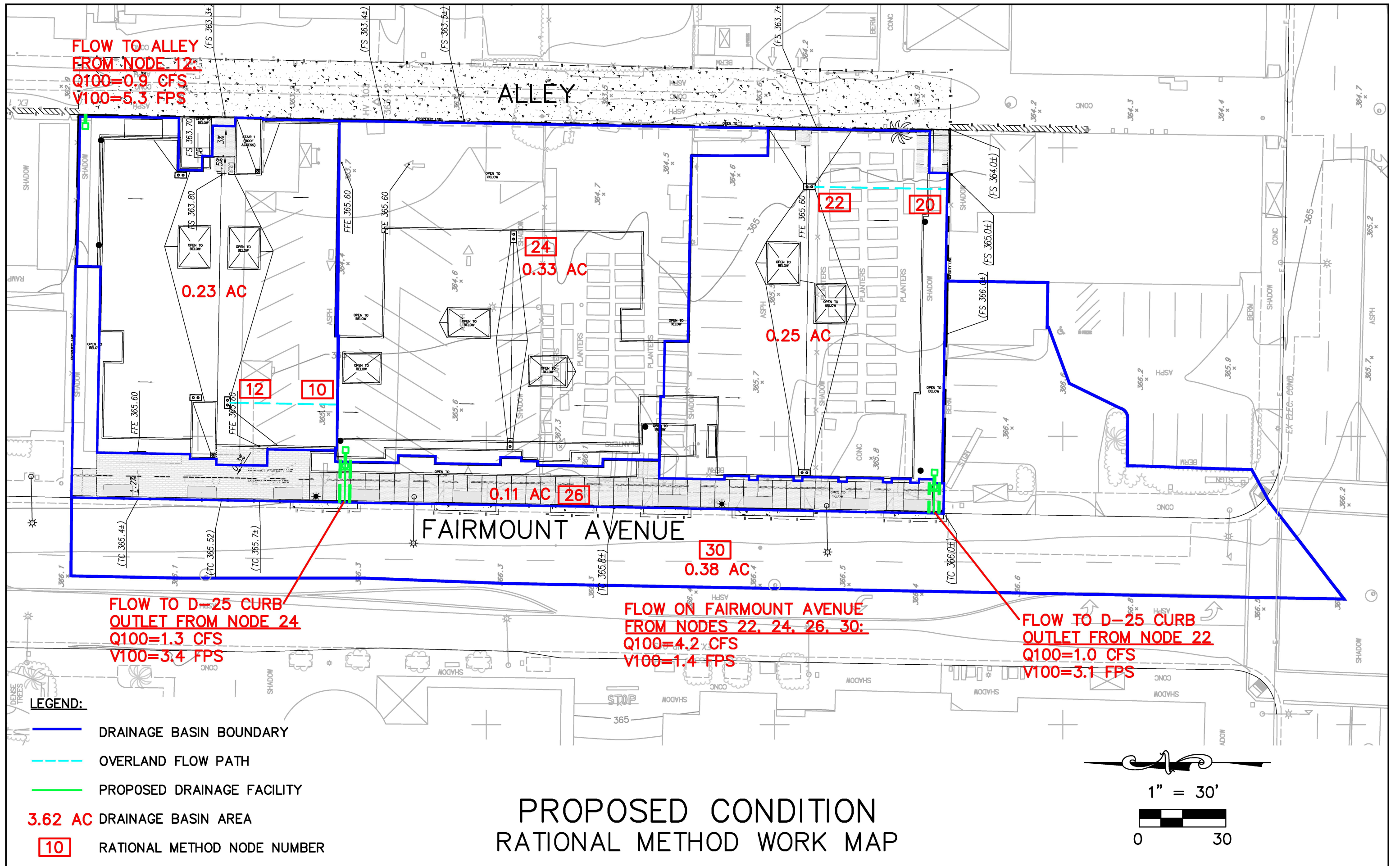
Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.13	ft
Critical Depth	0.18	ft
Channel Slope	0.02080	ft/ft
Critical Slope	0.00675	ft/ft

# **APPENDIX A**

## **RATIONAL METHOD RESULTS**







## CHAPTER 2: HYDROLOGY

2. For all drainage channels and storm water conveyance systems, which will convey drainage from a tributary area equal to or greater than one (1) square mile, the runoff criteria, shall be based upon a 100-year frequency storm.



- b. The runoff criteria for the underground storm drain system shall be based upon a 50-year frequency storm.

### 2.3. Soil Type

For storm drain, culverts, channels, and all associated structures, Type D soil shall be used for all areas.

### 2.4. Other Requirements

1. Design runoff for drainage and flood control facilities within the City shall be based upon full development of the watershed area in accordance with the land uses shown on the City of San Diego, Progress Guide and General Plan.
2. When determining criteria for floodplain management and flood proofing, design runoff within the City shall be based upon existing conditions in accordance with the City Floodplain Management Requirements and FEMA Regulations.
3. Under City requirements, the minimum elevation of the finished, first floor elevation of any building is 2 feet above the 100-year frequency flood elevation.

### 2.5. Water Quality Considerations

Requirements for hydrologic studies specific to the design of pollution prevention controls and hydromodification management controls are detailed in the Storm Water Standards. Where the Storm Water Standards specify modifications to the guidelines stated herein on discharge flow methods, design storm frequency, or soil type, the modifications shall supersede these but only for the purposes stated in the Storm Water Standards. Where the Storm Water Standards does not specify a modification, the guidance found here in Chapter 2 shall apply.

Table A-1. Runoff Coefficients for Rational Method

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

**Note:**

<sup>(1)</sup> Type D soil to be used for all areas.

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<sub>c</sub> for a selected storm frequency. Once a particular storm frequency has been selected for design and a T<sub>c</sub> calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration-Frequency Design Chart (Figure A-1).



APPENDIX A: RATIONAL METHOD AND MODIFIED RATIONAL METHOD

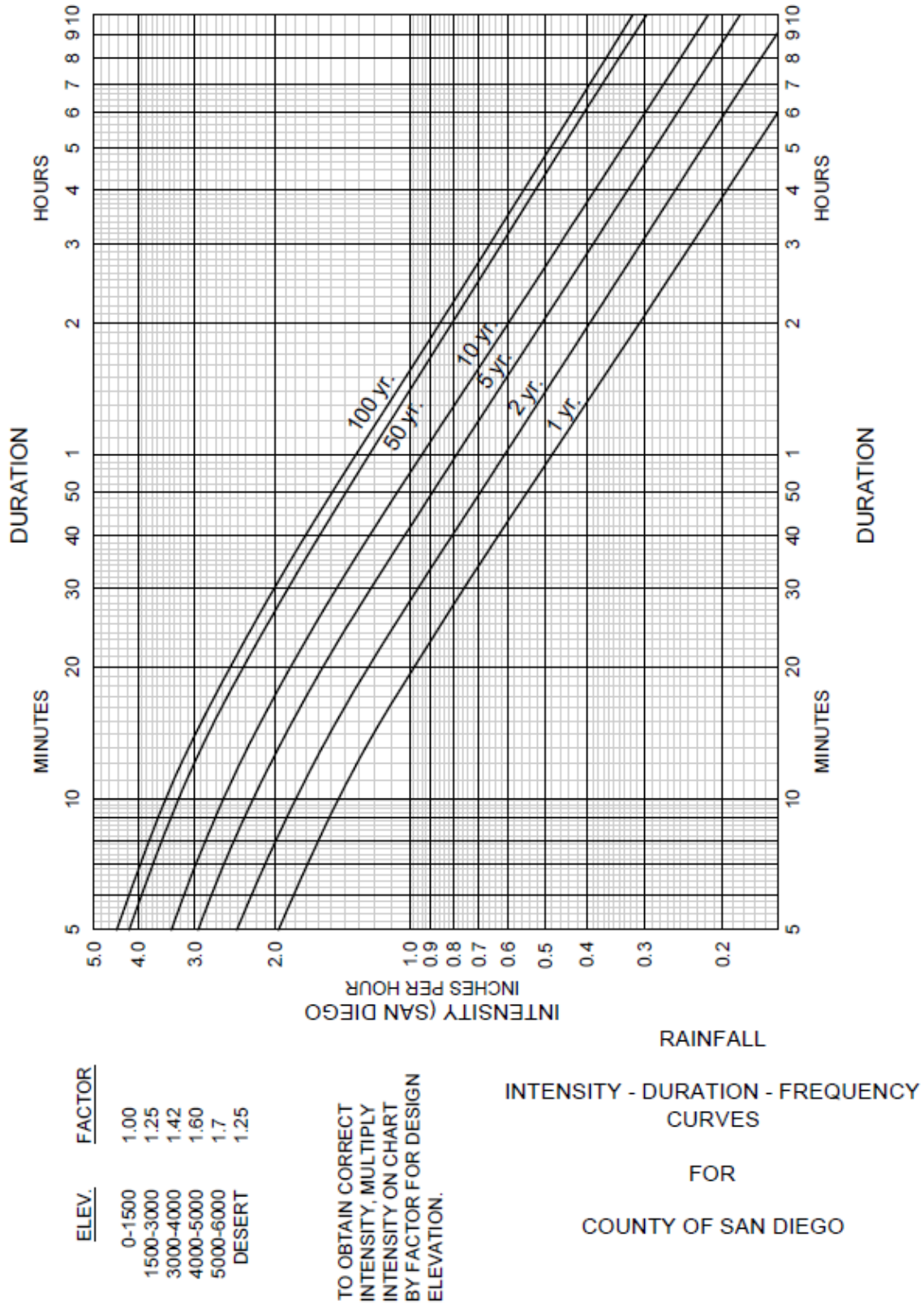


Figure A-1. Intensity-Duration-Frequency Design Chart



APPENDIX A: RATIONAL METHOD AND MODIFIED RATIONAL METHOD

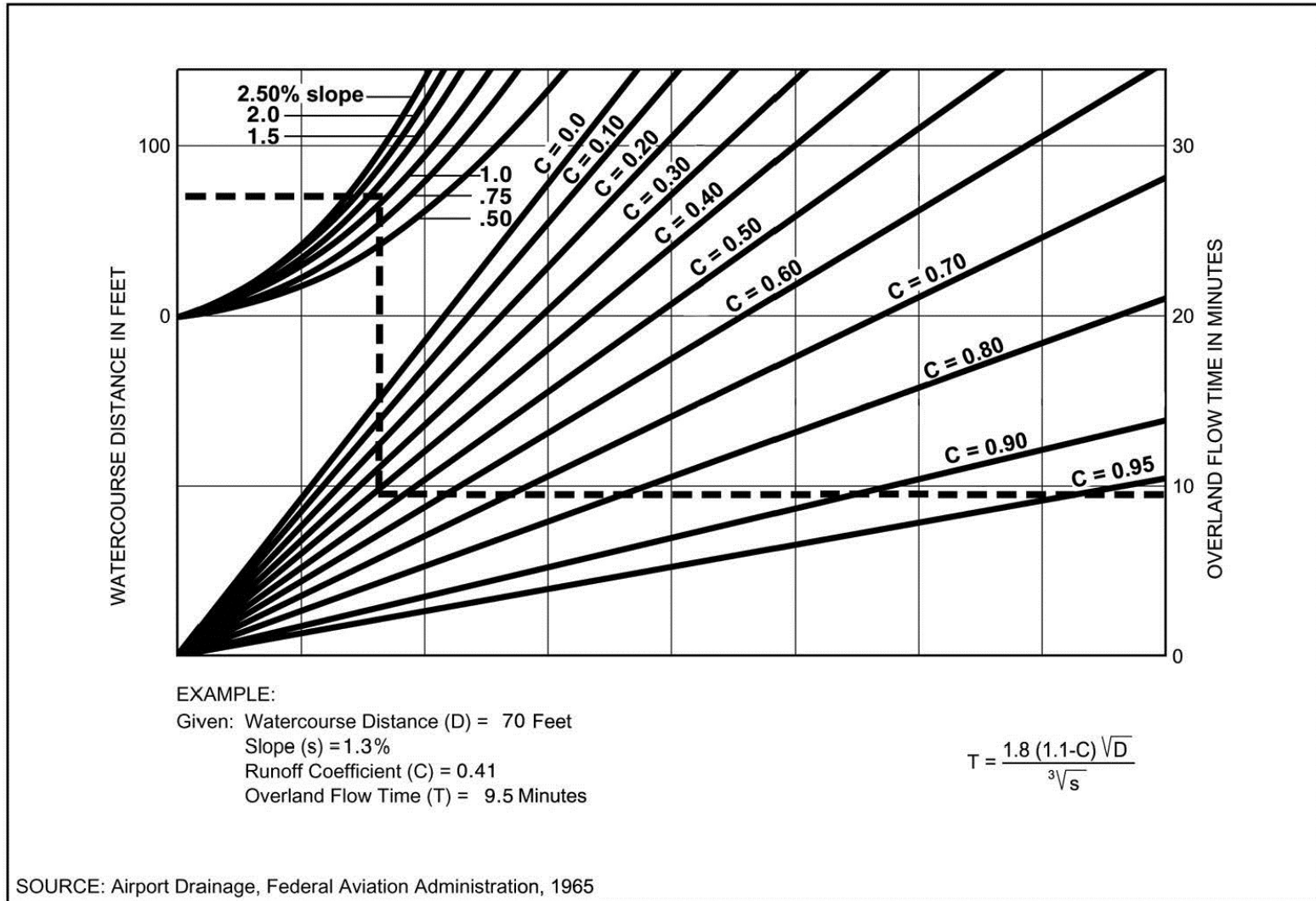


Figure A-4. Rational Formula - Overland Time of Flow Nomograph

**Note:** Use formula for watercourse distances in excess of 100 feet.

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2005 Version 6.4

Rational method hydrology program based on  
San Diego County Flood Control Division 1985 hydrology manual  
Rational Hydrology Study Date: 06/11/20

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**4th Corner Apartments**  
**Preliminary Analyses**  
**Existing Conditions**  
**100-Year Storm Event**  
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\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*  
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Program License Serial Number 4028  
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Rational hydrology study storm event year is 100.0  
English (in-lb) input data Units used  
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and  
Elevation 0 - 1500 feet  
Factor (to multiply \* intensity) = 1.000  
Only used if inside City of San Diego  
San Diego hydrology manual 'C' values used  
Runoff coefficients by rational method

+++++  
Process from Point/Station 10.000 to Point/Station 12.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

-----  
User specified 'C' value of 0.770 given for subarea  
Initial subarea flow distance = 130.000(Ft.)  
Highest elevation = 366.100(Ft.)  
Lowest elevation = 364.200(Ft.)  
Elevation difference = 1.900(Ft.)  
Time of concentration calculated by the urban  
areas overland flow method (App X-C) = 5.97 min.  
TC = [1.8\*(1.1-C)\*distance(Ft.)<sup>0.5</sup>/(% slope<sup>1/3</sup>)]  
TC = [1.8\*(1.1-0.770)\*(130.000<sup>0.5</sup>)/(1.462<sup>1/3</sup>)] = 5.97  
Rainfall intensity (I) = 4.089(In/Hr) for a 100.0 year storm  
Effective runoff coefficient used for area (Q=KCIA) is C = 0.770  
Subarea runoff = 2.204(CFS)  
Total initial stream area = 0.700(Ac.)

+++++  
Process from Point/Station 20.000 to Point/Station 22.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

User specified 'C' value of 0.770 given for subarea  
Initial subarea flow distance = 46.000(Ft.)  
Highest elevation = 366.200(Ft.)  
Lowest elevation = 365.600(Ft.)  
Elevation difference = 0.600(Ft.)  
Time of concentration calculated by the urban  
areas overland flow method (App X-C) = 3.69 min.  
TC =  $[1.8*(1.1-C)*distance(Ft.)^{.5}/(%\ slope^{(1/3)})]$   
TC =  $[1.8*(1.1-0.7700)*(46.000^{.5})/(1.304^{(1/3)})]= 3.69$   
Setting time of concentration to 5 minutes  
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm  
Effective runoff coefficient used for area (Q=KCIA) is C = 0.770  
Subarea runoff = 0.744(CFS)  
Total initial stream area = 0.220(Ac.)  
End of computations, total study area = 0.920 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology program based on  
San Diego County Flood Control Division 1985 hydrology manual  
Rational Hydrology Study Date: 06/11/20

-----  
**4th Corner Apartments**  
**Preliminary Analyses**  
**Proposed Conditions**  
**100-Year Storm Event**  
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\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*  
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Program License Serial Number 4028  
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Rational hydrology study storm event year is 100.0  
English (in-lb) input data Units used  
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and  
Elevation 0 - 1500 feet  
Factor (to multiply \* intensity) = 1.000  
Only used if inside City of San Diego  
San Diego hydrology manual 'C' values used  
Runoff coefficients by rational method

+++++  
Process from Point/Station 10.000 to Point/Station 12.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

-----  
User specified 'C' value of 0.870 given for subarea  
Initial subarea flow distance = 37.000(Ft.)  
Highest elevation = 380.000(Ft.)  
Lowest elevation = 379.630(Ft.)  
Elevation difference = 0.370(Ft.)  
Time of concentration calculated by the urban  
areas overland flow method (App X-C) = 2.52 min.  
TC = [1.8\*(1.1-C)\*distance(Ft.)<sup>0.5</sup>]/(% slope<sup>1/3</sup>)  
TC = [1.8\*(1.1-0.870)\*( 37.000<sup>0.5</sup>)/( 1.000<sup>1/3</sup>)] = 2.52  
Setting time of concentration to 5 minutes  
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm  
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870  
Subarea runoff = 0.878(CFS)  
Total initial stream area = 0.230(Ac.)



+++++  
Process from Point/Station 20.000 to Point/Station 22.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

User specified 'C' value of 0.870 given for subarea  
Initial subarea flow distance = 46.000(Ft.)  
Highest elevation = 380.000(Ft.)  
Lowest elevation = 379.540(Ft.)  
Elevation difference = 0.460(Ft.)  
Time of concentration calculated by the urban  
areas overland flow method (App X-C) = 2.81 min.  
TC = [1.8\*(1.1-C)\*distance(Ft.)<sup>0.5</sup>/(% slope<sup>1/3</sup>)]  
TC = [1.8\*(1.1-0.870)\*( 46.000<sup>0.5</sup>)/( 1.000<sup>1/3</sup>)] = 2.81  
Setting time of concentration to 5 minutes  
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm  
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870  
Subarea runoff = 0.955(CFS)  
Total initial stream area = 0.250(Ac.)

+++++  
Process from Point/Station 24.000 to Point/Station 22.000  
\*\*\*\* SUBAREA FLOW ADDITION \*\*\*\*

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User specified 'C' value of 0.870 given for subarea  
Time of concentration = 5.00 min.  
Rainfall intensity = 4.389(In/Hr) for a 100.0 year storm  
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.870  
Subarea runoff = 1.260(CFS) for 0.330(Ac.)  
Total runoff = 2.215(CFS) Total area = 0.58(Ac.)

+++++  
Process from Point/Station 26.000 to Point/Station 22.000  
\*\*\*\* SUBAREA FLOW ADDITION \*\*\*\*

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User specified 'C' value of 0.870 given for subarea  
Time of concentration = 5.00 min.  
Rainfall intensity = 4.389(In/Hr) for a 100.0 year storm  
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.870  
Subarea runoff = 0.420(CFS) for 0.110(Ac.)  
Total runoff = 2.635(CFS) Total area = 0.69(Ac.)

+++++  
Process from Point/Station 30.000 to Point/Station 22.000  
\*\*\*\* SUBAREA FLOW ADDITION \*\*\*\*

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Decimal fraction soil group A = 0.000  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 1.000  
[INDUSTRIAL area type ]  
Time of concentration = 5.00 min.  
Rainfall intensity = 4.389(In/Hr) for a 100.0 year storm  
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950  
Subarea runoff = 1.584(CFS) for 0.380(Ac.)  
Total runoff = 4.219(CFS) Total area = 1.07(Ac.)  
End of computations, total study area = 1.300 (Ac.)