Drainage Study

Lotus Place
Tentative Map – CDP

5064 Lotus Street
San Diego, CA 92107

Prepared for:
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PTS No.

Introduction

This project is located at 5064 Lotus Street, on Lots 3 & 4, Block 101 of Map No. 1189, in San Diego. The project proposes the removal of the existing single-family residence and appurtenances with its replacement with four new single-family residences, with attached garages, landscaping, and hardscape. This is a discretionary project, including a Tentative Map, a Small Lot Subdivision, Coastal and Site Development Permits.

The site, in its existing pre-construction condition, conveys runoff northwesterly onto the adjacent alley and northwesterly to Lotus Street, by surface flow. Following improvement of the 4 new parcels, runoff will be conveyed similarly, with runoff to the alley and Lotus Street continuing to flow to each by sheet flow, after running through landscaped areas. There is no change in runoff conveyed to the public storm drain system despite a small increase in site imperviousness. Existing site imperviousness is 2,271 sf (33.3%). Proposed site imperviousness is 5,632 sf (82.5%). The same public storm drain curb inlet, at the southeast corner of Abbott and Lotus Streets, collects site runoff before and following development.

Section 404 of CWA regulates the discharge of dredged or fill material into waters of the United States. Section 404 is regulated by the Army Corps of Engineers. Section 401 of CWA requires that the State provide certification that any activity authorized under Section 404 is in compliance with effluent limits, the state's water quality standards, and any other appropriate requirements of state law. Section 401 is administered by the State Regional Water Quality Control Board. The project does not require a Federal CWA Section 404 permit nor Section 401 Certification because it does not cause dredging or filling in waters of the United States and is in compliance with the State Water Quality Standards.

The Rational Method was used to calculate the anticipated flow for the 100-year storm return frequency event using the method outlined in the City of San Diego Drainage Design Manual.

The proposed project will have no adverse effect on the neighboring properties nor the public storm drain system.

______________________________ 07-06-20

Antony K. Christensen Date
RCE 54021
Exp. 12-31-21
JN A2020-53

Calculations

1. Intensity Calculation

(From the City of San Diego Drainage Design Manual)
Tc = Time of concentration

$Tc = 1.8 (1.1-C) (D)^{1/2} / S^{1/3}$

Since the difference in elevation is 0.7’ (11.2’-10.5’) and the distance traveled is 126’ (S=0.56%). C=0.55.

Tc = 13.48 minutes

From table in Manual:

I_{100} = 2.8 inches

2. Coefficient Determination

This is a single family residential with no offsite areas tributary to it that will contribute to runoff:

Pre-Construction:
Single-Family

C= 0.55

Post construction:
Single-Family

C= 0.55

3. Volume calculations

Q = CIA

Areas of Drainage

Pre-Construction

Area of site draining northwesterly to alley	A = 0.028 Acre
Area of site draining southwesterly to street	S = 0.129 Acre

Post-Construction

Area of site draining to alley from all parcels by sheet flow	DA = 0.067 Acre
Area of site draining from Parcel 3 to alley by sheet flow	3A = 0.015 Acre
Area of site draining from Parcel 4 to alley by sheet flow	4A = 0.016 Acre
Area of site draining from northerly Parcel 1 to street by underdrain	1SN = 0.018 Acre
Area of site draining from southerly Parcel 1 to street by underdrain	1SS = 0.010 Acre
Area of site draining from northerly Parcel 2 to street by underdrain	2SN = 0.017 Acre
Area of site draining from southerly Parcel 2 to street by underdrain	2SS = 0.014 Acre

Pre-Construction

Q_{100A} = (0.55) (2.8) (0.028)
Q_{100S} = (0.55) (2.8) (0.129)

Q_{100A} = 0.04 cfs
Q_{100S} = 0.20 cfs

Post-Construction

Q_{100DA} = (0.55) (2.8) (0.067)
Q_{1003A} = (0.55) (2.8) (0.015)
Q_{1004A} = (0.55) (2.8) (0.016)
Q_{1001SN} = (0.55) (2.8) (0.018)
Q_{1001SS} = (0.55) (2.8) (0.010)
Q_{1002SN} = (0.55) (2.8) (0.017)
Q_{1002SS} = (0.55) (208) (0.014)

Q_{100DA} = 0.10 cfs
Q_{1003A} = 0.02 cfs
Q_{1004A} = 0.02 cfs
Q_{1001SN} = 0.03 cfs
Q_{1001SS} = 0.02 cfs
Q_{1002SN} = 0.03 cfs
Q_{1002SS} = 0.02 cfs

4. Discussion

The site, in its existing pre-construction condition, conveys runoff to both Lotus Street, southwesterly and to the adjacent alley, northwesterly. Prior to construction the total runoff conveyed to the alley is 0.04 cfs. Following construction, the total runoff to the alley will be 0.14 cfs. Total runoff to Lotus Street, prior to construction is 0.20 cfs and following construction is 0.10 cfs. The total runoff from the project remains unchanged. The slight increase in runoff to the alley (0.10 cfs) and decrease to the street (0.10 cfs) will have no adverse effect on the public storm drain system. A curb inlet at the southeast corner of Abbott and Lotus Street collects site runoff before and after development.

5. *Test for Adequacy*

The proposed system requires the use of a pump to convey 0.52 cfs (100 year storm) of runoff from 3636 catch basin onsite to the curb outlet in the street. The pump needs to overcome head loss from elevation changes, friction and small bends. Entrance and exit losses are ignored since they are insignificant.

The pump in this system delivers flow through a 4” PVC drain to the sidewalk underdrain. The sum of the head losses results in the Total Dynamic Head.

The total elevation change is (428.5’ – 408.5’) = 20’.

To determine other head losses, the velocity in each pipe must be known. To provide conservative values for each head loss it will be assumed that the flow from the pump is at the approximate TDH value. For the 3 HP Goulds pump (WS30D4) the maximum flow for a static head of 30 feet is 280 gpm. This is equivalent to 0.62 cfs.

$V=Q/A$

$A= \pi r^2$

For a 4” pipe r = .165

$A =\pi\ (0.165)^2$

$A= 0.086\ ft^2$

$V= 0.62/0.086$

V= 7.2 fps

The friction loss for a length of pipe can be calculated using the following Hazen – Williams formula:

$h_f = 3.02LD^{-1.167} (V/C_h)^{1.85}$

for a 4" pipe

L = 110 ft (from catch basin to curb outlet)

D = 4" = 0.33'

V=10.2

C_h = 140 (plastic pipe)

$h_f = 3.02(110)(0.33)^{-1.167} (7.2/140)^{1.85}$

h_f = 5.0'

Therefore, the elevation and frictional headloss is

TDH = 20' + 5.0 = 25'

Say 25 feet.

Since the Q = 0.52 cfs = 7.48 gal/ft^3(0.52)(60sec/min) = 233 gpm

Therefore, a pump must be capable of conveying 233 gpm with a total dynamic head of 25 feet.

Each 3 hp Goulds pump is capable of conveying 365 gpm at a head of 25 feet and is therefore adequate. Even assuming some loss for the bends in the system the pump will be adequate.

The pump will be placed in a catch basin and an alarm system will be needed to alert the homeowner to the failure of the pump. A check valve will be needed to keep the runoff from flowing back into the catch basin, once the pump shuts off. Should the pump fail the is a provision for overflow to flow southerly.

If a 6" PVC drain is used to convey runoff from the catch basin to the curb outlet a 2 hp Goulds pump WS20D4 will be adequate.

The PVC drains throughout the site were tested to determine if they could convey the maximum expected runoff and all were found capable. The program used to test each conveyance and the test results are included at the end of this report.

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APPENDIX

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

<u>Note:</u>
[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).

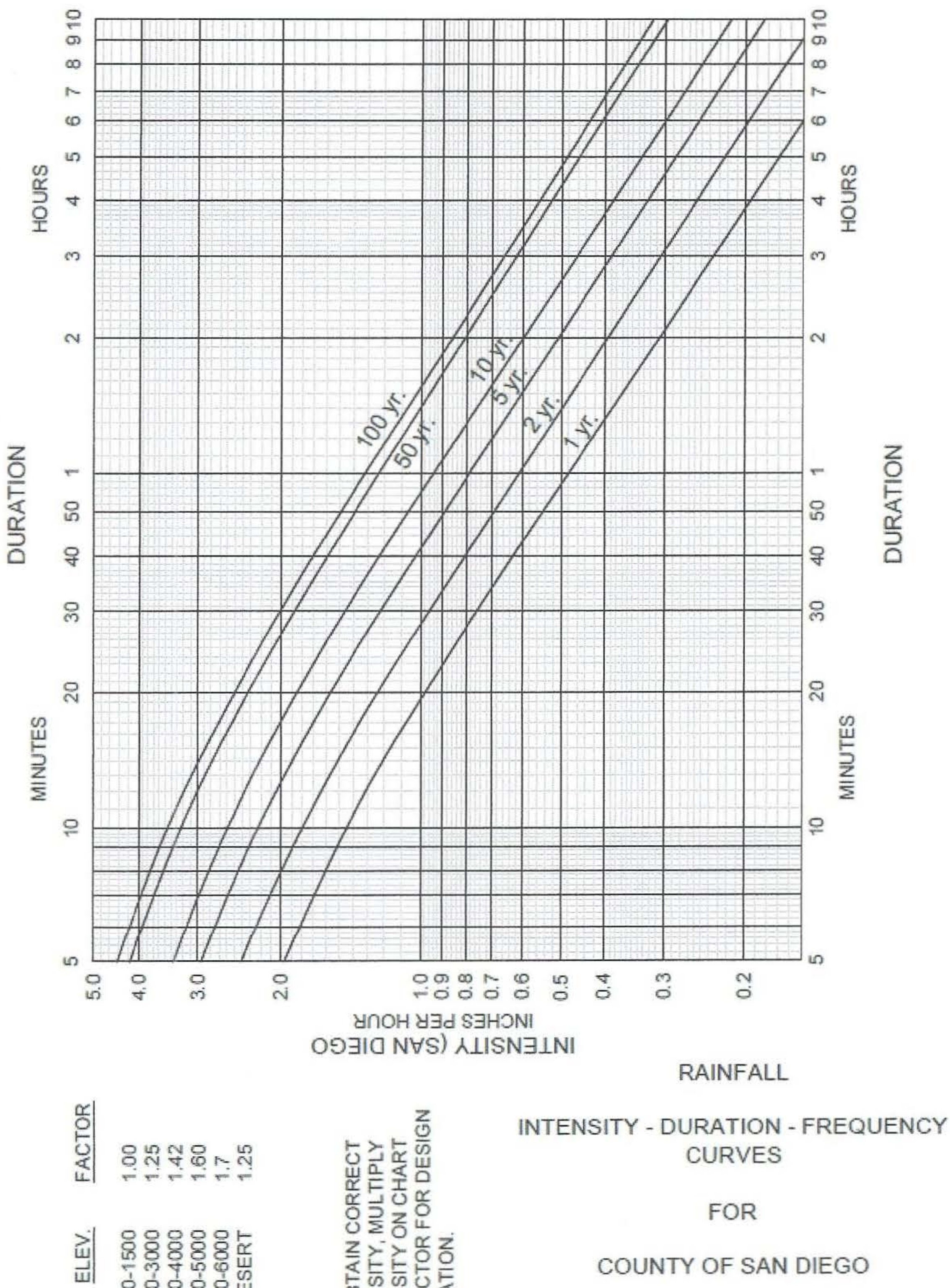
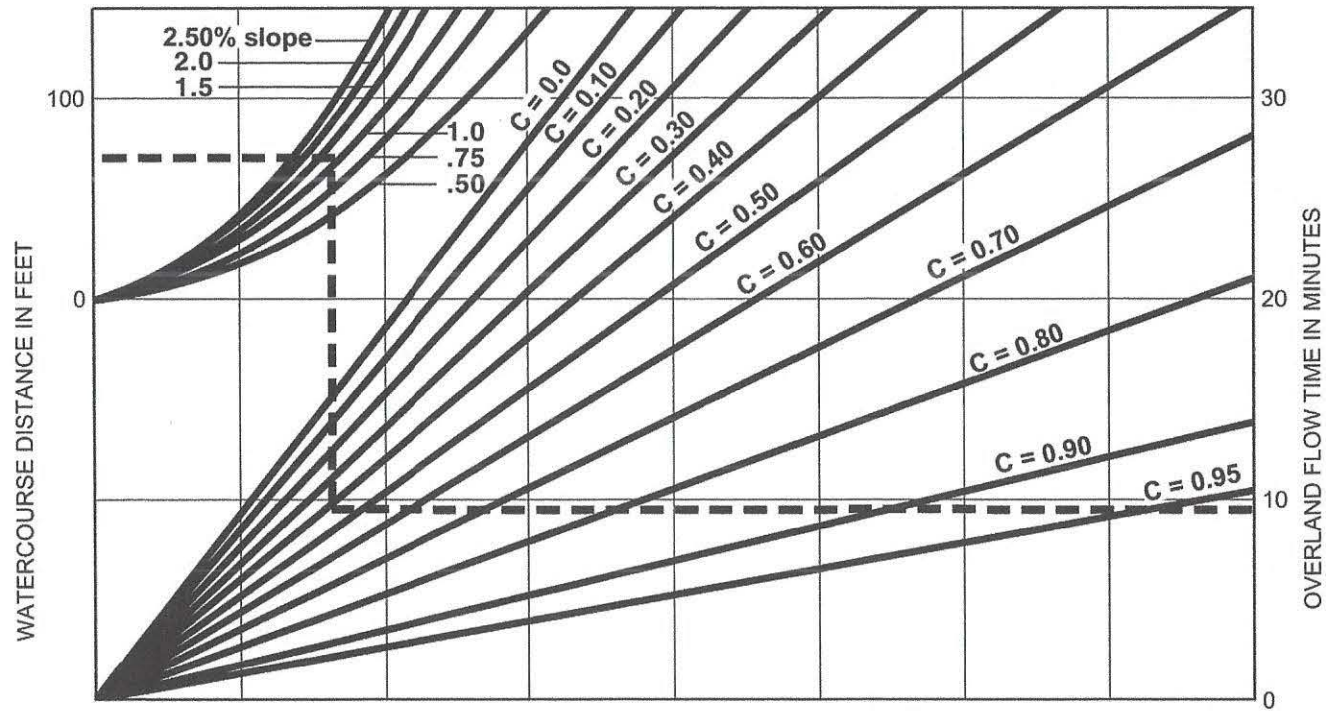


Figure A-1. Intensity-Duration-Frequency Design Chart



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1 - C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

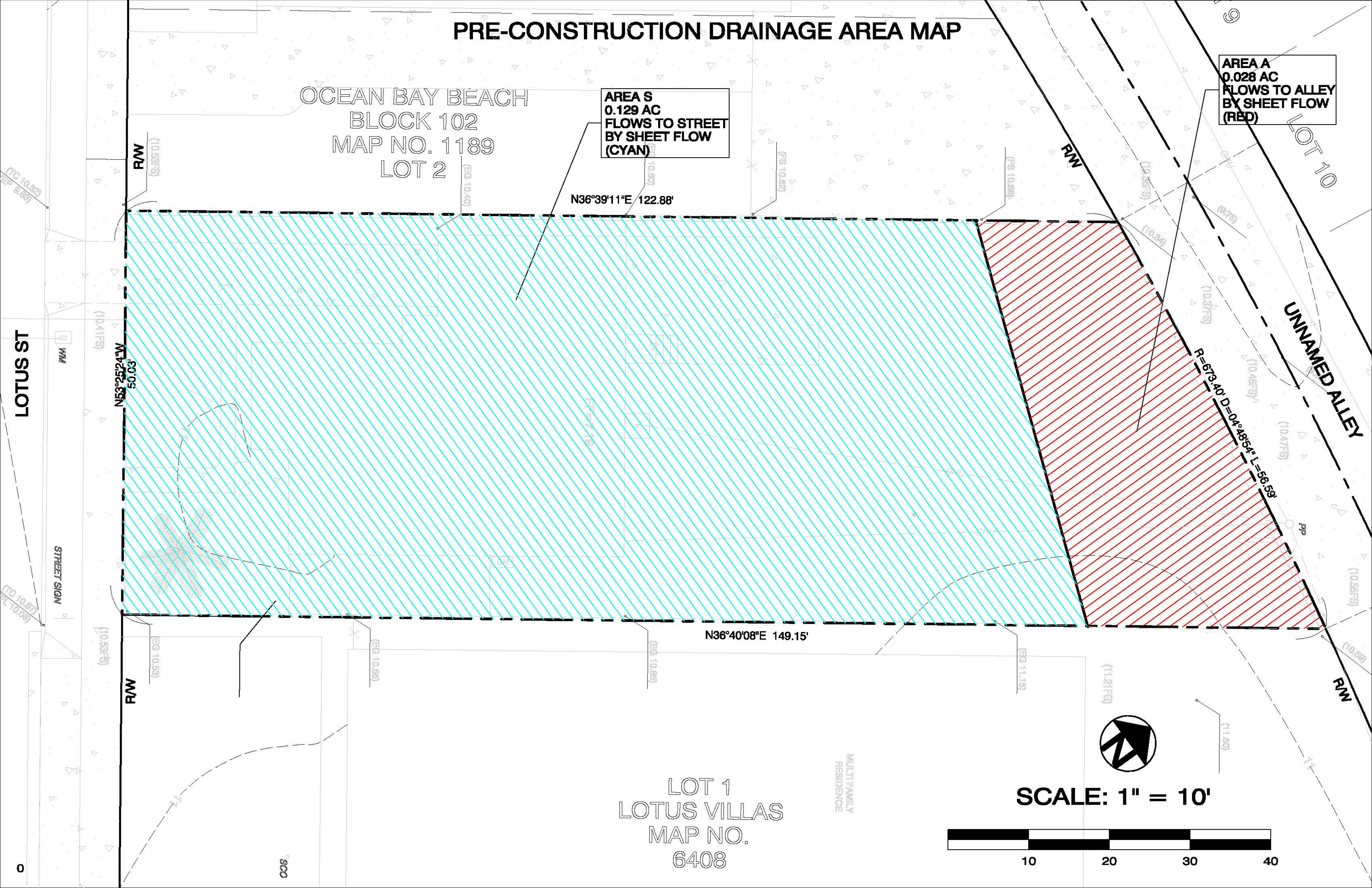
Figure A-4. Rational Formula – Overland Time of Flow Nomograph

<u>Note</u>: Use formula for watercourse distances in excess of 100 feet.

Type of conveyance is a: Sidewalk Underdrain
Diameter of conveyance equals .25 Feet
Slope of conveyance equals 1.5 %
Roughness equals .01
Flow quantity equals 5.001737E-02 CFS
Area equals 2.023433E-02 Square Feet
Velocity equals 2.471048 FPS
Depth of flow equals 9.100001E-02 Feet

DRAINAGE AREA MAPS

PRE-DEVELOPMENT DRAINAGE AREA MAP


PRE-CONSTRUCTION DRAINAGE AREA MAP
OCEAN BAY BEACH
BLOCK 102
MAP NO. 1189
LOT 2
AREA S
0.129 AC
FLOWS TO STREET
BY SHEET FLOW
(CYAN)
AREA A
0.028 AC
FLOWS TO ALLEY
BY SHEET FLOW
(RED)
LOT 10
UNNAMED ALLEY
LOTUS ST
R/W
N36°39'11"E 122.88'
N36°40'08"E 149.15'
N53°25'24"W
50.03'
R=673.40' D=04°48'54" L=56.59'
STREET SIGN
MULTI FAMILY RESIDENCE
LOT 1
LOTUS VILLAS
MAP NO.
6408
SCALE: 1" = 10'
0
10
20
30
40

POST-DEVELOPMENT DRAINAGE AREA MAP

POST-CONSTRUCTION DRAINAGE AREA MAP