WALSH ENGINEERING & SURVEYING, INC.

DRAINAGE STUDY
for
(Vacant) Fuerte Drive
APN 498-151-23
PDS2018-TPM-21261

Prepared for:
Carolyn Marie Lawson, Trustee
Lawson Family Survivor's Trust
1553 E. Chase Avenue
El Cajon, CA 92020
619-339-4024

Prepared by:
Walsh Engineering & Surveying, Inc.
607 Aldwych Road
El Cajon, CA 92020
Phone (619) 588-6747
www.walsh-engineering.com
Job No. 16905

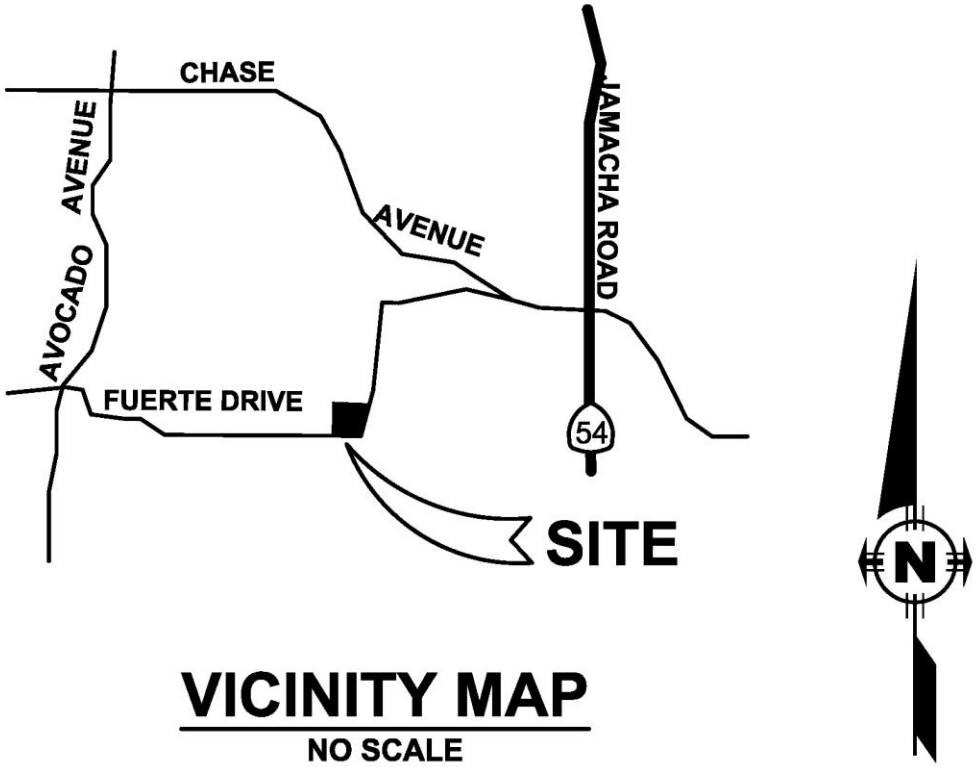
Table of Contents

DECLARATION OF RESPONSIBLE CHARGE

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS DRAINAGE STUDY, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE PREPARATION OF SAID STUDY AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE, AND THAT THE RECOMMENDATIONS ARE CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF THIS DRAINAGE STUDY BY THE COUNTY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES.

Lawrence W. Walsh, RCE 46316 — 9-8-20 Date



VICINITY MAP

NO SCALE

PROJECT DESCRIPTION

The project is located on Fuerte Drive in San Diego County. The project site is an undeveloped parcel totaling in 2.6 acres to be subdivided into 3 parcels. The Assessor Parcel Number is 498-151-23. Access to Parcel 1 will be from the private road to the north. Parcels 2 and 3 will front Fuerte Drive. See attached Preliminary Grading Plan in Section A.

HYDROLOGY DESCRIPTION

The project site is comprised of one drainage basin. The basin is 2.44 acres in size and encompasses the site and the house to the north. The basin elevations range from 615 feet to 594 feet over a span of 560 feet. The average slope of the basin is 3%. Runoff sheet flows to the Point of Comparison (POC) at the southwest corner of the property. To the west of the property, there is an existing drainage channel which will remain unaffected. This existing drainage channel was analyzed to confirm the proposed homes will remain flood free during the 100-year storm event. This analysis can be viewed in Section E. The existing drainage improvements were determined by an onsite field survey by Walsh Engineering & Surveying, Inc. on December 28, 2016.

In the proposed condition, the 3 proposed homes will increase the amount of impervious area on the site and lead to an increase in runoff if left unmitigated. Runoff from the project will be routed around the proposed homes into a proposed earthen drainage channel on the west side of the property and will be directed to a detention basin. A proposed spillway will capture any overflow of runoff and direct it towards the existing culvert on Fuerte Drive to the POC. The infiltration rate near the basin is 2.5 in/hr per testing done in the area which will allow the basin to infiltrate in less than 72 hours. The two drainage channels will not commingle flows and will be separated as shown on the cross sections of the Preliminary Grading Plan. See the attached Drainage Basin Maps in Section G.

HYDROLOGY AND HYDRAULIC ANALYSIS

The proposed drainage condition was analyzed using a computer application based on the County of San Diego Flood Control District's Hydrology Manual (2003). The application is offered by CivilDesign® Corporation. Weighted c-values are automatically calculated by the program based on soil type and density. The flowrates used were obtained from the post-developed analysis. See the summary table on the following page. For the hydraulic analysis, the Q100 was used to ensure the proposed improvements are sized adequately.

DETENTION ANALYSIS

The volume to be detained in order to reduce post-developed flow rates to pre-developed levels is calculated using the "Detention Storage Computation Procedure, Single Hydrograph Form" as outlined in the 2003 County of San Diego Hydrology Manual. It was calculated that 470 cubic feet would need to be detained in the proposed detention basin to match pre-developed levels. This will be the minimum volume of the proposed detention basin. The

TABULATED HYDROLOGIC COMPUTATIONAL RESULTS

Existing Condition*

Nodes	Description	Effective C	Tc (min.)	I (in/hr)	Area (ac) Total	Velocity (fps)	Q_{peak} (cfs) total
1.011 to 1.022	Basin to POC	0.34	18.71	3.037	2.44	2	**2.5**
-	Offsite channel	0.36	15.1	3.5	69	-	87**

* See Section B for calculations
** See Section E for details on how flow rate was determined

Unmitigated Developed Condition*

Nodes	Description	Effective C	Tc (min.)	I (in/hr)	Area (ac) Total	Velocity (fps)	Qpeak (cfs) total
1.011 to 1.023	Basin to POC	0.38	18.87	3.201	2.44	3	**2.8**
-	Offsite channel	0.36	15.1	3.5	69	-	87**

*See Section C for calculations
** See Hydrology Description section for details on how flow rate was determined

Mitigated Developed Condition*

Mitigation required (cfs)	Q_{in} (cfs)	Q_{out} (cfs)	Time to peak (min)	Velocity (fps)	V_d (cf)	Q_{peak} (cfs)
0.3	2.8	2.5	20.89	3	470	**2.5**

*See Section D for calculations

RESULTS AND CONCLUSION

With the increase in impervious surface (building roofs and hardscape) the post-development flow of 2.8 cfs has increased compared to the pre-development flow of 2.5 cfs. This increase will be mitigated with a 470 CF detention basin. The peak flow rate of the drainage basin will be reduced from 2.8 cfs to 2.5 cfs which provides 0.3 cfs of mitigation. The mitigated peak flow rate at the POC will be 2.5 cfs which will result in no net impact on downstream drainage facilities due to an increased peak flow rate. The flow rate for the post-developed condition is equal to that of the pre-developed condition, providing compliance with the CEQA policy.

For CEQA purposes, the following information is provided in this study for project review and approval of the tentative map.

Q: Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?

A: No. The overall existing drainage patterns will be maintained, no alterations to streams or rivers will occur and no increase in off-site erosion or siltation will be caused by this project.

Q: Will the project substantially alter the existing drainage pattern of the site or area including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

A: No. The overall existing drainage patterns will be maintained. No alterations to streams or rivers will occur and the rate or amount of runoff will not increase. Furthermore, a detention basin has been added to the project to provide mitigation.

Q: Will the project create or contribute runoff water which will exceed the capacity of existing or planned storm water drainage systems?

A: No. The project will not create or contribute runoff water which will exceed the capacity of existing or planned storm water drainage systems. The project's rate or amount of runoff will not increase.

Q: Will the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps?

A: No. The project does not propose to place housing within a 100-year flood hazard area as determined by the FEMA floodplain map.

Q: Will the project place within a 100-year flood hazard area structures which would impede or redirect flood flows?

A: No. The project will not place structures within a 100-year flood hazard area or in an area that would impede or redirect flows.

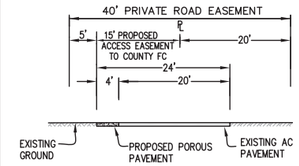
Q: Will the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or off-site?

A: No. The project will not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of failure of Dam(s) or levee(s).

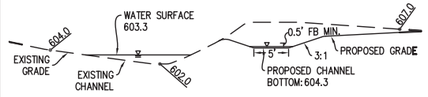
Section A

Preliminary Grading Plan

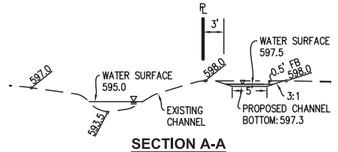
PRELIMINARY GRADING PLAN



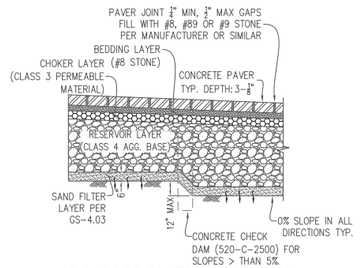
PRIVATE DRIVEWAY
TYPICAL SECTION
NO SCALE
LOOKING WEST



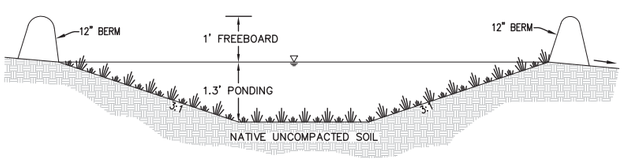
SECTION B-B
H: 1"=10'
V: 1"=10'



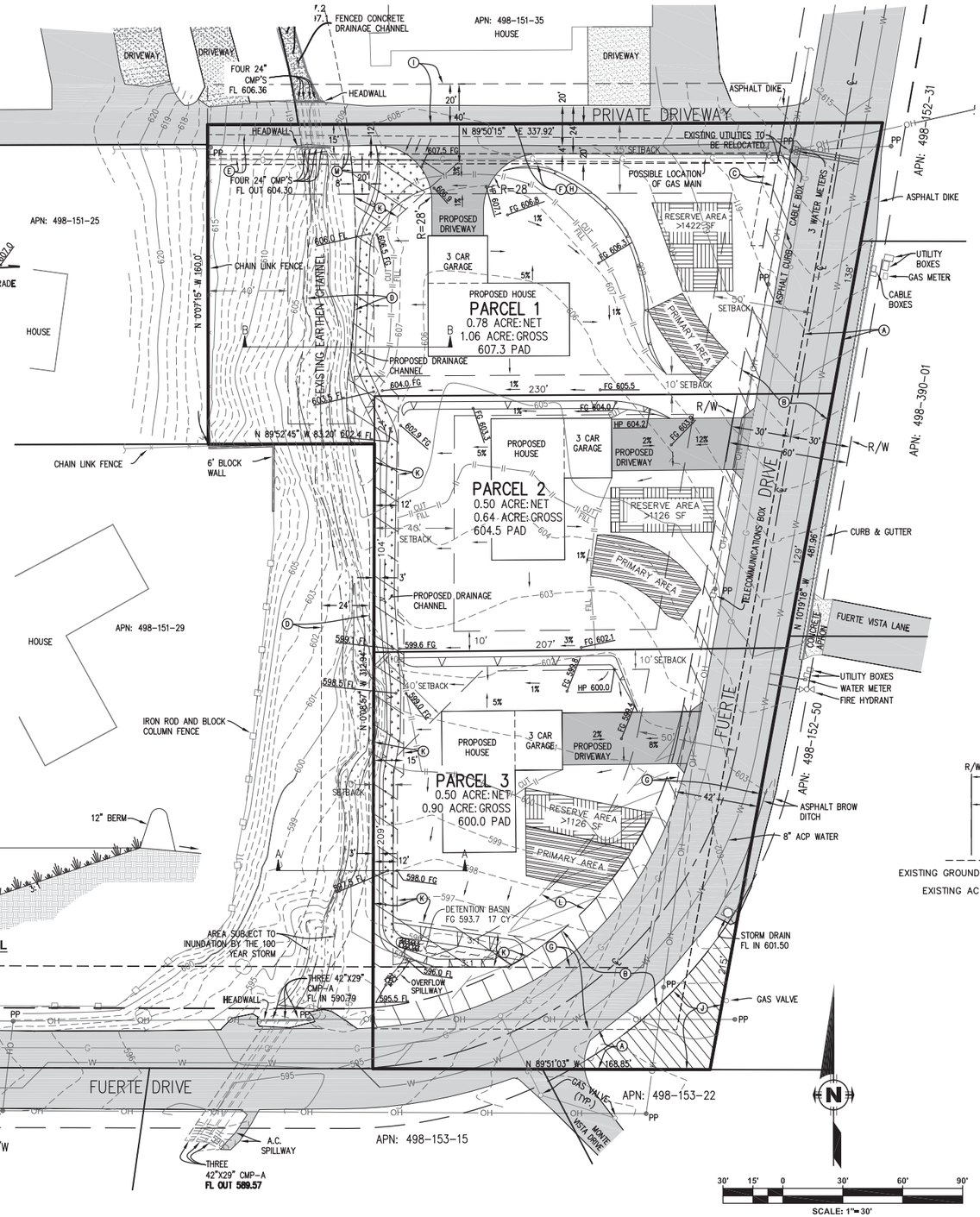
SECTION A-A
H: 1"=10'
V: 1"=10'

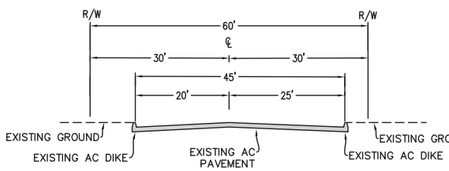


PROPOSED PAVEMENT SECTION
TYPICAL SECTION
NO SCALE
SEE GREEN STREET DESIGN STANDARD GS-4.01

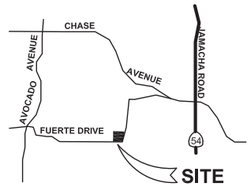


DETENTION BASIN DETAIL
NO SCALE





FUERTE DRIVE
TYPICAL SECTION
NO SCALE
LOOKING NORTH



VICINITY MAP
NO SCALE

OWNER:
CAROLYN MARIE LAWSON, TRUSTEE
LAWSON FAMILY SURVIVOR'S TRUST
1553 E CHASE AVENUE
EL CAJON, CA 92020
(619) 339-4024

SITE ADDRESS:
(VACANT) FUERTE DRIVE, EL CAJON, CA 92020

ASSESSOR PARCEL NUMBER:
498-151-23

LEGAL DESCRIPTION:
PARCEL 2 OF PARCEL MAP NO. 4558

BENCHMARK:
DESCRIPTION: STANDARD BRASS DISC STAMPED "S.D. COUNTY SURVEYOR MONUMENT EC 187"

LOCATION: SOUTHWEST CURB RETURN AT THE INTERSECTION OF FUERTE DRIVE AND SHADOW GLEN ROAD.

ELEVATION: 666.885 (NGVD29)

SOURCE: COUNTY OF SAN DIEGO VERTICAL CONTROL BENCHBOOK.

TOPOGRAPHY:
FIELD SURVEY PERFORMED BY WALSH ENGINEERING & SURVEYING, INC. ON 12/28/2016.

NOTE:
THIS PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DISCRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN VALID GRADING PERMISSIONS BEFORE COMMENCING SUCH ACTIVITY.

GRADING:

CUT=	600 C.Y.
FILL=	600 C.Y.
IMPORT=	0 C.Y.
EXPORT=	0 C.Y.

REFERENCE DRAWING:
L7518*
*ONSITE DRAINAGE IMPROVEMENTS PER ONSITE FIELD SURVEY

LEGEND:
- 655 — EXISTING CONTOUR
- PROPOSED LOT LINE
- PROPERTY LINE
- W — EXISTING WATER MAIN
- OH — EXISTING OVERHEAD LINE
- G — EXISTING GAS MAIN
- DAYLIGHT LINE
- 1.5:1 CUT SLOPE
- PROPOSED PERVIOUS PAVEMENT
- EXISTING ASPHALT PAVEMENT
- EXISTING CONCRETE
- PROPOSED SEPTIC AREA
- PROPOSED SEPTIC AREA
- RELINQUISHMENT OF ACCESS RIGHTS
- PROPOSED RIP RAP
- DRAINAGE PATH
- EXISTING TREE
- EXISTING POWER POLE = PP

EASEMENT NOTES:
EASEMENTS PLOTTED PER PRELIMINARY REPORT PREPARED BY STEWART TITLE AS ORDER NO. 01180-201048 DATED 11/29/2017

(A) EASEMENT FOR PUBLIC ROAD PURPOSES PER DOC. RECORDED 6/5/1897 IN BOOK 257, PAGE 281 OF DEEDS. 20' WIDE

(B) HIGHWAY EASEMENT PER DOC. RECORDED 2/17/1949 IN BOOK 3114, PAGE 276 OF OFFICIAL RECORDS. 60' WIDE

(C) EASEMENT FOR WATER PIPELINE PURPOSES PER DOC. RECORDED 5/11/1954 IN BOOK 5234, PAGE 9 OF OFFICIAL RECORDS. 6' WIDE

(D) EASEMENT FOR FLOOD DRAINAGE PURPOSES PER DOC. NO. 1976-063220, RECORDED 3/3/1976 OF OFFICIAL RECORDS. 24' WIDE

(E) SDGE EASEMENT AND RIGHT OF WAY FOR POWER POLES PER DOC. 1976-143187, RECORDED 5/12/1976, OF OFFICIAL RECORDS. 12' WIDE

(F) EASEMENT FOR ROAD AND PUBLIC UTILITIES PER DOC. NO. 1976-153711, RECORDED 5/21/1976, OF OFFICIAL RECORDS. 20' WIDE

(G) IRREVOCABLE OFFER TO DEDICATE REAL PROPERTY FOR ROADWAY PURPOSES GRANTED TO THE COUNTY OF SAN DIEGO PER DOC. NO. 75-035079, RECORDED 2/14/1975, OF OFFICIAL RECORDS. 42' WIDE

(H) SDGE EASEMENT FOR UTILITY PURPOSES PER DOC. NO. 1983-218209, RECORDED 6/28/1983, OF OFFICIAL RECORDS. 20' WIDE

(I) PRIVATE ROAD AND UTILITY EASEMENT PER DOC#2014-0261689. 20' WIDE

(J) PROPOSED LANDSCAPE EASEMENT

(K) PROPOSED 10'-15' PRIVATE DRAINAGE EASEMENT

(L) PROPOSED CLEAR SPACE EASEMENT

(M) PROPOSED ACCESS EASEMENT FOR INGRESS/EGGRESS TO THE SAN DIEGO COUNTY FLOOD CONTROL DISTRICT. 15' WIDE

EASEMENT FOR WATERWAY RIGHTS PER DOC. RECORDED 4/25/1893 IN BOOK 212, PAGE 401 OF DEEDS. EXTENTS OF EASEMENT NOT PLOTTABLE.

EASEMENT FOR ROAD AND PUBLIC UTILITY PURPOSES PER DOC. RECORDED 2/6/1953 IN BOOK 4740, PAGE 59 OF OFFICIAL RECORDS. OFFSITE, NOT PLOTTED.

REGISTERED PROFESSIONAL ENGINEER
LAWRENCE W. WALSH
46316
CIVIL
STATE OF CALIFORNIA

PREPARED BY:

LAWRENCE W. WALSH RCE 46316 DATE

Walsh Engineering & Surveying, Inc.
607 Aldwych Road, El Cajon, CA 92020
(619) 588-6747 (619) 792-1232 Fax

PRELIMINARY GRADING PLAN - FUERTE

C:\USERS\MIGUEL.WALSHENGINEERIN\DESKTOP\PROJECTS 3D\FUERTE 3D\DELIVERABLES\PGP.DWG April 02, 2020 - 4:31pm

Section B

Pre-Developed Condition

16905FuertePre

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2012 Version 7.9

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 01/31/20

Drainage Study
Pre-Developed
Fuerte Drive

********* Hydrology Study Control Information **********

Program License Serial Number 6326

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.700
24 hour precipitation(inches) = 5.600
P6/P24 = 48.2%
San Diego hydrology manual 'C' values used

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Process from Point/Station 1.011 to Point/Station 1.021
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance = 70.000(Ft.)
Highest elevation = 615.000(Ft.)
Lowest elevation = 614.000(Ft.)
Elevation difference = 1.000(Ft.) Slope = 1.429 %
Top of Initial Area Slope adjusted by User to 1.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 70.00 (Ft)
for the top area slope value of 1.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 11.50 minutes
(for slope value of 1.00 %)
Rainfall intensity (I) = 4.157(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff = 0.022(CFS)
Total initial stream area = 0.020(Ac.)

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Process from Point/Station        1.021 to Point/Station        1.022
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      1.299(CFS)
Depth of flow =   0.120(Ft.), Average velocity =   1.814(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              1.00
       2             50.00              0.00
       3            100.00              1.00
Manning's 'N' friction factor =   0.020
------------------------------------------------------------------------
Sub-Channel flow  =      1.299(CFS)
  '     '        flow top width =     11.966(Ft.)
  '     '    velocity=    1.814(Ft/s)
  '     '        area =      0.716(Sq.Ft)
  '     '        Froude number =     1.307

Upstream point elevation =   614.000(Ft.)
Downstream point elevation =   594.000(Ft.)
Flow length =   785.000(Ft.)
Travel time  =    7.21 min.
Time of concentration =   18.71 min.
Depth of flow =   0.120(Ft.)
Average velocity =   1.814(Ft/s)
Total irregular channel flow =     1.299(CFS)
Irregular channel normal depth above invert elev. =   0.120(Ft.)
Average velocity of channel(s) =   1.814(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.037(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
[LOW DENSITY RESIDENTIAL                      ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.340
Rainfall intensity =      3.037(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.339  CA =      0.828
Subarea runoff =      2.493(CFS) for      2.420(Ac.)
Total runoff =      2.515(CFS)  Total area =       2.440(Ac.)
Depth of flow =   0.153(Ft.), Average velocity =   2.140(Ft/s)
End of computations, total study area =          2.440 (Ac.)
```

Section C

Developed Condition

16905fuertepost

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2012 Version 7.9

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 01/31/20

Drainage Study
Post-Developed
Fuerte Drive

********* Hydrology Study Control Information **********

Program License Serial Number 6326

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.700
24 hour precipitation(inches) = 5.600
P6/P24 = 48.2%
San Diego hydrology manual 'C' values used

++

Process from Point/Station 1.011 to Point/Station 1.021
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance = 70.000(Ft.)
Highest elevation = 615.000(Ft.)
Lowest elevation = 614.000(Ft.)
Elevation difference = 1.000(Ft.) Slope = 1.429 %
Top of Initial Area Slope adjusted by User to 1.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 70.00 (Ft)
for the top area slope value of 1.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 11.50 minutes
(for slope value of 1.00 %)
Rainfall intensity (I) = 4.157(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff = 0.022(CFS)
Total initial stream area = 0.020(Ac.)

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.021 to Point/Station        1.022
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.455(CFS)
Depth of flow =   0.084(Ft.), Average velocity =   1.274(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              1.00
       2             50.00              0.00
       3            100.00              1.00
Manning's 'N' friction factor =   0.020
------------------------------------------------------------------
Sub-Channel flow  =      0.455(CFS)
  '     '        flow top width =      8.447(Ft.)
  '     '    velocity=    1.274(Ft/s)
  '     '        area =      0.357(Sq.Ft)
  '     '        Froude number =     1.093

Upstream point elevation =   614.000(Ft.)
Downstream point elevation =   607.000(Ft.)
Flow length =   350.000(Ft.)
Travel time  =    4.58 min.
Time of concentration =   16.08 min.
Depth of flow =   0.084(Ft.)
Average velocity =   1.274(Ft/s)
Total irregular channel flow =     0.455(CFS)
Irregular channel normal depth above invert elev. =   0.084(Ft.)
Average velocity of channel(s) =   1.274(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.349(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
[LOW DENSITY RESIDENTIAL                      ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.340
Rainfall intensity =      3.349(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.338  CA =      0.267
Subarea runoff =      0.872(CFS) for      0.770(Ac.)
Total runoff =      0.895(CFS)  Total area =       0.790(Ac.)
Depth of flow =   0.109(Ft.), Average velocity =   1.509(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.022 to Point/Station        1.023
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   607.000(Ft.)
Downstream point elevation =   595.000(Ft.)
Channel length thru subarea  =   445.000(Ft.)
Channel base width      =    5.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =      1.829(CFS)
Manning's 'N'    = 0.023
Maximum depth of channel  =    0.250(Ft.)
Flow(q) thru subarea =      1.829(CFS)
```

Depth of flow = 0.132(Ft.), Average velocity = 2.660(Ft/s)
Channel flow top width = 5.397(Ft.)
Flow Velocity = 2.66(Ft/s)
Travel time = 2.79 min.
Time of concentration = 18.87 min.
Critical depth = 0.158(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 3.021(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
[LOW DENSITY RESIDENTIAL]
(2.0 DU/A or Less)
Impervious value, Ai = 0.200
Sub-Area C Value = 0.400
Rainfall intensity = 3.021(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.380 CA = 0.927
Subarea runoff = 1.906(CFS) for 1.650(Ac.)
Total runoff = 2.801(CFS) Total area = 2.440(Ac.)
Depth of flow = 0.171(Ft.), Average velocity = 3.123(Ft/s)
Critical depth = 0.209(Ft.)
End of computations, total study area = 2.440 (Ac.)

Section D

Detention Calculations

HYDRAULIC CALCULATIONS

100-year storm

Basin (Proposed Condition)

METHODOLOGY: The volume to be detained is calculated using the "Detention Storage Computation Procedure, Single Hydrograph Form" as outlined in the 2003 County of San Diego Hydrology Manual. Since we have a target flowrate (Q_O=2.5 cfs), a Detention Volume (V_D) is calculated herein.

GIVEN:
P_6 = 2.7 IN
T_C = 18.87 MIN
C = 0.38
A = 2.44 AC
Q_P = 2.8 CFS
Q_O = 2.5 CFS

Time to Peak:
$T_P = 1.1072 * T_C$
$= 1.1072 * 18.87$ MIN
$= 20.89$ MIN

Depth of Precipitation (2 HRS):
$D_{120} = 0.6785(P_6)$
$= 0.6785(2.7)$
$= 1.8$ IN

Depth of Precipitation for Hydrograph:
$D_H = (P_6 * TC^{0.355}) / 5.83$
$= (2.7 * 20.89^{.355}) / 5.83$
$= 1.36$

Surrounding Intensity:
$I_S = [60 (D_{120} – D_H) / (120 - 2.5 * T_C)]$
$= [60 (1.8 – 1.36) / (120 - 2.5 * 20.89)]$
$= 0.39$ $^{IN}/_{HR}$

Surrounding Flowrate:
$Q_S = C * I_S * A$
$= 0.38 * 0.39 * 2.44$
$= 0.36$ CFS

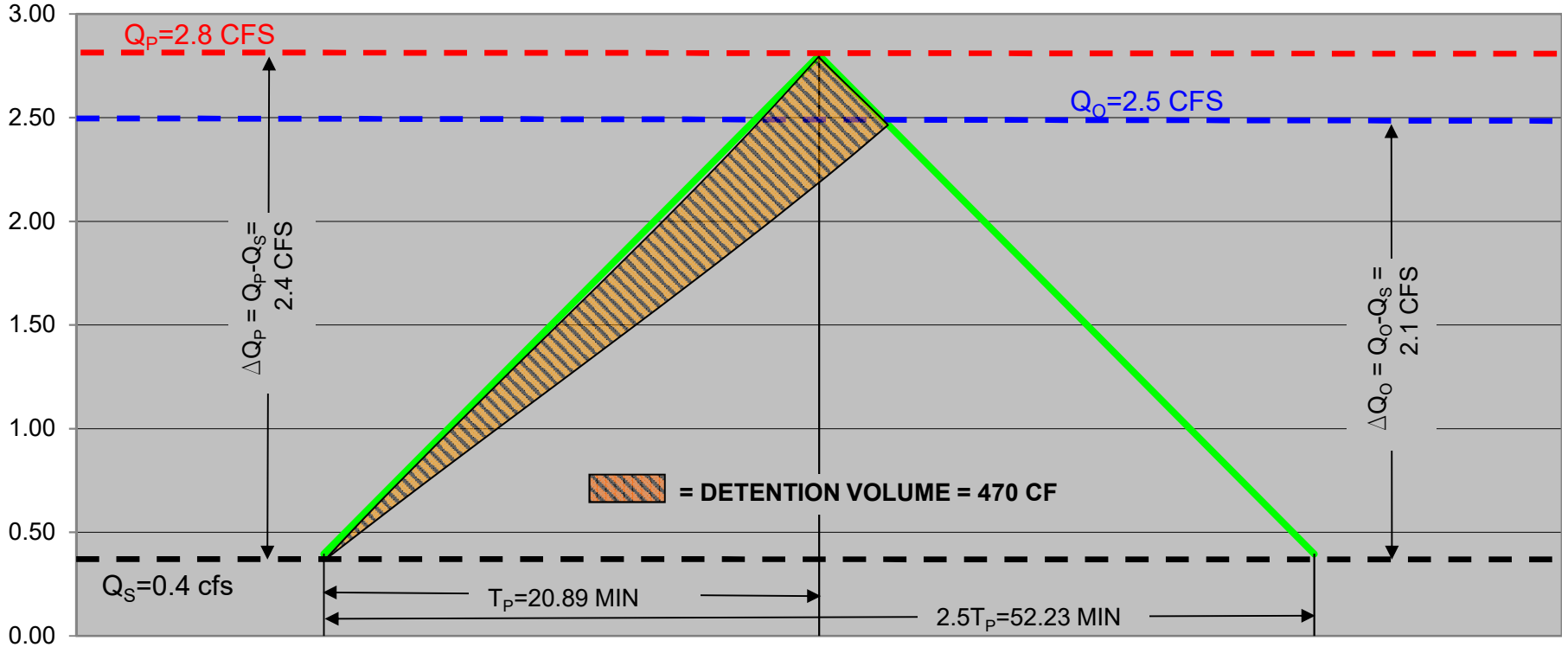
Flowrate Out:

(See hydrograph for all values)

$V_D = 1.25 T_P (Q_P – Q_O)$ x 60 sec/min

$V_D = 1.25$ x 20.89 (2.8 – 2.5) x 60 sec/min = 470 CF

Hydrograph Basin



Section E

Offsite Drainage Channel Analysis

HYDROLOGY CALCULATIONS:

Rational Method ($Q_{100\text{-year}}$)

BASIN

BASIN AREA:

A_{Total} = 69.0 acres — per Pre-Dev Drainage Map

RUNOFF COEFFICIENT:

Soil Type = A, B, C & D
Land Use = LDR weighted C = 0.36 per Table 3-1

C = 0.36

TIME OF CONCENTRATION:

Tc = Ti + Tt

Initial Time, T_i

Land Use = Natural
Slope = 1 % per Drainage Map

Ti = 12.5 min per Table 3-2

Travel Time, T_1

Elevation Difference = 226 feet
Length = 3,060 feet per Drainage Map
T_1 = 2.6 min assumed (3,060 feet at 12 fps)

Tc = 15.1 min

INTENSITY: $I = 7.44\ (P6)\ (Tc)^{-0.645}$ in/hr per Figure 3-1

,where P6 = 2.7 in per Isopluvial Map

I = 3.5 in/hr per Equation

FLOW RATE: Q = C I A where,

C = 0.36
I = 3.5 in/hr
A = 69.0 acres

Q_{100} = 86.8 cfs

DRAINAGE BASIN MAP:

POST-DEVELOPED
FUERTE DRIVE

FUERTE DRIVE

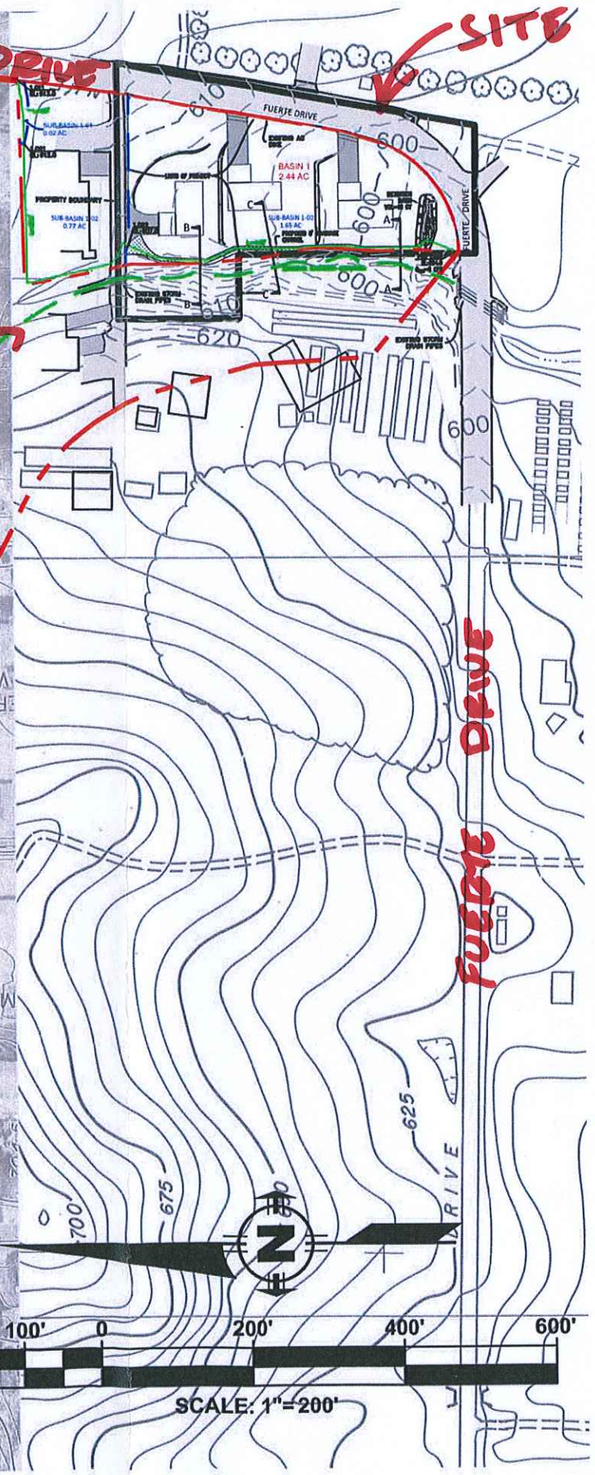
SITE

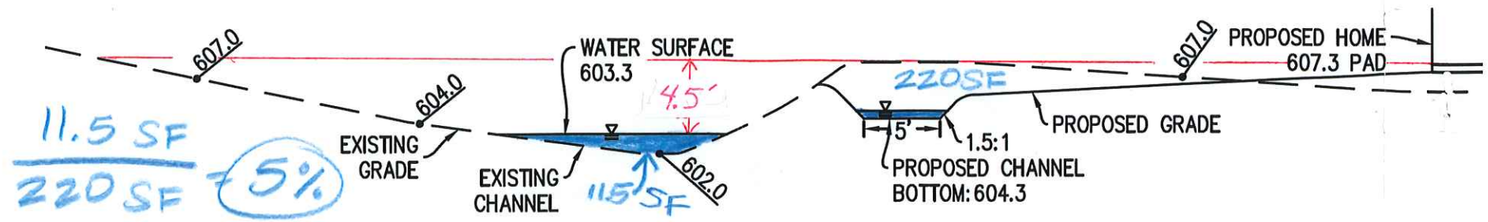
DRAINAGE BASIN BOUNDARY

3,060'

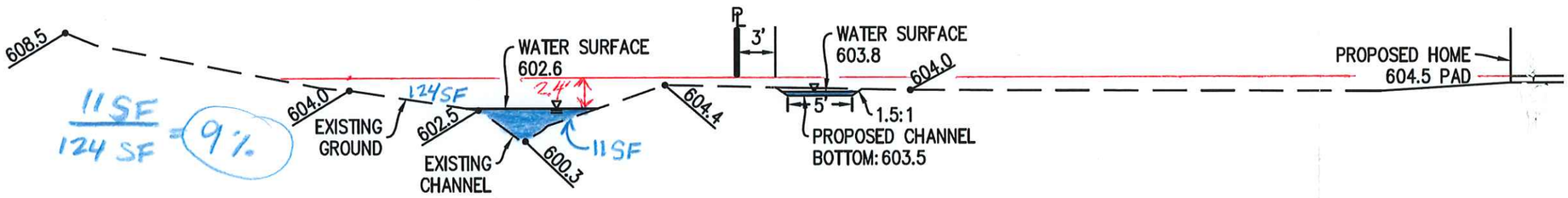
TRAVEL PATH

Q = CIA
C = 0.36
I = 3.5 in/hr
A = 69 AC
Q = 87 CFS

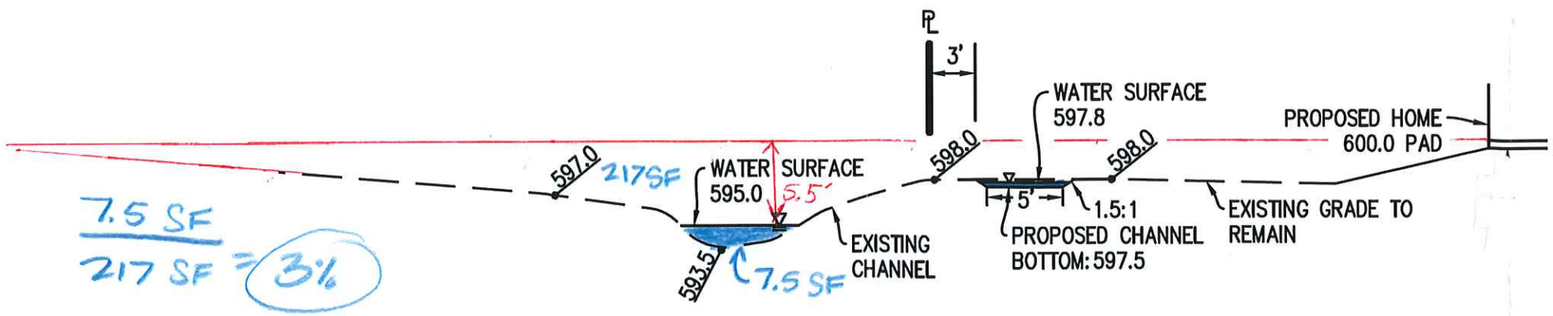




SECTION B-B
H: 1"=10'
V: 1"=10'



SECTION C-C
H: 1"=10'
V: 1"=10'



SECTION A-A
H: 1"=10'
V: 1"=10'

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Dec 17 2019

Section A-A

User-defined

Invert Elev (ft)	= 593.50
Slope (%)	= 3.20
N-Value	= 0.020

Calculations

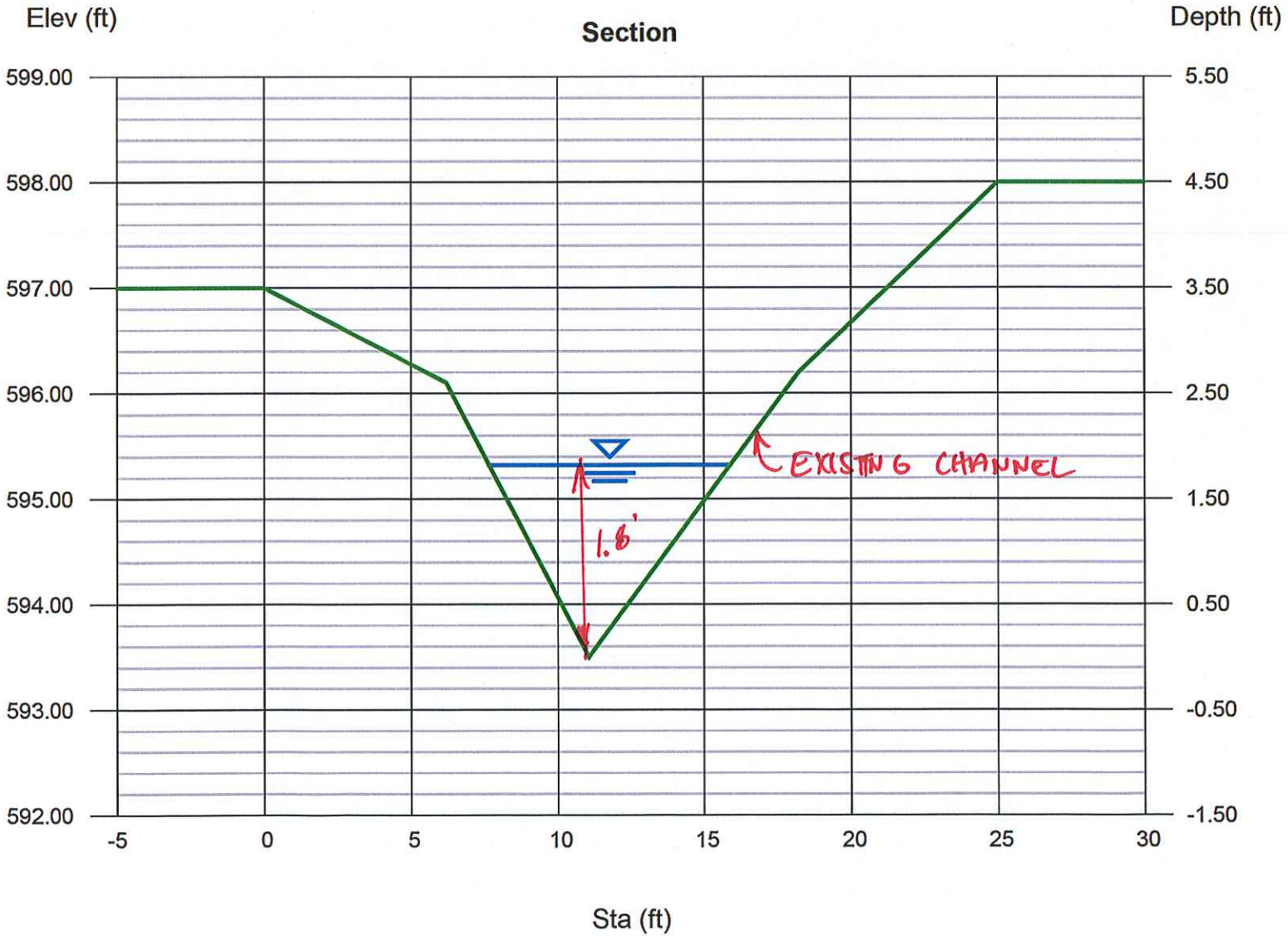
Compute by:	Known Q
Known Q (cfs)	= 87.00

Highlighted

Depth (ft)	= 1.82
Q (cfs)	= 87.00
Area (sqft)	= 7.49
Velocity (ft/s)	= 11.61
Wetted Perim (ft)	= 9.02
Crit Depth, Yc (ft)	= 2.48
Top Width (ft)	= 8.23
EGL (ft)	= 3.92

(Sta, El, n)-(Sta, El, n)...

(0.00, 597.00)-(6.21, 596.10, 0.020)-(11.06, 593.50, 0.020)-(18.24, 596.20, 0.020)-(25.00, 598.00, 0.020)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Dec 18 2019

Section B-B

User-defined

Invert Elev (ft)	= 602.00
Slope (%)	= 2.10
N-Value	= 0.020

Calculations

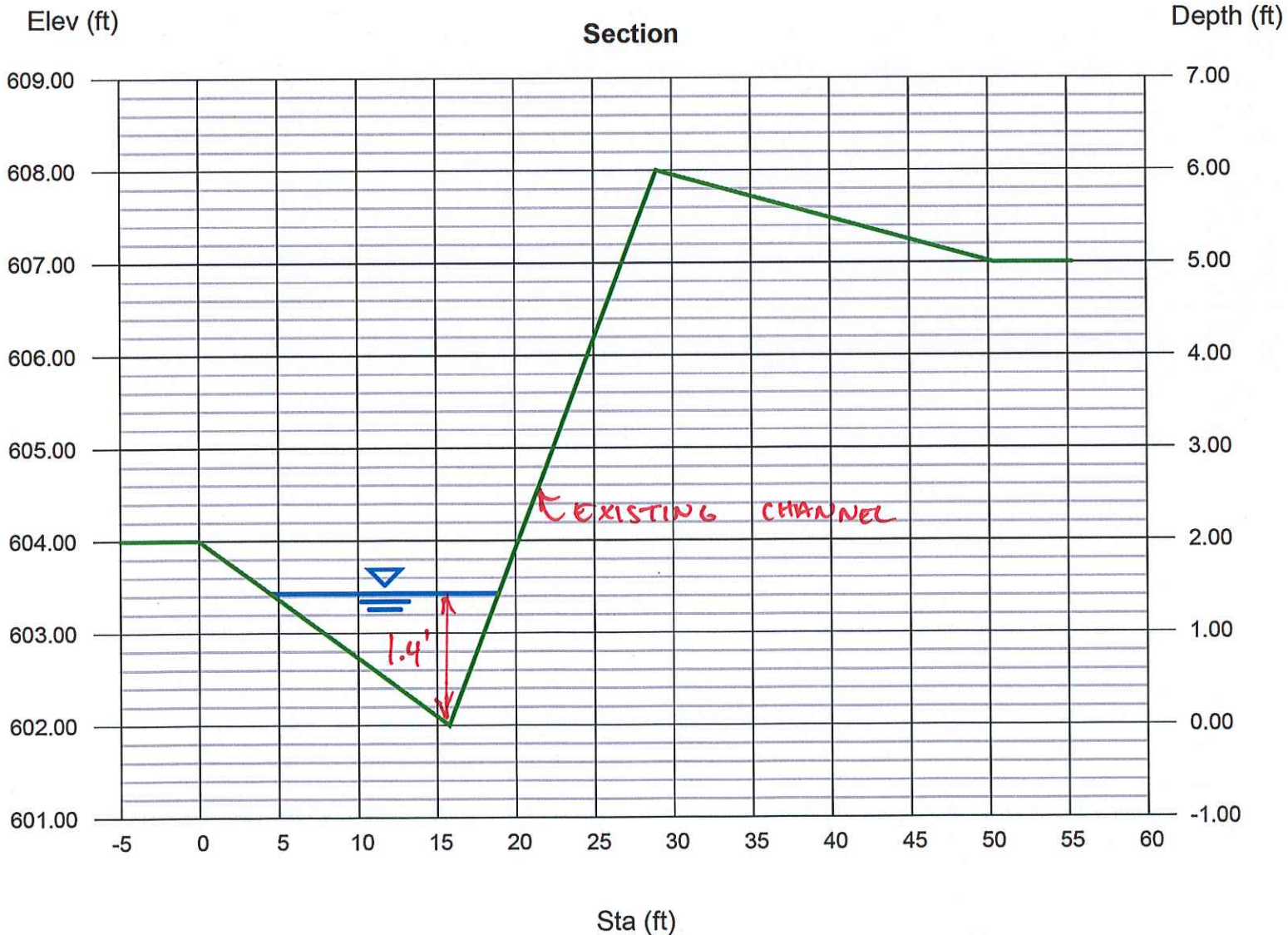
Compute by:	Known Q
Known Q (cfs)	= 87.00

Highlighted

Depth (ft)	= 1.43
Q (cfs)	= 87.00
Area (sqft)	= 10.32
Velocity (ft/s)	= 8.43
Wetted Perim (ft)	= 14.83
Crit Depth, Yc (ft)	= 1.80
Top Width (ft)	= 14.43
EGL (ft)	= 2.54

(Sta, El, n)-(Sta, El, n)...

(0.00, 604.00)-(15.77, 602.00, 0.020)-(29.00, 608.00, 0.020)-(50.30, 607.00, 0.020)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Dec 18 2019

Section C-C

User-defined

Invert Elev (ft)	= 600.30
Slope (%)	= 1.30
N-Value	= 0.020

Calculations

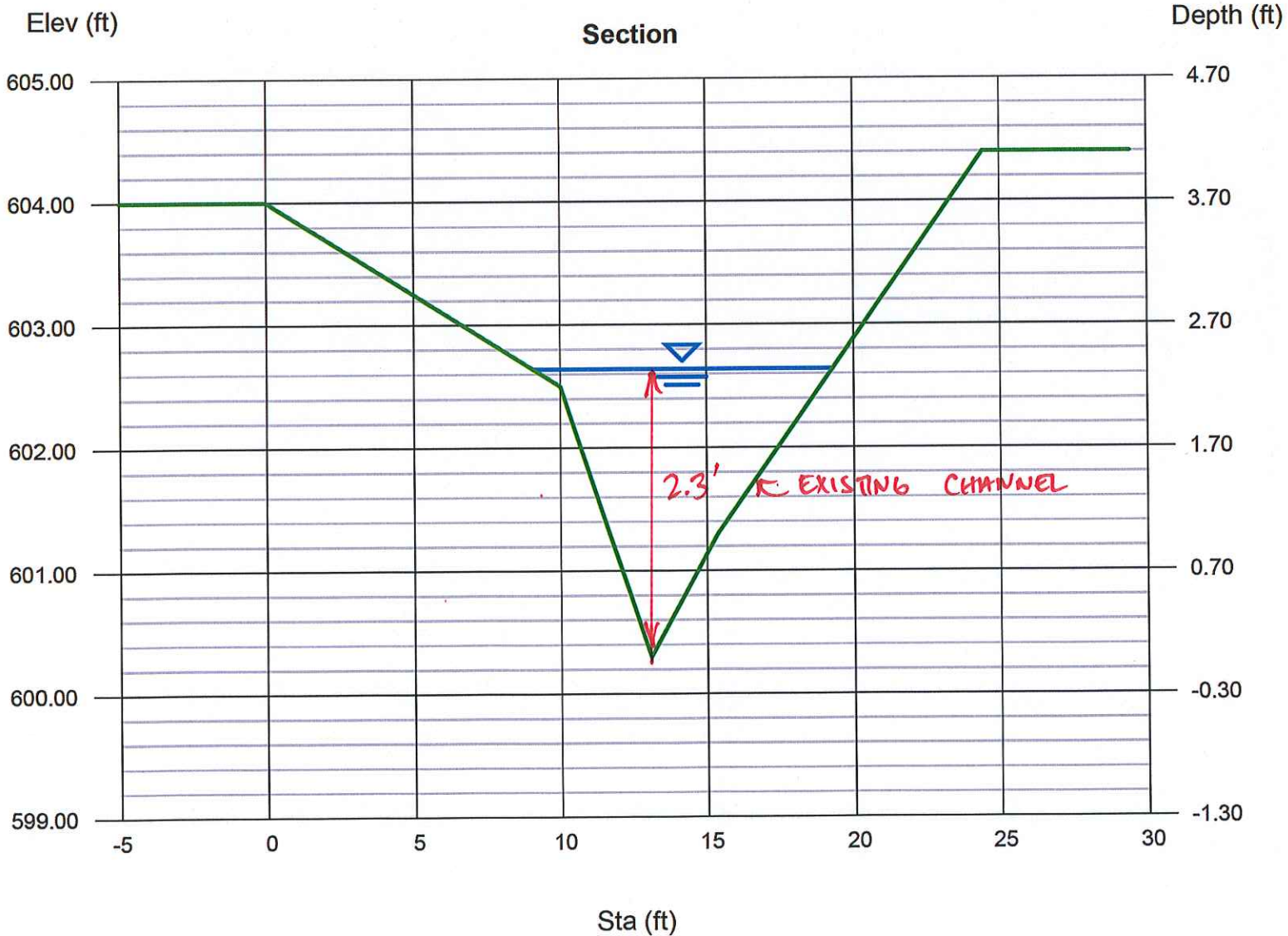
Compute by:	Known Q
Known Q (cfs)	= 87.00

Highlighted

Depth (ft)	= 2.34
Q (cfs)	= 87.00
Area (sqft)	= 10.71
Velocity (ft/s)	= 8.13
Wetted Perim (ft)	= 11.36
Crit Depth, Yc (ft)	= 2.68
Top Width (ft)	= 10.21
EGL (ft)	= 3.37

(Sta, El, n)-(Sta, El, n)...

(0.00, 604.00)-(10.01, 602.50, 0.020)-(13.09, 600.30, 0.020)-(15.37, 601.30, 0.020)-(24.44, 604.40, 0.020)



Section F

Rainfall Isopluvials: 100 Year 6 Hour and 24 Hour.

Hydrologic Soil Map

Runoff Coefficients for Urban Areas

Maximum Overland Flow Length & Initial Time of Concentration

Intensity-Duration Design Chart

County of San Diego Hydrology Manual

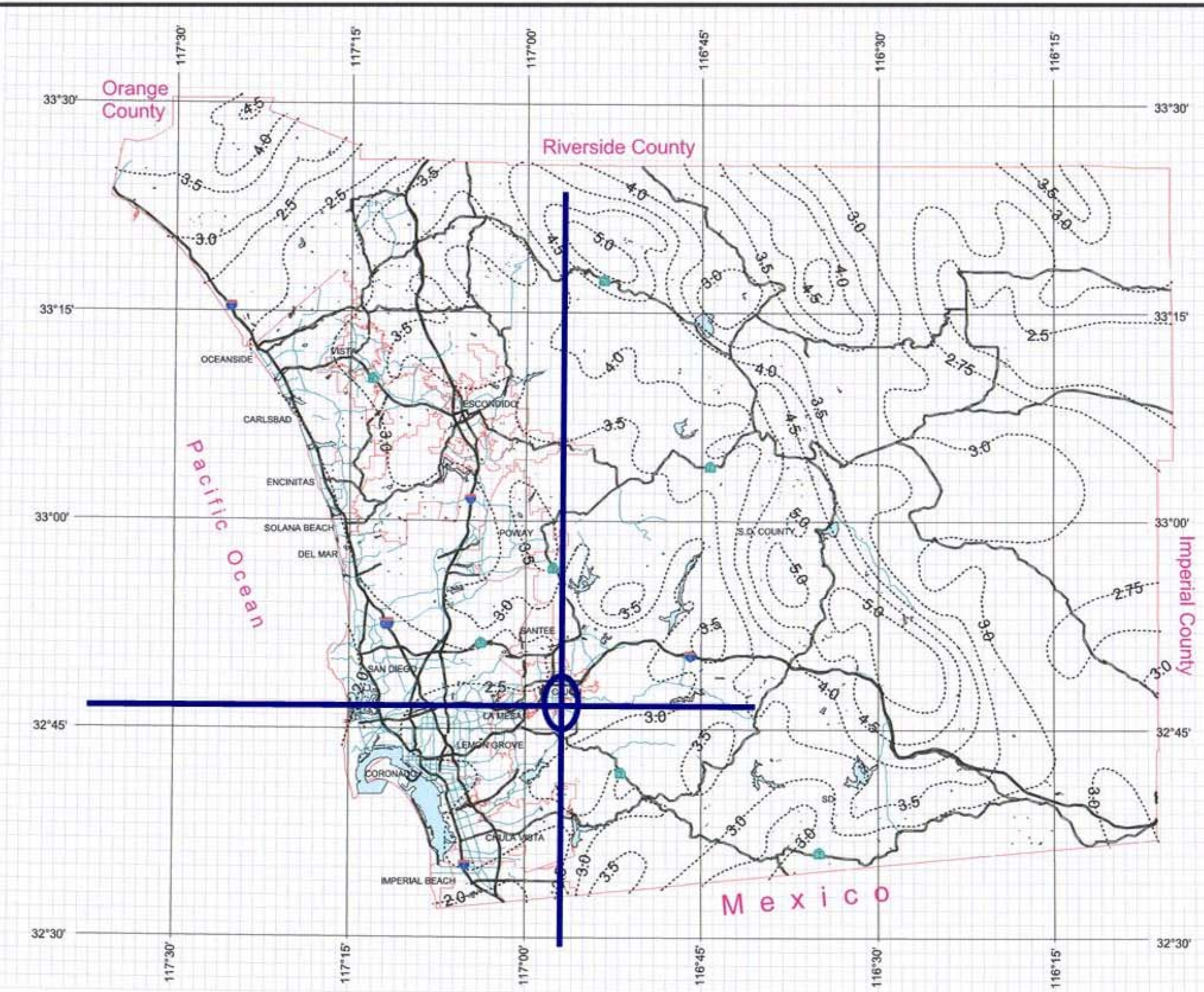
Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Lat: 32°45'47"
Long: 116°56'32"

P6 = 2.7 in



DPW GIS — Department of Public Works Geographic Information Services

SanGIS — We Have San Diego Covered!

N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

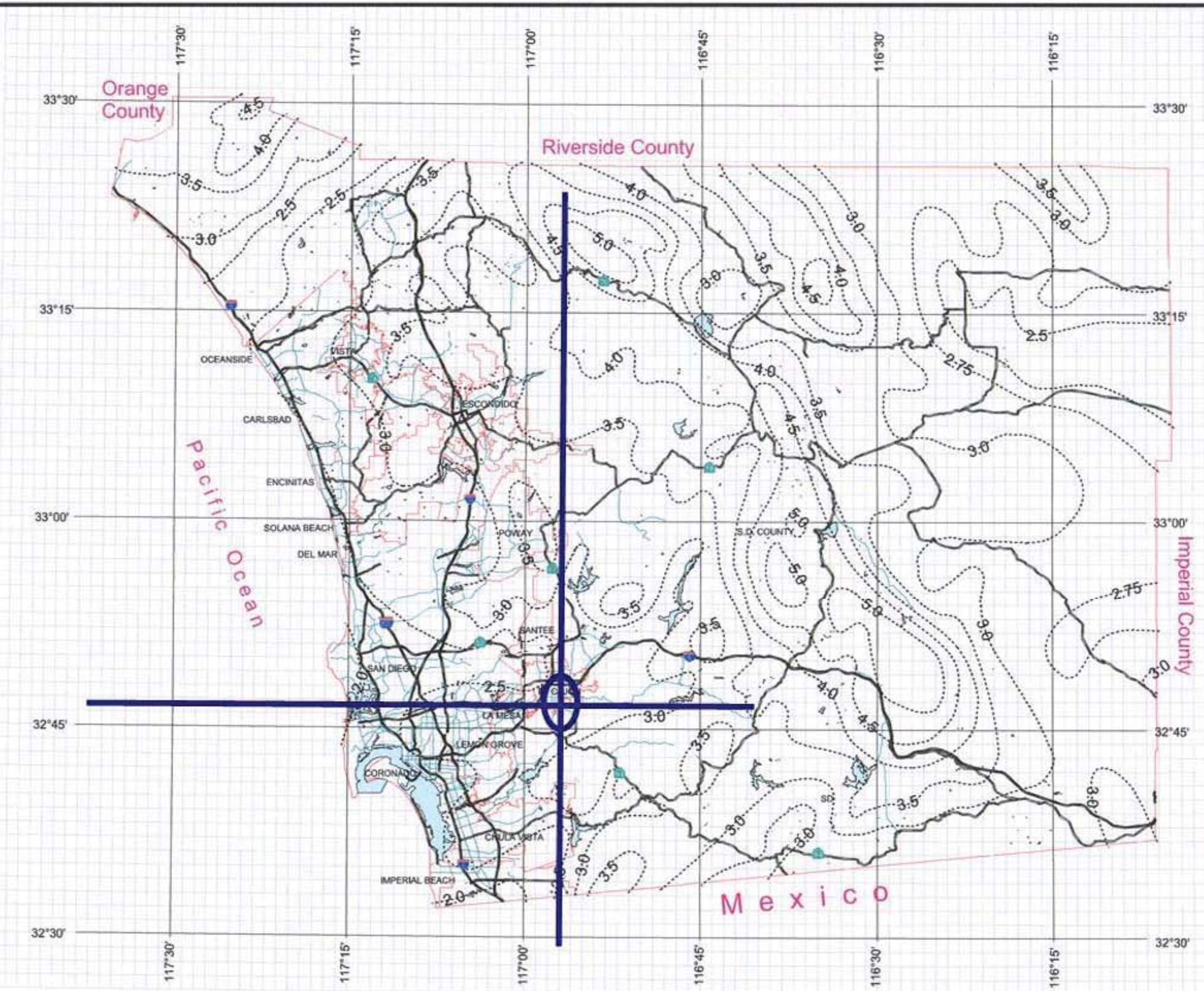
Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Lat: 32°45'47"
Long: 116°56'32"

P6 = 2.7 in



DPW GIS — Department of Public Works Geographic Information Services

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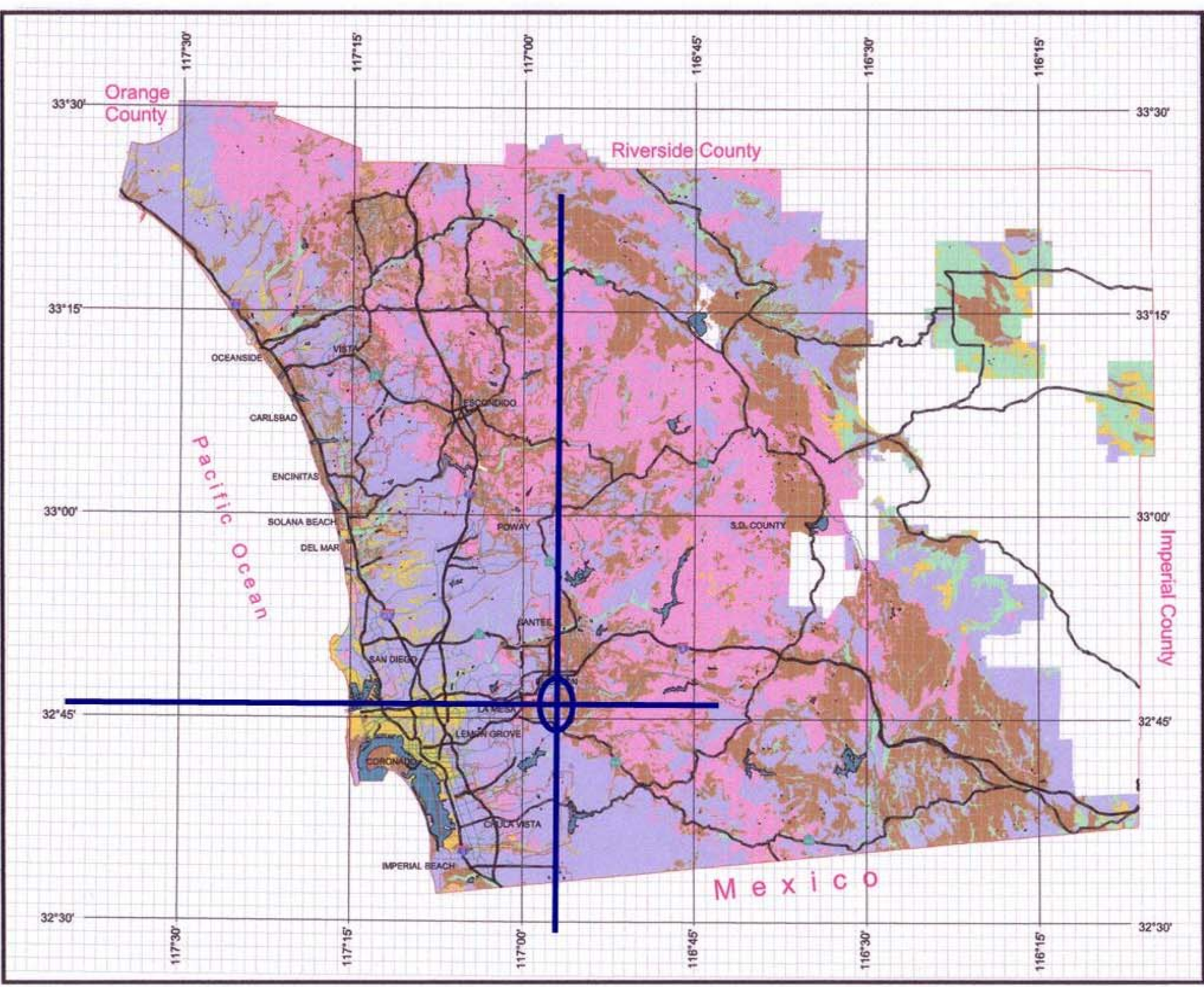
N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

Soil Type = A, B, C & D

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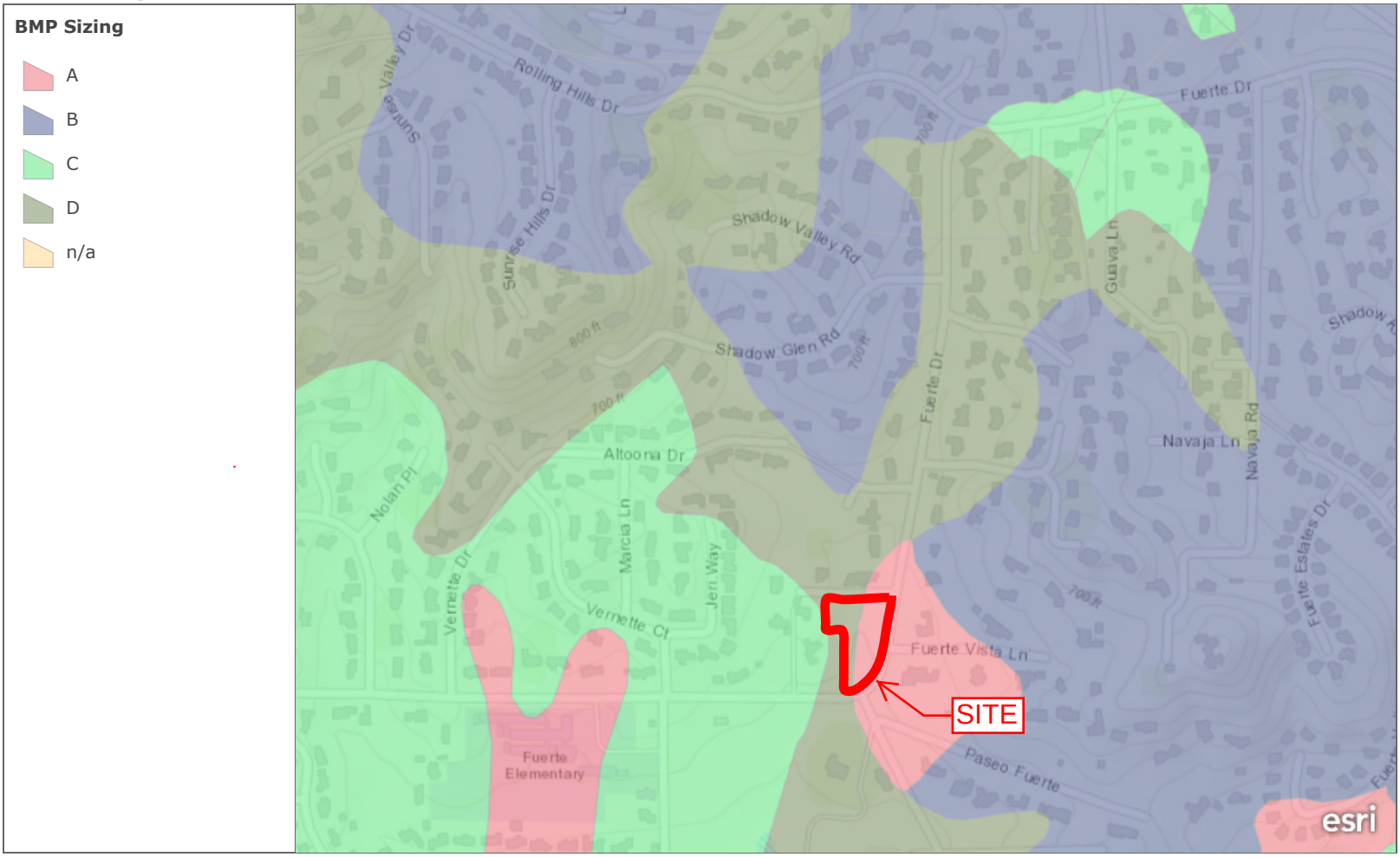
N
W E
S

3 0 3 Miles

BMP Sizing Calculator



This map is intended to assist in BMP sizing for the unincorporated portion of the County of San Diego.

SanGIS, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

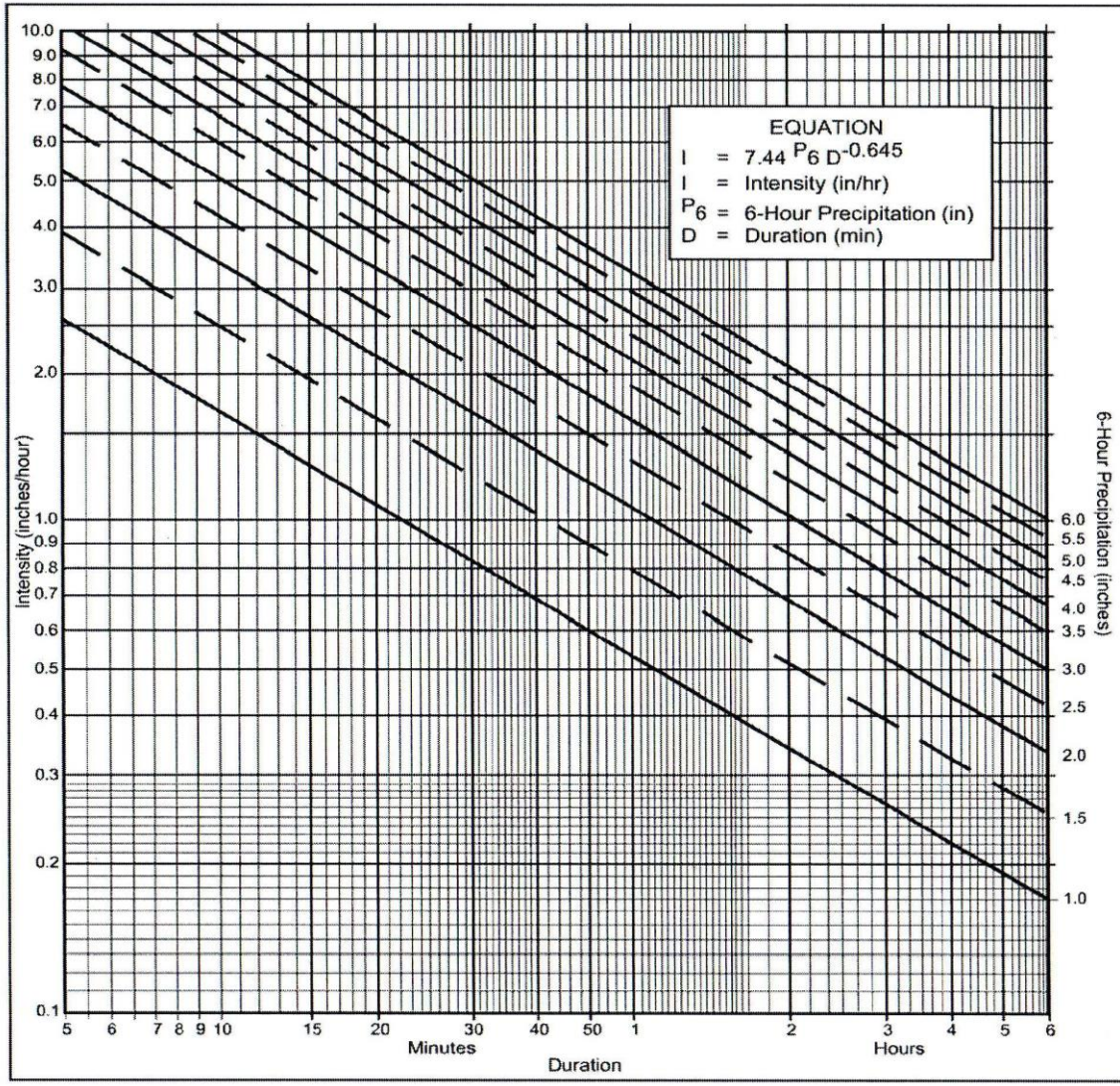
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	Basin	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.7 in., P_{24} = 5.6, $\frac{P_6}{P_{24}}$ = 48 %(2)

(c) Adjusted P_6(2) = 2.7 in.

(d) t_x = *** min. *** -See Calculation Summary

(e) I = *** in./hr. *** -See Calculation Summary

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

Section G

Hydrology Maps

Pre-Development
Post-Development

DRAINAGE BASIN MAP:

PRE-DEVELOPED
FUERTE DRIVE

FUERTE DRIVE

1.011
EL: 615.0

SUB-BASIN 1-01
0.02 AC
L=70'

1.021
EL: 614.0

EXISTING CONCRETE DITCH

BASIN 1
2.44 AC

EXISTING AC
DIKE

PROPERTY BOUNDARY

L=785'

SUB-BASIN 1-02
2.42 AC

POC 1.022
EL: 594.0
Q_{100}=2.23

EXISTING EARTHEN CHANNEL

FUERTE DRIVE

610
600
600
600

N

40' 20' 0 40' 80' 120'

SCALE: 1"=40'

BASIN
SUB BASIN
NODE

NODE 1.022
EL=613.0

NODE ELEVATION

LEGEND:

BASIN BOUNDARY
SUB-BASIN BOUNDARY
FLOWPATH (T_c)

DRAINAGE BASIN MAP:

POST-DEVELOPED
FUERTE DRIVE

1.011
EL: 615.0
L=70'

SUB-BASIN 1-01
0.02 AC

1.021
EL: 614.0

L=350'

PROPERTY BOUNDARY

SUB-BASIN 1-02
0.77 AC

1.022
EL: 607.0

FUERTE DRIVE

610

EXISTING AC DIKE

LIMITS OF PROJECT

BASIN 1
2.44 AC

600

DETENTION BASIN
VOL=48 CY

DETENTION BASIN
FG 593.7

2:1

2:1

FUERTE DRIVE

C

A

SUB-BASIN 1-02
1.65 AC

PROPOSED 5' DRAINAGE CHANNEL

L=445'

B

EXISTING EARTHEN CHANNEL

POC 1.023
EL: 594.0
Q_{100}=5 CFS

600

A

C

B

610

EXISTING STORM DRAIN PIPES

EXISTING STORM

N

40' 20' 0 40' 80' 120'

SCALE: 1"=40'

BASIN
SUB BASIN
NODE

NODE 1.011
EL=790

NODE ELEVATION

LEGEND:

BASIN BOUNDARY
SUB-BASIN BOUNDARY
FLOWPATH (T_c)