WALSH ENGINEERING & SURVEYING, INC.

CEQA DRAINAGE STUDY

For

PDS2017-TM-5621
1460 Marshall Road
Alpine, CA 91901
(APN 403-271-20 & 21)

Prepared for:
Richard J. Bonjorno
1469 Marshall Road
Alpine, CA 91901

Prepared by:
Walsh Engineering & Surveying, Inc.
607 Aldwych Road
El Cajon, CA 92020

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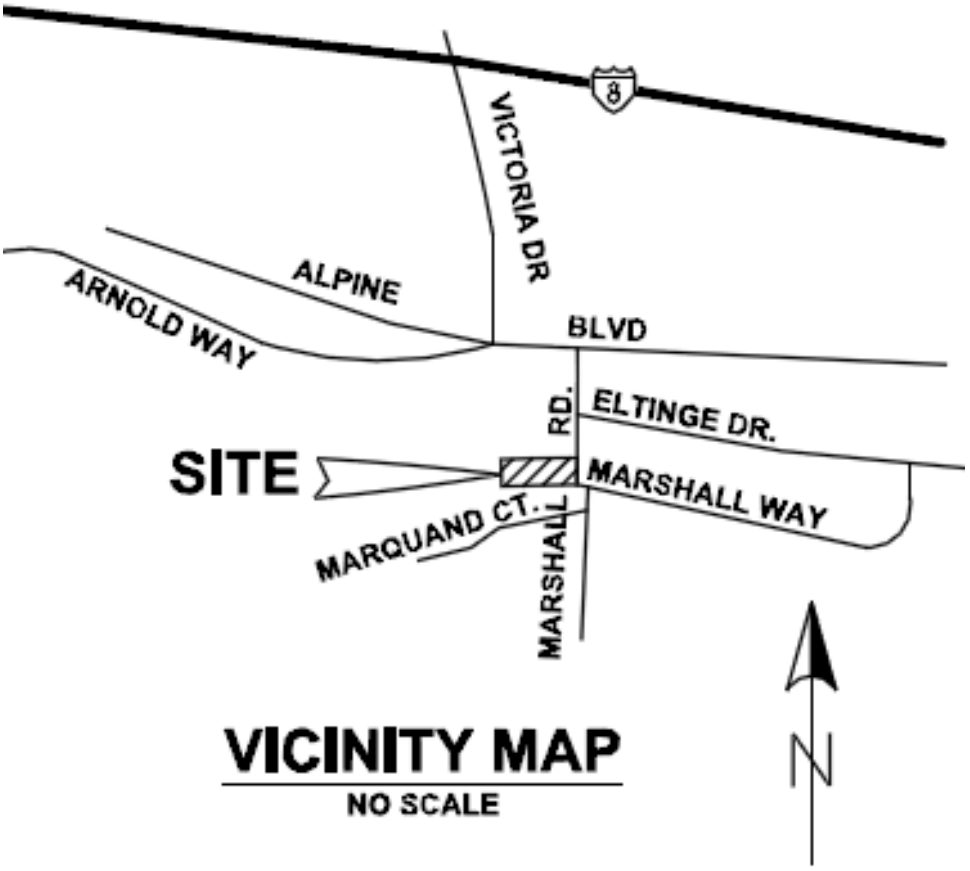
DECLARATION OF RESPONSIBLE CHARGE

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 Date



VICINITY MAP

NO SCALE

Project Description

This Drainage Study is prepared for a 23 unit development off of Marshall Road in Alpine on a 1.84 acre property. A 24' wide AC paved private road will provide access to the units. Each unit will be a 2-story, 1,800 square foot unit with a two car garage. There will be two stepped biofiltration basins, acting as one large basin. This basin will provide sufficient detention for the 23 unit project. See the Preliminary Grading Plan in Attachment "A" for reference.

Hydrologic Description

Currently on the site, there are several existing homes and sheds to be removed. The topography slopes east to west with slopes ranging from 10% to 20%. The site consists of mostly dirt with a few scattered trees. Drainage Basin 1 covers the majority of the site and runoff from Basin 1 flows to a series of brow ditches located adjacent and west of the westerly property line. Runoff leaving these brow ditches travels a short distance to the POC (Point of Comparison), located in the existing AC paved parking lot west of the project. The small amount of runoff that does not flow to these westerly brow ditches enters brow ditches along the north and south property lines as represented by Basins 2 and 3. Since the areas of Basins 2 and 3 are decreased from 0.26 acres to 0.12 acres & 0.44 acres to 0.12 acres, respectively from pre to post-developed; analysis is not provided due to the reduction in flowrate.

In the proposed condition the area of Basin 1 is increased from 1.4 acres to 1.8 acres from the pre to post-developed condition, meaning 0.4 acres of additional area is routed to the POC in the post-developed condition. The additional area added to Basin 1 is due to a proposed 5' max retaining wall along the north property line, which will inhibit runoff from sheet flowing north as it does in the existing condition. This proposed retaining wall could not be avoided due existing topography constraints. Downstream of the site runoff from Basins, 1, 2, & 3 will converge. See Attachment "A" for the drainage maps.

Hydrologic Analysis

The hydrologic analysis is done to assess the impact of the proposed development on the existing drainage patterns and any increase to runoff that will require mitigation. The project's major drainage basins are divided into minor sub-basins based on changes in grade, conveyance geometry and run-off coefficients along the drainage paths. The projects estimated storm runoff for the existing and developed condition is analyzed using a computer

application of the County of San Diego Flood Control District's Hydrology Manual. This program also includes the necessary retardation/detention basin routines required to analyze the detention basins and mitigate an increase in runoff. The application is offered by CivilDesign® Corporation.

Tabulated Hydrologic Computational Results

A summary table of the flow rates at key nodes in the pre-developed, post-developed, and mitigated condition is presented below. Numbers in the table are shown to the same decimal place as the computer printout for ease of identification.

Existing 100 year (16954Pre.out, Attachment "B")

Nodes	Description	Effective C	Tc (min.)	I (in/hr)	Area (ac) Total	Qpeak (cfs) total
1.011 to 1.023	Basin 1 to POC	0.42	9.46	5.851	1.43	**3.514**

Developed 100 year (16954Post.out, Attachment "C")

Nodes	Description	Effective C	Tc (min.)	I (in/hr)	Area (ac) Total	Qpeak (cfs) total
1.011 to 1.033	Basin 1 to POC	0.559	8.30	6.271	1.81	**6.343**

Mitigated 100 year (16954Pond.out & 16954Mit.out, Attachments "D" & "E")

With a pre-developed flow rate of 3.5 cfs and a post-developed unmitigated flow rate of 6.3 cfs, 2.8 cfs needs to be detained in the proposed biofiltration basin. After designing an outlet structure within CivilD, an inflow hydrograph was generated at the point where runoff enters the biofiltration basin (Node 1.023) and an outflow hydrograph was generated at the point where runoff leaves the biofiltration basin (Node 1.031). The peak outflow from the biofiltration basin was determined to be 3.0 cfs and was added as a user defined flow for the mitigated condition. The time difference between the peak outflow and the peak inflow from the biofiltration basin was four minutes and this value was added to the time of concentration in the mitigated condition. Flow from an additional 0.31 acres combines with the 3.0 cfs leaving the biofiltration basin and the runoff at the POC is 3.1 cfs.

Nodes	Description	Effective C	Tc (min.)	I (in/hr)	Area (ac) Total	Qpeak (cfs) total
1.011 to 1.033	Basin 1 to POC	0.534	12.73	4.758	1.81	**3.100**

Detention Analysis

The biofiltration basin was designed to ensure the 100 year post-developed flow rate does not exceed the pre-developed flow rate. The biofiltration basin elements consist of a 1.5 foot thick amended soil layer on top of a 4 foot thick gravel storage layer. There will be a proposed 36”x36” catch basin with a solid cover and an effective 9” diameter opening for water to enter. The top of the catch basin will be 6” above the finish grade of the basin to allow for ponding. An additional 12” of freeboard will be provided. The biofiltration basin will have a 6 inch diameter perforated PVC pipe to be placed 3 inches from the bottom of the gravel storage layer. A detail of the biofiltration basin can be seen in Attachment “A”.

Hydraulic Analysis

As calculated in the mitigated output file in Attachment “”E” (Nodes 1.031 to 1.032), the proposed brow ditch receiving outflow from the biofiltration basin is flowing half full at a depth of 0.5 feet at a minimum slope of 2% and will sufficiently transport runoff leaving the basin. There are two proposed curb inlets, one located near the end of the proposed private road and one located at the end of the driveway between units 13 and 14. These curb inlets will capture runoff from the proposed private road and driveway and will convey it to the biofiltration basin through a 12” diameter HDPE storm drain pipe. In CivilD, a 9” diameter pipe was calculated to be the minimum pipe size, however, a 12” diameter HDPE pipe will be proposed.

Conclusion

The addition of impervious surface in the form of AC pavement, building roofs, and hardscape, increases flow from the pre to post condition. A 0.4 acre increase in drainage basin area from pre to post also plays a role in the increased unmitigated flowrate at the POC. The pre-developed flow rate was determined to be 3.5 cfs and the post-developed unmitigated flow rate was determined to be 6.3 cfs. This increase will be mitigated by detaining runoff within a biofiltration basin. In the mitigated condition, the peak runoff will be 3.1 cfs. All drainage ditches, curb inlets, AC dikes, storm drain pipes, and riprap are adequate to convey runoff associated with this project. There will be no net impact from the development.

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

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

A: No.

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 the 100-year floodplain.

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 which would impede or redirect flood 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).

Attachment “A”

Preliminary Grading Plan, Hydrology Maps and Biofiltration Basin Detail

-Preliminary Grading Plan
-Pre-Developed Map
-Post-Developed Map
-Biofiltration Basin Detail

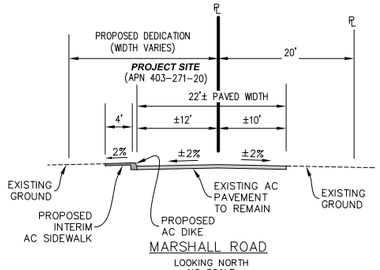
PRELIMINARY GRADING PLAN

LEGEND:

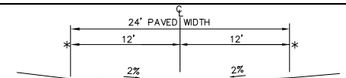
SYMBOL	ITEM
	EXISTING AC PAVEMENT
	PROPOSED AC PAVEMENT
	PROPOSED PCC PACEMENT
	AREA WHERE NO GRADING IS PROPOSED
	BUILDING WALL PER ARCHITECT'S PLAN
	PROPOSED RETAINING WALL
OH	OVERHEAD UTILITY LINES
OH	EXISTING OVERHEAD UTILITY LINES TO BE REMOVED/UNDERGROUNDED

NOTES:

1. EXISTING POWER POLE TO REMAIN
2. EXISTING POWER POLE TO BE RELOCATED ON THE EAST SIDE OF MARSHALL ROAD
3. EXISTING FENCE TO REMAIN
4. PROPOSED SEWER PUMP STATION
5. PROPOSED MODIFIED TYPE "C" CURB INLET PER RSD D-03A
6. REMOVE EXISTING GUY ANCHOR AND INSTALL PROPOSED GUY POLE
7. PROPOSED GUY ANCHOR
8. PROPOSED 8" PVC PRIVATE SEWER MAIN (GRAVITY)
9. PROPOSED 1.25" PVC PRIVATE SEWER (FORCE MAIN)
10. PROPOSED SEWER MANHOLE
11. PROPOSED TYPE G-1 CATCH BASIN PER RSD D-08
12. PROPOSED PROPOSED GRAVEL TO DISPERSE DITCH OVERFLOW
13. PROPOSED BIORETENTION BASIN
14. PROPOSED 12" HDPE STORM DRAIN PIPE
15. PROPOSED TYPE "B" BROW DITCH PER RSD D-75
16. PROPOSED L-TYPE HEADWALL PER RSD D-36
17. PROPOSED STRAIGHT HEADWALL PER RSD D-30
18. EXISTING EARTHEN DITCH
19. PROPOSED 12"x12" BROOKS BOX CATCH BASIN
20. PROPOSED 6" AC DIKE PER RSD G-05
21. 80' OF CONCRETE BROW DITCH AT ZERO PERCENT SLOPE. DITCH IS DESIGNED TO OVERFLOW IN A SHEET FLOW CONDITION TO MODEL THE EXISTING CONDITION
22. PROPOSED RIP-RAP PER RSD D-40
23. EXISTING CONCRETE BROW DITCH TO REMAIN
24. PROPOSED 14' CURB INLET TYPE B-1 PER RSD D-02
25. EXISTING CONCRETE BROW DITCH OUTLETTING ONTO EXISTING AC PARKING LOT
26. 15' OF PROPOSED BROW DITCH TO RUN UNDER CORNER OF UNIT ON PIERS
27. PROPOSED FIRE HYDRANT 3' OF EDGE OF ROAD
28. EXISTING FIRE HYDRANT TO REMAIN
29. EXISTING POWER POLE, GUY WIRE, AND ANCHOR TO BE REMOVED
30. EXISTING OVERHEAD UTILITY LINES TO BE REMOVED/UNDERGROUNDED
31. EXISTING WATER METERS TO REMAIN
32. EXISTING MANHOLE TO REMAIN
33. EXISTING GUY WIRE AND ANCHOR TO REMAIN
34. PROPOSED INTERIM AC SIDEWALK
35. PROPOSED AC PED RAMP
36. EXISTING RETAINING WALL TO REMAIN



MARSHALL ROAD
LOOKING NORTH
NO SCALE



*"NO PARKING FIRE LANE" SIGNS POSTED EVERY 30 FEET ON BOTH SIDES OF PRIVATE ROAD "A". COMPLY WITH CVC 22500.2

PRIVATE ROAD "A" (TYPICAL SECTION)
NO SCALE

VICINITY MAP
NO SCALE

OWNER:
RICHARD J. BONJORNO
AND JUDY C. BONJORNO
1469 MARSHALL ROAD
ALPINE, CA 91901
(619) 379-9120

GRADING:
CUT: 5,500 C.Y.
FILL: 2,500 C.Y.
EXPORT: 3,000 C.Y.

LEGAL DESCRIPTION:

A PORTION OF SOUTHWEST QUARTER OF SECTION 27, TOWNSHIP 15 SOUTH, RANGE 2 EAST, SAN BERNARDINO BASE & MERIDIAN IN THE COUNTY OF SAN DIEGO, STATE OF CALIFORNIA. AS DESCRIBED IN DEED REC JUNE 16, 1993 PER DOC. 1993-0381217

BENCHMARK:

DESCRIPTION: 3" BRASS DISC STAMPED "SD CO ENGR DEPT. SURVEY MON. 1975" IN STANDARD STREET WELL MONUMENT.

LOCATION: 188.77' SW FROM APPARENT CL/CL INTERSECTION OF ELTINGE DR. AND MARSHALL WAY. POINT IS ON APPARENT CL AND N'LY BC OF 46' CURVE.

ELEVATION: 1936.99 (NGVD 29)

SOURCE: SAN DIEGO COUNTY BENCH BOOK PER R.O.S. 13702

TOPOGRAPHY:

BY PHOTOGEODETIC, INC. DATE FLOWN: 04-21-17

SITE ADDRESS:

1460 MARSHAL ROAD
ALPINE, CA 91901

ASSESSOR PARCEL NUMBERS:

403-271-20 & 21

EASEMENT NOTES:

(PER TITLE REPORT DATED JANUARY 22, 2018)

(A) EASEMENT FOR SANITATION UTILITIES PER DOC. RECORDED 12/22/1953, BOOK 5095, PAGE 452 OF OFFICIAL RECORDS.

(B) EASEMENT FOR WATER UTILITIES PER DOC.# 1962-58561 RECORDED 04/5/1962.

(C) EASEMENT FOR COUNTY HIGHWAY PER DOC.# 2004-0069636 RECORDED 01/29/2004.

(D) 26' WIDE EASEMENT FOR PUBLIC ROAD AND DRAINAGE PURPOSES DEDICATED AND ACCEPTED PER MAP 14936.

CENTERLINE OF SDG&E EASEMENT (NO WIDTH GIVEN) PER DOC. RECORDED 01/30/1934, BOOK 264, PAGE 363 OF OFFICIAL RECORDS NOT PLOTTED (TO BE VACATED)

2' WIDE SDG&E EASEMENT PER DOC. RECORDED 04/01/1924 BOOK 1006, PAGE 8 NOT PLOTTABLE; EXACT LOCATION NOT DISCLOSED (TO BE VACATED)

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.

ALL EXISTING HOMES/STRUCTURES ON SITE ARE TO BE REMOVED AS PART OF THIS PROJECT.

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

SCALE: 1"=20'

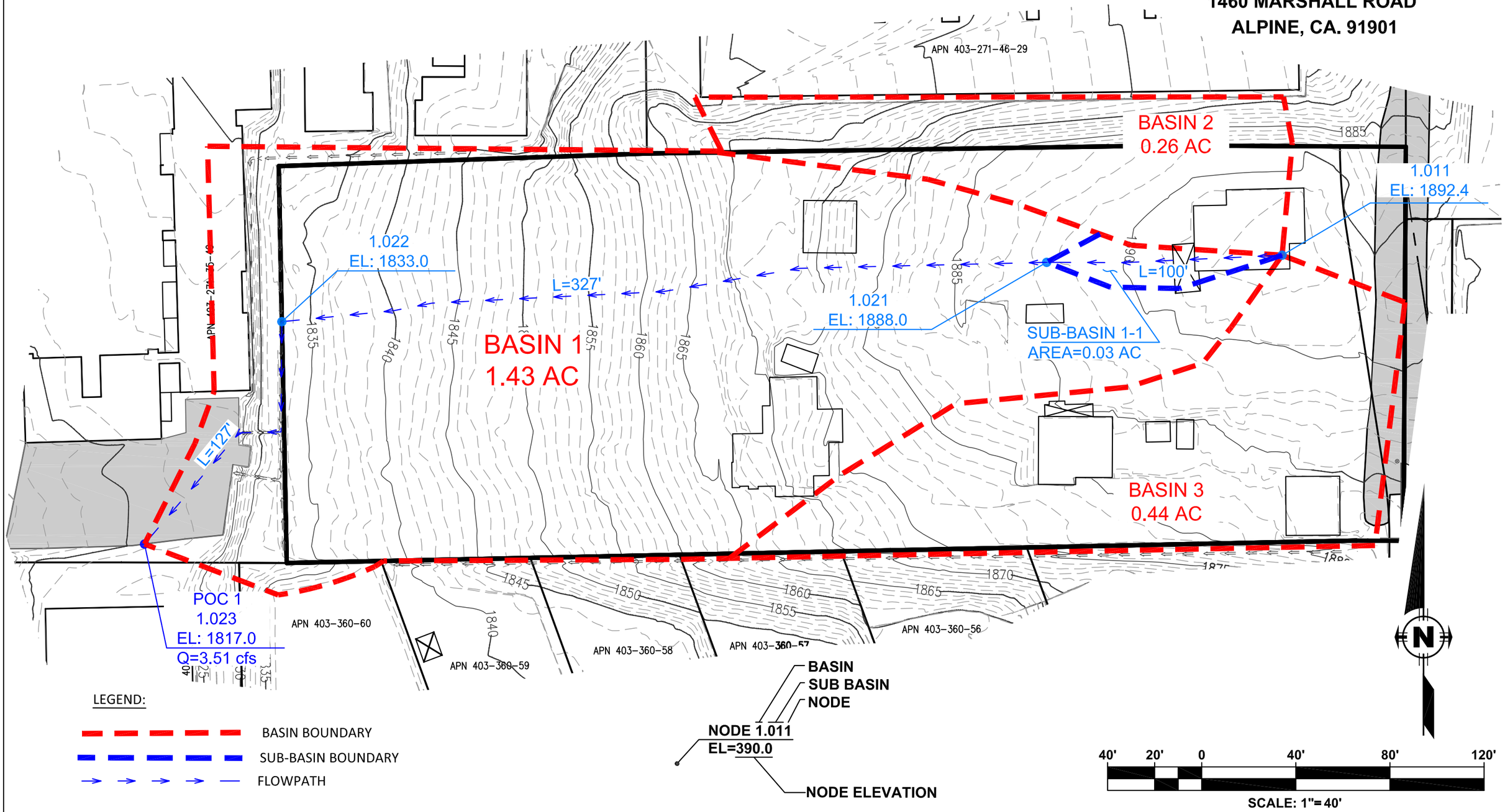
PREPARED BY:

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

L:\PROJECTS 3D\16954-MARSHALL\PRODUCTION DRAWINGS\16954 PGP.DWG March 20, 2018 - 10:15am

DRAINAGE BASINS: PRE-DEVELOPED

1460 MARSHALL ROAD
ALPINE, CA. 91901



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DRAINAGE BASINS: POST-DEVELOPED

1460 MARSHALL ROAD
ALPINE, CA. 91901

APN 403-271-46-29

1.031
EL: 1837.0

BASIN 2
AREA 0.12 AC

BASIN 1
AREA 1.81 AC

SUB BASIN 1-2
AREA
1.45 AC

SUB BASIN 1-1
AREA
0.05 AC

1.011
EL: 1890.0

1.023
EL: 1845.0

L= 324'

L= 85'

L= 142'

L= 104'

L= 14'

1.032
EL: 1822.0

1.022
EL: 1849.0

1.021
EL: 1888.2

L= 62'

BASIN 3
AREA
0.12 AC

SUB BASIN 1-3
AREA
0.31 AC

POC
1.033
EL: 1820.8
Q=3.10 cfs

APN 403-360-60

APN 403-360-58

APN 403-360-57

APN 403-360-56

LEGEND:

BASIN BOUNDARY

SUB-BASIN BOUNDARY

FLOWPATH

BASIN
SUB BASIN
NODE

NODE 1.011
EL=390.0

NODE ELEVATION

N

40' 20' 0 40' 80' 120'

SCALE: 1"= 40'

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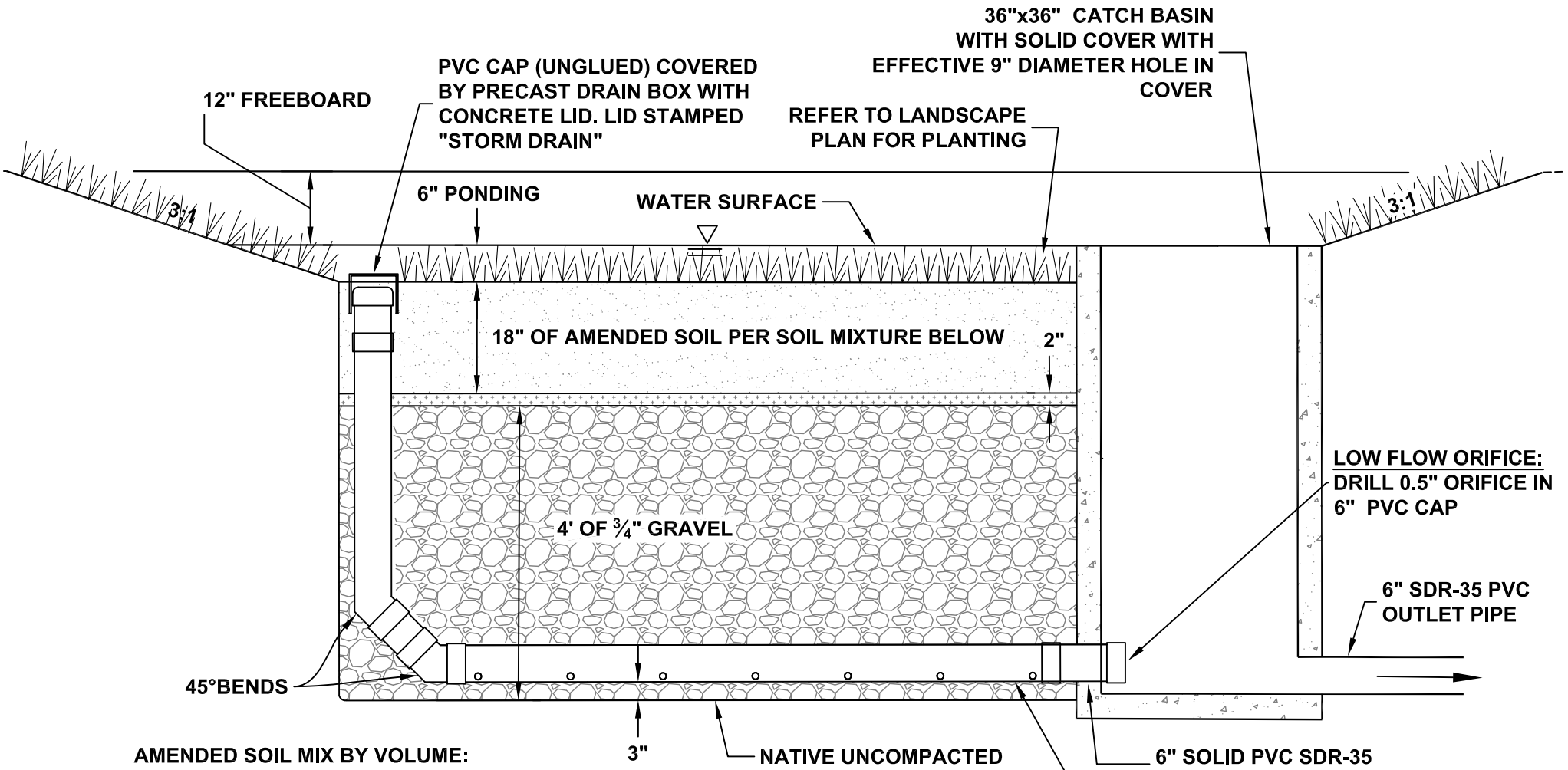

AMENDED SOIL MIX BY VOLUME:
- 65% SAND
- 20% SANDY LOAM
- 15% COMPOST

PERCOLATION RATE 5-10 IN/HR
MIN SUSTAINED

BIOFILTRATION BASIN DETAIL

1" = 2'

Attachment “B”

Pre-Developed Calculations

-16954Pre.out

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: 10/05/17

16954 Pre

********* 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) = 3.300
24 hour precipitation(inches) = 7.000
P6/P24 = 47.1%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(2.0 DU/A or Less)
Impervious value, Ai = 0.200
Sub-Area C Value = 0.420
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 1892.400(Ft.)
Lowest elevation = 1888.000(Ft.)
Elevation difference = 4.400(Ft.) Slope = 4.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 4.40 %, in a development type of
2.0 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 7.40 minutes
(for slope value of 5.00 %)
Rainfall intensity (I) = 6.752(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.420
Subarea runoff = 0.085(CFS)
Total initial stream area = 0.030(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 =      1.836(CFS)
Depth of flow =   0.111(Ft.), Average velocity =   2.961(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 =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      1.836(CFS)
  '     '        flow top width =     11.134(Ft.)
  '     '    velocity=    2.961(Ft/s)
  '     '        area =      0.620(Sq.Ft)
  '     '        Froude number =     2.212

Upstream point elevation =  1888.000(Ft.)
Downstream point elevation =  1833.000(Ft.)
Flow length =   327.000(Ft.)
Travel time  =    1.84 min.
Time of concentration =    9.24 min.
Depth of flow =   0.111(Ft.)
Average velocity =   2.961(Ft/s)
Total irregular channel flow =     1.836(CFS)
Irregular channel normal depth above invert elev. =   0.111(Ft.)
Average velocity of channel(s) =   2.961(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.851(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                      ]
(2.0 DU/A or Less       )
Impervious value, Ai = 0.200
Sub-Area C Value = 0.420
Rainfall intensity =      5.851(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.420  CA =      0.601
Subarea runoff =      3.429(CFS) for      1.400(Ac.)
Total runoff =      3.514(CFS)  Total area =       1.430(Ac.)
Depth of flow =   0.142(Ft.), Average velocity =   3.483(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.022 to Point/Station        1.023
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =  1833.000(Ft.)
Downstream point elevation =  1817.000(Ft.)
Channel length thru subarea  =   127.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.514(CFS)
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16954Pre
Depth of flow = 0.166(Ft.), Average velocity = 9.746(Ft/s)
Channel flow top width = 2.333(Ft.)
Flow Velocity = 9.75(Ft/s)
Travel time = 0.22 min.
Time of concentration = 9.46 min.
Critical depth = 0.426(Ft.)
End of computations, total study area = 1.430 (Ac.)

Attachment “C”

Post-Developed Calculations

-16954Post.out

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: 03/20/18

16954 Post

********* 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) = 3.300
24 hour precipitation(inches) = 7.000
P6/P24 = 47.1%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(14.5 DU/A or Less)
Impervious value, Ai = 0.500
Sub-Area C Value = 0.600
Initial subarea total flow distance = 85.000(Ft.)
Highest elevation = 1890.000(Ft.)
Lowest elevation = 1888.500(Ft.)
Elevation difference = 1.500(Ft.) Slope = 1.765 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 80.00 (Ft)
for the top area slope value of 1.76 %, in a development type of
14.5 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 6.50 minutes
(for slope value of 2.00 %)
Rainfall intensity (I) = 7.341(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.600
Subarea runoff = 0.220(CFS)
Total initial stream area = 0.050(Ac.)

++

Process from Point/Station 1.021 to Point/Station 1.022
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1888.500(Ft.)
Downstream point elevation = 1849.000(Ft.)
Channel length thru subarea = 324.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 50.000
Slope or 'Z' of right channel bank = 50.000
Estimated mean flow rate at midpoint of channel = 3.133(CFS)
Manning's 'N' = 0.016
Maximum depth of channel = 0.240(Ft.)
Flow(q) thru subarea = 3.133(CFS)
Depth of flow = 0.114(Ft.), Average velocity = 4.807(Ft/s)
Channel flow top width = 11.417(Ft.)
Flow Velocity = 4.81(Ft/s)
Travel time = 1.12 min.
Time of concentration = 7.62 min.
Critical depth = 0.189(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 6.624(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL]
(14.5 DU/A or Less)
Impervious value, Ai = 0.500
Sub-Area C Value = 0.600
Rainfall intensity = 6.624(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.600 CA = 0.900
Subarea runoff = 5.741(CFS) for 1.450(Ac.)
Total runoff = 5.961(CFS) Total area = 1.500(Ac.)
Depth of flow = 0.145(Ft.), Average velocity = 5.646(Ft/s)
Critical depth = 0.244(Ft.)

++
Process from Point/Station 1.022 to Point/Station 1.023
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1849.000(Ft.)
Downstream point/station elevation = 1845.000(Ft.)
Pipe length = 14.00(Ft.) Slope = 0.2857 Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.961(CFS)
Nearest computed pipe diameter = 9.00(In.)
Calculated individual pipe flow = 5.961(CFS)
Normal flow depth in pipe = 5.41(In.)
Flow top width inside pipe = 8.81(In.)
Critical depth could not be calculated.
Pipe flow velocity = 21.48(Ft/s)
Travel time through pipe = 0.01 min.
Time of concentration (TC) = 7.63 min.

++
Process from Point/Station 1.023 to Point/Station 1.031
**** 6 HOUR HYDROGRAPH ****

++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003

Time of Concentration = 7.63
Basin Area = 1.50 Acres
6 Hour Rainfall = 3.300 Inches
Runoff Coefficient = 0.600
Peak Discharge = 5.96 CFS

Time (Min)	Discharge (CFS)
0	0.000
7	0.178
14	0.180
21	0.185
28	0.188
35	0.193
42	0.196
49	0.202
56	0.205
63	0.212
70	0.216
77	0.224
84	0.228
91	0.237
98	0.242
105	0.252
112	0.258
119	0.270
126	0.277
133	0.292
140	0.300
147	0.319
154	0.329
161	0.353
168	0.367
175	0.399
182	0.417
189	0.463
196	0.491
203	0.563
210	0.610
217	0.746
224	0.849
231	1.247
238	1.757
245	5.961
252	1.000
259	0.669
266	0.524
273	0.439
280	0.382
287	0.341
294	0.309
301	0.284
308	0.264
315	0.247
322	0.232
329	0.220
336	0.209
343	0.199
350	0.191
357	0.183
364	0.176

++

6 - H O U R S T O R M
R u n o f f H y d r o g r a p h

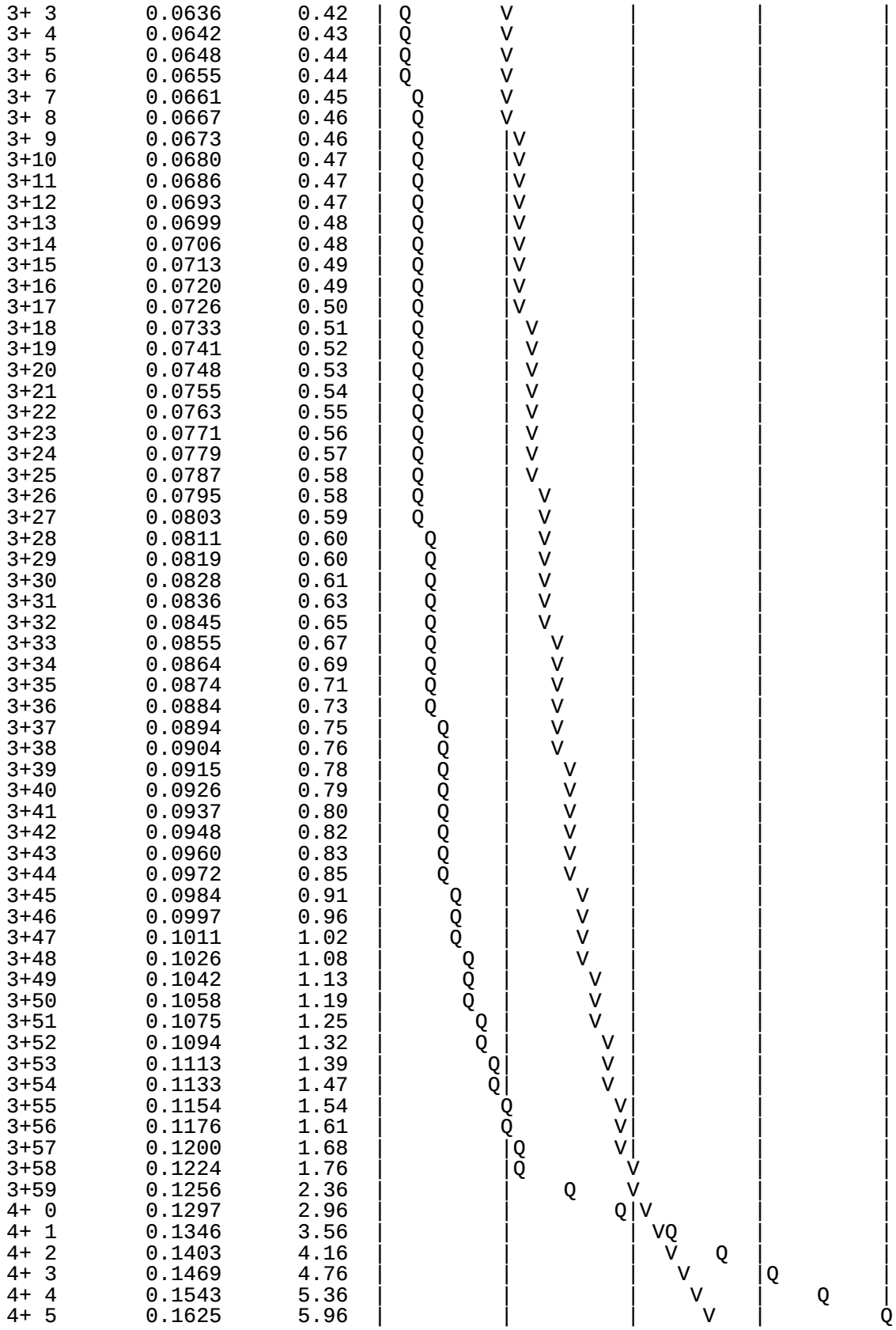
16954Post

Hydrograph in 1 Minute intervals ((CFS))

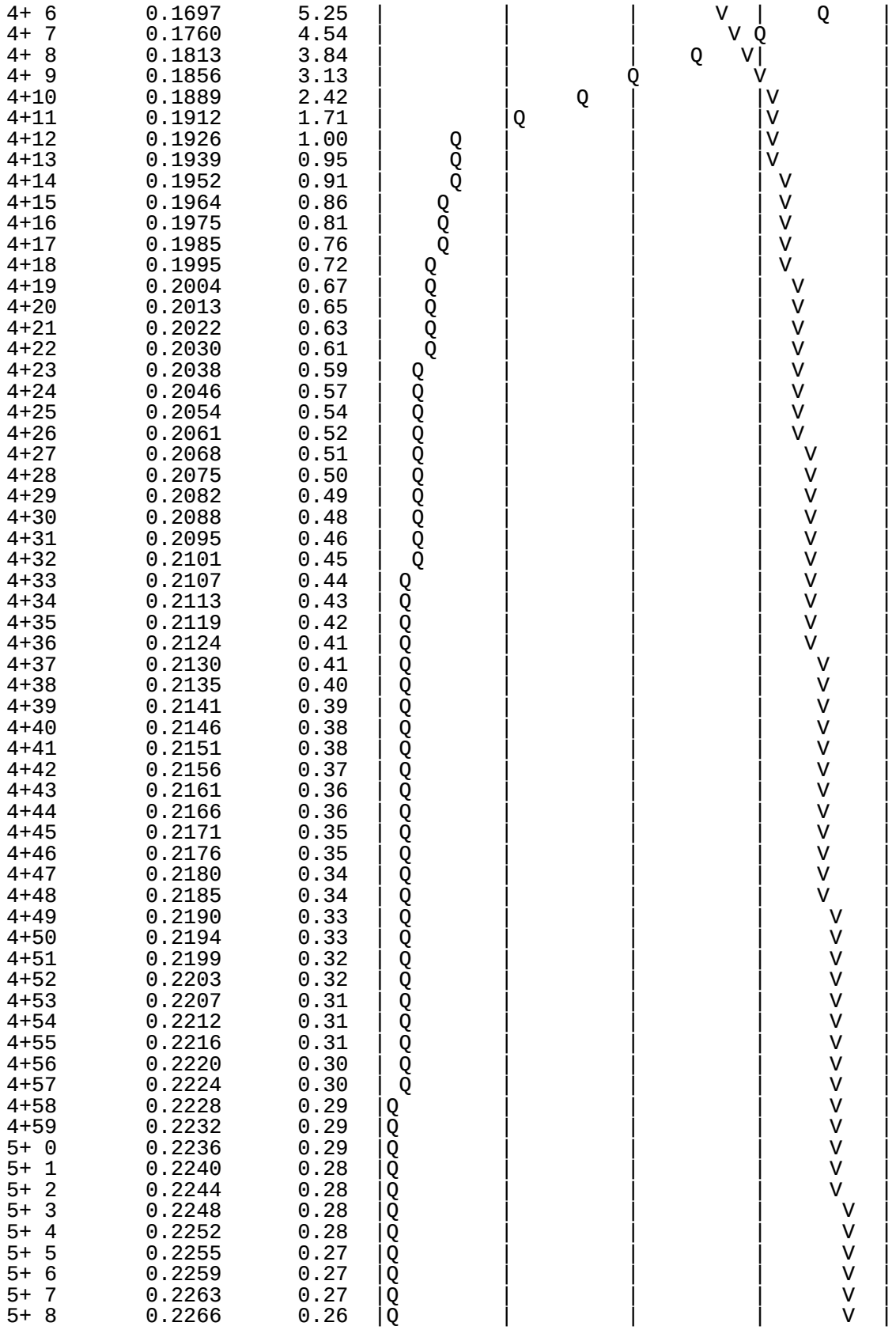
Time(h+m)	Volume Ac.Ft	Q(CFS)	0	1.5	3.0	4.5	6.0
0+ 0	0.0000	0.00	Q				
0+ 1	0.0000	0.03	Q				
0+ 2	0.0001	0.05	Q				
0+ 3	0.0002	0.08	Q				
0+ 4	0.0004	0.10	Q				
0+ 5	0.0005	0.13	Q				
0+ 6	0.0007	0.15	VQ				
0+ 7	0.0010	0.18	VQ				
0+ 8	0.0012	0.18	VQ				
0+ 9	0.0015	0.18	VQ				
0+10	0.0017	0.18	VQ				
0+11	0.0020	0.18	VQ				
0+12	0.0022	0.18	VQ				
0+13	0.0025	0.18	VQ				
0+14	0.0027	0.18	VQ				
0+15	0.0030	0.18	VQ				
0+16	0.0032	0.18	VQ				
0+17	0.0035	0.18	VQ				
0+18	0.0037	0.18	VQ				
0+19	0.0040	0.18	VQ				
0+20	0.0042	0.18	VQ				
0+21	0.0045	0.19	VQ				
0+22	0.0047	0.19	VQ				
0+23	0.0050	0.19	VQ				
0+24	0.0052	0.19	VQ				
0+25	0.0055	0.19	VQ				
0+26	0.0058	0.19	VQ				
0+27	0.0060	0.19	VQ				
0+28	0.0063	0.19	|Q				
0+29	0.0065	0.19	|Q				
0+30	0.0068	0.19	|Q				
0+31	0.0071	0.19	|Q				
0+32	0.0073	0.19	|Q				
0+33	0.0076	0.19	|Q				
0+34	0.0079	0.19	|Q				
0+35	0.0081	0.19	|Q				
0+36	0.0084	0.19	|Q				
0+37	0.0087	0.19	|Q				
0+38	0.0089	0.19	|Q				
0+39	0.0092	0.19	|Q				
0+40	0.0095	0.20	|Q				
0+41	0.0097	0.20	|Q				
0+42	0.0100	0.20	|Q				
0+43	0.0103	0.20	|Q				
0+44	0.0105	0.20	|Q				
0+45	0.0108	0.20	|Q				
0+46	0.0111	0.20	|Q				
0+47	0.0114	0.20	|Q				
0+48	0.0116	0.20	|Q				
0+49	0.0119	0.20	|Q				
0+50	0.0122	0.20	|QV				
0+51	0.0125	0.20	|QV				
0+52	0.0128	0.20	|QV				
0+53	0.0130	0.20	|QV				
0+54	0.0133	0.20	|QV				
0+55	0.0136	0.20	|QV				
0+56	0.0139	0.21	|QV				

0+57	0.0142	0.21	QV	|	|	|
0+58	0.0145	0.21	QV	|	|	|
0+59	0.0148	0.21	QV	|	|	|
1+ 0	0.0150	0.21	QV	|	|	|
1+ 1	0.0153	0.21	QV	|	|	|
1+ 2	0.0156	0.21	QV	|	|	|
1+ 3	0.0159	0.21	QV	|	|	|
1+ 4	0.0162	0.21	QV	|	|	|
1+ 5	0.0165	0.21	QV	|	|	|
1+ 6	0.0168	0.21	QV	|	|	|
1+ 7	0.0171	0.21	QV	|	|	|
1+ 8	0.0174	0.21	QV	|	|	|
1+ 9	0.0177	0.22	QV	|	|	|
1+10	0.0180	0.22	QV	|	|	|
1+11	0.0183	0.22	Q V	|	|	|
1+12	0.0186	0.22	Q V	|	|	|
1+13	0.0189	0.22	Q V	|	|	|
1+14	0.0192	0.22	Q V	|	|	|
1+15	0.0195	0.22	Q V	|	|	|
1+16	0.0198	0.22	Q V	|	|	|
1+17	0.0201	0.22	Q V	|	|	|
1+18	0.0204	0.22	Q V	|	|	|
1+19	0.0207	0.22	Q V	|	|	|
1+20	0.0210	0.23	Q V	|	|	|
1+21	0.0213	0.23	Q V	|	|	|
1+22	0.0217	0.23	Q V	|	|	|
1+23	0.0220	0.23	Q V	|	|	|
1+24	0.0223	0.23	Q V	|	|	|
1+25	0.0226	0.23	Q V	|	|	|
1+26	0.0229	0.23	Q V	|	|	|
1+27	0.0232	0.23	Q V	|	|	|
1+28	0.0236	0.23	Q V	|	|	|
1+29	0.0239	0.23	Q V	|	|	|
1+30	0.0242	0.24	Q V	|	|	|
1+31	0.0245	0.24	Q V	|	|	|
1+32	0.0249	0.24	Q V	|	|	|
1+33	0.0252	0.24	Q V	|	|	|
1+34	0.0255	0.24	Q V	|	|	|
1+35	0.0258	0.24	Q V	|	|	|
1+36	0.0262	0.24	Q V	|	|	|
1+37	0.0265	0.24	Q V	|	|	|
1+38	0.0268	0.24	Q V	|	|	|
1+39	0.0272	0.24	Q V	|	|	|
1+40	0.0275	0.24	Q V	|	|	|
1+41	0.0278	0.25	Q V	|	|	|
1+42	0.0282	0.25	Q V	|	|	|
1+43	0.0285	0.25	Q V	|	|	|
1+44	0.0289	0.25	Q V	|	|	|
1+45	0.0292	0.25	Q V	|	|	|
1+46	0.0296	0.25	Q V	|	|	|
1+47	0.0299	0.25	Q V	|	|	|
1+48	0.0303	0.25	Q V	|	|	|
1+49	0.0306	0.26	Q V	|	|	|
1+50	0.0310	0.26	Q V	|	|	|
1+51	0.0313	0.26	Q V	|	|	|
1+52	0.0317	0.26	Q V	|	|	|
1+53	0.0320	0.26	Q V	|	|	|
1+54	0.0324	0.26	Q V	|	|	|
1+55	0.0328	0.26	Q V	|	|	|
1+56	0.0331	0.26	Q V	|	|	|
1+57	0.0335	0.27	Q V	|	|	|
1+58	0.0339	0.27	Q V	|	|	|
1+59	0.0342	0.27	Q V	|	|	|

2+ 0	0.0346	0.27	Q V			
2+ 1	0.0350	0.27	Q V			
2+ 2	0.0354	0.27	Q V			
2+ 3	0.0357	0.27	Q V			
2+ 4	0.0361	0.27	Q V			
2+ 5	0.0365	0.28	Q V			
2+ 6	0.0369	0.28	Q V			
2+ 7	0.0373	0.28	Q V			
2+ 8	0.0377	0.28	Q V			
2+ 9	0.0380	0.28	Q V			
2+10	0.0384	0.29	Q V			
2+11	0.0388	0.29	Q V			
2+12	0.0392	0.29	Q V			
2+13	0.0396	0.29	Q V			
2+14	0.0400	0.29	Q V			
2+15	0.0404	0.29	Q V			
2+16	0.0408	0.30	Q V			
2+17	0.0413	0.30	Q V			
2+18	0.0417	0.30	Q V			
2+19	0.0421	0.30	Q V			
2+20	0.0425	0.30	Q V			
2+21	0.0429	0.30	Q V			
2+22	0.0433	0.31	Q V			
2+23	0.0438	0.31	Q V			
2+24	0.0442	0.31	Q V			
2+25	0.0446	0.31	Q V			
2+26	0.0451	0.32	Q V			
2+27	0.0455	0.32	Q V			
2+28	0.0459	0.32	Q V			
2+29	0.0464	0.32	Q V			
2+30	0.0468	0.32	Q V			
2+31	0.0473	0.32	Q V			
2+32	0.0477	0.33	Q V			
2+33	0.0482	0.33	Q V			
2+34	0.0486	0.33	Q V			
2+35	0.0491	0.33	Q V			
2+36	0.0495	0.34	Q V			
2+37	0.0500	0.34	Q V			
2+38	0.0505	0.34	Q V			
2+39	0.0510	0.35	Q V			
2+40	0.0514	0.35	Q V			
2+41	0.0519	0.35	Q V			
2+42	0.0524	0.35	Q V			
2+43	0.0529	0.36	Q V			
2+44	0.0534	0.36	Q V			
2+45	0.0539	0.36	Q V			
2+46	0.0544	0.36	Q V			
2+47	0.0549	0.36	Q V			
2+48	0.0554	0.37	Q V			
2+49	0.0559	0.37	Q V			
2+50	0.0564	0.38	Q V			
2+51	0.0570	0.38	Q V			
2+52	0.0575	0.38	Q V			
2+53	0.0580	0.39	Q V			
2+54	0.0586	0.39	Q V			
2+55	0.0591	0.40	Q V			
2+56	0.0597	0.40	Q V			
2+57	0.0602	0.40	Q V			
2+58	0.0608	0.41	Q V			
2+59	0.0613	0.41	Q V			
3+ 0	0.0619	0.41	Q V			
3+ 1	0.0625	0.41	Q V			
3+ 2	0.0631	0.42	Q V			



3+ 3	0.0636	0.42	
3+ 4	0.0642	0.43	
3+ 5	0.0648	0.44	
3+ 6	0.0655	0.44	
3+ 7	0.0661	0.45	
3+ 8	0.0667	0.46	
3+ 9	0.0673	0.46	
3+10	0.0680	0.47	
3+11	0.0686	0.47	
3+12	0.0693	0.47	
3+13	0.0699	0.48	
3+14	0.0706	0.48	
3+15	0.0713	0.49	
3+16	0.0720	0.49	
3+17	0.0726	0.50	
3+18	0.0733	0.51	
3+19	0.0741	0.52	
3+20	0.0748	0.53	
3+21	0.0755	0.54	
3+22	0.0763	0.55	
3+23	0.0771	0.56	
3+24	0.0779	0.57	
3+25	0.0787	0.58	
3+26	0.0795	0.58	
3+27	0.0803	0.59	
3+28	0.0811	0.60	
3+29	0.0819	0.60	
3+30	0.0828	0.61	
3+31	0.0836	0.63	
3+32	0.0845	0.65	
3+33	0.0855	0.67	
3+34	0.0864	0.69	
3+35	0.0874	0.71	
3+36	0.0884	0.73	
3+37	0.0894	0.75	
3+38	0.0904	0.76	
3+39	0.0915	0.78	
3+40	0.0926	0.79	
3+41	0.0937	0.80	
3+42	0.0948	0.82	
3+43	0.0960	0.83	
3+44	0.0972	0.85	
3+45	0.0984	0.91	
3+46	0.0997	0.96	
3+47	0.1011	1.02	
3+48	0.1026	1.08	
3+49	0.1042	1.13	
3+50	0.1058	1.19	
3+51	0.1075	1.25	
3+52	0.1094	1.32	
3+53	0.1113	1.39	
3+54	0.1133	1.47	
3+55	0.1154	1.54	
3+56	0.1176	1.61	
3+57	0.1200	1.68	
3+58	0.1224	1.76	
3+59	0.1256	2.36	
4+ 0	0.1297	2.96	
4+ 1	0.1346	3.56	
4+ 2	0.1403	4.16	
4+ 3	0.1469	4.76	
4+ 4	0.1543	5.36	
4+ 5	0.1625	5.96	



4+ 6	0.1697	5.25	V Q
4+ 7	0.1760	4.54	V Q
4+ 8	0.1813	3.84	Q V
4+ 9	0.1856	3.13	Q V
4+10	0.1889	2.42	Q V
4+11	0.1912	1.71	Q V
4+12	0.1926	1.00	Q V
4+13	0.1939	0.95	Q V
4+14	0.1952	0.91	Q V
4+15	0.1964	0.86	Q V
4+16	0.1975	0.81	Q V
4+17	0.1985	0.76	Q V
4+18	0.1995	0.72	Q V
4+19	0.2004	0.67	Q V
4+20	0.2013	0.65	Q V
4+21	0.2022	0.63	Q V
4+22	0.2030	0.61	Q V
4+23	0.2038	0.59	Q V
4+24	0.2046	0.57	Q V
4+25	0.2054	0.54	Q V
4+26	0.2061	0.52	Q V
4+27	0.2068	0.51	Q V
4+28	0.2075	0.50	Q V
4+29	0.2082	0.49	Q V
4+30	0.2088	0.48	Q V
4+31	0.2095	0.46	Q V
4+32	0.2101	0.45	Q V
4+33	0.2107	0.44	Q V
4+34	0.2113	0.43	Q V
4+35	0.2119	0.42	Q V
4+36	0.2124	0.41	Q V
4+37	0.2130	0.41	Q V
4+38	0.2135	0.40	Q V
4+39	0.2141	0.39	Q V
4+40	0.2146	0.38	Q V
4+41	0.2151	0.38	Q V
4+42	0.2156	0.37	Q V
4+43	0.2161	0.36	Q V
4+44	0.2166	0.36	Q V
4+45	0.2171	0.35	Q V
4+46	0.2176	0.35	Q V
4+47	0.2180	0.34	Q V
4+48	0.2185	0.34	Q V
4+49	0.2190	0.33	Q V
4+50	0.2194	0.33	Q V
4+51	0.2199	0.32	Q V
4+52	0.2203	0.32	Q V
4+53	0.2207	0.31	Q V
4+54	0.2212	0.31	Q V
4+55	0.2216	0.31	Q V
4+56	0.2220	0.30	Q V
4+57	0.2224	0.30	Q V
4+58	0.2228	0.29	Q V
4+59	0.2232	0.29	Q V
5+ 0	0.2236	0.29	Q V
5+ 1	0.2240	0.28	Q V
5+ 2	0.2244	0.28	Q V
5+ 3	0.2248	0.28	Q V
5+ 4	0.2252	0.28	Q V
5+ 5	0.2255	0.27	Q V
5+ 6	0.2259	0.27	Q V
5+ 7	0.2263	0.27	Q V
5+ 8	0.2266	0.26	Q V

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5+ 9	0.2270	0.26	Q				V
5+10	0.2273	0.26	Q				V
5+11	0.2277	0.26	Q				V
5+12	0.2280	0.25	Q				V
5+13	0.2284	0.25	Q				V
5+14	0.2287	0.25	Q				V
5+15	0.2291	0.25	Q				V
5+16	0.2294	0.24	Q				V
5+17	0.2297	0.24	Q				V
5+18	0.2301	0.24	Q				V
5+19	0.2304	0.24	Q				V
5+20	0.2307	0.24	Q				V
5+21	0.2311	0.23	Q				V
5+22	0.2314	0.23	Q				V
5+23	0.2317	0.23	Q				V
5+24	0.2320	0.23	Q				V
5+25	0.2323	0.23	Q				V
5+26	0.2326	0.23	Q				V
5+27	0.2329	0.22	Q				V
5+28	0.2332	0.22	Q				V
5+29	0.2335	0.22	Q				V
5+30	0.2338	0.22	Q				V
5+31	0.2341	0.22	Q				V
5+32	0.2344	0.22	Q				V
5+33	0.2347	0.21	Q				V
5+34	0.2350	0.21	Q				V
5+35	0.2353	0.21	Q				V
5+36	0.2356	0.21	Q				V
5+37	0.2359	0.21	Q				V
5+38	0.2362	0.21	Q				V
5+39	0.2365	0.20	Q				V
5+40	0.2367	0.20	Q				V
5+41	0.2370	0.20	Q				V
5+42	0.2373	0.20	Q				V
5+43	0.2376	0.20	Q				V
5+44	0.2378	0.20	Q				V
5+45	0.2381	0.20	Q				V
5+46	0.2384	0.20	Q				V
5+47	0.2386	0.19	Q				V
5+48	0.2389	0.19	Q				V
5+49	0.2392	0.19	Q				V
5+50	0.2394	0.19	Q				V
5+51	0.2397	0.19	Q				V
5+52	0.2400	0.19	Q				V
5+53	0.2402	0.19	Q				V
5+54	0.2405	0.19	Q				V
5+55	0.2407	0.19	Q				V
5+56	0.2410	0.18	Q				V
5+57	0.2412	0.18	Q				V
5+58	0.2415	0.18	Q				V
5+59	0.2417	0.18	Q				V
6+ 0	0.2420	0.18	Q				V
6+ 1	0.2422	0.18	Q				V
6+ 2	0.2425	0.18	Q				V
6+ 3	0.2427	0.18	Q				V
6+ 4	0.2430	0.18	Q				V

++
Process from Point/Station 1.023 to Point/Station 1.031
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1845.000(Ft.)
Downstream point/station elevation = 1837.000(Ft.)
Pipe length = 104.00(Ft.) Slope = 0.0769 Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.961(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 5.961(CFS)
Normal flow depth in pipe = 6.72(In.)
Flow top width inside pipe = 11.91(In.)
Critical depth could not be calculated.
Pipe flow velocity = 13.17(Ft/s)
Travel time through pipe = 0.13 min.
Time of concentration (TC) = 7.77 min.

++
Process from Point/Station 1.031 to Point/Station 1.032
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1837.000(Ft.)
Downstream point elevation = 1822.000(Ft.)
Channel length thru subarea = 142.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 1.000
Slope or 'Z' of right channel bank = 1.000
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 5.961(CFS)
Depth of flow = 0.689(Ft.), Average velocity = 12.558(Ft/s)
Channel flow top width = 1.378(Ft.)
Flow Velocity = 12.56(Ft/s)
Travel time = 0.19 min.
Time of concentration = 7.95 min.
Critical depth = 1.148(Ft.)

++
Process from Point/Station 1.032 to Point/Station 1.033
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1822.000(Ft.)
Downstream point elevation = 1820.800(Ft.)
Channel length thru subarea = 62.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 50.000
Slope or 'Z' of right channel bank = 50.000
Estimated mean flow rate at midpoint of channel = 6.179(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 6.179(CFS)
Depth of flow = 0.203(Ft.), Average velocity = 2.999(Ft/s)
Channel flow top width = 20.301(Ft.)
Flow Velocity = 3.00(Ft/s)
Travel time = 0.34 min.
Time of concentration = 8.30 min.
Critical depth = 0.248(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 6.271(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000

```
Decimal fraction soil group C = 1.000
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 = 0.360
Rainfall intensity =      6.271(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.559  CA =      1.012
Subarea runoff =      0.382(CFS) for      0.310(Ac.)
Total runoff =      6.343(CFS)  Total area =       1.810(Ac.)
Depth of flow =   0.205(Ft.), Average velocity =   3.018(Ft/s)
Critical depth =      0.252(Ft.)
End of computations, total study area =          1.810 (Ac.)
```

Attachment “D”

Biofiltration Basin Routing

-16954Pond1.out

16954Pond1

FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 10/09/17

16954 Pond

Program License Serial Number 6326

********** HYDROGRAPH INFORMATION **********

From study/file name: 16954Post.rte
**********HYDROGRAPH DATA**********
Number of intervals = 368
Time interval = 1.0 (Min.)
Maximum/Peak flow rate = 5.469 (CFS)
Total volume = 0.234 (Ac.Ft)

Status of hydrographs being held in storage

	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Peak (CFS)	0.000	0.000	0.000	0.000	0.000
Vol (Ac.Ft)	0.000	0.000	0.000	0.000	0.000

****

++
Process from Point/Station 1.023 to Point/Station 1.031
**** RETARDING BASIN ROUTING ****

Program computation of outflow v. depth

CALCULATED OUTFLOW DATA AT DEPTH = 4.00(Ft.))
Pipe length = 10.00(Ft.) Elevation difference = 0.10(Ft.)
Manning's N = 0.013 No. of pipes = 1
Given pipe size = 1.00(In.)
NOTE: Assuming free outlet flow.
NOTE: Normal flow is pressure flow.
The total friction loss through the pipe is 3.850(Ft.)
Pipe friction loss = 3.279(Ft.)
Minor friction loss = 0.572(Ft.) K-factor = 1.50
Calculated flow rate through pipe(s) = 0.027(CFS)

Total outflow at this depth = 0.03(CFS)

CALCULATED OUTFLOW DATA AT DEPTH = 5.50(Ft.))
Pipe length = 10.00(Ft.) Elevation difference = 0.10(Ft.)

Manning's N = 0.013 No. of pipes = 1
Given pipe size = 1.00(In.)
 NOTE: Assuming free outlet flow.
NOTE: Normal flow is pressure flow.
The total friction loss through the pipe is 5.350(Ft.)
Pipe friction loss = 4.556(Ft.)
Minor friction loss = 0.795(Ft.) K-factor = 1.50
Calculated flow rate through pipe(s) = 0.032(CFS)

Total outflow at this depth = 0.03(CFS)

CALCULATED OUTFLOW DATA AT DEPTH = 6.00(Ft.))
Pipe length = 10.00(Ft.) Elevation difference = 0.10(Ft.)
Manning's N = 0.013 No. of pipes = 1
Given pipe size = 1.00(In.)
 NOTE: Assuming free outlet flow.
NOTE: Normal flow is pressure flow.
The total friction loss through the pipe is 5.850(Ft.)
Pipe friction loss = 4.982(Ft.)
Minor friction loss = 0.869(Ft.) K-factor = 1.50
Calculated flow rate through pipe(s) = 0.033(CFS)

Total outflow at this depth = 0.03(CFS)

CALCULATED OUTFLOW DATA AT DEPTH = 7.00(Ft.))
Pipe length = 10.00(Ft.) Elevation difference = 0.10(Ft.)
Manning's N = 0.013 No. of pipes = 1
Given pipe size = 1.00(In.)
 NOTE: Assuming free outlet flow.
NOTE: Normal flow is pressure flow.
The total friction loss through the pipe is 6.850(Ft.)
Pipe friction loss = 5.833(Ft.)
Minor friction loss = 1.018(Ft.) K-factor = 1.50
Calculated flow rate through pipe(s) = 0.036(CFS)

Free outlet pipe flow: Pipe Diameter = 0.75(Ft.)
Capacity = 8 * Pipe area * depth ^ 0.5(Using feet as units)
Note: Depth of 0.75(Ft.) is greater than diameter of pipe,
flow capacity is being calculated using depth = diameter
Depth above pipe = 1.00(Ft.) Capacity = 3.06(CFS)

Total outflow at this depth = 3.10(CFS)

Total number of inflow hydrograph intervals = 368
Hydrograph time unit = 1.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
4.000	0.051	0.027	0.051	0.051

5.500	0.071	0.032	0.071	0.071
6.000	0.089	0.033	0.089	0.089
7.000	0.132	3.097	0.130	0.134

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0 1.4 2.73 4.10 5.47	Depth (Ft.)
0.017	0.02	0.00	0.000	O	0.00
0.033	0.04	0.00	0.000	O	0.00
0.050	0.06	0.00	0.000	O	0.01
0.067	0.08	0.00	0.000	O	0.02
0.083	0.11	0.00	0.000	O	0.03
0.100	0.13	0.00	0.001	O	0.04
0.117	0.15	0.00	0.001	O	0.06
0.133	0.17	0.00	0.001	O	0.07
0.150	0.17	0.00	0.001	O	0.09
0.167	0.17	0.00	0.001	O	0.11
0.183	0.17	0.00	0.002	O	0.13
0.200	0.17	0.00	0.002	O	0.15
0.217	0.17	0.00	0.002	O	0.16
0.233	0.17	0.00	0.002	O	0.18
0.250	0.17	0.00	0.003	O	0.20
0.267	0.17	0.00	0.003	OI	0.22
0.283	0.17	0.00	0.003	OI	0.24
0.300	0.17	0.00	0.003	OI	0.26
0.317	0.17	0.00	0.003	OI	0.27
0.333	0.17	0.00	0.004	OI	0.29
0.350	0.17	0.00	0.004	OI	0.31
0.367	0.17	0.00	0.004	OI	0.33
0.383	0.18	0.00	0.004	OI	0.35
0.400	0.18	0.00	0.005	OI	0.37
0.417	0.18	0.00	0.005	OI	0.39
0.433	0.18	0.00	0.005	OI	0.40
0.450	0.18	0.00	0.005	OI	0.42
0.467	0.18	0.00	0.006	OI	0.44
0.483	0.18	0.00	0.006	OI	0.46
0.500	0.18	0.00	0.006	OI	0.48
0.517	0.18	0.00	0.006	OI	0.50
0.533	0.18	0.00	0.007	OI	0.52
0.550	0.18	0.00	0.007	OI	0.54
0.567	0.18	0.00	0.007	OI	0.56
0.583	0.18	0.00	0.007	OI	0.58
0.600	0.18	0.00	0.008	OI	0.59
0.617	0.18	0.00	0.008	OI	0.61
0.633	0.18	0.00	0.008	OI	0.63
0.650	0.18	0.00	0.008	OI	0.65
0.667	0.19	0.00	0.009	OI	0.67
0.683	0.19	0.00	0.009	OI	0.69
0.700	0.19	0.00	0.009	OI	0.71
0.717	0.19	0.00	0.009	OI	0.73
0.733	0.19	0.01	0.010	OI	0.75
0.750	0.19	0.01	0.010	OI	0.77
0.767	0.19	0.01	0.010	OI	0.79
0.783	0.19	0.01	0.010	OI	0.81
0.800	0.19	0.01	0.011	OI	0.83
0.817	0.19	0.01	0.011	OI	0.85
0.833	0.19	0.01	0.011	OI	0.87
0.850	0.19	0.01	0.011	OI	0.89
0.867	0.19	0.01	0.012	OI	0.91

0.883	0.19	0.01	0.012	OI				0.93
0.900	0.19	0.01	0.012	OI				0.95
0.917	0.19	0.01	0.012	OI				0.97
0.933	0.19	0.01	0.013	OI				0.99
0.950	0.20	0.01	0.013	OI				1.01
0.967	0.20	0.01	0.013	OI				1.03
0.983	0.20	0.01	0.013	OI				1.05
1.000	0.20	0.01	0.014	OI				1.07
1.017	0.20	0.01	0.014	OI				1.09
1.033	0.20	0.01	0.014	OI				1.11
1.050	0.20	0.01	0.014	OI				1.13
1.067	0.20	0.01	0.015	OI				1.15
1.083	0.20	0.01	0.015	OI				1.17
1.100	0.20	0.01	0.015	OI				1.19
1.117	0.20	0.01	0.015	OI				1.21
1.133	0.20	0.01	0.016	OI				1.24
1.150	0.20	0.01	0.016	OI				1.26
1.167	0.20	0.01	0.016	OI				1.28
1.183	0.21	0.01	0.017	OI				1.30
1.200	0.21	0.01	0.017	OI				1.32
1.217	0.21	0.01	0.017	OI				1.34
1.233	0.21	0.01	0.017	OI				1.36
1.250	0.21	0.01	0.018	OI				1.38
1.267	0.21	0.01	0.018	OI				1.41
1.283	0.21	0.01	0.018	OI				1.43
1.300	0.21	0.01	0.018	OI				1.45
1.317	0.21	0.01	0.019	OI				1.47
1.333	0.21	0.01	0.019	OI				1.49
1.350	0.21	0.01	0.019	OI				1.51
1.367	0.21	0.01	0.020	OI				1.54
1.383	0.21	0.01	0.020	OI				1.56
1.400	0.22	0.01	0.020	OI				1.58
1.417	0.22	0.01	0.020	OI				1.60
1.433	0.22	0.01	0.021	OI				1.62
1.450	0.22	0.01	0.021	OI				1.65
1.467	0.22	0.01	0.021	OI				1.67
1.483	0.22	0.01	0.022	OI				1.69
1.500	0.22	0.01	0.022	OI				1.71
1.517	0.22	0.01	0.022	OI				1.74
1.533	0.22	0.01	0.022	OI				1.76
1.550	0.22	0.01	0.023	OI				1.78
1.567	0.22	0.01	0.023	OI				1.81
1.583	0.22	0.01	0.023	OI				1.83
1.600	0.22	0.01	0.024	OI				1.85
1.617	0.23	0.01	0.024	OI				1.87
1.633	0.23	0.01	0.024	OI				1.90
1.650	0.23	0.01	0.024	OI				1.92
1.667	0.23	0.01	0.025	OI				1.94
1.683	0.23	0.01	0.025	OI				1.97
1.700	0.23	0.01	0.025	OI				1.99
1.717	0.23	0.01	0.026	OI				2.01
1.733	0.24	0.01	0.026	OI				2.04
1.750	0.24	0.01	0.026	OI				2.06
1.767	0.24	0.01	0.027	OI				2.09
1.783	0.24	0.01	0.027	OI				2.11
1.800	0.24	0.01	0.027	OI				2.13
1.817	0.24	0.01	0.028	OI				2.16
1.833	0.24	0.01	0.028	OI				2.18
1.850	0.24	0.01	0.028	OI				2.21
1.867	0.24	0.02	0.028	OI				2.23
1.883	0.24	0.02	0.029	OI				2.26
1.900	0.24	0.02	0.029	OI				2.28
1.917	0.25	0.02	0.029	OI				2.31

1.933	0.25	0.02	0.030	OI				2.33
1.950	0.25	0.02	0.030	OI				2.36
1.967	0.25	0.02	0.030	OI				2.38
1.983	0.25	0.02	0.031	OI				2.41
2.000	0.25	0.02	0.031	OI				2.43
2.017	0.26	0.02	0.031	OI				2.46
2.033	0.26	0.02	0.032	OI				2.48
2.050	0.26	0.02	0.032	OI				2.51
2.067	0.26	0.02	0.032	OI				2.54
2.083	0.26	0.02	0.033	OI				2.56
2.100	0.26	0.02	0.033	OI				2.59
2.117	0.26	0.02	0.033	OI				2.61
2.133	0.26	0.02	0.034	OI				2.64
2.150	0.26	0.02	0.034	OI				2.67
2.167	0.27	0.02	0.034	OI				2.69
2.183	0.27	0.02	0.035	OI				2.72
2.200	0.27	0.02	0.035	OI				2.75
2.217	0.27	0.02	0.035	OI				2.77
2.233	0.27	0.02	0.036	OI				2.80
2.250	0.28	0.02	0.036	OI				2.83
2.267	0.28	0.02	0.036	OI				2.86
2.283	0.28	0.02	0.037	OI				2.89
2.300	0.28	0.02	0.037	OI				2.91
2.317	0.28	0.02	0.038	OI				2.94
2.333	0.28	0.02	0.038	OI				2.97
2.350	0.28	0.02	0.038	OI				3.00
2.367	0.28	0.02	0.039	OI				3.03
2.383	0.29	0.02	0.039	OI				3.06
2.400	0.29	0.02	0.039	OI				3.08
2.417	0.29	0.02	0.040	OI				3.11
2.433	0.29	0.02	0.040	OI				3.14
2.450	0.29	0.02	0.040	OI				3.17
2.467	0.30	0.02	0.041	OI				3.20
2.483	0.30	0.02	0.041	OI				3.23
2.500	0.30	0.02	0.042	OI				3.26
2.517	0.31	0.02	0.042	OI				3.29
2.533	0.31	0.02	0.042	OI				3.32
2.550	0.31	0.02	0.043	OI				3.35
2.567	0.31	0.02	0.043	OI				3.38
2.583	0.31	0.02	0.044	OI				3.42
2.600	0.31	0.02	0.044	OI				3.45
2.617	0.32	0.02	0.044	OI				3.48
2.633	0.32	0.02	0.045	OI				3.51
2.650	0.32	0.02	0.045	OI				3.54
2.667	0.32	0.02	0.046	OI				3.57
2.683	0.32	0.02	0.046	OI				3.61
2.700	0.33	0.02	0.046	OI				3.64
2.717	0.33	0.02	0.047	OI				3.67
2.733	0.33	0.03	0.047	OI				3.70
2.750	0.34	0.03	0.048	OI				3.74
2.767	0.34	0.03	0.048	OI				3.77
2.783	0.34	0.03	0.049	O I				3.81
2.800	0.35	0.03	0.049	O I				3.84
2.817	0.35	0.03	0.049	O I				3.87
2.833	0.35	0.03	0.050	O I				3.91
2.850	0.35	0.03	0.050	O I				3.95
2.867	0.36	0.03	0.051	O I				3.98
2.883	0.36	0.03	0.051	O I				4.02
2.900	0.36	0.03	0.052	O I				4.05
2.917	0.36	0.03	0.052	O I				4.08
2.933	0.36	0.03	0.053	O I				4.12
2.950	0.37	0.03	0.053	O I				4.15
2.967	0.37	0.03	0.054	O I				4.19

2.983	0.38	0.03	0.054	O I				4.23
3.000	0.38	0.03	0.054	O I				4.26
3.017	0.39	0.03	0.055	O I				4.30
3.033	0.39	0.03	0.055	O I				4.34
3.050	0.40	0.03	0.056	O I				4.37
3.067	0.40	0.03	0.057	O I				4.41
3.083	0.41	0.03	0.057	O I				4.45
3.100	0.41	0.03	0.058	O I				4.49
3.117	0.41	0.03	0.058	O I				4.53
3.133	0.42	0.03	0.059	O I				4.57
3.150	0.42	0.03	0.059	O I				4.61
3.167	0.42	0.03	0.060	O I				4.65
3.183	0.42	0.03	0.060	O I				4.69
3.200	0.43	0.03	0.061	O I				4.73
3.217	0.44	0.03	0.061	O I				4.77
3.233	0.44	0.03	0.062	O I				4.82
3.250	0.45	0.03	0.062	O I				4.86
3.267	0.46	0.03	0.063	O I				4.90
3.283	0.47	0.03	0.064	O I				4.95
3.300	0.47	0.03	0.064	O I				4.99
3.317	0.48	0.03	0.065	O I				5.04
3.333	0.49	0.03	0.065	O I				5.09
3.350	0.50	0.03	0.066	O I				5.13
3.367	0.50	0.03	0.067	O I				5.18
3.383	0.51	0.03	0.067	O I				5.23
3.400	0.51	0.03	0.068	O I				5.28
3.417	0.52	0.03	0.069	O I				5.33
3.433	0.52	0.03	0.069	O I				5.38
3.450	0.53	0.03	0.070	O I				5.43
3.467	0.53	0.03	0.071	O I				5.48
3.483	0.55	0.03	0.071	O I				5.51
3.500	0.56	0.03	0.072	O I				5.53
3.517	0.58	0.03	0.073	O I				5.55
3.533	0.59	0.03	0.074	O I				5.57
3.550	0.61	0.03	0.074	O I				5.60
3.567	0.62	0.03	0.075	O I				5.62
3.583	0.64	0.03	0.076	O I				5.64
3.600	0.65	0.03	0.077	O I				5.66
3.617	0.66	0.03	0.078	O I				5.69
3.633	0.67	0.03	0.079	O I				5.71
3.650	0.68	0.03	0.080	O I				5.74
3.667	0.70	0.03	0.080	O I				5.76
3.683	0.71	0.03	0.081	O I				5.79
3.700	0.72	0.03	0.082	O I				5.81
3.717	0.73	0.03	0.083	O I				5.84
3.733	0.74	0.03	0.084	O I				5.87
3.750	0.78	0.03	0.085	O I				5.90
3.767	0.83	0.03	0.086	O I				5.93
3.783	0.87	0.03	0.087	O I				5.96
3.800	0.91	0.03	0.089	O I				5.99
3.817	0.96	0.09	0.090	O I				6.02
3.833	1.00	0.17	0.091	|O I				6.05
3.850	1.04	0.25	0.092	|O I				6.07
3.867	1.09	0.33	0.093	|O I				6.10
3.883	1.14	0.40	0.094	| O I				6.12
3.900	1.20	0.47	0.095	| O I|			6.14
3.917	1.25	0.55	0.096	| O I|			6.17
3.933	1.31	0.61	0.097	| O I|			6.19
3.950	1.36	0.68	0.098	| O I|			6.21
3.967	1.42	0.75	0.099	| O I				6.23
3.983	1.48	0.81	0.100	| O I				6.25
4.000	1.53	0.88	0.101	| O I				6.28
4.017	2.02	0.96	0.102	| O | I				6.30

4.033	2.52	1.08	0.104	O	I			6.34
4.050	3.01	1.24	0.106	O	I			6.39
4.067	3.50	1.43	0.109	O	I			6.46
4.083	3.99	1.65	0.112	O	I			6.53
4.100	4.48	1.89	0.115	O	I			6.61
4.117	4.98	2.15	0.119	O	I			6.69
4.133	5.47	2.44	0.123	O	I			6.79
4.150	4.89	2.70	0.126	O	I			6.87
4.167	4.32	2.88	0.129	O	I			6.93
4.183	3.74	2.98	0.130	O	I			6.96
4.200	3.17	3.03	0.131	OI				6.98
4.217	2.60	3.02	0.131	O	I			6.97
4.233	2.02	2.95	0.130	O	I			6.95
4.250	1.45	2.84	0.128	O	I			6.91
4.267	0.87	2.68	0.126	O	I			6.86
4.283	0.84	2.51	0.124	O	I			6.81
4.300	0.80	2.35	0.122	O	I			6.76
4.317	0.76	2.20	0.119	O	I			6.71
4.333	0.73	2.07	0.118	O	I			6.66
4.350	0.69	1.94	0.116	O	I			6.62
4.367	0.66	1.82	0.114	O	I			6.58
4.383	0.62	1.71	0.113	O	I			6.55
4.400	0.58	1.61	0.111	O	I			6.51
4.417	0.57	1.51	0.110	O	I			6.48
4.433	0.55	1.42	0.108	O	I			6.45
4.450	0.54	1.34	0.107	O	I			6.43
4.467	0.52	1.26	0.106	O	I			6.40
4.483	0.50	1.19	0.105	O	I			6.38
4.500	0.49	1.13	0.104	O	I			6.36
4.517	0.47	1.07	0.104	O	I			6.34
4.533	0.46	1.01	0.103	O	I			6.32
4.550	0.45	0.96	0.102	O	I			6.30
4.567	0.44	0.91	0.101	O	I			6.29
4.583	0.43	0.87	0.101	O	I			6.27
4.600	0.42	0.82	0.100	O	I			6.26
4.617	0.41	0.79	0.100	O	I			6.25
4.633	0.40	0.75	0.099	O	I			6.23
4.650	0.39	0.72	0.099	O	I			6.22
4.667	0.38	0.69	0.098	O	I			6.21
4.683	0.38	0.66	0.098	O	I			6.20
4.700	0.37	0.63	0.097	O	I			6.20
4.717	0.36	0.61	0.097	O	I			6.19
4.733	0.36	0.58	0.097	O	I			6.18
4.750	0.35	0.56	0.096	O	I			6.17
4.767	0.35	0.54	0.096	O	I			6.17
4.783	0.34	0.52	0.096	O	I			6.16
4.800	0.33	0.51	0.096	O	I			6.15
4.817	0.33	0.49	0.095	O	I			6.15
4.833	0.32	0.47	0.095	O	I			6.14
4.850	0.32	0.46	0.095	O	I			6.14
4.867	0.31	0.45	0.095	O	I			6.13
4.883	0.31	0.43	0.095	O	I			6.13
4.900	0.31	0.42	0.094	O	I			6.13
4.917	0.30	0.41	0.094	O	I			6.12
4.933	0.30	0.40	0.094	O	I			6.12
4.950	0.29	0.39	0.094	O	I			6.12
4.967	0.29	0.38	0.094	O	I			6.11
4.983	0.29	0.37	0.094	O	I			6.11
5.000	0.28	0.36	0.094	O	I			6.11
5.017	0.28	0.36	0.094	O	I			6.11
5.033	0.28	0.35	0.093	O	I			6.10
5.050	0.27	0.34	0.093	O	I			6.10
5.067	0.27	0.34	0.093	O	I			6.10

5.083	0.27	0.33	0.093	O				6.10
5.100	0.26	0.32	0.093	O				6.09
5.117	0.26	0.32	0.093	O				6.09
5.133	0.26	0.31	0.093	O				6.09
5.150	0.26	0.31	0.093	O				6.09
5.167	0.25	0.30	0.093	O				6.09
5.183	0.25	0.30	0.093	O				6.09
5.200	0.25	0.29	0.093	O				6.08
5.217	0.25	0.29	0.093	O				6.08
5.233	0.24	0.28	0.093	O				6.08
5.250	0.24	0.28	0.092	O				6.08
5.267	0.24	0.28	0.092	O				6.08
5.283	0.24	0.27	0.092	O				6.08
5.300	0.23	0.27	0.092	O				6.08
5.317	0.23	0.27	0.092	O				6.08
5.333	0.23	0.26	0.092	O				6.07
5.350	0.23	0.26	0.092	O				6.07
5.367	0.23	0.26	0.092	O				6.07
5.383	0.22	0.25	0.092	O				6.07
5.400	0.22	0.25	0.092	O				6.07
5.417	0.22	0.25	0.092	O				6.07
5.433	0.22	0.25	0.092	O				6.07
5.450	0.22	0.24	0.092	O				6.07
5.467	0.21	0.24	0.092	O				6.07
5.483	0.21	0.24	0.092	O				6.07
5.500	0.21	0.24	0.092	O				6.07
5.517	0.21	0.23	0.092	O				6.07
5.533	0.21	0.23	0.092	O				6.06
5.550	0.21	0.23	0.092	O				6.06
5.567	0.21	0.23	0.092	O				6.06
5.583	0.20	0.22	0.092	O				6.06
5.600	0.20	0.22	0.092	O				6.06
5.617	0.20	0.22	0.092	O				6.06
5.633	0.20	0.22	0.092	O				6.06
5.650	0.20	0.22	0.092	O				6.06
5.667	0.20	0.22	0.092	O				6.06
5.683	0.20	0.21	0.092	O				6.06
5.700	0.19	0.21	0.092	O				6.06
5.717	0.19	0.21	0.091	O				6.06
5.733	0.19	0.21	0.091	O				6.06
5.750	0.19	0.21	0.091	O				6.06
5.767	0.19	0.21	0.091	O				6.06
5.783	0.19	0.20	0.091	O				6.06
5.800	0.19	0.20	0.091	O				6.06
5.817	0.19	0.20	0.091	O				6.05
5.833	0.18	0.20	0.091	O				6.05
5.850	0.18	0.20	0.091	O				6.05
5.867	0.18	0.20	0.091	O				6.05
5.883	0.18	0.19	0.091	O				6.05
5.900	0.18	0.19	0.091	O				6.05
5.917	0.18	0.19	0.091	O				6.05
5.933	0.18	0.19	0.091	O				6.05
5.950	0.18	0.19	0.091	O				6.05
5.967	0.18	0.19	0.091	O				6.05
5.983	0.17	0.19	0.091	O				6.05
6.000	0.17	0.19	0.091	O				6.05
6.017	0.17	0.18	0.091	O				6.05
6.033	0.17	0.18	0.091	O				6.05
6.050	0.17	0.18	0.091	IO				6.05
6.067	0.17	0.18	0.091	IO				6.05
6.083	0.17	0.18	0.091	IO				6.05
6.100	0.17	0.18	0.091	IO				6.05
6.117	0.17	0.18	0.091	IO				6.05

6.133	0.17	0.18	0.091	IO				6.05
6.150	0.00	0.17	0.091	O				6.04
6.167	0.00	0.15	0.091	O				6.04
6.183	0.00	0.14	0.090	O				6.03
6.200	0.00	0.13	0.090	O				6.03
6.217	0.00	0.11	0.090	O				6.03
6.233	0.00	0.10	0.090	O				6.02
6.250	0.00	0.09	0.090	O				6.02
6.267	0.00	0.08	0.090	O				6.02
6.283	0.00	0.08	0.090	O				6.01
6.300	0.00	0.07	0.090	O				6.01
6.317	0.00	0.06	0.089	O				6.01
6.333	0.00	0.06	0.089	O				6.01
6.350	0.00	0.05	0.089	O				6.01
6.367	0.00	0.05	0.089	O				6.00
6.383	0.00	0.04	0.089	O				6.00
6.400	0.00	0.04	0.089	O				6.00
6.417	0.00	0.03	0.089	O				6.00
6.433	0.00	0.03	0.089	O				6.00
6.450	0.00	0.03	0.089	O				6.00
6.467	0.00	0.03	0.089	O				6.00
6.483	0.00	0.03	0.089	O				6.00
6.500	0.00	0.03	0.089	O				5.99
6.517	0.00	0.03	0.089	O				5.99
6.533	0.00	0.03	0.089	O				5.99
6.550	0.00	0.03	0.089	O				5.99
6.567	0.00	0.03	0.089	O				5.99
6.583	0.00	0.03	0.089	O				5.99
6.600	0.00	0.03	0.089	O				5.99
6.617	0.00	0.03	0.088	O				5.99
6.633	0.00	0.03	0.088	O				5.98
6.650	0.00	0.03	0.088	O				5.98
6.667	0.00	0.03	0.088	O				5.98
6.683	0.00	0.03	0.088	O				5.98
6.700	0.00	0.03	0.088	O				5.98
6.717	0.00	0.03	0.088	O				5.98
6.733	0.00	0.03	0.088	O				5.98
6.750	0.00	0.03	0.088	O				5.98
6.767	0.00	0.03	0.088	O				5.97
6.783	0.00	0.03	0.088	O				5.97
6.800	0.00	0.03	0.088	O				5.97
6.817	0.00	0.03	0.088	O				5.97
6.833	0.00	0.03	0.088	O				5.97
6.850	0.00	0.03	0.088	O				5.97
6.867	0.00	0.03	0.088	O				5.97
6.883	0.00	0.03	0.088	O				5.96
6.900	0.00	0.03	0.088	O				5.96
6.917	0.00	0.03	0.088	O				5.96
6.933	0.00	0.03	0.088	O				5.96
6.950	0.00	0.03	0.088	O				5.96
6.967	0.00	0.03	0.088	O				5.96
6.983	0.00	0.03	0.087	O				5.96
7.000	0.00	0.03	0.087	O				5.96
7.017	0.00	0.03	0.087	O				5.95
7.033	0.00	0.03	0.087	O				5.95
7.050	0.00	0.03	0.087	O				5.95
7.067	0.00	0.03	0.087	O				5.95
7.083	0.00	0.03	0.087	O				5.95
7.100	0.00	0.03	0.087	O				5.95
7.117	0.00	0.03	0.087	O				5.95
7.133	0.00	0.03	0.087	O				5.95
7.150	0.00	0.03	0.087	O				5.94
7.167	0.00	0.03	0.087	O				5.94

82.783	0.00	0.00	0.003	O	|	|	|	0.27
82.800	0.00	0.00	0.003	O	|	|	|	0.27
82.817	0.00	0.00	0.003	O	|	|	|	0.27
82.833	0.00	0.00	0.003	O	|	|	|	0.27
82.850	0.00	0.00	0.003	O	|	|	|	0.27
82.867	0.00	0.00	0.003	O	|	|	|	0.27
82.883	0.00	0.00	0.003	O	|	|	|	0.27
82.900	0.00	0.00	0.003	O	|	|	|	0.27
82.917	0.00	0.00	0.003	O	|	|	|	0.27
82.933	0.00	0.00	0.003	O	|	|	|	0.27
82.950	0.00	0.00	0.003	O	|	|	|	0.27
82.967	0.00	0.00	0.003	O	|	|	|	0.27
82.983	0.00	0.00	0.003	O	|	|	|	0.27
83.000	0.00	0.00	0.003	O	|	|	|	0.27
83.017	0.00	0.00	0.003	O	|	|	|	0.27
83.033	0.00	0.00	0.003	O	|	|	|	0.27
83.050	0.00	0.00	0.003	O	|	|	|	0.27
83.067	0.00	0.00	0.003	O	|	|	|	0.27
83.083	0.00	0.00	0.003	O	|	|	|	0.27
83.100	0.00	0.00	0.003	O	|	|	|	0.27
83.117	0.00	0.00	0.003	O	|	|	|	0.27
83.133	0.00	0.00	0.003	O	|	|	|	0.27
83.150	0.00	0.00	0.003	O	|	|	|	0.27
83.167	0.00	0.00	0.003	O	|	|	|	0.27
83.183	0.00	0.00	0.003	O	|	|	|	0.27
83.200	0.00	0.00	0.003	O	|	|	|	0.27
83.217	0.00	0.00	0.003	O	|	|	|	0.27
83.233	0.00	0.00	0.003	O	|	|	|	0.27
83.250	0.00	0.00	0.003	O	|	|	|	0.27
83.267	0.00	0.00	0.003	O	|	|	|	0.27
83.283	0.00	0.00	0.003	O	|	|	|	0.27
83.300	0.00	0.00	0.003	O	|	|	|	0.27
83.317	0.00	0.00	0.003	O	|	|	|	0.27
83.333	0.00	0.00	0.003	O	|	|	|	0.26

Remaining water in basin = 0.00 (Ac.Ft)

**********HYDROGRAPH DATA**********

Number of intervals = 5001
Time interval = 1.0 (Min.)
Maximum/Peak flow rate = 3.029 (CFS)
Total volume = 0.231 (Ac.Ft)

Status of hydrographs being held in storage

	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Peak (CFS)	0.000	0.000	0.000	0.000	0.000
Vol (Ac.Ft)	0.000	0.000	0.000	0.000	0.000

****

Attachment “E”

Mitigated Calculations

-16954Mit.out

16954Mit

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: 10/09/17

16954 Post

 *********   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) = 3.300
24 hour precipitation(inches) = 7.000
P6/P24 =   47.1%
San Diego hydrology manual 'C' values used

++
Process from Point/Station   1.011 to Point/Station   1.031
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
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 = 0.360
Rainfall intensity (I) =   4.917(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC = 12.10 min. Rain intensity =   4.92(In/Hr)
Total area =   1.500(Ac.) Total runoff =   3.000(CFS)

++
Process from Point/Station   1.031 to Point/Station   1.032
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 1837.000(Ft.)
Downstream point elevation = 1822.000(Ft.)
Channel length thru subarea =   142.000(Ft.)
Channel base width   =   0.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Manning's 'N'   = 0.015
Maximum depth of channel =   1.000(Ft.)

Flow(q) thru subarea = 3.000(CFS)
Depth of flow = 0.533(Ft.), Average velocity = 10.577(Ft/s)
Channel flow top width = 1.065(Ft.)
Flow Velocity = 10.58(Ft/s)
Travel time = 0.22 min.
Time of concentration = 12.32 min.
Critical depth = 0.891(Ft.)

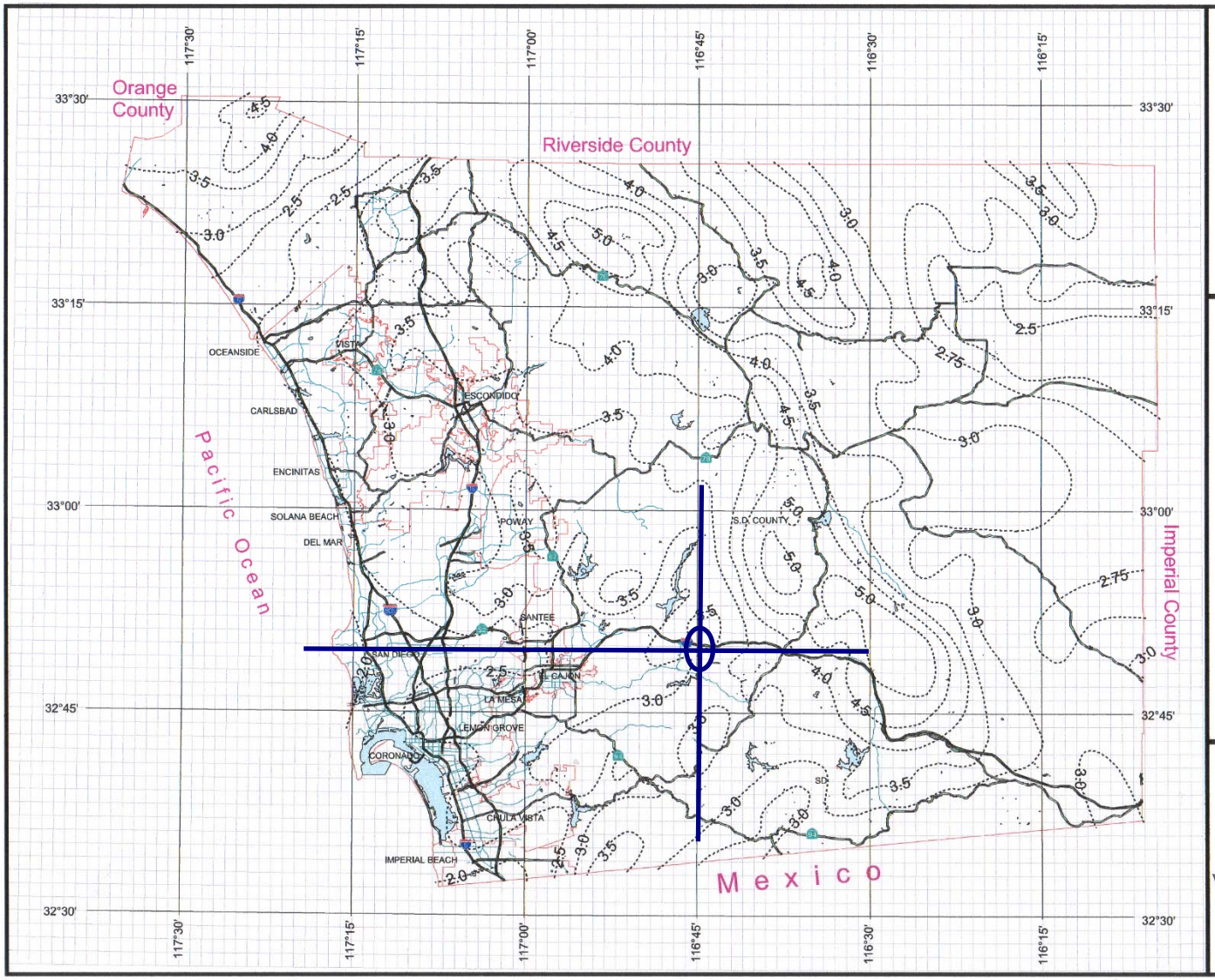
++
Process from Point/Station 1.032 to Point/Station 1.033
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1822.000(Ft.)
Downstream point elevation = 1820.800(Ft.)
Channel length thru subarea = 62.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 50.000
Slope or 'Z' of right channel bank = 50.000
Estimated mean flow rate at midpoint of channel = 3.083(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 3.083(CFS)
Depth of flow = 0.156(Ft.), Average velocity = 2.520(Ft/s)
Channel flow top width = 15.641(Ft.)
Flow Velocity = 2.52(Ft/s)
Travel time = 0.41 min.
Time of concentration = 12.73 min.
Critical depth = 0.188(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 4.758(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
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 = 0.360
Rainfall intensity = 4.758(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 0.652
Subarea runoff = 0.100(CFS) for 0.310(Ac.)
Total runoff = 3.100(CFS) Total area = 1.810(Ac.)
Depth of flow = 0.157(Ft.), Average velocity = 2.524(Ft/s)
Critical depth = 0.188(Ft.)
End of computations, total study area = 1.810 (Ac.)

Attachment “F”

Referenced Tables and Figures

-Rainfall Isopluvials: 100 Year 6 Hour and 24 Hour.
-San Diego County Soils Map
-Runoff Coefficients for Urban Areas (Table 3-1)
-Maximum Overland Flow Lengths and Initial Time of Concentration (Table 3-2)
-Time of concentration or Travel time for natural watershed (Fig 3-4)
-Intensity-Duration Design Chart (Fig 3-1)



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Lat:
32°50'02"
Long:
116°56'32"

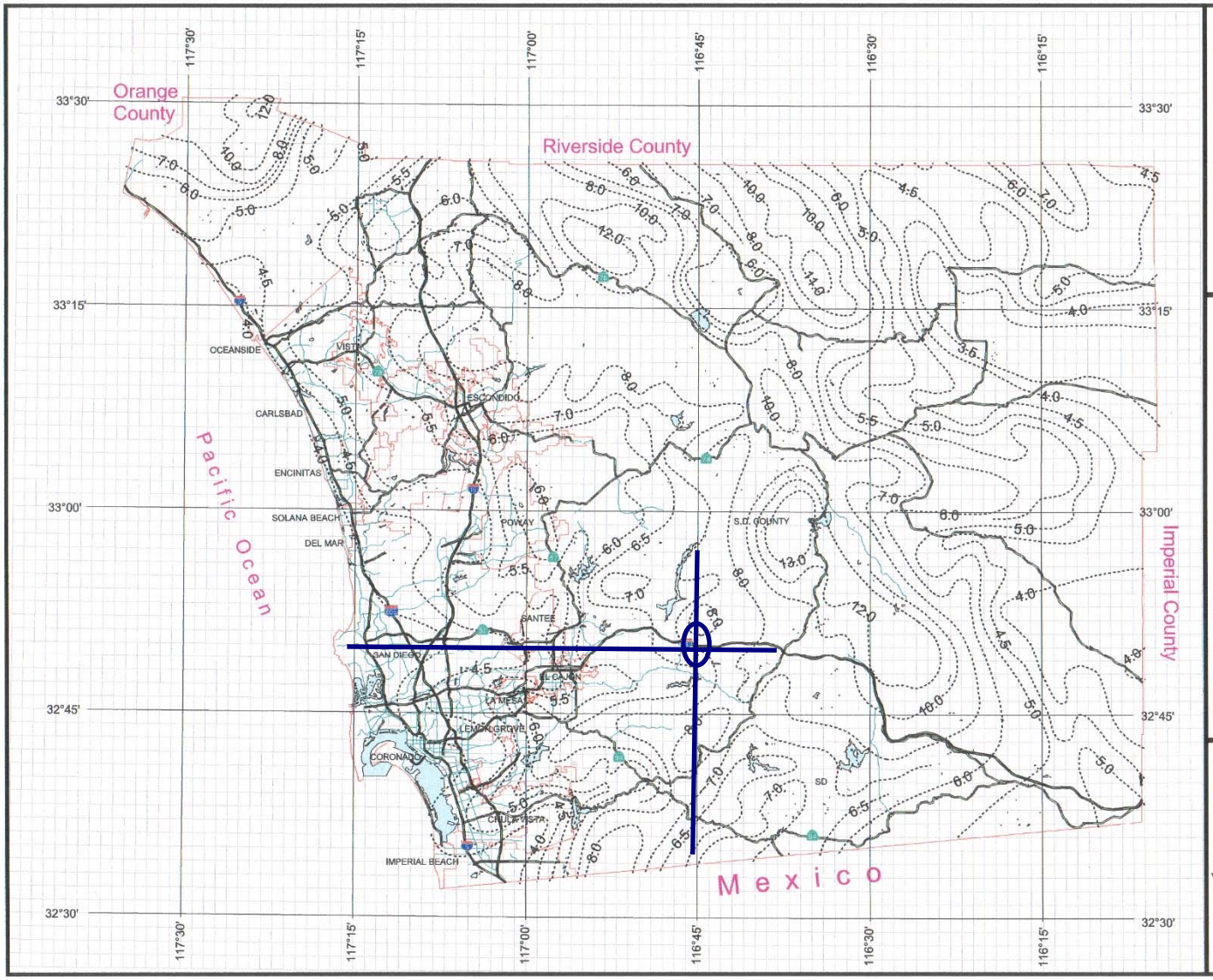
P6 =3.3 in

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 - 24 Hours

Isopluvial (inches)

Lat:
32°50'02"
Long:
116°56'32

P24 = 7.0 in

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

SOILS MAP - MARSHALL ROAD - TYPE C SOIL

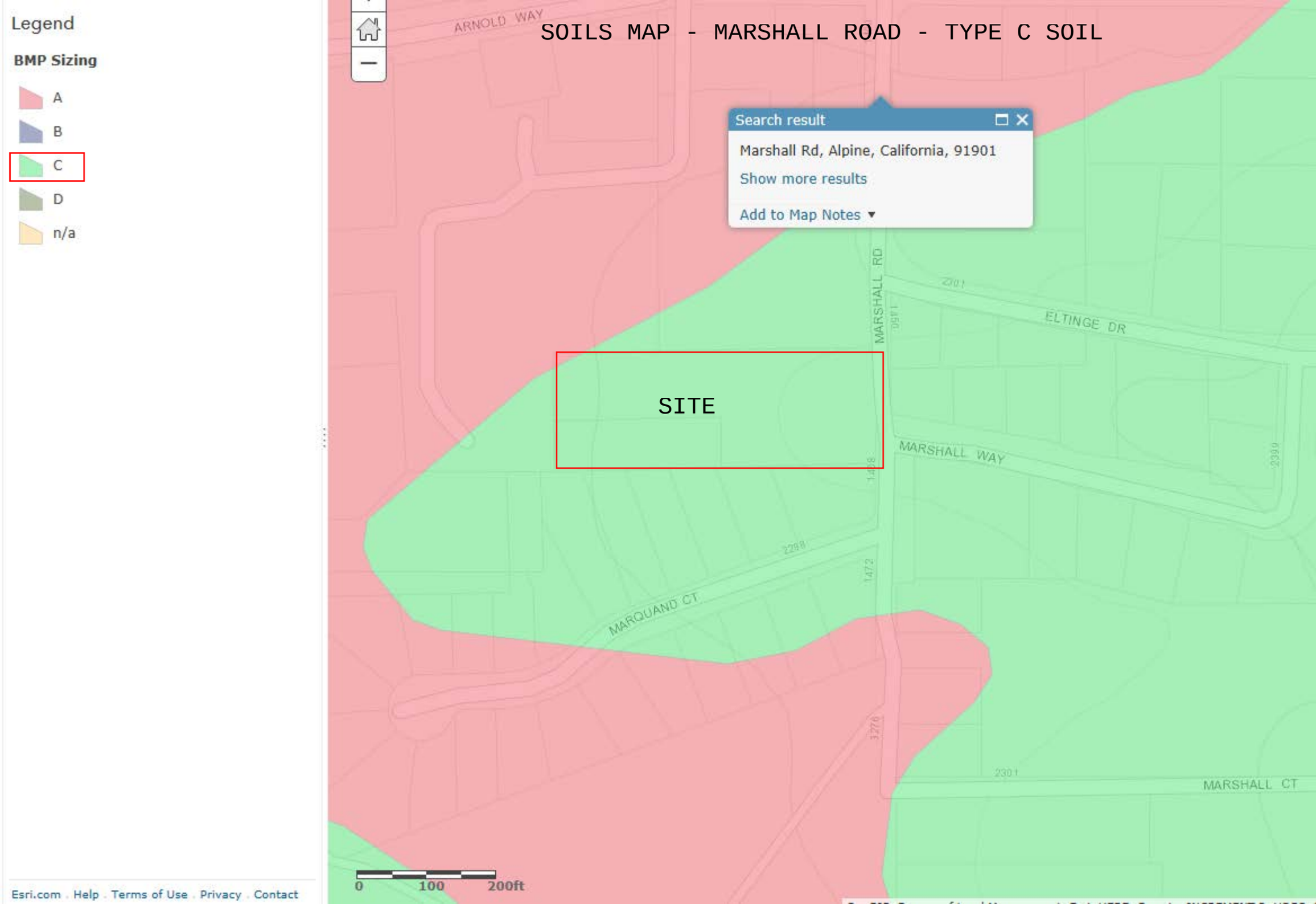


Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

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

Post-Developed (Sub-Basin 1-3)

Post-Developed (Sub-Basins 1-1 & 1-2)

Pre-Developed (Sub-Basins 1-1 & 1-2)

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.

Post-Developed

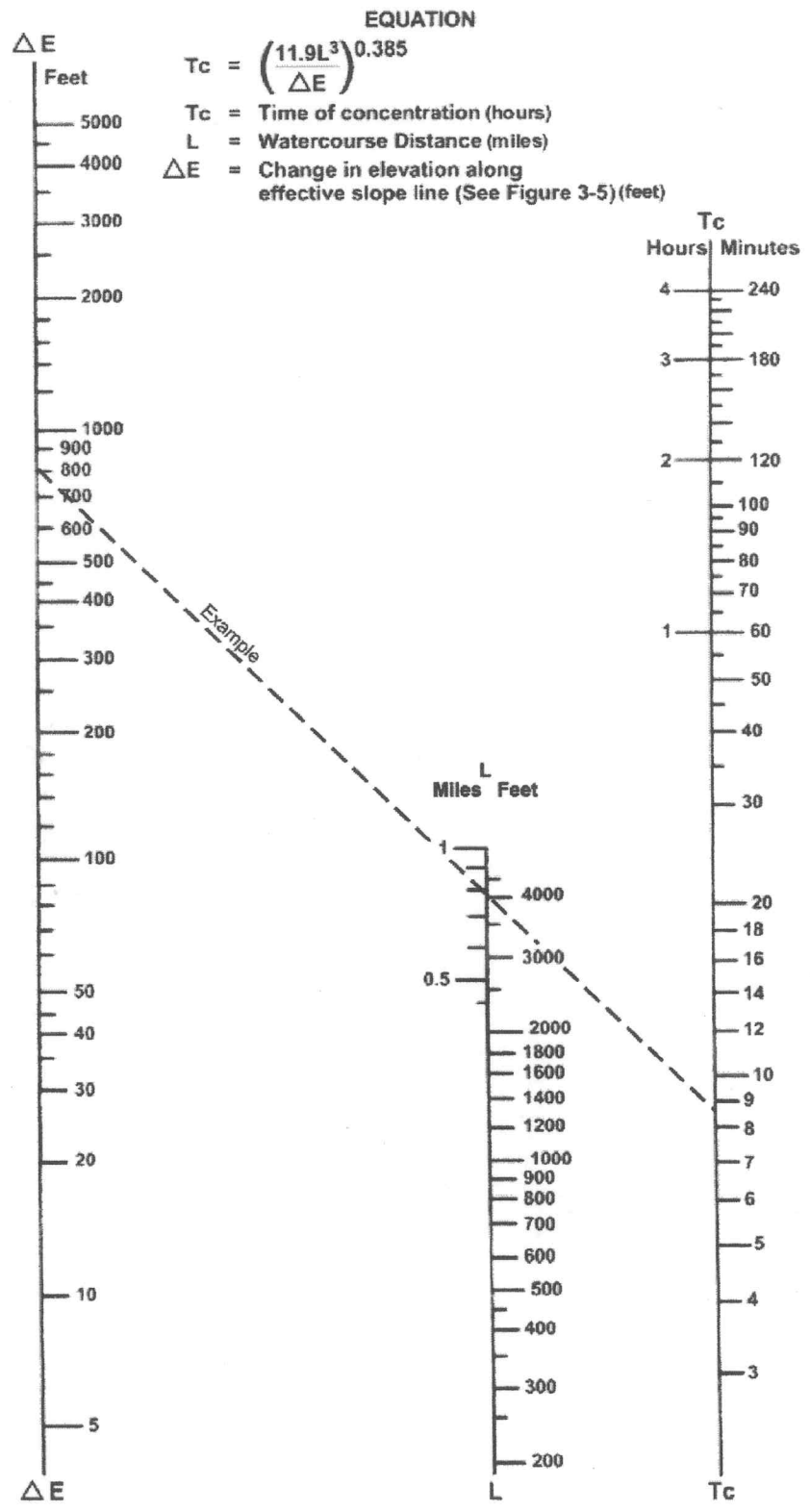
Pre-Developed

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	12.2	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

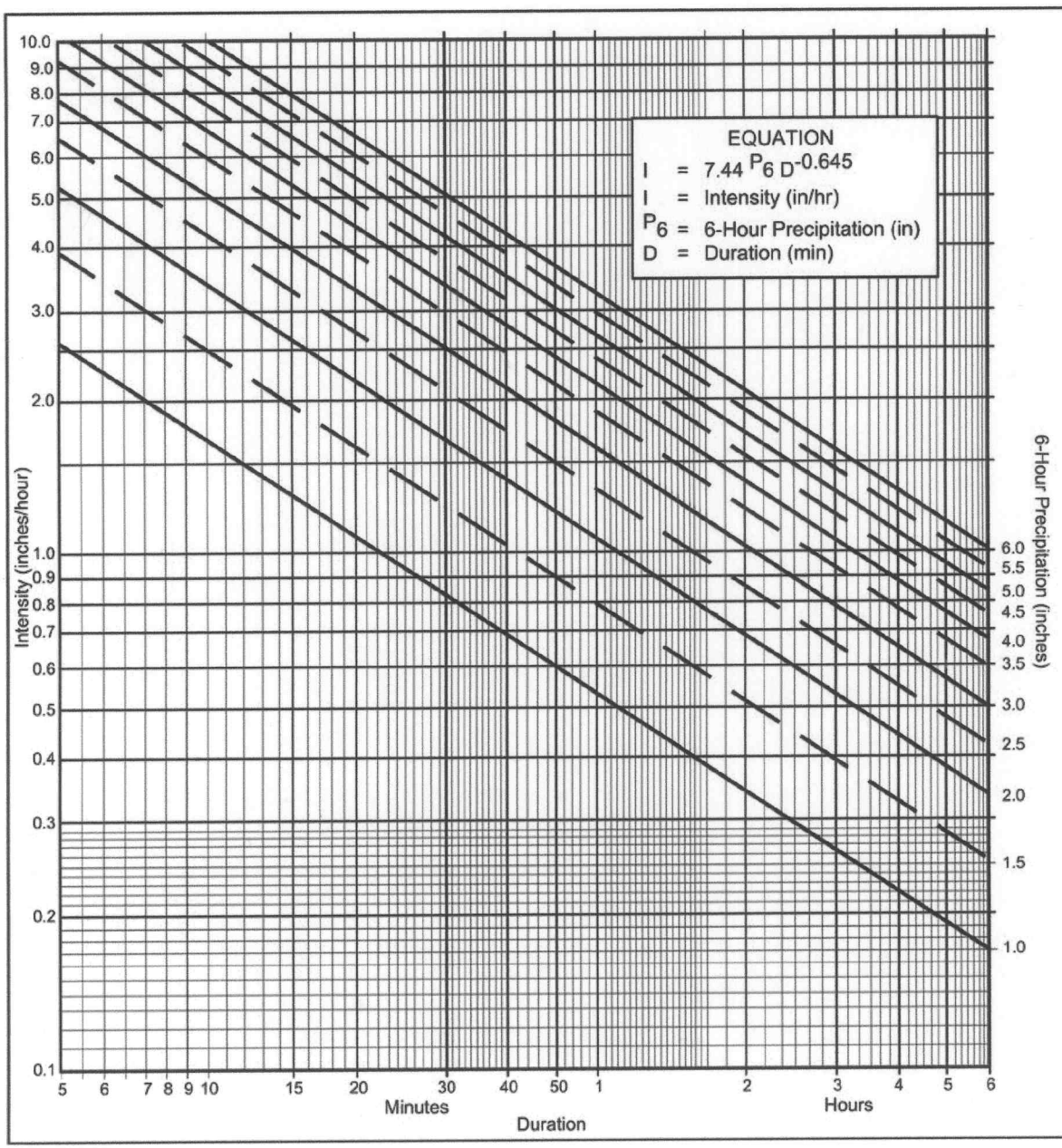
*See Table 3-1 for more detailed description



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds



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 _____ year

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

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

(d) t_x = _____ min.

(e) I = _____ in./hr.

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