CEQA Preliminary Hydrology/Drainage Study

For

Lake Jennings Park Road

Preparation: 3-25-14
Revision 6-23-14

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TM5578

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1 Project Summary

1.1 Introduction

The purpose of this drainage study is to obtain pre-project and post project peak runoff rates resulting from the 100-year 6-hour storm for the area where improvements are to take place within the County of San Diego, The hydrological analysis was conducted using the June 2003 County of San Diego Hydrology Manual and the July 2005 San Diego County Drainage Design Manual. The computations were performed with CIVILCADD/CIVILDESIGN Engineering Software, © 1989-2012 version 7.4, implementing the San Diego Rational Hydrology Program Option.

The proposed development includes a proposed bio-retention cell at the west low end; this facility will take care of water quality, hydromodification and flood control. This report will address specifically the flood control aspect.

This report will demonstrate that the bio-retention facility can handle the 100-year peak flow storm and that the post- development peak flow as a consequence of the 6-hour, 100-year storm event is equal or smaller than the peak flow occurring under pre-development conditions.

1.2 Project Description

The scope of this report is The Lake Jennings Park Road Residential Subdivision Development, a 5.17-Acre site located in the northeast corner of Lake Jennings Park Road and Blossom Valley Road, in the community of Lakeside, California.

The site is adjacent to single family homes to the northeast, a Mobile Home Park subdivision to the northwest and public roads to the southeast & southwest.

The site is currently undeveloped. Drainage runoff is from the high point located at the northeast side conveying sheet flows to the center area. There is an existing 30' RCP (Per TM-3639-1 and L-8834) discharging run-on from the adjacent upper basins to project site.

2 Method of Analysis

The Rational Method (RM) equation shall be used to determine storm runoff. The RM equation is as follows:

$Q=CIA$

Where:
Q= flow (in cfs)
C = runoff coefficient, ratio of rainfall that produces storm water runoff (runoff vs. infiltration/evaporation/absorption/etc)

I = average rainfall intensity for a duration equal to the Tc for the area, in inches per hour.
A = drainage area contributing to the basin in acres.

The rainfall intensity (I) is equal to:

I= 7.44 X P6 x D-O645

Where:
I = Intensity (in/hr)
P6 = 6-hour precipitation (inches)
D = duration (minutes - use Tc)

Using the Time of Concentration (Tc), which is the time required for a given element of water that originates at the most remote point of the basin being analyzed to reach the point at which the runoff from the basin is being analyzed

Area Hydrologic Conditions:

- The project site consists of soil class C.
- The 100-year 6-hour precipitation is 2.7 in.
- The 100-year 24-hour precipitation is 6.3 in.

The site has been divided into drainage Sub-Basins as shown in Appendices A & B. Sub Basin Areas and invert elevation calculations were calculated from the preliminary grading plans and existing topographic data as well as previous improvement plans.

A computer application of the County of San Diego Hydrology Manual was used to calculate the generated runoff and peak flows to the storm drain system. This program titled "San Diego County Rational Hydrology Program Package" is offered by CivilDesign ® Corporation and a complete program description is available upon request.

2.1 Attenuation Methodology

The reference program package incorporates a Modified Pulse Method routine for analyzing a storage routing retardation basin. To determine the affect the HMP bio-retention cell storage will have on the rational 100-year design storm the physical parameters of the HMP bio-retention cell are the input to this routine. The routine output is driven by a 6-hour hydrograph of the flow in, generated by the hydrology program and by the relationship between volume and elevation for the corresponding basin and by the relationship between discharge and elevation for the corresponding basin.
For routing purposes, it is assumed that the water reaches the bottom of the bio-retention basin instantly and the void spaces in the gravel and amended soil act as fully connected volume. See Appendix C for basin cross section and routing of hydrograph.

The HMP management requirements yielded a bigger volume storage requirement (See project SWMP for sizing) than needed for attenuation of the 100-year peak flows. Therefore the attenuated post development flows are reduced by over 2 cfs than pre-development conditions flows.

The outlet structure in both the Hydromodification analysis and this report are exactly for the bio-retention basin to insure that flood control and Hydromodification are both achieved.

3 Pre – Development Conditions

3.1 Project Site

Most of the run-on from upper basins that cross the site is coming from an existing 30" RCP pipe that discharges into the site at the northwest boundary. The existing pipe runs at 0.5%; with a flow of approximately 34.9 cfs. All runoff is routed following the natural grade on site to the southwest boundary to a concentration point that discharges into an existing earthen channel. The channel then transitions into the 44" x 72" CMP pipe conveying flows underground to the other side of Blossom valley Road into an earthen channel. Ultimately on-site and off-site flows discharge into Los Coches Creek.

*For more detailed results, including calculations, see Appendix A – Printout of Results for Existing Conditions.

4 Post - Development Conditions

4.1 Project Site

The development of the site will create impervious areas due to new paved driveways, sidewalk areas and the footprint of the houses. There will be an increase of 4.9 cfs peak flow after development; this added peak flow will be attenuated after routing within the proposed triple use bio-basin to below pre-development peak flows.

The project proposes to mitigate water quality by implementing LID techniques such as bioretention and self-retaining areas. Refer to the project Storm Water Management Plan for details and sizing of these facilities.

The resulting graded pads are to flow all runoff from the high points, typically back of the lot to the front of the property via surface flow and into proposed street gutters that ultimately discharge flows into the proposed bio basin

During the construction of this development the typical BMP's measures are to be on the ground (silt fence, BFM on resulting slopes, brow ditches, straw bales, etc) such measures are to be properly sized and designed during the grading plans phase approval.

*For more detailed results, including calculations see Appendix B– Printout of Results for Proposed Conditions.

5 Summary

A pre-development hydrograph was calculated as shown in Appendix A to estimate the pre-development Q100 peak flow. The maximum peak flow is determined to be **39.2cfs.** The post-development un-routed maximum flow is determined to be **45.4 cfs.**

The following table summarizes post-development peak flows before and after routing at the proposed bio-retention basin. (As determined by Appendices A and B).

Table 1

Sub-area →	**BASIN ONSITE A+B+G**	**BASIN OFFSITE X+Y+P+Q**	**TOTAL PROJECT (Confluenced at Node 75)**
Peak (unrouted)	10.4 cfs – Nodes 65 & 70	35.9 cfs Node 34	45.4 CFS
Peak (routed)	4.0 cfs Nodes 75 of Retarding Basin Routing	35.9 cfs Node 34	**39.4 CFS**

The following table summarizes onsite post-development peak flow value and the required basin volume for attenuation of flows to match predevelopment 100+-year peak flows.(As determined by Appendix C).

Table 2

Sub-area →	**BASIN ONSITE A+B+G**	**TOTAL Volume Required for 6.0 cfs attenuation**
Peak (unrouted)	10.4 cfs – Nodes 65 & 70	
Peak (routed)	4.0 cfs Nodes 75 of Retarding Basin Routing	**15,855 cu-ft**

6 Hydromodification

The residential project is considered a Priority Project as defined by the County's SUSMP and the project will need to manage Hydromodification.
The Hydromodification results are provided in the SWMP as part of the SWMM Technical Memorandum.

7 Conclusions

This report has been prepared in accordance with the County of San Diego Hydrology Manual. This report has evaluated and addressed the potential impacts and proposed mitigation measures. A summary of the facts and findings associated with this project and the measures addressed by this report is as follows:

- The project will not alter drainage patterns on the site or increase runoff after development.
- The proposed drainage pipes will be not working under pressure and will handle the 100-year storm runoff.
- The ultimate discharge points will not be changed and riprap energy dissipaters will be placed at the outlets of the new pipes to attenuate the flow velocities preventing downstream erosion.
- Graded areas and slopes will be hydroseeded to reduce or eliminate sediment discharge.
- Identify and discuss, with appropriate backup/research information, the following question item by item for CEQA purposes. Would the project:

A. Substantially alter the existing drainage patterns of the site or area, including through the alteration if the course of a stream or river, in a manner which would result in substantial erosion or siltation on – or off-site?

The project does not substantially alter the existing drainage pattern of the area, and it doesn't alter the course of a stream or river at all.
The storm drain system for the entire project is designed to route and convey all resulting runoff from developed conditions to existing points of discharge.

B. Substantially alter the existing drainage patterns 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?

The project will not substantially alter the existing drainage pattern of the area as it will not alter the course of a stream or river, and also will not substantially increase the rate or amount of surface runoff in a manner which would result in on- or off-site flooding.

C. Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems?

The project does not add flows since impervious areas have not been created.

D. 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? For example; research the foregoing and provide same (to indicate applicability or not) in the study?

The project does not place any housing within a 100-year flood hazard area.

E. Place within a 100-year flood hazard area structures which would impede or redirect flood flows?

There are no structures proposed within a 100-year flood hazard area.

F. 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-sit or off-site?

NA

8 DECLARATION OF RESPONSIBLE CHARGE

THIS PRELIMINARY DRAINAGE STUDY HAS BEEN PREPARED UNDER THE DIRECTION OF THE FOLLOWING REGISTERED CIVIL ENGINEER. THE REGISTERED ENGINEER ATTESTS TO THE TECHNICAL INFORMATION CONTAINED HEREIN AND THE ENGINEERING DATA UPON WHICH RECOMMENDATIONS, CONCLUSIONS, AND DECISIONS ARE BASED

BRUCE A. ROBERTSON *R.C.E. 48529* 8/4/14 *DATE*
EXPIRES ON 6/30/14

REGISTERED PROFESSIONAL ENGINEER
BRUCE A. ROBERTSON
NO.48529
EXP. 6/30/14
CIVIL
STATE OF CALIFORNIA

APPENDIX A
EXISTING CONDITIONS

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: 10/29/13

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

Program License Serial Number 6292

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) = 6.300
P6/P24 = 42.9%
Adjusted 6 hour precipitation (inches) = 2.835
Adjusted P6/P24 = 45.0%
San Diego hydrology manual 'C' values used

LAKE JENNINGS PARK ROAD RESIDENTIAL DEVELOPMENT
100 YR PEAK FLOWS - PRE DEVELOPMENT CONDITIONS

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****
BASIN X-X (OFFSITE)

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
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 1000.400(Ft.)
Lowest elevation = 975.000(Ft.)
Elevation difference = 25.400(Ft.) Slope = 25.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 25.40 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 4.90 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*(100.000^.5)/(25.400^(1/3)]= 4.90

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Calculated TC of    4.899 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      7.469(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.896(CFS)
Total initial stream area =        0.400(Ac.)


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Process from Point/Station        2.000 to Point/Station        3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
BASIN X (OFFSITE)
------------------------------------------------------------------------
Upstream point elevation =   975.000(Ft.)
Downstream point elevation =   823.000(Ft.)
Channel length thru subarea  =   390.000(Ft.)
Channel base width       =   10.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =      6.138(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      6.138(CFS)
Depth of flow =   0.074(Ft.), Average velocity =   7.987(Ft/s)
Channel flow top width =   10.741(Ft.)
Flow Velocity =    7.99(Ft/s)
Travel time  =    0.81 min.
Time of concentration =    5.71 min.
Critical depth =      0.219(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      6.854(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
[UNDISTURBED NATURAL TERRAIN                    ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity =      6.854(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      1.650
Subarea runoff =     10.413(CFS) for      5.100(Ac.)
Total runoff =     11.310(CFS)      Total area =       5.500(Ac.)
Depth of flow =   0.107(Ft.), Average velocity =  10.076(Ft/s)
Critical depth =      0.324(Ft.)


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Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
BASIN Y (OFFSITE)
------------------------------------------------------------------------
Upstream point elevation =   823.000(Ft.)
Downstream point elevation =   756.000(Ft.)
Channel length thru subarea  =  2200.000(Ft.)
Channel base width       =   24.000(Ft.)
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Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     23.153(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     23.153(CFS)
Depth of flow =   0.177(Ft.), Average velocity =   5.405(Ft/s)
Channel flow top width =   24.354(Ft.)
Flow Velocity =    5.41(Ft/s)
Travel time  =    6.78 min.
Time of concentration =   12.50 min.
Critical depth =      0.305(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.137(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                        ]
(2.9 DU/A or Less       )
Impervious value, Ai = 0.250
Sub-Area C Value = 0.450
Rainfall intensity =      4.137(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.410  CA =      8.445
Subarea runoff =     23.629(CFS) for     15.100(Ac.)
Total runoff =     34.939(CFS)      Total area =      20.600(Ac.)
Depth of flow =   0.227(Ft.), Average velocity =   6.358(Ft/s)
Critical depth =      0.402(Ft.)


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Process from Point/Station        5.000 to Point/Station        6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
EXISTING 18" RCP
------------------------------------------------------------------------------
Upstream point/station elevation =   745.800(Ft.)
Downstream point/station elevation =   736.300(Ft.)
Pipe length  =   130.00(Ft.) Slope =   0.0731  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    34.939(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
    13.982(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =     14.377(Ft.)
 Minor friction loss =      9.105(Ft.)    K-factor =   1.50
Pipe flow velocity =     19.77(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =    12.61 min.
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Process from Point/Station        6.000 to Point/Station        8.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
EXISTING 30" RCP

------------------------------------------------------------------------------
Upstream point/station elevation =   736.300(Ft.)
Downstream point/station elevation =   736.240(Ft.)
Pipe length  =    12.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    34.939(CFS)
Given pipe size =     30.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.207(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.087(Ft.)
 Minor friction loss =      1.180(Ft.)    K-factor =   1.50
Pipe flow velocity =      7.12(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    12.63 min.


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Process from Point/Station        8.000 to Point/Station       30.000
**** IMPROVED CHANNEL TRAVEL TIME ****
BASIN A

------------------------------------------------------------------------------
Upstream point elevation =   736.240(Ft.)
Downstream point elevation =   712.000(Ft.)
Channel length thru subarea  =   330.000(Ft.)
Channel base width       =    6.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     34.974(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     34.974(CFS)
Depth of flow =   0.453(Ft.), Average velocity =  10.491(Ft/s)
Channel flow top width =    8.718(Ft.)
Flow Velocity =   10.49(Ft/s)
Travel time  =    0.52 min.
Time of concentration =   13.16 min.
Critical depth =      0.875(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.002(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
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
The area added to the existing stream causes a
a lower flow rate of Q =     34.599(CFS)
therefore the upstream flow rate of Q =     34.939(CFS) is being used
Rainfall intensity =      4.002(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
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(Q=KCIA) is C = 0.406  CA =      8.646
Subarea runoff =      0.000(CFS) for      0.670(Ac.)
Total runoff =     34.939(CFS)      Total area =      21.270(Ac.)
Depth of flow =   0.453(Ft.), Average velocity =  10.488(Ft/s)
Critical depth =      0.875(Ft.)


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Process from Point/Station       30.000 to Point/Station       30.000
**** CONFLUENCE OF MINOR STREAMS ****
BASIN X + BASIN Y + BASIN A
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     21.270(Ac.)
Runoff from this stream =     34.939(CFS)
Time of concentration =   13.16 min.
Rainfall intensity =     4.002(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)


1        34.939     13.16                4.002
Qmax(1) =
          1.000 *    1.000 *    34.939) + =      34.939

Total of 1 streams to confluence:
Flow rates before confluence point:
       34.939
Maximum flow rates at confluence using above data:
        34.939
Area of streams before confluence:
       21.270
Results of confluence:
Total flow rate =     34.939(CFS)
Time of concentration =    13.158 min.
Effective stream area after confluence =     21.270(Ac.)


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Process from Point/Station       10.000 to Point/Station       20.000
**** INITIAL AREA EVALUATION ****
BASIN B-B
------------------------------------------------------------------------
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
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space    )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  782.000(Ft.)
Lowest elevation =  776.000(Ft.)
Elevation difference =    6.000(Ft.) Slope =  6.000 %
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INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   6.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   7.92 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(   6.000^(1/3)]=   7.92
Rainfall intensity (I) =      5.550(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.200(CFS)
Total initial stream area =        0.120(Ac.)


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Process from Point/Station       20.000 to Point/Station       30.000
**** IMPROVED CHANNEL TRAVEL TIME ****
BASIN B
------------------------------------------------------------------------------
Upstream point elevation =   776.000(Ft.)
Downstream point elevation =   712.000(Ft.)
Channel length thru subarea  =   490.000(Ft.)
Channel base width       =    6.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      1.320(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.320(CFS)
Depth of flow =   0.056(Ft.), Average velocity =   3.840(Ft/s)
Channel flow top width =    6.334(Ft.)
Flow Velocity =    3.84(Ft/s)
Travel time  =    2.13 min.
Time of concentration =   10.05 min.
Critical depth =      0.112(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.761(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
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity =      4.761(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      0.501
Subarea runoff =      2.185(CFS) for      1.550(Ac.)
Total runoff =      2.385(CFS)      Total area =       1.670(Ac.)
Depth of flow =   0.079(Ft.), Average velocity =   4.822(Ft/s)
Critical depth =      0.166(Ft.)
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Process from Point/Station       30.000 to Point/Station       30.000
**** CONFLUENCE OF MINOR STREAMS ****
BASIN X + BASIN Y + BASIN A + BASIN B
--------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.670(Ac.)
Runoff from this stream =      2.385(CFS)
Time of concentration =   10.05 min.
Rainfall intensity =     4.761(In/Hr)
Summary of stream data:

Stream    Flow rate       TC             Rainfall Intensity
 No.        (CFS)        (min)                   (In/Hr)


1        34.939      13.16                4.002
2         2.385      10.05                4.761
Qmax(1) =
          1.000 *     1.000 *    34.939) +
          0.841 *     1.000 *     2.385) + =      36.944
Qmax(2) =
          1.000 *     0.764 *    34.939) +
          1.000 *     1.000 *     2.385) + =      29.074

Total of 2 streams to confluence:
Flow rates before confluence point:
      34.939       2.385
Maximum flow rates at confluence using above data:
       36.944       29.074
Area of streams before confluence:
       21.270        1.670
Results of confluence:
Total flow rate =     36.944(CFS)
Time of concentration =    13.158 min.
Effective stream area after confluence =     22.940(Ac.)


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Process from Point/Station       30.000 to Point/Station       70.000
**** IMPROVED CHANNEL TRAVEL TIME ****
BASIN C
--------------------------------------------------------------------------------
Upstream point elevation =   712.000(Ft.)
Downstream point elevation =   698.000(Ft.)
Channel length thru subarea  =   270.000(Ft.)
Channel base width       =    6.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     36.990(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     36.990(CFS)
Depth of flow =   0.516(Ft.), Average velocity =   9.496(Ft/s)
Channel flow top width =    9.096(Ft.)
```

```
Flow Velocity =    9.50(Ft/s)
Travel time  =    0.47 min.
Time of concentration =   13.63 min.
Critical depth =      0.906(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =     3.911(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
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space    )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
The area added to the existing stream causes a
a lower flow rate of Q =    36.858(CFS)
therefore the upstream flow rate of Q =    36.944(CFS) is being used
Rainfall intensity =     3.911(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.395  CA =      9.423
Subarea runoff =      0.000(CFS) for      0.920(Ac.)
Total runoff =     36.944(CFS)      Total area =      23.860(Ac.)
Depth of flow =   0.516(Ft.), Average velocity =   9.492(Ft/s)
Critical depth =      0.906(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       70.000 to Point/Station       70.000
**** CONFLUENCE OF MINOR STREAMS ****
BASIN X + BASIN Y + BASIN A + BASIN B + BASIN C
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     23.860(Ac.)
Runoff from this stream =     36.944(CFS)
Time of concentration =   13.63 min.
Rainfall intensity =     3.911(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)


1       36.944     13.63                3.911
Qmax(1) =
         1.000 *    1.000 *    36.944) + =      36.944

Total of 1 streams to confluence:
Flow rates before confluence point:
      36.944
Maximum flow rates at confluence using above data:
       36.944
Area of streams before confluence:
       23.860
Results of confluence:
Total flow rate =     36.944(CFS)
Time of concentration =    13.632 min.
Effective stream area after confluence =     23.860(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station       60.000
**** INITIAL AREA EVALUATION ****
BASIN D-D
------------------------------------------------------------------------------
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
[UNDISTURBED NATURAL TERRAIN                    ]
(Permanent Open Space    )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  755.000(Ft.)
Lowest elevation =  727.500(Ft.)
Elevation difference =   27.500(Ft.) Slope = 27.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  27.50 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.77 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  27.500^(1/3)]=   4.77
Calculated TC of    4.771 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      7.469(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.583(CFS)
Total initial stream area =        0.260(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       70.000
**** IMPROVED CHANNEL TRAVEL TIME ****
BASIN D
------------------------------------------------------------------------------
Upstream point elevation =   727.500(Ft.)
Downstream point elevation =   698.000(Ft.)
Channel length thru subarea  =   625.000(Ft.)
Channel base width       =    6.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      1.935(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.935(CFS)
Depth of flow =   0.095(Ft.), Average velocity =   3.248(Ft/s)
Channel flow top width =    6.569(Ft.)
Flow Velocity =    3.25(Ft/s)
Travel time  =    3.21 min.
Time of concentration =    7.98 min.
Critical depth =      0.145(Ft.)
 Adding area flow to channel
```

```
Rainfall intensity (I) =      5.526(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
[UNDISTURBED NATURAL TERRAIN                    ]
(Permanent Open Space    )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity =      5.526(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      0.579
Subarea runoff =      2.617(CFS) for      1.670(Ac.)
Total runoff =      3.200(CFS)      Total area =      1.930(Ac.)
Depth of flow =   0.128(Ft.), Average velocity =   3.923(Ft/s)
Critical depth =      0.199(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       70.000 to Point/Station       70.000
**** CONFLUENCE OF MINOR STREAMS ****
BASIN X + BASIN Y + BASIN A + BASIN B + BASIN C + BASIN D
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.930(Ac.)
Runoff from this stream =      3.200(CFS)
Time of concentration =    7.98 min.
Rainfall intensity =     5.526(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)


1       36.944     13.63                3.911
2        3.200      7.98                5.526
Qmax(1) =
         1.000 *    1.000 *    36.944) +
         0.708 *    1.000 *     3.200) + =      39.208
Qmax(2) =
         1.000 *    0.585 *    36.944) +
         1.000 *    1.000 *     3.200) + =      24.820

Total of 2 streams to confluence:
Flow rates before confluence point:
      36.944       3.200
Maximum flow rates at confluence using above data:
       39.208       24.820
Area of streams before confluence:
       23.860        1.930
Results of confluence:
Total flow rate =     39.208(CFS)
Time of concentration =    13.632 min.
Effective stream area after confluence =     25.790(Ac.)
```

++
Process from Point/Station 70.000 to Point/Station 70.000
**** 6 HOUR HYDROGRAPH ****

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

Time of Concentration = 13.63
Basin Area = 25.79 Acres
6 Hour Rainfall = 2.835 Inches
Runoff Coefficient = 0.388
Peak Discharge = 39.21 CFS

Time (Min)	Discharge (CFS)
0	0.000
13	1.730
26	1.773
39	1.869
52	1.922
65	2.041
78	2.108
91	2.261
104	2.348
117	2.552
130	2.673
143	2.964
156	3.144
169	3.604
182	3.907
195	4.776
208	5.440
221	7.987
234	11.254
247	39.208
260	6.406
273	4.286
286	3.354
299	2.809
312	2.445
325	2.181
338	1.980
351	1.820
364	1.689

++
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

Hydrograph in 1 Minute intervals ((CFS))

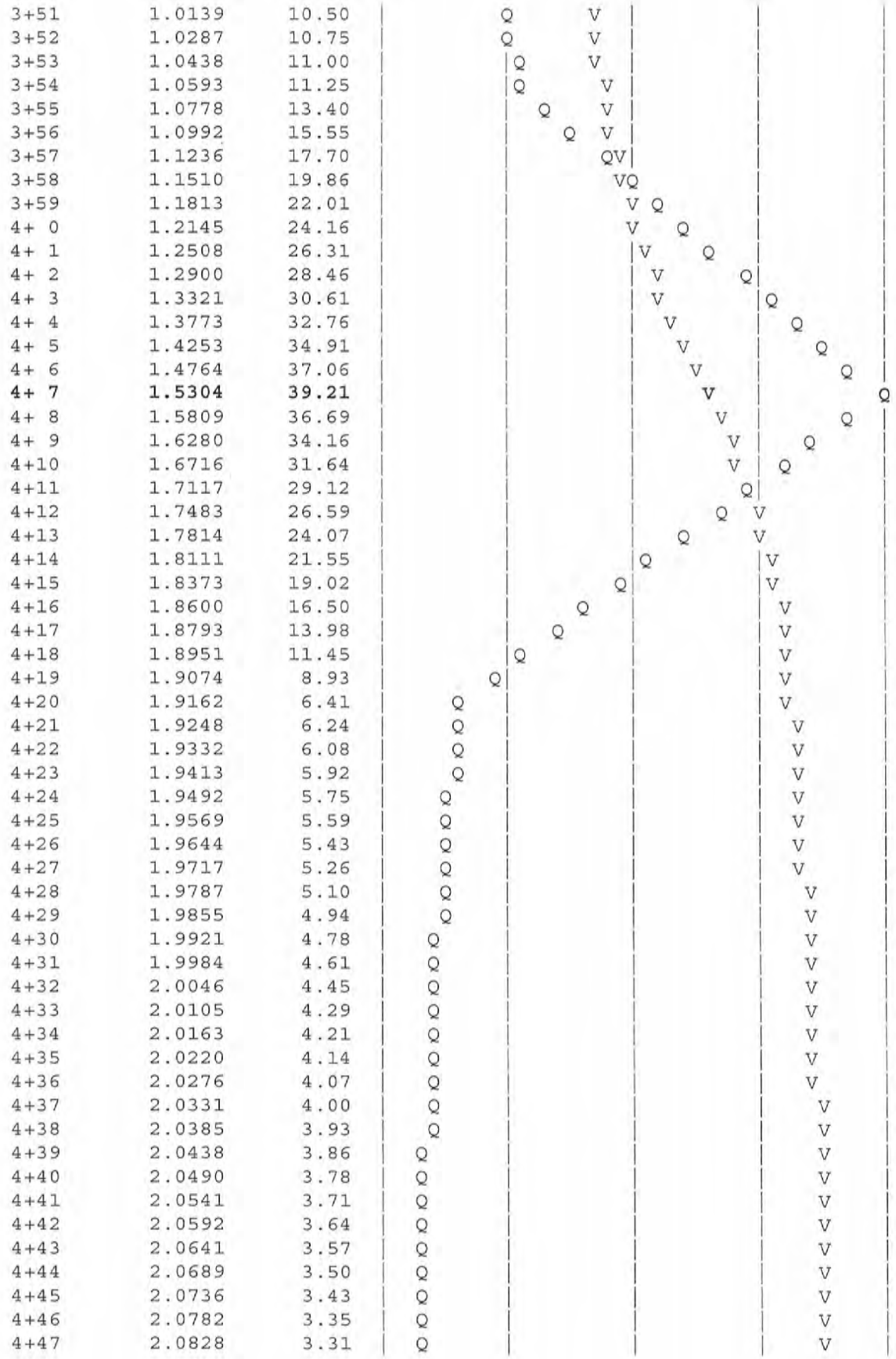
Time(h+m)	Volume Ac.Ft	Q(CFS)	0	9.8	19.6	29.4	39.2
0+ 0	0.0000	0.00	Q	|	|	|	|
0+ 1	0.0002	0.13	Q	|	|	|	|
0+ 2	0.0005	0.27	Q	|	|	|	|

0+ 3	0.0011	0.40	Q				
0+ 4	0.0018	0.53	Q				
0+ 5	0.0027	0.67	Q				
0+ 6	0.0038	0.80	Q				
0+ 7	0.0051	0.93	Q				
0+ 8	0.0066	1.06	VQ				
0+ 9	0.0082	1.20	VQ				
0+10	0.0101	1.33	VQ				
0+11	0.0121	1.46	VQ				
0+12	0.0143	1.60	VQ				
0+13	0.0167	1.73	VQ				
0+14	0.0191	1.73	VQ				
0+15	0.0215	1.74	VQ				
0+16	0.0239	1.74	VQ				
0+17	0.0263	1.74	VQ				
0+18	0.0287	1.75	VQ				
0+19	0.0311	1.75	VQ				
0+20	0.0335	1.75	VQ				
0+21	0.0359	1.76	VQ				
0+22	0.0383	1.76	VQ				
0+23	0.0408	1.76	VQ				
0+24	0.0432	1.77	VQ				
0+25	0.0456	1.77	VQ				
0+26	0.0481	1.77	VQ				
0+27	0.0505	1.78	VQ				
0+28	0.0530	1.79	VQ				
0+29	0.0555	1.80	VQ				
0+30	0.0579	1.80	VQ				
0+31	0.0604	1.81	|Q				
0+32	0.0629	1.82	|Q				
0+33	0.0655	1.82	|Q				
0+34	0.0680	1.83	|Q				
0+35	0.0705	1.84	|Q				
0+36	0.0731	1.85	|Q				
0+37	0.0756	1.85	|Q				
0+38	0.0782	1.86	|Q				
0+39	0.0807	1.87	|Q				
0+40	0.0833	1.87	|Q				
0+41	0.0859	1.88	|Q				
0+42	0.0885	1.88	|Q				
0+43	0.0911	1.89	|Q				
0+44	0.0937	1.89	|Q				
0+45	0.0963	1.89	|Q				
0+46	0.0989	1.90	|Q				
0+47	0.1015	1.90	|Q				
0+48	0.1042	1.91	|Q				
0+49	0.1068	1.91	|Q				
0+50	0.1094	1.91	|Q				
0+51	0.1121	1.92	|Q				
0+52	0.1147	1.92	|Q				
0+53	0.1174	1.93	|QV				
0+54	0.1201	1.94	|QV				
0+55	0.1227	1.95	|QV				
0+56	0.1254	1.96	|QV				
0+57	0.1282	1.97	| Q				
0+58	0.1309	1.98	| Q				
0+59	0.1336	1.99	| Q				

1+ 0	0.1364	2.00	Q				
1+ 1	0.1391	2.00	Q				
1+ 2	0.1419	2.01	Q				
1+ 3	0.1447	2.02	Q				
1+ 4	0.1475	2.03	Q				
1+ 5	0.1503	2.04	Q				
1+ 6	0.1531	2.05	Q				
1+ 7	0.1559	2.05	Q				
1+ 8	0.1588	2.06	Q				
1+ 9	0.1616	2.06	Q				
1+10	0.1645	2.07	Q				
1+11	0.1673	2.07	Q				
1+12	0.1702	2.08	Q				
1+13	0.1730	2.08	Q				
1+14	0.1759	2.09	QV				
1+15	0.1788	2.09	QV				
1+16	0.1817	2.10	QV				
1+17	0.1846	2.10	QV				
1+18	0.1875	2.11	QV				
1+19	0.1904	2.12	QV				
1+20	0.1934	2.13	QV				
1+21	0.1963	2.14	QV				
1+22	0.1993	2.16	QV				
1+23	0.2023	2.17	QV				
1+24	0.2053	2.18	QV				
1+25	0.2083	2.19	QV				
1+26	0.2113	2.20	QV				
1+27	0.2144	2.21	QV				
1+28	0.2174	2.23	QV				
1+29	0.2205	2.24	QV				
1+30	0.2236	2.25	QV				
1+31	0.2267	2.26	QV				
1+32	0.2298	2.27	QV				
1+33	0.2330	2.27	Q V				
1+34	0.2361	2.28	Q V				
1+35	0.2393	2.29	Q V				
1+36	0.2424	2.29	Q V				
1+37	0.2456	2.30	Q V				
1+38	0.2488	2.31	Q V				
1+39	0.2520	2.31	Q V				
1+40	0.2552	2.32	Q V				
1+41	0.2584	2.33	Q V				
1+42	0.2616	2.33	Q V				
1+43	0.2648	2.34	Q V				
1+44	0.2680	2.35	Q V				
1+45	0.2713	2.36	Q V				
1+46	0.2746	2.38	Q V				
1+47	0.2779	2.40	Q V				
1+48	0.2812	2.41	Q V				
1+49	0.2845	2.43	Q V				
1+50	0.2879	2.44	Q V				
1+51	0.2913	2.46	Q V				
1+52	0.2947	2.47	Q V				
1+53	0.2981	2.49	Q V				
1+54	0.3016	2.51	Q V				
1+55	0.3051	2.52	Q V				
1+56	0.3085	2.54	Q V				

1+57	0.3121	2.55	Q V			
1+58	0.3156	2.56	Q V			
1+59	0.3191	2.57	Q V			
2+ 0	0.3227	2.58	Q V			
2+ 1	0.3263	2.59	Q V			
2+ 2	0.3298	2.60	Q V			
2+ 3	0.3334	2.61	Q V			
2+ 4	0.3370	2.62	Q V			
2+ 5	0.3406	2.63	Q V			
2+ 6	0.3443	2.64	Q V			
2+ 7	0.3479	2.65	Q V			
2+ 8	0.3516	2.65	Q V			
2+ 9	0.3552	2.66	Q V			
2+10	0.3589	2.67	Q V			
2+11	0.3626	2.70	Q V			
2+12	0.3664	2.72	Q V			
2+13	0.3702	2.74	Q V			
2+14	0.3740	2.76	Q V			
2+15	0.3778	2.79	Q V			
2+16	0.3817	2.81	Q V			
2+17	0.3856	2.83	Q V			
2+18	0.3895	2.85	Q V			
2+19	0.3935	2.87	Q V			
2+20	0.3974	2.90	Q V			
2+21	0.4015	2.92	Q V			
2+22	0.4055	2.94	Q V			
2+23	0.4096	2.96	Q V			
2+24	0.4137	2.98	Q V			
2+25	0.4178	2.99	Q V			
2+26	0.4220	3.01	Q V			
2+27	0.4261	3.02	Q V			
2+28	0.4303	3.03	Q V			
2+29	0.4345	3.05	Q V			
2+30	0.4387	3.06	Q V			
2+31	0.4430	3.07	Q V			
2+32	0.4472	3.09	Q V			
2+33	0.4515	3.10	Q V			
2+34	0.4558	3.12	Q V			
2+35	0.4601	3.13	Q V			
2+36	0.4644	3.14	Q V			
2+37	0.4688	3.18	Q V			
2+38	0.4732	3.21	Q V			
2+39	0.4777	3.25	Q V			
2+40	0.4822	3.29	Q V			
2+41	0.4868	3.32	Q V			
2+42	0.4914	3.36	Q V			
2+43	0.4961	3.39	Q V			
2+44	0.5008	3.43	Q V			
2+45	0.5056	3.46	Q V			
2+46	0.5104	3.50	Q V			
2+47	0.5153	3.53	Q V			
2+48	0.5202	3.57	Q V			
2+49	0.5251	3.60	Q V			
2+50	0.5301	3.63	Q V			
2+51	0.5352	3.65	Q V			
2+52	0.5402	3.67	Q V			
2+53	0.5453	3.70	Q V			

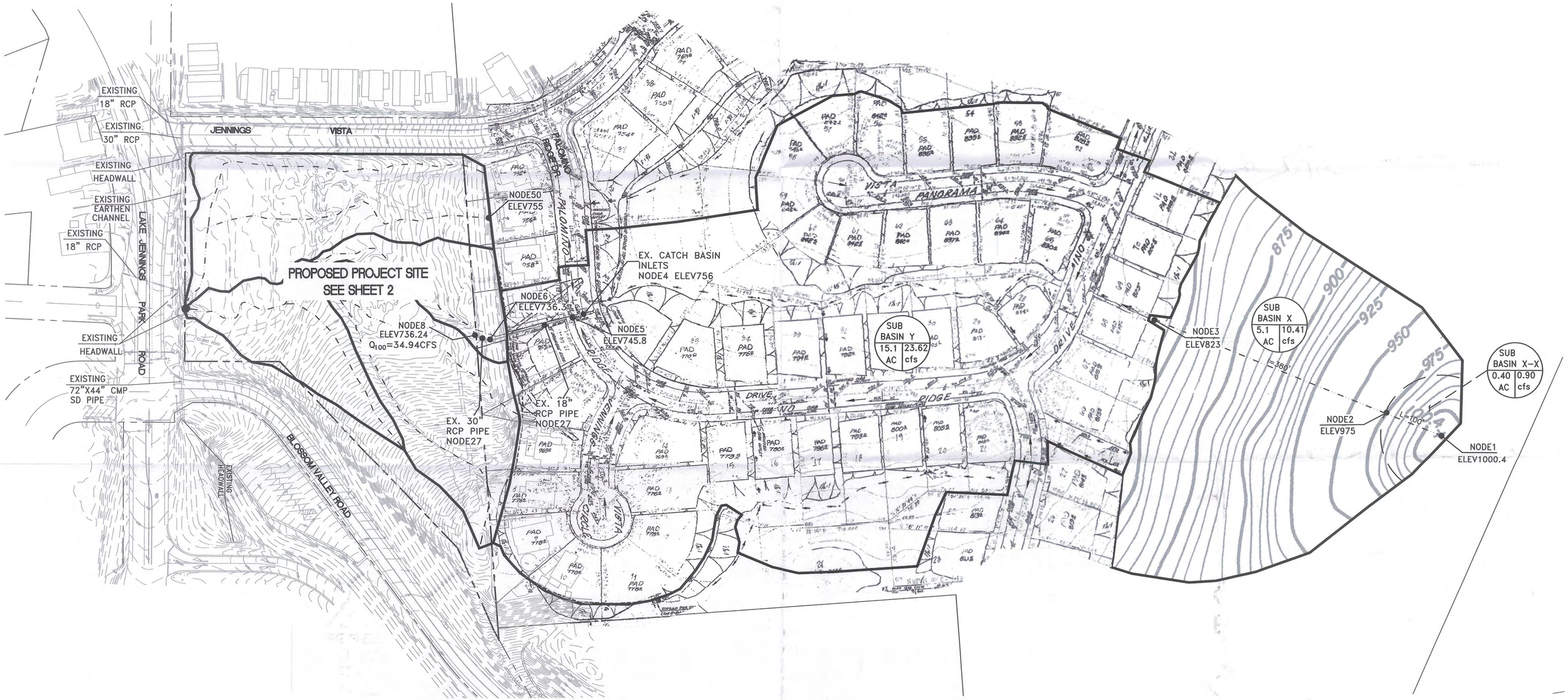
2+54	0.5504	3.72	Q V				
2+55	0.5556	3.74	Q V				
2+56	0.5608	3.77	Q V				
2+57	0.5660	3.79	Q V				
2+58	0.5713	3.81	Q V				
2+59	0.5765	3.84	Q V				
3+ 0	0.5819	3.86	Q V				
3+ 1	0.5872	3.88	Q V				
3+ 2	0.5926	3.91	Q V				
3+ 3	0.5981	3.97	Q V				
3+ 4	0.6036	4.04	Q V				
3+ 5	0.6093	4.11	Q V				
3+ 6	0.6150	4.17	Q V				
3+ 7	0.6209	4.24	Q V				
3+ 8	0.6268	4.31	Q V				
3+ 9	0.6328	4.37	Q V				
3+10	0.6390	4.44	Q V				
3+11	0.6452	4.51	Q V				
3+12	0.6515	4.58	Q V				
3+13	0.6579	4.64	Q V				
3+14	0.6644	4.71	Q V				
3+15	0.6709	4.78	Q V				
3+16	0.6776	4.83	Q V				
3+17	0.6843	4.88	Q V				
3+18	0.6911	4.93	Q V				
3+19	0.6980	4.98	Q V				
3+20	0.7049	5.03	Q V				
3+21	0.7119	5.08	Q V				
3+22	0.7190	5.13	Q V				
3+23	0.7261	5.18	Q V				
3+24	0.7333	5.24	Q V				
3+25	0.7406	5.29	Q V				
3+26	0.7479	5.34	Q V				
3+27	0.7554	5.39	Q V				
3+28	0.7629	5.44	Q V				
3+29	0.7706	5.64	Q V				
3+30	0.7786	5.83	Q V				
3+31	0.7870	6.03	Q V				
3+32	0.7955	6.22	Q V				
3+33	0.8044	6.42	Q V				
3+34	0.8135	6.62	Q V				
3+35	0.8229	6.81	Q V				
3+36	0.8325	7.01	Q V				
3+37	0.8424	7.20	Q V				
3+38	0.8526	7.40	Q V				
3+39	0.8631	7.60	Q V				
3+40	0.8738	7.79	Q V				
3+41	0.8848	7.99	Q V				
3+42	0.8962	8.24	Q V				
3+43	0.9079	8.49	Q V				
3+44	0.9199	8.74	Q V				
3+45	0.9323	8.99	Q V				
3+46	0.9450	9.24	Q V				
3+47	0.9581	9.49	Q V				
3+48	0.9715	9.75	Q V				
3+49	0.9853	10.00	Q V				
3+50	0.9994	10.25	Q V				



4+48	2.0873	3.27	Q			V
4+49	2.0917	3.23	Q			V
4+50	2.0961	3.19	Q			V
4+51	2.1005	3.14	Q			V
4+52	2.1047	3.10	Q			V
4+53	2.1089	3.06	Q			V
4+54	2.1131	3.02	Q			V
4+55	2.1172	2.98	Q			V
4+56	2.1212	2.93	Q			V
4+57	2.1252	2.89	Q			V
4+58	2.1292	2.85	Q			V
4+59	2.1330	2.81	Q			V
5+ 0	2.1369	2.78	Q			V
5+ 1	2.1406	2.75	Q			V
5+ 2	2.1444	2.73	Q			V
5+ 3	2.1481	2.70	Q			V
5+ 4	2.1518	2.67	Q			V
5+ 5	2.1554	2.64	Q			V
5+ 6	2.1590	2.61	Q			V
5+ 7	2.1626	2.58	Q			V
5+ 8	2.1661	2.56	Q			V
5+ 9	2.1696	2.53	Q			V
5+10	2.1730	2.50	Q			V
5+11	2.1764	2.47	Q			V
5+12	2.1798	2.44	Q			V
5+13	2.1832	2.42	Q			V
5+14	2.1865	2.40	Q			V
5+15	2.1897	2.38	Q			V
5+16	2.1930	2.36	Q			V
5+17	2.1962	2.34	Q			V
5+18	2.1994	2.32	Q			V
5+19	2.2026	2.30	Q			V
5+20	2.2057	2.28	Q			V
5+21	2.2089	2.26	Q			V
5+22	2.2120	2.24	Q			V
5+23	2.2150	2.22	Q			V
5+24	2.2180	2.20	Q			V
5+25	2.2211	2.18	Q			V
5+26	2.2240	2.17	Q			V
5+27	2.2270	2.15	Q			V
5+28	2.2299	2.13	Q			V
5+29	2.2329	2.12	Q			V
5+30	2.2358	2.10	Q			V
5+31	2.2386	2.09	Q			V
5+32	2.2415	2.07	Q			V
5+33	2.2443	2.06	Q			V
5+34	2.2471	2.04	Q			V
5+35	2.2499	2.03	Q			V
5+36	2.2527	2.01	Q			V
5+37	2.2554	2.00	Q			V
5+38	2.2582	1.98	Q			V
5+39	2.2609	1.97	Q			V
5+40	2.2636	1.95	Q			V
5+41	2.2662	1.94	Q			V
5+42	2.2689	1.93	Q			V
5+43	2.2715	1.92	Q			V
5+44	2.2742	1.91	Q			V

5+45	2.2768	1.89	Q				V
5+46	2.2794	1.88	Q				V
5+47	2.2819	1.87	Q				V
5+48	2.2845	1.86	Q				V
5+49	2.2870	1.84	Q				V
5+50	2.2896	1.83	Q				V
5+51	2.2921	1.82	Q				V
5+52	2.2946	1.81	Q				V
5+53	2.2970	1.80	Q				V
5+54	2.2995	1.79	Q				V
5+55	2.3020	1.78	Q				V
5+56	2.3044	1.77	Q				V
5+57	2.3068	1.76	Q				V
5+58	2.3092	1.75	Q				V
5+59	2.3116	1.74	Q				V
6+ 0	2.3140	1.73	Q				V
6+ 1	2.3164	1.72	Q				V
6+ 2	2.3187	1.71	Q				V
6+ 3	2.3211	1.70	Q				V
6+ 4	2.3234	1.69	Q				V

End of computations, total study area = 25.790 (Ac.)



LEGEND

BASIN DESIGNATOR

AREA (AC)

Q (CFS)

BASIN LIMITS

PROJECT BOUNDARY

NODE ELEV. 2295

NODE NUMBER 5

FLOW-LINE

0 40 80 160 240

SCALE: 1"= 80'

"LAKE JENNINGS PARK ROAD" HYDROLOGY MAP EXISTING CONDITIONS OFFSITE BASIN

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