DRAINAGE STUDY

FOR

AUTOZONE
PDS2017-LDGRMJ-30144

Valley Center, California

April 4, 2018

Prepared By:

Alidade ENGINEERING
41743 Enterprise Circle North, Suite 209
Temecula, CA 92590
(951) 587-2020

REGISTERED PROFESSIONAL ENGINEER
BRENT C. MOORE
No. 59121
6/30/19
CIVIL
STATE OF CALIFORNIA

Brent C. Moore RCE 59121
Registration Expires 6-30-2019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

SITE AND PROJECT DESCRIPTION:

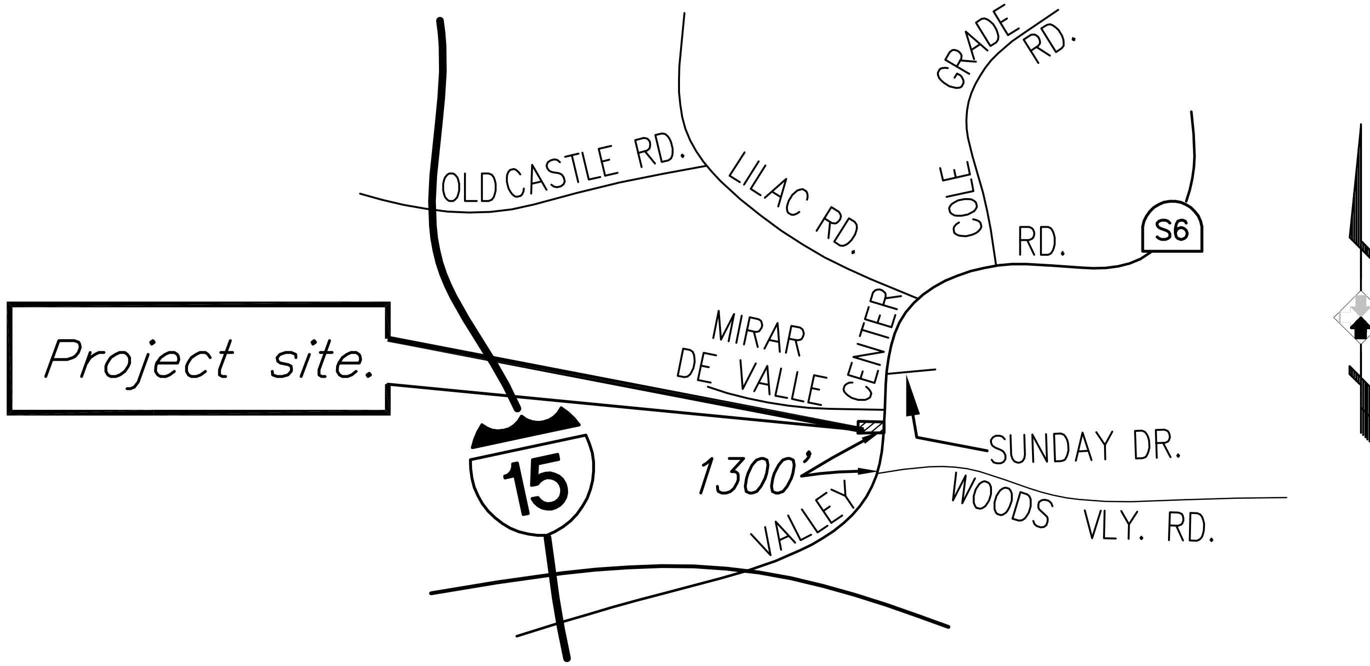
This drainage study has been prepared as part of the Grading Permit submittal requirements for the AutoZone project. The project consists of construction of one 7,380 square foot commercial building with parking lot, hardscape and landscaping on a 0.850 acre parcel. In addition, a private access road will be constructed to the north of the property to provide delivery truck access to the building. The private access road will be accessed off the unnamed private road serving the Tractor Supply property along with existing residential properties to the west and will terminate south of the Old Mirar De Valle Road. The site is located east of Interstate 15 on Valley Center Road between Woods Valley Road and Lilac Road in Valley Center, California. The site can be accessed from an unnamed private road that runs east – west from Valley Center Road located adjacent to the southerly properly line. The site is bound by Old Mirar De Valle to the north, Valley Center Road to the east, commercial development (future Tractor Supply) to the south and future residential to the west. See Figure No. 1 for Vicinity Map. See Figures 2A and 2B Existing and Proposed Hydrology Maps attached at the end of this report for the on-site and tributary offsite drainage basins. A Storm Water Quality Management Plan (SWQMP) will be prepared as a separate document and included with the plan submittal to address both pre-and post-construction BMPs.

The adjacent land uses are commercial to the south (future Tractor Supply) and east and undeveloped (future residential) to the north and west. Tributary drainage areas of approximately 1.2 acres extend to the south and west into the low density single-family developed area which is predominately undeveloped with a few homesites with typical landscaping.

The pre-project site topography is characterized by gentle slopes. The pre-project site topography descends in a northerly and easterly direction. The highest elevation at the southwest corner is approximately 1316.2 feet and the lowest elevation near the northeast corner of the site is approximately 1303.0. The topographic source for the project was a site topographic survey prepared by Alidade Engineering in October, 2016 combined with the assumed as-built condition of the Tractor Supply property to the south based upon construction drawings prepared by Alidade Engineering dated January, 2017. County of San Diego 200-scale topographic map sheet number 378-1755 was utilized to supplement the offsite topography along with an aerial topo survey performed by SanLo Aerial dated September, 2010 to aid in determining the offsite tributary drainage basins.

METHODOLOGY

This drainage study has been prepared in accordance with the current County of San Diego regulations and procedures. All storm water calculations were based on the 100-year storm event. The AES Rational Method Hydrology Computer Program (Version 17.0), developed by Advanced Engineering Software, was utilized to compute the onsite runoff for the developed condition in order to properly size the on-site drainage facilities (inlets, catch basins and pipes). The proposed biofiltration basin and underground storm water detention system were sized by REC Consultants. See Appendix 9 for the 100-year routing analysis. The following references have been used in preparation of this report:



INTERSECTION OF VALLEY CENTER ROAD AND
WOODS VALLEY ROAD 1,300 FEET TO S'LY PROPERTY LINE AT VALLEY CENTER ROAD.

VICINITY MAP

NOT TO SCALE
THOMAS BROS. 1090-E4

(1) San Diego County Hydrology Manual, June, 2003.
(2) San Diego County Hydraulic Design Manual, September 2014.
(3) Kings Handbook of Hydraulics, E.F. Brater & H.W. King, 6th Ed., 1976.
(4) County of San Diego BMP Design Manual, February, 2016.

HYDROLOGIC ANALYSIS:

The Rational Method is the most widely used hydrologic model for estimating peak runoff rates. Applied to small urban and semi-urban areas with drainage areas less than one square mile, the Rational Method relates storm rainfall intensity, a runoff coefficient, and drainage area to peak runoff rate. This relationship is expressed by the following equation:

Q = C*I*A where:

- Q = The peak runoff rate in cubic feet per second at the point of analysis.
- C = A runoff coefficient representing the area-averaged ratio of runoff to rainfall intensity.
- I = The time-averaged rainfall intensity in inches per hour corresponding to the time of concentration.
- A = The drainage basin area in acres.

In performing a link-node study, the total watershed area is divided into subareas which discharge at designated nodes. The procedure for the Subarea Summation Model is as follows:

(1) Subdivide the watershed into subareas with the initial subarea being less than ten acres in size and subsequent subareas gradually increasing in size. Assign upstream and downstream node numbers to each subarea to correlate calculations to the watershed map.
(2) Estimate a time of concentration (Tc) by using a nomograph or overland flow velocity estimation.
(3) Using Tc, determine the corresponding values of I. Then Q = C*I*A.
(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to the particular channel or conduit linking the two nodes. The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The sixteen options in the AES computer program for link routing are listed below. The model allows more definition below the top code number, which is documented as a two-digit code. For example, a code 52 is an open channel flow analysis using a natural valley nomograph.

1. Confluence analysis at node.
2. Initial subarea analysis (including time of concentration calculation).
3. Pipe flow travel time (computer estimated pipe size).
4. Pipe flow travel time (user specified pipe size).
5. Open channel travel time.
6. Street flow analysis through subarea.
7. User-specified information at node.
8. Addition of subarea runoff to main line.

9. V-gutter flow through area.
10. Copy main stream data to memory bank.
11. Confluence a memory bank with the main stream memory.
12. Clear a memory bank.
13. Clear the main stem.
14. Copy memory bank into main stem memory.
15. Hydrologic data bank storage functions.
16. User specified source of flow at a node.

The engineer enters in the pertinent nodes and then performs the hydrologic process. At the confluence point of two or more basins, the following procedure is used to adjust the total summation of peak flow rates to allow for differences in basin times of concentration. This adjustment is based on the assumption that each basin's hydrographs are triangular in shape.

(1) If the collection streams have the same times of concentration, then the Q values are directly summed:
   Qp = Qa + Qb; Tp = Ta = Tb
(2) If the collection streams have different times of concentration, the smaller of the tributary Q values may be adjusted as follows:
   (i) The most frequent case is where the collection stream with the longer time of concentration has the larger Q. The smaller Q value is adjusted by the ratio of rainfall intensities:
   Qp = Qa + Qb*(Ia/Ib); Tp = Ta
   (ii) In some cases, the collection stream with the shorter time of concentration has the larger Q. Then the smaller Q is adjusted by the ratio of Tc values:
   Qp = Qa + Qb*(Tb/Ta); Tp = Tb

Underground storm drains are analyzed in a similar way. Flow data obtained from the surface model for inlets and collection points are input into the nodes representing those structures. Design grades and lengths are used to compute the capacity of the storm drains and to model the downstream travel times.

Runoff Coefficient – C:

Per the Natural Resources Conservation Service (NRCS) Web Soil Survey, the onsite soils are identified as 'Co' which is currently un-rated with regards to the Hydrologic Soil Group. Therefore, we referred to the NRCS Soil Survey dated December 1973 which rated 'Co' soils as Hydrologic Soil Group D; but based upon the infiltration characteristics of the soils within the proposed biofiltration basin, the in situ soils could be considered Hydrologic Soil Group C. From the flood control point of view, the worst case scenario between C and D soils are the D soils as they produce a higher runoff volume and higher peak flow (both in pre and post-development conditions). Therefore, we utilized Type D soils in our calculations. C values for the individual areas were obtained either directly from Table 3.1 of the County of San Diego Hydrology Manual or were weighted based upon the actual percent impervious in each basin where actual conditions deviate from the tabulated values in Table 3.1.

Manning's Coefficient – N:

A Manning's coefficient of 0.013 was used for the proposed storm drains.

Storm Frequency / Intensity – I:

As noted above, the design storm frequency used for all storm water calculations was the 100-year storm event. Figure 3-2 of the County of San Diego Hydrology Manual was used in conjunction with the 100-year 6-hour and 24-hour isopluvial maps to determine the intensity based upon time of concentration. The 6-hour 100-year runoff amount is 3.7 inches for the project area as noted on the County precipitation isopluvial map and plotted on the intensity-duration nomograph.

Time of Concentration – Tc:

The time of concentration for initial areas was determined using the maximum overland flow length per Table 3-2 of the County of San Diego Hydrology Manual. The time of concentration between nodes was calculated using Manning's equation for pipes and channels.

EXISTING CONDITIONS:

The project site is currently undeveloped. There are some new street trees located along the Valley Center Road frontage. There are native weeds and grasses on the remainder of the property. There is an existing PCC riser/catch basin located near the northeast corner of the property that intercepts runoff from the project site.

DEVELOPED CONDITIONS:

The project proposes construction of one commercial building with parking lot, hardscape and landscaping on a 0.850 acres parcel. The project includes construction of an offsite access drive which would be solely used by delivery and trash trucks and an offsite site wall to shield future residential development from the commercial development. The developed area for AutoZone including the offsite access drive and site walls will be approximately 64.4% impervious (28,867 square feet of building, site/retaining walls, hardscape and pavement).

EXISTING RUNOFF ANALYSIS:

The project site accepts offsite run-on from existing properties to the south and west. The offsite run-on and the majority of the onsite runoff comingle onsite following the existing contours. The comingled runoff sheet flows in a northerly and easterly direction to an existing PCC riser/catch basin located near the northeast corner of the property as noted above. The runoff is then conveyed to the public storm drain system in Valley Center Road which conveys the runoff to Moosa Canyon Creek which ultimately drains to the Pacific Ocean by way of the San Luis Rey River. The runoff from the remainder of the site (407 square feet) sheet flows to the Tractor Supply project in order to keep runoff from draining over the 2:1 slope that was constructed on site as part of the Tractor Supply project. This runoff has been included in the drainage design for the Tractor Supply project.

The runoff coefficients for the onsite were based on soil group D (as noted above) as well as the existing site improvements and were weighted based upon the amount of pervious area included within each basin. See the attached calculations for particulars

DEVELOPED RUNOFF ANALYSIS:

Site run-on from the adjacent properties to the south and west will be intercepted near the westerly edge of the proposed private access road by a proposed bladed swale and directed towards Old Mirar De Valle and away from the developed portion of the AutoZone property.

Project site runoff from the proposed parking lot will be intercepted by the proposed private storm drain system and conveyed to the proposed biofiltration basin located just east of the AutoZone building. The runoff from the offsite access drive will be directed to either a proposed private curb inlet or to a proposed private Type F catch basin. The runoff from both structures will be conveyed to the proposed biofiltration basin via a proposed private storm drain located adjacent to the north wall of the proposed building. The runoff from the building roof will hard connect to the proposed private storm drain located north of the proposed building which will outlet into the proposed biofiltration basin. The runoff from the landscape area between the proposed parking lot and Valley Center Road including runoff from minor impervious areas (200 square feet of hardscaped area and retaining wall) will sheet flow directly to Valley Center Road where it will be conveyed within the existing curb and gutter and intercepted by an existing curb inlet located near the northeast corner of the project. As a result of tying the parking lot and offsite access drive to the proposed improved and unnamed private road, a minor amount of runoff will sheet flow to the future Tractor Supply site. There will be approximately 50 square feet of impervious area draining to Tractor Supply from the proposed offsite access road and approximately 3 square feet of impervious area draining to Tractor Supply from the proposed parking lot connection to the unnamed private road. In order to offset this additional runoff from impervious areas draining to Tractor Supply, the AutoZone project will accept run-on from approximately 55 square feet of impervious area from the Tractor Supply property due to the result of tying the parking lot and offsite access drive to the unnamed private road noted above. The remainder of the runoff will be conveyed via bladed swale directly to Old Mirar El Valle Road where it will follow existing contours and ultimately drain to the existing catch basin located near the northeast corner of the project.

Due to site constraints, the proposed biofiltration basin will be sized for pollutant control and flow control when combined with the proposed underground storage. Within the biofiltration basin itself, the available storage volume below the elevation of the overflow structure, designed with a flow control orifice on the subdrain connection to the overflow structure, will be used in conjunction with one of the two proposed 48-inch culverts connected to a junction box designed with internal flow control orifices and an overflow weir to meet the hydromod flow requirement. The available storage located above the overflow structure will be used in conjunction with the second proposed 48-inch culvert connected to a junction box with a single flow control orifice and overflow weir to attenuate the increase in runoff from the 100-year storm event. The runoff from the underground system will be conveyed via the private storm drain system to the 24-inch diameter stub which serves as the point of discharge for the project.

Storm drain discharge locations into the biofiltration basins are noted on Figure 2B, Developed Hydrology Exhibit attached at the end of the report. The project has one main point of discharge at the easterly project boundary which is the existing 24-inch storm drain stub that was extended to the project with the widening of Valley Center Road. The stub connects to the public storm drain system in Valley Center Road at the existing curb inlet located near the northeast corner of the project. The public storm drain system outlets to Moosa Creek located north of the project site.

The runoff coefficients for the onsite were based on soil group D (as noted above) as well as the existing site improvements and were weighted based upon the amount of pervious area included within each basin. See the attached calculations for particulars.

STORM WATER DETENTION ANALYSIS:

See the attached 100-Year Routing Analysis for Tractor Supply Company prepared by REC Consultants in Appendix 9.

RESULTS AND CONCLUSIONS:

A summary of pre-developed and post-developed project flows and additional data is noted in Table 1 below for the point of compliance for the project including runoff from offsite areas and runoff that flows directly to either Old Mirar De Valle or Valley Center Road. The Developed Condition Hydrology Exhibit 2B also notes flows and velocities at strategic project locations.

Table 1: Summary of Project Flows at Point of Compliance

Condition	Node	Area (ac)	C-value	Tc (min)	Intensity (in/hr)	V100 (ft/sec)	Q100 (cfs)	Q100* (cfs)
Pre-Developed	108	2.145	0.362	15.54	4.69		3.64	
Pre-Developed	701	0.009	0.350	1.92	9.75		0.03	
Pre-Developed Total		2.154	0.362				3.67	
Developed ***	108	2.056	0.545	5.02	9.75		8.79	
Developed	201	0.003	0.550	3.55	9.75		0.02	
Developed	301	0.00007	0.900	0.65	9.75		0.0004	
Developed	401	0.094	0.380	4.19	9.75		0.35	
Developed	701	0.004	0.350	1.35	9.75		0.01	
Developed Total		2.157	0.537	5.02	9.75	5.27**	9.17	3.59

*Q100 with mitigation at project discharge point (terminus of existing 24-inch RCP stub)

**Velocity in existing 24-inch RCP stub based upon the mitigated Q100
***Includes Offsite run-on from the adjacent properties to the south and west

The difference in areas between the existing and proposed conditions (2.154 ac versus 2.157 ac) is due to the additional run-on draining to the project site from the Tractor Supply project associated with the proposed private access drive and parking lot tying to the unnamed private road running adjacent to the AutoZone project's southerly boundary.

The AutoZone project drainage and storm water designs provide a comprehensive scenario for mitigating any impact from the developed condition runoff flows. The proposed biofiltration basin working in unison with the underground storm water detention system will provide attenuation of the developed 100-year storm flows as illustrated in the 100-Year Routing Analysis for AutoZone prepared by REC Consultants and as shown in Table 1 above. The main point of discharge for the project is the existing 24-inch RCP stub (Node 108) that was installed with the widening of Valley Center Road near the northeast corner of the project. The 24-inch RCP stub ties directly to the public storm drain system at the existing curb inlet located just north of the project site. The proposed site design created a relatively minor area (0.094 acres) where the runoff sheet flows directly to Valley Center Road (Node 401). Within Valley Center Road, the runoff then drains within the existing curb and gutter to the existing curb inlet noted above located just north of the project site. In addition, as a result of tying the proposed parking lot and offsite access drive to the unnamed private road, a minor amount of runoff will sheet flow to the future Tractor Supply site. There will be approximately 50 square feet of impervious area draining to Tractor Supply from the proposed offsite access road (Node 201) and approximately 3 square feet of impervious area draining to Tractor Supply from the proposed parking lot connection to the unnamed private road (Node 301). The remainder of the runoff, including offsite run-on from the adjacent properties to the south and west (Nodes 600 through 604) with the exception of the minor amount of landscaped area that drains to the Tractor Supply project in both the existing and proposed conditions (Node 701), drains to Old Mirar De Valle where it follows natural contours and gets intercepted by the existing PCC riser/catch basin located near the northeast corner of the project site (Node 108). As the offsite run-on and onsite runoff noted above bypassed the proposed biofiltration basin and underground detention system, the runoff was treated as bypass flow. The design of the underground detention system and associated flow control structure were adjusted accordingly to account for the bypass flow.

Due to the proposed biofiltration basin working in unison with the underground storm water detention system, the mitigated post-development runoff from the project for the 100-year storm event will not increase the amount of runoff currently generated on site in its existing condition. In addition, as the runoff from the project site will be conveyed to the public storm drain system in Valley Center Road in both the existing and developed conditions, the developed condition will not create a diversion of runoff.

EXISTING CONDITION 100-YEAR CALCULATIONS

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2010 Advanced Engineering Software (aes)
              Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                           Analysis prepared by:

                            Alidade Engineering
                            41743 Enterprise Circle North, Suite 209
                            Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* EXISTING CONDITION BASIN A                                               *
 **************************************************************************

  FILE NAME: E16202A.DAT
  TIME/DATE OF STUDY: 14:31 03/15/2018
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   122.00
  UPSTREAM ELEVATION(FEET) =  1340.00
  DOWNSTREAM ELEVATION(FEET) =  1330.00
  ELEVATION DIFFERENCE(FEET) =    10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.160
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =  100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.521
  SUBAREA RUNOFF(CFS) =      0.27
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1330.00  DOWNSTREAM(FEET) =   1316.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   233.00   CHANNEL SLOPE =  0.0579
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.495
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.73
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.20
  AVERAGE FLOW DEPTH(FEET) =   0.05   TRAVEL TIME(MIN.) =   3.22
  Tc(MIN.) =    9.38
  SUBAREA AREA(ACRES) =     0.33       SUBAREA RUNOFF(CFS) =    0.89
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.410
  TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       1.10

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   1.30
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    603.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1316.50  DOWNSTREAM(FEET) =   1305.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   314.00   CHANNEL SLOPE =  0.0350
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.219
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3500
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.92
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.38
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   3.79
  Tc(MIN.) =   13.17
  SUBAREA AREA(ACRES) =     0.89       SUBAREA RUNOFF(CFS) =    1.63
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.369
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       2.51

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.11   FLOW VELOCITY(FEET/SEC.) =   1.48
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     669.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    108.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1305.50  DOWNSTREAM(FEET) =   1303.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   165.00   CHANNEL SLOPE =  0.0152
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.691
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.20
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.16
  AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   2.37
  Tc(MIN.) =   15.54
  SUBAREA AREA(ACRES) =     0.84       SUBAREA RUNOFF(CFS) =    1.38
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.362
  TOTAL AREA(ACRES) =        2.1         PEAK FLOW RATE(CFS) =       3.64

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   1.23
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    108.00 =     834.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.1  TC(MIN.) =     15.54
  PEAK FLOW RATE(CFS)   =       3.64
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Nodes 600 – 603 flow to right-of-way of Old Mirar De Valle Road. The runoff then follows existing contours and gets intercepted by the existing catch basin located near the northeast corner of the project (Node 108).

```
****************************************************************************

              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
              Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2010 Advanced Engineering Software (aes)
               Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                           Analysis prepared by:

                            Alidade Engineering
                            41743 Enterprise Circle North, Suite 209
                            Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* EXISTING CONDITION BASIN B                                               *
 **************************************************************************

  FILE NAME: E16202B.DAT
  TIME/DATE OF STUDY: 10:45 02/14/2017
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    700.00 TO NODE    701.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =     1.00
  UPSTREAM ELEVATION(FEET) =   1308.50
  DOWNSTREAM ELEVATION(FEET) =   1308.49
  ELEVATION DIFFERENCE(FEET) =      0.01
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.916
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.00
  TOTAL AREA(ACRES) =      0.009   TOTAL RUNOFF(CFS) =      0.00
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.009  TC(MIN.) =      1.92
  PEAK FLOW RATE(CFS)   =       0.03
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Sheet flows to future Tractor Supply site due to the proposed project grading for the Tractor Supply site improvements.

DEVELOPED CONDITION 100-YEAR CALCULATIONS

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2010 Advanced Engineering Software (aes)
              Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                            Analysis prepared by:

                             Alidade Engineering
                             41743 Enterprise Circle North, Suite 209
                             Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN A (REVISED LAYOUT)                                                 *
 **************************************************************************

  FILE NAME: D16202R.DAT
  TIME/DATE OF STUDY: 10:42 03/14/2018
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   24.0     19.0    0.020/0.020/0.020   0.50    1.50 0.0312 0.125 0.0175

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
```

```
 *USER SPECIFIED(SUBAREA):
 GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8000
 S.C.S. CURVE NUMBER (AMC II) =   0
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
 UPSTREAM ELEVATION(FEET) =   1311.70
 DOWNSTREAM ELEVATION(FEET) =   1308.21
 ELEVATION DIFFERENCE(FEET) =      3.49
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.956
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.90
 TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.90

****************************************************************************
 FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =   1308.21
 DOWNSTREAM NODE ELEVATION(FEET) =   1307.42
 CHANNEL LENGTH THRU SUBAREA(FEET) =    94.00
 "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.130
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
 MAXIMUM DEPTH(FEET) =   0.50
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 *USER SPECIFIED(SUBAREA):
 GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8200
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.98
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.03
 AVERAGE FLOW DEPTH(FEET) =   0.24   FLOOD WIDTH(FEET) =   12.63
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.77   Tc(MIN.) =    3.73
 SUBAREA AREA(ACRES) =    0.27       SUBAREA RUNOFF(CFS) =    2.17
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.814
 TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       3.07

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.27   FLOOD WIDTH(FEET) =   15.73
 FLOW VELOCITY(FEET/SEC.) =   2.17   DEPTH*VELOCITY(FT*FT/SEC) =   0.58
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     174.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1304.41  DOWNSTREAM(FEET) =  1304.22
 FLOW LENGTH(FEET) =    19.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.99
 GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =       3.07
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    3.79
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     193.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8035
  SUBAREA AREA(ACRES) =    0.01   SUBAREA RUNOFF(CFS) =    0.03
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       3.10
  TC(MIN.) =    3.79

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.22  DOWNSTREAM(FEET) =  1304.16
  FLOW LENGTH(FEET) =     6.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.00
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.10
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    3.81
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     199.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .6300
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8001
  SUBAREA AREA(ACRES) =    0.01   SUBAREA RUNOFF(CFS) =    0.05
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       3.15
  TC(MIN.) =    3.81

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
```

```
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.16  DOWNSTREAM(FEET) =  1304.05
  FLOW LENGTH(FEET) =    11.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.01
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.15
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    3.85
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     210.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  51
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1304.05  DOWNSTREAM(FEET) =   1303.88
  CHANNEL LENGTH THRU SUBAREA(FEET) =    35.00   CHANNEL SLOPE =  0.0049
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.21
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.78
  AVERAGE FLOW DEPTH(FEET) =   0.20   TRAVEL TIME(MIN.) =   0.74
  Tc(MIN.) =    4.59
  SUBAREA AREA(ACRES) =     0.03       SUBAREA RUNOFF(CFS) =    0.11
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.769
  TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       3.26

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   0.80
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     245.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  10
------------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
==============================================================================

******************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1316.40
  DOWNSTREAM ELEVATION(FEET) =   1310.50
```

```
  ELEVATION DIFFERENCE(FEET) =      5.90
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.195
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    91.80
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.52
  TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.52

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1310.50  DOWNSTREAM ELEVATION(FEET) = 1308.96
  STREET LENGTH(FEET) =    25.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 24.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  19.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0175
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0175

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.60
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.17
    HALFSTREET FLOOD WIDTH(FEET) =    2.29
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.53
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.61
  STREET FLOW TRAVEL TIME(MIN.) =   0.12   Tc(MIN.) =    2.31
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.870
  SUBAREA AREA(ACRES) =    0.02      SUBAREA RUNOFF(CFS) =    0.17
  TOTAL AREA(ACRES) =        0.1        PEAK FLOW RATE(CFS) =       0.69

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.18   HALFSTREET FLOOD WIDTH(FEET) =   2.89
  FLOW VELOCITY(FEET/SEC.) =  3.40   DEPTH*VELOCITY(FT*FT/SEC.) =   0.63
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    112.00 =     125.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =   1
----------------------------------------------------------------------------
```

```
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    2.31
  RAINFALL INTENSITY(INCH/HR) =   9.75
  TOTAL STREAM AREA(ACRES) =     0.08
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.69

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    121.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3600
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    92.00
  UPSTREAM ELEVATION(FEET) =   1311.80
  DOWNSTREAM ELEVATION(FEET) =   1308.50
  ELEVATION DIFFERENCE(FEET) =      3.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    8.092
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    86.47
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.146
  SUBAREA RUNOFF(CFS) =      0.08
  TOTAL AREA(ACRES) =      0.03   TOTAL RUNOFF(CFS) =      0.08

****************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    112.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.09
  RAINFALL INTENSITY(INCH/HR) =   7.15
  TOTAL STREAM AREA(ACRES) =     0.03
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.08

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.69     2.31        9.749          0.08
      2        0.08     8.09        7.146          0.03

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
```

```
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        0.71     2.31       9.749
      2        0.58     8.09       7.146

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       0.71   Tc(MIN.) =    2.31
  TOTAL AREA(ACRES) =        0.1
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    112.00 =     125.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    113.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1305.22  DOWNSTREAM(FEET) =  1304.91
  FLOW LENGTH(FEET) =    69.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.60
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.71
  PIPE TRAVEL TIME(MIN.) =   0.44    Tc(MIN.) =    2.76
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    113.00 =     194.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    113.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    2.76
  RAINFALL INTENSITY(INCH/HR) =   9.75
  TOTAL STREAM AREA(ACRES) =     0.11
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.71

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    131.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    85.00
  UPSTREAM ELEVATION(FEET) =   1313.00
  DOWNSTREAM ELEVATION(FEET) =   1308.61
  ELEVATION DIFFERENCE(FEET) =      4.39
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.112
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.13
  TOTAL AREA(ACRES) =      0.01   TOTAL RUNOFF(CFS) =      0.13
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    131.00 TO NODE    113.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   1308.61
  DOWNSTREAM NODE ELEVATION(FEET) =   1307.07
  CHANNEL LENGTH THRU SUBAREA(FEET) =    50.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.130
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8400
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.38
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.80
  AVERAGE FLOW DEPTH(FEET) =   0.13   FLOOD WIDTH(FEET) =    3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.30   Tc(MIN.) =    2.41
  SUBAREA AREA(ACRES) =    0.06       SUBAREA RUNOFF(CFS) =    0.50
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.848
  TOTAL AREA(ACRES) =        0.1         PEAK FLOW RATE(CFS) =       0.63

         NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
         DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.14   FLOOD WIDTH(FEET) =    3.00
  FLOW VELOCITY(FEET/SEC.) =   3.07   DEPTH*VELOCITY(FT*FT/SEC) =   0.43
  LONGEST FLOWPATH FROM NODE    130.00 TO NODE    113.00 =     135.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    131.00 TO NODE    113.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    2.41
  RAINFALL INTENSITY(INCH/HR) =   9.75
  TOTAL STREAM AREA(ACRES) =     0.08
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.63

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        0.71     2.76        9.749          0.11
     2        0.63     2.41        9.749          0.08

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.
```

```
  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        1.34     2.41       9.749
      2        1.34     2.76       9.749

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       1.34   Tc(MIN.) =    2.76
  TOTAL AREA(ACRES) =        0.2
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    113.00 =     194.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    114.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.81  DOWNSTREAM(FEET) =  1304.61
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.19
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.34
  PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =    2.96
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    114.00 =     234.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    114.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8011
  SUBAREA AREA(ACRES) =    0.07   SUBAREA RUNOFF(CFS) =    0.56
  TOTAL AREA(ACRES) =        0.3   TOTAL RUNOFF(CFS) =       1.98
  TC(MIN.) =    2.96

****************************************************************************
  FLOW PROCESS FROM NODE    114.00 TO NODE    115.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.61  DOWNSTREAM(FEET) =  1304.44
  FLOW LENGTH(FEET) =    34.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.48
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.98
```

```
  PIPE TRAVEL TIME(MIN.) =   0.16    Tc(MIN.) =    3.13
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    115.00 =     268.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    114.00 TO NODE    115.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8127
  SUBAREA AREA(ACRES) =    0.05   SUBAREA RUNOFF(CFS) =    0.43
  TOTAL AREA(ACRES) =        0.3   TOTAL RUNOFF(CFS) =       2.42
  TC(MIN.) =    3.13

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    116.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.44  DOWNSTREAM(FEET) =  1304.28
  FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.56
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.42
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    3.28
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    116.00 =     300.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    116.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8239
  SUBAREA AREA(ACRES) =    0.06   SUBAREA RUNOFF(CFS) =    0.52
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       2.94
  TC(MIN.) =    3.28

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    117.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =  1304.28  DOWNSTREAM(FEET) =  1304.14
  FLOW LENGTH(FEET) =    28.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.74
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.94
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    3.40
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    117.00 =     328.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    117.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .6700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8190
  SUBAREA AREA(ACRES) =    0.01   SUBAREA RUNOFF(CFS) =    0.08
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       3.02
  TC(MIN.) =    3.40

****************************************************************************
  FLOW PROCESS FROM NODE    117.00 TO NODE    118.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.14  DOWNSTREAM(FEET) =  1304.08
  FLOW LENGTH(FEET) =    12.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.84
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.02
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    3.45
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    118.00 =     340.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    117.00 TO NODE    118.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8165
  SUBAREA AREA(ACRES) =    0.00   SUBAREA RUNOFF(CFS) =    0.01
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       3.02
```

```
  TC(MIN.) =    3.45

****************************************************************************
  FLOW PROCESS FROM NODE    118.00 TO NODE    119.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1304.08  DOWNSTREAM(FEET) =  1304.06
  FLOW LENGTH(FEET) =     4.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.85
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.02
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    3.47
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    119.00 =     344.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    119.00 TO NODE    106.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1304.06  DOWNSTREAM(FEET) =   1303.88
  CHANNEL LENGTH THRU SUBAREA(FEET) =    35.00   CHANNEL SLOPE =  0.0051
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.07
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.79
  AVERAGE FLOW DEPTH(FEET) =   0.20   TRAVEL TIME(MIN.) =   0.73
  Tc(MIN.) =    4.21
  SUBAREA AREA(ACRES) =     0.03       SUBAREA RUNOFF(CFS) =    0.09
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.788
  TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       3.12

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   0.81
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    106.00 =     379.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    119.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
```

```
      1         3.12     4.21       9.749        0.41
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    106.00 =     379.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1         3.26     4.59       9.749        0.44
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     245.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1       6.11       4.21        9.749
      2       6.38       4.59        9.749

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.38   Tc(MIN.) =    4.59
  TOTAL AREA(ACRES) =        0.8

****************************************************************************
  FLOW PROCESS FROM NODE    119.00 TO NODE    106.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1300.00  DOWNSTREAM(FEET) =  1299.50
  FLOW LENGTH(FEET) =    67.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.13
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.38
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =    4.73
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    107.00 =     446.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1299.50  DOWNSTREAM(FEET) =  1298.43
  FLOW LENGTH(FEET) =   143.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.13
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.38
```

```
  PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =    5.02
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    108.00 =     589.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.8  TC(MIN.) =      5.02
  PEAK FLOW RATE(CFS)   =       6.38
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Discharges to existing 24-inch RCP storm drain stub at Node 108 that is connected to the public storm drain system in Valley Center Road. This runoff does not take into account the underground storage facility that is designed to reduce the developed 100-year storm event to mimic existing conditions. See the 100-year design report prepared by REC Consultants included in the Appendices.

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                           Analysis prepared by:

                            Alidade Engineering
                            41743 Enterprise Circle North, Suite 209
                            Temecula, CA  92590

 ************************* DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN B                                                                  *
 **************************************************************************

  FILE NAME: D16202B.DAT
  TIME/DATE OF STUDY: 09:38 10/03/2017
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .5500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    24.00
  UPSTREAM ELEVATION(FEET) =   1315.69
  DOWNSTREAM ELEVATION(FEET) =   1315.08
  ELEVATION DIFFERENCE(FEET) =      0.61
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.554
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.02
  TOTAL AREA(ACRES) =      0.003   TOTAL RUNOFF(CFS) =      0.02
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.0  TC(MIN.) =      3.55
  PEAK FLOW RATE(CFS)   =       0.02
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Flows to Tractor Supply site. Sixty-three square feet of the landscaped area already drained to the Tractor Supply site in the existing condition due to offsite grading performed as part of the Tractor Supply grading and improvements.

```
****************************************************************************

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2010 Advanced Engineering Software (aes)
              Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                            Analysis prepared by:

                             Alidade Engineering
                             41743 Enterprise Circle North, Suite 209
                             Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN C                                                                  *
 **************************************************************************

  FILE NAME: D16202C.DAT
  TIME/DATE OF STUDY: 09:48 10/03/2017
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =     8.00
  UPSTREAM ELEVATION(FEET) =   1310.10
  DOWNSTREAM ELEVATION(FEET) =   1309.79
  ELEVATION DIFFERENCE(FEET) =      0.31
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    0.648
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.0004
  TOTAL AREA(ACRES) =      0.00005   TOTAL RUNOFF(CFS) =      0.0004
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.0  TC(MIN.) =      0.65
  PEAK FLOW RATE(CFS)   =       0.0004
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Flows to the Tractor Supply site.

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                           Analysis prepared by:

                            Alidade Engineering
                            41743 Enterprise Circle North, Suite 209
                            Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN D                                                                  *
 **************************************************************************

  FILE NAME: D16202D.DAT
  TIME/DATE OF STUDY: 11:08 03/14/2018
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    43.00
  UPSTREAM ELEVATION(FEET) =   1310.60
  DOWNSTREAM ELEVATION(FEET) =   1307.00
  ELEVATION DIFFERENCE(FEET) =      3.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.186
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.35
  TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.35
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.1  TC(MIN.) =      4.19
  PEAK FLOW RATE(CFS)   =       0.35
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Sheet flows to Valley Center Road and gets intercepted by the existing curb inlet located near the northeast corner of the project site.

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                           Analysis prepared by:

                            Alidade Engineering
                            41743 Enterprise Circle North, Suite 209
                            Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN E                                                                  *
 **************************************************************************

  FILE NAME: D16202E.DAT
  TIME/DATE OF STUDY: 15:48 02/08/2017
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    14.00
  UPSTREAM ELEVATION(FEET) =   1305.55
  DOWNSTREAM ELEVATION(FEET) =   1305.30
  ELEVATION DIFFERENCE(FEET) =      0.25
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.942
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.06
  TOTAL AREA(ACRES) =      0.02   TOTAL RUNOFF(CFS) =      0.06
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.0  TC(MIN.) =      3.94
  PEAK FLOW RATE(CFS)   =       0.06
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Sheet flows to Valley Center Road. Gets intercepted by the existing curb inlet located near the northeast corner of the project site.

```
*****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                            Analysis prepared by:

                             Alidade Engineering
                             41743 Enterprise Circle North, Suite 209
                             Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN F (REVISED GRADING AT BACK OF AUTOZONE)                            *
 **************************************************************************

  FILE NAME: D16202F.DAT
  TIME/DATE OF STUDY: 11:18 03/14/2018
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   122.00
  UPSTREAM ELEVATION(FEET) =  1340.00
  DOWNSTREAM ELEVATION(FEET) =  1330.00
  ELEVATION DIFFERENCE(FEET) =    10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.160
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.521
  SUBAREA RUNOFF(CFS) =      0.27
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    602.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1330.00  DOWNSTREAM(FEET) =   1316.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   233.00   CHANNEL SLOPE =  0.0579
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.495
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.73
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.20
  AVERAGE FLOW DEPTH(FEET) =   0.05   TRAVEL TIME(MIN.) =   3.22
  Tc(MIN.) =    9.38
  SUBAREA AREA(ACRES) =     0.33       SUBAREA RUNOFF(CFS) =    0.89
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.410
  TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       1.10

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   1.30
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    602.00 =     355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    602.00 TO NODE    603.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1316.50  DOWNSTREAM(FEET) =   1307.10
  CHANNEL LENGTH THRU SUBAREA(FEET) =   226.00   CHANNEL SLOPE =  0.0416
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.542
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3500
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.79
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.44
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   2.62
  Tc(MIN.) =   12.00
  SUBAREA AREA(ACRES) =     0.71       SUBAREA RUNOFF(CFS) =    1.38
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.372
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       2.32

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   1.50
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    603.00 =     581.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    603.00 TO NODE    604.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1307.10  DOWNSTREAM(FEET) =   1306.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =    19.00   CHANNEL SLOPE =  0.0474
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.514
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3700
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.37
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.34
  AVERAGE FLOW DEPTH(FEET) =   0.28   TRAVEL TIME(MIN.) =   0.09
  Tc(MIN.) =   12.10
  SUBAREA AREA(ACRES) =     0.05       SUBAREA RUNOFF(CFS) =    0.10
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.372
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       2.41

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.28   FLOW VELOCITY(FEET/SEC.) =   3.37
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    604.00 =     600.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    604.00 TO NODE    108.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1306.20  DOWNSTREAM(FEET) =   1303.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   194.00   CHANNEL SLOPE =  0.0165
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.143
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.45
```

```
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.34
  AVERAGE FLOW DEPTH(FEET) =   0.38   TRAVEL TIME(MIN.) =   1.38
  Tc(MIN.) =   13.48
  SUBAREA AREA(ACRES) =     0.04       SUBAREA RUNOFF(CFS) =    0.07
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.371
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       2.41

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOW VELOCITY(FEET/SEC.) =   2.32
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    108.00 =     794.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.2  TC(MIN.) =     13.48
  PEAK FLOW RATE(CFS)   =       2.41
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Drains to existing catch basin (Node 108) that was installed with the widening of Valley Center Road and confluences with the mitigated runoff from the AutoZone underground storage at eh 24” RCP storm drain stub that connects to the public storm drain system in Valley Center Road.

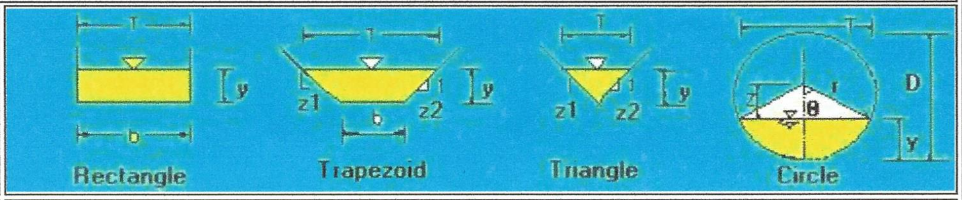
```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1630

                           Analysis prepared by:

                            Alidade Engineering
                            41743 Enterprise Circle North, Suite 209
                            Temecula, CA  92590

 ************************** DESCRIPTION OF STUDY **************************
* AUTOZONE                                                                 *
* 100-YEAR STORM EVENT                                                     *
* BASIN G                                                                  *
 **************************************************************************

  FILE NAME: D16202G.DAT
  TIME/DATE OF STUDY: 10:19 10/03/2017
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    700.00 TO NODE    701.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =     1.00
  UPSTREAM ELEVATION(FEET) =   1317.11
  DOWNSTREAM ELEVATION(FEET) =   1317.10
  ELEVATION DIFFERENCE(FEET) =      0.01
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.350
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  9.749
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.01
  TOTAL AREA(ACRES) =      0.004   TOTAL RUNOFF(CFS) =      0.01
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.0  TC(MIN.) =      1.35
  PEAK FLOW RATE(CFS)   =       0.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

This basin sheet flows to the Tractor Supply property in both the existing and proposed conditions.

The open channel flow calculator

Select Channel Type: Circle



Depth from Q | Select unit system: Feet(ft)

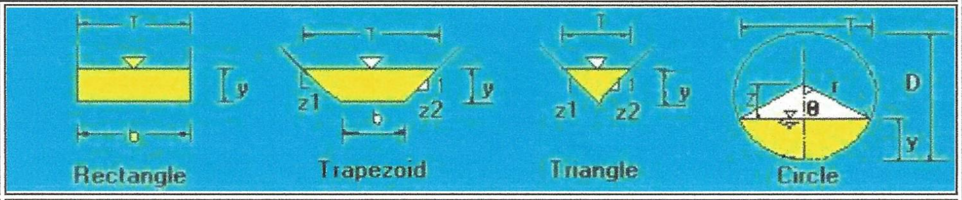
Channel slope: 0.01 ft/ft	Water depth(y): 0.54 ft	Radius (r) 1 ft
Flow velocity 5.265 ft/s	LeftSlope (Z1): to 1 (H:	RightSlope (Z2): to 1 (H:V
Flow discharge 3.59 ft^3/s	Input n value 0.013 or select n	
Calculate!	Status: Calculation finished	Reset

Wetted perimeter 2.18 ft	Flow area 0.68 ft^2	Top width(T) 1.77 ft
Specific energy 0.97 ft	Froude number 1.5	Flow status Supercritical flow
Critical depth 0.67 ft	Critical slope 0.0044 ft/ft	Velocity head 0.43 ft

PROJECT DISCHARGE POINT (NODE 108) AT EXISTING 24"
RCP STUB

The open channel flow calculator

Select Channel Type: Circle



Depth from Q

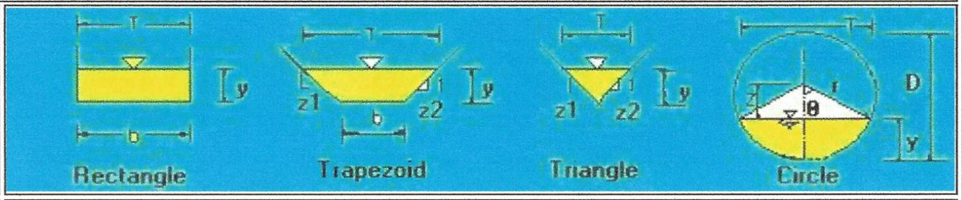
Select unit system: Feet(ft)

Channel slope: 0.0075 ft/ft	Water depth(y): 0.47 ft	Radius (r) 0.5 ft
Flow velocity 3.8396 ft/s	LeftSlope (Z1): to 1 (H:'	RightSlope (Z2): to 1 (H:V
Flow discharge 1.39 ft^3/s	Input n value 0.013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 1.52 ft	Flow area 0.37 ft^2	Top width(T) 1 ft
Specific energy 0.7 ft	Froude number 1.12	Flow status Supercritical flow
Critical depth 0.5 ft	Critical slope 0.0061 ft/ft	Velocity head 0.23 ft

OUTFLOW FROM UNDERGROUND DETENTION FACILITY TO EXIST STORM DRAIN RISER.

The open channel flow calculator

Select Channel Type: Circle



Depth from Q

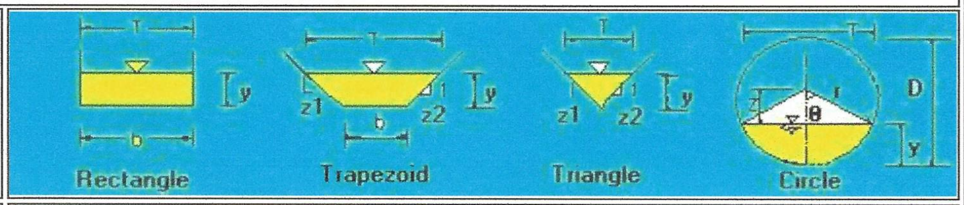
Select unit system: Feet(ft)

Channel slope: 0.01 ft/ft	Water depth(y): 0.74 ft	Radius (r) 0.5 ft
Flow velocity 5.127 ft/s	LeftSlope (Z1): to 1 (H:	RightSlope (Z2): to 1 (H:V
Flow discharge 3.15 ft^3/s	Input n value 0.013 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 2.06 ft	Flow area 0.62 ft^2	Top width(T) 0.88 ft
Specific energy 1.14 ft	Froude number 1.08	Flow status Supercritical flow
Critical depth 0.76 ft	Critical slope 0.009 ft/ft	Velocity head 0.41 ft

NODES 100-105 DISCHARGING TO BIOFILTRATION BASIN

The open channel flow calculator

Select Channel Type: Circle



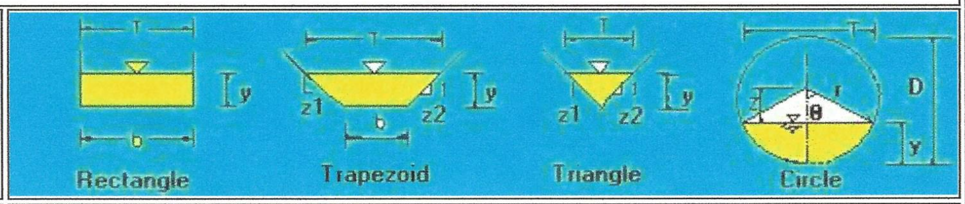
Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.005 ft/ft	Water depth(y): ft	Radius (r) 0.5 ft
Flow velocity 3.85 ft/s	LeftSlope (Z1): to 1 (H:	RightSlope (Z2): to 1 (H:V
Flow discharge 3.02 ft^3/s	Input n value 0.013 or select r	
Calculate!	Status:	Reset
Wetted perimeter 2.06 ft	Flow area 0.62 ft^2	Top width(T) 0.88 ft
Specific energy 1.14 ft	Froude number 1.08	Flow status Supercritical flow
Critical depth 0.76 ft	Critical slope 0.009 ft/ft	Velocity head 0.41 ft

NODES 110-119, 120-121 AND 130-131 DISCHARGING TO BIOFILTRATION BASIN

The open channel flow calculator

Select Channel Type: Triangle



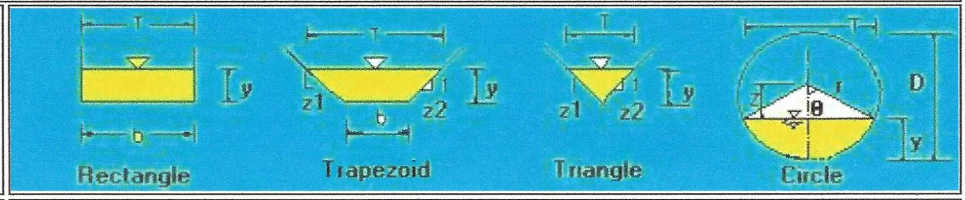
Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.0126 ft/ft	Water depth(y): 0.55 ft	Bottom W(b) 0 ft
Flow velocity 1.926 ft/s	LeftSlope (Z1): 4 to 1 (H:'	RightSlope (Z2): 4 to 1 (H:V
Flow discharge 2.32 ft^3/s	Input n value 0.035 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 4.53 ft	Flow area 1.2 ft^2	Top width(T) 4.39 ft
Specific energy 0.61 ft	Froude number 0.65	Flow status Subcritical flow
Critical depth 0.47 ft	Critical slope 0.0289 ft/ft	Velocity head 0.06 ft

NODES 600 THRU 603 AT TRIANGLE BLADED SWALE TERMINUS

The open channel flow calculator

Select Channel Type: Triangle



Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.01 ft/ft	Water depth(y): 0.18 ft	Bottom W(b) 0 ft
Flow velocity 0.80342 ft/s	LeftSlope (Z1): 4 to 1 (H:'	RightSlope (Z2): 4 to 1 (H:V
Flow discharge 0.10 ft^3/s	Input n value 0.035 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 1.45 ft	Flow area 0.12 ft^2	Top width(T) 1.41 ft
Specific energy 0.19 ft	Froude number 0.48	Flow status Subcritical flow
Critical depth 0.13 ft	Critical slope 0.044 ft/ft	Velocity head 0.01 ft

NODE 604 AT TRIANGLE BLADED SWALE TERMINUS

DECLARATION OF RESPONSIBLE CHARGE:

I hereby declare that I am the Civil Engineer of Work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand that the check of the project design reports and calculations by the County of San Diego is confined to review only and does not relieve me, as Engineer of Work, of my responsibilities for project design.

Brent C. Moore, RCE 59121 Date
EXP 6/30/2019

APPENDIX

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

A-1

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

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

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

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

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

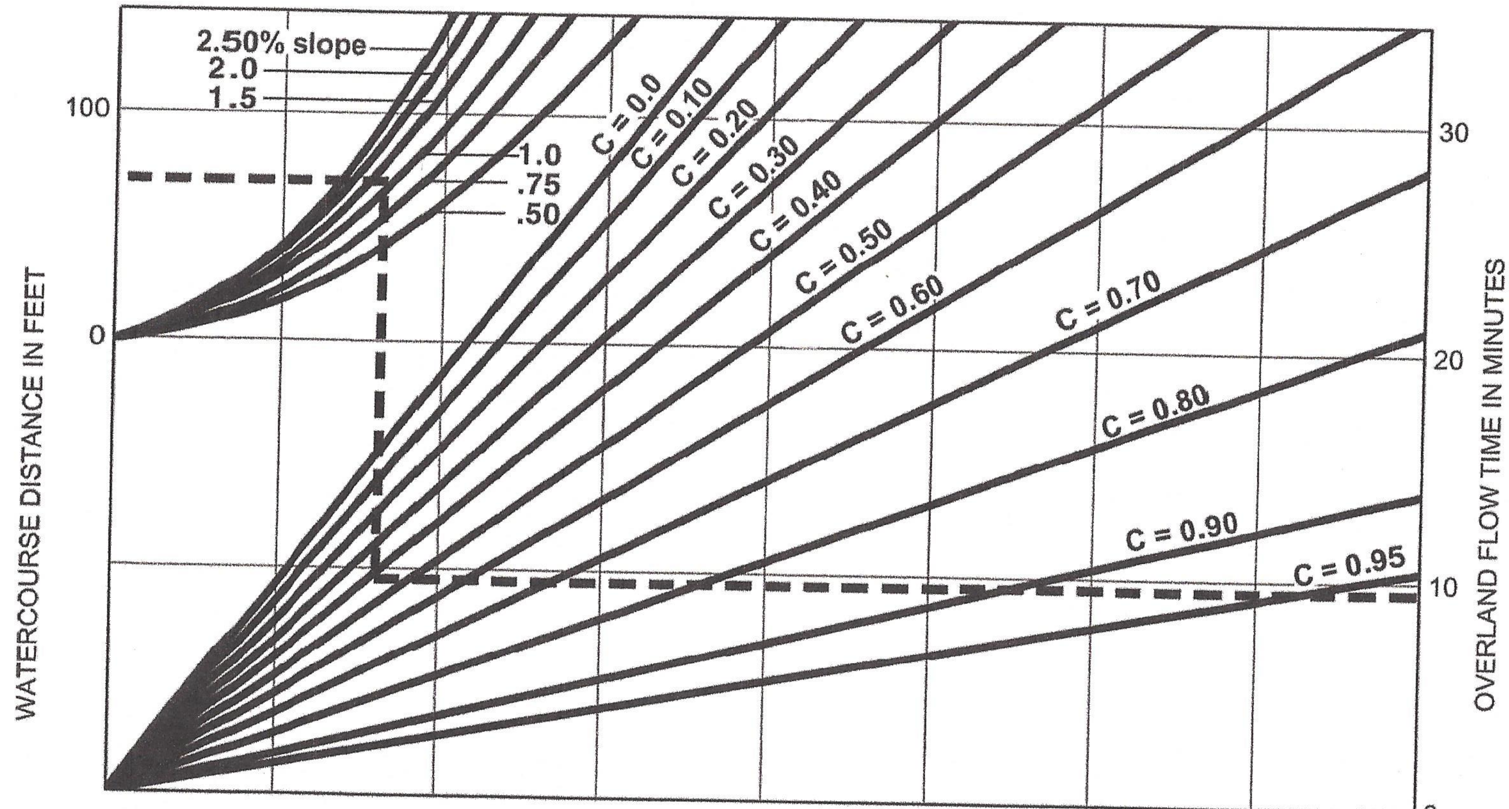
Table 3-2

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

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	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

A-2



EXAMPLE:

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

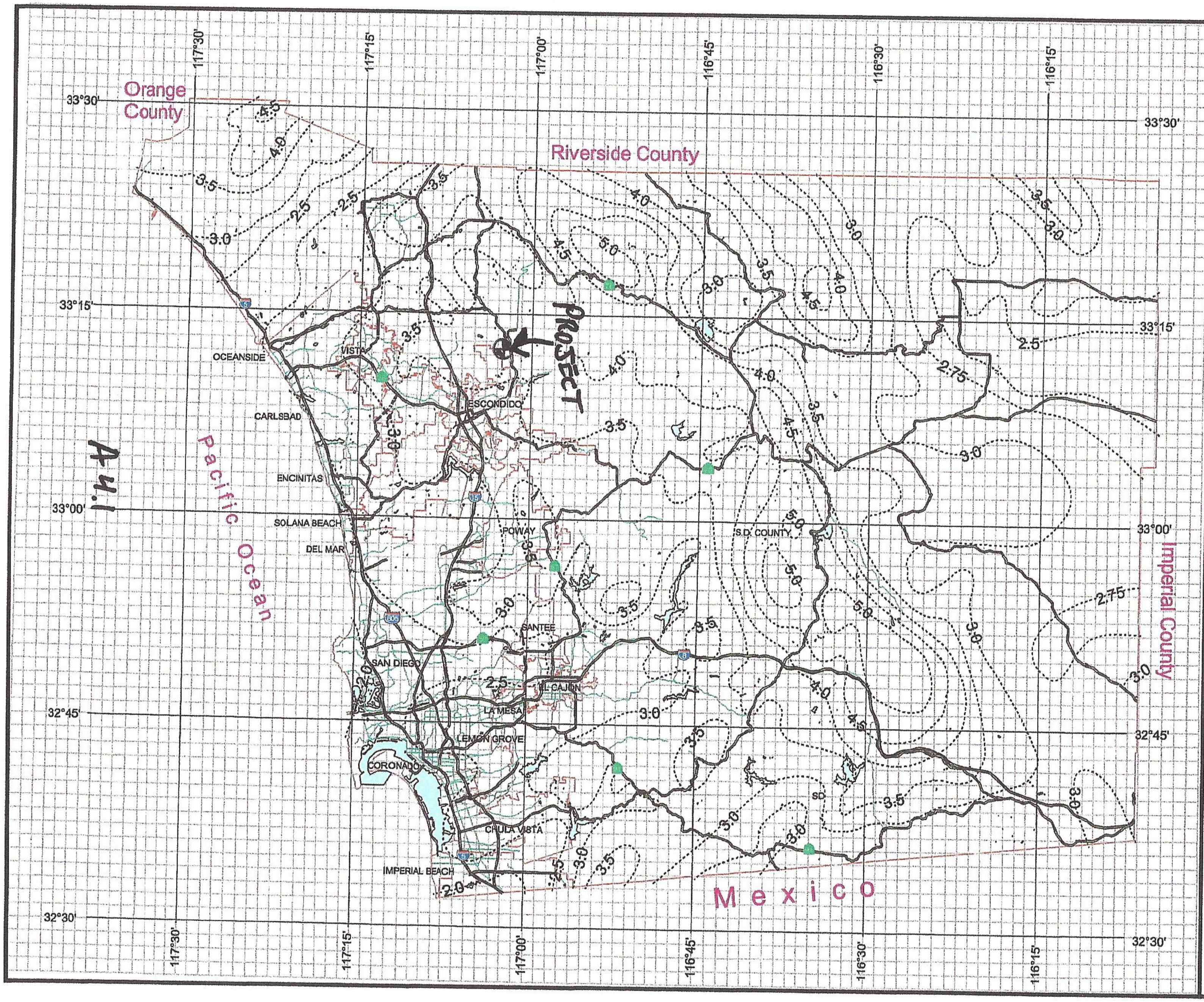
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE

3-3



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

------- Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N S E W

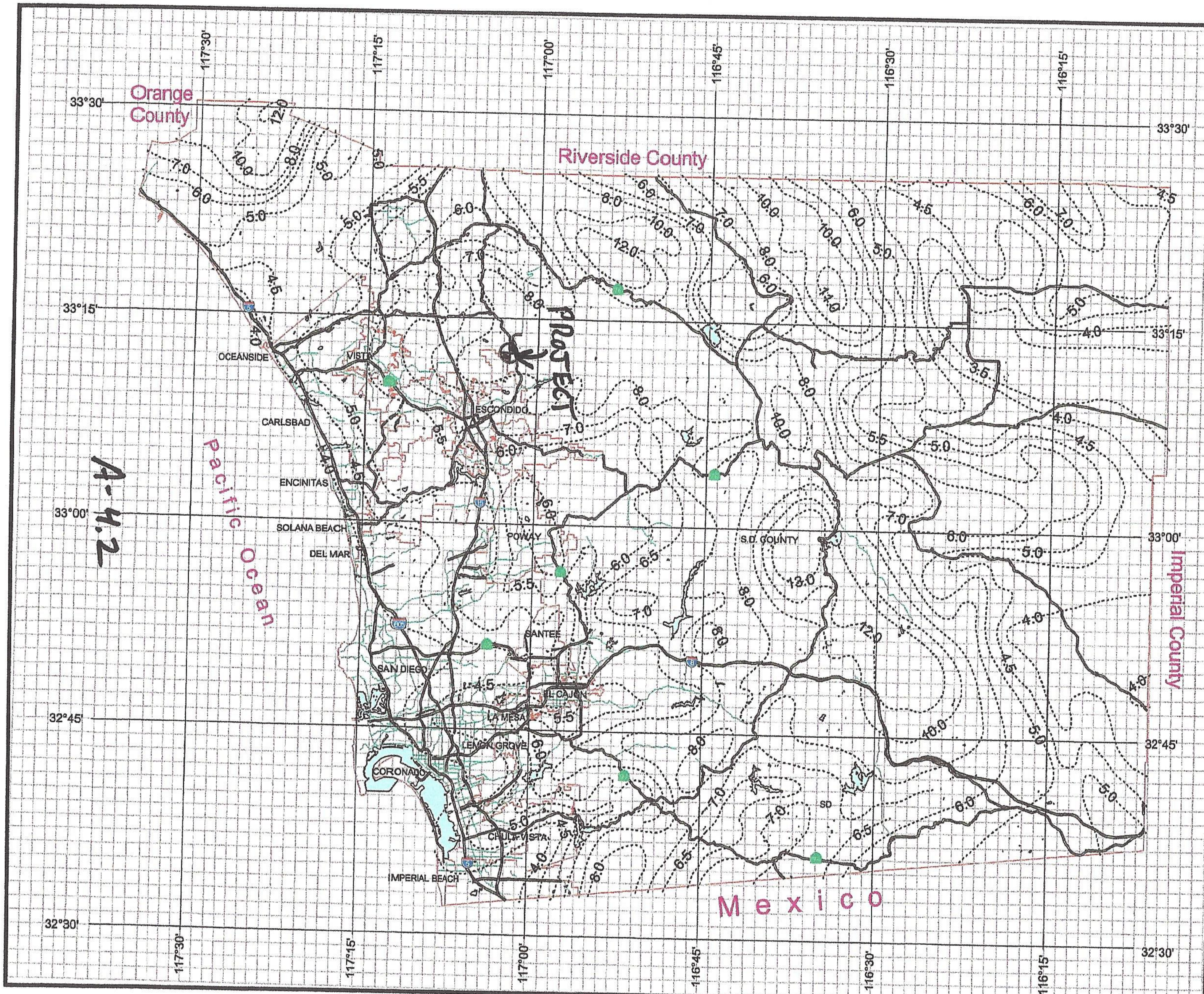
3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)



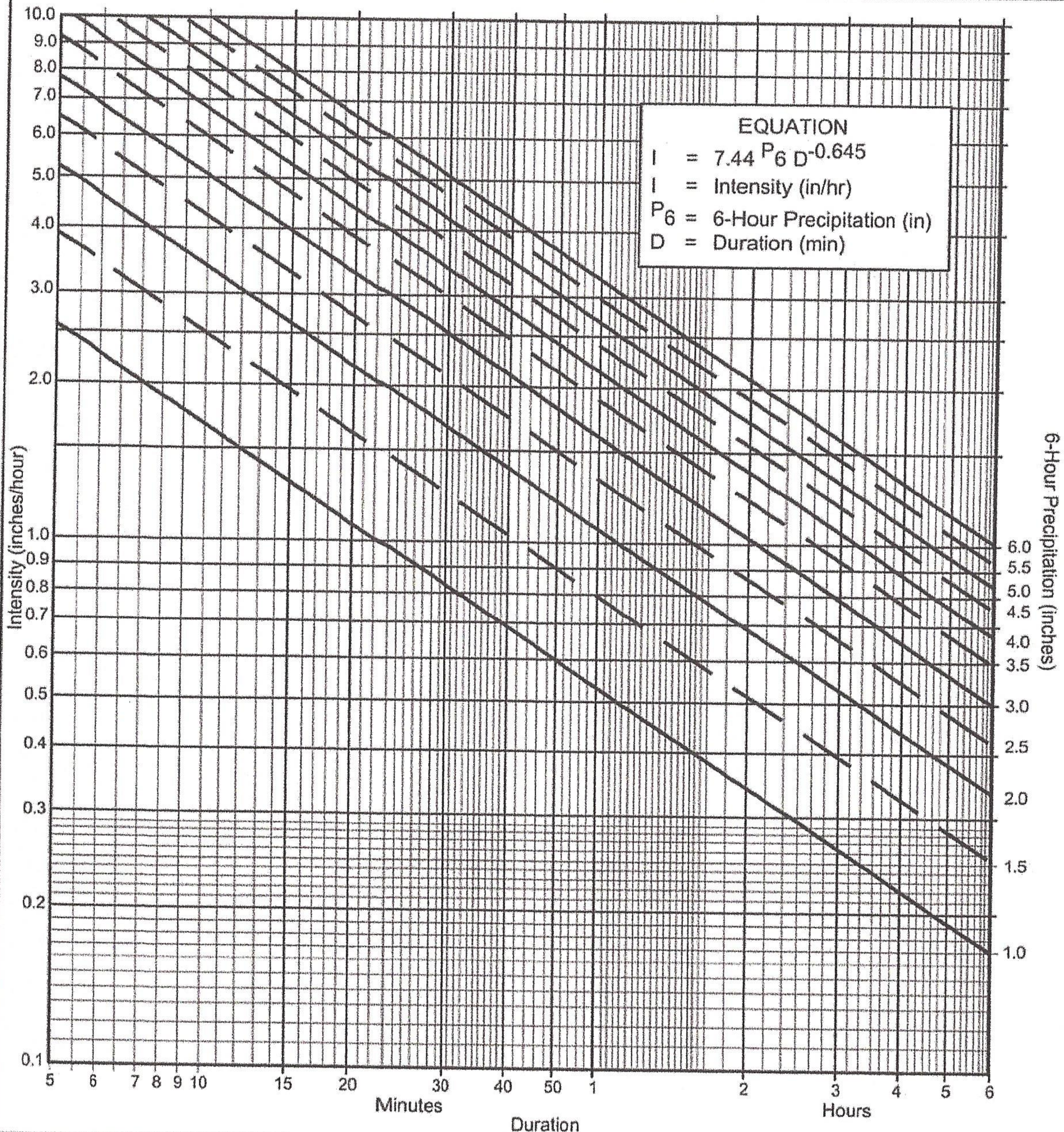
DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!

N E S W

3 0 3 Miles

A-4.2



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.7 in., P_{24} = 8.1 , $\frac{P_6}{P_{24}}$ = 46 %$^{(2)}$

(c) Adjusted $P_6^{(2)}$ = ______ in.

(d) t_x = ______ min.

(e) I = ______ in./hr.

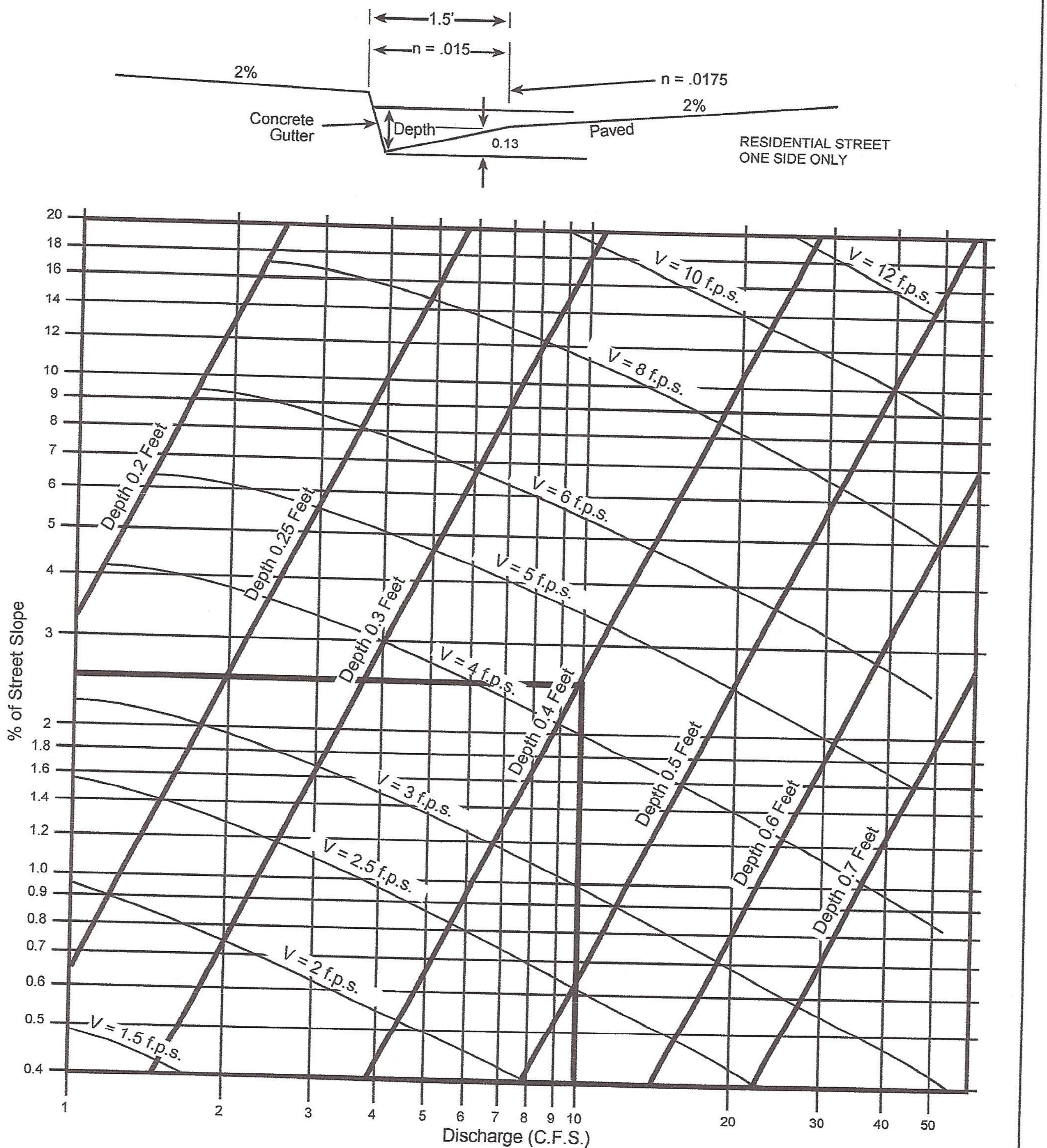
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 Duration	1 I	1.5 I	2 I	2.5 I	3 I	3.5 I	4 I	4.5 I	5 I	5.5 I	6 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



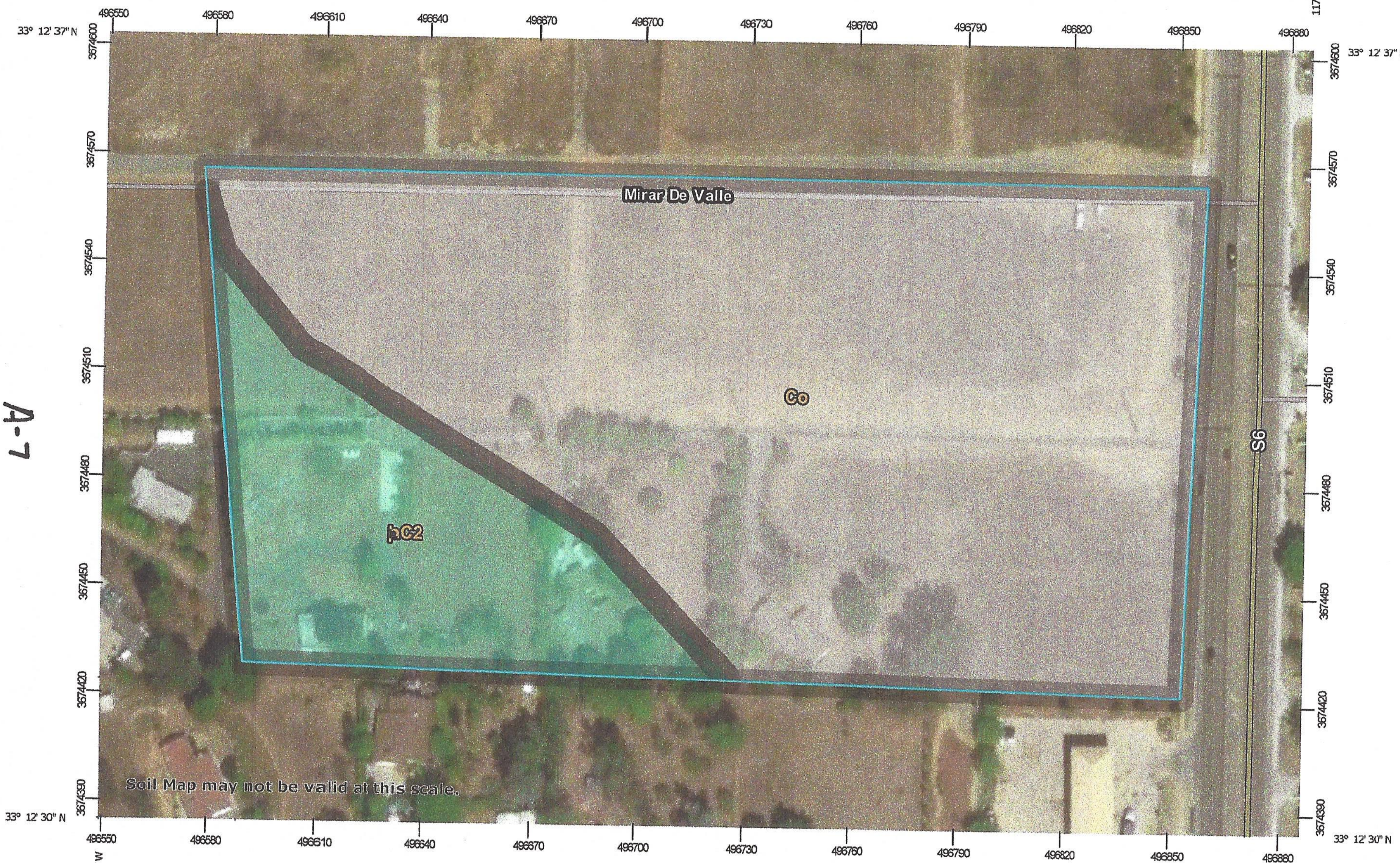
EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE 3-6

Gutter and Roadway Discharge - Velocity Chart

Hydrologic Soil Group—San Diego County Area, California
(AUTOZONE - VALLEY CENTER)



A-7

Map Scale: 1:1,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 20, 40, 80, 120

Feet: 0, 50, 100, 200, 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

> Warning: Soil Map may not be valid at this scale.
>
> Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 10, Sep 12, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Feb 2, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Co	Clayey alluvial land		7.4	78.5%
LpC2	Las Posas fine sandy loam, 5 to 9 percent slopes, erode d	C	2.0	21.5%
Totals for Area of Interest			**9.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table A-1 Average Manning Roughness Coefficients for Pavement and Gutters[1]

Concrete Gutter[2]	0.015
Concrete Pavement	
Float Finish	0.014
Broom Finish	0.016
Concrete Gutter with Asphalt Pavement	
Smooth Finish	0.013
Rough Texture	0.015
Asphalt Pavement	
Smooth Finish	0.013
Rough Texture	0.016

Based on FHWA HEC-22.

[1] Based on materials and workmanship required by standard specifications.
[2] Increase roughness coefficient in gutters with mild slopes where sediment might accumulate by 0.020.

Table A-5 Average Manning Roughness Coefficients for Natural Channels

Minor Streams (Surface Width at Flood Stage < 100 ft)	
Fairly Regular Section	
(A) Some Grass and Weeds, Little or No Brush	0.030
(B) Dense Growth of Weeds, Depth of Flow Materially Greater Than Weed Height	0.040
(C) Some Weeds, Light Brush on Banks	0.040
(D) Some Weeds, Heavy Brush on Banks	0.060
(E) For Trees within Channel with Branches Submerged at High Stage, Increase All Above Values By	0.015
Irregular Section, with Pools, Slight Channel Meander Channels (A) to (E) Above, Increase All Values By	0.015
Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage	
(A) Bottom, Gravel, Cobbles and Few Boulders	0.050
(B) Bottom, Cobbles with Large Boulders	0.060
Flood Plains (Adjacent To Natural Streams)	
Pasture, No Brush	
(A) Short Grass	0.030
(B) High Grass	0.040
Cultivated Areas	
(A) No Crop	0.040
(B) Mature Row Crops	0.040
(C) Mature Field Crops	0.050
Heavy Weeds, Scattered Brush	0.050
Light Brush and Trees	0.060
Medium To Dense Brush	0.090
Dense Willows	0.170
Cleared Land with Tree Stumps, 100-150 Per Acre	0.060
Heavy Stand of Timber, Little Undergrowth	
(A) Flood Depth below Branches	0.110
(B) Flood Depth Reaches Branches	0.140

R·E·C

100-YEAR ROUTING ANALYSIS

For

AUTOZONE VALLEY CENTER,

VALLEY CENTER, CA

Prepared For:

Alidade Engineering

March 15, 2017 (Revised April 2, 2018)

REC Consultants
2442 Second Avenue
San Diego, CA 92101

Telephone: (619) 232-9200

Prepared by:

Luis Parra, PhD, CPSWQ, ToR, D.WRE.

R.C.E. 66377

REGISTERED PROFESSIONAL ENGINEER
LUIS A PARRA-ROSALES
RCE ~ 66377
EXP 6/30/18
CIVIL
STATE OF CALIFORNIA

TABLE OF CONTENTS

CHAPTER 1 - EXECUTIVE SUMMARY

1.1 - Introduction

The Autozone Valley Center project site is located in Valley Center, on the west side of Valley Center Road, approximately one mile south of the intersection with Lilac Road.

The project site drains to one (1) Points of Compliance (POC) or Point of Discharge (POD), POC-1 is located on the north-east corner on Valley Center Drive.

Per the "*Drainage Study for Autozone*" by Alidade Engineering, dated October 2017, modified rational method hydrologic analysis has been undertaken for the project site.

This study performs a modified-puls detention routing analysis using developed condition 100-year peak flowrates from the development to one POC using peak flow hydrology determined within the aforementioned drainage study.

Treatment of storm water runoff from the site has been addressed in a separate report - the "*Storm Water Quality Management Plan for Autozone*" by Alidade Engineering. Hydromodification (HMP) analysis has been presented within the "Technical Memorandum: SWMM Modeling for Autozone", dated April, 2018 by REC-Consultants.

Per County of San Diego drainage criteria, the Modified Rational Method should be used to determine peak design flowrates when the contributing drainage area is less than 1.0 square mile.

Methodology used for the computation of hydrographs is consistent with criteria set forth in the "2003 County of San Diego Drainage Design Manual." A more detailed explanation of methodology used for this analysis is listed in Chapter 2 of this report.

Hydraulic Modified-Puls detention basin routing of the aforementioned modified rational method hydrology was performed using the Army Corps of Engineers HEC-HMS 4.2.1 software. Hydrographs were generated using the RatHydro program developed by Rick Engineering Company.

1.2 – Summary of Existing Conditions

In current existing conditions, runoff from the project site discharges to one (1) POC, located to the north east of the project site. The project site is currently undeveloped.

Per the "*Drainage Study for Autozone*" by Alidade Engineering, dated October 2017, the pre-developed peak flow is provided in Table 1:

TABLE 1 – SUMMARY OF EXISTING CONDITIONS 100-YEAR EVENT FLOWS

Discharge Location	Drainage Area (Ac)	100-Year Peak Flow (cfs)
POC-1	2.154	3.67

1.3 – Summary of Developed Conditions

Runoff from the proposed project drains to a treatment train as follows: first, one (1) onsite receiving biofiltration with partial infiltration LID-1 collects the runoff. From there, low-flow runoff discharging the French-drain orifice and also the excess runoff that overflows the riser structure are collected and conveyed to an underground system for hydromodification compliance (UG-1), which is a 130 ft horizontal 48" diameter pipe. Excess of runoff is overflowed to another underground pipe with the same dimensions, UG-2 (mostly used during the occurrence of very extreme events) and all runoff joints and is discharged in POC-1. Some small by-pass areas (DMAs 2 to 6) also discharge into the same POC-1, but they do not drain to the LID system due to topographic constraints. It should be noted that all by-passed areas are either pervious or impervious satisfying the De-minimis requirements of the BMP Manual.

Per the "*Drainage Study for Autozone"* by Alidade Engineering dated October 2017, the post-developed peak flows are provided in Table 2 below:

TABLE 2 – SUMMARY OF DEVELOPED CONDITION 100-YEAR EVENT FLOWS

Discharge Location	Drainage Area (Ac)	Un-detained 100-Year Peak Flow (cfs)
POC-1	2.157	9.17

One (1) LID biofiltration basin plus one (1) Underground System (UG-1) are located within the project site and are responsible for handling hydromodification requirements for the project. The additional underground system (UG-2) is the system that is responsible for reducing the post developed peak flow to the peak flow in existing conditions. It should be pointed out that in developed conditions, the biofiltration with partial infiltration basin, and both underground systems will have a discharge structure with orifices, slots and/or weir, as defined in Table 3.

All flows will be either by-passed or discharged from the basins via the outlet structure or infiltrate through the base of the facility to the receiving amended soil and low flow orifice. The riser structure will act as a spillway such that peak flows can be safely discharged to the receiving underground systems and from there to the storm drain system in Valley Center Road, representing POC-1.

In regards to the biofiltration basin with partial infiltration, beneath the basins' invert lays the proposed LID biofiltration portion of the drainage facility. This portion of the basin is comprised of an 18-inch layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr) and a layer of gravel. The basins will be unlined to allow partial infiltration, but lateral impervious liners will prevent lateral infiltration (basin is unlined at the bottom, but lined along the walls due to geotechnical safety concerns).

Additionally, an underground horizontal storage pipe (UG-1) will be located in POC-1 to help comply with the hydromodification requirements. The 4 feet diameter pipe will be 130 feet in length. At the downstream end of the pipe a riser structure with slots will control the discharge to meet hydromodification requirements and emergency weir will safely discharge excessive flows into a second underground pipe (UG-2). This second system only discharges thru a 3" orifice to control the peak flow during the occurrence of an extreme event; this is the system that controls the Q_{100} event.

One (1) BMP biofiltration with partial infiltration basin (LD-1) and an underground 48" horizontal storage pipe (UG-1) are proposed for hydromodification conformance for the project site, in addition to an emergency underground pipe (UG-2) mostly used for extreme events. Tables 3 & 4 illustrate the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project.

TABLE 3 – SUMMARY OF BIOFILTRATION / PARTIAL INFILTRATION BMP

BMP	DIMENSIONS					
	BMP Area[(1)], (ft^2)	Low Flow Orif. on gravel layer (in)	Gravel Depth (in)[(2)]	Depth to Riser Invert (ft)[(3)]	Weir Perimeter Length[(3)] (ft)	Total Surface Depth[(4)] (ft)
LID-1	1,089	1.25"	18"	1.00'	8	2.00'

(1): Area of amended soil = area of gravel layer
(2): Filter layer (3" sand + 3" pea gravel) included here. Also included 3" of gravel below invert of LID orifice.
(3): Riser is at 12" above mulch, which is 3" above amended soil. The equivalent depth of ponding (considering mulch porosity of 0.4 and change in area with elevation) is 13.93", which is the depth to be included in model.
(4): 2 ft = 3" of mulch + 12" to reach invert of riser + 9" of free board over riser invert to discharge peak flows.

TABLE 4 – SUMMARY OF OUTLET STRUCTURE DETAILS AT UNDERGROUND SYSTEMS:

UNDERGROUND PIPE SYSTEM OUTLET STRUCTURE (See Attachment 5 for configuration)							
Outlet	Bottom Orifice		Lower Slot(1)			Weir	
	# of orifices and Diameter (in)	Elev. (ft)	width (in)	height (in)	Invert Elev. (in)	Width (ft)	Elev. (ft)
UG-1	2 orifices, 5/8" each	0.00(1)	16	1.5	32	6.00	3.50
UG-2	1 orifice, 3"(2)	0.00	n/a	n/a	n/a	n/a	n/a

Notes:
(1) Slot and orifices on UG-1 will be placed in a wall located at distribution box to control outlet peak to discharge pipe system. Weir will discharge to UG-2.
(2) Orifice in UG-2 to be placed in a plate upstream of discharge pipe to control UG-2 discharges

The developed condition peak flows calculated using modified rational method were then routed through the biofiltration and two (2) underground detention facilities on the project site in HEC-HMS. It must be noted that the LID BMP Basin was assumed full up to the emergency weir. This was done as the volume below the weir is considered Water Quality volume and only the volume above the weir was used for Q100 routing. As a consequence the HEC-HMS model only accounts for volume above the weir for the routing. The HMS Modified-Puls results are summarized in Table 5.

TABLE 5 – SUMMARY OF OFFSITE DETENTION BASIN ROUTING

POC	100-Year Peak Unrouted (cfs)	100-Year Peak routed (cfs)
POC-1	9.17	3.59

Input hydrographs for the HMS analysis were generated using the RatHydro program developed by Rick Engineering Company and are provided Chapter 3 of this report. To ensure accuracy, time steps of 1 minute intervals were inputted within the HMS model such that an accurate routing analysis could be undertaken.

Rational method hydrographs, stage-storage, stage-discharge relationships and HEC-HMS model output is provided in Chapter 3 of this report.

1.4 - Summary of Results

Table 6 below summarizes developed and existing condition drainage areas and resultant 100-year peak flow rates at the POC discharge locations from the Autozone Valley Center site.

TABLE 6 – SUMMARY OF PEAK FLOWS

Discharge Location	Drainage Area (Ac)	100 Year Peak Discharge (cfs)
POC-1		
-Existing Condition	2.154	3.67
-Developed Condition	2.157	3.59
Difference	**+0.003**	**-0.08**

As shown in the above table, the development of the proposed Autozone Valley Center project site will result on an equal amount of peak flow discharged from the project site in both existing and proposed conditions.

All developed runoff will receive water quality treatment in accordance with the site specific SWMP. Additionally, the POC is HMP compliant as analyzed in the Hydromodification Technical Memo.

1.5 - References

County of San Diego Design Hydrology Manual, June 2003

"*Storm Water Quality Management Plan for Autozone"*, Alidade Engineering, April 2018.

"*Technical Memorandum: SWMM Modeling for Autozone*", REC Consultants, April 2018.

"*Drainage Study for Autozone"*, Alidade Engineering, October 2017.

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION

2.1 – County of San Diego Design Criteria

SECTION 3
RATIONAL METHOD AND MODIFIED RATIONAL METHOD

3.1 THE RATIONAL METHOD

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage, where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and small drainage structures. The RM is recommended for analyzing the runoff response from drainage areas up to approximately 1 square mile in size. It should not be used in instances where there is a junction of independent drainage systems or for drainage areas greater than approximately 1 square mile in size. In these instances, the Modified Rational Method (MRM) should be used for junctions of independent drainage systems in watersheds up to approximately 1 square mile in size (see Section 3.4); or the NRCS Hydrologic Method should be used for watersheds greater than approximately 1 square mile in size (see Section 4).

The RM can be applied using any design storm frequency (e.g., 100-year, 50-year, 10-year, etc.). The local agency determines the design storm frequency that must be used based on the type of project and specific local requirements. A discussion of design storm frequency is provided in Section 2.3 of this manual. A procedure has been developed that converts the 6-hour and 24-hour precipitation isopluvial map data to an Intensity-Duration curve that can be used for the rainfall intensity in the RM formula as shown in Figure 3-1. The RM is applicable to a 6-hour storm duration because the procedure uses Intensity-Duration Design Charts that are based on a 6-hour storm duration.

3.1.1 Rational Method Formula

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (T_c), which is the time required for water to

CHAPTER 2

METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION

2.2 – Hydrograph Development Summary (from San Diego County Hydrology Manual)

SECTION 6
RATIONAL METHOD HYDROGRAPH PROCEDURE

6.1 INTRODUCTION

The procedures in this section are for the development of hydrographs from RM study results for study areas up to approximately 1 square mile in size. The RM, discussed in Section 3, is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage, where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and small drainage structures. However, in some instances such as for design of detention basins, the peak runoff rate is insufficient information for the design, and a hydrograph is needed. Unlike the NRCS hydrologic method (discussed in Section 4), the RM itself does not create hydrographs. The procedures for detention basin design based on RM study results were first developed as part of the East Otay Mesa Drainage Study. Rick Engineering Company performed this study under the direction of County Flood Control. The procedures in this section may be used for the development of hydrographs from RM study results for study areas up to approximately 1 square mile in size.

6.2 HYDROGRAPH DEVELOPMENT

The concept of this hydrograph procedure is based on the RM formula:

$$Q = C\,I\,A$$

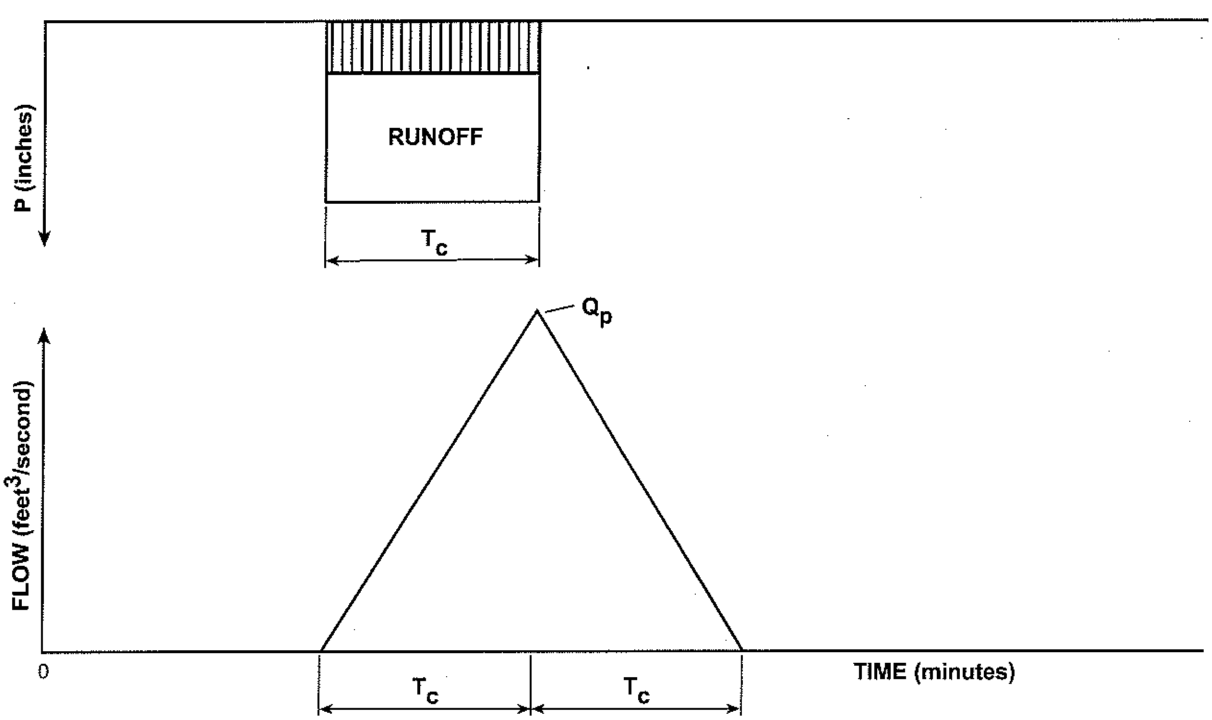
Where:
- Q = peak discharge, in cubic feet per second (cfs)
- C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)
- I = average rainfall intensity for a duration equal to the T_c for the area, in inches per hour
- A = drainage area contributing to the design location, in acres

The RM formula is discussed in more detail in Section 3.

An assumption of the RM is that discharge increases linearly over the T_c for the drainage area until reaching the peak discharge as defined by the RM formula, and then decreases linearly. A linear hydrograph can be developed for the peak flow occurring over the T_c as shown in Figure 6-1. However, for designs that are dependent on the total storm volume, it is not sufficient to consider a single hydrograph for peak flow occurring over the T_c at the beginning of a 6-hour storm event because the hydrograph does not account for the entire volume of runoff from the storm event. The volume under the hydrograph shown in Figure 6-1 is equal to the rainfall intensity multiplied by the duration for which that intensity occurs (T_c), the drainage area (A) contributing to the design location, and the runoff coefficient (C) for the drainage area. For designs that are dependent on the total storm volume, a hydrograph must be generated to account for the entire volume of runoff from the 6-hour storm event. The hydrograph for the entire 6-hour storm event is generated by creating a rainfall distribution consisting of blocks of rain, creating an incremental hydrograph for each block of rain, and adding the hydrographs from each block of rain. This process creates a hydrograph that contains runoff from all the blocks of rain and accounts for the entire volume of runoff from the 6-hour storm event. The total volume under the resulting hydrograph is equal to the following equation:

$$VOL = CP_6A \qquad \text{(Eq. 6-1)}$$

Where: VOL = volume of runoff (acre-inches)
P_6 = 6-hour rainfall (inches)
C = runoff coefficient
A = area of the watershed (acres)



Triangular Hydrograph

FIGURE

6-1

6.2.1 Rainfall Distribution

Figure 6-2 shows a 6-hour rainfall distribution consisting of blocks of rain over increments of time equal to T_c. The number of blocks is determined by rounding T_c to the nearest whole number of minutes, dividing 360 minutes (6 hours) by T_c, and rounding again to the nearest whole number. The blocks are distributed using a (2/3, 1/3) distribution in which the peak rainfall block is placed at the 4-hour time within the 6-hour rainfall duration. The additional blocks are distributed in a sequence alternating two blocks to the left and one block to the right of the 4-hour time (see Figure 6-2). The total amount of rainfall ($P_{T(N)}$) for any given block (N) is determined as follows:

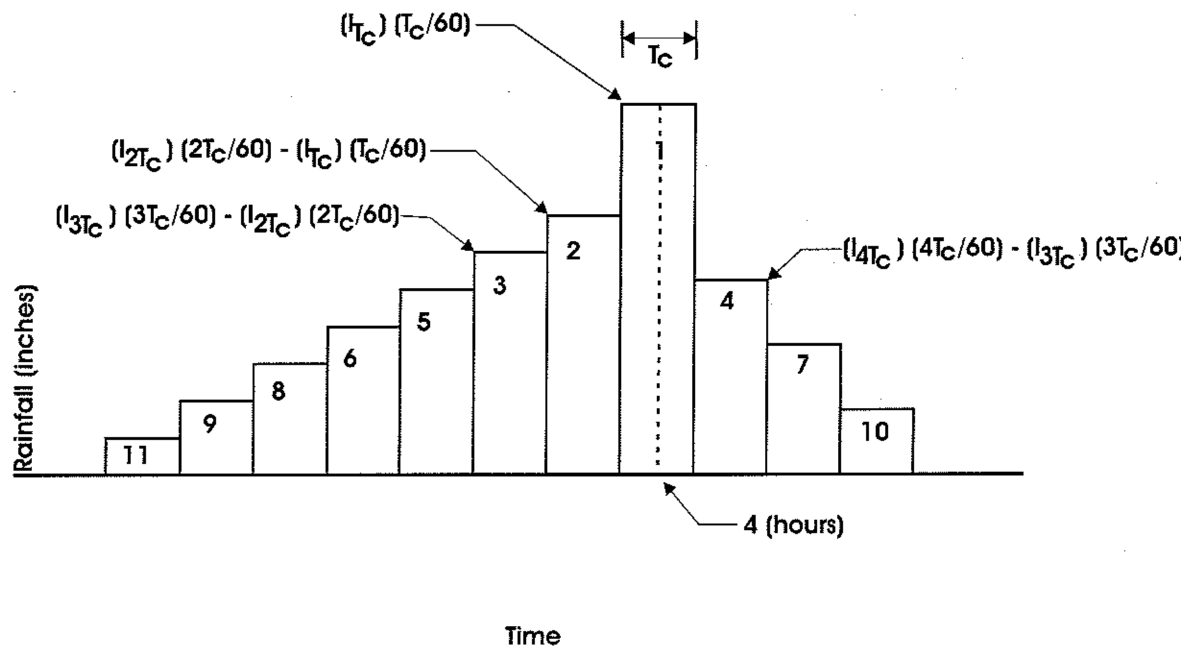
$$P_{T(N)} = (I_{T(N)} \, T_{T(N)}) / 60$$

Where: $P_{T(N)}$ = total amount of rainfall for any given block (N)
$I_{T(N)}$ = average rainfall intensity for a duration equal to $T_{T(N)}$ in inches per hour
$T_{T(N)}$ = NT_c in minutes (N is an integer representing the given block number of rainfall)

Intensity is calculated using the following equation (described in detail in Section 3):

$$I = 7.44 \, P_6 \, D^{-0.645}$$

Where: I = average rainfall intensity for a duration equal to D in inches per hour
P_6 = adjusted 6-hour storm rainfall
D = duration in minutes



Rainfall Distribution

FIGURE

6-2

Substituting the equation for I in the equation above for $P_{T(N)}$ and setting the duration (D) equal to $T_{T(N)}$ yields:

$$P_{T(N)} = [(7.44\ P_6/T_{T(N)}^{0.645})(T_{T(N)})]\ /\ 60$$
$$P_{T(N)} = 0.124\ P_6 T_{T(N)}^{0.355}$$

Substituting NT_c for T_T (where N equals the block number of rainfall) in the equation above yields:

$$P_{T(N)} = 0.124\ P_6\ (NT_c)^{0.355} \qquad \text{(Eq. 6-2)}$$

Equation 6-2 represents the total rainfall amount for a rainfall block with a time base equal to $T_{T(N)}$ (NT_c). The actual time base of each rainfall block in the rainfall distribution is T_c, as shown in Figure 6-2. The actual rainfall amount (P_N) for each block of rain is equal to P_T at N ($P_{T(N)}$) minus the previous P_T at N–1 ($P_{T(N-1)}$) at any given multiple of T_c (any NT_c). For example, the rainfall for block 2 is equal to $P_{T(N)}$ at $T_{T(N)} = 2T_c$ minus the $P_{T(N)}$ at $T_{T(N)} = 1T_c$, and the rainfall for block 3 equals $P_{T(N)}$ at $T_{T(N)} = 3T_c$ minus the $P_{T(N)}$ at $T_{T(N)} = 2T_c$, or P_N can be represented by the following equation:

$$P_N = P_{T(N)} - P_{T(N-1)} \qquad \text{(Eq. 6-3)}$$

For the rainfall distribution, the rainfall at block N = 1, ($1T_c$), is centered at 4 hours, the rainfall at block N = 2, ($2T_c$), is centered at 4 hours – $1T_c$, the rainfall at block N = 3, ($3T_c$), is centered at 4 hours – $2T_c$, and the rainfall at at block N = 4, ($4T_c$), is centered at 4 hours + $1T_c$. The sequence continues alternating two blocks to the left and one block to the right (see Figure 6-2).

6.2.2 Construction of Incremental Hydrographs

Figure 6-1 shows the relationship of a single block of rain to a single hydrograph. Figure 6-3 shows the relationship of the rainfall distribution to the overall hydrograph for the storm event. The peak flow amount from each block of rain is determined by the RM formula, Q = CIA, where I equals I_N (the actual rainfall intensity for the rainfall block). I_N is determined by dividing P_N by the actual time base of the block, T_c. The following equation shows this relationship:

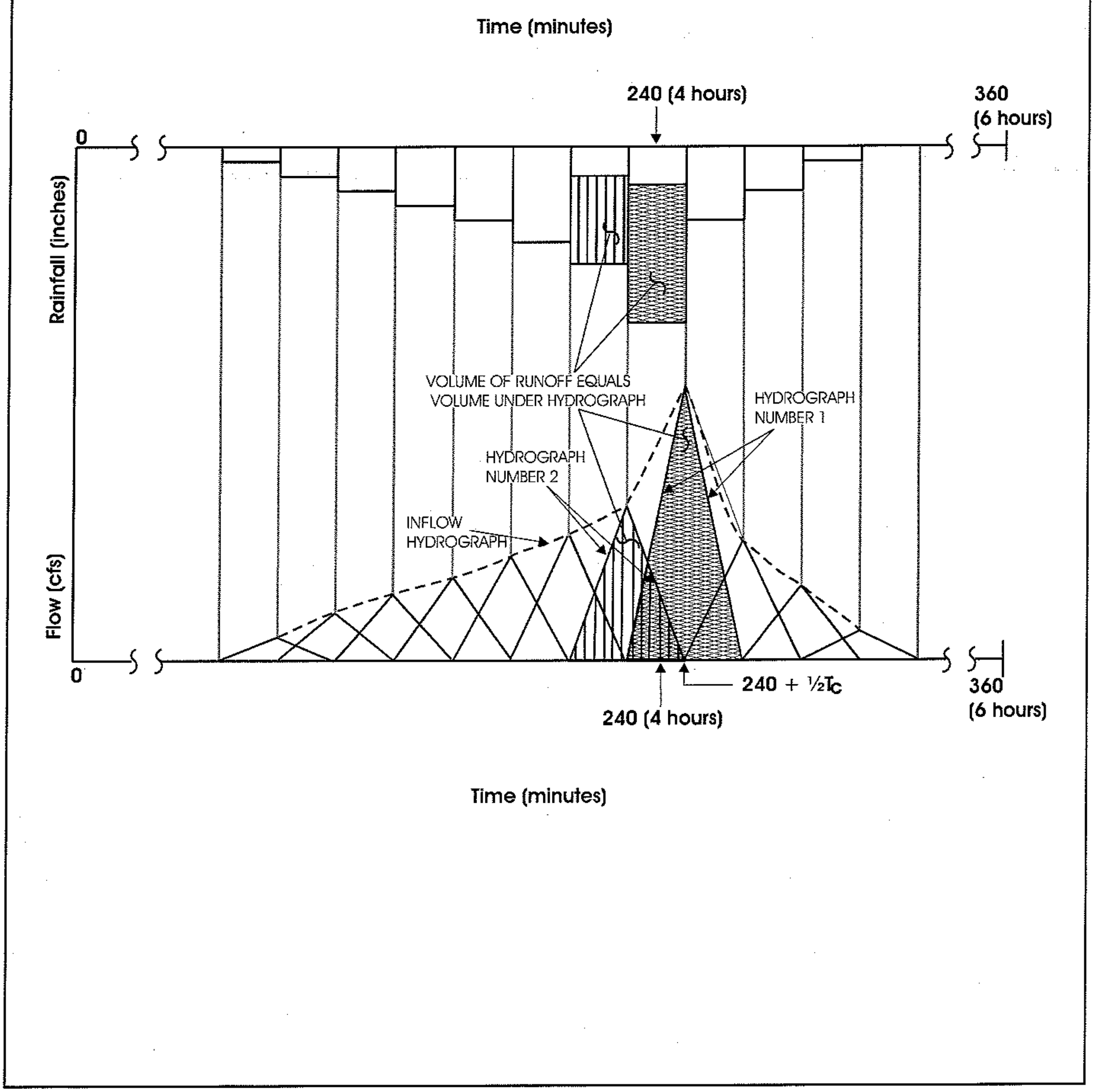
$$I_N = 60\ P_N/T_c \qquad \text{(Eq. 6-4)}$$

Where: I_N = average rainfall intensity for a duration equal to T_c in inches per hour
P_N = rainfall amount for the block in inches
T_c = time of concentration in minutes

By substituting equation 6-4 into the rational equation, the following relationship is obtained:

$$Q_N = 60\ CAP_N/T_c\ \text{(cfs)} \qquad \text{(Eq. 6-5)}$$

Finally, the overall hydrograph for the storm event is determined by adding all the hydrographs from each block of rain. Since the peak flow amount for each incremental hydrograph corresponds to a zero flow amount from the previous and proceeding hydrographs, as shown in Figure 6-3, the inflow hydrograph can be plotted by connecting the peak flow amounts (see the dashed line in Figure 6-3).



6-Hour Rational Method Hydrograph

FIGURE

6-3

6.3 GENERATING A HYDROGRAPH USING RATHYDRO

The rainfall distribution and related hydrographs can be developed using the RATHYDRO computer program provided to the County by Rick Engineering Company. A copy of this program is available at no cost from the County. The output from this computer program may be used with HEC-1 or other software for routing purposes.

The design storm pattern used by the RATHYDRO program is based on the (2/3, 1/3) distribution described in Sections 4.1.1 and 6.2.1. The ordinates on the hydrograph are calculated based on the County of San Diego Intensity-Duration Design Chart (Figure 3-1), which uses the intensity equation described in Sections 3.1.3 and 6.2.1 to relate the intensity (I) of the storm to T_c, $I = 7.44\ P_6 D^{-0.645}$. The computer program uses equations 6-2 and 6-3 described above and calculates I_N directly. The intensity at any given multiple of T_c is calculated by the following equation:

$$I_N = [(I_{T(N)})\ (T_{T(N)}) - (I_{T(N-1)})\ (T_{T(N-1)})]\ /\ T_c \qquad \text{(Eq. 6-6)}$$

Where: N = number of rainfall blocks

$T_{T(N)}$ = time of concentration at rainfall block N in minutes (equal to NT_c)

I_N = actual rainfall intensity at rainfall block N in inches per hour

$I_{T(N)}$ = rainfall intensity at time of concentration $T_{T(N)}$ in inches per hour

Figure 6-2 shows the rainfall distribution used in the RM hydrograph, computed at multiples of T_c. The rainfall at block N = 1, ($1T_c$), is centered at 4 hours, the rainfall at block N = 2, ($2T_c$), is centered at 4 hours – $1T_c$, the rainfall at block N = 3, ($3T_c$), is centered at 4 hours – $2T_c$, and the rainfall at at block N = 4, ($4T_c$), is centered at 4 hours + $1T_c$. The sequence continues alternating two blocks to the left and one block to the right (see Figure 6-2).

As described in Section 6.2.2, the peak discharge (Q_N) of the hydrograph for any given rainfall block (N) is determined by the RM formula Q = CIA, where $I = I_N$ = the actual rainfall intensity for the rainfall block. The RATHYDRO program substitutes equation 6-6 into the RM formula to determine Q_N yielding the following equation:

$$Q_N = [(I_{T(N)})\,(T_{T(N)}) - (I_{T(N-1)})\,(T_{T(N-1)})]\ CA / T_c \qquad \text{(Eq. 6-7)}$$

Where: Q_N = peak discharge for rainfall block N in cubic feet per second (cfs)
N = number of rainfall blocks
$T_{T(N)}$ = time of concentration at rainfall block N in minutes (equal to NT_c)
$I_{T(N)}$ = rainfall intensity at time of concentration $T_{T(N)}$ in inches per hour
C = RM runoff coefficient
A = area of the watershed (acres)

To develop the hydrograph for the 6-hour design storm, a series of triangular hydrographs with ordinates at multiples of the given T_c are created and added to create the hydrograph. This hydrograph has its peak at 4 hours plus ½ of the T_c. The total volume under the hydrograph is equal to the following equation (equation 6-1):

$$VOL = CP_6A$$

Where: VOL = volume of runoff (acre-inches)
P_6 = 6-hour rainfall (inches)
C = runoff coefficient
A = area of the watershed (acres)

CHAPTER 3

MODIFIED-PULS DETENTION ROUTING

3.1 – Rational Method Hydrographs

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 3/30/2018
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 3.7 INCHES
BASIN AREA 0.842 ACRES
RUNOFF COEFFICIENT 0.777
PEAK DISCHARGE 6.38 CFS

TIME (MIN) = 0 DISCHARGE (CFS) = 0
TIME (MIN) = 5 DISCHARGE (CFS) = 0.1
TIME (MIN) = 10 DISCHARGE (CFS) = 0.1
TIME (MIN) = 15 DISCHARGE (CFS) = 0.1
TIME (MIN) = 20 DISCHARGE (CFS) = 0.1
TIME (MIN) = 25 DISCHARGE (CFS) = 0.2
TIME (MIN) = 30 DISCHARGE (CFS) = 0.2
TIME (MIN) = 35 DISCHARGE (CFS) = 0.2
TIME (MIN) = 40 DISCHARGE (CFS) = 0.2
TIME (MIN) = 45 DISCHARGE (CFS) = 0.2
TIME (MIN) = 50 DISCHARGE (CFS) = 0.2
TIME (MIN) = 55 DISCHARGE (CFS) = 0.2
TIME (MIN) = 60 DISCHARGE (CFS) = 0.2
TIME (MIN) = 65 DISCHARGE (CFS) = 0.2
TIME (MIN) = 70 DISCHARGE (CFS) = 0.2
TIME (MIN) = 75 DISCHARGE (CFS) = 0.2
TIME (MIN) = 80 DISCHARGE (CFS) = 0.2
TIME (MIN) = 85 DISCHARGE (CFS) = 0.2
TIME (MIN) = 90 DISCHARGE (CFS) = 0.2
TIME (MIN) = 95 DISCHARGE (CFS) = 0.2
TIME (MIN) = 100 DISCHARGE (CFS) = 0.2
TIME (MIN) = 105 DISCHARGE (CFS) = 0.2
TIME (MIN) = 110 DISCHARGE (CFS) = 0.2
TIME (MIN) = 115 DISCHARGE (CFS) = 0.2
TIME (MIN) = 120 DISCHARGE (CFS) = 0.2
TIME (MIN) = 125 DISCHARGE (CFS) = 0.2
TIME (MIN) = 130 DISCHARGE (CFS) = 0.2
TIME (MIN) = 135 DISCHARGE (CFS) = 0.2
TIME (MIN) = 140 DISCHARGE (CFS) = 0.2
TIME (MIN) = 145 DISCHARGE (CFS) = 0.3
TIME (MIN) = 150 DISCHARGE (CFS) = 0.3
TIME (MIN) = 155 DISCHARGE (CFS) = 0.3
TIME (MIN) = 160 DISCHARGE (CFS) = 0.3
TIME (MIN) = 165 DISCHARGE (CFS) = 0.3
TIME (MIN) = 170 DISCHARGE (CFS) = 0.3
TIME (MIN) = 175 DISCHARGE (CFS) = 0.3
TIME (MIN) = 180 DISCHARGE (CFS) = 0.3
TIME (MIN) = 185 DISCHARGE (CFS) = 0.4
TIME (MIN) = 190 DISCHARGE (CFS) = 0.4
TIME (MIN) = 195 DISCHARGE (CFS) = 0.4
TIME (MIN) = 200 DISCHARGE (CFS) = 0.4
TIME (MIN) = 205 DISCHARGE (CFS) = 0.5
TIME (MIN) = 210 DISCHARGE (CFS) = 0.5
TIME (MIN) = 215 DISCHARGE (CFS) = 0.6
TIME (MIN) = 220 DISCHARGE (CFS) = 0.6
TIME (MIN) = 225 DISCHARGE (CFS) = 0.8
TIME (MIN) = 230 DISCHARGE (CFS) = 0.9
TIME (MIN) = 235 DISCHARGE (CFS) = 1.3
TIME (MIN) = 240 DISCHARGE (CFS) = 1.8
TIME (MIN) = 245 DISCHARGE (CFS) = 6.38
TIME (MIN) = 250 DISCHARGE (CFS) = 1
TIME (MIN) = 255 DISCHARGE (CFS) = 0.7
TIME (MIN) = 260 DISCHARGE (CFS) = 0.5
TIME (MIN) = 265 DISCHARGE (CFS) = 0.4
TIME (MIN) = 270 DISCHARGE (CFS) = 0.4
TIME (MIN) = 275 DISCHARGE (CFS) = 0.3
TIME (MIN) = 280 DISCHARGE (CFS) = 0.3
TIME (MIN) = 285 DISCHARGE (CFS) = 0.3
TIME (MIN) = 290 DISCHARGE (CFS) = 0.3
TIME (MIN) = 295 DISCHARGE (CFS) = 0.2
TIME (MIN) = 300 DISCHARGE (CFS) = 0.2
TIME (MIN) = 305 DISCHARGE (CFS) = 0.2
TIME (MIN) = 310 DISCHARGE (CFS) = 0.2
TIME (MIN) = 315 DISCHARGE (CFS) = 0.2
TIME (MIN) = 320 DISCHARGE (CFS) = 0.2
TIME (MIN) = 325 DISCHARGE (CFS) = 0.2
TIME (MIN) = 330 DISCHARGE (CFS) = 0.2
TIME (MIN) = 335 DISCHARGE (CFS) = 0.2
TIME (MIN) = 340 DISCHARGE (CFS) = 0.2
TIME (MIN) = 345 DISCHARGE (CFS) = 0.2
TIME (MIN) = 350 DISCHARGE (CFS) = 0.2
TIME (MIN) = 355 DISCHARGE (CFS) = 0.2
TIME (MIN) = 360 DISCHARGE (CFS) = 0.1
TIME (MIN) = 365 DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 3/30/2018
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 3.7 INCHES
BASIN AREA 0.101 ACRES
RUNOFF COEFFICIENT 0.384
PEAK DISCHARGE 0.38 CFS
TIME (MIN) = 0 DISCHARGE (CFS) = 0
TIME (MIN) = 5 DISCHARGE (CFS) = 0
TIME (MIN) = 10 DISCHARGE (CFS) = 0
TIME (MIN) = 15 DISCHARGE (CFS) = 0
TIME (MIN) = 20 DISCHARGE (CFS) = 0
TIME (MIN) = 25 DISCHARGE (CFS) = 0
TIME (MIN) = 30 DISCHARGE (CFS) = 0
TIME (MIN) = 35 DISCHARGE (CFS) = 0
TIME (MIN) = 40 DISCHARGE (CFS) = 0
TIME (MIN) = 45 DISCHARGE (CFS) = 0
TIME (MIN) = 50 DISCHARGE (CFS) = 0
TIME (MIN) = 55 DISCHARGE (CFS) = 0
TIME (MIN) = 60 DISCHARGE (CFS) = 0
TIME (MIN) = 65 DISCHARGE (CFS) = 0
TIME (MIN) = 70 DISCHARGE (CFS) = 0
TIME (MIN) = 75 DISCHARGE (CFS) = 0
TIME (MIN) = 80 DISCHARGE (CFS) = 0
TIME (MIN) = 85 DISCHARGE (CFS) = 0
TIME (MIN) = 90 DISCHARGE (CFS) = 0
TIME (MIN) = 95 DISCHARGE (CFS) = 0
TIME (MIN) = 100 DISCHARGE (CFS) = 0
TIME (MIN) = 105 DISCHARGE (CFS) = 0
TIME (MIN) = 110 DISCHARGE (CFS) = 0
TIME (MIN) = 115 DISCHARGE (CFS) = 0
TIME (MIN) = 120 DISCHARGE (CFS) = 0
TIME (MIN) = 125 DISCHARGE (CFS) = 0
TIME (MIN) = 130 DISCHARGE (CFS) = 0
TIME (MIN) = 135 DISCHARGE (CFS) = 0
TIME (MIN) = 140 DISCHARGE (CFS) = 0
TIME (MIN) = 145 DISCHARGE (CFS) = 0
TIME (MIN) = 150 DISCHARGE (CFS) = 0
TIME (MIN) = 155 DISCHARGE (CFS) = 0
TIME (MIN) = 160 DISCHARGE (CFS) = 0
TIME (MIN) = 165 DISCHARGE (CFS) = 0
TIME (MIN) = 170 DISCHARGE (CFS) = 0
TIME (MIN) = 175 DISCHARGE (CFS) = 0
TIME (MIN) = 180 DISCHARGE (CFS) = 0
TIME (MIN) = 185 DISCHARGE (CFS) = 0
TIME (MIN) = 190 DISCHARGE (CFS) = 0
TIME (MIN) = 195 DISCHARGE (CFS) = 0
TIME (MIN) = 200 DISCHARGE (CFS) = 0
TIME (MIN) = 205 DISCHARGE (CFS) = 0
TIME (MIN) = 210 DISCHARGE (CFS) = 0
TIME (MIN) = 215 DISCHARGE (CFS) = 0
TIME (MIN) = 220 DISCHARGE (CFS) = 0
TIME (MIN) = 225 DISCHARGE (CFS) = 0
TIME (MIN) = 230 DISCHARGE (CFS) = 0.1
TIME (MIN) = 235 DISCHARGE (CFS) = 0.1
TIME (MIN) = 240 DISCHARGE (CFS) = 0.1
TIME (MIN) = 245 DISCHARGE (CFS) = 0.38
TIME (MIN) = 250 DISCHARGE (CFS) = 0.1
TIME (MIN) = 255 DISCHARGE (CFS) = 0
TIME (MIN) = 260 DISCHARGE (CFS) = 0
TIME (MIN) = 265 DISCHARGE (CFS) = 0
TIME (MIN) = 270 DISCHARGE (CFS) = 0
TIME (MIN) = 275 DISCHARGE (CFS) = 0
TIME (MIN) = 280 DISCHARGE (CFS) = 0
TIME (MIN) = 285 DISCHARGE (CFS) = 0
TIME (MIN) = 290 DISCHARGE (CFS) = 0
TIME (MIN) = 295 DISCHARGE (CFS) = 0
TIME (MIN) = 300 DISCHARGE (CFS) = 0
TIME (MIN) = 305 DISCHARGE (CFS) = 0
TIME (MIN) = 310 DISCHARGE (CFS) = 0
TIME (MIN) = 315 DISCHARGE (CFS) = 0
TIME (MIN) = 320 DISCHARGE (CFS) = 0
TIME (MIN) = 325 DISCHARGE (CFS) = 0
TIME (MIN) = 330 DISCHARGE (CFS) = 0
TIME (MIN) = 335 DISCHARGE (CFS) = 0
TIME (MIN) = 340 DISCHARGE (CFS) = 0
TIME (MIN) = 345 DISCHARGE (CFS) = 0
TIME (MIN) = 350 DISCHARGE (CFS) = 0
TIME (MIN) = 355 DISCHARGE (CFS) = 0
TIME (MIN) = 360 DISCHARGE (CFS) = 0
TIME (MIN) = 365 DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY
RUN DATE 3/30/2018
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 13 MIN.
6 HOUR RAINFALL 3.7 INCHES
BASIN AREA 1.214 ACRES
RUNOFF COEFFICIENT 0.386
PEAK DISCHARGE 2.41 CFS
TIME (MIN) = 0 DISCHARGE (CFS) = 0
TIME (MIN) = 13 DISCHARGE (CFS) = 0
TIME (MIN) = 26 DISCHARGE (CFS) = 0.1
TIME (MIN) = 39 DISCHARGE (CFS) = 0.1
TIME (MIN) = 52 DISCHARGE (CFS) = 0.1
TIME (MIN) = 65 DISCHARGE (CFS) = 0.1
TIME (MIN) = 78 DISCHARGE (CFS) = 0.1
TIME (MIN) = 91 DISCHARGE (CFS) = 0.1
TIME (MIN) = 104 DISCHARGE (CFS) = 0.1
TIME (MIN) = 117 DISCHARGE (CFS) = 0.1
TIME (MIN) = 130 DISCHARGE (CFS) = 0.2
TIME (MIN) = 143 DISCHARGE (CFS) = 0.2
TIME (MIN) = 156 DISCHARGE (CFS) = 0.2
TIME (MIN) = 169 DISCHARGE (CFS) = 0.2
TIME (MIN) = 182 DISCHARGE (CFS) = 0.2
TIME (MIN) = 195 DISCHARGE (CFS) = 0.2
TIME (MIN) = 208 DISCHARGE (CFS) = 0.3
TIME (MIN) = 221 DISCHARGE (CFS) = 0.3
TIME (MIN) = 234 DISCHARGE (CFS) = 0.5
TIME (MIN) = 247 DISCHARGE (CFS) = 0.7
TIME (MIN) = 260 DISCHARGE (CFS) = 2.41
TIME (MIN) = 273 DISCHARGE (CFS) = 0.4
TIME (MIN) = 286 DISCHARGE (CFS) = 0.3
TIME (MIN) = 299 DISCHARGE (CFS) = 0.2
TIME (MIN) = 312 DISCHARGE (CFS) = 0.2
TIME (MIN) = 325 DISCHARGE (CFS) = 0.1
TIME (MIN) = 338 DISCHARGE (CFS) = 0.1
TIME (MIN) = 351 DISCHARGE (CFS) = 0.1
TIME (MIN) = 364 DISCHARGE (CFS) = 0.1
TIME (MIN) = 377 DISCHARGE (CFS) = 0

CHAPTER 3

MODIFIED-PULS DETENTION ROUTING

3.2 – Stage Storage Discharge Relationships

DISCHARGE EQUATIONS

1) Weir:

   $Q_W = C_W \cdot L \cdot H^{3/2}$ (1)

2) Slot:

   As an orifice: $Q_s = B_s \cdot h_s \cdot c_g \cdot \sqrt{2g\left(H - \frac{h_s}{2}\right)}$ (2.a)

   As a weir: $Q_s = C_W \cdot B_s \cdot H^{3/2}$ (2.b)

   For H > h_s slot works as weir until orifice equation provides a smaller discharge. The elevation such that equation (2.a) = equation (2.b) is the elevation at which the behavior changes from weir to orifice.

3) Vertical Orifices

   As an orifice: $Q_o = 0.25 \cdot \pi D^2 \cdot c_g \cdot \sqrt{2g\left(H - \frac{D}{2}\right)}$ (3.a)

   As a weir: Critical depth and geometric family of circular sector must be solved to determined Q as a function of H:

$$\frac{Q_O^2}{g} = \frac{A_{cr}^3}{T_{cr}}; \quad H = y_{cr} + \frac{A_{cr}}{2 \cdot T_{cr}}; \; T_{cr} = 2\sqrt{y_{cr}(D - y_{cr})}\,; \quad A_{cr} = \frac{D^2}{8}[\alpha_{cr} - sin(\alpha_{cr})]\,;$$

   $y_{cr} = \frac{D}{2}[1 - sin(0.5 \cdot \alpha_{cr})]$ (3.b.1, 3.b.2, 3.b.3, 3.b.4 and 3.b.5)

   There is a value of H (approximately H = 110% D) from which orifices no longer work as weirs as critical depth is not possible at the entrance of the orifice. This value of H is obtained equaling the discharge using critical equations and equations (3.b).

A mathematical model is prepared with the previous equations depending on the type o discharge.

The following are the variables used above:

Q_W, Q_s, Q_O = Discharge of weir, slot or orifice (cfs)

C_W, c_g : Coefficients of discharge of weir (typically 3.1) and orifice (0.61 to 0.62)

L, B_s, D, h_s : Length of weir, width of slot, diameter of orifice and height of slot, respectively; (ft)

H: Level of water in the pond over the invert of slot, weir or orifice (ft)

A_{cr}, T_{cr}, y_{cr}, α_{cr}: Critical variables for circular sector: area (sq-ft), top width (ft), critical depth (ft), and angle to the center, respectively.

Stage-Area for Biofiltration BMP Basin 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-0.25	1089	0	Bottom of 3" layer of mulch [(1)]
0.00	1089	109	
0.25	1162	390	
0.50	1238	690	
0.75	1314	1009	
1.00	1393	1348	
1.25	1473	1706	**Surface Outlet [(3)]**
1.50	1555	2084	
1.75	1639	2484	
2.00	1724	2904	

SUB SURFACE STORAGE BASIN 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.75	1089	490	**Amended Soil Base (0.3 voids)**
-3.25	1089	653	**Gravel Base (0.4 voids) [(4)]**
Gravel & Amended Soil	**TOTAL =**	1143	(ft^3)
Surface Total	**TOTAL =**	1009	(ft^3)
IMP	**TOTAL =**	**2153**	**(ft^3)**

Effective Depth[(5)]:	18.80 in

At Elevation 0.75 ft is the WQ Area:	**1089**	**(ft^2)**	**BIOFILTRATION [(2)]**

(1): The three inches of mulch begin here, they have a porosity of 0.4 voids.
(2): The Water Quality (WQ) area corresponds to the area at the bottom of the Biofiltration.
This is the area corresponding to the ammended soil and gravel.
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet) which is the 2 feet by 2 feet emergency weir.
(4): The gravel depth includes the 6 inches of storage below the LID orifice.
(5): Depth to be used in the SWMM LID Controls. See Attachment 7 for more details.

Outlet structure for Discharge of Basin 1

Discharge vs Elevation Table

Lower orifice:	0.625	"	Lower slot		
Number of orif:	0		Number of slots:	0	
Cg-low:	0.61		Invert:	0.00	ft
			B:	0.000	ft
Middle orifice	2.500	"	h_{slot}:	0.000	ft
Number of orif:	0.000				
Cg-middle:	0.61		Emergency weir		
invert elev:	0	ft	Invert:	0.000	ft
			W:	8.00	ft

*Note: h = head above the invert of the Emergency Weir discharge opening.

h* (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qslot-low (cfs)	Qemerg (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.800	0.200	0.000	0.000	0.000	0.000	0.211	0.211
0.083	1.600	0.400	0.000	0.000	0.000	0.000	0.597	0.597
0.125	2.400	0.600	0.000	0.000	0.000	0.000	1.096	1.096
0.167	3.200	0.800	0.000	0.000	0.000	0.000	1.687	1.687
0.208	4.000	1.000	0.000	0.000	0.000	0.000	2.358	2.358
0.250	4.800	1.200	0.000	0.000	0.000	0.000	3.100	3.100
0.292	5.600	1.400	0.000	0.000	0.000	0.000	3.906	3.906
0.333	6.400	1.600	0.000	0.000	0.000	0.000	4.773	4.773
0.375	7.200	1.800	0.000	0.000	0.000	0.000	5.695	5.695
0.417	8.000	2.000	0.000	0.000	0.000	0.000	6.670	6.670
0.458	8.800	2.200	0.000	0.000	0.000	0.000	7.695	7.695
0.500	9.600	2.400	0.000	0.000	0.000	0.000	8.768	8.768
0.542	10.400	2.600	0.000	0.000	0.000	0.000	9.887	9.887
0.583	11.200	2.800	0.000	0.000	0.000	0.000	11.049	11.049
0.625	12.000	3.000	0.000	0.000	0.000	0.000	12.254	12.254
0.667	12.800	3.200	0.000	0.000	0.000	0.000	13.499	13.499
0.708	13.600	3.400	0.000	0.000	0.000	0.000	14.785	14.785
0.750	14.400	3.600	0.000	0.000	0.000	0.000	16.108	16.108

Underground Unit 1- Flood Control System

h (ft)	h (inch)	α (°)	Vol (cu-ft)	A (sq-ft)	Q (cfs)	Vol (ac-ft)	Δt (hr)
0.000	0	0	0.00	70	0.000	0	
0.083	1	33.2	10.12	172.9	0.005	0.0002	1.13
0.167	2	47.1	26.96	231.2	0.008	0.0006	0.73
0.250	3	57.9	48.01	274.1	0.010	0.0011	0.66
0.333	4	67.1	72.36	310.1	0.012	0.0017	0.63
0.417	5	75.3	99.43	339.7	0.013	0.0023	0.61
0.500	6	82.8	128.86	366.5	0.014	0.0030	0.60
0.583	7	89.8	160.34	389.0	0.016	0.0037	0.58
0.667	8	96.4	193.63	410.0	0.017	0.0044	0.57
0.750	9	102.6	228.54	427.8	0.018	0.0052	0.56
0.833	10	108.6	264.90	444.8	0.019	0.0061	0.55
0.917	11	114.4	302.56	459.0	0.020	0.0069	0.54
1.000	12	120.0	341.38	472.7	0.021	0.0078	0.54
1.083	13	125.4	381.24	484.0	0.021	0.0088	0.53
1.167	14	130.8	422.03	495.1	0.022	0.0097	0.52
1.250	15	136.0	463.66	503.9	0.023	0.0106	0.51
1.333	16	141.1	506.01	512.6	0.024	0.0116	0.50
1.417	17	146.1	549.00	519.2	0.025	0.0126	0.49
1.500	18	151.0	592.55	525.8	0.025	0.0136	0.48
1.583	19	156.0	636.56	530.4	0.026	0.0146	0.48
1.667	20	160.8	680.95	535.1	0.027	0.0156	0.47
1.750	21	165.6	725.65	537.7	0.027	0.0167	0.46
1.833	22	170.4	770.58	540.5	0.028	0.0177	0.45
1.917	23	175.2	815.66	541.4	0.029	0.0187	0.44
2.000	24	180.0	860.81	542.3	0.029	0.0198	0.43
2.083	25	184.8	905.97	541.4	0.030	0.0208	0.42
2.167	26	189.6	951.05	540.5	0.031	0.0218	0.41
2.250	27	194.4	995.97	537.7	0.031	0.0229	0.41
2.333	28	199.2	1040.67	535.1	0.032	0.0239	0.40
2.417	29	204.0	1085.07	530.4	0.032	0.0249	0.39
2.500	30	209.0	1129.08	525.8	0.033	0.0259	0.38
2.583	31	213.9	1172.62	519.2	0.033	0.0269	0.37
2.667	32	218.9	1215.62	512.6	0.034	0.0279	0.36
2.750	33	224.0	1257.97	503.9	0.133	0.0289	0.14
2.833	34	229.2	1299.59	495.1	0.298	0.0298	0.05
2.917	35	234.6	1340.39	484.0	0.388	0.0308	0.03
3.000	36	240.0	1380.25	472.7	0.460	0.0317	0.03
3.083	37	245.6	1419.07	459.0	0.522	0.0326	0.02
3.167	38	251.4	1456.73	444.8	0.576	0.0334	0.02
3.250	39	257.4	1493.09	427.8	0.626	0.0343	0.02
3.333	40	263.6	1528.00	410.0	0.672	0.0351	0.01
3.417	41	270.2	1561.29	389.0	0.715	0.0358	0.01
3.500	42	277.2	1592.77	366.5	0.755	0.0366	0.01
3.583	43	284.7	1622.19	339.7	1.240	0.0372	0.01
3.667	44	292.9	1649.27	310.1	2.095	0.0379	0.00
3.750	45	302.1	1673.62	274.1	3.189	0.0384	0.00
3.833	46	312.9	1694.67	231.2	4.477	0.0389	0.00
3.917	47	326.8	1711.51	172.9	5.932	0.0393	0.00
4.000	48	360.0	1721.63	70.0	7.537	0.0395	0.00
					TOT drying time (hr):		**16.96**

Underground Unit 2- HMP System

h (ft)	h (inch)	α (°)	Vol (cu-ft)	A (sq-ft)	Q (cfs)	Vol (ac-ft)	Δt (hr)
0.000	0	0	0.00	72	0.000	0.0000	
0.083	1	33.2	10.29	174.9	0.011	0.0002	0.51
0.167	2	47.1	27.29	233.2	0.041	0.0006	0.18
0.250	3	57.9	48.51	276.1	0.081	0.0011	0.10
0.333	4	67.1	73.02	312.1	0.110	0.0017	0.07
0.417	5	75.3	100.27	341.7	0.130	0.0023	0.06
0.500	6	82.8	129.86	368.5	0.147	0.0030	0.06
0.583	7	89.8	161.51	391.0	0.163	0.0037	0.06
0.667	8	96.4	194.97	412.0	0.177	0.0045	0.05
0.750	9	102.6	230.04	429.8	0.190	0.0053	0.05
0.833	10	108.6	266.57	446.8	0.202	0.0061	0.05
0.917	11	114.4	304.39	461.0	0.214	0.0070	0.05
1.000	12	120.0	343.38	474.7	0.225	0.0079	0.05
1.083	13	125.4	383.41	486.0	0.235	0.0088	0.05
1.167	14	130.8	424.37	497.1	0.245	0.0097	0.05
1.250	15	136.0	466.16	505.9	0.255	0.0107	0.05
1.333	16	141.1	508.68	514.6	0.264	0.0117	0.05
1.417	17	146.1	551.84	521.2	0.273	0.0127	0.04
1.500	18	151.0	595.55	527.8	0.282	0.0137	0.04
1.583	19	156.0	639.73	532.4	0.290	0.0147	0.04
1.667	20	160.8	684.29	537.1	0.298	0.0157	0.04
1.750	21	165.6	729.15	539.7	0.306	0.0167	0.04
1.833	22	170.4	774.25	542.5	0.314	0.0178	0.04
1.917	23	175.2	819.49	543.4	0.322	0.0188	0.04
2.000	24	180.0	864.81	544.3	0.329	0.0199	0.04
2.083	25	184.8	910.13	543.4	0.336	0.0209	0.04
2.167	26	189.6	955.38	542.5	0.343	0.0219	0.04
2.250	27	194.4	1000.47	539.7	0.350	0.0230	0.04
2.333	28	199.2	1045.34	537.1	0.357	0.0240	0.04
2.417	29	204.0	1089.90	532.4	0.364	0.0250	0.03
2.500	30	209.0	1134.08	527.8	0.370	0.0260	0.03
2.583	31	213.9	1177.79	521.2	0.377	0.0270	0.03
2.667	32	218.9	1220.95	514.6	0.383	0.0280	0.03
2.750	33	224.0	1263.47	505.9	0.389	0.0290	0.03
2.833	34	229.2	1305.26	497.1	0.395	0.0300	0.03
2.917	35	234.6	1346.22	486.0	0.401	0.0309	0.03
3.000	36	240.0	1386.25	474.7	0.407	0.0318	0.03
3.083	37	245.6	1425.24	461.0	0.413	0.0327	0.03
3.167	38	251.4	1463.06	446.8	0.419	0.0336	0.03
3.250	39	257.4	1499.59	429.8	0.425	0.0344	0.02
3.333	40	263.6	1534.66	412.0	0.430	0.0352	0.02
3.417	41	270.2	1568.12	391.0	0.436	0.0360	0.02
3.500	42	277.2	1599.77	368.5	0.441	0.0367	0.02
3.583	43	284.7	1629.36	341.7	0.447	0.0374	0.02
3.667	44	292.9	1656.61	312.1	0.452	0.0380	0.02
3.750	45	302.1	1681.12	276.1	0.458	0.0386	0.01
3.833	46	312.9	1702.34	233.2	0.463	0.0391	0.01
3.917	47	326.8	1719.34	174.9	0.468	0.0398	0.01
4.000	48	360.0	1729.63	72.0	0.473	0.0403	0.01
					TOT drying time (hr):		**2.44**

Divider Structure Discharge

Discharge vs Elevation Table

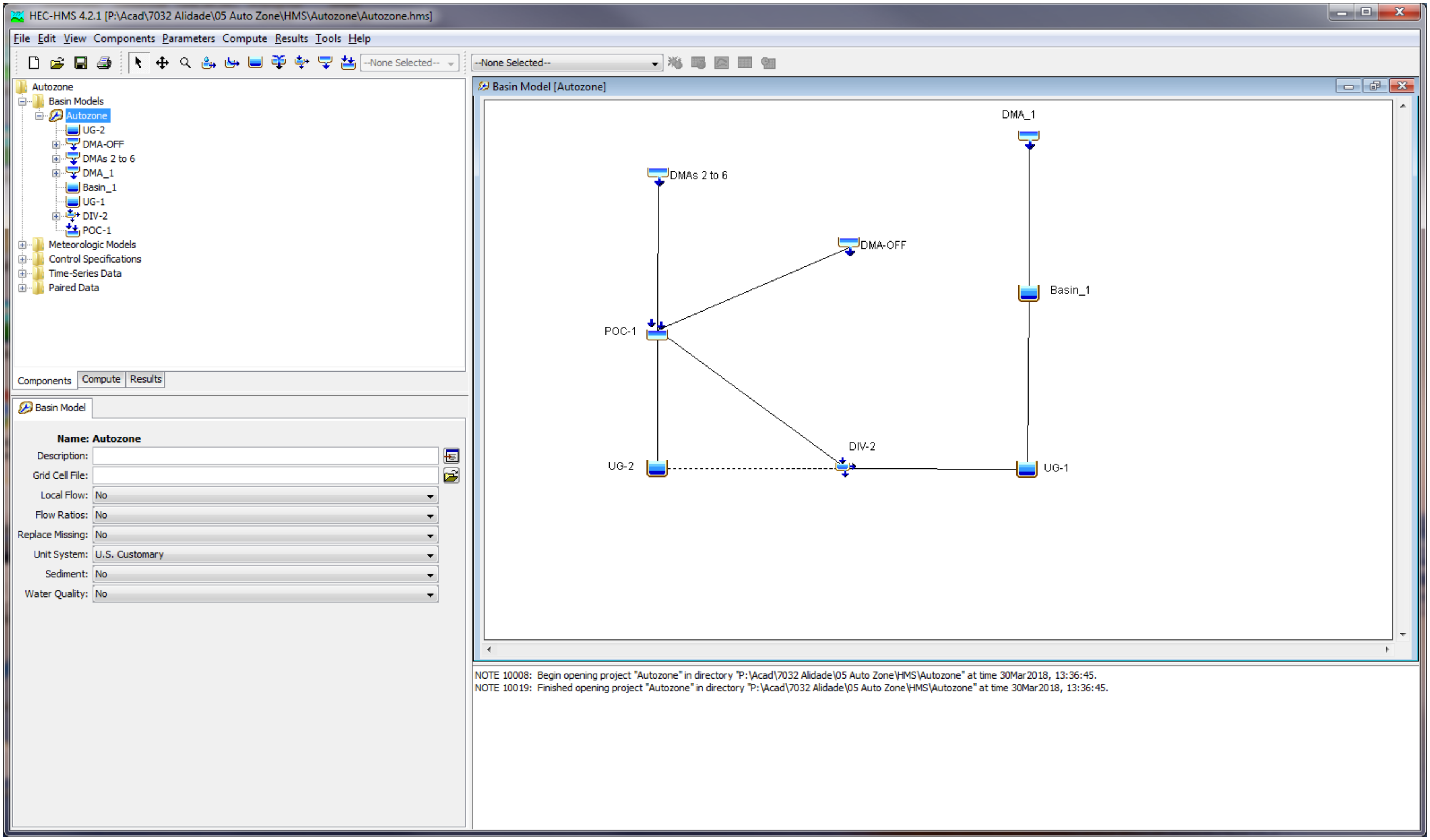
Lower orifice:	0.625 "		Lower slot	
Number of orif:	2		Number of slots:	1
Cg-low:	0.61		Invert:	2.67 ft
			B:	1.333 ft
Middle orifice	2.500 "		h_{slot}:	0.125 ft
Number of orif:	0.000			
Cg-middle:	0.61		Emergency weir	
invert elev:	0 ft		Invert:	3.500 ft
			W:	6.00 ft

h* (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qslot-low (cfs)	Qemerg (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	1.600	0.400	0.005	0.006	0.005	0.000	0.000	0.005
0.167	3.200	0.800	0.008	0.009	0.008	0.000	0.000	0.008
0.250	4.800	1.200	0.010	0.044	0.010	0.000	0.000	0.010
0.333	6.400	1.600	0.012	0.116	0.012	0.000	0.000	0.012
0.417	8.000	2.000	0.013	0.130	0.013	0.000	0.000	0.013
0.500	9.600	2.400	0.014	0.144	0.014	0.000	0.000	0.014
0.583	11.200	2.800	0.016	0.156	0.016	0.000	0.000	0.016
0.667	12.800	3.200	0.017	0.167	0.017	0.000	0.000	0.017
0.750	14.400	3.600	0.018	0.177	0.018	0.000	0.000	0.018
0.833	16.000	4.000	0.019	0.187	0.019	0.000	0.000	0.019
0.917	17.600	4.400	0.020	0.197	0.020	0.000	0.000	0.020
1.000	19.200	4.800	0.021	0.206	0.021	0.000	0.000	0.021
1.083	20.800	5.200	0.021	0.214	0.021	0.000	0.000	0.021
1.167	22.400	5.600	0.022	0.223	0.022	0.000	0.000	0.022
1.250	24.000	6.000	0.023	0.231	0.023	0.000	0.000	0.023
1.333	25.600	6.400	0.024	0.238	0.024	0.000	0.000	0.024
1.417	27.200	6.800	0.025	0.246	0.025	0.000	0.000	0.025
1.500	28.800	7.200	0.025	0.253	0.025	0.000	0.000	0.025
1.583	30.400	7.600	0.026	0.260	0.026	0.000	0.000	0.026
1.667	32.000	8.000	0.027	0.267	0.027	0.000	0.000	0.027
1.750	33.600	8.400	0.027	0.274	0.027	0.000	0.000	0.027
1.833	35.200	8.800	0.028	0.280	0.028	0.000	0.000	0.028
1.917	36.800	9.200	0.029	0.287	0.029	0.000	0.000	0.029
2.000	38.400	9.600	0.029	0.293	0.029	0.000	0.000	0.029
2.083	40.000	10.000	0.030	0.299	0.030	0.000	0.000	0.030
2.167	41.600	10.400	0.031	0.305	0.031	0.000	0.000	0.031
2.250	43.200	10.800	0.031	0.311	0.031	0.000	0.000	0.031
2.333	44.800	11.200	0.032	0.317	0.032	0.000	0.000	0.032
2.417	46.400	11.600	0.032	0.323	0.032	0.000	0.000	0.032
2.500	48.000	12.000	0.033	0.328	0.033	0.000	0.000	0.033
2.583	49.600	12.400	0.033	0.334	0.033	0.000	0.000	0.033
2.667	51.200	12.800	0.034	0.339	0.034	0.000	0.000	0.034
2.750	52.800	13.200	0.034	0.344	0.034	0.099	0.000	0.133
2.833	54.400	13.600	0.035	0.349	0.035	0.263	0.000	0.298
2.917	56.000	14.000	0.035	0.355	0.035	0.353	0.000	0.388
3.000	57.600	14.400	0.036	0.360	0.036	0.424	0.000	0.460
3.083	59.200	14.800	0.036	0.365	0.036	0.485	0.000	0.522
3.167	60.800	15.200	0.037	0.370	0.037	0.539	0.000	0.576
3.250	62.400	15.600	0.037	0.375	0.037	0.588	0.000	0.626
3.333	64.000	16.000	0.038	0.379	0.038	0.634	0.000	0.672
3.417	65.600	16.400	0.038	0.384	0.038	0.676	0.000	0.715
3.500	67.200	16.800	0.039	0.389	0.039	0.716	0.000	0.755
3.583	68.800	17.200	0.039	0.393	0.039	0.754	0.447	1.240
3.667	70.400	17.600	0.040	0.398	0.040	0.790	1.266	2.095
3.750	72.000	18.000	0.040	0.403	0.040	0.824	2.325	3.189
3.833	73.600	18.400	0.041	0.407	0.041	0.857	3.580	4.477
3.917	75.200	18.800	0.041	0.411	0.041	0.889	5.003	5.932
4.000	76.800	19.200	0.042	0.416	0.042	0.919	6.576	7.537

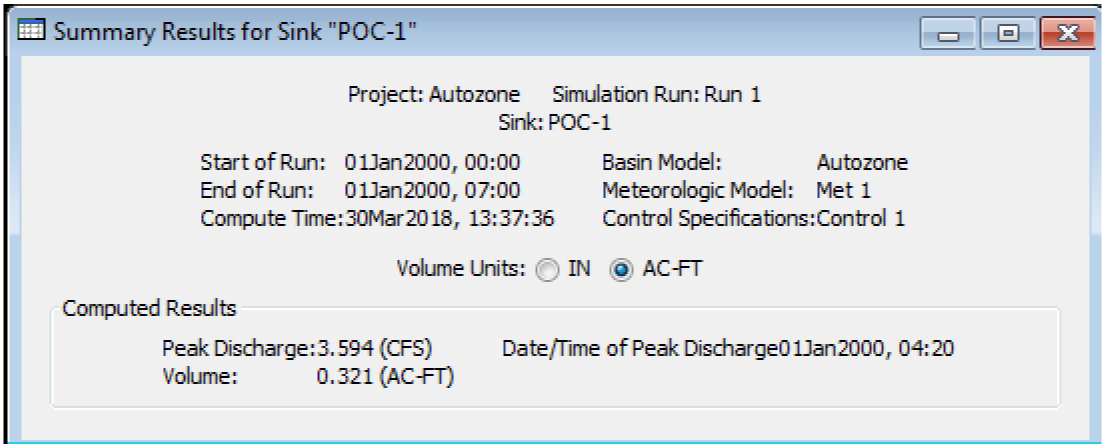
CHAPTER 3

MODIFIED-PULS DETENTION ROUTING

3.3 – HEC-HMS Modified-Puls Routing Results



HEC-HMS 4.2.1 [P:\Acad\7032 Alidade\05 Auto Zone\HMS\Autozone\Autozone.hms]
File Edit View Components Parameters Compute Results Tools Help
--None Selected--
--None Selected--
Autozone
Basin Models
Autozone
UG-2
DMA-OFF
DMAs 2 to 6
DMA_1
Basin_1
UG-1
DIV-2
POC-1
Meteorologic Models
Control Specifications
Time-Series Data
Paired Data
Components
Compute
Results
Basin Model
Name: Autozone
Description:
Grid Cell File:
Local Flow: No
Flow Ratios: No
Replace Missing: No
Unit System: U.S. Customary
Sediment: No
Water Quality: No
Basin Model [Autozone]
DMA_1
DMAs 2 to 6
DMA-OFF
Basin_1
POC-1
DIV-2
UG-2
UG-1
NOTE 10008: Begin opening project "Autozone" in directory "P:\Acad\7032 Alidade\05 Auto Zone\HMS\Autozone" at time 30Mar2018, 13:36:45.
NOTE 10019: Finished opening project "Autozone" in directory "P:\Acad\7032 Alidade\05 Auto Zone\HMS\Autozone" at time 30Mar2018, 13:36:45.


Summary Results for Sink "POC-1"
Project: Autozone Simulation Run: Run 1
Sink: POC-1
Start of Run: 01Jan2000, 00:00
End of Run: 01Jan2000, 07:00
Compute Time: 30Mar2018, 13:37:36
Basin Model: Autozone
Meteorologic Model: Met 1
Control Specifications: Control 1
Volume Units: IN AC-FT
Computed Results
Peak Discharge: 3.594 (CFS)
Date/Time of Peak Discharge 01Jan2000, 04:20
Volume: 0.321 (AC-FT)

Project: Autozone Simulation Run: Run 1
Sink: POC-1

Start of Run: 01Jan2000, 00:00 Basin Model: Autozone
End of Run: 01Jan2000, 07:00 Meteorologic Model: Met 1
Compute Time: 30Mar2018, 13:45:58 Control Specifications: Control 1

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	00:00	0.000	0.000	0.000	0.000	0.000
01Jan2000	00:01	0.000	0.000	0.000	0.000	0.000
01Jan2000	00:02	0.000	0.000	0.000	0.000	0.000
01Jan2000	00:03	0.000	0.000	0.000	0.001	0.001
01Jan2000	00:04	0.000	0.000	0.000	0.003	0.003
01Jan2000	00:05	0.000	0.000	0.000	0.004	0.004
01Jan2000	00:06	0.000	0.000	0.000	0.005	0.005
01Jan2000	00:07	0.000	0.000	0.000	0.006	0.006
01Jan2000	00:08	0.000	0.000	0.000	0.007	0.007
01Jan2000	00:09	0.000	0.000	0.000	0.007	0.007
01Jan2000	00:10	0.000	0.000	0.000	0.008	0.008
01Jan2000	00:11	0.000	0.000	0.000	0.009	0.009
01Jan2000	00:12	0.000	0.000	0.000	0.009	0.009
01Jan2000	00:13	0.000	0.000	0.000	0.009	0.009
01Jan2000	00:14	0.000	0.010	0.000	0.010	0.020
01Jan2000	00:15	0.000	0.020	0.000	0.010	0.030
01Jan2000	00:16	0.000	0.020	0.000	0.011	0.031
01Jan2000	00:17	0.000	0.030	0.000	0.011	0.041
01Jan2000	00:18	0.000	0.040	0.000	0.011	0.051
01Jan2000	00:19	0.000	0.050	0.000	0.012	0.062
01Jan2000	00:20	0.000	0.050	0.000	0.012	0.062
01Jan2000	00:21	0.000	0.060	0.000	0.012	0.072
01Jan2000	00:22	0.000	0.070	0.000	0.013	0.083
01Jan2000	00:23	0.000	0.080	0.000	0.013	0.093
01Jan2000	00:24	0.000	0.080	0.000	0.013	0.093
01Jan2000	00:25	0.000	0.090	0.000	0.013	0.103

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	00:26	0.000	0.100	0.000	0.014	0.114
01Jan2000	00:27	0.000	0.100	0.000	0.014	0.114
01Jan2000	00:28	0.000	0.100	0.000	0.014	0.114
01Jan2000	00:29	0.000	0.100	0.000	0.015	0.115
01Jan2000	00:30	0.000	0.100	0.000	0.015	0.115
01Jan2000	00:31	0.000	0.100	0.000	0.016	0.116
01Jan2000	00:32	0.000	0.100	0.000	0.016	0.116
01Jan2000	00:33	0.000	0.100	0.000	0.017	0.117
01Jan2000	00:34	0.000	0.100	0.000	0.017	0.117
01Jan2000	00:35	0.000	0.100	0.000	0.017	0.117
01Jan2000	00:36	0.000	0.100	0.000	0.018	0.118
01Jan2000	00:37	0.000	0.100	0.000	0.018	0.118
01Jan2000	00:38	0.000	0.100	0.000	0.018	0.118
01Jan2000	00:39	0.000	0.100	0.000	0.019	0.119
01Jan2000	00:40	0.000	0.100	0.000	0.019	0.119
01Jan2000	00:41	0.000	0.100	0.000	0.019	0.119
01Jan2000	00:42	0.000	0.100	0.000	0.019	0.119
01Jan2000	00:43	0.000	0.100	0.000	0.020	0.120
01Jan2000	00:44	0.000	0.100	0.000	0.020	0.120
01Jan2000	00:45	0.000	0.100	0.000	0.020	0.120
01Jan2000	00:46	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:47	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:48	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:49	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:50	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:51	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:52	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:53	0.000	0.100	0.000	0.021	0.121
01Jan2000	00:54	0.000	0.100	0.000	0.022	0.122
01Jan2000	00:55	0.000	0.100	0.000	0.022	0.122
01Jan2000	00:56	0.000	0.100	0.000	0.022	0.122

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	00:57	0.000	0.100	0.000	0.022	0.122
01Jan2000	00:58	0.000	0.100	0.000	0.023	0.123
01Jan2000	00:59	0.000	0.100	0.000	0.023	0.123
01Jan2000	01:00	0.000	0.100	0.000	0.023	0.123
01Jan2000	01:01	0.000	0.100	0.000	0.023	0.123
01Jan2000	01:02	0.000	0.100	0.000	0.024	0.124
01Jan2000	01:03	0.000	0.100	0.000	0.024	0.124
01Jan2000	01:04	0.000	0.100	0.000	0.024	0.124
01Jan2000	01:05	0.000	0.100	0.000	0.024	0.124
01Jan2000	01:06	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:07	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:08	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:09	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:10	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:11	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:12	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:13	0.000	0.100	0.000	0.025	0.125
01Jan2000	01:14	0.000	0.100	0.000	0.026	0.126
01Jan2000	01:15	0.000	0.100	0.000	0.026	0.126
01Jan2000	01:16	0.000	0.100	0.000	0.026	0.126
01Jan2000	01:17	0.000	0.100	0.000	0.026	0.126
01Jan2000	01:18	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:19	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:20	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:21	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:22	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:23	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:24	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:25	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:26	0.000	0.100	0.000	0.027	0.127
01Jan2000	01:27	0.000	0.100	0.000	0.028	0.128

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	01:28	0.000	0.100	0.000	0.028	0.128
01Jan2000	01:29	0.000	0.100	0.000	0.028	0.128
01Jan2000	01:30	0.000	0.100	0.000	0.028	0.128
01Jan2000	01:31	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:32	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:33	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:34	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:35	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:36	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:37	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:38	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:39	0.000	0.100	0.000	0.029	0.129
01Jan2000	01:40	0.000	0.100	0.000	0.030	0.130
01Jan2000	01:41	0.000	0.100	0.000	0.030	0.130
01Jan2000	01:42	0.000	0.100	0.000	0.030	0.130
01Jan2000	01:43	0.000	0.100	0.000	0.030	0.130
01Jan2000	01:44	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:45	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:46	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:47	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:48	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:49	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:50	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:51	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:52	0.000	0.100	0.000	0.031	0.131
01Jan2000	01:53	0.000	0.100	0.000	0.032	0.132
01Jan2000	01:54	0.000	0.100	0.000	0.032	0.132
01Jan2000	01:55	0.000	0.100	0.000	0.032	0.132
01Jan2000	01:56	0.000	0.100	0.000	0.032	0.132
01Jan2000	01:57	0.000	0.100	0.000	0.032	0.132
01Jan2000	01:58	0.000	0.110	0.000	0.032	0.142

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	01:59	0.000	0.120	0.000	0.032	0.152
01Jan2000	02:00	0.000	0.120	0.000	0.032	0.152
01Jan2000	02:01	0.000	0.130	0.000	0.032	0.162
01Jan2000	02:02	0.000	0.140	0.000	0.033	0.173
01Jan2000	02:03	0.000	0.150	0.000	0.033	0.183
01Jan2000	02:04	0.000	0.150	0.000	0.033	0.183
01Jan2000	02:05	0.000	0.160	0.000	0.033	0.193
01Jan2000	02:06	0.000	0.170	0.000	0.033	0.203
01Jan2000	02:07	0.000	0.180	0.000	0.033	0.213
01Jan2000	02:08	0.000	0.180	0.000	0.033	0.213
01Jan2000	02:09	0.000	0.190	0.000	0.033	0.223
01Jan2000	02:10	0.000	0.200	0.000	0.033	0.233
01Jan2000	02:11	0.000	0.200	0.000	0.034	0.234
01Jan2000	02:12	0.000	0.200	0.000	0.034	0.234
01Jan2000	02:13	0.000	0.200	0.000	0.046	0.246
01Jan2000	02:14	0.000	0.200	0.000	0.065	0.265
01Jan2000	02:15	0.000	0.200	0.000	0.083	0.283
01Jan2000	02:16	0.000	0.200	0.000	0.098	0.298
01Jan2000	02:17	0.000	0.200	0.000	0.111	0.311
01Jan2000	02:18	0.000	0.200	0.000	0.122	0.322
01Jan2000	02:19	0.000	0.200	0.000	0.132	0.332
01Jan2000	02:20	0.000	0.200	0.000	0.146	0.346
01Jan2000	02:21	0.000	0.200	0.000	0.159	0.359
01Jan2000	02:22	0.000	0.200	0.000	0.169	0.369
01Jan2000	02:23	0.000	0.200	0.000	0.179	0.379
01Jan2000	02:24	0.000	0.200	0.000	0.188	0.388
01Jan2000	02:25	0.000	0.200	0.000	0.198	0.398
01Jan2000	02:26	0.000	0.200	0.000	0.209	0.409
01Jan2000	02:27	0.000	0.200	0.000	0.220	0.420
01Jan2000	02:28	0.000	0.200	0.000	0.231	0.431
01Jan2000	02:29	0.000	0.200	0.000	0.242	0.442

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	02:30	0.000	0.200	0.000	0.252	0.452
01Jan2000	02:31	0.000	0.200	0.000	0.261	0.461
01Jan2000	02:32	0.000	0.200	0.000	0.268	0.468
01Jan2000	02:33	0.000	0.200	0.000	0.274	0.474
01Jan2000	02:34	0.000	0.200	0.000	0.279	0.479
01Jan2000	02:35	0.000	0.200	0.000	0.284	0.484
01Jan2000	02:36	0.000	0.200	0.000	0.287	0.487
01Jan2000	02:37	0.000	0.200	0.000	0.290	0.490
01Jan2000	02:38	0.000	0.200	0.000	0.292	0.492
01Jan2000	02:39	0.000	0.200	0.000	0.294	0.494
01Jan2000	02:40	0.000	0.200	0.000	0.295	0.495
01Jan2000	02:41	0.000	0.200	0.000	0.296	0.496
01Jan2000	02:42	0.000	0.200	0.000	0.297	0.497
01Jan2000	02:43	0.000	0.200	0.000	0.298	0.498
01Jan2000	02:44	0.000	0.200	0.000	0.298	0.498
01Jan2000	02:45	0.000	0.200	0.000	0.298	0.498
01Jan2000	02:46	0.000	0.200	0.000	0.298	0.498
01Jan2000	02:47	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:48	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:49	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:50	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:51	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:52	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:53	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:54	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:55	0.000	0.200	0.000	0.299	0.499
01Jan2000	02:56	0.000	0.200	0.000	0.300	0.500
01Jan2000	02:57	0.000	0.200	0.000	0.300	0.500
01Jan2000	02:58	0.000	0.200	0.000	0.300	0.500
01Jan2000	02:59	0.000	0.200	0.000	0.300	0.500
01Jan2000	03:00	0.000	0.200	0.000	0.300	0.500

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	03:01	0.000	0.200	0.000	0.300	0.500
01Jan2000	03:02	0.000	0.200	0.000	0.301	0.501
01Jan2000	03:03	0.000	0.200	0.000	0.303	0.503
01Jan2000	03:04	0.000	0.200	0.000	0.306	0.506
01Jan2000	03:05	0.000	0.200	0.000	0.311	0.511
01Jan2000	03:06	0.000	0.200	0.000	0.317	0.517
01Jan2000	03:07	0.000	0.200	0.000	0.324	0.524
01Jan2000	03:08	0.000	0.200	0.000	0.330	0.530
01Jan2000	03:09	0.000	0.200	0.000	0.337	0.537
01Jan2000	03:10	0.000	0.200	0.000	0.344	0.544
01Jan2000	03:11	0.000	0.200	0.000	0.350	0.550
01Jan2000	03:12	0.000	0.200	0.000	0.355	0.555
01Jan2000	03:13	0.000	0.200	0.000	0.360	0.560
01Jan2000	03:14	0.000	0.200	0.000	0.364	0.564
01Jan2000	03:15	0.000	0.200	0.000	0.368	0.568
01Jan2000	03:16	0.000	0.210	0.000	0.372	0.582
01Jan2000	03:17	0.000	0.220	0.000	0.375	0.595
01Jan2000	03:18	0.000	0.220	0.000	0.378	0.598
01Jan2000	03:19	0.000	0.230	0.000	0.381	0.611
01Jan2000	03:20	0.000	0.240	0.000	0.383	0.623
01Jan2000	03:21	0.000	0.250	0.000	0.385	0.635
01Jan2000	03:22	0.000	0.250	0.000	0.388	0.638
01Jan2000	03:23	0.000	0.260	0.000	0.391	0.651
01Jan2000	03:24	0.000	0.270	0.000	0.395	0.665
01Jan2000	03:25	0.000	0.280	0.000	0.400	0.680
01Jan2000	03:26	0.000	0.280	0.000	0.407	0.687
01Jan2000	03:27	0.000	0.290	0.000	0.414	0.704
01Jan2000	03:28	0.000	0.300	0.000	0.421	0.721
01Jan2000	03:29	0.000	0.300	0.000	0.428	0.728
01Jan2000	03:30	0.000	0.300	0.000	0.435	0.735
01Jan2000	03:31	0.000	0.300	0.000	0.441	0.741

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	03:32	0.000	0.300	0.000	0.448	0.748
01Jan2000	03:33	0.000	0.300	0.000	0.455	0.755
01Jan2000	03:34	0.000	0.300	0.000	0.462	0.762
01Jan2000	03:35	0.000	0.300	0.000	0.470	0.770
01Jan2000	03:36	0.000	0.300	0.000	0.478	0.778
01Jan2000	03:37	0.000	0.300	0.000	0.487	0.787
01Jan2000	03:38	0.000	0.300	0.000	0.495	0.795
01Jan2000	03:39	0.000	0.300	0.000	0.504	0.804
01Jan2000	03:40	0.000	0.300	0.000	0.512	0.812
01Jan2000	03:41	0.000	0.300	0.000	0.519	0.819
01Jan2000	03:42	0.000	0.320	0.000	0.528	0.848
01Jan2000	03:43	0.000	0.330	0.000	0.537	0.867
01Jan2000	03:44	0.000	0.350	0.000	0.548	0.898
01Jan2000	03:45	0.000	0.360	0.000	0.562	0.922
01Jan2000	03:46	0.000	0.380	0.020	0.577	0.977
01Jan2000	03:47	0.000	0.390	0.040	0.591	1.021
01Jan2000	03:48	0.000	0.410	0.060	0.606	1.076
01Jan2000	03:49	0.000	0.420	0.080	0.622	1.122
01Jan2000	03:50	0.000	0.440	0.100	0.638	1.178
01Jan2000	03:51	0.000	0.450	0.100	0.656	1.206
01Jan2000	03:52	0.000	0.470	0.100	0.675	1.245
01Jan2000	03:53	0.000	0.480	0.100	0.699	1.279
01Jan2000	03:54	0.000	0.500	0.100	0.724	1.324
01Jan2000	03:55	0.000	0.520	0.100	0.749	1.369
01Jan2000	03:56	0.008	0.530	0.100	0.774	1.413
01Jan2000	03:57	0.038	0.550	0.100	0.790	1.478
01Jan2000	03:58	0.083	0.560	0.100	0.798	1.541
01Jan2000	03:59	0.115	0.580	0.100	0.803	1.598
01Jan2000	04:00	0.139	0.590	0.100	0.807	1.636
01Jan2000	04:01	0.161	0.610	0.160	0.815	1.746
01Jan2000	04:02	0.185	0.620	0.210	0.833	1.847

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	04:03	0.216	0.640	0.270	0.860	1.986
01Jan2000	04:04	0.253	0.650	0.320	0.884	2.107
01Jan2000	04:05	0.293	0.670	0.380	0.908	2.252
01Jan2000	04:06	0.334	0.680	0.320	0.921	2.256
01Jan2000	04:07	0.373	0.700	0.270	0.914	2.256
01Jan2000	04:08	0.403	0.830	0.210	0.896	2.340
01Jan2000	04:09	0.429	0.960	0.160	0.876	2.425
01Jan2000	04:10	0.449	1.090	0.100	0.849	2.488
01Jan2000	04:11	0.463	1.230	0.080	0.824	2.598
01Jan2000	04:12	0.468	1.360	0.060	0.808	2.696
01Jan2000	04:13	0.470	1.490	0.040	0.795	2.795
01Jan2000	04:14	0.470	1.620	0.020	0.784	2.893
01Jan2000	04:15	0.467	1.750	0.000	0.774	2.992
01Jan2000	04:16	0.464	1.880	0.000	0.766	3.111
01Jan2000	04:17	0.460	2.020	0.000	0.760	3.240
01Jan2000	04:18	0.454	2.150	0.000	0.755	3.359
01Jan2000	04:19	0.449	2.280	0.000	0.749	3.478
01Jan2000	04:20	0.443	2.410	0.000	0.741	3.594
01Jan2000	04:21	0.439	2.260	0.000	0.731	3.429
01Jan2000	04:22	0.434	2.100	0.000	0.719	3.253
01Jan2000	04:23	0.430	1.950	0.000	0.704	3.083
01Jan2000	04:24	0.426	1.790	0.000	0.687	2.903
01Jan2000	04:25	0.422	1.640	0.000	0.670	2.731
01Jan2000	04:26	0.418	1.480	0.000	0.653	2.551
01Jan2000	04:27	0.414	1.330	0.000	0.636	2.380
01Jan2000	04:28	0.410	1.170	0.000	0.620	2.200
01Jan2000	04:29	0.406	1.020	0.000	0.605	2.032
01Jan2000	04:30	0.403	0.860	0.000	0.591	1.854
01Jan2000	04:31	0.399	0.710	0.000	0.577	1.686
01Jan2000	04:32	0.395	0.550	0.000	0.561	1.507
01Jan2000	04:33	0.392	0.400	0.000	0.546	1.338

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	04:34	0.389	0.390	0.000	0.530	1.309
01Jan2000	04:35	0.386	0.380	0.000	0.515	1.280
01Jan2000	04:36	0.383	0.380	0.000	0.499	1.261
01Jan2000	04:37	0.379	0.370	0.000	0.483	1.232
01Jan2000	04:38	0.376	0.360	0.000	0.468	1.204
01Jan2000	04:39	0.373	0.350	0.000	0.453	1.176
01Jan2000	04:40	0.369	0.350	0.000	0.438	1.157
01Jan2000	04:41	0.366	0.340	0.000	0.424	1.130
01Jan2000	04:42	0.363	0.330	0.000	0.412	1.104
01Jan2000	04:43	0.359	0.320	0.000	0.400	1.080
01Jan2000	04:44	0.356	0.320	0.000	0.390	1.066
01Jan2000	04:45	0.353	0.310	0.000	0.380	1.042
01Jan2000	04:46	0.349	0.300	0.000	0.371	1.020
01Jan2000	04:47	0.346	0.290	0.000	0.362	0.999
01Jan2000	04:48	0.343	0.280	0.000	0.355	0.978
01Jan2000	04:49	0.340	0.280	0.000	0.349	0.969
01Jan2000	04:50	0.337	0.270	0.000	0.343	0.950
01Jan2000	04:51	0.333	0.260	0.000	0.338	0.931
01Jan2000	04:52	0.330	0.250	0.000	0.333	0.913
01Jan2000	04:53	0.327	0.250	0.000	0.327	0.904
01Jan2000	04:54	0.324	0.240	0.000	0.320	0.884
01Jan2000	04:55	0.321	0.230	0.000	0.312	0.864
01Jan2000	04:56	0.318	0.220	0.000	0.304	0.842
01Jan2000	04:57	0.314	0.220	0.000	0.295	0.829
01Jan2000	04:58	0.311	0.210	0.000	0.280	0.801
01Jan2000	04:59	0.308	0.200	0.000	0.267	0.775
01Jan2000	05:00	0.305	0.200	0.000	0.256	0.761
01Jan2000	05:01	0.302	0.200	0.000	0.247	0.748
01Jan2000	05:02	0.298	0.200	0.000	0.239	0.737
01Jan2000	05:03	0.295	0.200	0.000	0.232	0.727
01Jan2000	05:04	0.292	0.200	0.000	0.227	0.718

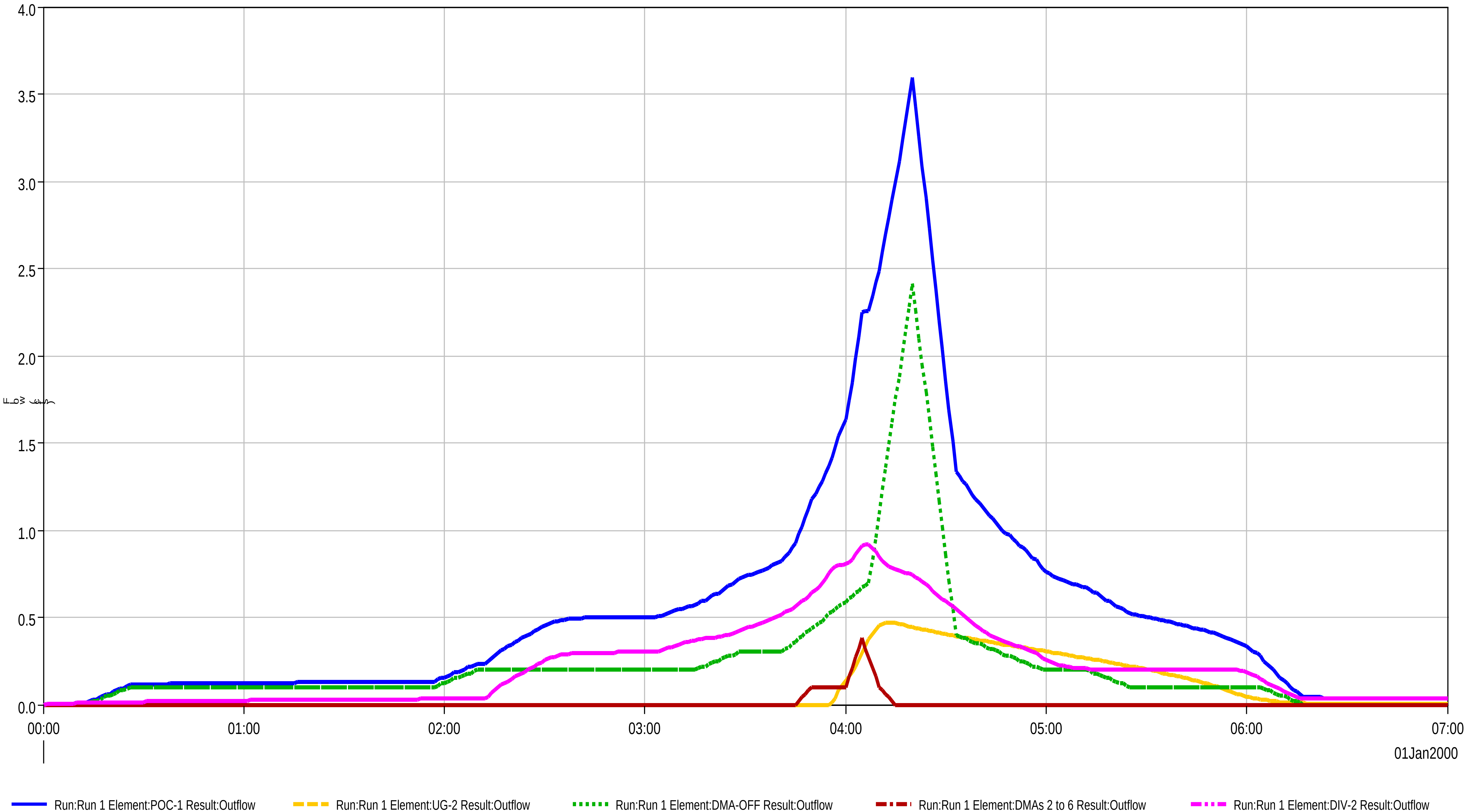
Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	05:05	0.289	0.200	0.000	0.222	0.711
01Jan2000	05:06	0.285	0.200	0.000	0.218	0.703
01Jan2000	05:07	0.282	0.200	0.000	0.215	0.697
01Jan2000	05:08	0.279	0.200	0.000	0.212	0.691
01Jan2000	05:09	0.275	0.200	0.000	0.210	0.685
01Jan2000	05:10	0.272	0.200	0.000	0.208	0.680
01Jan2000	05:11	0.269	0.200	0.000	0.207	0.675
01Jan2000	05:12	0.265	0.200	0.000	0.205	0.671
01Jan2000	05:13	0.262	0.190	0.000	0.204	0.657
01Jan2000	05:14	0.259	0.180	0.000	0.204	0.642
01Jan2000	05:15	0.256	0.180	0.000	0.203	0.639
01Jan2000	05:16	0.252	0.170	0.000	0.202	0.625
01Jan2000	05:17	0.249	0.160	0.000	0.202	0.611
01Jan2000	05:18	0.245	0.150	0.000	0.202	0.597
01Jan2000	05:19	0.242	0.150	0.000	0.201	0.593
01Jan2000	05:20	0.238	0.140	0.000	0.201	0.579
01Jan2000	05:21	0.234	0.130	0.000	0.201	0.565
01Jan2000	05:22	0.231	0.120	0.000	0.201	0.552
01Jan2000	05:23	0.227	0.120	0.000	0.201	0.548
01Jan2000	05:24	0.224	0.110	0.000	0.200	0.534
01Jan2000	05:25	0.220	0.100	0.000	0.200	0.520
01Jan2000	05:26	0.216	0.100	0.000	0.200	0.517
01Jan2000	05:27	0.213	0.100	0.000	0.200	0.513
01Jan2000	05:28	0.209	0.100	0.000	0.200	0.509
01Jan2000	05:29	0.205	0.100	0.000	0.200	0.505
01Jan2000	05:30	0.201	0.100	0.000	0.200	0.501
01Jan2000	05:31	0.197	0.100	0.000	0.200	0.497
01Jan2000	05:32	0.193	0.100	0.000	0.200	0.493
01Jan2000	05:33	0.189	0.100	0.000	0.200	0.489
01Jan2000	05:34	0.185	0.100	0.000	0.200	0.485
01Jan2000	05:35	0.181	0.100	0.000	0.200	0.481

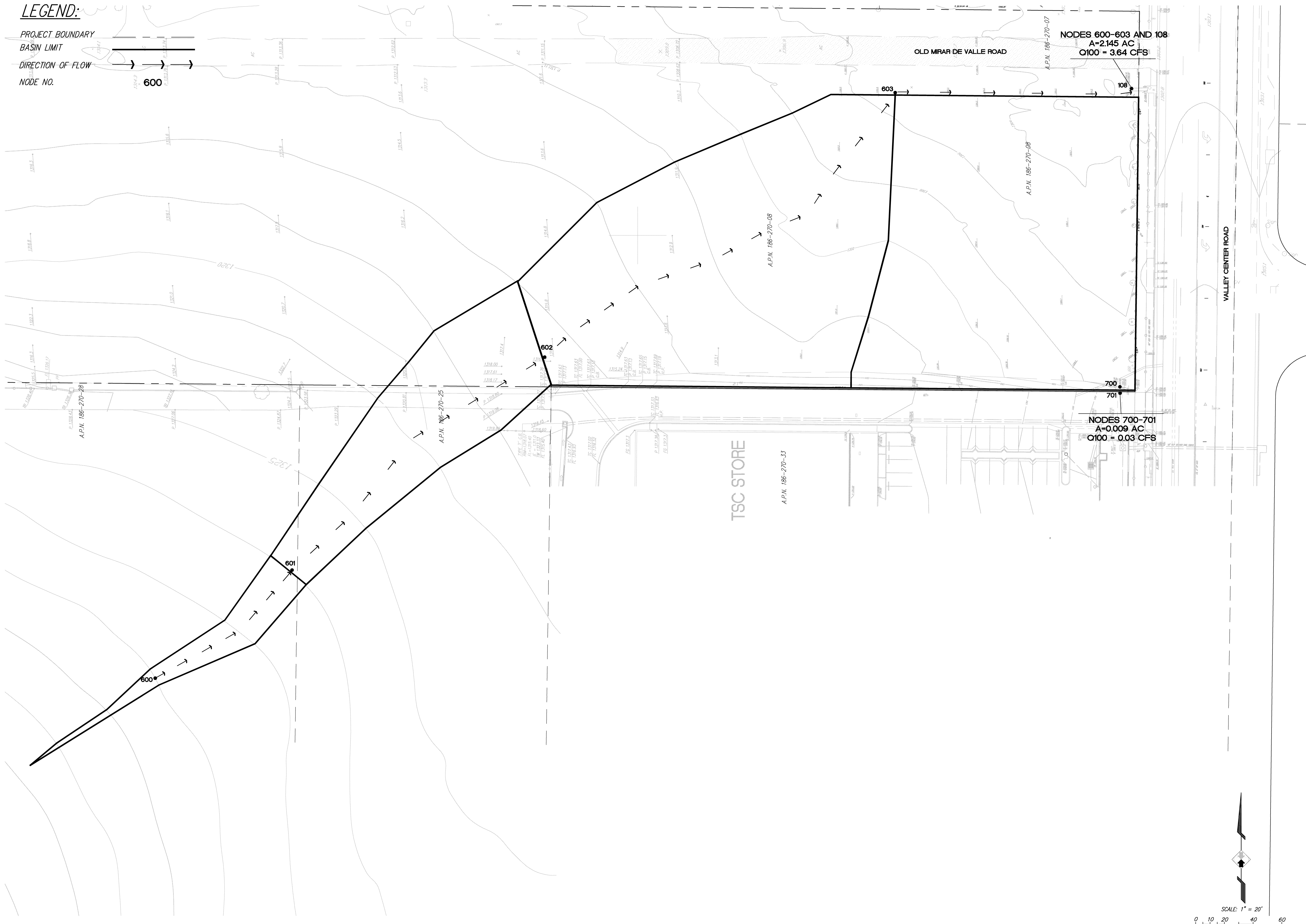
Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	05:36	0.177	0.100	0.000	0.200	0.477
01Jan2000	05:37	0.173	0.100	0.000	0.200	0.473
01Jan2000	05:38	0.168	0.100	0.000	0.200	0.468
01Jan2000	05:39	0.164	0.100	0.000	0.200	0.464
01Jan2000	05:40	0.160	0.100	0.000	0.200	0.460
01Jan2000	05:41	0.155	0.100	0.000	0.200	0.455
01Jan2000	05:42	0.150	0.100	0.000	0.200	0.450
01Jan2000	05:43	0.145	0.100	0.000	0.200	0.445
01Jan2000	05:44	0.140	0.100	0.000	0.200	0.440
01Jan2000	05:45	0.136	0.100	0.000	0.200	0.436
01Jan2000	05:46	0.131	0.100	0.000	0.200	0.431
01Jan2000	05:47	0.126	0.100	0.000	0.200	0.426
01Jan2000	05:48	0.120	0.100	0.000	0.200	0.420
01Jan2000	05:49	0.115	0.100	0.000	0.200	0.415
01Jan2000	05:50	0.110	0.100	0.000	0.200	0.410
01Jan2000	05:51	0.103	0.100	0.000	0.200	0.403
01Jan2000	05:52	0.096	0.100	0.000	0.200	0.396
01Jan2000	05:53	0.090	0.100	0.000	0.200	0.390
01Jan2000	05:54	0.084	0.100	0.000	0.200	0.384
01Jan2000	05:55	0.077	0.100	0.000	0.200	0.377
01Jan2000	05:56	0.069	0.100	0.000	0.200	0.369
01Jan2000	05:57	0.062	0.100	0.000	0.199	0.361
01Jan2000	05:58	0.055	0.100	0.000	0.196	0.352
01Jan2000	05:59	0.050	0.100	0.000	0.192	0.342
01Jan2000	06:00	0.044	0.100	0.000	0.187	0.331
01Jan2000	06:01	0.040	0.100	0.000	0.179	0.319
01Jan2000	06:02	0.036	0.100	0.000	0.170	0.306
01Jan2000	06:03	0.032	0.100	0.000	0.159	0.292
01Jan2000	06:04	0.029	0.100	0.000	0.147	0.277
01Jan2000	06:05	0.026	0.090	0.000	0.134	0.251
01Jan2000	06:06	0.024	0.080	0.000	0.126	0.230

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	06:07	0.021	0.080	0.000	0.117	0.218
01Jan2000	06:08	0.019	0.070	0.000	0.108	0.197
01Jan2000	06:09	0.017	0.060	0.000	0.097	0.175
01Jan2000	06:10	0.016	0.050	0.000	0.087	0.152
01Jan2000	06:11	0.014	0.050	0.000	0.077	0.141
01Jan2000	06:12	0.013	0.040	0.000	0.067	0.120
01Jan2000	06:13	0.012	0.030	0.000	0.059	0.100
01Jan2000	06:14	0.011	0.020	0.000	0.052	0.082
01Jan2000	06:15	0.010	0.020	0.000	0.045	0.075
01Jan2000	06:16	0.009	0.010	0.000	0.039	0.058
01Jan2000	06:17	0.008	0.000	0.000	0.034	0.043
01Jan2000	06:18	0.008	0.000	0.000	0.034	0.042
01Jan2000	06:19	0.007	0.000	0.000	0.034	0.041
01Jan2000	06:20	0.007	0.000	0.000	0.034	0.041
01Jan2000	06:21	0.006	0.000	0.000	0.034	0.040
01Jan2000	06:22	0.006	0.000	0.000	0.034	0.040
01Jan2000	06:23	0.005	0.000	0.000	0.034	0.039
01Jan2000	06:24	0.005	0.000	0.000	0.034	0.039
01Jan2000	06:25	0.005	0.000	0.000	0.034	0.038
01Jan2000	06:26	0.004	0.000	0.000	0.034	0.038
01Jan2000	06:27	0.004	0.000	0.000	0.034	0.037
01Jan2000	06:28	0.004	0.000	0.000	0.033	0.037
01Jan2000	06:29	0.003	0.000	0.000	0.033	0.037
01Jan2000	06:30	0.003	0.000	0.000	0.033	0.037
01Jan2000	06:31	0.003	0.000	0.000	0.033	0.036
01Jan2000	06:32	0.003	0.000	0.000	0.033	0.036
01Jan2000	06:33	0.002	0.000	0.000	0.033	0.036
01Jan2000	06:34	0.002	0.000	0.000	0.033	0.036
01Jan2000	06:35	0.002	0.000	0.000	0.033	0.035
01Jan2000	06:36	0.002	0.000	0.000	0.033	0.035
01Jan2000	06:37	0.002	0.000	0.000	0.033	0.035

Date	Time	Inflow from UG-2 (CFS)	Inflow from DMA-OFF (CFS)	Inflow from DMAs 2 to 6 (CFS)	Inflow from DIV-2 (CFS)	Total Inflow (CFS)
01Jan2000	06:38	0.002	0.000	0.000	0.033	0.035
01Jan2000	06:39	0.002	0.000	0.000	0.033	0.035
01Jan2000	06:40	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:41	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:42	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:43	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:44	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:45	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:46	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:47	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:48	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:49	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:50	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:51	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:52	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:53	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:54	0.001	0.000	0.000	0.033	0.034
01Jan2000	06:55	0.000	0.000	0.000	0.033	0.033
01Jan2000	06:56	0.000	0.000	0.000	0.033	0.033
01Jan2000	06:57	0.000	0.000	0.000	0.033	0.033
01Jan2000	06:58	0.000	0.000	0.000	0.033	0.033
01Jan2000	06:59	0.000	0.000	0.000	0.033	0.033
01Jan2000	07:00	0.000	0.000	0.000	0.033	0.033

Sink "POC-1" Results for Run "Run 1"



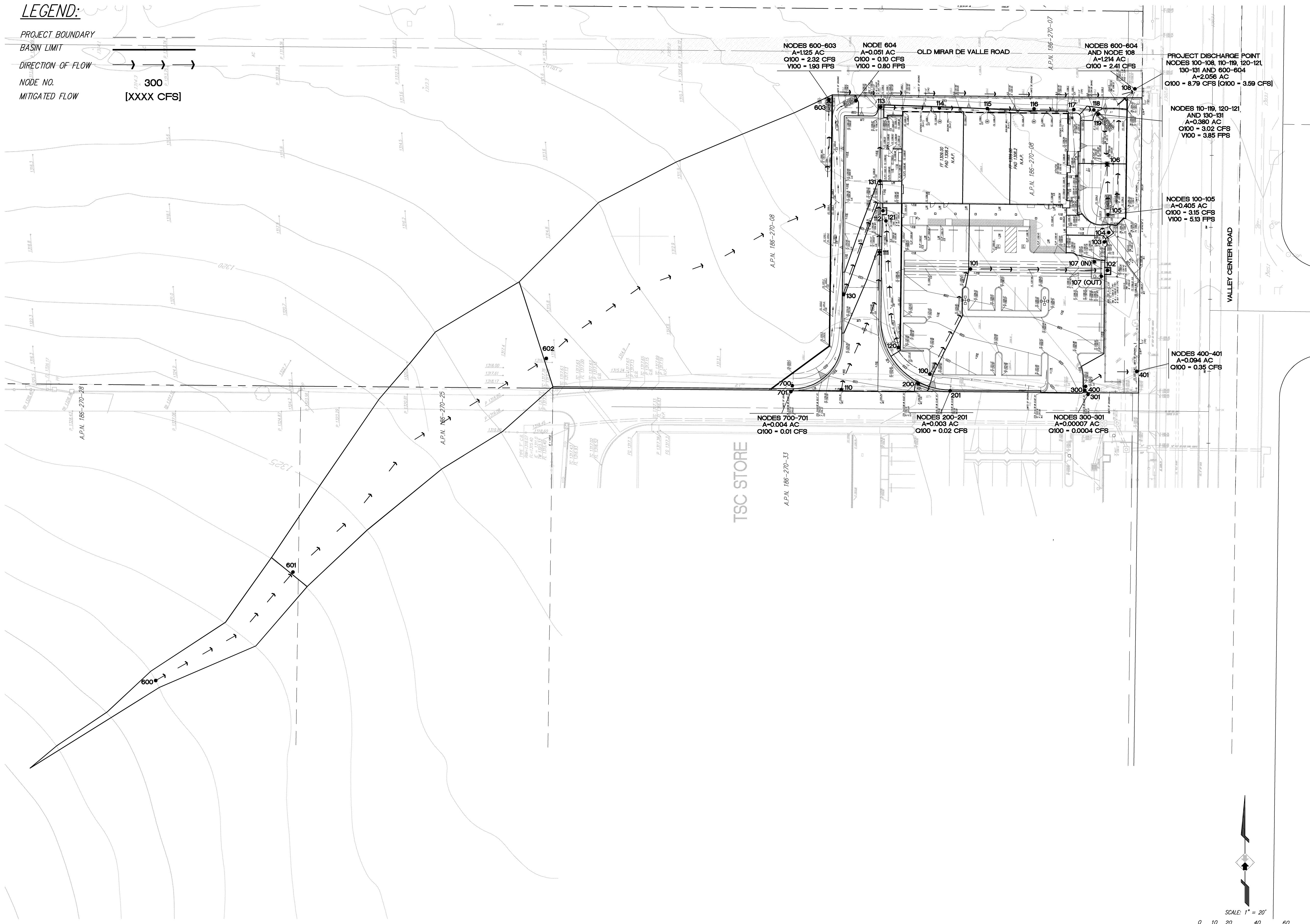


EXISTING HYDROLOGY EXHIBIT

AUTOZONE

FIGURE: 2A

EXISTING HYDROLOGY EXHIBIT



DEVELOPED HYDROLOGY EXHIBIT

AUTOZONE

FIGURE: 2B
DEVELOPED HYDROLOGY EXHIBIT

LEGEND:

DMA1	DMA BASIN IDENTIFICATION
BA1	BIOFILTRATION AREA
	PERVIOUS AREA
	BIOFILTRATION BASIN
	IMPERVIOUS AREA
	BASIN BOUNDARY
	DRAINAGE MANAGEMENT AREA BOUNDARY (DMA)
INLET	STORM WATER STENCILING "NO DUMPING, DRAINS TO MOOSA CREEK" OR SIMILAR
UG1	UNDERGROUND STORAGE
→ → →	FLOW DIRECTION

UNDERLYING HYDROLOGIC SOIL GROUP:
SOIL GROUP 'C'

HISTORIC DEPTH TO GROUND WATER:
10.1 FEET BELOW EXISTING GROUND

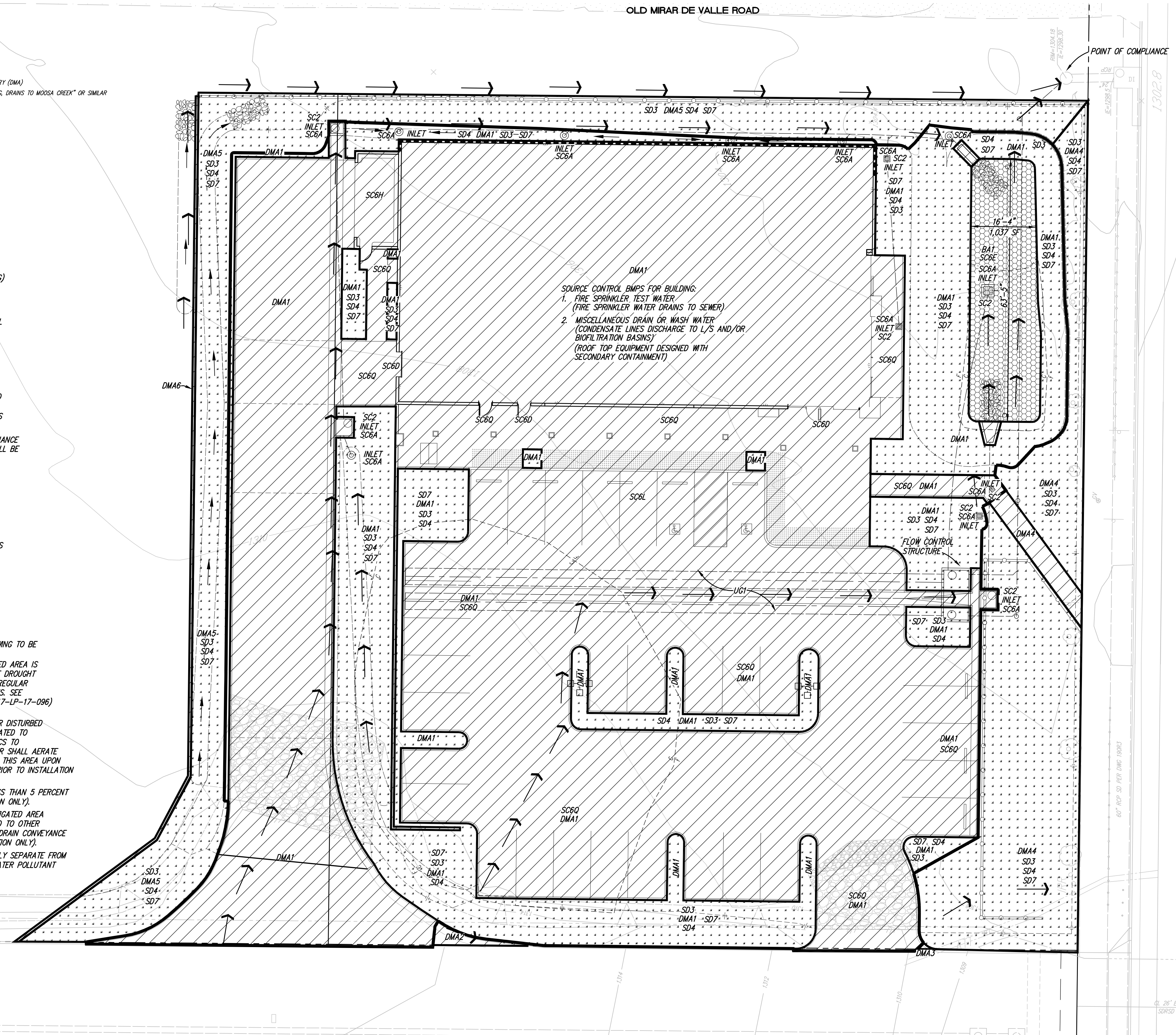
CRITICAL COARSE SEDIMENT YIELD AREAS:
NONE ONSITE

OFFSITE COARSE SEDIMENT YIELD AREAS – NONE TRIBUTARY TO THE PROJECT LIMITS

SOURCE CONTROL BMPS
- SC2 STORM DRAIN STENCILING OR SIGNAGE (STENCILS ON CONCRETE CATCH BASINS AND INLETS PROHIBITING ILLEGAL DUMPING)
- SC6A ONSITE STORM DRAIN INLETS (SHOW LOCATIONS OF INLETS AND CATCH BASINS)
- SC6D NEED FOR FUTURE INDOOR & STRUCTURAL PEST CONTROL (NO LANDSCAPING ADJACENT TO DOORS)
- SC6E LANDSCAPE/OUTDOOR PESTICIDE USE (SHOW STORM WATER TREATMENT FACILITIES)
- SC6H REFUSE AREAS (REFUSE AREA WILL BE COVERED, GRADED AND PAVED TO PREVENT RUN-ON AND PROTECTED WITH DOORS AND BIN COVERS TO PREVENT WIND DISPERSAL)
- SC6L VEHICLE/EQUIPMENT REPAIR AND MAINTENANCE (NO VEHICLE REPAIR OR MAINTENANCE WILL BE DONE OUTDOORS)
- SC6Q PLAZAS, SIDEWALKS AND PARKING LOTS (SWEPT REGULARLY TO PREVENT THE ACCUMULATION OF LITTER & DEBRIS)

SITE DESIGN BMPS
- SD3 MINIMIZE IMPERVIOUS AREAS (MINIMIZE THE USE OF IMPERVIOUS AREAS IN LANDSCAPING DESIGN)
- SD4 MINIMIZE SOIL COMPACTION (MINIMIZE SOIL COMPACTION IN LANDSCAPED AREAS)
- SD7 LANDSCAPE WITH NATIVE OR DROUGHT TOLERANT SPECIES

SELF MITIGATING DMAS MUST MEET THE FOLLOWING TO BE ELIGIBLE FOR EXCLUSION:
- VEGETATION IN THE NATURAL OR LANDSCAPED AREA IS NATIVE AND/OR NON-NATIVE/NON-INVASIVE DROUGHT TOLERANT SPECIES THAT DO NOT REQUIRE REGULAR APPLICATION OF FERTILIZERS AND PESTICIDES. SEE LANDSCAPE AND IRRIGATION PLANS (PDS2017-LP-17-096) FOR PROPOSED LANDSCAPING.
- SOILS ARE UNDISTURBED NATIVE TOPSOIL, OR DISTURBED SOILS THAT HAVE BEEN AMENDED AND AERATED TO PROMOTE WATER RETENTION CHARACTERISTICS TO UNDISTURBED NATIVE TOPSOIL. CONTRACTOR SHALL AERATE THE SOIL WITHIN THE LIMITS OF GRADING IN THIS AREA UPON COMPLETION OF GRADING ACTIVITIES AND PRIOR TO INSTALLATION OF LANDSCAPING AND IRRIGATION.
- THE INCIDENTAL IMPERVIOUS AREAS ARE LESS THAN 5 PERCENT OF THE SELF-MITIGATING AREA (INFORMATION ONLY).
- THE IMPERVIOUS AREA WITHIN THE SELF-MITIGATED AREA SHOULD NOT BE HYDRAULICALLY CONNECTED TO OTHER IMPERVIOUS AREAS UNLESS IT IS A STORM DRAIN CONVEYANCE SYSTEM SUCH AS A BROW DITCH (INFORMATION ONLY).
- THE SELF-MITIGATING AREA IS HYDRAULICALLY SEPARATE FROM DMAS THAT CONTAIN PERMANENT STORM WATER POLLUTANT CONTROL BMPS (INFORMATION ONLY).



SOURCE CONTROL EXHIBIT / DRAINAGE MANAGEMENT AREA (DMA) EXHIBIT
AUTOZONE

Alidade ENGINEERING
41743 ENTERPRISE CIRCLE NORTH, SUITE 209
TEMECULA, CA 92590
PH: (951) 587-2020
FAX: (951) 587-2626

16-202DMA.dwg 01-28-19

DMA1	DMA AREA (FT^2)	POST-PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR	SOIL TYPE	IMP NAME
	27,144*	IMPERVIOUS	0.9	24,429.6	C	BA1
	1,294**	IMPERVIOUS	0.9	1,164.6		
	8,694	LANDSCAPING	0.1	869.4		
			TOTAL	26,463.6		

IMP SIZING FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	(FT^2)
0.03	794	1,037	IMP AREA

*INCLUDES 55 SF OF IMPERVIOUS AREA FROM TRACTOR SUPPLY SITE
**ONSITE IMPERVIOUS AREA THAT WAS CONSTRUCTED WITH THE ADJACENT TRACTOR SUPPLY PROJECT.

DMA2	DMA AREA (FT^2)	POST-PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR	SOIL TYPE
	50	IMPERVIOUS	0.9	45.0	C
			TOTAL	45.0	DE MINIMIS AREA

SHEET FLOWS TO ADJACENT PROPERTY TO THE SOUTH (TRACTOR SUPPLY SITE)

DMA3	DMA AREA (FT^2)	POST-PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR	SOIL TYPE
	3	IMPERVIOUS	0.9	2.7	C
			TOTAL	2.7	DE MINIMIS AREA

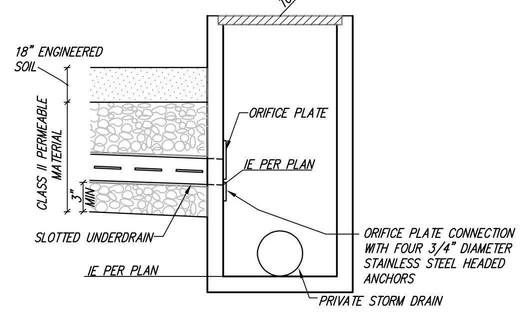
SHEET FLOWS TO ADJACENT PROPERTY TO THE SOUTH (TRACTOR SUPPLY SITE)

DMA4	DMA AREA (FT^2)	POST-PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR	SOIL TYPE
	172	IMPERVIOUS	0.9	154.8	C
	3,431	LANDSCAPING	0.1	343.1	
			TOTAL	497.9	SELF-MITIGATING

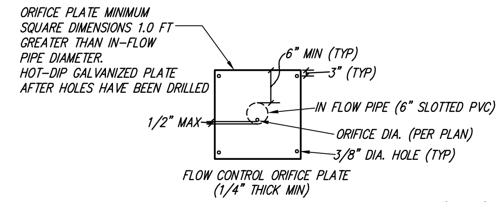
SHEET FLOWS TO VALLEY CENTER ROAD

DMA5	DMA AREA (FT^2)	POST-PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR	SOIL TYPE
	151	IMPERVIOUS	0.9	135.9	C
	3,901	LANDSCAPING	0.1	390.1	
			TOTAL	526.0	SELF-MITIGATING

SHEET FLOWS TO OLD MIRAR DE VALLE ROAD



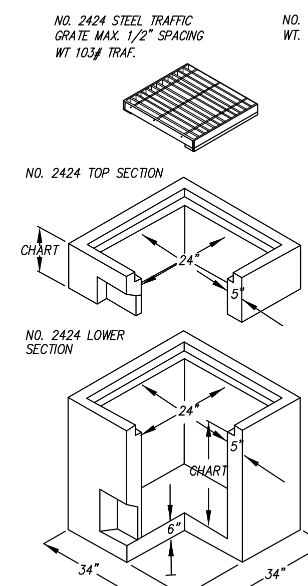
SECTION BIORETENTION CATCH BASIN
NOT TO SCALE



DETAIL: FLOW CONTROL ORIFICE PLATE (PVT)
NOT TO SCALE

NO. 2424 STEEL TRAFFIC GRATE MAX. 1/2" SPACING WT 103# TRAF.

NO. 2424 STEEL TRAFFIC COVER WT. 114#



TOP SECTION	HT.	LBS	AVAILABLE
2424 T6	6"	270	NO K.O.
2424 T12	12"	495	(4) 6" X 11"
2424 T18	18"	745	(4) 9" X 12"
2424 T24	24"	870	(4) 14" X 14"

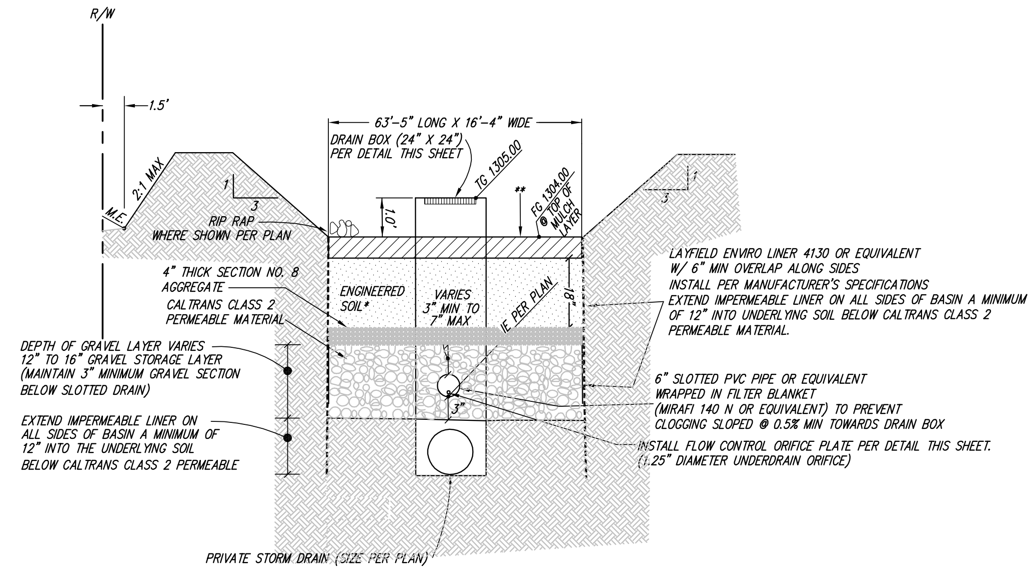
LOWER	HT.	LBS	AVAILABLE
2424 L12	12"	495	(4) 6" X 11"
2424 L18	18"	745	(4) 9" X 12"
2424 L24	24"	870	(4) 14" X 14"

BOTTOM	HT.	LBS	AVAILABLE
2424 B30	30"	1595	(4) 18" X 18"
2424 B36	36"	1905	(4) 18" X 18"

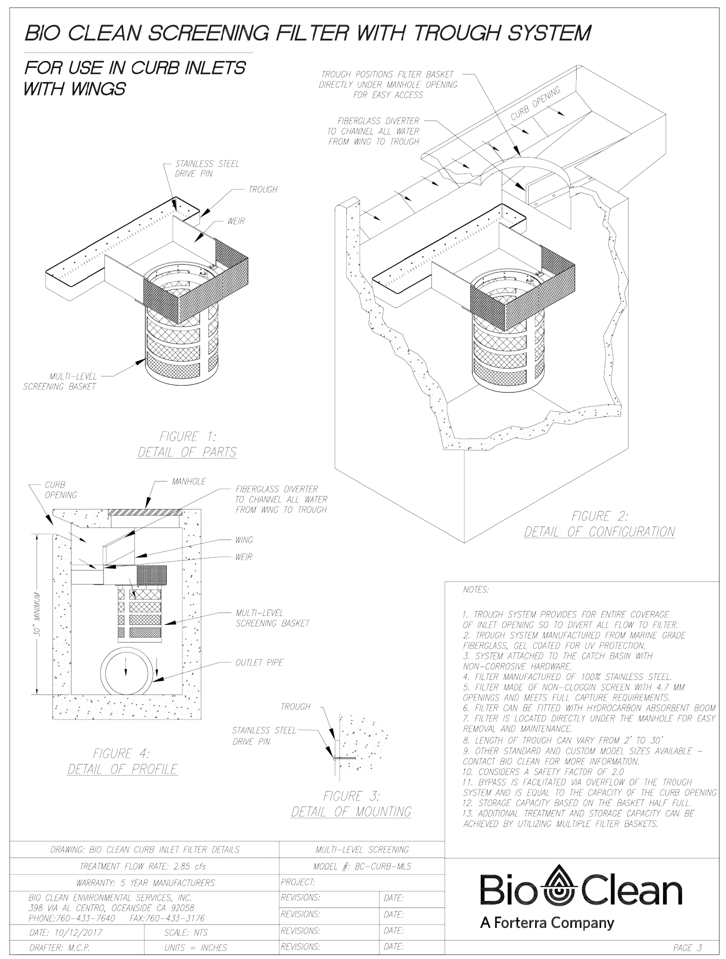
24" X 24" BROOKS BOX CATCH BASIN (PVT)
(OR EQUIVALENT)
NOT TO SCALE

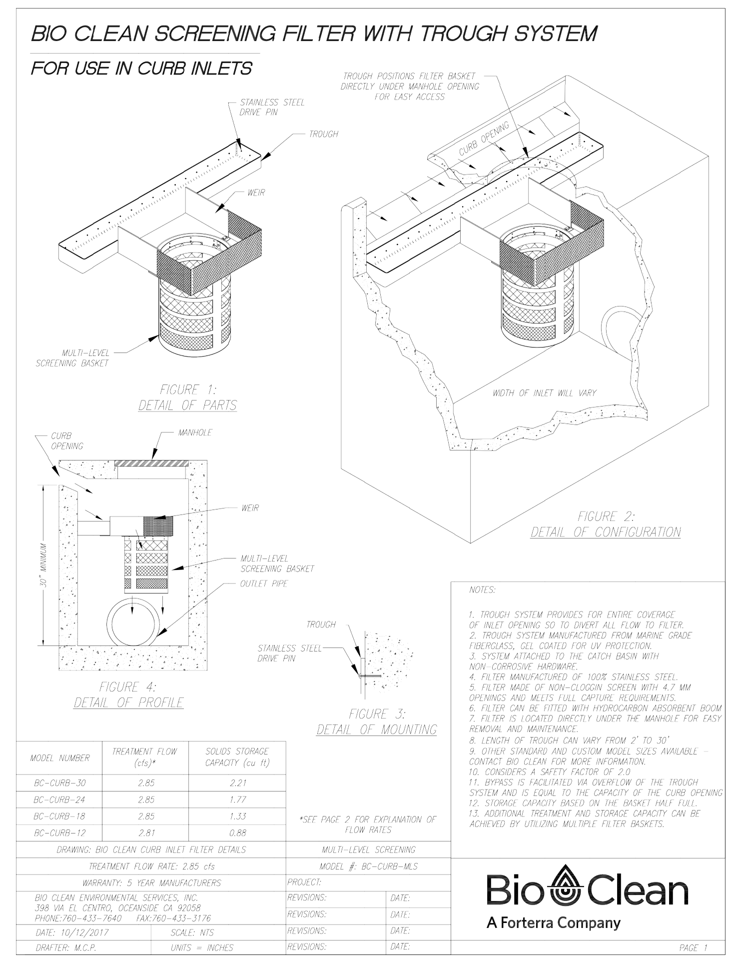
*ENGINEERED SOIL: 75% – 80% SAND, 10% MAX SILT, 3% MAX CLAY AND 9% MAX COMPOST. COMPOST SHOULD COMPOSE NO MORE THAN 9% BULK WEIGHT OF THE ENGINEERED SOIL PER THE COUNTY OF SAN DIEGO LOW IMPACT DESIGN MANUAL, APPENDIX G.

**INSTALL 3" DEPTH SECTION OF WELL-AGED, SHREDDED HARDWOOD MULCH THAT HAS BEEN STOCKPILED OR STORED FOR AT LEAST 12 MONTHS.

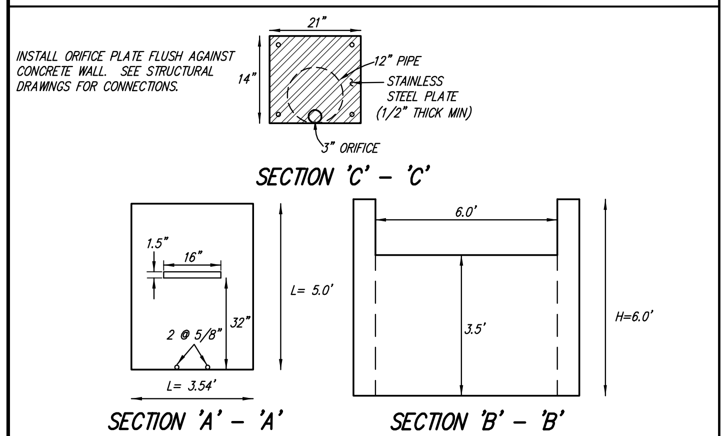


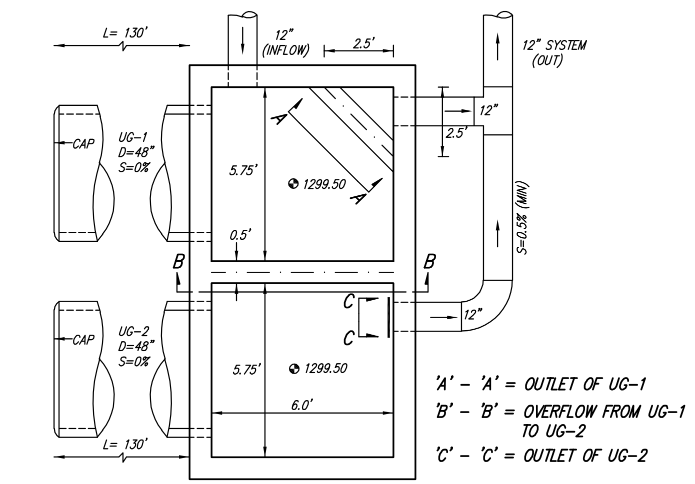
DETAIL: BIOFILTRATION BASIN (PVT) W/ NUTRIENT SENSITIVE MEDIA DESIGN
NOT TO SCALE





INSTALL ORIFICE PLATE FLUSH AGAINST CONCRETE WALL. SEE STRUCTURAL DRAWINGS FOR CONNECTIONS.





PLAN VIEW
6' X 12' JUNCTION STRUCTURE (PVT)
NOT TO SCALE

DRAINAGE MANAGEMENT AREA (DMA) EXHIBIT
AUTOZONE

Alidade ENGINEERING
41743 ENTERPRISE CIRCLE NORTH, SUITE 209
TEMECULA, CA 92590
PH: (951) 587-2020
FAX: (951) 587-2626

16-2020MA2.dwg 1-29-19