PRELIMINARY DRAINAGE STUDY

for

McDonalds Learning Center

Big Bear Lake, County of San Bernardino, California

APN: 0315-421-02
Project No.: P201800235

Prepared for:
Lisa Burtner
PO Box 150
Big Bear Lake, CA 92315
909-709-4041

Prepared by:
Transtech Engineers, Inc.
413 Mackay Drive
San Bernardino, CA 92408
909-384-7464

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TRANSTECH

David B. Ragland 6/10/19
David B. Ragland, RCE

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1. INTRODUCTION

This report presents the findings of a drainage study prepared to address the onsite and offsite drainage flows adjacent and around the subject property of the proposed McDonald Learning Center. The subject property is located in the County of San Bernardino, in the Sugar Loaf area near Big Bear Lake. The property consists of approximately one acre located near the southeast corner of Erwin Ranch Road and State Highway 38. This report is prepared to address Condition of Approval requirements for a Drainage Study.

The proposed project is a child care center composed of a 2,400 square foot building for the child care facility with an office and storage area and parking lot. The entire site is approximately 9 acres. The learning center will occupy approximately one half acre in the southwest corner of the property. The site is currently vacant. The overall property is generally rectangular in shape. The natural topography of the site is relatively level, descending gradually from southwest to northeast at a slope of approximately three to four percent. Vegetation on the site consists of a sparse undergrowth of young trees and shrubs with pine trees providing the overstory.

The site is bounded on the south by the Big Bear Christen Center and on the west by Erwin Ranch Road. Erwin Ranch Road is a narrow paved road. Drainage improvements consist of roadside drainage swales/ditches and periodic culvert crossings. The immediate surrounding properties are vacant pine forest. A rural residential area of approximately 3-4 dwelling units per acre exists a few hundred feet to the east.

2. HYDROLOGIC CONDITIONS

2.1 Existing Condition

The existing site drainage trends from southwest to northeast characterized by sheet flow with slopes of approximately three to four percent. There is a minor water course draining northeasterly from the subject property. There are no other distinguishing drainage or topographical features located on the site.

Offsite flow towards the project originates from the southwest. The majority of these flows begin from the northeasterly side of State Highway 38 and sheet flow across the Christen Center site or along the drainage ditches associated with Erwin Ranch Road.

Offsite flows from the watershed and forest area southwesterly of State Highway 38 are intercepted by the highway. USGS topographic mapping was used to determine the offsite watershed areas. A field review was performed to verify flow patterns and conditions of the offsite areas.

Flows in these areas are conveyed across the highway through culverts. One culvert is located north of Erwin Ranch Road. The offsite watershed is southwest of the State Highway and consists of approximately 112 acres. Runoff from this watershed is intercepted by State Highway 38 and conveyed southeasterly in an open channel to a 18-inch by 24-inch corrugated pipe culvert. Some of the flow is conveyed under the highway through the culvert, discharged and then continues northerly. The remaining flows continue southeasterly along the south side of the highway. Flows from the culvert discharge northerly of Erwin Ranch Road and continue northeasterly and do not affect the subject property.

The second culvert is located southerly at Mitchell Lane. Runoff from this watershed is also intercepted by State Highway 38. Runoff is collected and conveyed along an open channel towards a catch basin located at the southerly corner of State Highway 38 and Mitchell Lane. These flows are conveyed under the highway into an open channel along the south side of Mitchell Lane. These flows continue northeasterly as sheet flow and along minor water courses. The majority of the runoff in this area continues northeasterly and easterly of the project site. These flows are south of the subject site and do not affect the project site.

2.2 Proposed condition

The proposed project will construct the learning center building, sidewalks, parking lot and access driveway. Drainage improvements on the site will include curbs and swales to control and direct runoff to the water quality mitigation basin. The water quality basin will be used for water quality mitigation and for mitigation of the Hydrological Conditions of Concern. (See separate WQMP prepared for the project) Swales will be constructed southerly of the learning center to divert offsite runoff around the improvements. A culvert will be installed under the access driveway to allow the continuance of flow from the south.

2.3 Soils

The Natural Resource Conservation Service soil data base was used to classify the onsite and offsite soils. The primary soils located on the project site are comprised of Morical Heckler family soils (BoD).

The Morical series consists of moderately deep, well drained soils formed in residuum and colluvium from granite or quartzite lithology with an influence of volcanic ash and loess in the surface. They are on ridgetops, mountain slopes, and foothills. Slopes range from 2 to 15 percent. The onsite soils, in general, consist of slightly clayey, silty fine, and fine to medium course sandy alluviums of variable consistency with rock, overlaying moderately stiff to dense, clayey silty fine to medium course sand with rocks and cobbles. The hydrologic soil group for this soil is C.

2.4 Flood Zone

The project site is located in FEMA Zone D on Flood Insurance Rate Map Number 06071C8035H, dated August 28, 2008. The Zone D designation is used for areas where there are possible but undetermined flood hazards, as no analysis of flood hazards has been conducted. The designation of Zone D is also used when a community incorporates portions of another community's area where no map has been prepared.

3. METHODOLOGY

This study is based on the County of San Bernardino Hydrology Manual and the April 2010 Addendum to the Hydrology Manual. This study will determine the peak flow rates for a 100 year storm event. The Rational Method Hydrology software by Advanced Engineering Software (AES) version 18.0 was used for the peak flow calculations. Based upon the 2010 Hydrology Manual Addendum, the NOAA Atlas 14, Volume 6, Version 2 point precipitation frequency estimates were used to calculate the peak flow rates. The 100-year, 1-hour point precipitation near the middle of the watershed is 2.14 inches.

The Advanced Engineering Software Hydraulic Elements Program along with hand calculations were used to determine street flows and water surface elevations for the stream cross sections. The 100 year peak flow rates will be used to determine street flows and water surface elevations of adjacent water courses and determination of potential areas that may be subject to inundation.

4. HYDROLOGIC RESULTS

The summary of the existing and developed condition onsite flows and the 100 year peak flow rates from the offsite contributory drainage areas are presented in Table 4.1. The Rational Method calculations are included in Appendix A.

Table 4.1 Peak Flow Summary 100 Year Storm

Node Number	Existing 100-Year Peak Flow (cfs)	Developed 100-Year Peak flow (cfs)	Mitigated Peak Flow Rate (cfs)
11	4.0	4.0	4.0
21	12.2	9.1	9.1
31	2.2	2.2	2.2
41	.40	5.1	3.4
Totals	18.8	20.4	18.7

A detention flood routing analysis was prepared for the proposed water quality basin in order to analyze its capabilities for storm water detention in addition to its water quality and HCOC function. The routing analysis indicates the basin will detain and reduce the peak flow rate to 3.4 cubic feet per second. This reduction on peak flow rate reduces the proposed project peak flow rate to less than the pre-existing condition.

5. CONCLUSIONS AND RECOMMENDATIONS

Based upon the hydrologic and hydraulic calculations and the topographic conditions observed at and along the project site, the following recommendations for grading and development of the site from a drainage perspective are herein provided.

1. The project is an approximate 2,400 square foot building, driveway and parking lot project and only minor grading to develop the building site will be necessary. Construct swales along the south side to divert offsite runoff around the site to prevent flows from comingling with runoff from the impervious surfaces on the site that are being directed to the water quality infiltration basin.

2. Placing the proposed building on raised foundations thus minimizing the size, depth and quantity of drainage swales.

3. This area is identified as being within Flood Zone D on the FEMA Flood Insurance Rate Maps. This drainage study does not purport to establish FEMA Base Flood Elevations for this area but to provide an analysis of potential flood hazards. It is recommended that finish floor elevations of future structures be placed one to two feet above existing grade. The FEMA Elevation Certificate form and flood insurance parameters for Zone D should be consulted in determining finished floor elevations and the effect on flood insurance coverage requirements and rates, if necessary.

4. The proposed project will increase the 100-year peak flow runoff rate by an estimated 1.6 cubic feet per second. This is an approximate 9 percent increase in peak flow rate. This increase is not considered significant in this type of terrain and with discharge into naturally existing mountainous area streams and will not affect downstream properties. However, as noted above, the water quality basin provides detention and peak flow attenuation to reduce project flows to existing condition levels. A portion of onsite run-on is being diverted around the proposed school site. These flows are being concentrated and discharged through a culvert under the proposed access

driveway. The flows are being discharged into an existing water course and rip rap will be provided at the culvert exit tom reduce velocity and prevent channel erosion. A water quality basin is being provided which will address the mitigation necessary for the Hydrological Conditions of Concern.

5. Rip-rap energy dissipation and flow spreading should be provided at all discharge points where flows are concentrated onsite and eventfully released to existing channels or as sheet flow.

REFERENCES

Advanced Engineering Software, “Rational Method Computer Program Package,” version 18.0, 2011.

Brater, E.F. and King, “Handbook of Hydraulics, Sixth Ed.,” McGraw Hill, 1976.

County of San Bernardino, Department of Public Works “Hydrology Manual,” August 1986.

FEMA, National flood Insurance Program, “Unmapped Areas on Flood Hazard Maps, Zone D.” August 2008.

NOAA Atlas 14, Volume 6, Version 2, “Point Precipitation Frequency Estimates.”

USDA Forest Service, “Soil Survey of San Bernardino National forest Area, California”.

Soil Web Survey, San Bernardino Area, California (2013). U.S. Department of Agriculture, Natural Resource Conservation Service.

APPENDIX A
Rational Method Hydrology

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**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2012 Advanced Engineering Software (aes)
            Ver. 18.2  Release Date: 05/08/2012  License ID 1542

                          Analysis prepared by:

                        Transtech Engineers, Inc.
                             413 Mackay Drive
                         San Bernardino, CA 92408


--------------------------------------------------------------------------
  FILE NAME: BURTNER.DAT
  TIME/DATE OF STUDY: 11:46 02/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 2.1400

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED
```

OFF-SITE

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**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   995.00
  ELEVATION DATA: UPSTREAM(FEET) =   7435.00  DOWNSTREAM(FEET) =   7320.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   22.770
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.217
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "WOODLAND"                  C        4.40      0.26     1.000    87   22.77
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =     15.67
  TOTAL AREA(ACRES) =      4.40   PEAK FLOW RATE(CFS) =     15.67

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   7320.00  DOWNSTREAM(FEET) =   7040.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  3550.00   CHANNEL SLOPE =  0.0789
  CHANNEL FLOW THRU SUBAREA(CFS) =      15.67
  FLOW VELOCITY(FEET/SEC) =   3.93 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =  15.05   Tc(MIN.) =   37.82
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    4545.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   37.82
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.956
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "WOODLAND"                  C       70.30      0.26     1.000    87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =   70.30      SUBAREA RUNOFF(CFS) =  170.59
  EFFECTIVE AREA(ACRES) =     74.70   AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =       74.7       PEAK FLOW RATE(CFS) =     181.26

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  53
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   7040.00  DOWNSTREAM(FEET) =   6930.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1710.00   CHANNEL SLOPE =  0.0643
  CHANNEL FLOW THRU SUBAREA(CFS) =     181.26
  FLOW VELOCITY(FEET/SEC) =   8.02 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   3.55   Tc(MIN.) =   41.37
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    6255.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
================================================================================
  MAINLINE Tc(MIN.) =   41.37
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.776
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "WOODLAND"                 C       95.50      0.26     1.000    87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =   95.50      SUBAREA RUNOFF(CFS) =  216.26
  EFFECTIVE AREA(ACRES) =    170.20   AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =      170.2       PEAK FLOW RATE(CFS) =     385.42

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   6930.00  DOWNSTREAM(FEET) =   6830.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2225.00   CHANNEL SLOPE =  0.0449
  CHANNEL FLOW THRU SUBAREA(CFS) =     385.42
  FLOW VELOCITY(FEET/SEC) =   8.62 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   4.30   Tc(MIN.) =   45.67
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =    8480.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
================================================================================
  MAINLINE Tc(MIN.) =   45.67
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.590
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "WOODLAND"                 C      102.50      0.23     1.000    89
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
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  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =  102.50      SUBAREA RUNOFF(CFS) =  217.75
  EFFECTIVE AREA(ACRES) =    272.70   AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =      272.7       PEAK FLOW RATE(CFS) =     574.73

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   960.00
  ELEVATION DATA: UPSTREAM(FEET) =   7215.00  DOWNSTREAM(FEET) =   7120.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   23.154
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.168
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "WOODLAND"                 C        6.70      0.26     1.000    87   23.15
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =     23.56
  TOTAL AREA(ACRES) =      6.70   PEAK FLOW RATE(CFS) =     23.56

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   7120.00  DOWNSTREAM(FEET) =   6920.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2775.00   CHANNEL SLOPE =  0.0721
  CHANNEL FLOW THRU SUBAREA(CFS) =      23.56
  FLOW VELOCITY(FEET/SEC) =   4.31 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =  10.74   Tc(MIN.) =   33.90
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =    3735.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   33.90
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.192
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "WOODLAND"                 C       58.90      0.26     1.000    87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
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```
  SUBAREA AREA(ACRES) =   58.90      SUBAREA RUNOFF(CFS) =  155.41
  EFFECTIVE AREA(ACRES) =     65.60   AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =       65.6       PEAK FLOW RATE(CFS) =     173.08

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   6920.00  DOWNSTREAM(FEET) =   6820.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2340.00   CHANNEL SLOPE =  0.0427
  CHANNEL FLOW THRU SUBAREA(CFS) =     173.08
  FLOW VELOCITY(FEET/SEC) =   6.44 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   6.06   Tc(MIN.) =   39.95
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =    6075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   39.95
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.845
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "WOODLAND"                 C       46.50      0.23     1.000    89
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =   46.50      SUBAREA RUNOFF(CFS) =  109.43
  EFFECTIVE AREA(ACRES) =    112.10   AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =      112.1       PEAK FLOW RATE(CFS) =     262.03
```

ON-SITE Developed

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****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   375.00
  ELEVATION DATA: UPSTREAM(FEET) =   6821.00  DOWNSTREAM(FEET) =   6807.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.588
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.759
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "WOODLAND"                 C        0.79      0.23     1.000    89   14.59
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      3.93
  TOTAL AREA(ACRES) =      0.79   PEAK FLOW RATE(CFS) =      3.93

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   335.00
  ELEVATION DATA: UPSTREAM(FEET) =   6821.00  DOWNSTREAM(FEET) =   6808.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.958
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) = 10.778
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        0.30      0.27     0.100    86    5.96
  NATURAL FAIR COVER
  "WOODLAND"                 C        0.65      0.23     1.000    89   13.84
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.716
  SUBAREA RUNOFF(CFS) =      9.07
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      9.07

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   435.00
  ELEVATION DATA: UPSTREAM(FEET) =   6831.00  DOWNSTREAM(FEET) =   6804.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.984
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.932
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "WOODLAND"                 C        0.43      0.23     1.000    89   13.98
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      2.21
  TOTAL AREA(ACRES) =      0.43   PEAK FLOW RATE(CFS) =      2.21

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
```

```
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  ELEVATION DATA: UPSTREAM(FEET) =   6809.00  DOWNSTREAM(FEET) =   6806.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.862
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) = 10.901
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        0.52      0.27     0.100    86    5.86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      5.09
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      5.09
==========================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.5  TC(MIN.) =      5.86
  EFFECTIVE AREA(ACRES) =      0.52  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       5.09
==========================================================================
```

ON-SITE Developed

```
**************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   375.00
  ELEVATION DATA: UPSTREAM(FEET) =   6821.00  DOWNSTREAM(FEET) =   6807.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.588
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.759
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "WOODLAND"                 C        0.79      0.23     1.000    89   14.59
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      3.93
  TOTAL AREA(ACRES) =      0.79   PEAK FLOW RATE(CFS) =      3.93

**************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   460.00
  ELEVATION DATA: UPSTREAM(FEET) =   6821.00  DOWNSTREAM(FEET) =   6803.50
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.791
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  9.835
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "WOODLAND"                C        1.11      0.23     1.000    89   15.77
  COMMERCIAL                C        0.30      0.27     0.100    86    6.79
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.809
  SUBAREA RUNOFF(CFS) =     12.24
  TOTAL AREA(ACRES) =      1.41   PEAK FLOW RATE(CFS) =     12.24

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 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.) =    6.79
  RAINFALL INTENSITY(INCH/HR) =   9.84
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.23
  AREA-AVERAGED Ap =  0.81
  EFFECTIVE STREAM AREA(ACRES) =       1.41
  TOTAL STREAM AREA(ACRES) =       1.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      12.24

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   135.00
  ELEVATION DATA: UPSTREAM(FEET) =   6813.00  DOWNSTREAM(FEET) =   6808.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.710
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  7.657
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "WOODLAND"                C        0.06      0.23     1.000    89    9.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.06   PEAK FLOW RATE(CFS) =      0.40

****************************************************************************
  FLOW PROCESS FROM NODE     41.00 TO NODE     21.00 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.) =    9.71
  RAINFALL INTENSITY(INCH/HR) =   7.66
  AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.23
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.06
  TOTAL STREAM AREA(ACRES) =       0.06
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.40

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.24    6.79    9.835  0.23( 0.19) 0.81       1.4      20.00
      2        0.40    9.71    7.657  0.23( 0.23) 1.00       0.1      40.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.61    6.79    9.835  0.23( 0.19) 0.81       1.5      20.00
      2        9.88    9.71    7.657  0.23( 0.19) 0.82       1.5      40.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      12.61    Tc(MIN.) =     6.79
  EFFECTIVE AREA(ACRES) =       1.45   AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.81
  TOTAL AREA(ACRES) =        1.5
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     21.00 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   435.00
  ELEVATION DATA: UPSTREAM(FEET) =   6831.00  DOWNSTREAM(FEET) =   6804.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.984
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.932
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "WOODLAND"                 C        0.43      0.23     1.000    89   13.98
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
```

```
  SUBAREA RUNOFF(CFS) =      2.21
  TOTAL AREA(ACRES) =      0.43   PEAK FLOW RATE(CFS) =      2.21
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =     13.98
  EFFECTIVE AREA(ACRES) =      0.43  AREA-AVERAGED Fm(INCH/HR)=  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       2.21
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Detention Basin Modeling

```
**********************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
**********************************************************************
         (C) Copyright 1989-2012 Advanced Engineering Software (aes)
             Ver. 19.0  Release Date: 06/01/2012  License ID 1542

                          Analysis prepared by:

                        Transtech Engineers, Inc.
                             413 Mackay Drive
                         San Bernardino, CA 92408

**********************************************************************
----------------------------------------------------------------------

 Problem Descriptions:  WATER QUALITY BASIN
                        DETETNION MODELING

----------------------------------------------------------------------

    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.46
    TOTAL CATCHMENT AREA(ACRES) =    0.52
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.030
    LOW LOSS FRACTION = 0.229
    TIME OF CONCENTRATION(MIN.) =  5.86
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.61
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.52
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  2.14
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  3.39
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  4.82
      24-HOUR   POINT RAINFALL VALUE(INCHES) = 11.00
```

```
--------------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.65
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =    -0.17

********************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------------
  0.08      0.0006      0.18  Q         .         .         .         .
  0.18      0.0021      0.18  Q         .         .         .         .
  0.28      0.0036      0.19  Q         .         .         .         .
  0.37      0.0051      0.19  Q         .         .         .         .
  0.47      0.0066      0.19  Q         .         .         .         .
  0.57      0.0081      0.19  Q         .         .         .         .
  0.67      0.0096      0.19  Q         .         .         .         .
  0.76      0.0111      0.19  Q         .         .         .         .
  0.86      0.0127      0.19  Q         .         .         .         .
  0.96      0.0142      0.19  Q         .         .         .         .
  1.06      0.0157      0.19  Q         .         .         .         .
  1.15      0.0172      0.19  Q         .         .         .         .
  1.25      0.0188      0.19  Q         .         .         .         .
  1.35      0.0203      0.19  Q         .         .         .         .
  1.45      0.0219      0.19  Q         .         .         .         .
  1.55      0.0234      0.19  Q         .         .         .         .
  1.64      0.0250      0.19  Q         .         .         .         .
  1.74      0.0265      0.19  Q         .         .         .         .
  1.84      0.0281      0.19  Q         .         .         .         .
  1.94      0.0297      0.19  Q         .         .         .         .
  2.03      0.0312      0.20  Q         .         .         .         .
  2.13      0.0328      0.20  Q         .         .         .         .
  2.23      0.0344      0.20  Q         .         .         .         .
  2.33      0.0360      0.20  Q         .         .         .         .
  2.42      0.0376      0.20  Q         .         .         .         .
  2.52      0.0392      0.20  Q         .         .         .         .
  2.62      0.0408      0.20  Q         .         .         .         .
  2.72      0.0424      0.20  Q         .         .         .         .
  2.81      0.0440      0.20  Q         .         .         .         .
  2.91      0.0457      0.20  Q         .         .         .         .
  3.01      0.0473      0.20  Q         .         .         .         .
  3.11      0.0489      0.20  Q         .         .         .         .
  3.21      0.0506      0.20  Q         .         .         .         .
  3.30      0.0522      0.20  Q         .         .         .         .
  3.40      0.0539      0.20  Q         .         .         .         .
  3.50      0.0555      0.21  Q         .         .         .         .
  3.60      0.0572      0.21  Q         .         .         .         .
  3.69      0.0588      0.21  Q         .         .         .         .
  3.79      0.0605      0.21  Q         .         .         .         .
  3.89      0.0622      0.21  Q         .         .         .         .
  3.99      0.0639      0.21  Q         .         .         .         .
  4.08      0.0656      0.21  Q         .         .         .         .
  4.18      0.0673      0.21  Q         .         .         .         .
  4.28      0.0690      0.21  Q         .         .         .         .
  4.38      0.0707      0.21  Q         .         .         .         .
  4.48      0.0724      0.21  Q         .         .         .         .
```

4.57	0.0741	0.21	Q	.	.	.	.
4.67	0.0758	0.21	Q	.	.	.	.
4.77	0.0776	0.22	Q	.	.	.	.
4.87	0.0793	0.22	Q	.	.	.	.
4.96	0.0811	0.22	Q	.	.	.	.
5.06	0.0828	0.22	Q	.	.	.	.
5.16	0.0846	0.22	Q	.	.	.	.
5.26	0.0864	0.22	Q	.	.	.	.
5.35	0.0881	0.22	Q	.	.	.	.
5.45	0.0899	0.22	Q	.	.	.	.
5.55	0.0917	0.22	Q	.	.	.	.
5.65	0.0935	0.22	Q	.	.	.	.
5.74	0.0953	0.22	Q	.	.	.	.
5.84	0.0971	0.23	Q	.	.	.	.
5.94	0.0990	0.23	Q	.	.	.	.
6.04	0.1008	0.23	Q	.	.	.	.
6.14	0.1026	0.23	Q	.	.	.	.
6.23	0.1045	0.23	Q	.	.	.	.
6.33	0.1063	0.23	Q	.	.	.	.
6.43	0.1082	0.23	Q	.	.	.	.
6.53	0.1101	0.23	Q	.	.	.	.
6.62	0.1120	0.23	Q	.	.	.	.
6.72	0.1138	0.23	Q	.	.	.	.
6.82	0.1157	0.24	Q	.	.	.	.
6.92	0.1176	0.24	Q	.	.	.	.
7.01	0.1196	0.24	Q	.	.	.	.
7.11	0.1215	0.24	Q	.	.	.	.
7.21	0.1234	0.24	Q	.	.	.	.
7.31	0.1254	0.24	Q	.	.	.	.
7.41	0.1273	0.24	Q	.	.	.	.
7.50	0.1293	0.24	Q	.	.	.	.
7.60	0.1313	0.24	Q	.	.	.	.
7.70	0.1332	0.25	Q	.	.	.	.
7.80	0.1352	0.25	Q	.	.	.	.
7.89	0.1372	0.25	Q	.	.	.	.
7.99	0.1392	0.25	Q	.	.	.	.
8.09	0.1413	0.25	.Q	.	.	.	.
8.19	0.1433	0.25	.Q	.	.	.	.
8.28	0.1454	0.25	.Q	.	.	.	.
8.38	0.1474	0.26	.Q	.	.	.	.
8.48	0.1495	0.26	.Q	.	.	.	.
8.58	0.1516	0.26	.Q	.	.	.	.
8.68	0.1537	0.26	.Q	.	.	.	.
8.77	0.1558	0.26	.Q	.	.	.	.
8.87	0.1579	0.26	.Q	.	.	.	.
8.97	0.1600	0.26	.Q	.	.	.	.
9.07	0.1622	0.27	.Q	.	.	.	.
9.16	0.1643	0.27	.Q	.	.	.	.
9.26	0.1665	0.27	.Q	.	.	.	.
9.36	0.1687	0.27	.Q	.	.	.	.
9.46	0.1709	0.27	.Q	.	.	.	.
9.55	0.1731	0.27	.Q	.	.	.	.
9.65	0.1753	0.28	.Q	.	.	.	.
9.75	0.1775	0.28	.Q	.	.	.	.
9.85	0.1798	0.28	.Q	.	.	.	.

9.94	0.1821	0.28	.Q	.	.	.	.
10.04	0.1844	0.28	.Q	.	.	.	.
10.14	0.1867	0.29	.Q	.	.	.	.
10.24	0.1890	0.29	.Q	.	.	.	.
10.34	0.1913	0.29	.Q	.	.	.	.
10.43	0.1937	0.29	.Q	.	.	.	.
10.53	0.1961	0.29	.Q	.	.	.	.
10.63	0.1984	0.30	.Q	.	.	.	.
10.73	0.2009	0.30	.Q	.	.	.	.
10.82	0.2033	0.30	.Q	.	.	.	.
10.92	0.2057	0.30	.Q	.	.	.	.
11.02	0.2082	0.31	.Q	.	.	.	.
11.12	0.2107	0.31	.Q	.	.	.	.
11.21	0.2132	0.31	.Q	.	.	.	.
11.31	0.2157	0.31	.Q	.	.	.	.
11.41	0.2183	0.32	.Q	.	.	.	.
11.51	0.2209	0.32	.Q	.	.	.	.
11.60	0.2235	0.32	.Q	.	.	.	.
11.70	0.2261	0.33	.Q	.	.	.	.
11.80	0.2288	0.33	.Q	.	.	.	.
11.90	0.2314	0.33	.Q	.	.	.	.
12.00	0.2341	0.34	.Q	.	.	.	.
12.09	0.2368	0.32	.Q	.	.	.	.
12.19	0.2392	0.29	.Q	.	.	.	.
12.29	0.2416	0.29	.Q	.	.	.	.
12.39	0.2440	0.30	.Q	.	.	.	.
12.48	0.2464	0.30	.Q	.	.	.	.
12.58	0.2489	0.31	.Q	.	.	.	.
12.68	0.2514	0.31	.Q	.	.	.	.
12.78	0.2540	0.32	.Q	.	.	.	.
12.87	0.2565	0.32	.Q	.	.	.	.
12.97	0.2592	0.33	.Q	.	.	.	.
13.07	0.2618	0.33	.Q	.	.	.	.
13.17	0.2645	0.34	.Q	.	.	.	.
13.27	0.2673	0.34	.Q	.	.	.	.
13.36	0.2701	0.35	.Q	.	.	.	.
13.46	0.2730	0.36	.Q	.	.	.	.
13.56	0.2759	0.37	.Q	.	.	.	.
13.66	0.2789	0.37	.Q	.	.	.	.
13.75	0.2819	0.38	.Q	.	.	.	.
13.85	0.2851	0.39	.Q	.	.	.	.
13.95	0.2882	0.40	.Q	.	.	.	.
14.05	0.2915	0.41	.Q	.	.	.	.
14.14	0.2945	0.35	.Q	.	.	.	.
14.24	0.2974	0.35	.Q	.	.	.	.
14.34	0.3003	0.37	.Q	.	.	.	.
14.44	0.3033	0.38	.Q	.	.	.	.
14.53	0.3064	0.40	.Q	.	.	.	.
14.63	0.3097	0.41	.Q	.	.	.	.
14.73	0.3130	0.43	.Q	.	.	.	.
14.83	0.3166	0.45	.Q	.	.	.	.
14.93	0.3203	0.48	.Q	.	.	.	.
15.02	0.3242	0.49	.Q	.	.	.	.
15.12	0.3283	0.53	. Q	.	.	.	.
15.22	0.3327	0.56	. Q	.	.	.	.

TRANSTECH

```
15.32      0.3375      0.61   . Q        .          .          .          .
15.41      0.3427      0.68   . Q        .          .          .          .
15.51      0.3489      0.86   .  Q       .          .          .          .
15.61      0.3560      0.92   .  Q       .          .          .          .
15.71      0.3641      1.08   .   Q      .          .          .          .
15.80      0.3734      1.23   .   Q      .          .          .          .
15.90      0.3851      1.66   .     Q    .          .          .          .
16.00      0.4005      2.16   .       Q  .          .          .          .
16.10      0.4298      5.12   .          .          Q          .          .
16.20      0.4561      1.40   .    Q     .          .          .          .
16.29      0.4658      0.99   .  Q       .          .          .          .
16.39      0.4730      0.81   .  Q       .          .          .          .
16.49      0.4786      0.58   . Q        .          .          .          .
16.59      0.4831      0.51   . Q        .          .          .          .
16.68      0.4870      0.46   .Q         .          .          .          .
16.78      0.4905      0.42   .Q         .          .          .          .
16.88      0.4938      0.39   .Q         .          .          .          .
16.98      0.4968      0.36   .Q         .          .          .          .
17.07      0.4997      0.36   .Q         .          .          .          .
17.17      0.5027      0.39   .Q         .          .          .          .
17.27      0.5059      0.38   .Q         .          .          .          .
17.37      0.5088      0.36   .Q         .          .          .          .
17.47      0.5117      0.35   .Q         .          .          .          .
17.56      0.5145      0.34   .Q         .          .          .          .
17.66      0.5171      0.33   .Q         .          .          .          .
17.76      0.5197      0.31   .Q         .          .          .          .
17.86      0.5222      0.31   .Q         .          .          .          .
17.95      0.5247      0.30   .Q         .          .          .          .
18.05      0.5270      0.29   .Q         .          .          .          .
18.15      0.5295      0.34   .Q         .          .          .          .
18.25      0.5322      0.33   .Q         .          .          .          .
18.34      0.5349      0.32   .Q         .          .          .          .
18.44      0.5374      0.32   .Q         .          .          .          .
18.54      0.5400      0.31   .Q         .          .          .          .
18.64      0.5425      0.31   .Q         .          .          .          .
18.73      0.5449      0.30   .Q         .          .          .          .
18.83      0.5473      0.30   .Q         .          .          .          .
18.93      0.5497      0.29   .Q         .          .          .          .
19.03      0.5520      0.29   .Q         .          .          .          .
19.13      0.5543      0.28   .Q         .          .          .          .
19.22      0.5566      0.28   .Q         .          .          .          .
19.32      0.5589      0.28   .Q         .          .          .          .
19.42      0.5611      0.27   .Q         .          .          .          .
19.52      0.5632      0.27   .Q         .          .          .          .
19.61      0.5654      0.27   .Q         .          .          .          .
19.71      0.5675      0.26   .Q         .          .          .          .
19.81      0.5696      0.26   .Q         .          .          .          .
19.91      0.5717      0.26   .Q         .          .          .          .
20.00      0.5738      0.25   .Q         .          .          .          .
20.10      0.5758      0.25   .Q         .          .          .          .
20.20      0.5778      0.25   Q          .          .          .          .
20.30      0.5798      0.25   Q          .          .          .          .
20.39      0.5818      0.24   Q          .          .          .          .
20.49      0.5838      0.24   Q          .          .          .          .
20.59      0.5857      0.24   Q          .          .          .          .
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  20.69      0.5876      0.24  Q          .          .          .          .
  20.79      0.5895      0.23  Q          .          .          .          .
  20.88      0.5914      0.23  Q          .          .          .          .
  20.98      0.5932      0.23  Q          .          .          .          .
  21.08      0.5951      0.23  Q          .          .          .          .
  21.18      0.5969      0.23  Q          .          .          .          .
  21.27      0.5987      0.22  Q          .          .          .          .
  21.37      0.6005      0.22  Q          .          .          .          .
  21.47      0.6023      0.22  Q          .          .          .          .
  21.57      0.6041      0.22  Q          .          .          .          .
  21.66      0.6058      0.22  Q          .          .          .          .
  21.76      0.6076      0.22  Q          .          .          .          .
  21.86      0.6093      0.21  Q          .          .          .          .
  21.96      0.6110      0.21  Q          .          .          .          .
  22.06      0.6127      0.21  Q          .          .          .          .
  22.15      0.6144      0.21  Q          .          .          .          .
  22.25      0.6161      0.21  Q          .          .          .          .
  22.35      0.6178      0.21  Q          .          .          .          .
  22.45      0.6194      0.20  Q          .          .          .          .
  22.54      0.6211      0.20  Q          .          .          .          .
  22.64      0.6227      0.20  Q          .          .          .          .
  22.74      0.6243      0.20  Q          .          .          .          .
  22.84      0.6259      0.20  Q          .          .          .          .
  22.93      0.6275      0.20  Q          .          .          .          .
  23.03      0.6291      0.20  Q          .          .          .          .
  23.13      0.6307      0.20  Q          .          .          .          .
  23.23      0.6323      0.19  Q          .          .          .          .
  23.33      0.6339      0.19  Q          .          .          .          .
  23.42      0.6354      0.19  Q          .          .          .          .
  23.52      0.6369      0.19  Q          .          .          .          .
  23.62      0.6385      0.19  Q          .          .          .          .
  23.72      0.6400      0.19  Q          .          .          .          .
  23.81      0.6415      0.19  Q          .          .          .          .
  23.91      0.6430      0.19  Q          .          .          .          .
  24.01      0.6445      0.19  Q          .          .          .          .
  24.11      0.6453      0.00  Q          .          .          .          .
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------------------------------------------------------------------------------
---
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                Duration
        Peak Flow Rate                     (minutes)
    ======================                 =========
               0%                           1441.6
              10%                             93.8
              20%                             35.2
              30%                             17.6
              40%                             11.7
              50%                              5.9
              60%                              5.9
              70%                              5.9
              80%                              5.9
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TRANSTECH

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              90%                                5.9

  Problem Descriptions:




================================================================================
     FLOW-THROUGH DETENTION BASIN MODEL

     SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
     CONSTANT HYDROGRAPH TIME UNIT(MINUTES) =    5.860
     DEAD STORAGE(AF) =       0.00
     SPECIFIED DEAD STORAGE(AF) FILLED =       0.00
     ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN =    0.00


                    INFLOW
                      |
                      |
                      |
                      V                __effective depth
                -------------          |   (and volume)
                |           |    |     |
                | detention |    |....V.............
                |   basin   |<-->|          outflow
                |           |    |........._________
                -------------    |         |   \
                      |          | storage |     basin outlet
                      V          -----------
                   OUTFLOW


     DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
     TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES =   4
     *BASIN-DEPTH  STORAGE    OUTFLOW  **BASIN-DEPTH  STORAGE    OUTFLOW  *
     *   (FEET)  (ACRE-FEET)   (CFS)   **   (FEET)  (ACRE-FEET)   (CFS)   *
     *      0.000      0.000      0.000**      0.100      0.010      0.025*
     *      2.000      0.059      0.025**      2.750      0.089      5.500*
--------------------------------------------------------------------------------
     BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:
      INTERVAL   DEPTH   {S-O*DT/2}   {S+O*DT/2}
       NUMBER   (FEET)   (ACRE-FEET)  (ACRE-FEET)
           1     0.00       0.00000      0.00000
           2     0.10       0.00990      0.01010
           3     2.00       0.05880      0.05900
           4     2.75       0.06660      0.11100
     WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)
--------------------------------------------------------------------------------
     DETENTION BASIN ROUTING RESULTS:
     NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES
           OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE
           AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.
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TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	EFFECTIVE DEPTH(FT)	OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
0.080	0.000	0.18	0.01	0.00	0.001
0.178	0.000	0.18	0.03	0.01	0.003
0.276	0.000	0.19	0.04	0.01	0.004
0.373	0.000	0.19	0.06	0.01	0.006
0.471	0.000	0.19	0.07	0.02	0.007
0.569	0.000	0.19	0.08	0.02	0.008
0.666	0.000	0.19	0.10	0.02	0.010
0.764	0.000	0.19	0.14	0.02	0.011
0.862	0.000	0.19	0.19	0.03	0.012
0.959	0.000	0.19	0.25	0.03	0.014
1.057	0.000	0.19	0.30	0.03	0.015
1.155	0.000	0.19	0.35	0.03	0.016
1.252	0.000	0.19	0.40	0.03	0.018
1.350	0.000	0.19	0.45	0.03	0.019
1.448	0.000	0.19	0.51	0.03	0.020
1.545	0.000	0.19	0.56	0.03	0.022
1.643	0.000	0.19	0.61	0.03	0.023
1.741	0.000	0.19	0.66	0.03	0.025
1.838	0.000	0.19	0.72	0.03	0.026
1.936	0.000	0.19	0.77	0.03	0.027
2.034	0.000	0.20	0.82	0.03	0.029
2.131	0.000	0.20	0.88	0.03	0.030
2.229	0.000	0.20	0.93	0.03	0.031
2.327	0.000	0.20	0.99	0.03	0.033
2.424	0.000	0.20	1.04	0.03	0.034
2.522	0.000	0.20	1.09	0.03	0.036
2.620	0.000	0.20	1.15	0.03	0.037
2.717	0.000	0.20	1.20	0.03	0.038
2.815	0.000	0.20	1.26	0.03	0.040
2.913	0.000	0.20	1.31	0.03	0.041
3.010	0.000	0.20	1.37	0.03	0.043
3.108	0.000	0.20	1.43	0.03	0.044
3.206	0.000	0.20	1.48	0.03	0.046
3.303	0.000	0.20	1.54	0.03	0.047
3.401	0.000	0.20	1.59	0.03	0.048
3.499	0.000	0.21	1.65	0.03	0.050
3.596	0.000	0.21	1.71	0.03	0.051
3.694	0.000	0.21	1.76	0.03	0.053
3.792	0.000	0.21	1.82	0.03	0.054
3.889	0.000	0.21	1.88	0.03	0.056
3.987	0.000	0.21	1.94	0.03	0.057
4.085	0.000	0.21	2.00	0.03	0.059
4.182	0.000	0.21	2.02	0.10	0.060
4.280	0.000	0.21	2.02	0.19	0.060
4.378	0.000	0.21	2.03	0.21	0.060
4.475	0.000	0.21	2.03	0.21	0.060
4.573	0.000	0.21	2.03	0.21	0.060
4.671	0.000	0.21	2.03	0.21	0.060
4.768	0.000	0.22	2.03	0.21	0.060
4.866	0.000	0.22	2.03	0.22	0.060
4.964	0.000	0.22	2.03	0.22	0.060

5.061	0.000	0.22	2.03	0.22	0.060
5.159	0.000	0.22	2.03	0.22	0.060
5.257	0.000	0.22	2.03	0.22	0.060
5.354	0.000	0.22	2.03	0.22	0.060
5.452	0.000	0.22	2.03	0.22	0.060
5.550	0.000	0.22	2.03	0.22	0.060
5.647	0.000	0.22	2.03	0.22	0.060
5.745	0.000	0.22	2.03	0.22	0.060
5.843	0.000	0.23	2.03	0.22	0.060
5.940	0.000	0.23	2.03	0.23	0.060
6.038	0.000	0.23	2.03	0.23	0.060
6.136	0.000	0.23	2.03	0.23	0.060
6.233	0.000	0.23	2.03	0.23	0.060
6.331	0.000	0.23	2.03	0.23	0.060
6.429	0.000	0.23	2.03	0.23	0.060
6.526	0.000	0.23	2.03	0.23	0.060
6.624	0.000	0.23	2.03	0.23	0.060
6.722	0.000	0.23	2.03	0.23	0.060
6.819	0.000	0.24	2.03	0.23	0.060
6.917	0.000	0.24	2.03	0.24	0.060
7.015	0.000	0.24	2.03	0.24	0.060
7.112	0.000	0.24	2.03	0.24	0.060
7.210	0.000	0.24	2.03	0.24	0.060
7.308	0.000	0.24	2.03	0.24	0.060
7.405	0.000	0.24	2.03	0.24	0.060
7.503	0.000	0.24	2.03	0.24	0.060
7.601	0.000	0.24	2.03	0.24	0.060
7.698	0.000	0.25	2.03	0.25	0.060
7.796	0.000	0.25	2.03	0.25	0.060
7.894	0.000	0.25	2.03	0.25	0.060
7.991	0.000	0.25	2.03	0.25	0.060
8.089	0.000	0.25	2.03	0.25	0.060
8.187	0.000	0.25	2.03	0.25	0.060
8.284	0.000	0.25	2.03	0.25	0.060
8.382	0.000	0.26	2.03	0.25	0.060
8.480	0.000	0.26	2.03	0.26	0.060
8.577	0.000	0.26	2.03	0.26	0.060
8.675	0.000	0.26	2.03	0.26	0.060
8.773	0.000	0.26	2.03	0.26	0.060
8.870	0.000	0.26	2.03	0.26	0.060
8.968	0.000	0.26	2.03	0.26	0.060
9.066	0.000	0.27	2.03	0.27	0.060
9.163	0.000	0.27	2.03	0.27	0.060
9.261	0.000	0.27	2.03	0.27	0.060
9.359	0.000	0.27	2.03	0.27	0.060
9.456	0.000	0.27	2.03	0.27	0.060
9.554	0.000	0.27	2.03	0.27	0.060
9.652	0.000	0.28	2.03	0.28	0.060
9.749	0.000	0.28	2.03	0.28	0.060
9.847	0.000	0.28	2.03	0.28	0.060
9.945	0.000	0.28	2.04	0.28	0.060
10.042	0.000	0.28	2.04	0.28	0.060
10.140	0.000	0.29	2.04	0.29	0.060
10.238	0.000	0.29	2.04	0.29	0.060
10.335	0.000	0.29	2.04	0.29	0.060

10.433	0.000	0.29	2.04	0.29	0.060
10.531	0.000	0.29	2.04	0.29	0.060
10.628	0.000	0.30	2.04	0.30	0.060
10.726	0.000	0.30	2.04	0.30	0.060
10.824	0.000	0.30	2.04	0.30	0.060
10.921	0.000	0.30	2.04	0.30	0.060
11.019	0.000	0.31	2.04	0.31	0.060
11.117	0.000	0.31	2.04	0.31	0.060
11.214	0.000	0.31	2.04	0.31	0.060
11.312	0.000	0.31	2.04	0.31	0.060
11.410	0.000	0.32	2.04	0.32	0.061
11.507	0.000	0.32	2.04	0.32	0.061
11.605	0.000	0.32	2.04	0.32	0.061
11.703	0.000	0.33	2.04	0.33	0.061
11.800	0.000	0.33	2.04	0.33	0.061
11.898	0.000	0.33	2.04	0.33	0.061
11.996	0.000	0.34	2.04	0.33	0.061
12.093	0.000	0.32	2.04	0.33	0.061
12.191	0.000	0.29	2.04	0.31	0.060
12.289	0.000	0.29	2.04	0.30	0.060
12.386	0.000	0.30	2.04	0.30	0.060
12.484	0.000	0.30	2.04	0.30	0.060
12.582	0.000	0.31	2.04	0.30	0.060
12.679	0.000	0.31	2.04	0.31	0.060
12.777	0.000	0.32	2.04	0.31	0.060
12.875	0.000	0.32	2.04	0.32	0.061
12.972	0.000	0.33	2.04	0.32	0.061
13.070	0.000	0.33	2.04	0.33	0.061
13.168	0.000	0.34	2.04	0.34	0.061
13.265	0.000	0.34	2.04	0.34	0.061
13.363	0.000	0.35	2.04	0.35	0.061
13.461	0.000	0.36	2.05	0.35	0.061
13.558	0.000	0.37	2.05	0.36	0.061
13.656	0.000	0.37	2.05	0.37	0.061
13.754	0.000	0.38	2.05	0.38	0.061
13.851	0.000	0.39	2.05	0.38	0.061
13.949	0.000	0.40	2.05	0.39	0.061
14.047	0.000	0.41	2.05	0.40	0.061
14.144	0.000	0.35	2.05	0.38	0.061
14.242	0.000	0.35	2.04	0.35	0.061
14.340	0.000	0.37	2.05	0.36	0.061
14.437	0.000	0.38	2.05	0.37	0.061
14.535	0.000	0.40	2.05	0.38	0.061
14.633	0.000	0.41	2.05	0.40	0.061
14.730	0.000	0.43	2.06	0.42	0.061
14.828	0.000	0.45	2.06	0.44	0.061
14.926	0.000	0.48	2.06	0.46	0.061
15.023	0.000	0.49	2.06	0.48	0.061
15.121	0.000	0.53	2.07	0.51	0.062
15.219	0.000	0.56	2.07	0.54	0.062
15.316	0.000	0.61	2.08	0.58	0.062
15.414	0.000	0.68	2.09	0.64	0.062
15.512	0.000	0.86	2.11	0.75	0.063
15.609	0.000	0.92	2.12	0.87	0.064
15.707	0.000	1.08	2.14	0.98	0.065

15.805	0.000	1.23	2.16	1.13	0.065
15.902	0.000	1.66	2.21	1.40	0.067
16.000	0.000	2.16	2.28	1.83	0.070
16.098	0.000	5.12	2.64	3.37	0.084
16.195	0.000	1.40	2.26	3.27	0.069
16.293	0.000	0.99	2.15	1.51	0.065
16.391	0.000	0.81	2.11	0.99	0.063
16.488	0.000	0.58	2.08	0.74	0.062
16.586	0.000	0.51	2.07	0.58	0.062
16.684	0.000	0.46	2.06	0.50	0.061
16.781	0.000	0.42	2.06	0.45	0.061
16.879	0.000	0.39	2.05	0.41	0.061
16.977	0.000	0.36	2.05	0.38	0.061
17.074	0.000	0.36	2.05	0.36	0.061
17.172	0.000	0.39	2.05	0.37	0.061
17.270	0.000	0.38	2.05	0.38	0.061
17.367	0.000	0.36	2.05	0.37	0.061
17.465	0.000	0.35	2.04	0.36	0.061
17.563	0.000	0.34	2.04	0.34	0.061
17.660	0.000	0.33	2.04	0.33	0.061
17.758	0.000	0.31	2.04	0.32	0.060
17.856	0.000	0.31	2.04	0.31	0.060
17.953	0.000	0.30	2.04	0.30	0.060
18.051	0.000	0.29	2.04	0.29	0.060
18.149	0.000	0.34	2.04	0.31	0.061
18.246	0.000	0.33	2.04	0.33	0.061
18.344	0.000	0.32	2.04	0.33	0.061
18.442	0.000	0.32	2.04	0.32	0.060
18.539	0.000	0.31	2.04	0.31	0.060
18.637	0.000	0.31	2.04	0.31	0.060
18.735	0.000	0.30	2.04	0.30	0.060
18.832	0.000	0.30	2.04	0.30	0.060
18.930	0.000	0.29	2.04	0.29	0.060
19.028	0.000	0.29	2.04	0.29	0.060
19.125	0.000	0.28	2.04	0.29	0.060
19.223	0.000	0.28	2.03	0.28	0.060
19.321	0.000	0.28	2.03	0.28	0.060
19.418	0.000	0.27	2.03	0.27	0.060
19.516	0.000	0.27	2.03	0.27	0.060
19.614	0.000	0.27	2.03	0.27	0.060
19.711	0.000	0.26	2.03	0.26	0.060
19.809	0.000	0.26	2.03	0.26	0.060
19.907	0.000	0.26	2.03	0.26	0.060
20.004	0.000	0.25	2.03	0.26	0.060
20.102	0.000	0.25	2.03	0.25	0.060
20.200	0.000	0.25	2.03	0.25	0.060
20.297	0.000	0.25	2.03	0.25	0.060
20.395	0.000	0.24	2.03	0.24	0.060
20.493	0.000	0.24	2.03	0.24	0.060
20.590	0.000	0.24	2.03	0.24	0.060
20.688	0.000	0.24	2.03	0.24	0.060
20.786	0.000	0.23	2.03	0.24	0.060
20.883	0.000	0.23	2.03	0.23	0.060
20.981	0.000	0.23	2.03	0.23	0.060
21.079	0.000	0.23	2.03	0.23	0.060

21.176	0.000	0.23	2.03	0.23	0.060
21.274	0.000	0.22	2.03	0.23	0.060
21.372	0.000	0.22	2.03	0.22	0.060
21.469	0.000	0.22	2.03	0.22	0.060
21.567	0.000	0.22	2.03	0.22	0.060
21.665	0.000	0.22	2.03	0.22	0.060
21.762	0.000	0.22	2.03	0.22	0.060
21.860	0.000	0.21	2.03	0.21	0.060
21.958	0.000	0.21	2.03	0.21	0.060
22.055	0.000	0.21	2.03	0.21	0.060
22.153	0.000	0.21	2.03	0.21	0.060
22.251	0.000	0.21	2.03	0.21	0.060
22.348	0.000	0.21	2.02	0.21	0.060
22.446	0.000	0.20	2.02	0.21	0.060
22.544	0.000	0.20	2.02	0.20	0.060
22.641	0.000	0.20	2.02	0.20	0.060
22.739	0.000	0.20	2.02	0.20	0.060
22.837	0.000	0.20	2.02	0.20	0.060
22.934	0.000	0.20	2.02	0.20	0.060
23.032	0.000	0.20	2.02	0.20	0.060
23.130	0.000	0.20	2.02	0.20	0.060
23.227	0.000	0.19	2.02	0.19	0.060
23.325	0.000	0.19	2.02	0.19	0.060
23.423	0.000	0.19	2.02	0.19	0.060
23.520	0.000	0.19	2.02	0.19	0.060
23.618	0.000	0.19	2.02	0.19	0.060
23.716	0.000	0.19	2.02	0.19	0.060
23.813	0.000	0.19	2.02	0.19	0.060
23.911	0.000	0.19	2.02	0.19	0.060
24.009	0.000	0.19	2.02	0.19	0.060
24.106	0.000	0.00	2.00	0.11	0.059

APPENDIX B
Hydraulic Calculations

```
**************************************************************************
               HYDRAULIC ELEMENTS - I  PROGRAM PACKAGE
        (C) Copyright 1982-2012 Advanced Engineering Software (aes)
            Ver. 19.0  Release Date: 06/01/2012  License ID 1542

                          Analysis prepared by:

                        Transtech Engineers, Inc.
                            413 Mackay Drive
                         San Bernardino, CA 92408


--------------------------------------------------------------------------
  TIME/DATE OF STUDY: 17:59 03/04/2019
==========================================================================
 Problem Descriptions: CMP UNDER DRIVEWAY



**************************************************************************
>>>>PIPEFLOW HYDRAULIC INPUT INFORMATION<<<<
--------------------------------------------------------------------------
    PIPE SLOPE(FEET/FEET) =  0.0100
    PIPEFLOW(CFS) =         9.10
    MANNINGS FRICTION FACTOR = 0.022000
    >>>>>SOFFIT-FLOW PIPE DIAMETER(FEET) =   1.731  20.8 inches Round Eq.
     VELOCITY = 3.87 CFS
     USE 28"X20" CMP PIPE ARCH WITH A ROUND EQUIVALENT OF 24 INCHES.
     HW/D = 1.0(1.67) = 1.67
     W.S. = 7.5 + 1.67 = 9.2

     USE NO. 2 BACKING CLASS RIP RAP


==========================================================================

 Problem Descriptions:  WATER QUALITY BASIN SPILLWAY

     Spillway as a Broad Crested Weir: Q=CLH^1/2
     5.1(1.35%)=2.8(3.0)H^1/2
     H = 0.88'

**************************************************************************
>>>>CHANNEL INPUT INFORMATION<<<<
--------------------------------------------------------------------------
    CHANNEL Z1(HORIZONTAL/VERTICAL) =    2.00
            Z2(HORIZONTAL/VERTICAL) =    2.00
    BASEWIDTH(FEET) =     3.00
    CONSTANT CHANNEL SLOPE(FEET/FEET) = 0.330000
```

```
    UNIFORM FLOW(CFS) =        6.89
    MANNINGS FRICTION FACTOR = 0.0370  for No. 2 Backing
 ===============================================================================
    NORMAL-DEPTH FLOW INFORMATION:
 -------------------------------------------------------------------------------
    >>>>> NORMAL DEPTH(FEET) =   0.24
    FLOW TOP-WIDTH(FEET) =         3.97
    FLOW AREA(SQUARE FEET) =           0.84
    HYDRAULIC DEPTH(FEET) =     0.21
    FLOW AVERAGE VELOCITY(FEET/SEC.) =     8.16
    UNIFORM FROUDE NUMBER =    3.119
    PRESSURE + MOMENTUM(POUNDS) =           115.08
    AVERAGED VELOCITY HEAD(FEET) =      1.035
    SPECIFIC ENERGY(FEET) =      1.277
 ===============================================================================
    CRITICAL-DEPTH FLOW INFORMATION:
 -------------------------------------------------------------------------------
    CRITICAL FLOW TOP-WIDTH(FEET) =         4.95
    CRITICAL FLOW AREA(SQUARE FEET) =           1.94
    CRITICAL FLOW HYDRAULIC DEPTH(FEET) =     0.39
    CRITICAL FLOW AVERAGE VELOCITY(FEET/SEC.) =     3.55
    CRITICAL DEPTH(FEET) =     0.49
    CRITICAL FLOW PRESSURE + MOMENTUM(POUNDS) =           74.54
    AVERAGED CRITICAL FLOW VELOCITY HEAD(FEET) =      0.196
    CRITICAL FLOW SPECIFIC ENERGY(FEET) =      0.684
 ===============================================================================

USE NO. 2 BACKING ROCK CLASS, MINIMUM THICKNESS 1.25 FEET.
```

State Highway 38 Culvert Flows

The following is the estimated flow rate that can be conveyed by the culvert under State Highway 38.

Culvert at PM 46.87- 18-inch x 2'-4" elliptical CMP with a headwater depth of 4 feet. Per Federal Highway Administration "Hydraulic Charts for the Selection of Highway Culverts," Chart 5, , flow in culvert is estimated at 45 cfs.

APPENDIX C
Rainfall Data

NOAA Atlas 14, Volume 6, Version 2
Location name: Big Bear City, California, USA*
Latitude: 34.2462°, Longitude: -116.8113°
Elevation: 6818.39 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.146 (0.121-0.176)	0.199 (0.164-0.243)	0.274 (0.226-0.336)	0.340 (0.278-0.420)	0.437 (0.346-0.558)	0.518 (0.402-0.676)	0.607 (0.459-0.811)	0.706 (0.519-0.970)	0.852 (0.601-1.22)	0.969 (0.668-1.45)
10-min	0.210 (0.173-0.256)	0.285 (0.236-0.348)	0.393 (0.324-0.481)	0.487 (0.398-0.602)	0.626 (0.495-0.800)	0.743 (0.576-0.969)	0.871 (0.658-1.16)	1.01 (0.744-1.39)	1.22 (0.862-1.75)	1.41 (0.957-2.08)
15-min	0.253 (0.210-0.309)	0.345 (0.285-0.421)	0.475 (0.391-0.582)	0.589 (0.481-0.727)	0.757 (0.599-0.967)	0.898 (0.696-1.17)	1.05 (0.796-1.41)	1.22 (0.900-1.68)	1.48 (1.04-2.12)	1.70 (1.16-2.52)
30-min	0.365 (0.302-0.445)	0.496 (0.410-0.606)	0.683 (0.563-0.837)	0.847 (0.693-1.05)	1.09 (0.862-1.39)	1.29 (1.00-1.69)	1.52 (1.15-2.02)	1.76 (1.30-2.42)	2.13 (1.50-3.05)	2.44 (1.67-3.62)
60-min	0.516 (0.427-0.630)	0.702 (0.580-0.856)	0.967 (0.797-1.19)	1.20 (0.981-1.48)	1.54 (1.22-1.97)	1.83 (1.42-2.39)	2.14 (1.62-2.87)	2.49 (1.83-3.43)	3.01 (2.12-4.31)	3.46 (2.36-5.13)
2-hr	0.730 (0.604-0.891)	0.983 (0.813-1.20)	1.34 (1.10-1.64)	1.64 (1.34-2.03)	2.08 (1.64-2.65)	2.44 (1.89-3.18)	2.82 (2.13-3.77)	3.24 (2.38-4.44)	3.83 (2.70-5.49)	4.32 (2.95-6.41)
3-hr	0.902 (0.746-1.10)	1.21 (0.997-1.47)	1.63 (1.34-2.00)	1.99 (1.63-2.46)	2.51 (1.99-3.21)	2.94 (2.28-3.83)	3.39 (2.56-4.53)	3.87 (2.85-5.32)	4.57 (3.22-6.54)	5.13 (3.50-7.60)
6-hr	1.31 (1.08-1.59)	1.74 (1.44-2.13)	2.34 (1.93-2.87)	2.85 (2.33-3.53)	3.59 (2.84-4.59)	4.19 (3.25-5.46)	4.82 (3.65-6.45)	5.51 (4.05-7.57)	6.48 (4.57-9.28)	7.28 (4.96-10.6)
12-hr	1.79 (1.48-2.19)	2.42 (2.00-2.96)	3.31 (2.73-4.05)	4.07 (3.33-5.03)	5.19 (4.10-6.62)	6.10 (4.73-7.96)	7.09 (5.36-9.47)	8.16 (6.00-11.2)	9.72 (6.85-13.9)	11.0 (7.50-16.3)
24-hr	2.52 (2.23-2.90)	3.47 (3.07-4.00)	4.83 (4.26-5.58)	6.03 (5.28-7.03)	7.81 (6.62-9.41)	9.32 (7.73-11.4)	11.0 (8.69-13.8)	12.8 (10.1-16.6)	15.5 (11.8-21.0)	17.9 (13.1-24.9)
2-day	3.15 (2.79-3.62)	4.35 (3.85-5.02)	6.12 (5.40-7.07)	7.69 (6.74-8.97)	10.1 (8.55-12.1)	12.1 (10.1-14.9)	14.4 (11.7-18.2)	17.0 (13.4-22.0)	21.0 (15.9-28.2)	24.4 (17.8-34.0)
3-day	3.45 (3.06-3.97)	4.78 (4.24-5.52)	6.75 (5.96-7.81)	8.53 (7.47-9.94)	11.2 (9.53-13.5)	13.6 (11.3-16.7)	16.2 (13.2-20.4)	19.3 (15.2-24.9)	23.9 (18.1-32.2)	28.0 (20.5-39.0)
4-day	3.70 (3.28-4.26)	5.15 (4.56-5.94)	7.29 (6.44-8.43)	9.23 (8.09-10.8)	12.2 (10.3-14.7)	14.8 (12.3-18.2)	17.7 (14.3-22.3)	21.0 (16.6-27.2)	26.1 (19.8-35.2)	30.6 (22.4-42.7)
7-day	4.21 (3.73-4.85)	5.90 (5.22-6.80)	8.41 (7.42-9.72)	10.7 (9.35-12.4)	14.1 (12.0-17.0)	17.1 (14.2-21.1)	20.5 (16.6-25.8)	24.3 (19.2-31.5)	30.2 (22.8-40.7)	35.3 (25.8-49.2)
10-day	4.54 (4.02-5.22)	6.40 (5.66-7.37)	9.14 (8.07-10.6)	11.6 (10.2-13.5)	15.4 (13.0-18.5)	18.6 (15.5-22.9)	22.3 (18.1-28.0)	26.4 (20.8-34.2)	32.7 (24.7-44.1)	38.1 (27.9-53.2)
20-day	5.47 (4.85-6.30)	7.77 (6.88-8.96)	11.2 (9.85-12.9)	14.2 (12.4-16.5)	18.8 (15.9-22.6)	22.7 (18.8-27.9)	27.1 (21.9-34.1)	32.0 (25.2-41.4)	39.4 (29.8-53.1)	45.7 (33.4-63.8)
30-day	6.39 (5.67-7.36)	9.09 (8.05-10.5)	13.0 (11.5-15.1)	16.6 (14.5-19.3)	21.9 (18.5-26.3)	26.4 (21.9-32.4)	31.4 (25.4-39.5)	36.9 (29.1-47.8)	45.3 (34.3-61.0)	52.4 (38.3-73.1)
45-day	7.87 (6.89-8.83)	10.9 (9.61-12.5)	15.5 (13.7-17.9)	19.6 (17.2-22.8)	25.8 (21.8-31.0)	31.0 (25.7-38.1)	36.7 (29.7-46.2)	43.1 (34.0-55.7)	52.5 (39.7-70.8)	60.5 (44.3-84.4)
60-day	8.91 (7.89-10.3)	12.5 (11.1-14.4)	17.7 (15.6-20.5)	22.3 (19.6-26.0)	29.2 (24.8-35.2)	35.0 (29.1-43.0)	41.4 (33.5-52.1)	48.4 (38.1-62.6)	58.7 (44.4-79.1)	67.4 (49.3-94.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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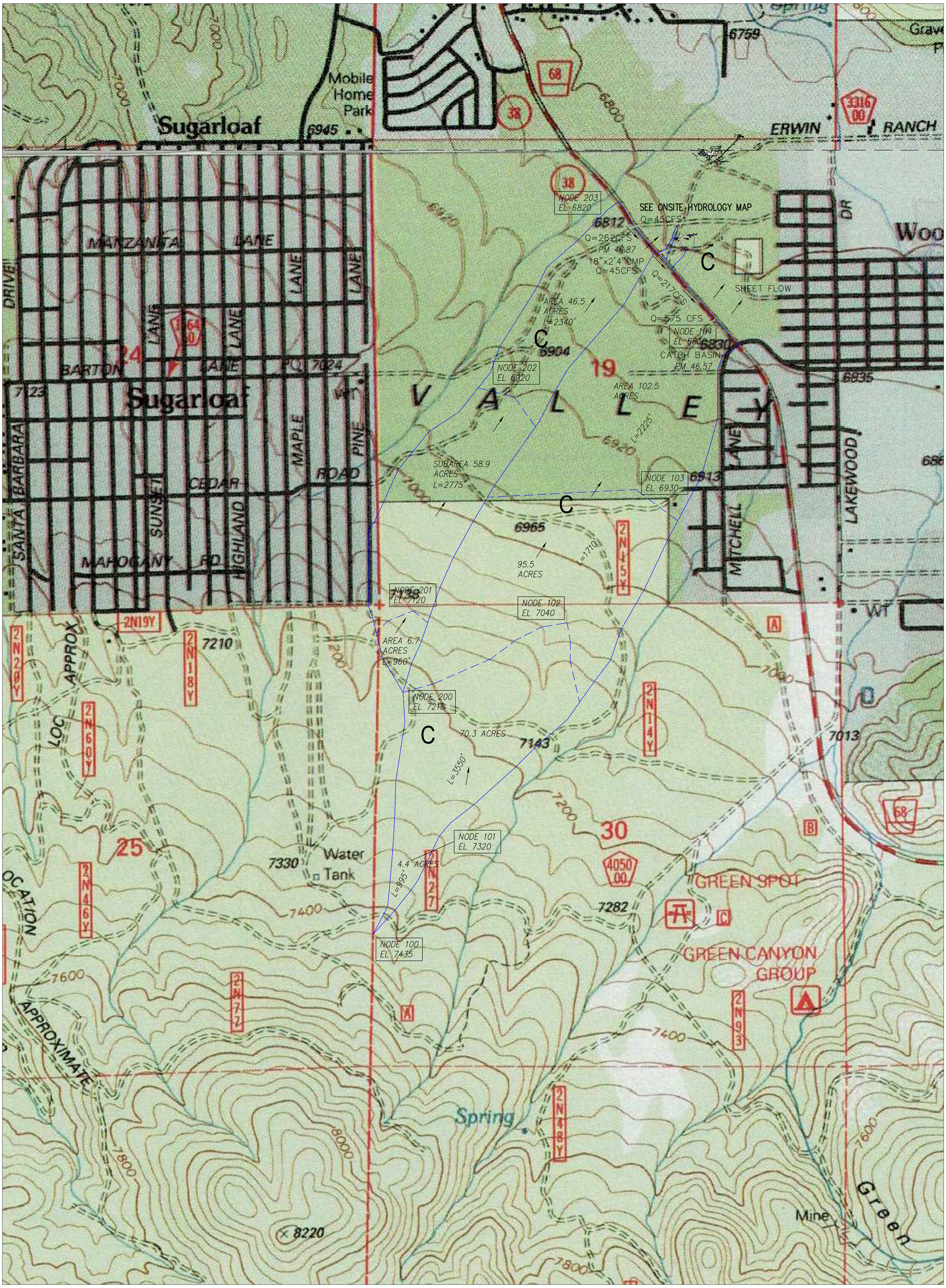
APPENDIX D
Maps and Exhibits



LEGEND:

SUB-AREA BOUNDARY

HYDROLOGIC SOIL GROUP

100 YEAR PEAK FLOW RATE FROM SUB-BAREA — 24.0 CFS

PIPE FLOW RATE — (13.6 CFS)

NODE NUMBER/ELEVATION — NODE 125 EL 7520

* SEE HYDROLOGY STUDY FOR ESTIMATED FLOW CALCULATIONS FOR CULVERTS UNDER THE STATE HIGHWAY

NORTH
SCALE: 1"= 500'

500' 0' 500' 1000' 1500'
GRAPHIC SCALE: 1" = 500'

REVISIONS		
DATE	NOTES	APP.

REGISTERED PROFESSIONAL ENGINEER
DAVID B. RAGLAND
REG. NO. 35985
EXP. 6/30/20
CIVIL
STATE OF CALIFORNIA

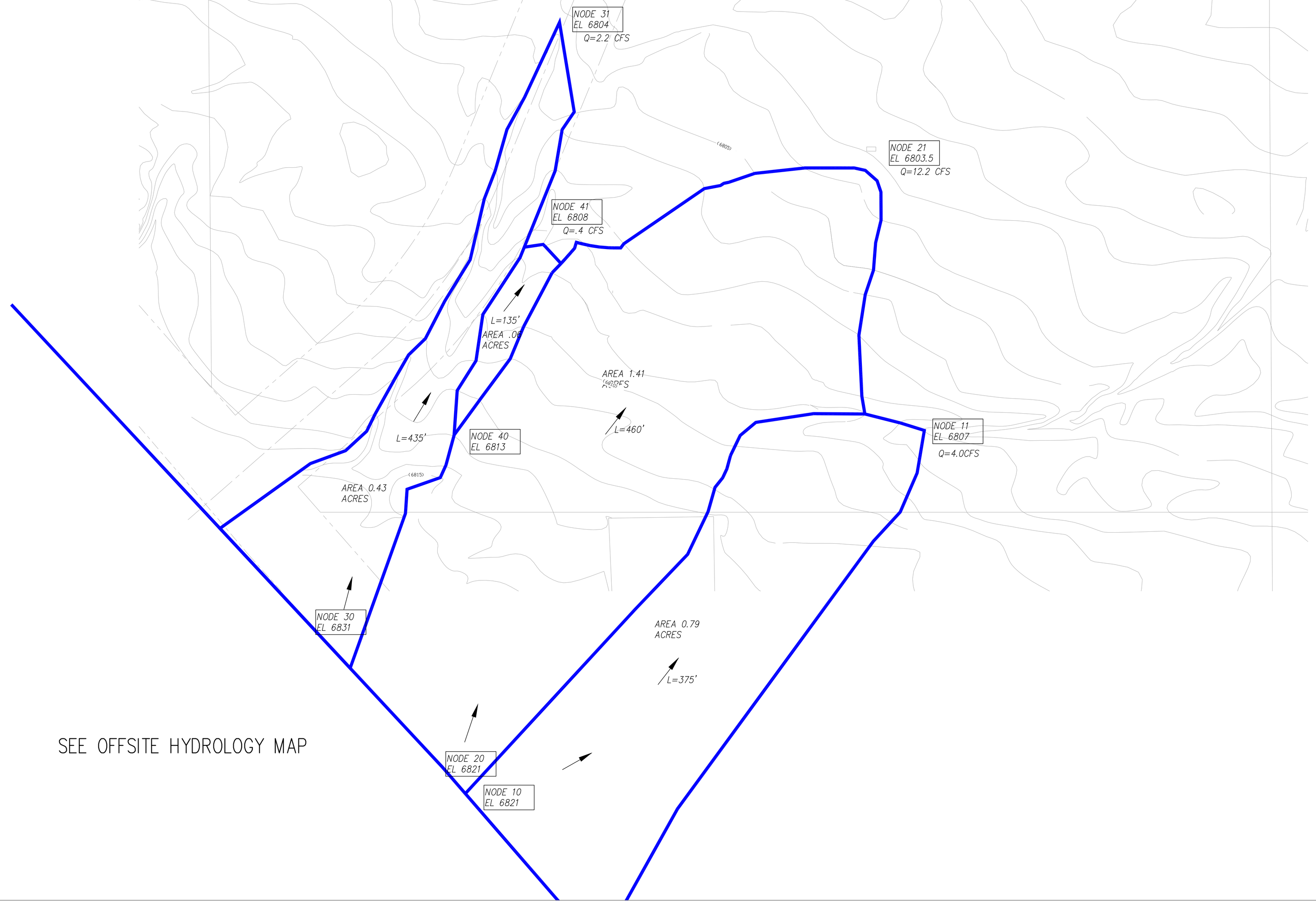
DAVID B. RAGLAND R.C.E. 35985 DATE

TRANSTECH
413 MACKAY DRIVE.
SAN BERNARDINO, CA. 92408
(909) 384-7464

COUNTY OF SAN BERNARDINO

McDONALDS LEARNING CENTER
HYDROLOGY MAP
OFFSITE

DRAWN BY:	DATE:	SCALE:	SHEET:	JOB NO.
G.D.A.	02/25/2019	AS SHOWN	1 OF 2	18155



SEE OFFSITE HYDROLOGY MAP

NORTH
SCALE: 1"= 30'

30 0 30 60 90
GRAPHIC SCALE: 1" = 30'

ASSESSOR'S PARCEL NUMBER:
0315-421-02

REVISIONS		
DATE	NOTES	APP.

REGISTERED PROFESSIONAL ENGINEER
DAVID B. RAGLAND
REG. NO. 35985
EXP. 6/30/20
CIVIL
STATE OF CALIFORNIA

DAVID B. RAGLAND R.C.E. 35985 DATE

TRANSTECH
413 MACKAY DRIVE.
SAN BERNARDINO, CA. 92408
(909) 384-7464

COUNTY OF SAN BERNARDINO

McDONALDS LEARNING CENTER
HYDROLOGY MAP ONSITE
Existing Conditions

DRAWN BY:	DATE:	SCALE:	SHEET:	JOB NO.
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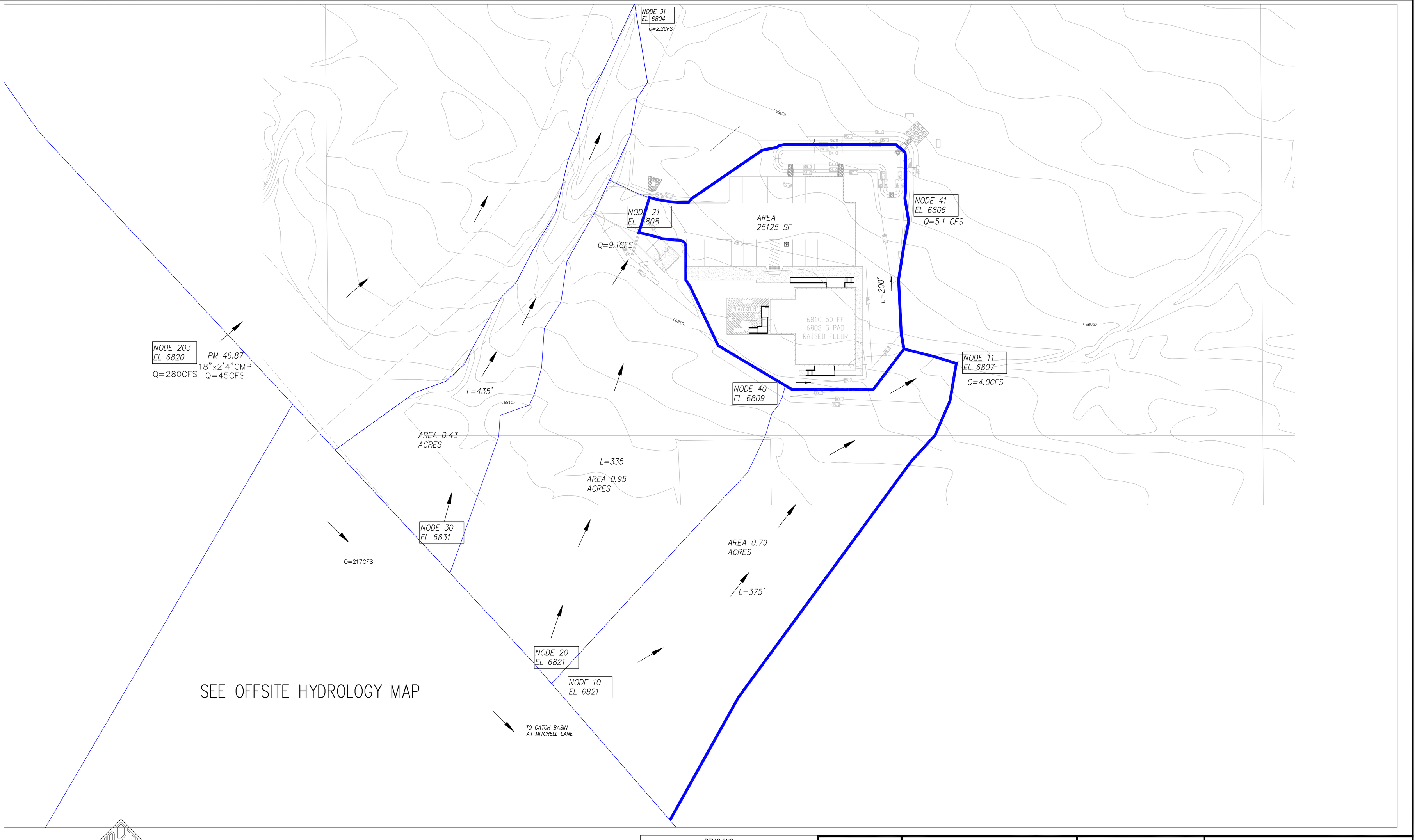

ASSESSOR'S PARCEL NUMBER:
0315-421-02

REVISIONS		
DATE	NOTES	APP.

REGISTERED PROFESSIONAL ENGINEER
DAVID B. RAGLAND
REG. NO. 35985
EXP. 6/30/20
CIVIL
STATE OF CALIFORNIA

DAVID B. RAGLAND R.C.E. 35985 DATE

TRANSTECH
413 MACKAY DRIVE.
SAN BERNARDINO, CA. 92408
(909) 384-7464

COUNTY OF SAN BERNARDINO

McDONALDS LEARNING CENTER
HYDROLOGY MAP ONSITE
Proposed Conditions

DRAWN BY:	DATE:	SCALE:	SHEET:	JOB NO.
G.D.A.	02/06/2019	1"= 30'	2 OF 2	15155