Appendix F:
Hydrology Supporting Information

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F.1 - Preliminary Drainage Study for SD Homes Redlands Apartments, City of Redlands, California

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Preliminary Drainage Study

for (1)

SD Homes Redlands Apartments

City of Redlands, California

Assessor's Parcel Numbers: 0292-167-08, 11, 12, 13, 18, 25, 0292-168-03, 16, 21 & 22
Project Number: To Be Determined

Prepared for:
SD Homes Enterprises
2358 University Avenue, Suite 33
San Diego, CA 92104

OFFICE COPY

9-17-18

Prepared by:
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COMMENTS

July 30, 2018
Revised:
Project No. 17634

TRANSTECH

REGISTERED PROFESSIONAL ENGINEER
DAVID B. RAGLAND
No. 33375
CIVIL
STATE OF CALIFORNIA

David B. Ragland 7-30-18
David B. Ragland, RCE

Table of Contents

1. INTRODUCTION

This report presents the design criteria, hydrologic conditions and hydrologic analysis for a proposed apartment project located along Orange Avenue between Alabama Street and Iowa Street in the City of Redlands.

The proposed project is the development of a 412 unit apartment project to be situated on approximately 18.9 acres. The project will consist of studio, one, two and three bedroom apartment units in two and four story buildings. Parking on the site will be in tuck under garages, covered carports, parking structure and open surface parking.

1.1 Site Description

The proposed project site consists of two development areas. Proposed project development area one would be the lands located on the north side of Orange Avenue, designated the north parcels. Development area two would be the lands on the south side of orange Avenue, designated as the south parcels.

The north parcels consist of a residential and commercial uses and vacant/undeveloped areas. The residential uses are generally located in the east along Alabama Street with a density of about two dwelling units per acre. Commercial development along the north side of Orange Avenue consists of a landscape and maintenance business. The remainder of the property north of Orange Avenue consists of a citrus orchard and non-native grass land. The northerly extents of the north parcels is delineated by a natural water course with a relatively narrow and deep channel with medium to very dense vegetation within and along the sides and bottom. The water course is known locally as ~~Morey Wash~~ or Morey Arroyo.

The south parcels are comprised of two dwelling units with the remainder of the property primarily being non-native grass land. The south parcels are bounded on the east by Alabama Street and a few single family residents and a parking lot. The west side of the south parcel is bounded by a single family residential subdivision. The remains of the Zanja Wash bound the parcels to the south.

2. HYDROLOGIC CONDITIONS

2.1 North Parcel

Natural drainage on the north parcel of the project site tends to flow in a southeasterly to northwesterly direction. Natural slope across the site is approximately two percent. There are not any natural drainage courses on the site as flows tend to be sheet flow until reaching the Morey Wash on the north and Iowa Street located adjacent to the site on the west. Storm water flows along Iowa Street continue north towards the Morey Wash. Very little offsite run-on affects the north parcel property. The north parcel is bounded on the east and south by Alabama Street and Orange Avenue respectively. Upon project buildout and completion of street improvements to Alabama Street and Orange Avenue, offsite run-on will be diverted.

There is an existing bridge on Iowa Street at the Morey Wash. Per the Morey Arroyo Regional Drainage Study, the 100-year storm event flow is approximately 3,000 cfs. The crossing under Iowa Street appears to have sufficient capacity to handle this flow. However, significant entrance losses to the bridge structure that render it under designed for the flow entering it.

There is a 48 inch storm drain pipe located in Iowa Street, directly adjacent to project site. This pipe system conveys storm water from the contributory drainage area located southeasterly towards Barton Road and Alabama Street. It is anticipated, runoff form the development of the north parcel will be directed to this existing storm drain pipe.

TYPO

2.2 South Parcel

The existing natural drainage on the south parcel is primarily sheet flow southeast to northwest. Storm water flows are intercepted by Orange Avenue and conveyed westerly along an open drainage channel initially to curb and gutter improvements and a storm drain inlet located at the southeast corner of Iowa Street and Orange Avenue. Storm water flows are conveyed northerly in the above mentioned 48 inch pipe underground storm drain system within Iowa Street to the Morey ~~Wash~~.

Approximately 12 acres of area to the south of the site will contribute offsite run-on to the south parcel. The offsite flows will be collected in an underground storm drain system and conveyed through the property.

3. PROJECT DESCRIPTION AND PROPOSED STORM DRAIN

The proposed project storm drain system will collect runoff from the building roofs, parking areas and other impervious surfaces in an on-site storm drainage system. Storm water runoff will be conveyed and directed to the northwesterly portion the north and south parcels. The low flow water quality flows will be diverted to the water quality infiltration basin by a low flow diversion structures and drainage swales. Storm water flows greater than the water quality flow rate will be discharged to the existing 48-inch storm drain pipe located in Iowa Street or the proposed new storm drain in Orange Avenue. Detention basins will be provided to restrict the post-development flow rates to less than 95 percent of the pre-developed project peak flow rates.

3.1 Water Quality

The proposed project is subject to the City's water quality and NPDES requirements. A separate Water quality Management Plan (WQMP) will be prepared for the project. The project will be required to capture and infiltrate the water quality design capture volume.

This project is comprised of two separate development areas. The water quality management design for the project will be sized for each of the two developments. The estimated design capture volume that must be infiltrated for each of the two development areas is:

North Parcel: 22,486 cubic feet
South Parcel: 21,099 cubic feet

4. FEMA FLOOD PLAIN

Portions of the proposed project lie within FEMA Flood Zone AO as depicted on the FEMA Flood Insurance Rate Map (FIRM) Panel Number 06071C8712H dated August 28, 2008. The majority of the are of the northerly parcels are within zone AO. The southerly portion of the project fall within FEMA Zone X. Zone AO is considered a Special Flood Hazard Area and is defined as areas with flood depths of 1 to 3 feet (usually sheet flow on sloping terrain) with the average depths determined and indicated on the FIRM panel. Zone X are other areas and are areas determined to be outside the 0.2% annual chance floodplain.

The City of Redlands has adopted Ordinance No. 2837 for the purpose of providing for the sound use and development of areas of special hazards including properties located in special flood hazard areas. Chapter 15.32.110 Construction Standards specifies the elevation and flood proofing requirements for residential construction in zone AO as follows:

> *Residential construction, new or substantial improvement, of any structure in zone AO shall have the lowest floor, including basement, elevated above the highest adjacent grade to a height exceeding the depth number specified in feet on the FIRM by at least two feet, or elevated at least four feet above the highest adjacent grade if no depth number is specified.*

The FIRM panel for this property specifies a depth of one foot. Therefore, the proposed project grading design will establish the finished floor elevations for all structures to be elevated at least three feet above the highest adjacent grade elevation for each structure.

5. SOILS

The north parcel and the northerly portion of the south parcel are comprised of the Hanford course sandy loam soils (HaC). The Hanford series consists of very deep, well drained soils that formed in moderately coarse textured alluvium dominantly from granite. Hanford soils are on stream bottoms, floodplains and alluvial fans and have slopes of 0 to 15 percent. The soils are well drained with negligible to low runoff and moderately rapid permeability. The hydrologic soil group for these soils is B.

The southerly portion of the south parcel are Ramona sandy loam soils(RmC). The Ramona series is a member of the fine-loamy, mixed, thermic family of Typic Haploxeralfs. Typically, Ramona soils have brown, slightly and medium acid, sandy loam and fine sandy loam A horizons, reddish brown and yellowish red, slightly acid, sandy clay loam B2t horizons, and strong brown, neutral, fine sandy loam C horizons. Well-drained with slow to rapid runoff; moderately slow permeability. The hydrologic soil group is B.

A water infiltration rate report was prepared for the project by Soils Southwest, Inc. in November 2017. The report recommends a soil infiltration rate for water quality BMP design of 2.74 inches per hour with a factor of safety of 2.0.

6. HYDROLOGY

The results of the onsite Rational Method hydrologic analysis are used herein to present the anticipated pre and post-development peak flow rate runoff conditions for the proposed project. (Table 4.1) The project drainage system will be designed to reduce the post-developed condition peak flow rate to less than 95 percent of the pre-developed peak flow rate. The required detention volume to reduce the peak flows are indicated in Table 4.1. The calculations for determining the detention capacity required are include in Appendix B.

Table 4.1 Existing and Developed Condition Peak Flow Rate (cfs) Summary

Development Area	100 Year (cfs)		95 Percent of Existing Peak Flow (CFS)	Flow Rate to be Detained (cfs)(1)	Detention Capacity Required (cf)
	Existing	Developed			
North Parcels	23.79	25.52	22.60	2.92	3,416
South Parcels	16.04	21.73	15.24	6.49	6,776

(1) 95 percent of the existing peak flow rate.

AES Hydrologic Results indicated in Table 4.1 and the Hydrology Map for the Crossings Development Project are included in the appendix. The 100 year storm event was used to determine the peak flow runoff from each subarea and the underground storm drain system sizing and analysis. Since development over the entire site is fairly consistent, peak runoff from each drainage subarea onsite was determined by proportion.

Pre-Development Flows

North Parcel = 23.79 CFS
South Parcel = 16.04 CFS

Post Development Flows North Parcel

Q = 22.6 CFS discharged at the northwest corner of the north parcel to the existing storm drain in Iowa Street.

Q = 2.92 CFS – 2.92 CFS detained from north parcel. (Detention Volume Required 3,416 cubic feet)

Post Development Flows South Parcel

Q= 15.24 discharged at northwest corner of the south parcel into proposed storm drain in Orange Avenue.

Q= 6.49 CFS – 6.49 CFS detained from the south parcel (Detention Volume Required 6,776 cubic feet)

7. HYDRAULIC CALCULATIONS

A detailed analysis will ultimately be prepared for the project as the improvement plans are developed which will include detailed onsite hydrology, pipe size determination, hydraulic grade line calculations and verification of water quality flow rates and volumes. The preliminary design for the proposed storm drain system will be based upon the hydraulic grade line at the Iowa Street Bridge. The existing 100-year storm event flow at Iowa Street is approximately 3,000 cubic feet per second per the Morey Arroyo Regional Drainage Study Table 4.1. The existing culvert crossing under Iowa Street has sufficient capacity to handle this flow with a normal depth of 5.25 feet. This represents a hydraulic grade line elevation of 1010.75 feet. This is consentient with the hydraulic grade line elevation of 1010.5 as shown on the City of Redlands Drawing No. 1695-SD, dated October 2004.

There are significant entrance losses at the existing culvert that render it under designed for the flow entering it. This results in the flooding conditions depicted on the FEMA Flood Insurance Rate Maps for the site area and the depth number shown thereon. As discussed above, the proposed buildings will be elevated above this flood depth as required by the City of Redlands Municipal Code.

8. CONCLUSION

The proposed project will increase peak runoff rates as indicated in Table 4.1. The 100-year post-developed peak flow rates on each parcel will be mitigated to 95 percent of the pre-development flow through the provision of a minimum of 3,416 cubic feet and 6,776 cubic feet of storage in detention basins on the north parcel and south parcel respectively.

The remaining portion of the site drainage on the north parcel flows towards a local storm drain system at the west end of the project in Iowa Street. The remaining portion of the site drainage of the south parcel and the offsite runoff being conveyed through parcel will be conveyed westerly in Orange Avenue in a new underground storm drain system to the existing underground storm drain system in Iowa Street.

The design capture water quality volume will be captured and infiltrated in underground infiltration facilities located in the project landscaped areas.

REFERENCES

Advanced Engineering Software, "Rational Method Analysis Model," version 18.0, 2009.

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

City of Redlands, "Drainage Master Plan," May 15, 2014.

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

County of San Bernardino, Department of Public Works "Detention Basin Design Criteria for San Bernardino County."

County of San Bernardino, Transportation Flood Control Water Resources Division, "Master Drainage Study," November, 2004.

County of San Bernardino, Land Use Services Department, "Conditions of Approval P201200086/P201300195 University Crossing," November 22, 2013.

Metcalf & Eddy, "Morey Arroyo Regional Drainage Study," prepared for Deane Properties, January 1986.

Thatcher Engineering & Associates, Inc. "Drainage Study Tentative Tract Map No. 17693 City of Redlands," August 2007.

Transtech Engineers, Inc. "Detention and Water Quality Infiltration Basin Analysis," June 2014.

Soils Southwest, Inc. "Updated Report of Soil Percolation Testing for WQMP-BMP Using Double Ring Infiltrameter Proposed University Crossing Detention Basin." April 2, 2014

APPENDIX A
Pre and Post Hydrology Calculations

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**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
       (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
     (c) Copyright 1983-2011 Advanced Engineering Software (aes)
          Ver. 18.0  Release Date: 07/01/2011  License ID 1542

                    Analysis prepared by:
```

EXISTING 100 YEAR

```
--------------------------------------------------------------------------
  FILE NAME: SDHOMES.DAT
  TIME/DATE OF STUDY: 13:44 06/01/2018
==========================================================================
  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)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.1100

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

****************************************************************************
  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) =   915.00
  ELEVATION DATA: UPSTREAM(FEET) =   1246.00  DOWNSTREAM(FEET) =   1226.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.411
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.509
  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.)
  RESIDENTIAL
  "1 DWELLING/ACRE"          B        2.35      0.42      0.800    76   15.41
  NATURAL GOOD COVER
  "GRASS"                    B        5.93      0.36      1.000    80   30.72
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.943
  SUBAREA RUNOFF(CFS) =     16.04
  TOTAL AREA(ACRES) =      8.28   PEAK FLOW RATE(CFS) =     16.04

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   751.00
  ELEVATION DATA: UPSTREAM(FEET) =   1232.00  DOWNSTREAM(FEET) =   1220.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.159
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.640
  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.)
  AGRICULTURAL GOOD COVER
  "ORCHARDS"                 B        2.04      0.40      1.000    77   30.22
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        2.35      0.42      0.700    76   14.16
  NATURAL POOR COVER
  "BARREN"                   B        1.20      0.11      1.000    97   16.97
  NATURAL GOOD COVER
  "GRASS"                    B        0.92      0.36      1.000    80   30.22
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.892
  SUBAREA RUNOFF(CFS) =     13.69
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 TOTAL AREA(ACRES) =      6.51   PEAK FLOW RATE(CFS) =     13.69

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     15.00 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.) =   14.16
 RAINFALL INTENSITY(INCH/HR) =   2.64
 AREA-AVERAGED Fm(INCH/HR) =  0.30
 AREA-AVERAGED Fp(INCH/HR) =  0.34
 AREA-AVERAGED Ap =  0.89
 EFFECTIVE STREAM AREA(ACRES) =       6.51
 TOTAL STREAM AREA(ACRES) =       6.51
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      13.69

****************************************************************************
 FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   695.00
 ELEVATION DATA: UPSTREAM(FEET) =   1225.00  DOWNSTREAM(FEET) =   1216.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.936
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.265
 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                 B        1.08      0.42      0.100    76    9.94
 NATURAL POOR COVER
 "BARREN"                   B        1.84      0.11      1.000    97   17.16
 RESIDENTIAL
 ".4 DWELLING/ACRE"         B        1.25      0.42      0.900    76   15.92
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.737
 SUBAREA RUNOFF(CFS) =     11.61
 TOTAL AREA(ACRES) =      4.17   PEAK FLOW RATE(CFS) =     11.61

****************************************************************************
 FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 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.) =    9.94
```

```
RAINFALL INTENSITY(INCH/HR) =   3.27
AREA-AVERAGED Fm(INCH/HR) =  0.17
AREA-AVERAGED Fp(INCH/HR) =  0.23
AREA-AVERAGED Ap =  0.74
EFFECTIVE STREAM AREA(ACRES) =       4.17
TOTAL STREAM AREA(ACRES) =       4.17
PEAK FLOW RATE(CFS) AT CONFLUENCE =      11.61

** CONFLUENCE DATA **
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
    1       13.69   14.16    2.640  0.34( 0.30) 0.89       6.5      12.00
    2       11.61    9.94    3.265  0.23( 0.17) 0.74       4.2      14.00

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       23.79    9.94    3.265  0.29( 0.24) 0.82       8.7      14.00
    2       22.96   14.16    2.640  0.30( 0.25) 0.83      10.7      12.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      23.79    Tc(MIN.) =     9.94
EFFECTIVE AREA(ACRES) =       8.74   AREA-AVERAGED Fm(INCH/HR) =  0.24
AREA-AVERAGED Fp(INCH/HR) =  0.29  AREA-AVERAGED Ap =  0.82
TOTAL AREA(ACRES) =       10.7
LONGEST FLOWPATH FROM NODE     12.00 TO NODE     15.00 =     751.00 FEET.
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DEVELOPED 100 YEAR

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****************************************************************************
  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) =   960.00
  ELEVATION DATA: UPSTREAM(FEET) =   1231.00  DOWNSTREAM(FEET) =   1222.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.002
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.778
  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.)
  APARTMENTS                B        6.50      0.42      0.200    76   13.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =     15.76
  TOTAL AREA(ACRES) =      6.50   PEAK FLOW RATE(CFS) =     15.76
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****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     23.00 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.) =   13.00
  RAINFALL INTENSITY(INCH/HR) =   2.78
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       6.50
  TOTAL STREAM AREA(ACRES) =       6.50
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      15.76

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     23.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   870.00
  ELEVATION DATA: UPSTREAM(FEET) =   1224.50  DOWNSTREAM(FEET) =   1219.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.372
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.732
  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.)
  APARTMENTS                  B        4.14      0.42      0.200    76   13.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      9.86
  TOTAL AREA(ACRES) =      4.14   PEAK FLOW RATE(CFS) =      9.86

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     23.00 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.) =   13.37
  RAINFALL INTENSITY(INCH/HR) =   2.73
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       4.14
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 TOTAL STREAM AREA(ACRES) =       4.14
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       9.86

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       15.76   13.00    2.778  0.42( 0.08) 0.20        6.5       20.00
     2        9.86   13.37    2.732  0.42( 0.08) 0.20        4.1       22.00

 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       25.52   13.00    2.778  0.42( 0.08) 0.20       10.5       20.00
     2       25.35   13.37    2.732  0.42( 0.08) 0.20       10.6       22.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      25.52    Tc(MIN.) =    13.00
 EFFECTIVE AREA(ACRES) =      10.53   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =       10.6
 LONGEST FLOWPATH FROM NODE     20.00 TO NODE     23.00 =     960.00 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) =  1110.00
 ELEVATION DATA: UPSTREAM(FEET) =   1248.50  DOWNSTREAM(FEET) =   1225.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.575
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.979
 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.)
 APARTMENTS                  B        8.34      0.42       0.200    76   11.58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =     21.73
 TOTAL AREA(ACRES) =      8.34   PEAK FLOW RATE(CFS) =     21.73
```

OFFSITE 100 YEAR

```
****************************************************************************
 FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   967.00
  ELEVATION DATA: UPSTREAM(FEET) =   1265.00  DOWNSTREAM(FEET) =   1232.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.342
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.388
  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                  B        2.21      0.42      0.100    76    9.34
  COMMERCIAL                  B        1.85      0.42      0.100    76    9.34
  NATURAL GOOD COVER
  "GRASS"                     B        0.46      0.36      1.000    80   28.73
  MOBILE HOME PARK            B        2.02      0.42      0.250    76   10.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.210
  SUBAREA RUNOFF(CFS) =     19.44
  TOTAL AREA(ACRES) =      6.54   PEAK FLOW RATE(CFS) =     19.44

********************************************************************************
  FLOW PROCESS FROM NODE     52.00 TO NODE     52.50 IS CODE =  21
--------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =   1258.00  DOWNSTREAM(FEET) =   1248.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.711
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.308
  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
  "GRASS"                     B        0.39      0.36      1.000    80   17.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.39   PEAK FLOW RATE(CFS) =      0.68

********************************************************************************
  FLOW PROCESS FROM NODE     52.50 TO NODE     53.00 IS CODE =  82
--------------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   230.00
  ELEVATION DATA: UPSTREAM(FEET) =   1248.00  DOWNSTREAM(FEET) =   1246.50
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   22.523
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.998
  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
  "GRASS"                     B        0.23      0.36      1.000    80   22.52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    0.23   INITIAL SUBAREA RUNOFF(CFS) =    0.34

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =   17.71
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.308
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.40
  EFFECTIVE AREA(ACRES) =      0.62   AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.36  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        0.6       PEAK FLOW RATE(CFS) =       1.08

****************************************************************************
  FLOW PROCESS FROM NODE     54.00 TO NODE     55.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   750.00
  ELEVATION DATA: UPSTREAM(FEET) =   1262.00  DOWNSTREAM(FEET) =   1239.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.359
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.734
  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.)
  RESIDENTIAL
  "1 DWELLING/ACRE"           B        0.80      0.42      0.800    76   13.36
  NATURAL GOOD COVER
  "GRASS"                     B        3.79      0.36      1.000    80   26.63
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.37
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.965
  SUBAREA RUNOFF(CFS) =      9.81
  TOTAL AREA(ACRES) =      4.59   PEAK FLOW RATE(CFS) =      9.81
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =        4.6  TC(MIN.) =     13.36
  EFFECTIVE AREA(ACRES) =      4.59  AREA-AVERAGED Fm(INCH/HR)=  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.965
  PEAK FLOW RATE(CFS)    =       9.81
============================================================================
```

APPENDIX B
Water Quality Volume

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Treatment Control BMP's
Volume Based Design Calculations

Infiltration Southerly Parcels (DMA 1)
8.275 Acres (360,444 s.f.)
Determine Composite Runoff Coefficient

$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$

Where: i = watershed imperviousness ratio, with i = .73

$C_{BMP} = 0.858(.73)^3 - 0.78(.73)^2 + 0.774(.73) + 0.04$
$C_{BMP} = .3338 - .4157 + .5650 + .04$
$C_{BMP} = .5231$

Determine area-averaged "6-hour Mean Storm Rainfall", P6 for the drainage area. The intensity from NOAA Atlas 14 map (2-yr 1-hr rainfall): .462 inches

P6 = I_{map} x regression coefficient (Table D-1).
P6 = .462(1.4807) = .684 in

Determine Drawdown time: a = 1.963 for 48 hours

Calculate "Maximized Detention Volume"

Po = (a) C_{BMP}(P6)
Po = (1.963)(.5231)(.684) = .702 in

Calculate "Target Capture Volume"

Vo = (Po • A)/12
Vo = (.702)(8.275)/12 = 0.484 ac-ft = 21,087 cf

Infiltration Northerly Parcels Site (DMA 2)
10.662 Acres (464,428 s.f.)

Determine Composite Runoff Coefficient

$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$

Where: i = watershed imperviousness ratio, with i = .63

$C_{BMP} = 0.858(.63)^3 - 0.78(.63)^2 + 0.774(.63) + 0.04$
$C_{BMP} = .2145 - .3096 + .4876 + .04$
$C_{BMP} = .4325$

Determine area-averaged "6-hour Mean Storm Rainfall", P6 for the drainage area. The intensity from NOAA Atlas 14 map (2-yr 1-hr rainfall): .462inches

P6 = I_{map} x regression coefficient (Table D-1).

P6 = .462(1.4807) = 0.684 in

Determine Drawdown time: a = 1.963 for 48 hours

Calculate "Maximized Detention Volume"

Po = (a) C_{BMP}(P6)
Po = (1.963)(.4325)(0.684) = .581 in

Calculate "Target Capture Volume"

Vo = (Po • A)/12
Vo = (.581)(10.662)/12 = .5162 ac-ft = 22,486 cf

APPENDIX C
Hydraulic Calculations

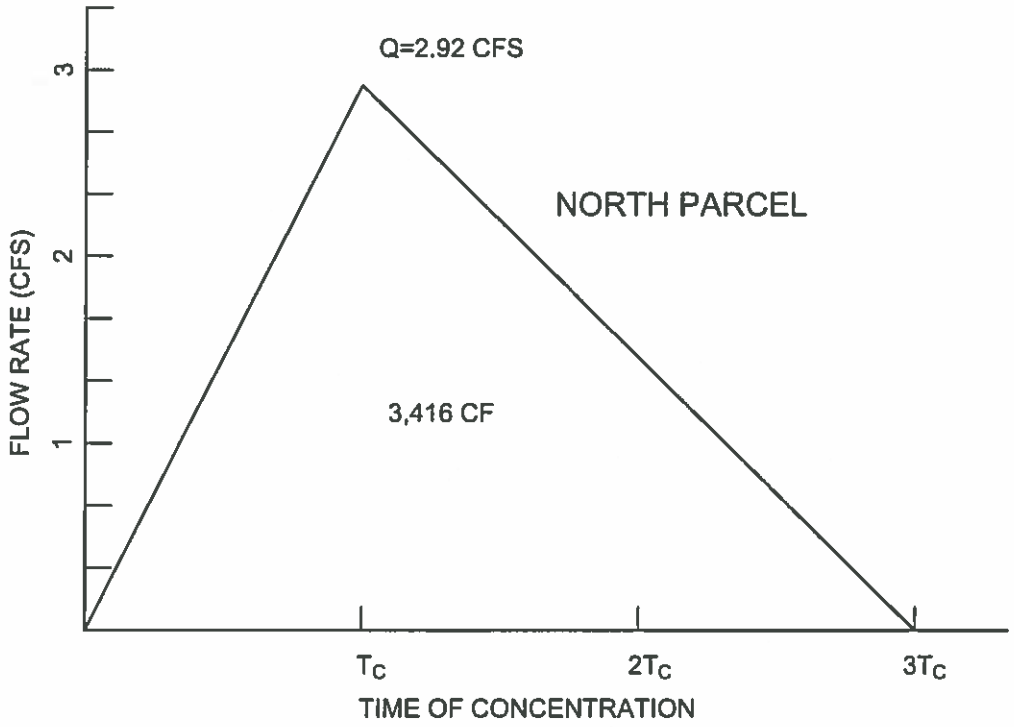
Determination of Detention Capacity Required

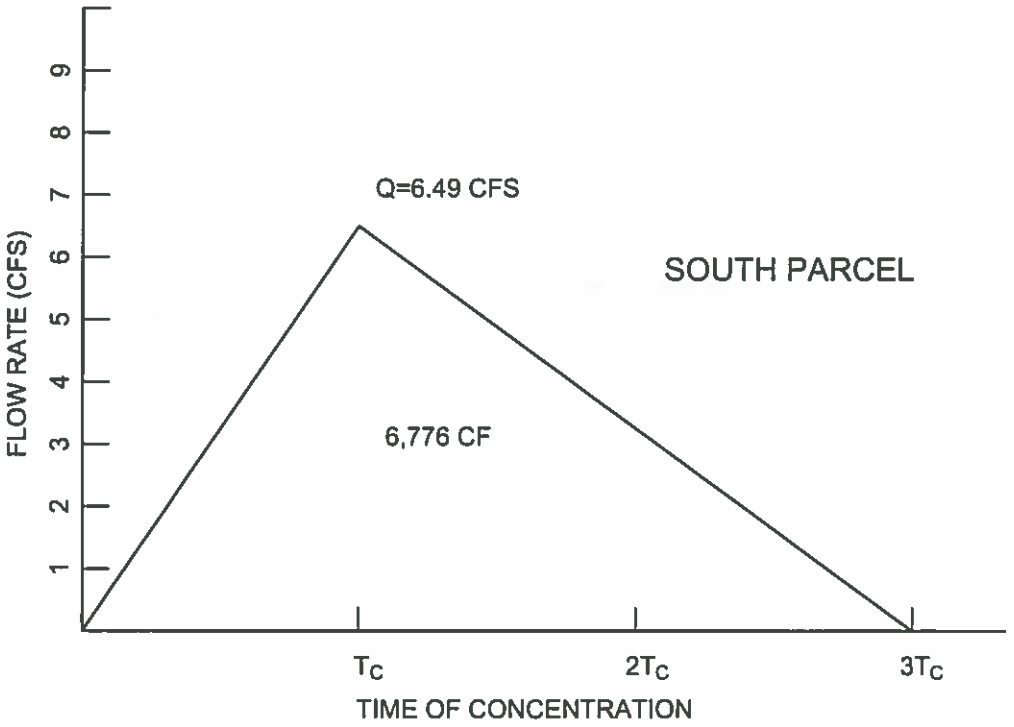
Detention of storm water flows will be provided prior to release offsite to the public storm drain system. The required detention capacity required for each developed area is calculated using the unit hydrograph procedure and based upon the Detention Basin Capacity Requirements as presented in the "Drainage Study for Tract 17693 City of Redlands," prepared by Thatcher Engineering, dated August 2007.

Required Storage Vol. = 3/2 Tc ($Q_{Incremental}$)

North Parcel: Required Storage Vol. = 3/2(13.0 min)(60sec/min)(2.92 cfs) = 3,416 cf

South Parcel: Required Storage Vol. = 3/2(11.6 min)(60sec/min)(6.49 cfs) = 6,776 cf





DETENTION VOLUME REQUIRED

TRANSTECH

Base Hydraulic Grade Line for Preliminary Design

Iowa Street Bridge 6.5' x 15' box "bridge" structure.
Q=3,016 cfs per Morey Arroyo Regional Drainage Study
Normal depth of flow = 5.25 feet
HGL for box is estimated to be 1010.75 feet. This is consistent with the HGL shown on the storm drain improvement plans for connection of the Iowa Street 48-inch storm drain to the existing box under Iowa Street. (City of Redlands Drawing No. 1694-SD)

```
**************************************************************************
 >>>>CHANNEL INPUT INFORMATION<<<<
 ------------------------------------------------------------------------
   CHANNEL Z1(HORIZONTAL/VERTICAL) =    0.00
        Z2(HORIZONTAL/VERTICAL) =    0.00
   BASEWIDTH(FEET) =    15.00
   CONSTANT CHANNEL SLOPE(FEET/FEET) = 0.025000
   UNIFORM FLOW(CFS) =     3016.00
   MANNINGS FRICTION FACTOR = 0.0130
==========================================================================
   NORMAL-DEPTH FLOW INFORMATION:
--------------------------------------------------------------------------
   >>>>> NORMAL DEPTH(FEET) =   5.25
   FLOW TOP-WIDTH(FEET) =       15.00
   FLOW AREA(SQUARE FEET) =        78.71
   HYDRAULIC DEPTH(FEET) =     5.25
   FLOW AVERAGE VELOCITY(FEET/SEC.) =    38.32
   UNIFORM FROUDE NUMBER =    2.948
   PRESSURE + MOMENTUM(POUNDS) =      236849.72
   AVERAGED VELOCITY HEAD(FEET) =     22.801
   SPECIFIC ENERGY(FEET) =     28.048
==========================================================================
   CRITICAL-DEPTH FLOW INFORMATION:
--------------------------------------------------------------------------
   CRITICAL FLOW TOP-WIDTH(FEET) =       15.00
   CRITICAL FLOW AREA(SQUARE FEET) =       161.81
   CRITICAL FLOW HYDRAULIC DEPTH(FEET) =    10.79
   CRITICAL FLOW AVERAGE VELOCITY(FEET/SEC.) =    18.64
   CRITICAL DEPTH(FEET) =    10.79
   CRITICAL FLOW PRESSURE + MOMENTUM(POUNDS) =      163399.22
   AVERAGED CRITICAL FLOW VELOCITY HEAD(FEET) =     5.395
   CRITICAL FLOW SPECIFIC ENERGY(FEET) =     16.182
==========================================================================
```

Water Quality Volume Calculations

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Treatment Control BMP's
Volume Based Design Calculations

Infiltration Southerly Parcels (DMA 2)
8.28 Acres (360,676 s.f.)
Determine Composite Runoff Coefficient

$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$

Where: i = watershed imperviousness ratio, with i = .73

$C_{BMP} = 0.858(.73)^3 - 0.78(.73)^2 + 0.774(.73) + 0.04$
$C_{BMP} = .3338 - .4157 + .5650 + .04$
$C_{BMP} = .5231$

Determine area-averaged "6-hour Mean Storm Rainfall", P6 for the drainage area. The intensity from NOAA Atlas 14 map (2-yr 1-hr rainfall): .462 inches

P6 = I_{map} x regression coefficient (Table D-1).
P6 = .462(1.4807) = .684 in

Determine Drawdown time: a = 1.963 for 48 hours

Calculate "Maximized Detention Volume"

Po = (a) C_{BMP}(P6)
Po = (1.963)(.5231)(.684) = .702 in

Calculate "Design Capture Volume"

Vo = (Po • A)/12
Vo = (.702)(8.28)/12 = 0.484 ac-ft = 21,099 cf

Infiltration Northerly Parcels Site (DMA 1)
10.662 Acres (464,428 s.f.)

Determine Composite Runoff Coefficient

$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$

Where: i = watershed imperviousness ratio, with i = .63

$C_{BMP} = 0.858(.63)^3 - 0.78(.63)^2 + 0.774(.63) + 0.04$
$C_{BMP} = .2145 - .3096 + .4876 + .04$
$C_{BMP} = .4325$

Determine area-averaged "6-hour Mean Storm Rainfall", P6 for the drainage area. The intensity from NOAA Atlas 14 map (2-yr 1-hr rainfall): .462inches

P6 = I_{map} x regression coefficient (Table D-1).
P6 = .462(1.4807) = 0.684 in

Determine Drawdown time: a = 1.963 for 48 hours

Calculate "Maximized Detention Volume"

Po = (a) C_{BMP}(P6)
Po = (1.963)(.4325)(0.684) = .581 in

Calculate "Design Capture Volume"

Vo = (Po • A)/12
Vo = (.581)(10.662)/12 = .5162 ac-ft = 22,486 cf

F.2 - Water Quality Management Plan for Redlands Apartments

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Water Quality Management Plan

For:

Redlands Apartments

APN NO.0292-167-08,11,12,13,18,25, 0292-168-03,16,21,22, PROJECT NO.

Prepared for:

SD Homes Enterprises

2358 University Avenue, Suite 33

San Diego, CA 992104

(619) 291-2229

Prepared by:

Transtech Engineers, Inc.

413 Mackay Drive

San Bernardino, CA 92408

(909)384-7464

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for The Redlands Apartments by Transtech Engineers, Inc.. The WQMP is intended to comply with the requirements of the City of Redlands and the County of San Bernardino and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

.

Project Data			
Permit/Application Number(s):	To be determined	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	Not Applicable	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN NO.s 0292-167-08,11,12,13,18,25, 0292-168-03,16,21,22

Owner's Signature			
Owner Name: SD Homes Enterprises			
Title			
Company			
Address	2358 University Avenue, Suite 33, San Diego, CA 92104		
Email	tim@theluxview.com		
Telephone #	(619)291-2229		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	To be determined	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	Not Applicable	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN NO.0292-167-08,11,12,13,18,25, 0292-168-03,16,21,22

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: David Ragland		PE Stamp Below
Title	Project Engineer	
Company	Transtech Engineers, Inc.	
Address	413 Mackay Drive, San Bernardino, CA 92408	
Email	david.ragland@transtech.org	
Telephone #	(909)384-7464	
Signature		
Date		

Table of Contents

Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Redlands Apartments				
Project Owner Contact Name:	Tim Barzal				
Mailing Address:	2358 University Avenue, Suite 33 San Diego, CA 92104	E-mail Address:	jimmatim@theluzview.com	Telephone:	(619)291-2229
Permit/Application Number(s):		Tract/Parcel Map Number(s):			
Additional Information/ Comments:					
Description of Project:	The project is a Residential Development project for 412 multi-family apartment units, associated parking, garages and amentites of openspace and pool recreataion areas on approximately 18.98 acres. The project consists of two development areas. Project area 1 is located on the northh side of Orange Avenue and project area 2 is located on the south side of Orange Avenue.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	This report is the "Preliminary" Water Quality Management Plan for the project. Final condistions of approval have not been establsihed, but the project will as a minimum comply with the standard water quality management conditions generally required by the City of Redlands. This includes the proposed infiltration and percolation into the underlying soils of the water quality design capture volume.				

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):

☐ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☒ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day

☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.*

2 Project Area (ft2):	826,769	3 Number of Dwelling Units:	412	4 SIC Code:	6513

5 Is Project going to be phased? Yes ☒ No ☐ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

The property is currently owned by SD Homes Enterprises. The owner is also the developer of the project. The owner will be resposible for the funding and inplemetation of all required BMPs. Upon completion of construction, the owner will commence with the rental program for the units. The owner will contine to own and manage the apartment project. To assure long term maintenance of the water quality facilities, a Covenant and Agreement Regarding Water Quality Management Plan and Stormwater Best Management Practices Transfer, Access and Maintenance will be recorded. This document will be recorded and run with the property and will be subject to any future owners of the property.

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	The proliferation of bacteria and viruses is generally caused by the transport of animal or fecal waste within stormwater runoff from a project site.
Nutrients - Phosphorous	E ☒	N ☐	Primary source of nutrients and phosphorous are typically caused by excessive and careless use of fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Primary source of nutrients and nitrogen are typically caused by excessive and careless use of fertilizers and eroded soils.
Noxious Aquatic Plants	E ☐	N ☒	
Sediment	E ☒	N ☐	Sediments are generally caused by eroded soils, transport of sediment not properly contained and poorly maintained landscape and pavements.
Metals	E ☐	N ☒	Brake pads
Oil and Grease	E ☒	N ☐	Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E ☒	N ☐	Trash and other debris including paper, plastic, foam, aluminum, leaves, cut grass and food wastes, should be controlled with regular maintanence, inspection and cleanup.
Pesticides / Herbicides	E ☒	N ☐	Pesticides and hebicides are commonly used for landscaping and pest control around multi family projects. Care should be taken to minimize their use as much as possible and apply according to the manufacture's specifications.
Organic Compounds	E ☒	N ☐	Sources of organic compounds include waste handling areas and vehicle and landscape maintanence areas. Care should be taken to ensure that when cleaning and rinsing dirt, grease and grime from vehicles and equipment, cleaning fluids and rinse water is not discharged into storm drains.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Other:	E ☐	N ☐	

2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits

[1] Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
[2] Total Credit % *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)			

Section 3 Site and Watershed Description

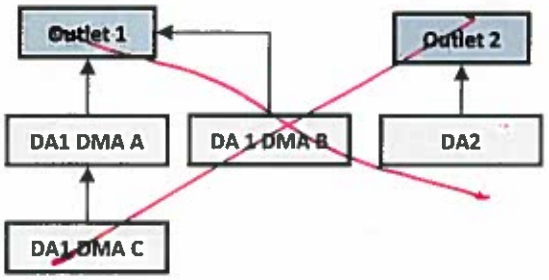
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34°03'07.3"	Longitude 117°12'38.9"	Thomas Bros Map page 647

[1] San Bernardino County climatic region: ☒ Valley ☐ Mountain

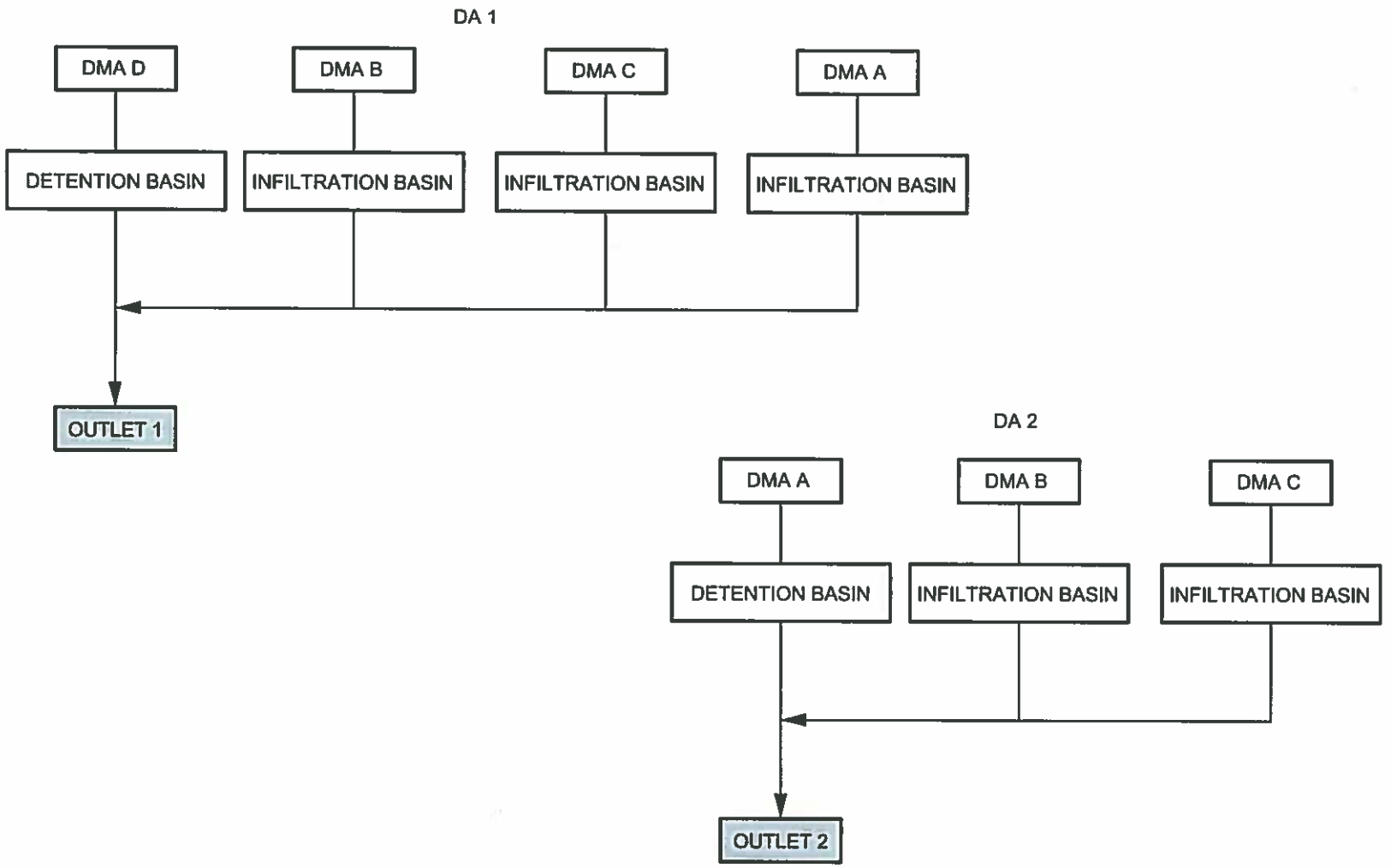
[2] Does the site have more than one drainage area (DA): Yes☒ No☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Example only – modify for project specific WQMP using additional form

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Outlet 1	Drainage from the site flows from the southeast portion of the property towards the northwest portion of the property where the water quality design flows are diverted to the infitration basin and the larger storm water flows are conveyed to the existing storm drain system located in Iowa Street.
DA1 DMA B to Outlet 1	
DA2 to Outlet 2	Drainage flows from southeast to northwest. Runoff will be diverted to three or four infitration basins prior to discharge into a new storm drain system to be constructed in Orange Avenue. These flows will continue westerly along Orange Avenue to the existing storm drain system in Iowa Street.

SD HOMES - REDLANDS APARTMENTS



DRAINAGE AREA FLOW ROUTING

TRANSTECH

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	466,092			
2 Existing site impervious area (ft^2)	188,437	0	0	
3 Antecedent moisture condition *For desert areas, use* http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf	2			
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* http://sbcounty.permitrack.com/WAP	B			
5 Longest flowpath length (ft)	1270			
6 Longest flowpath slope (ft/ft)	.01			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Grass, Orchard & Commercial Business			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Fair			

Form 3-2 Existing Hydrologic Characteristics (DA 2)

For Drainage Area 2's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	360,677			
2 Existing site impervious area (ft^2)	75,135			
3 Antecedent moisture condition *For desert areas, use* http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf	2			
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* http://sbcounty.permitrack.com/WAP	B			
5 Longest flowpath length (ft)	883			
6 Longest flowpath slope (ft/ft)	.02			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Grass and single Family Homes			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Fair			

Form 3-2 Existing Hydrologic Characteristics (DA) (use only as needed for additional DMA w/in DA)				
For Drainage Area 's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition *For desert areas, use* http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf				
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* http://sbcounty.permitrock.com/WAP				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*				
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*				

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition *For desert areas, use* http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf				
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* http://sbcounty.permitrock.com/WAP				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*				
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*				

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool -* *http://sbcounty.permitrack.com/WAP* *See 'Drainage Facilities" link at this website*	Morrey Arroyo to Mission Channel Santa Ana River Reach 2, 3 and 4
Applicable TMDLs *Refer to Local Implementation Plan*	Santa Ana River Reach 3 - Bacterial Indicator, Fecal Coliform, E.coli
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	Santa Ana River Reach 2 - E. Coli and Enterococcus Santa Ana River Reach 3 - E Coli and Enterococcus, Metals Screen - Copper, Metals Screen - Lead Santa Ana River Reach 4 - E. Coli abd Enterococcus
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	N/A
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	Portions of the Santa Ana River downstream of the project are unlined
Hydrologic Conditions of Concern	☐ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☒ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Property owners shall receive a packet listing those activities that are allowed and those that are not. These are normally provided as part of escrow, since the maintenance covenant for the BMPs will appear on title. See sample in Attachment H.
N2	Activity Restrictions	☒	☐	Property owners shall receive a packet listing those activities that are allowed and those that are not. New tenants will be provided with descriptions of property restrictions upon execution of leases.
N3	Landscape Management BMPs	☒	☐	Onsite landscaping will be maintained by the property owner.
N4	BMP Maintenance	☒	☐	BMP maintenance will be provided by the property owners of the two properties that utilize the infiltration basins on the respective sites. The BMP maintenance responsibilities are outlined in the owners covenant.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	The project is not expected to produce hazardous waste.
N6	Local Water Quality Ordinances	☒	☐	The project will comply with local water quality ordinances. Volume based BMPs will be implemented along with non-structural BMPs, education of tenants and activity restrictions.
N7	Spill Contingency Plan	☐	☒	This is an apartment project and spills of hazardous matertials are not anticipated with the project.
N8	Underground Storage Tank Compliance	☐	☒	There will not be any underground storage tanks associated with the project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	The project is not anticipated to generate or produce hazardous materials.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	The project is subject to the Uniform Fire Code and will be designed in accordance with the Code.
N11	Litter/Debris Control Program	☒	☐	The owner of the project will implement a trash management progam that will be enforced by the managers of the apartment project.
N12	Employee Training	☒	☐	As part of the tenant education program, employee training will also be provided.
N13	Housekeeping of Loading Docks	☐	☒	The project does not include loading docks.
N14	Catch Basin Inspection Program	☒	☐	All onsite catch basins will be inspected periodically as part of the BMP Maintenance Plan.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Onsite private streets and parking areas will be vacuumed and or swept as part of the BMP Maintenance Plan.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	This is not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	The project will comply with all applicable NPDES permits.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	All catch basins constructed as part of the project will include storm drain stenciling at the catch basin.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	There are not any outdoor material storage areas proposed for the project.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Most trash enclosure areas are interior enclosures. The trash enclosers located outside will be constructed per County Standards and all will be covered.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Landscaping and irrigation will be designed by a licensed landscape architeict and will incorporate the State and Local requirements for landscaping.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	A note to this effrect will be included on the grading and landscape plans.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Open channels and outlets will be for minimal flow velocities and energy dissipation and scour protection will be provided.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	The project does not include dock areas.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	The project does not included maintence facilities or bays.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☒	☐	The washing of tenant vehicles will be restricted to specific areas. Only personal vehicles may be washed and spills of hazardous materials are not anticipated.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	The project does not include outdoor processing areas.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	The project does not include equipment wash areas.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	The fueling of vehicles is not permited. Note: During construction, equipment may be fueled, maintained and washed on-site. These areas will be specified and specific requirements and contingency plans will be included in the project SWPPP.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	This is not a hillside development project.
S14	Wash water control for food preparation areas	☒	☐	The project does not include retail or food establishments. Food preparation areas for residents and guests for community or private gatherings will be restricted to the community recreation facilities.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	The project does not propose a community car wash rack.

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist

Site Design Practices

If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets

Minimize impervious areas: Yes ☒ No ☐

Explanation: This project uses multi-story aparments to increase the building density and maximize the permeable area. Landscape buffeer areas to the major streets and other landscaped open space areas are incorporated into the project.

Maximize natural infiltration capacity: Yes ☐ No ☐

Explanation: The propsed design has achieved a landscaped area of approximately 32 percent of the site area.

Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒

Explanation: The project is located in an area that has been used for agriculture and has been disked and graded for a number of years. Portions of the site are currently utilized for a commercial landscaping business and single family residential.

Disconnect impervious areas: Yes ☒ No ☐

Explanation: Roof drains and flows from other impervious surfaces such as sidewalks and parking areas will be discharged to landscaped areas prior to collection by the storm drain system. Two detention basins to retard peak flows are provided.

Protect existing vegetation and sensitive areas: Yes ☒ No ☒

Explanation: The site has been used for agriculture and commercial for a number of years. There is no natural existing vegetation on the site. No distrubance to the channel north of the site is proposed.

Re-vegetate disturbed areas: Yes ☒ No ☐

Explanation: All areas not covered by buildings, sidewalks, parking and other impervious surfaces will be landscaped.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐

Explanation: Speical care will be taken during construction of the infiltration basin so that the bottom of the basins will not be compacted.

Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒

Explanation: Vegetated drainage swales are used to convey flows to the water quality facilities. Where possible, roof drains and runoff from impervious surfaces will be directed to landscaped areas.

Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒

Explanation: It will not be practical to stake off the landscaped areas. However, prior to landscape installaiion, landscaped areas will be scarified and soil amendments provided to assist in plan establishement and growth and minimize compaction.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project area DA 1 (ft^2): 464,428	2 Imperviousness after applying preventative site design practices (Imp%): 63	3 Runoff Coefficient (Rc): _.4325 *$R_c = 0.858(Imp\%)^{3} - 0.78(Imp\%)^{2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): .462 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): .684 *P_6 = Item 4 * C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 22,486 *DCV = 1/12 * (Item 1* Item 3 *Item 5 * C_2), where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2)

1 Project area DA 2 (ft^2): 360,676	2 Imperviousness after applying preventative site design practices (Imp%): 73	3 Runoff Coefficient (Rc): _.5231 *$R_c = 0.858(Imp\%)^{3}-0.78(Imp\%)^{2}+0.774(Imp\%)+0.04$*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): .462 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): .684

*P_6 = Item 4 * C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*

6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*	24-hrs ☐ 48-hrs ☒

7 Compute design capture volume, DCV (ft^3): 21,099

*DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)*
Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2

Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☒ No ☒

Go to: http://sbcounty.permitrack.com/WAP

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below

(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 *Form 4.2-3 Item 12*	2 *Form 4.2-4 Item 13*	3 *Form 4.2-5 Item 10*
Post-developed	4 *Form 4.2-3 Item 13*	5 *Form 4.2-4 Item 14*	6 *Form 4.2-5 Item 14*
Difference	7 *Item 4 – Item 1*	8 *Item 2 – Item 5*	9 *Item 6 – Item 3*
Difference (as % of pre-developed)	10 % *Item 7 / Item 1*	11 % *Item 8 / Item 2*	12 % *Item 9 / Item 3*

Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 2 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet HCOC Requirement, (ft^3):
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o = *Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} = *(1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t = *Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c = *Item 5 + Item 11*								

13 Pre-developed time of concentration (min):	*Minimum of Item 12 pre-developed DMA*
14 Post-developed time of concentration (min):	*Minimum of Item 12 post-developed DMA*
15 Additional time of concentration needed to meet HCOC requirement (min):	$T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14*

Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	9 Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	10 Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs):		*Maximum of Item 8, 9, and 10 (including additional forms as needed)*
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs):		*Maximum of Item 11, 12, and 13 (including additional forms as needed)*
15 Peak runoff reduction needed to meet HCOC Requirement (cfs):		*$Q_{p\text{-}HCOC}$ = (Item 14 * 0.95) – Item 10*

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment.**

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

1 Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒

Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

2 Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒

(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

3 Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

4 Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒

If Yes, Provide basis: (attach)

5 Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒

If Yes, Provide basis: (attach)

6 Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒

See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

7 Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒

If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.

8 Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒

If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP.
If no, then proceed to Item 9, below.

9 All answers to Item 1 through Item 6 are "No":

Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.
Proceed to Form 4.3-2, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA 1 DMA BMP Type Infiltration	DA 2 DMA BMP Type Infiltration	DA 3 DMA BMP Type Infiltration *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3):	$V_{retention}$ *=Sum of Item 4 for all BMPs*		
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA 1 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ = *(Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3):	$V_{retention}$ *=Sum of Item 12 for all BMPs*		

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) $V_{retention}$ = *Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3): $V_{retention}$ =*Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) $V_{retention}$ = *Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3): $V_{retention}$ = *Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) $V_{retention}$ = *Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): $V_{retention}$ =*Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 *Sum of Items 5, 13, 20, 25 and 29*			

4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 22,486 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A BMP Type Infiltration Basin	DA DMA B BMP Type Infiltration Basin	DA 1 DMA c BMP Type Infiltration Basin *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	2.74	2.74	2.74
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2	2	2
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.37	1.37	1.37
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	48
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	5.5	5.5	5.5
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2	2	2
8 Infiltrating surface area, *SA_{BMP}* (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	2099	1049	1764
9 Amended soil depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0	0	6
10 Amended soil porosity	~~N/A~~ 0	0	0
11 Gravel depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	~~N/A~~ 0	0	0
12 Gravel porosity	~~N/A~~ 0	0	0
13 Duration of storm as basin is filling (hrs) *Typical ~3hrs*	3	3	3
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	4198	2100	3528
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0	0	0
16 Total Retention Volume from LID Infiltration BMPs: 23,170 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA D BMP Type Infiltration	DA 1 DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	2.74		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.37		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	5.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2		
8 Infiltrating surface area, *SA_{BMP}* (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	6672		
9 Amended soil depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	13344		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			
16 Total Retention Volume from LID Infiltration BMPs: *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: % *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☐ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 2)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 21,099 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 2 DMA A BMP Type	DA 2 DMA B BMP Type	DA 2 DMA C BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	2.74	2.74	2.74
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2	2	2
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.37	1.37	1.37
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	48
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	5.5	5.5	5.5
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.0	2.0	2.0
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	4496	2712	2763
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0	0	1.5
10 Amended soil porosity	0	0	.33
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0	0	3
12 Gravel porosity	0	0	.4
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3	3	3
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	8993	5742	10209
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			
16 Total Retention Volume from LID Infiltration BMPs: 24,944 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

applicable category of development and repeat all above calculations.

4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

Form 4.3-4 Harvest and Use BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): ○ *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*			
BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			
9 Total Retention Volume (ft^3) from Harvest and Use BMP ○ *Sum of Item 8 for all harvest and use BMP included in plan*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest and use BMPs? Yes ☐ No ☐ *If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): 0 *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*			
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) P_{design} = *Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) d_{BMP} = *Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) $V_{biotreated}$ = *Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*			

Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} = *(Item 8$_{forebay}$ + Item 8$_{basin}$) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item 8$_{forebay}$ + Item 8$_{basin}$) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*			
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w = *(Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} = *(Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 22,486 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 23,170 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3–5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 2)

1 Total LID DCV for the Project DA 2 (ft^3): 21,099 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 24,944 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3–5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for HCOC performance criteria (ft^3): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐
  BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Education of Property Owners	Property Owner	Property owners/tenants shall receive an educational packet with information on "good housekeeping", BMP maintenance and listing those activities that are allowed and those that are not. See sample packet in Attachment H	Upon Rental of property and once per year thereafter
Activity Restrictions	Property Owner	Property owners/tenants shall receive a packet listing those activities that are allowed and those that are not. See list in Attachment H	Upon rental of property and onec pe year thereafter
Street Sweeping Private Streets and Parking Lots	Property Owner	All paved areas within the site shall be swept at once each quarter or as needed by a qualified firm specializing in this task. The owner shall be responsible for this task.	Upon issuance of Certificate of Occupancy (CO) and then at least twice annually, prior to the storm season* in the late summer or early fall and as needed.
Common Areas Catch Basin Inspection	Property Owner	Catch basin shall be inspected at the beginning of the rainy season and after each storm thereafter. Catch basins will inspected visually for sediment build up or trash and cleaned of trash when seen and cleaned for sediment when sediment levels reach 2" or more. See Attachment I for storm drain and	Upon issuance of CO, at least twice annually and at the beginning of the rainy season* and each storm there after

first

		catch basin locations. Remove grates and inspect and clean skimmer trays and remove and replace hydrocarbon booms.	
Landscape Planning (SD-10)	Property Owner	The owner shall replace all dead vegetation with living and maintain or improve on the ground cover	Monthly after planting with replacement as needed
Roof Runoff Controls (SD-11)	Property Owner	The owner will ensure that roof drains are unobstructed and free of any debris.	Upon issuance of first CO and at the beginning of the rainy season* and each storm there after
Efficient Irrigation (SD-13)	Property Owner	The owner will replace or repair any damaged or broken components of the irrigation system.	Upon issuance of first CO and monthly thereafter
Employee Training and Education Program	Property Owner	Employees shall be trained in the proper care of the drainage facilities and their maintenance by a qualified and certified instructor in water quality management. Training shall occur within 6 months of employment and annually thereafter. Employees shall be provided with a copy of all applicable BMP details for their use	Within 6 months of hiring and yearly thereafter

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

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