TENTATIVE TRACT MAP 20267

Unincorporated San Bernardino County, CA

DRAINAGE STUDY

February 22, 2019

Reference 103-242

PREPARED BY:

Encompass Associates, Inc.

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CONTENTS

DISCUSSION

The purpose of this drainage study is to determine the drainage facility requirements for Tentative Tract Map 20267 in Unincorporated San Bernardino County. Specifically, the subject project is located south of Mission Boulevard, west of existing mobile home park and vacant land, north of single-family residences, and east of single-family residences and a car wash, in the City of Unincorporated San Bernardino County, County of San Bernardino, California.

The subject site will consist of 2 single-family and 40 condominium residences, with an approximate area of 4.7 acres. Proposed drainage is overland and by sheet flow generally in a southwesterly direction.. The site is not subject to off-site runoff.

The 100-year storm event was modeled in the rational method hydrology calculations in this study.

The rational method hydrologic model, as defined by Flood Control for San Bernardino County, was followed in the determination of storm runoff. AES software was utilized for hydrology calculations and some street flow depth analysis.

RATIONAL METHOD

HYDROLOGY

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2012 Advanced Engineering Software (aes)
            Ver. 19.0  Release Date: 06/01/2012  License ID 1584

                          Analysis prepared by:

                        ENCOMPASS ASSOCIATES, INC.
                            5699 COUSINS PLACE
                        RANCHO CUCAMONGA CA 91737
                   909-684-0093 askeers@encompasscivil.com

 ************************* DESCRIPTION OF STUDY *************************
* TTM 20267                                                             *
* HYDROLOGY CALCULATIONS                                                *
* 100-YEAR                                                              *
 ************************************************************************

  FILE NAME: 20267D00.DAT
  TIME/DATE OF STUDY: 11:03 02/22/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  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) = 1.5100

  *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   18.0      9.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
```

```
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   656.00
  ELEVATION DATA: UPSTREAM(FEET) =    942.00  DOWNSTREAM(FEET) =    935.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.416
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.886
  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
  "8-10 DWELLINGS/ACRE"      A        3.78      0.74     0.400    52   12.42
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.400
  SUBAREA RUNOFF(CFS) =     12.21
  TOTAL AREA(ACRES) =      3.78   PEAK FLOW RATE(CFS) =     12.21

********************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  62
--------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =  935.00  DOWNSTREAM ELEVATION(FEET) =  930.00
  STREET LENGTH(FEET) =   220.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   9.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.55
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.42
    HALFSTREET FLOOD WIDTH(FEET) =   12.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.89
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.64
  STREET FLOW TRAVEL TIME(MIN.) =   0.94   Tc(MIN.) =   13.36
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.719
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        0.91      0.74     0.600    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.91      SUBAREA RUNOFF(CFS) =    2.68
  EFFECTIVE AREA(ACRES) =      4.69    AREA-AVERAGED Fm(INCH/HR) =  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        4.7        PEAK FLOW RATE(CFS) =      14.32

  END OF SUBAREA STREET FLOW HYDRAULICS:
```

```
  DEPTH(FEET) = 0.43   HALFSTREET FLOOD WIDTH(FEET) =  12.90
  FLOW VELOCITY(FEET/SEC.) =  3.95   DEPTH*VELOCITY(FT*FT/SEC.) =   1.68
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     876.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.7  TC(MIN.) =     13.36
  EFFECTIVE AREA(ACRES) =      4.69  AREA-AVERAGED Fm(INCH/HR)=  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap = 0.439
  PEAK FLOW RATE(CFS)   =      14.32
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

REFERENCES & MAPS

WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Friday, February 15, 2019

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	101135102
Project Site Acreage:	4.696
HCOC Exempt Area:	Yes. Verify that the project is completely with the HCOC exemption area.
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - 112 **Facility Name** - West State Street Storm Drain **Owner** - SBCFCD
Closest channel segment's susceptibility to Hydromodification:	EHM
Highest downstream hydromodification susceptibility:	High
Is this drainage segment subject to TMDLs?	No
Are there downstream drainage segments subject to TMDLs?	Yes
Is this drainage segment a 303d listed stream?	No
Are there 303d listed streams downstream?	Yes
Are there unlined downstream waterbodies?	Yes
Project Site Onsite Soil Group(s):	A
Environmentally Sensitive Areas within 200':	None
Groundwater Depth (FT):	-311
Parcels with potential septic tanks within 1000':	No
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	Chino Basin Recharge Master Plan Chino Basin Water Master 32nd Annual Report Master Plan of Storm Drain Facilities CSDP Project No. 1 CSDP 1 Comprehensive Storm Drain CSDP Drainage Study Calculations City of Montclair MPD West San Bernardino SD Master Plan (Proof) Chino Creek Master Plan Chino & San Antonio Creek Summary Hydrology Zone 1, San Antonio and Chino San Antonio and Chino Creeks Channel

NOAA Atlas 14, Volume 6, Version 2
Location name: Ontario, California, USA*
Latitude: 34.0548°, Longitude: -117.6835°
Elevation: 938.64 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.119** (0.100-0.145)	**0.157** (0.131-0.190)	**0.207** (0.172-0.251)	**0.248** (0.204-0.304)	**0.304** (0.242-0.386)	**0.348** (0.271-0.451)	**0.393** (0.298-0.523)	**0.440** (0.324-0.603)	**0.505** (0.356-0.722)	**0.556** (0.379-0.825)
10-min	**0.171** (0.143-0.207)	**0.225** (0.188-0.273)	**0.297** (0.246-0.360)	**0.355** (0.293-0.435)	**0.436** (0.347-0.553)	**0.498** (0.388-0.647)	**0.563** (0.427-0.749)	**0.630** (0.465-0.864)	**0.723** (0.511-1.03)	**0.797** (0.543-1.18)
15-min	**0.207** (0.173-0.251)	**0.272** (0.227-0.330)	**0.359** (0.298-0.436)	**0.429** (0.354-0.526)	**0.527** (0.419-0.669)	**0.603** (0.469-0.782)	**0.681** (0.517-0.906)	**0.762** (0.562-1.05)	**0.875** (0.617-1.25)	**0.964** (0.656-1.43)
30-min	**0.307** (0.256-0.372)	**0.404** (0.337-0.490)	**0.532** (0.442-0.646)	**0.637** (0.525-0.781)	**0.781** (0.622-0.992)	**0.894** (0.696-1.16)	**1.01** (0.766-1.34)	**1.13** (0.833-1.55)	**1.30** (0.916-1.86)	**1.43** (0.973-2.12)
60-min	**0.458** (0.382-0.554)	**0.602** (0.502-0.730)	**0.793** (0.659-0.964)	**0.950** (0.782-1.16)	**1.17** (0.927-1.48)	**1.33** (1.04-1.73)	**1.51** (1.14-2.00)	**1.69** (1.24-2.31)	**1.93** (1.37-2.77)	**2.13** (1.45-3.16)
2-hr	**0.689** (0.575-0.834)	**0.902** (0.751-1.09)	**1.18** (0.978-1.43)	**1.40** (1.15-1.72)	**1.70** (1.35-2.16)	**1.93** (1.50-2.50)	**2.16** (1.64-2.88)	**2.40** (1.77-3.29)	**2.73** (1.92-3.90)	**2.98** (2.03-4.42)
3-hr	**0.872** (0.728-1.06)	**1.14** (0.948-1.38)	**1.48** (1.23-1.80)	**1.75** (1.44-2.15)	**2.12** (1.69-2.69)	**2.40** (1.87-3.12)	**2.69** (2.04-3.57)	**2.98** (2.19-4.08)	**3.37** (2.38-4.82)	**3.67** (2.50-5.45)
6-hr	**1.23** (1.03-1.49)	**1.60** (1.33-1.94)	**2.07** (1.72-2.52)	**2.45** (2.02-3.01)	**2.96** (2.36-3.76)	**3.35** (2.61-4.34)	**3.74** (2.84-4.97)	**4.13** (3.05-5.67)	**4.67** (3.29-6.68)	**5.08** (3.46-7.54)
12-hr	**1.62** (1.35-1.96)	**2.11** (1.76-2.56)	**2.75** (2.28-3.34)	**3.26** (2.69-4.00)	**3.95** (3.15-5.02)	**4.48** (3.49-5.81)	**5.01** (3.81-6.68)	**5.56** (4.10-7.62)	**6.30** (4.45-9.02)	**6.87** (4.68-10.2)
24-hr	**2.16** (1.91-2.49)	**2.84** (2.51-3.28)	**3.74** (3.29-4.32)	**4.47** (3.91-5.21)	**5.47** (4.63-6.59)	**6.24** (5.17-7.67)	**7.02** (5.69-8.85)	**7.84** (6.17-10.2)	**8.95** (6.77-12.1)	**9.82** (7.18-13.7)
2-day	**2.64** (2.34-3.04)	**3.54** (3.13-4.09)	**4.74** (4.18-5.49)	**5.74** (5.02-6.69)	**7.11** (6.02-8.57)	**8.19** (6.80-10.1)	**9.31** (7.54-11.7)	**10.5** (8.26-13.6)	**12.1** (9.16-16.3)	**13.4** (9.80-18.7)
3-day	**2.87** (2.54-3.30)	**3.89** (3.44-4.49)	**5.28** (4.65-6.11)	**6.43** (5.62-7.50)	**8.04** (6.81-9.69)	**9.31** (7.72-11.5)	**10.6** (8.61-13.4)	**12.0** (9.48-15.6)	**14.0** (10.6-18.9)	**15.5** (11.4-21.7)
4-day	**3.09** (2.74-3.57)	**4.24** (3.75-4.89)	**5.78** (5.10-6.69)	**7.07** (6.18-8.24)	**8.87** (7.51-10.7)	**10.3** (8.53-12.7)	**11.8** (9.53-14.8)	**13.3** (10.5-17.3)	**15.5** (11.7-21.0)	**17.3** (12.6-24.1)
7-day	**3.54** (3.13-4.08)	**4.89** (4.33-5.65)	**6.71** (5.92-7.77)	**8.23** (7.20-9.60)	**10.3** (8.76-12.5)	**12.0** (9.96-14.8)	**13.7** (11.1-17.3)	**15.6** (12.3-20.1)	**18.1** (13.7-24.4)	**20.1** (14.7-28.1)
10-day	**3.84** (3.40-4.43)	**5.34** (4.72-6.17)	**7.36** (6.49-8.51)	**9.03** (7.90-10.5)	**11.4** (9.62-13.7)	**13.2** (10.9-16.2)	**15.1** (12.2-19.0)	**17.1** (13.5-22.1)	**19.9** (15.0-26.8)	**22.1** (16.2-30.8)
20-day	**4.62** (4.09-5.32)	**6.49** (5.73-7.49)	**9.01** (7.94-10.4)	**11.1** (9.72-13.0)	**14.1** (11.9-17.0)	**16.4** (13.6-20.2)	**18.8** (15.3-23.7)	**21.4** (16.9-27.7)	**25.0** (18.9-33.7)	**27.9** (20.4-38.9)
30-day	**5.45** (4.83-6.29)	**7.66** (6.77-8.84)	**10.7** (9.40-12.3)	**13.2** (11.5-15.4)	**16.8** (14.2-20.2)	**19.6** (16.3-24.1)	**22.6** (18.3-28.5)	**25.8** (20.3-33.4)	**30.3** (22.9-40.8)	**33.9** (24.8-47.3)
45-day	**6.52** (5.77-7.52)	**9.08** (8.03-10.5)	**12.6** (11.1-14.6)	**15.6** (13.7-18.2)	**19.9** (16.9-24.0)	**23.4** (19.4-28.8)	**27.1** (22.0-34.2)	**31.1** (24.5-40.3)	**36.8** (27.8-49.6)	**41.4** (30.2-57.7)
60-day	**7.57** (6.70-8.73)	**10.4** (9.21-12.0)	**14.4** (12.7-16.7)	**17.8** (15.6-20.8)	**22.8** (19.3-27.5)	**26.8** (22.3-33.0)	**31.2** (25.3-39.3)	**35.9** (28.3-46.5)	**42.7** (32.3-57.6)	**48.3** (35.3-67.4)

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

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

Please refer to NOAA Atlas 14 document for more information.

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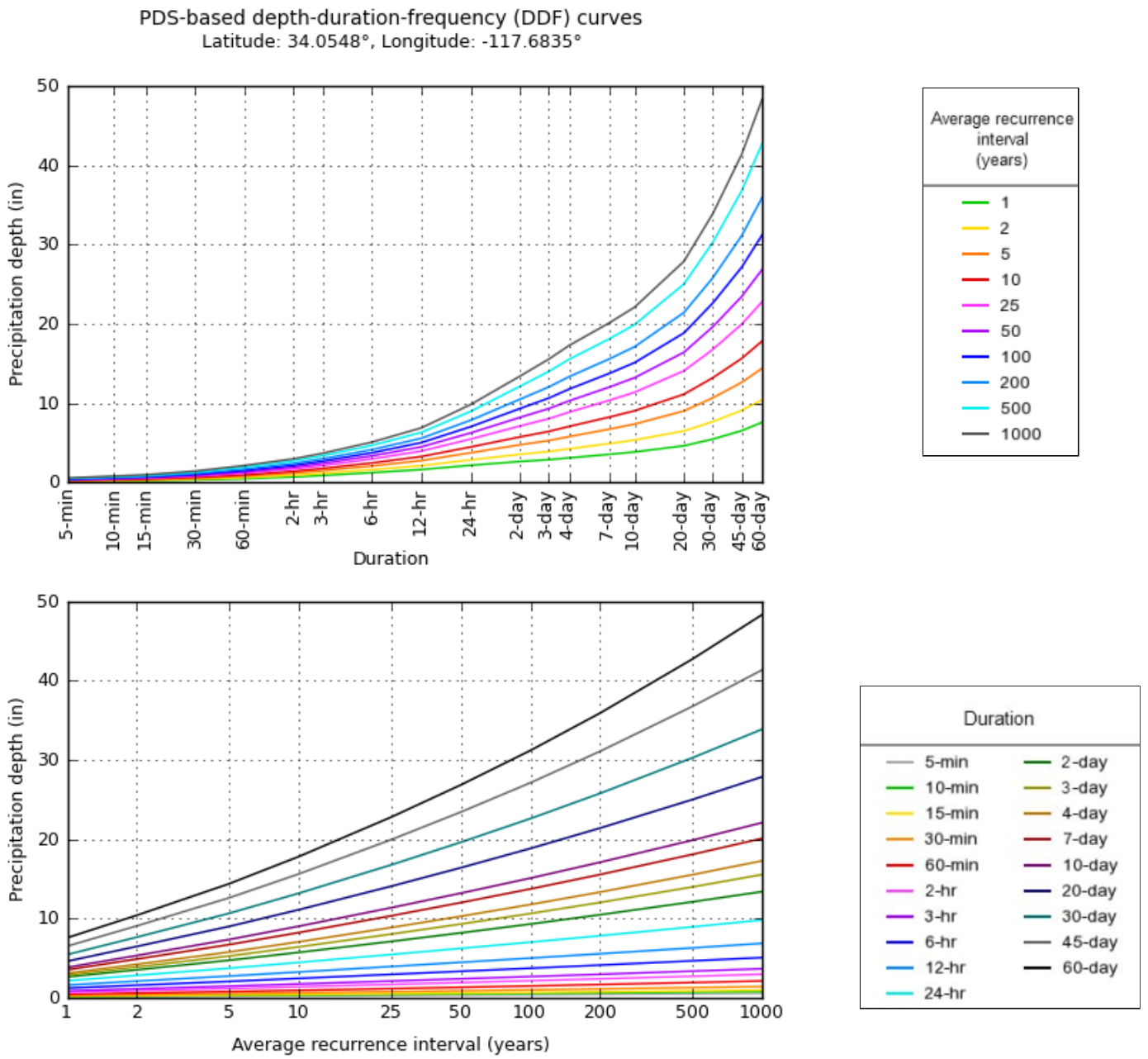
PF graphical



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Created (GMT): Fri Feb 15 18:39:51 2019

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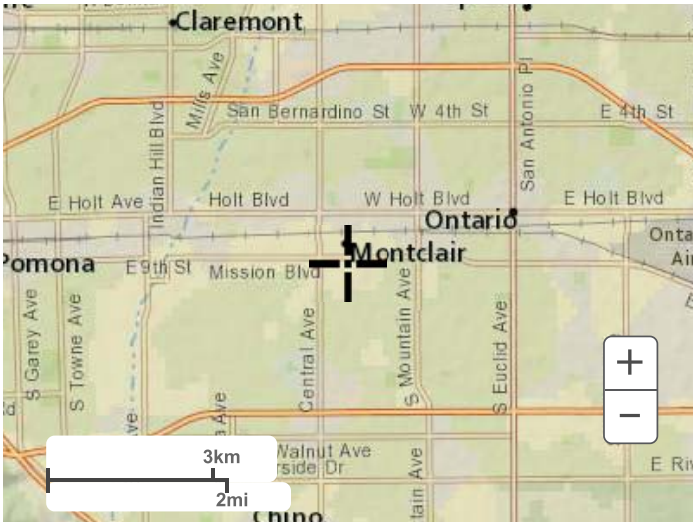
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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Questions?: HDSC.Questions@noaa.gov

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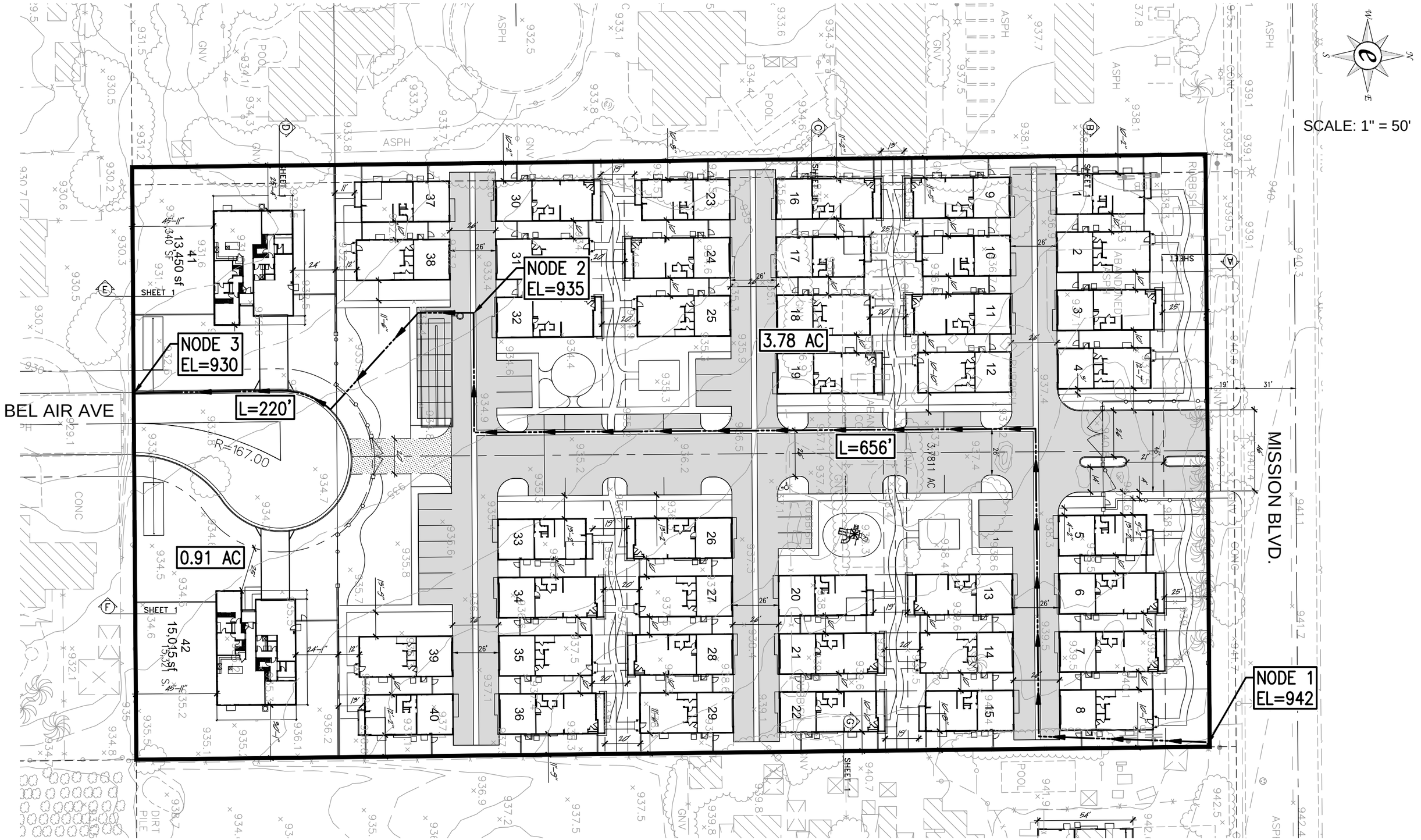

ENCOMPASS ASSOCIATES, INC.

HYDROLOGY MAP
TTM20267