APPENDIX F

HYDROLOGY STUDIES

PRELIMINARY HYDROLOGY STUDY
ORANGE AVENUE TOWNHOMES
2219 W. ORANGE AVENUE, ANAHEIM, CA
TTM No. 19192
TECH2022-01419

Project Address:

2219 W. Orange Avenue
Anaheim, CA 92804

Prepared For:

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Prepared: January 2022
Revised: June 2022

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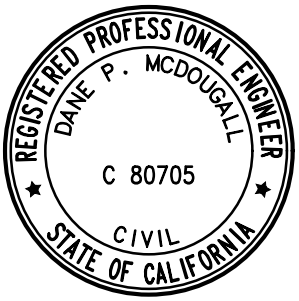
Preliminary Hydrology Study
for
Orange Avenue Townhomes
2219 W. Orange Avenue
Anaheim, Ca 92804

ACKNOWLEDGEMENT AND SIGNATURE PAGE

This Preliminary Hydrology Study was prepared by C&V Consulting, Inc. under the supervision of Dane McDougall, P.E.



Dane McDougall, R.C.E. 80705
Principal, C&V Consulting, Inc.

Date 6/23/2022

1.0 SITE DESCRIPTION

The proposed development encompasses 2.79 gross acres and is located at 2219 W. Orange Avenue, in the City of Anaheim, County of Orange. The site is bounded by W. Orange Avenue to the south, single family residences to the west and north, restaurants to the northeast, and an auto repair shop and fitness center to the east. The site is currently owned and occupied by Faith Lutheran Church of Anaheim with approximately 3 buildings onsite. Currently there are no parking or access easements on the site. The proposed development will include a reciprocal access agreement between the church and the development. There will not be any vehicular gates or gates of any kind blocking access between the two lots.

The proposed development will be divided into two (2) lots. Lot 1 (1.10 ac) will be utilized for a church campus, and Lot 2 (1.30 ac) will consist of attached, multi-family residential condominiums. The proposed residential development will consist of six (6) 3-story, multi-family residential buildings which will consist of 24 total units. The residential development will include a private drive aisle, parking, sidewalks, and landscaped open-space areas. In the proposed condition, lot 2 will have an added 8' right of way abandonment which accounts for the difference between the pre-developed and post developed acreages. The net acreage of Lot 2 in the proposed condition will be 1.30 acres. In the proposed condition, there will be a reciprocal access easement between the two lots. The project will require ultimate street improvements across the frontages of both lots.

2.0 EXISTING CONDITIONS

The site is currently occupied by Faith Lutheran Church of Anaheim. Per the City of Anaheim Title 18 Zoning Map, revised July 23, 2020, the site is identified as a Transition (T) zone. This zone is defined as land used for "transitory or interim use restricted to limited uses because of special conditions, or not zoned to one of the zoning districts." The proposed development will require a zone reclassification to remain consistent with the General Plan Land Use of Low Medium Density Residential.

The site is not located within a specific plan area. Per the City of Anaheim General Plan Land Use Map, revised June 9, 2020, the site is identified as "Residential Corridor." The site is surrounded by Residential – Low and Residential- Low Medium. The development proposes a General Plan Amendment to re-designate the Corridor Residential to a Low Medium Density Residential.

Based on site topography, the existing project site contains approximately 87% impervious coverage overall. In the current condition, the site generally sheet flows overland in the westerly and southerly directions. The parking lot area to the north of the buildings generally slopes west and the drive aisle to the east of the building generally slopes south. All onsite runoff discharges to Orange Avenue. Field investigation was conducted along the northern property line and survey elevations were acquired. That site has inlets slightly north of the proposed development and the survey elevations indicated that runoff is collected into these inlets. In the event that these inlets clog, emergency overflow may be conveyed through an existing gate along the North property line onto the proposed development site. Further investigation will be conducted during final engineering to confirm emergency overflow limits and sufficient conveyance through the site if necessary.

According to the City of Anaheim, Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area, the site is located within Drainage Basin 8. Drainage Basin 8 has a tributary drainage

area of approximately 1100 acres consisting of 2 Drainage Areas. The project site is located within the Drainage Area 8-1 which is defined by the City of Anaheim to drain into an existing storm drain that conveys runoff to Carbon Creek. Stormwater runoff entering W. Orange Avenue flows west along the curb and gutter until it enters a city catch basin at Rosebay Street and enters a into an existing City of Anaheim public 54" pipe. Runoff continues west to Gilbert Street where it turns north until W. Broadway where it enters an 8'x6' RCB facility and continues west in Broadway into an 11'x8' RCB Facility until outletting into the Carbon Creek Channel at S. Dale Avenue. The Carbon Creek Channel eventually confluences with the San Gabriel River and ultimately outlets into the Pacific Ocean at San Pedro Bay. The storm drain line that runs in Broadway has a capacity of 455 cfs which is equivalent to 45% of the 10-year storm event. Refer to Appendix E for portions of the City of Anaheim, Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area.

The Orange County Flood Control District (OCFCD) Drainage Facilities Maps were utilized to verify the drainage pattern of site runoff. The topographic survey was utilized to identify existing onsite high points and overall site conveyance of storm water runoff. The entire site runoff was quantified based on the longest hydraulic path from the most remote high point to drop inlet low point. Refer to Appendix E for the applicable OCFCD Drainage Facilities Maps. Refer to the "Existing Conditions Hydrology Map" located within Appendix A of this study for additional information.

3.0 PURPOSE OF STUDY

The preliminary hydrology study will determine the amount of stormwater runoff generated from the project site in the existing and proposed conditions. This study will determine whether detention or other peak flow mitigation methods will be required by comparing the proposed and existing condition peak flow rates for the 10-, 25-, and 100-year storm events.

4.0 PROPOSED CONDITIONS

The proposed development will consist of 1.30 acres and provide a total of 24 attached, multi-family residential condominiums. The 2-, 3-, and 4-bedroom units will range in square footage between 1,606 and 1,979. Associated resident and guest parking areas, a private drive aisle, recreational areas, sidewalks, and landscaped areas are also proposed within the development. Based on the proposed land use of the residential lot, the imperviousness was assumed to be 80% per the Orange County Hydrology Manual, Figure C-4. Actual imperviousness will be calculated during final engineering, and hydrology calculations will be updated.

The residential site will be graded to convey stormwater as surface flow to two (2) localized sump areas within the drive aisle which will be equipped with curb inlet catch basins. Low flows will be conveyed through the modular wetland curb inlet and the water quality design flow rate will be treated. Runoff will then be conveyed into a proposed infiltration system designed to infiltrate the entire water quality Design Capture Volume (DCV) as well as store any increase in stormwater runoff in the proposed condition. During storm events that produce a larger runoff volume than the DCV and when the infiltration system is at capacity, stormwater will back up into the proposed Catch Basin and drain towards Orange Avenue via a proposed parkway culvert. Emergency (secondary) overflow will pond around the proposed catch basin and sheet flow into the right-of-way of Orange Avenue over the proposed driveway.

Emergency overflow may exist through the proposed development site from the property to the north. A proposed u-channel will collect and convey any offsite runon to the west property line. Any runon from the northern property will not be comingled with onsite runoff. Further field investigation and the sizing of the u-channel will be confirmed during final engineering. Upon entering the public right-of-way, sheet runoff will follow existing curb and gutter towards the existing catch basin in Rosebay Street. Upon entering the catch basin, site runoff will follow the historic drainage pattern and drain to Carbon Creek Channel.

Refer to "Proposed Conditions Preliminary Hydrology Map" in Appendix A within this study for additional information.

*An 8' right-of-way abandonment is proposed along the project's southern boundary, thus resulting in a net are of the proposed condition higher than that of the existing condition.

5.0 METHODOLOGY

The project site was analyzed using the Orange County Hydrology Manual 1986. The initial subareas were analyzed for acreage, land-use, soil type, peak flow rate and time of concentration according to the Rational Method described in the manual.

In this preliminary hydrology study, the recommended values per the Orange County Hydrology Manual 1986 were utilized for the percentage of impervious area of the proposed condition. Assumptions for impervious cover are shown in the Hydrology Calculations in Appendix B.

6.0 RESULTS

Drainage Area	Area (ac)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)	T_c (min)
Existing Conditions					
X1	0.33	0.96	1.15	1.47	7.16
X2	0.14	0.36	0.44	0.56	8.59
X3	0.81	2.15	2.20	2.84	10.88
Total to Orange Ave	**1.28**	**2.89**	**3.48**	**4.49**	10.88
Proposed Conditions					
P1	0.45	1.38	1.64	2.11	6.78
P2	0.85	2.36	2.82	3.62	7.79
Total	**1.30**	**3.60**	**4.31**	**5.53**	**7.79**

Note: All time of concentrations indicated above refer to the 100-year storm event.

Catch Basin Sizing

Proposed Catch Basin Sizing has been analyzed for the 100-year storm event peak flow rates. Emergency overflow at Catch Basin #1, will pond over the driveway and sheet flow into to the public right-of-way of W. Orange Avenue.

Parkway Culvert
One parkway culvert will provide a by-pass condition when the underground infiltration system is at capacity during larger storm events. The 100-year storm event peak runoff flowrates were utilized in sizing parkway culverts.

100-Year Water Surface Elevations
A ponding exhibit has been prepared to verify the 100-year water surface elevations at all onsite sump locations and to verify that nearby finish floor elevations have been set providing at least a 1' freeboard condition.

Detention Calculations
Due to the slight increased peak flow rate tributary to W. Orange Avenue from of the change in land use and increased impervious coverage, a small amount of stormwater will need to be detained and mitigated onsite. The small unit area hydrograph was analyzed to determine the volume of increased runoff that will need to be mitigated. Approximately 89 cf (cubic feet) will need to be detained onsite and mitigated based on the existing 100-year storm event. The water quality infiltration system will be designed to mitigate both water quality and increased 100-year peak flow rates. The system is sized to statically detain the required design capture volume of 3,822 cf to promote onsite retention and infiltration.

Refer to Appendix G for the small unit area hydrograph calculations.

7.0 CONCLUSION

The results from this preliminary hydrology study demonstrate that the proposed condition of the project site will generate a higher runoff volume to W. Orange Avenue than the existing condition. The change in peak flowrates that discharge into W. Orange Avenue is due to the fact that impervious area is increasing in the Drainage Areas from the existing condition to the proposed condition.

In the existing condition, subareas draining towards W. Orange Avenue total approximately 1.25 acres, in which approximately 0.22 acres (18%) is pervious.

In the proposed condition, subareas draining towards W. Orange Avenue total approximately 1.30 acres, in which approximately 0.26 acres (20%) is pervious. The proposed pervious coverage is based on land use corresponding to Apartments. Actual pervious coverage will be calculated based on a finalized landscape plan during final engineering.

Although W. Orange Avenue has an increase in runoff from the existing condition to the proposed condition, the proposed water quality stormwater retention and infiltration system will statically detain the increased peak flow volume that the difference in runoff between existing and proposed conditions produced by a small area unit hydrograph. Downstream facilities will not be hydrologically or hydraulically impacted by the proposed condition of the project site. Refer to Appendix B for Peak Runoff Calculations. Refer to Appendix G for the small area unit hydrograph for runoff tributary to W. Transit Avenue.

Proposed habitable structures have been designed to be at least 1' above the 100- year water surface elevation at designated sump location onsite. Proper emergency overflow has been established at the sump locations. Refer to Appendix F for 100-year depth of flow calculations and ponding exhibit.

8.0 DESIGN ASSUMPTIONS

1. The property is located in the City of Anaheim, Orange County rainfall region.

2. 100-year storm event flood level protection analysis required for habitable structures per the requirements of the Orange County Flood Control District Design Manual.

3. Site located within Hydrologic Soil Type "A" and "B" per the NRCS Hydrologic Soil Groups map.

4. Impervious coverage for the existing condition of the site was hand calculated based on existing topography maps.

5. Impervious coverage correlating to the land use category of Apartments, was assumed for the proposed conditions of the site. (20% Pervious Cover)

6. Peak flow rates and time of concentrations were calculated using Rational Method described in Orange County Hydrology Manual 1986.

7. Per FEMA Flood Map No. 06059C0128J, the project is located within Zone X, "Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood." Refer to Appendix J for a copy of the FEMA Flood Map and additional information regarding the flood elevation.

9.0 REFERENCES

1. Orange County Hydrology Manual 1986

2. Orange County Flood Control District Design Manual 2000

3. NRCS Web Soil Survey

4. City of Anaheim, Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area 2010

5. Orange County Drainage Facilities Map Nos. 12 & 13 and Carbon Creek Channel As-Built Plans

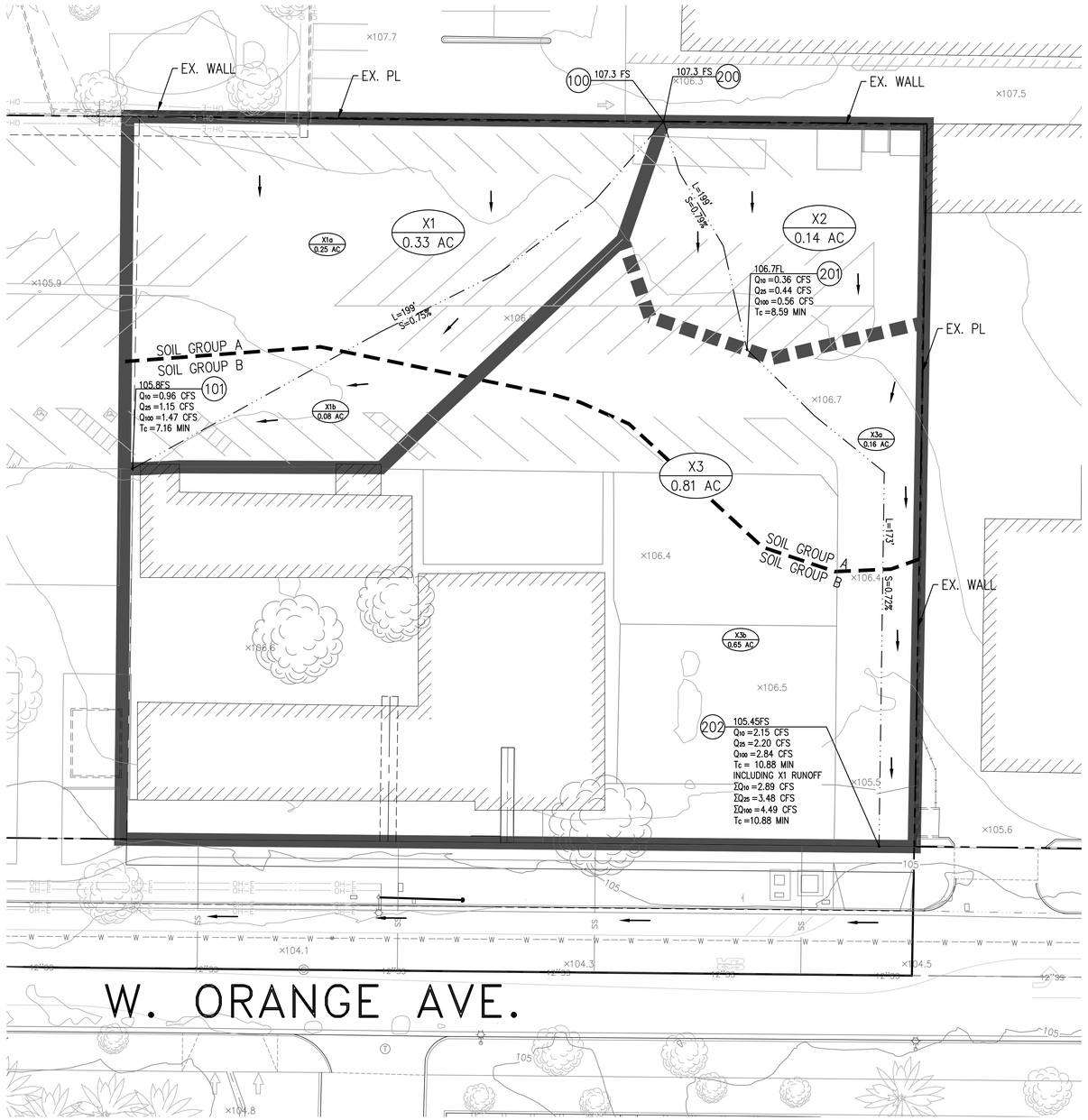
6. FEMA Firm Map Number 06059C0128J, December 3, 2009 and LOMR-F, Case No. No. 13-09-2281A dated September 19, 2013

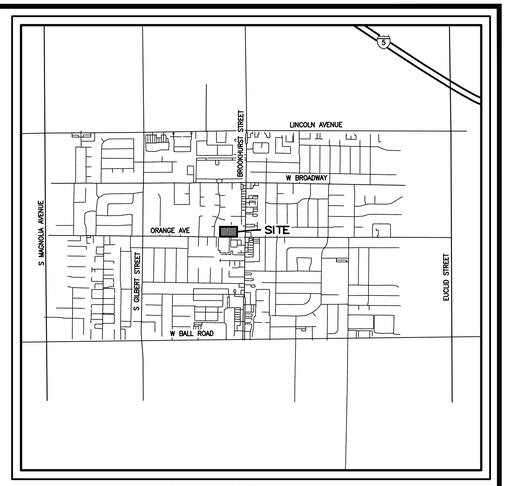
APPENDIX A
HYDROLOGY MAPS

Existing Conditions Hydrology Map

EXISTING CONDITIONS HYDROLOGY MAP

TR 19192
2219 W. ORANGE AVENUE
CITY OF ANAHEIM, COUNTY OF ORANGE





VICINITY MAP

NTS

LEGEND

- EXISTING RIGHT-OF-WAY/ BOUNDARY
- DRAINAGE AREA BOUNDARY
- DRAINAGE SUB AREA BOUNDARY
- LONGEST FLOW PATH
- FLOW DIRECTION
- XX — DRAINAGE AREA ID
- X.XX AC — DRAINAGE AREA IN ACRES
- 100 — INITIAL SUBAREA NODE
- (00.0) FS — SPOT ELEVATION
- Q100 =X.XX CFS — PEAK RUNOFF (CFS)
- Tc =X.X MIN — TIME OF CONCENTRATION (MIN)

SCALE: 1" = 20'

0 10 20 40

DEVELOPER :

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER & DEVELOPER :

MELIA HOMES
8951 RESEARCH DRIVE, #100
IRVINE, CA 92618
PHONE (949) 759-4367

SOILS ENGINEER :

PREPARED BY :

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REGISTERED PROFESSIONAL ENGINEER
DANE P. McDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

TRACT NO. 19192
EXISTING CONDITIONS HYDROLOGY MAP

DATE: 4/14/2022

SHEET 1 OF 1

SCALE: AS SHOWN | DRAWN BY: SP | CHECKED BY: SP

CITY OF ANAHEIM

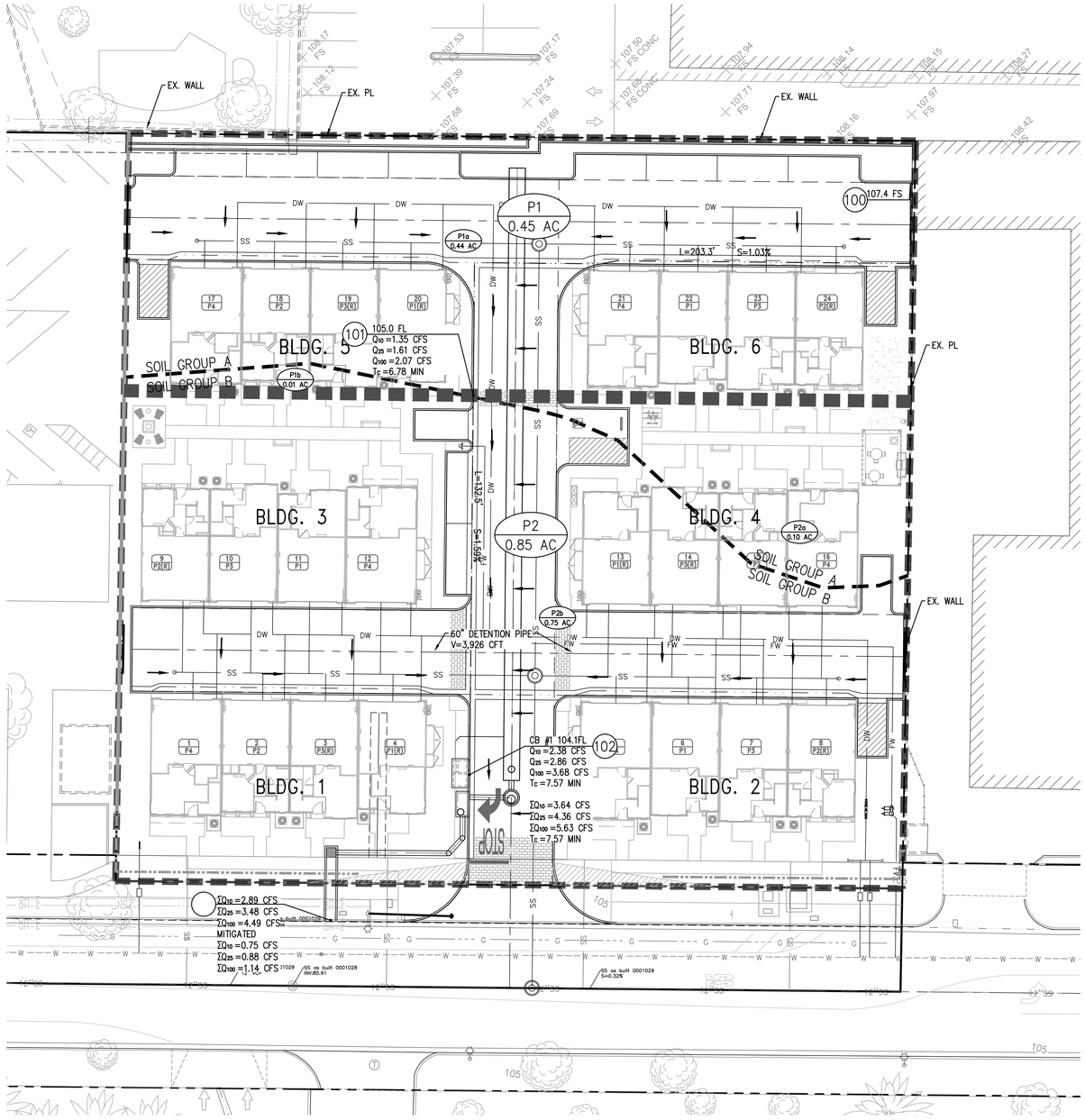
Proposed Conditions Hydrology Map

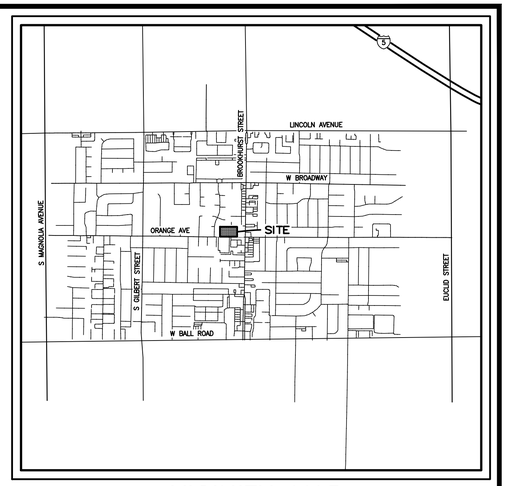
PROPOSED CONDITIONS HYDROLOGY MAP

TR 19192

2219 W. ORANGE AVENUE

CITY OF ANAHEIM, COUNTY OF ORANGE





VICINITY MAP

NTS

LEGEND

- EXISTING RIGHT-OF-WAY/ BOUNDARY
- DRAINAGE AREA BOUNDARY
- DRAINAGE SUB AREA BOUNDARY
- LONGEST FLOW PATH
- FLOW DIRECTION
- XX / X.XX AC — DRAINAGE AREA ID / DRAINAGE AREA IN ACRES
- 100 / (00.0) FS / Q100 =X.XX CFS / Tc =X.X MIN — INITIAL SUBAREA NODE / SPOT ELEVATION / PEAK RUNOFF (CFS) / TIME OF CONCENTRATION (MIN)

SCALE: 1" = 20'

0 10 20 40

DEVELOPER :

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER & DEVELOPER :

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CIVIL
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TRACT NO. 19192
PROPOSED CONDITIONS HYDROLOGY MAP

DATE: 6/21/2022

SHEET 1 OF 1

SCALE: AS SHOWN | DRAWN BY: SP | CHECKED BY: SP

CITY OF ANAHEIM

APPENDIX B
HYDROLOGY CALCULATIONS

Existing & Proposed Conditions Hydrology Calculations (10-year Storm Event)

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2014 Advanced Engineering Software (aes)
              Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                           Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* TOWNHOMWS AT ORANGE AVE                                                *
* TTM 19192                                                              *
* EXISTING Q10                                                           *
 **************************************************************************

  FILE NAME: ML10X10.DAT
  TIME/DATE OF STUDY: 14:28 04/13/2022
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II 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 0.0313 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    100.00 TO NODE    101.00 IS CODE =  21
```

```
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   199.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.30  DOWNSTREAM(FEET) =    105.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.155
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.306
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A        0.25      0.40     0.200    32    7.16
  APARTMENTS                 B        0.08      0.30     0.200    56    7.16
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.96
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      0.96

************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    101.00 IS CODE =  10
------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
========================================================================

************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   199.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.30  DOWNSTREAM(FEET) =    106.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.595
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.976
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A        0.14      0.40     0.200    32    8.59
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.36

************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  91
------------------------------------------------------------------------
```

```
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    106.70
  DOWNSTREAM NODE ELEVATION(FEET) =    105.45
  CHANNEL LENGTH THRU SUBAREA(FEET) =   173.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.00500
  MAXIMUM DEPTH(FEET) =   0.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.578
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        0.16      0.40     0.200    32
  APARTMENTS                 B        0.65      0.30     0.200    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.32
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.27
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.18
  AVERAGE FLOW DEPTH(FEET) =   0.12   FLOOD WIDTH(FEET) =   27.34
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.45   Tc(MIN.) =   11.04
  SUBAREA AREA(ACRES) =    0.81       SUBAREA RUNOFF(CFS) =    1.83
  EFFECTIVE AREA(ACRES) =    0.95     AREA-AVERAGED Fm(INCH/HR) =   0.07
  AREA-AVERAGED Fp(INCH/HR) =   0.33  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        0.9         PEAK FLOW RATE(CFS) =       2.15

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOOD WIDTH(FEET) =   34.91
  FLOW VELOCITY(FEET/SEC.) =   1.29   DEPTH*VELOCITY(FT*FT/SEC) =   0.17
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.15   11.04    2.578  0.33( 0.07) 0.20       0.9     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.96    7.16    3.306  0.38( 0.08) 0.20       0.3     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    202.00 =     199.00 FEET.

  ** PEAK FLOW RATE TABLE **
```

```
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        2.75    7.16    3.306  0.35( 0.07) 0.20       0.9     100.00
    2        2.89   11.04    2.578  0.34( 0.07) 0.20       1.3     200.00
  TOTAL AREA(ACRES) =         1.3

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        2.89  Tc(MIN.) =   11.041
 EFFECTIVE AREA(ACRES) =      1.28  AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.35  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        1.3
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.3  TC(MIN.) =     11.04
 EFFECTIVE AREA(ACRES) =      1.28  AREA-AVERAGED Fm(INCH/HR)=  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap = 0.200
 PEAK FLOW RATE(CFS)   =       2.89

 ** PEAK FLOW RATE TABLE **
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        2.75    7.16    3.306  0.35( 0.07) 0.20       0.9     100.00
    2        2.89   11.04    2.578  0.34( 0.07) 0.20       1.3     200.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
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                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* TOWNHOMES AT ORANGE                                                   *
* TTM 19192                                                             *
* PROPOSED Q10                                                          *
 ************************************************************************

  FILE NAME: ML10P10.DAT
  TIME/DATE OF STUDY: 16:55 04/13/2022
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II 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 0.0313 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    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   201.30
  ELEVATION DATA: UPSTREAM(FEET) =    107.40  DOWNSTREAM(FEET) =    105.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.559
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.475
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A        0.44      0.40     0.200    32    6.56
  APARTMENTS                 B        0.01      0.30     0.200    56    6.56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.38
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.38

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  61
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  105.00  DOWNSTREAM ELEVATION(FEET) =  104.10
  STREET LENGTH(FEET) =   135.10   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 13.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   6.50
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.001

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.56
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =   12.92
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.81
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.53
  STREET FLOW TRAVEL TIME(MIN.) =   1.24   Tc(MIN.) =    7.80
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.146
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        0.10      0.40     0.200    32
  APARTMENTS                 B        0.75      0.30     0.200    56
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.31
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.85      SUBAREA RUNOFF(CFS) =    2.36
  EFFECTIVE AREA(ACRES) =      1.30    AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.3        PEAK FLOW RATE(CFS) =       3.60

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =  13.00
  FLOW VELOCITY(FEET/SEC.) =  1.82   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     336.40 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.3  TC(MIN.) =      7.80
  EFFECTIVE AREA(ACRES) =      1.30  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       3.60
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Existing & Proposed Conditions Hydrology Calculations (25-year Storm Event)

```
**************************************************************************
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                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* TOWNHOMWS AT ORANGE AVE                                                *
* TTM 19192                                                              *
* EXISTING Q25                                                           *
 **************************************************************************

  FILE NAME: ML10X25.DAT
  TIME/DATE OF STUDY: 14:30 04/13/2022
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

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

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

```
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   199.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.30  DOWNSTREAM(FEET) =    105.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.155
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.938
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A        0.25      0.40     0.200    32    7.16
  APARTMENTS                 B        0.08      0.30     0.200    56    7.16
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.15
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      1.15

************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    101.00 IS CODE =  10
------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
========================================================================

************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   199.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.30  DOWNSTREAM(FEET) =    106.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.595
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.550
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A        0.14      0.40     0.200    32    8.59
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.44
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.44

************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  91
------------------------------------------------------------------------
```

```
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    106.70
  DOWNSTREAM NODE ELEVATION(FEET) =    105.45
  CHANNEL LENGTH THRU SUBAREA(FEET) =   173.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.00500
  MAXIMUM DEPTH(FEET) =   0.50
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.086
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        0.16      0.40     0.200    32
  APARTMENTS                 B        0.65      0.30     0.200    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.32
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.53
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.20
  AVERAGE FLOW DEPTH(FEET) =   0.12   FLOOD WIDTH(FEET) =   30.09
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.41   Tc(MIN.) =   11.01
  SUBAREA AREA(ACRES) =    0.81       SUBAREA RUNOFF(CFS) =    2.20
  EFFECTIVE AREA(ACRES) =    0.95     AREA-AVERAGED Fm(INCH/HR) =   0.07
  AREA-AVERAGED Fp(INCH/HR) =   0.33  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        0.9         PEAK FLOW RATE(CFS) =       2.58

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.14   FLOOD WIDTH(FEET) =   38.34
  FLOW VELOCITY(FEET/SEC.) =   1.30   DEPTH*VELOCITY(FT*FT/SEC) =   0.19
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.58   11.01    3.086  0.33( 0.07) 0.20       0.9     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.15    7.16    3.938  0.38( 0.08) 0.20       0.3     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    202.00 =     199.00 FEET.

  ** PEAK FLOW RATE TABLE **
```

```
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        3.30    7.16    3.938  0.35( 0.07) 0.20       0.9     100.00
    2        3.48   11.01    3.086  0.34( 0.07) 0.20       1.3     200.00
  TOTAL AREA(ACRES) =         1.3

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        3.48  Tc(MIN.) =   11.005
 EFFECTIVE AREA(ACRES) =      1.28  AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.35  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        1.3
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.3  TC(MIN.) =     11.01
 EFFECTIVE AREA(ACRES) =      1.28  AREA-AVERAGED Fm(INCH/HR)=  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap = 0.200
 PEAK FLOW RATE(CFS)   =       3.48

 ** PEAK FLOW RATE TABLE **
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        3.30    7.16    3.938  0.35( 0.07) 0.20       0.9     100.00
    2        3.48   11.01    3.086  0.34( 0.07) 0.20       1.3     200.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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            Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* TOWNHOMES AT ORANGE                                                   *
* TTM 19192                                                             *
* PROPOSED Q25                                                          *
 ************************************************************************

  FILE NAME: ML10P25.DAT
  TIME/DATE OF STUDY: 16:56 04/13/2022
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

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

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

```
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   201.30
  ELEVATION DATA: UPSTREAM(FEET) =    107.40  DOWNSTREAM(FEET) =    105.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.559
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.137
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A        0.44      0.40     0.200    32    6.56
  APARTMENTS                 B        0.01      0.30     0.200    56    6.56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.64
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.64

************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  61
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =  105.00  DOWNSTREAM ELEVATION(FEET) =  104.10
  STREET LENGTH(FEET) =   135.10   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 13.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   6.50
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.001

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.05
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.29   FLOOD WIDTH(FEET) =   13.00
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    1.82
    SPLIT DEPTH(FEET) =    0.20   SPLIT FLOOD WIDTH(FEET) =    8.25
    SPLIT FLOW(CFS) =    0.45   SPLIT VELOCITY(FEET/SEC.) =    1.07
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =   13.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.82
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.53
  STREET FLOW TRAVEL TIME(MIN.) =   1.23   Tc(MIN.) =    7.79
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.752
```

```
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        0.10      0.40     0.200    32
  APARTMENTS                 B        0.75      0.30     0.200    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.31
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.85      SUBAREA RUNOFF(CFS) =    2.82
  EFFECTIVE AREA(ACRES) =      1.30    AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.3        PEAK FLOW RATE(CFS) =       4.31

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =  13.00
  FLOW VELOCITY(FEET/SEC.) =  1.82   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     336.40 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.3  TC(MIN.) =      7.79
  EFFECTIVE AREA(ACRES) =      1.30  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       4.31
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Existing & Proposed Conditions Hydrology Calculations (100-year Storm Event)

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2014 Advanced Engineering Software (aes)
              Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                           Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* TOWNHOMWS AT ORANGE AVE                                                *
* TTM 19192                                                              *
* EXISTING Q100                                                          *
 **************************************************************************

  FILE NAME: ML10X100.DAT
  TIME/DATE OF STUDY: 14:31 04/13/2022
==========================================================================
  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
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

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

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

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   199.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.30  DOWNSTREAM(FEET) =    105.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.155
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.039
  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                 A        0.25      0.40     0.200    52    7.16
  APARTMENTS                 B        0.08      0.30     0.200    76    7.16
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.47
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      1.47

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    101.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   199.00
  ELEVATION DATA: UPSTREAM(FEET) =    107.30  DOWNSTREAM(FEET) =    106.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.595
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.536
  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                 A        0.14      0.40     0.200    52    8.59
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.56
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.56

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  91
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    106.70
  DOWNSTREAM NODE ELEVATION(FEET) =    105.45
  CHANNEL LENGTH THRU SUBAREA(FEET) =   173.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.00500
  MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.963
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        0.16      0.40     0.200    52
  APARTMENTS                 B        0.65      0.30     0.200    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.32
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.95
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.26
  AVERAGE FLOW DEPTH(FEET) =   0.13   FLOOD WIDTH(FEET) =   33.53
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.29   Tc(MIN.) =   10.88
  SUBAREA AREA(ACRES) =    0.81       SUBAREA RUNOFF(CFS) =    2.84
  EFFECTIVE AREA(ACRES) =    0.95     AREA-AVERAGED Fm(INCH/HR) =   0.07
  AREA-AVERAGED Fp(INCH/HR) =   0.33  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        0.9         PEAK FLOW RATE(CFS) =       3.33

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.15   FLOOD WIDTH(FEET) =   42.47
  FLOW VELOCITY(FEET/SEC.) =   1.39   DEPTH*VELOCITY(FT*FT/SEC) =   0.21
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.33   10.88    3.963  0.33( 0.07) 0.20       0.9     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.47    7.16    5.039  0.38( 0.08) 0.20       0.3     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    202.00 =     199.00 FEET.

  ** PEAK FLOW RATE TABLE **
```

```
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        4.27    7.16    5.039  0.35( 0.07) 0.20       1.0     100.00
    2        4.49   10.88    3.963  0.34( 0.07) 0.20       1.3     200.00
  TOTAL AREA(ACRES) =         1.3

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        4.49  Tc(MIN.) =   10.880
 EFFECTIVE AREA(ACRES) =      1.28  AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.35  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        1.3
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     372.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.3  TC(MIN.) =     10.88
 EFFECTIVE AREA(ACRES) =      1.28  AREA-AVERAGED Fm(INCH/HR)=  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap = 0.200
 PEAK FLOW RATE(CFS)   =       4.49

 ** PEAK FLOW RATE TABLE **
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        4.27    7.16    5.039  0.35( 0.07) 0.20       1.0     100.00
    2        4.49   10.88    3.963  0.34( 0.07) 0.20       1.3     200.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

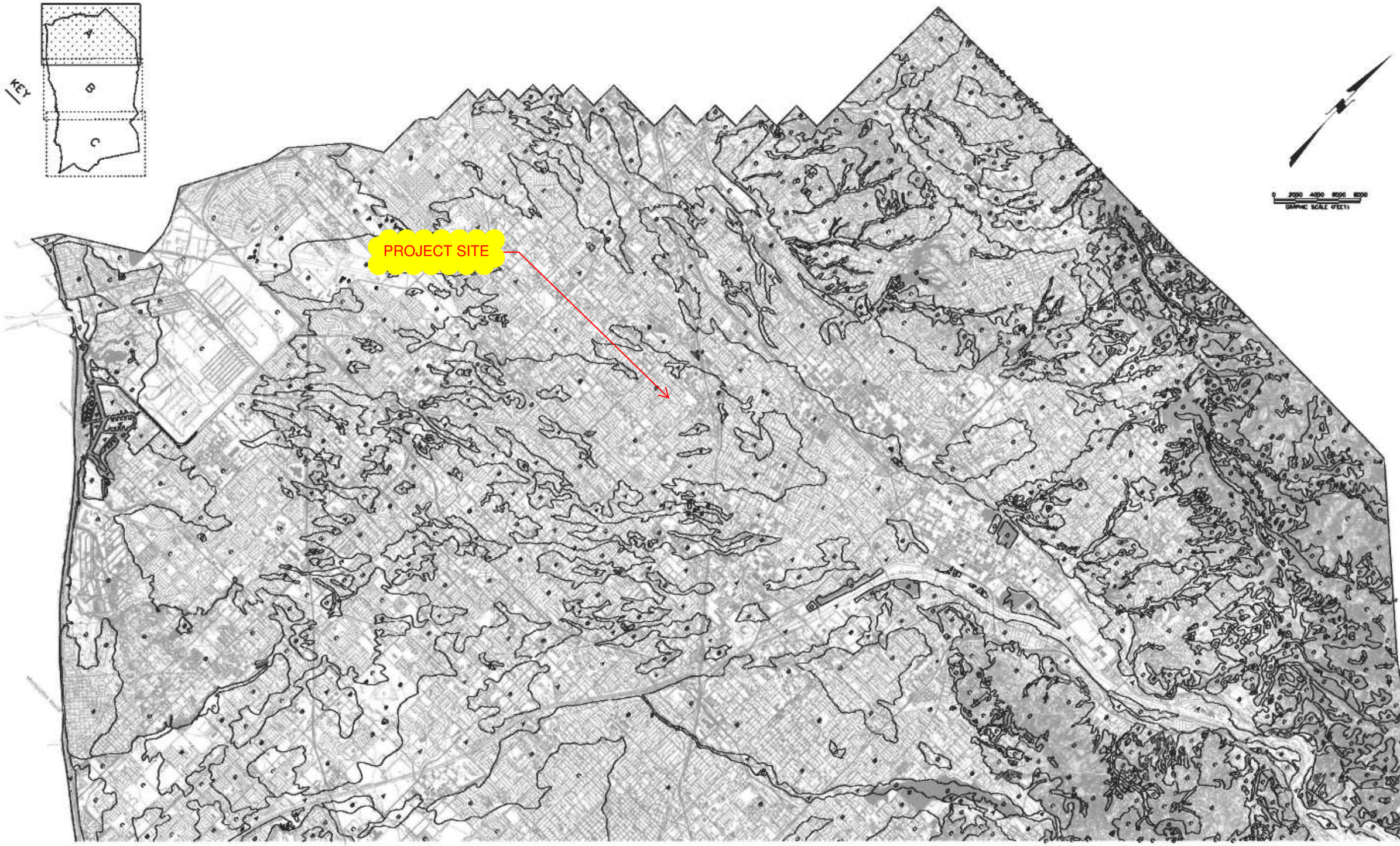
```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2014 Advanced Engineering Software (aes)
            Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                          Analysis prepared by:
```

```
 ************************* DESCRIPTION OF STUDY *************************
* TOWNHOMES AT ORANGE                                                   *
* TTM 19192                                                             *
* PROPOSED Q100                                                         *
 ************************************************************************

  FILE NAME: ML10P100.DAT
  TIME/DATE OF STUDY: 16:57 04/13/2022
==========================================================================
  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
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

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

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

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   201.30
  ELEVATION DATA: UPSTREAM(FEET) =    107.40  DOWNSTREAM(FEET) =    105.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.559
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.296
  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                 A        0.44      0.40     0.200    52    6.56
  APARTMENTS                 B        0.01      0.30     0.200    76    6.56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.11
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      2.11

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  61
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  105.00  DOWNSTREAM ELEVATION(FEET) =  104.10
  STREET LENGTH(FEET) =   135.10   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 13.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   6.50
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.001

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.92
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.29   FLOOD WIDTH(FEET) =   13.00
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    1.82
    SPLIT DEPTH(FEET) =    0.25   SPLIT FLOOD WIDTH(FEET) =   10.69
    SPLIT FLOW(CFS) =    1.32   SPLIT VELOCITY(FEET/SEC.) =    1.50
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =   13.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.82
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.53
  STREET FLOW TRAVEL TIME(MIN.) =   1.23   Tc(MIN.) =    7.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.798
```

```
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        0.10      0.40     0.200    52
  APARTMENTS                 B        0.75      0.30     0.200    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.31
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.85      SUBAREA RUNOFF(CFS) =    3.62
  EFFECTIVE AREA(ACRES) =      1.30    AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.3        PEAK FLOW RATE(CFS) =       5.53

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =  13.00
  FLOW VELOCITY(FEET/SEC.) =  1.86   DEPTH*VELOCITY(FT*FT/SEC.) =   0.55
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     336.40 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.3  TC(MIN.) =      7.79
  EFFECTIVE AREA(ACRES) =      1.30  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.34  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       5.53
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX C
Orange County Hydrology Manual: Hydrologic Classification of Soils Plate A
Orange County Infiltration Study NRCS Hydrology Soils Group Figure XVI-2a
NRCS Soil Map



ORANGE COUNTY
HYDROLOGY MANUAL

LEGEND
A B C D HYDROLOGIC SOIL GROUPS
HYDROLOGIC SOIL GROUP BOUNDARY

SOURCES:
BASE MAP - ORANGE COUNTY/RESOURCES & DEVELOPMENT MANAGEMENT DEPT GEOMATICS AND LAND INFORMATION SYSTEMS DIVISION
SOIL GROUPS - SOIL SURVEY OF ORANGE COUNTY AND WESTERN PART OF RIVERSIDE COUNTY, CALIFORNIA, USDA, SOIL CONSERVATION SERVICE, 1978.

HYDROLOGIC CLASSIFICATION OF SOILS
ORANGE COUNTY, CALIFORNIA
PLATE

SUBJECT TO FURTHER REVISION

PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

LEGEND

City Boundaries

Hydrologic Soil Groups

- A Soils
- B Soils
- C Soils
- D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

0 2.5 5 10 Kilometers
0 1.8 3.6 7.2 Miles

TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2a

P:\9526E\6-GIS\Mxds\Reports\Infiltration\Reasability_20110215\9526E_FigureXVI2a_HydroSoils_20110215.mxd

Map Scale: 1:600 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 25 50 100 150

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 15, Sep 13, 2021

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

Date(s) aerial images were photographed: Nov 19, 2020—Dec 5, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
163	Metz loamy sand	0.4	28.0%
166	Mocho loam, 0 to 2 percent slopes, warm MAAT, MLRA 19	0.5	32.1%
196	San Emigdio fine sandy loam, moderately fine substratum, 0 to 2 percent slopes	0.6	39.8%
Totals for Area of Interest		**1.5**	**100.0%**

Orange County and Part of Riverside County, California

163—Metz loamy sand

Map Unit Setting

National map unit symbol: hcn8
Elevation: 30 to 2,500 feet
Mean annual precipitation: 20 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from mixed

Typical profile

H1 - 0 to 17 inches: loamy sand
H2 - 17 to 63 inches: stratified sand to fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Ecological site: R019XD035CA - SANDY (1975)
Hydric soil rating: No

Minor Components

San emigdio, fine sandy loam
Percent of map unit: 4 percent
Hydric soil rating: No

Hueneme, fine sandy loam
Percent of map unit: 4 percent
Hydric soil rating: No

Corralitos, loamy sand
Percent of map unit: 4 percent
Hydric soil rating: No

Riverwash
Percent of map unit: 4 percent
Landform: Fans
Hydric soil rating: Yes

Metz, mod fine substratum
Percent of map unit: 4 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 15, Sep 13, 2021

Orange County and Part of Riverside County, California

196—San Emigdio fine sandy loam, moderately fine substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hcpb
Elevation: 10 to 700 feet
Mean annual precipitation: 12 to 81 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 270 to 350 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

San emigdio and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of San Emigdio

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Riser, flat
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 7 inches: fine sandy loam
H2 - 7 to 40 inches: stratified gravelly loamy coarse sand to very fine sandy loam
H3 - 40 to 44 inches: silty clay loam
H4 - 44 to 61 inches: stratified gravelly loamy coarse sand to very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: R019XD029CA - LOAMY
Hydric soil rating: No

Minor Components

Sorrento, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Metz, loamy sand

Percent of map unit: 5 percent
Hydric soil rating: No

Hueneme, fine sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 15, Sep 13, 2021

Orange County and Part of Riverside County, California

166—Mocho loam, 0 to 2 percent slopes, warm MAAT, MLRA 19

Map Unit Setting

National map unit symbol: 2tyyv
Elevation: 20 to 1,920 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 62 to 66 degrees F
Frost-free period: 320 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Mocho and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mocho

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

Ap - 0 to 10 inches: loam
A - 10 to 16 inches: loam
Bk1 - 16 to 34 inches: loam
Bk2 - 34 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R019XD029CA - LOAMY
Hydric soil rating: No

Minor Components

Sorrento
Percent of map unit: 6 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Bolsa, silt loam, drained
Percent of map unit: 3 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Anacapa
Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hueneme
Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Mocho, 2 to 9 percent slopes
Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Chino, drained
Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

Data Source Information

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 15, Sep 13, 2021

APPENDIX D
Portions of the City of Anaheim, Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area

9. Drainage Basin 8

Drainage Basin 8 drains approximately 1100 acres, and is generally bounded by Lincoln Avenue on the north, the I-5 Freeway on the northeast, Orange Avenue on the south, and Dale Avenue on the west. As shown in Figure 9, drainage basins are further divided into drainage areas depending on the existing flow patterns and storm drain outlets. Basin 8 consists of 2 Areas 8-1 and 8-2. Area 8-1 has an existing storm drain which outlets to Carbon Creek. Area 8-2 is a small area which drains directly to Carbon Creek.

9.1 Hydrologic Analysis

The hydrologic analysis for Basin 8 was performed in accordance with the hydrologic criteria outlined in Chapter 3 and is included in Appendix C. The hydrology map for Basin 8 is included in Appendix B. The following table highlights the flow rates at key drainage nodes for Areas within Basin 8 that have street flow and/or existing storm drains. The table shows associated drainage areas and flows for 10-, 25-, and 100-year storm events.

Table 11 – Basin 8 Summary of Hydrology

Drainage Area	Node	Location	Drainage Area (ac)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)
8-1	802	Loara St and Broadway	31	55	65	85
8-1	807	Empire St and Broadway	378	435	530	690
8-1	810	Brookhurst St and Broadway	636	620	765	1000
8-1	814	Magnolia Ave and Broadway	985	940	1175	1515
8-1	817	Dale Ave at Carbon Creek	1084	960	1195	1555
8-1	822	Euclid St and Lincoln Ave	13	20	25	35
8-1	826	Empire St and Lincoln Ave	193	245	295	385
8-1	833	Valley St and Orange Ave	109	95	125	165
8-1	842	Kathryn Dr and Lincoln Ave	16	16	20	25
8-1	853	Gilbert St and Orange Ave	95	105	135	180
8-1	862	Gilbert St, 500 ft South of Lincoln Ave	19	30	40	50
8-1	872	Magnolia Ave and Orange Ave	68	75	95	125
8-1	882	Shields Dr and Orange Ave	51	60	75	100
8-2	892	350 ft East of Dale Ave at Carbon Creek	11	18	25	30

9.2 Analysis of Existing Improvements

Storm water within Basin 8 is conveyed through a combination of existing storm drains and street flow. One area, Area 8-1, has an existing storm drain system. The main storm drain begins at Broadway and Loara Street and drains west in Broadway to Dale Avenue. At Dale Avenue, the storm drain turns north then outlets into Carbon Creek. This drain varies in size from a 36-inch to 96-inch RCP and has a capacity of 455 cfs which is equivalent to 45 percent of a 10-year storm.

Several lateral storm drains connect to the main line in Broadway. These laterals are located in Shields Drive, Magnolia Avenue, Gilbert Street, Brookhurst Street, Archer Street, Valley Street, and Empire Street/Lincoln Avenue. The Shields Drive storm drain is a 36-inch RCP and has a capacity of 18 cfs which is equivalent to 30 percent of a 10-year storm. The Magnolia Avenue storm drain is a 54-inch RCP and has a capacity of 35 cfs which is equivalent to 40 percent of a 10-year storm. The Gilbert Street storm drain north of Broadway varies in size from a 27-inch to 39-inch RCP and has a capacity of 35 cfs which is equivalent to 60 percent of a 10-year storm.

The Gilbert Street storm drain south of Broadway is a 45-inch RCP and has a capacity of 5 cfs which is equivalent to 5 percent of a 10-year storm. The Brookhurst Street storm drain varies in size from a 27-inch to 57-inch RCP and has a capacity of 70 cfs which is equivalent to 100 percent of a 10-year storm. The Archer Street storm drain is a 36-inch RCP and has a capacity of 30 cfs which is equivalent to 100 percent of a 10-year storm. The Valley Street storm drain varies in size from a 39-inch to 60-inch RCP and has a capacity of 125 cfs which is equivalent to 100 percent of a 10-year storm. The Empire Street/Lincoln Avenue storm drain varies in size from a 30-inch to 72-inch RCP and has a capacity of 230 cfs which is equivalent to 75 percent of a 10-year storm.

9.3 Proposed Improvements

In order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria, the following improvements are recommended for Area 8-1. In order to satisfy the City's flooded width criteria in Area 8-1, 15,075 feet of parallel storm drain is recommended in Broadway. The recommend storm drain varies is size from 42-inch RCP to 15-foot x 8-foot RCB.

Additionally, in order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria in Area 3-1, parallel storm drains in Shields Drive, Magnolia Avenue, Gilbert Street, Valley Street, and Empire Street/Lincoln Avenue are also proposed. In Shields Drive, 1,350 feet of 48-inch parallel RCP is proposed, 1,410 feet of 48-inch parallel RCP is proposed in Magnolia Avenue, 780 feet of 24-inch to 36-inch parallel RCP is proposed in north Gilbert Street, 1,330 feet of 54-inch to 7-foot x 4-foot parallel storm drain is proposed in south Gilbert Street, 1,390 feet of 30-inch to 42-inch parallel RCP is proposed in Valley Street, and 5,320 feet of 24-inch to 54-inch parallel RCP is proposed in Empire Street/Lincoln Avenue.

To satisfy the City's flooded width criteria in Area 8-1, an extension of the existing storm drain in Gilbert Street is proposed consisting of 1,500 feet of 54-inch RCP, an extension of the existing storm drain in Kathryn Drive is proposed consisting of 1,200 feet of 36-inch RCP, an extension of the existing storm drain in Valley Street is proposed consisting of 1,800

feet of 60-inch RCP, and an extension of the existing storm drain in Lincoln Avenue is proposed consisting of 980 feet of 36-inch RCP. The proposed improvements for Basin 8 are shown in Figure 9, the hydraulic calculations are included in Appendix E and the street flow calculations in Appendix F.

9.4 Cost Estimates

The estimated costs summarized in Table 12 include costs for construction, engineering, design, surveying, and construction management. Pipe costs are per linear foot of pipe and have been increased to include excavation, shoring, bedding, backfill, compaction, removal of excess material, and trench resurfacing. The detailed cost estimates for Basin 8 are included in Appendix A.

Since the construction of the recommended facilities will be spread out over a number of years, the total cost of master plan implementation will be subject to future construction cost increases. Therefore, it is recommended that the funding programs established for implementation of the Master Plan of Storm Drainage make provisions for the increased cost of deferred construction. Inflation factors should be applied to reflect a specific year's total cost over the 2010 total costs. Summarized in Table 12 are the construction cost estimates by project location for Area 8-in Basin 8.

Table 12 – Basin 8 Cost Estimate

Area	Storm Drain ID	Street	Type of Facility	Length (feet)	Estimated Cost (2010 Dollars)
8-1	SD 8-1_01 (P)	Broadway St.	Parallel 42-inch to 66-inch RCP and 8' by 8' to 15' by 8' RCB	14,930	$44,534,000
8-1	SD 8-1_02 (P)	Shields Dr.	Parallel 48-inch RCP	1,340	$1,899,000
8-1	SD 8-1_03 (P)	Magnolia Ave.	Parallel 48-inch RCP	1,405	$1,987,000
8-1	SD 8-1_04 (P)	Gilbert St. north of Broadway	Parallel 24-inch/36-inch RCP	825	$767,000
8-1	SD 8-1_05 (P)	Gilbert St. south of Broadway	Parallel 7' by 4' RCB	1,370	$3,441,000
8-1	SD 8-1_06 (P)	Orange Ave.	New 54-inch RCP	1,510	$2,507,000
8-1	SD 8-1_08 (P)	Valley St.	Parallel 30-inch/42-inch RCP	1,465	$1,690,000
8-1	SD 8-1_09 (P)	Orange Ave.	New 60--inch RCP	1,795	$3,345,000
8-1	SD 8-1_10 (P)	Camellia St/Lincoln Ave.	Parallel 42-inch/54-inch RCP	3,420	$5,294,000
TOTAL FOR BASIN 8					$65,464,000

Legend

- Anaheim City Limits
- Street Right of Way
- 5-1 Drainage Area

Proposed Storm Drains

- Priority 1
- Priority 2
- Priority 3

Existing Storm Drains

- 30 Anaheim (Pipe size in inches)
- County
- Caltrans
- Private
- Lateral

SD 1-1_01 (P) Proposed Pipeline ID
Drainage Area_Line No. (Proposed)

Note: Priority 2 proposed improvements will parallel existing storm drains unless otherwise noted

N

0 750 1,500 Feet

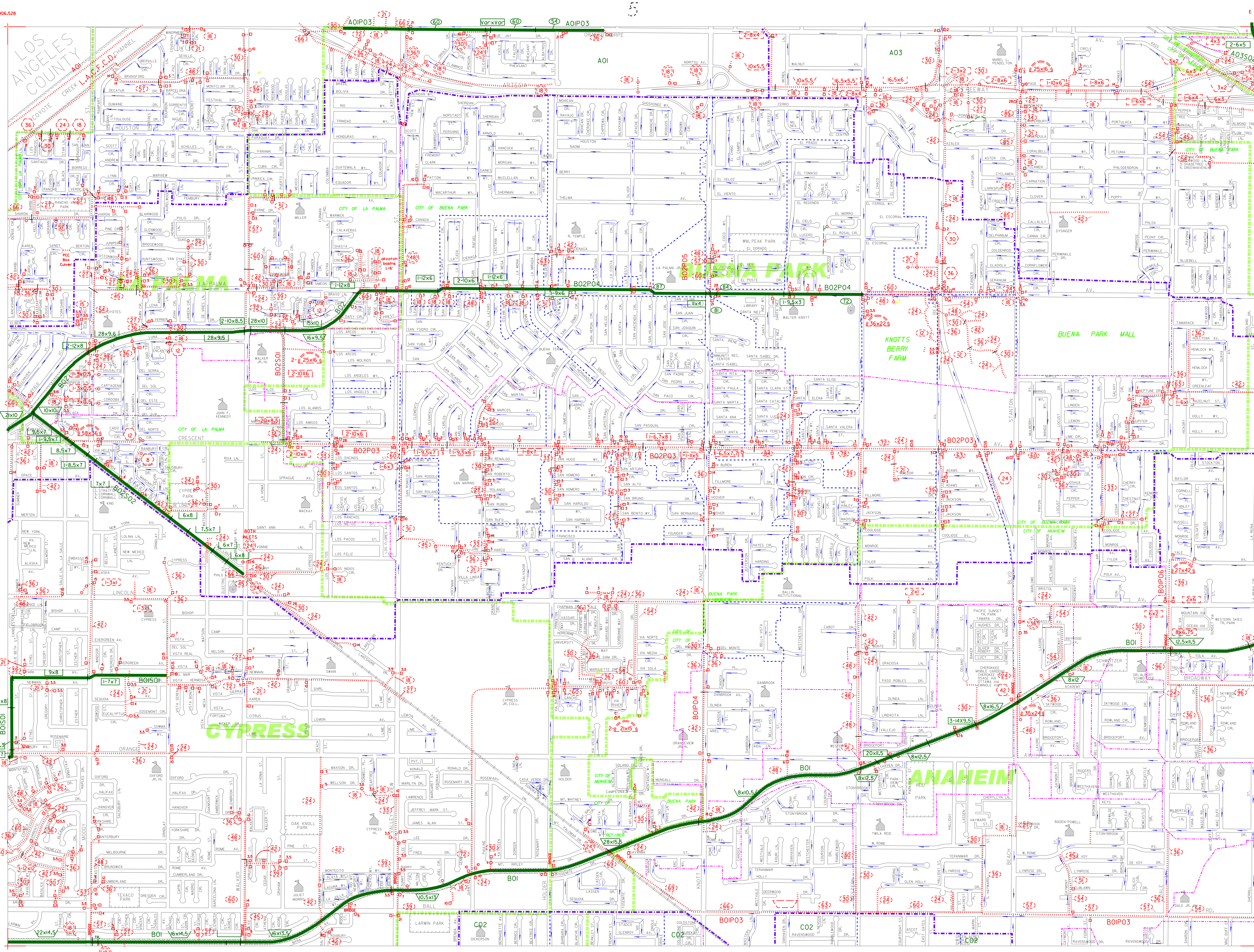
1 inch equals 1,500 feet

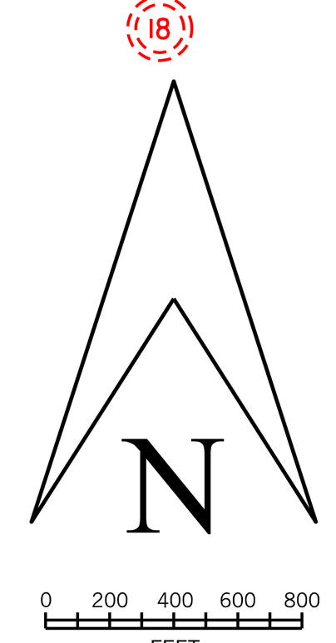
Figure 9
Drainage Basin 8

Master Plan of Storm Drainage for
Carbon Creek Channel Tributary Area

CH2MHILL

APPENDIX E
Orange County Drainage Facilities Maps





12

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To notify OC Public Works Flood Control Section of additions or corrections, please contact Sal Gutierrez at (714) 647–3992 or by email at sal.gutierrez@ocpw.ocgov.com

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	APR 23, 2012	12	MAPS–113–3

Channel Drainage Area Boundary
Major Sub–Area Drainage Boundary
Minor Sub–Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
OCFCD Basins or Reservoirs

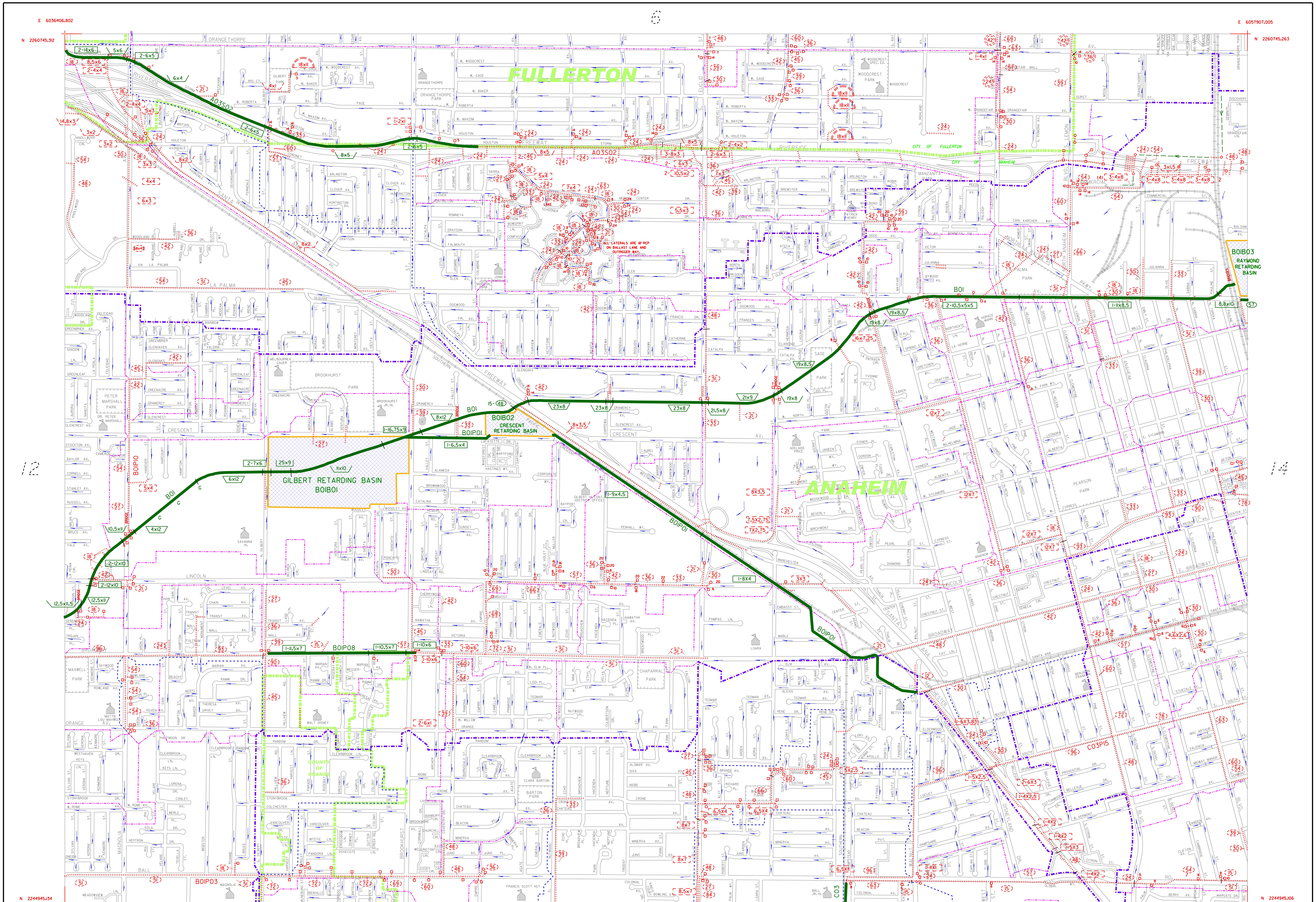
Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D. LOCAL

Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels–span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Metal Sheet Channel (MSC) (Base width by pile height in feet/Sheet pile total length)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)

12



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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	DEC. 20 2010	13	MAPS–113–3

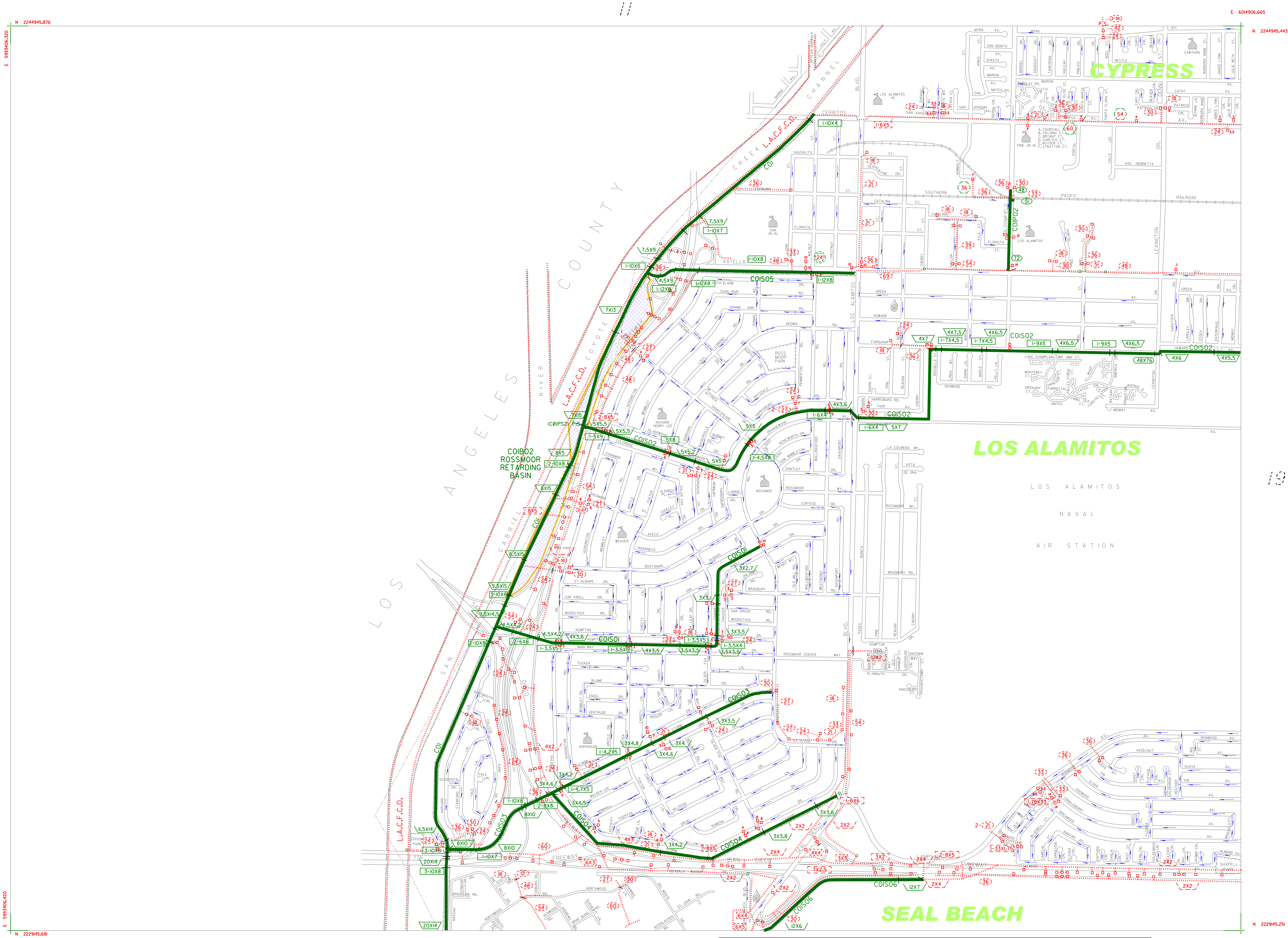
- Channel Drainage Area Boundary
- Major Sub–Area Drainage Boundary
- Minor Sub–Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G Greenbelt
- P.S. P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

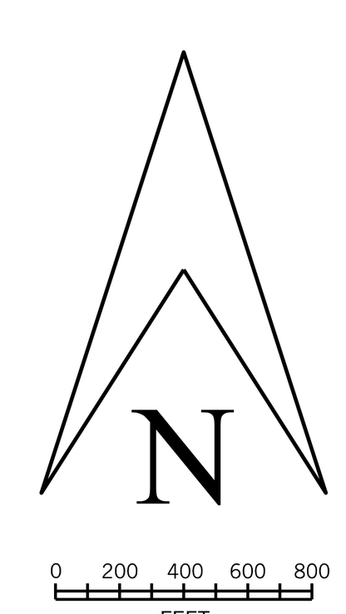
Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D. LOCAL

- Earth Trapezoidal Channel (base width by height in feet)
- Reinforced Concrete Trapezoidal Channel (base width by height in feet)
- Reinforced Concrete Rectangular Channel (base width by height in feet)
- Reinforced Concrete Box (RCB) (number of barrels–span by height in feet)
- Reinforced Concrete Pipe (RCP) (diameter in inches)
- Metal Sheet Channel (MSC) (Base width by pile height in feet/Sheet pile total length)
- Corrugated Metal Pipe (CMP) (diameter in inches)
- Concrete Pipe (diameter in inches)
- Concrete Oval Pipe (width by height in inches)
- Steel Pipe (diameter in inches)
- Reinforced Concrete Arch (base span by height in inches)
- Corrugated Metal Arch (base span by height in inches)





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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	JUN 9, 2008	18	MAPS–113–3

- Channel Drainage Area Boundary
- Major Sub–Area Drainage Boundary
- Minor Sub–Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G — Greenbelt
- P.S. P.S. — Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

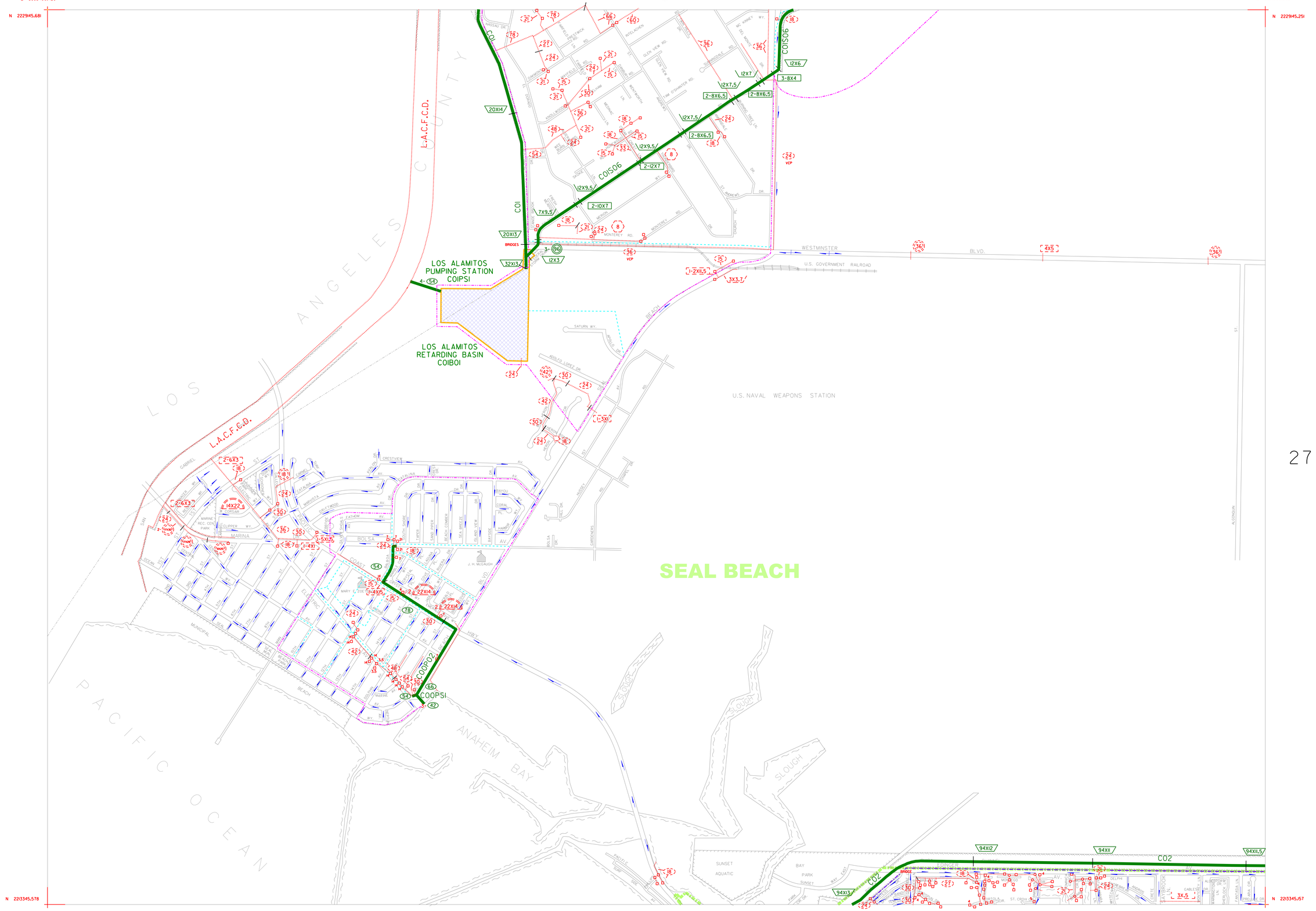
Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D. LOCAL

- Earth Trapezoidal Channel (base width by height in feet)
- Reinforced Concrete Trapezoidal Channel (base width by height in feet)
- Reinforced Concrete Rectangular Channel (base width by height in feet)
- Reinforced Concrete Box (RCB) (number of barrels–span by height in feet)
- Reinforced Concrete Pipe (RCP) (diameter in inches)
- Metal Sheet Channel (MSC) (Base width by pile height in feet/Sheet pile total length)
- Corrugated Metal Pipe (CMP) (diameter in inches)
- Concrete Pipe (diameter in inches)
- Concrete Oval Pipe (width by height in inches)
- Steel Pipe (diameter in inches)
- Reinforced Concrete Arch (base span by height in inches)
- Corrugated Metal Arch (base span by height in inches)

18



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To notify the Resources & Development Management Department (RDMD) of additions or corrections, please contact Sal Gutierrez at (714) 834-5396 or by email at sal.gutierrez@rdmd.ocgov.com

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	MAR. 7, 2007	26	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G Greenbelt
- P.S. P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D.	LOCAL	
		Earth Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Rectangular Channel (base width by height in feet)
		Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
		Reinforced Concrete Pipe (RCP) (diameter in inches)
		Metal Sheet Channel (MSC) (Base width by pile height in feet /Sheet pile total length)
		Corrugated Metal Pipe (CMP) (diameter in inches)
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

APPENDIX F
Hydraulic Calculations

Catch Basin Sizing

Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 14 2022

CB # 1 Sizing Q100

Curb Inlet

Location	= Sag
Curb Length (ft)	= 7.00
Throat Height (in)	= 6.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

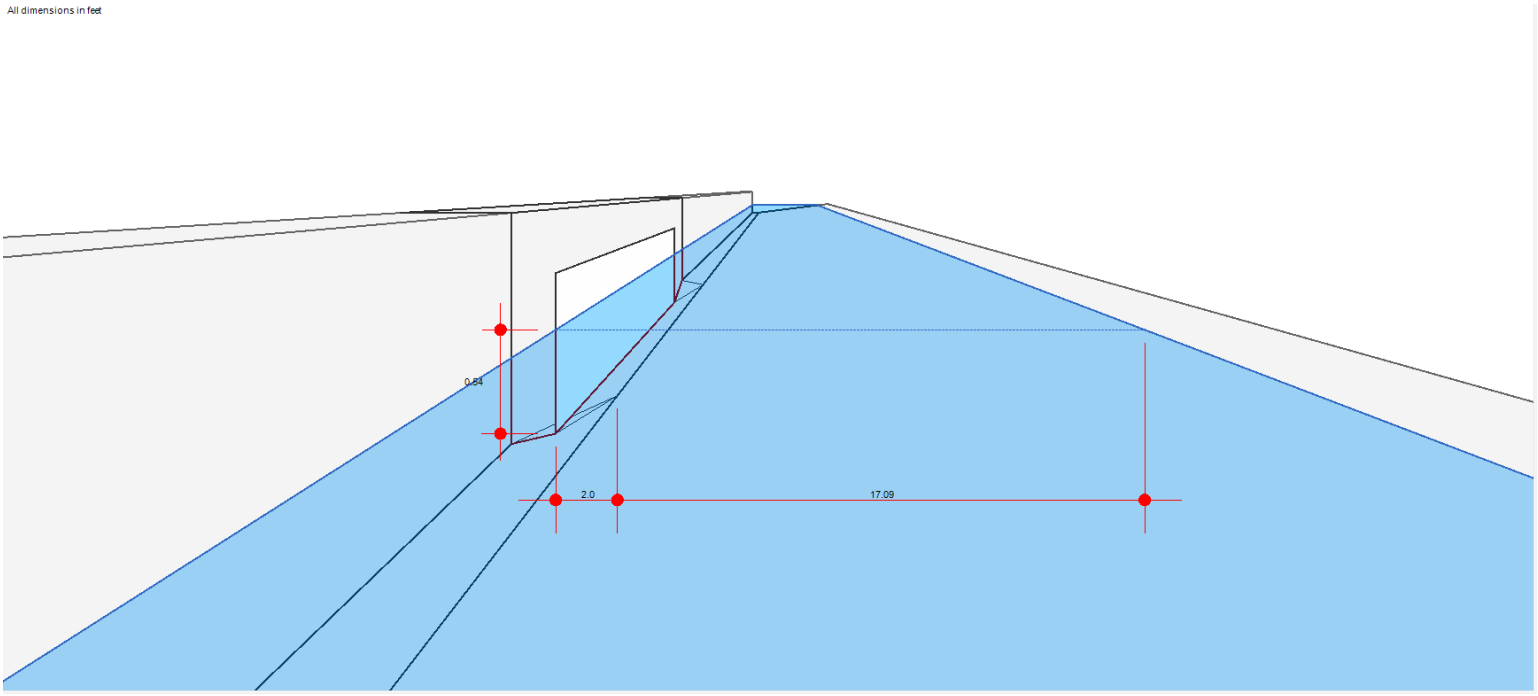
Slope, Sw (ft/ft)	= 0.015
Slope, Sx (ft/ft)	= 0.020
Local Depr (in)	= 2.00
Gutter Width (ft)	= 2.00
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 5.53

Highlighted

Q Total (cfs)	= 5.53
Q Capt (cfs)	= 5.53
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 6.46
Efficiency (%)	= 100
Gutter Spread (ft)	= 19.09
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Parkway Drain Sizing

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 14 2022

Q100 Parkway Drain

Rectangular

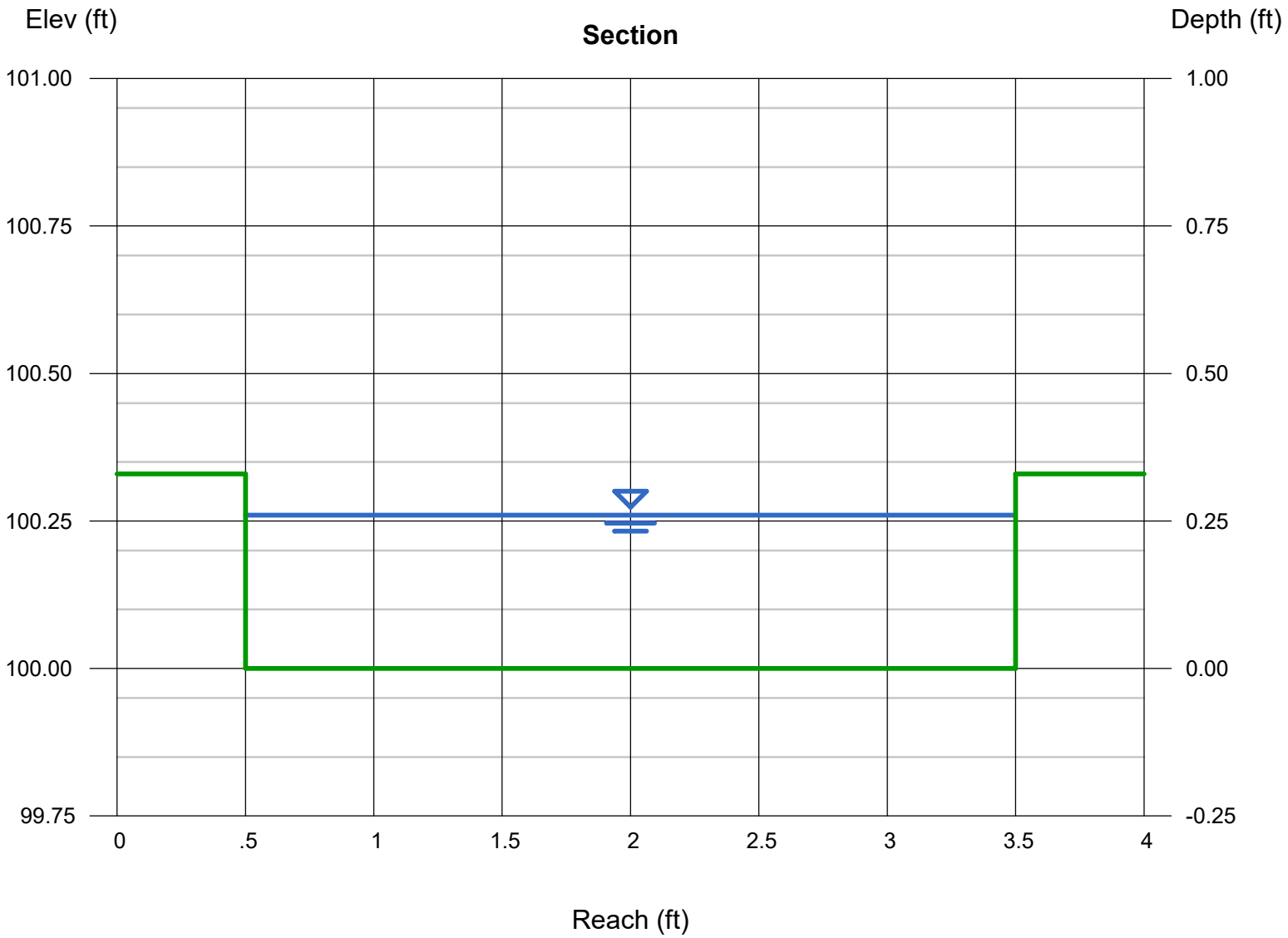
Bottom Width (ft)	= 3.00
Total Depth (ft)	= 0.33
Invert Elev (ft)	= 100.00
Slope (%)	= 2.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.49

Highlighted

Depth (ft)	= 0.26
Q (cfs)	= 4.490
Area (sqft)	= 0.78
Velocity (ft/s)	= 5.76
Wetted Perim (ft)	= 3.52
Crit Depth, Yc (ft)	= 0.33
Top Width (ft)	= 3.00
EGL (ft)	= 0.78



100-Year Ponding Calculations

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 14 2022

CB #1 DEPTH OF FLOW Q100

User-defined

Invert Elev (ft)	= 103.76
Slope (%)	= 0.70
N-Value	= 0.015

Calculations

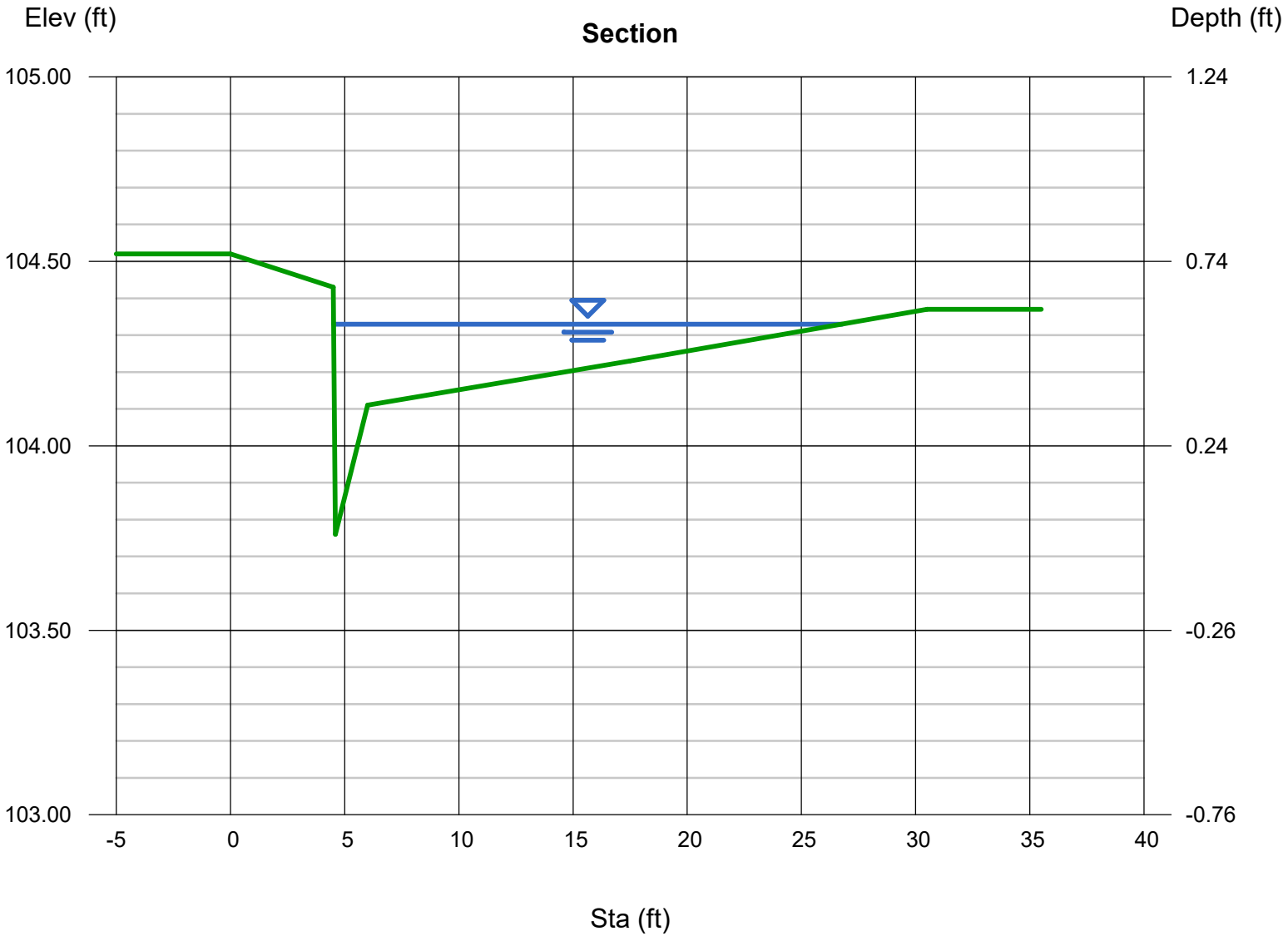
Compute by:	Known Q
Known Q (cfs)	= 5.53

Highlighted

Depth (ft)	= 0.57
Q (cfs)	= 5.530
Area (sqft)	= 2.88
Velocity (ft/s)	= 1.92
Wetted Perim (ft)	= 22.81
Crit Depth, Yc (ft)	= 0.57
Top Width (ft)	= 22.27
EGL (ft)	= 0.63

(Sta, El, n)-(Sta, El, n)...

(0.00, 104.52)-(4.50, 104.43, 0.015)-(4.60, 103.76, 0.015)-(6.00, 104.11, 0.015)-(17.50, 104.23, 0.015)-(30.50, 104.37, 0.015)

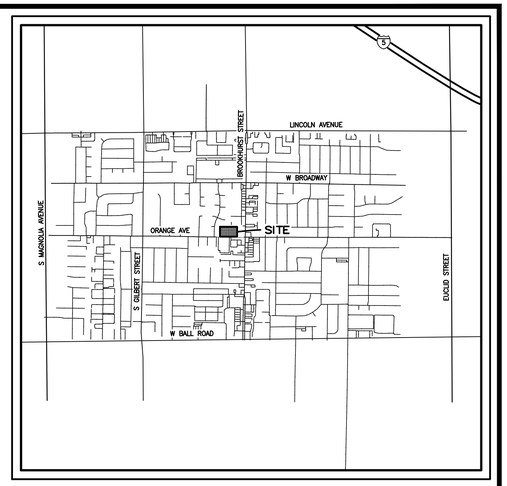


PONDING EXHIBIT

TR 19192

2219 W. ORANGE AVENUE

CITY OF ANAHEIM, COUNTY OF ORANGE



VICINITY MAP

NTS

LEGEND

EXISTING RIGHT-OF-WAY/ BOUNDARY

SCALE: 1" = 20'

0 10 20 40

DEVELOPER :

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER & DEVELOPER :

MELIA HOMES
8951 RESEARCH DRIVE, #100
IRVINE, CA 92618
PHONE (949) 759-4367

SOILS ENGINEER :

PREPARED BY :

C&V CONSULTING, INC.
CIVIL ENGINEERING
LAND PLANNING & SURVEYING
9830 IRVINE CENTER DRIVE
IRVINE, CALIFORNIA 92618
(949) 916-3800
INFO@CVC-INC.NET
WWW.CVC-INC.NET

REGISTERED PROFESSIONAL ENGINEER
DANE P. McDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

TRACT NO. 19192
PONDING EXHIBIT
HYDROLOGY

DATE: 6/21/2022

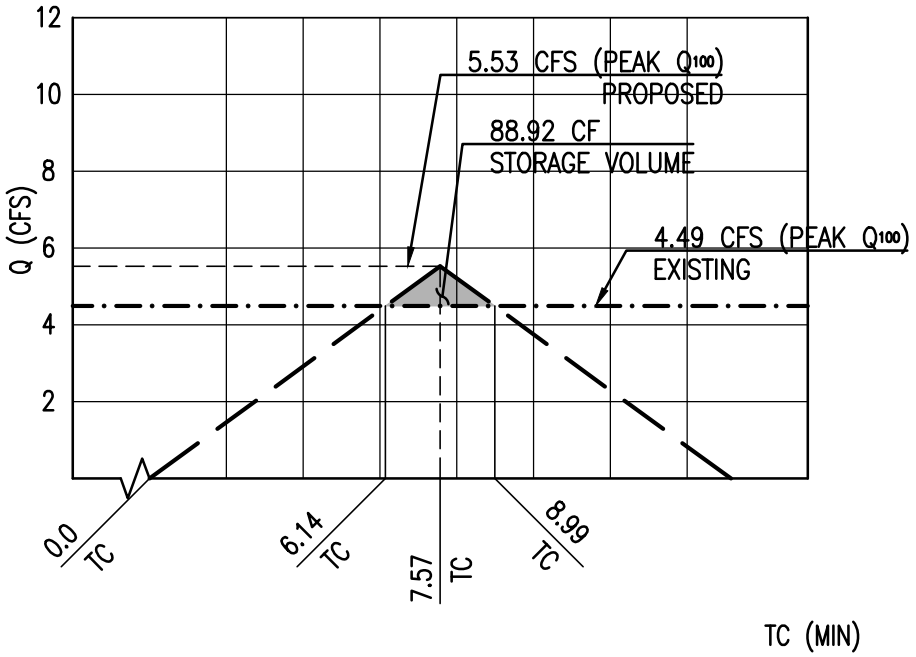
SHEET 1 OF 1

SCALE: AS SHOWN | DRAWN BY: SP | CHECKED BY: SP

CITY OF ANAHEIM

APPENDIX G
Small Area Runoff Hydrographs

100-YR STORM SMALL AREA RUNOFF HYDROGRAPH



CALCULATIONS:

V = VOLUME IN EXCESS OF Q ALLOWABLE OVER 24-HRS

V = 1/2 (dQ)(dTIME)

dTime = 8.99-6.14 = 2.85 min X 60 sec/min = 171 sec

dcfs = 5.53-4.49 = 1.04 cfs

VOLUME=1/2 (1.04) (171) = 88.92 CF

LEGEND:

TC-TIME OF CONCENTRATION

d-RATE OF CHANGE

NOTE:

TC-BASED ON (100 YR STORM EVENT)

HYDROGRAPH BASED ON ORANGE COUNTY HYDROLOGY MANUAL, SECTION J

WQMP2022-01416

City of Anaheim
County of Orange/Santa Ana Region
Priority Project
Preliminary Water Quality Management Plan (WQMP)

Project Name:

Townhomes at Orange Avenue

DEV2021-00195

2219 W. ORANGE AVENUE, ANAHEIM, CA 92804

TTM 19192

DEPARTMENT OF PUBLIC WORKS
SUBDIVISIONS
APPROVED
Aram Eftekhari, Associate Engineer
8/9/2022, 5:12:07 PM
ANAH-WQMP2022-01416
Aram Eftekhari

Prepared for:

Melia Homes

8951 Research Drive, Suite 100

Irvine, CA 92618

Chad Brown, Vice President of Planning & Development

(949) 759-4367

Prepared by:

C&V Consulting, Inc./ Dane McDougall, P.E.

9830 Irvine Center Drive

Irvine, Ca 92630

(949) 916-3800/ dmcdougall@cvc-inc.net

REGISTERED PROFESSIONAL ENGINEER
DANE P. MCDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

Prepared January 2022

Revised July 2022

Project Owner's Certification			
Planning Application No. (If applicable)	DEV2021-00195 WQMP-2022-01416	Grading Permit No.	TBD
		RCP No.	TBD
Tract/Parcel Map and Lot(s) No.	TTM19192	Building Permit No.	TBD
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			2219 W. Orange Avenue Anaheim, CA 92804 APN:127-102-21

This Preliminary Water Quality Management Plan (WQMP) has been prepared for Melia Homes by C&V Consulting, Inc. The WQMP is intended to comply with the requirements of the City of Anaheim and County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan , including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner: Chad Brown			
Title	Vice President of Planning & Development		
Company	Melia Homes		
Address	8951 Research Drive, Suite 100, Irvine, CA 92618		
Email	chad@melia-homes.com		
Telephone #	(949) 759-4367		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	7/26/22

Contents

Page No.

Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Project Infomation			
Permit/Application No. (If applicable)	DEV2021-00195 WQMP-2022-01416	Grading Permit No. & RCP No.	TBD
Address of Project Site (or Tract Map and Lot Number if no address) and APN	2219 W. Orange Avenue, Anaheim, CA 92804 TTM: 19192 APN:127-102-21		
Water Quality Conditions of Approval or Issuance			
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	Conditions of Approval have not been issued at this time. Water Quality Conditions of Approval will be provided in the Final WQMP.		
Conceptual WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	This is a Conceptual WQMP to support entitlement processing.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	Heavy Metals (Technical TMDL[1])		

[1] This TMDL has been adopted for Coyote/San Gabriel River by the Los Angeles Regional Water Quality Control Board (Region 4); however, it applies to the areas of Orange County that drain to Coyote Creek and San Gabriel River

Section II Project Description

II.1 Project Description

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td>Development Category (From Model WQMP, Table 7.11-2; or -3):</td><td colspan="4">All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety.
If the redevelopment results in the addition or replacement of less than 50 percent of the impervious area on-site and the existing development was not subject to WQMP requirement, the numeric sizing criteria discussed in Section 7.II-2.0 only applies to the addition or replacement area. If the addition or replacement accounts for 50 percent or more of the impervious area, the Project WQMP requirements apply to the entire development.</td></tr>
<tr><td>Project Area (ft²): 56,613</td><td colspan="3">Number of Dwelling Units: 24</td><td>SIC Code: n/a</td></tr>
<tr><td rowspan="2">Project Area</td><td colspan="2">Pervious</td><td colspan="2">Impervious</td></tr>
<tr><td>Area (square feet)</td><td>Percentage</td><td>Area (square feet)</td><td>Percentage</td></tr>
<tr><td>Pre-Project Conditions</td><td>7,360</td><td>13%</td><td>49,253</td><td>87%</td></tr>
<tr><td>Post-Project Conditions**</td><td>0</td><td>0%</td><td>56,613</td><td>100%</td></tr>
</table>

Drainage Patterns/Connections	The proposed development will consist of 1.30 acres. The existing site is relatively flat. The elevation of the existing site ranges from approximately 105.0' to 107.73' above mean sea level. In the current condition, the site generally sheet flows overland in the westerly and southerly directions. The parking lot area to the north of the buildings generally slopes west and the drive aisle to the east of the building generally slopes south to W. Orange Avenue. Existing topography shows the potential of emergency offsite runon through a gate along the property line. The property to the north has several inlets north of the property line but in case these facilities clog, emergency overflow may run onto the proposed site through the existing gate. Preliminary design proposes for a u-channel to be constructed on the proposed development site to capture any runoff and route it to the west property line where it will be conveyed to Orange Avenue. Limits of the offsite overflow watershed will be determined during final engineering and appropriate sizing of the u-channel will be provided. Stormwater runoff entering W. Orange Avenue flows west along the curb and gutter until it enters a city catch basin at Rosebay Street and enters a into an existing City of Anaheim public 54" pipe. Runoff continues west to Gilbert Street where it turns north until W. Broadway where it enters an 8'x6' RCB facility and continues west in Broadway into an 11'x8' RCB Facility until it outlets into the Carbon Creek Channel at S. Dale Avenue. The Carbon Creek Channel eventually confluences with the San Gabriel River and ultimately outlets into the Pacific Ocean at San Pedro Bay. Refer to Attachment D of this report for a copy of the OCFCD Drainage Facilities Maps. The proposed residential development will consist of one (1) Drainage Management Area (DMA) which will be graded to match the existing drainage condition. The proposed drainage system will collect and convey stormwater runoff to the proposed biofiltration system designed to treat the design treatment flow rate. Stormwater will then be conveyed into the infiltration system designed to retain and infiltrate the entire Design Capture Volume within a drawdown time of 48 hours. During larger storm events and when the infiltration system is at capacity, stormwater will overflow within the proposed biofiltration system by way of an internal weird wall and be conveyed offsite via a proposed parkway drain which outlets to W. Orange Avenue. Refer to Attachment B of this report for the Preliminary WQMP Exhibit. **Post-Project perviousness was assumed to be 100% to produce a conservative value for preliminary design. Post Project Area includes an 8' right of way abandonment along the entire frontage of the site. During final engineering, actual pervious coverage will be calculated as landscape plans become available.

Narrative Project Description: (Use as much space as necessary.)	The proposed 1.30-acre residential site is currently occupied by a church/ preschool consisting of 2 buildings, associated outdoor recreational areas, and asphalt concrete parking/drive aisles. Existing landscaped areas amount to approximately 13% pervious coverage within this area. Perimeter walls exist along the north, east, and west property lines of the site. The proposed site will be developed with six (6) 3-story, multi-family residential buildings with a total of 24 units. Units will consist of 2-, 3-, and 4-bedroom layouts and will range in between 1,606 and 1,979 square feet. The site will be accessible via one (1) proposed driveway entrance/ exit along W. Orange Avenue. Associated parking areas will consist of 48 private garage spaces and 14 guest stalls. In addition, the residential development will include a private drive aisle, recreational areas, sidewalks, and landscaped open-space areas. The drive aisle will be asphalt concrete pavement and sidewalks will be Portland cement concrete (PCC). Landscaped areas are assumed to amount to approximately 20% pervious coverage. During final engineering, actual project perviousness will be calculated. The project proposes an 8' wide Right-of-Way abandonment along the project frontage on W. Orange Avenue. Right-of-Way improvements include sidewalk replacement, one (1) proposed driveway entrance, and proposed parkway. The abandonment area has been included in the treatment area. Best Management Practice (BMP) selection for treatment of stormwater has been described in Section IV of this report. Implementation of BMPs will address the pollutants of concern associated with multi-family residential development. No car washing, trash enclosures, outdoor storage or food processing areas will be incorporated on this project. The project will be serviced by onsite private water system and onsite private sanitary sewer system that will be maintained by a homeowner's association. The proposed private water system will have two points of connection to the existing City maintained water line within W. Broadway. The proposed public sewer system will be gravity feed to one of point connection to an existing Orange County Sanitation District trunk main located within W. Orange Avenue. BMP strategy for the Right of Way area will be handled during final engineering. Long-term maintenance is planned to be handled by a Homeowner's Association appointed by Melia Homes. Refer to Attachment B of this report for a copy of the WQMP Exhibit.

II.2 Potential Stormwater Pollutants

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	Expected by proposed landscaped areas.
Nutrients	E ☒	N ☐	Expected by proposed landscaped areas.
Heavy Metals	E ☒	N ☐	Tributary by uncovered parking areas.
Pathogens (Bacteria/Virus)	E ☒	N ☐	Expected by proposed residence and pets.
Pesticides	E ☒	N ☐	Expected by proposed landscaped areas.
Oil and Grease	E ☒	N ☐	Expected by uncovered parking areas.
Toxic Organic Compounds	E ☐	N ☒	Per TGD, Table 2.1 this pollutant is not expected for attached residential developments.
Trash and Debris	E ☒	N ☐	Expected by proposed residence.

II.3 Hydrologic Conditions of Concern

☒ No – Show map

☐ Yes – Describe applicable hydrologic conditions of concern below.

Per the TGD Figure 1, Susceptibility Analysis of San Gabriel-Coyote Creek dated February 2013, the project site is indicated as a potential area of erosion, habitat, and physical structure susceptibility. The project site indirectly drains to the San Gabriel River, however it is downstream of the unstable portion of the river. Therefore, HCOCs do not exist. Refer to Attachment A for a the TGD Figure.

II.4 Post Development Drainage Characteristics

Post–development drainage will be consistent with a proposed attached Multi-Family Residential project. The tributary areas and direction of run-off flows for the proposed site are delineated on the attached WQMP Exhibit based on the grading and drainage design. Refer to the Preliminary WQMP Exhibit in Attachment B of this report.

In the current condition, the site generally sheet flows overland in the westerly and southerly directions. The parking lot area to the north of the buildings generally slopes west and the drive aisle to the east of the building generally slopes south to W. Orange Avenue. Existing topography shows the potential of emergency offsite runon through a gate along the property line. The property to the north has several inlets north of the property line but in case these facilities clog, emergency overflow may run onto the proposed site through the existing gate. Preliminary design proposes for a u-channel to be constructed on the proposed development site to capture any runoff and route it to the west property line where it will be conveyed to Orange Avenue. Stormwater runoff entering W. Orange Avenue flows west along the curb and gutter until it enters a city catch basin at Rosebay Street and enters a into an existing City of Anaheim public 54" pipe. Runoff continues west to Gilbert Street where it turns north until W. Broadway where it enters an 8'x6' RCB facility and continues west in Broadway into an 11'x8' RCB Facility until it outlets into the Carbon Creek Channel at S. Dale Avenue. The Carbon Creek Channel eventually confluences with the San Gabriel River and ultimately outlets into the Pacific Ocean at San Pedro Bay.

Proposed drainage runoff will be collected by a series of area drains and by one (1) proposed sump curb inlet Catch Basin within the proposed private drive aisle and be conveyed via proposed underground storm drain to proposed detention/ infiltration system sized for onsite retention for the Design Capture Volume (DCV). Pre-treatment of the DCV will be provided by a proposed Modular Wetlands System (MWS) Biofiltration vaults prior to entering the infiltration system.

The detention/ infiltration system will consist of a MaxWell IV Drainage System and an upstream 60" detention pipe, providing approximately 3,700 cubic feet (cf) of storage volume. During larger storm events and when the proposed detention/ infiltration system is at capacity, primary overflow will pond in the catch basin and overflow through a parkway drain, discharging to the existing concrete gutter located in W. Orange Avenue, matching historic drainage patterns. In an event where the proposed onsite storm drain system is at its full capacity or clogged, stormwater will pond at the proposed onsite sump area and excess stormwater will top over the proposed driveway where stormwater can safely discharge to the existing concrete gutter. Upon entering the existing concrete gutter, site runoff will follow the historic drainage path to the Carbon Creek Channel and eventually the Pacific Ocean. The proposed drainage pattern matches the existing historical drainage pattern from the site. Runoff from this area historically flows in the westerly direction and ultimately enters Carbon Creek Channel which flows in the southeasterly direction towards the Pacific Ocean. As part of the proposed development, the catch basin onsite will be equipped with storm drain signage and a catch basin trash rack and/or filter that complies with certified full capture system requirements.

II.5 Property Ownership/Management

The property is currently owned by Melia Homes. The Owner will be responsible for the long-term maintenance of the project's storm water facilities and conformance to this WQMP after construction is complete.

A Notice of Transfer of Responsibility is located in Attachment G of this report and should be executed as part of any ownership transfer after construction is complete.

Melia Homes will appoint a Homeowner's Association (HOA) to provide long term BMP maintenance for the proposed development. Refer to Section V of this report for additional information.

Section III Site Description

III.1 Physical Setting

Name of Planned Community/Planning Area (if applicable)	City of Anaheim
Location/Address	2219 W. Orange Avenue
	Anaheim, CA 92804
General Plan Land Use Designation	Residential Corridor
Existing Zoning	Transitional, T
Proposed Zoning	Low Medium Residential, RM-3
Acreage of Project Site	1.30 acres
Predominant Soil Type	Per TGD, Figure XVI-2a, NRCS Hydrologic Soils Groups the site is located within Soil Type B. Refer to Attachment A of this report for a copy of the map. **For site specific soil information, refer to Section III.2 and Attachment F of this report.**

III.2 Site Characteristics

Site Characteristics	
Precipitation Zone	The site falls under the 0.850" per the TGD, Figure XVI-1, Rainfall Zones map. Refer to Attachment A of this report for a copy of the map.
Topography	The site topography is relatively flat and sheet flows towards the project's southern and western boundaries. The site ranges in elevations from approximately 105.0' to 107.73'.
Drainage Patterns/Connections	The existing site is currently occupied by a church and has approximately 13% pervious cover. The existing site sheet flows overland towards the project's southern and eastern perimeter. Stormwater runoff entering W. Orange Avenue flows west along the curb and gutter until it enters a city catch basin at Rosebay Street and enters a into an existing City of Anaheim public 54" pipe. Runoff continues west to Gilbert Street where it turns north until W. Broadway where it enters an 8'x6' RCB facility and continues west in Broadway into an 11'x8' RCB Facility until it outlets into the Carbon Creek Channel at S. Dale Avenue. The proposed development will maintain the existing drainage condition.
Soil Type, Geology, and Infiltration Properties	Per the Geotechnical and Infiltration Evaluation prepared by GeoTek, Inc. dated September 21, 2021, the site's geotechnical properties are described as the following: "Artificial fill (asphalt concrete pavement sections consisting of asphalt concrete and aggregate base) was encountered in Borings B-1, B-2 and B-3. Borings B-4 and B-5 were conducted within landscape (lawn) areas of the site." "Alluvium was encountered beneath the fill/lawn in all the exploratory borings. The alluvium was found to consist of interbedded layers of silty and sandy clay, sandy and clayey silts, silty sands, and relatively clean sands (CL, ML, and SM soil types based upon the Unified Soil Classification System). The fine-grained alluvial soils (CL and ML soil types) were found to be medium stiff to hard while the coarse-grained alluvium was found to be medium dense to very dense." "Based on the results of laboratory testing, the upper site soils are considered to have a "low" (21-50) expansion potential (ASTM D 4829). Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). " Refer to Attachment F of this report for a copy of the Geotechnical Report.

Hydrogeologic (Groundwater) Conditions	Per the Geotechnical and Infiltration Evaluation prepared by GeoTek, Inc. dated September 21, 2021, the site's groundwater conditions are described as the following: "Groundwater was not encountered within any of the test borings drilled at the site. Based on review of available data, it is estimated that the depth to high groundwater at the site is greater than about 50 feet below grade. Based on the results of the field exploration, review of site area geomorphology and geology, groundwater is not anticipated to adversely affect the proposed improvements. " GeoTek, Inc. followed with a Supplemental Information on Site Groundwater Levels, dated June 1, 2022. Upon GeoTek, Inc.'s additional research, the following groundwater conditions are a more appropriate representation of the project site: "As noted in the referenced Geotechnical and Infiltration Evaluation report for the project (GeoTek, 2021), groundwater was not encountered to the maximum depth explored (approximately 51.5 feet for Boring B-1). This is consistent with data published by GeoTracker (https://geotracker.waterboards.ca.gov/) for a property located about ¼-mile northeast of the site (300 South Brookhurst Street), with a reported groundwater elevation of about 60 feet above mean sea level (amsl) in 2000. Given that the average elevation of this site is approximately 109 feet amsl, the indicated groundwater depth would correspond to a groundwater elevation of about 49 feet amsl. This report indicated that groundwater flow at this site was to the southwest (towards the project site). Review of the California Water Data Library (http://wdl.water.ca.gov/waterdatalibrary/) indicates that one well located approximately 3/4-mile north of the site (Site Code 338320N1179624W001) showed that the highest groundwater elevation was approximately 49 feet amsl in 1970. Based upon review, historic high groundwater level in the project area is greater than 50 feet below the existing ground surface. According to Appendix C of the Orange County Technical Guidance Document (County of Orange, 2017), a minimum separation of 10 feet is required between the mounded seasonally high groundwater and the bottom of the proposed infiltration system. GeoTek understands that drywell(s) approximately 35 feet in depth are planned for this site for the proposed infiltration system. Because groundwater at the site is deeper than 50 feet deep and the relatively shallow configuration of the proposed infiltration system, a separation to mounded seasonally high groundwater of more than 10 feet, as required by the City, is expected." Refer to Attachment F of this report for a copy of the geotechnical report and

<table>
<tr><td></td><td>Supplemental Information on Site Groundwater Levels letter.

Per additional research on the GeoTracker database, there are no known contaminated sites within 250 feet of the project site. Refer to Attachment D for a copy of the project site located on the GeoTracker map.</td></tr>
<tr><td>Geotechnical Conditions (relevant to infiltration)</td><td>Per the Geotechnical and Infiltration Evaluation prepared by GeoTek, Inc. dated September 21, 2021, the site's geotechnical infiltration properties are described as the following:

"In addition to the geotechnical exploratory borings, two (2) borings (I-1 and I-2) were excavated in the area of the anticipated storm water control systems as designated by the project developer. In addition to borings I-1 and I-2, boring B-1 was converted to an infiltration boring by partial backfill of the boring to a depth of about 40 feet, to a depths below the contact between the fine-grained alluvium (ML soil type) and the coarse-grained alluvium (SM soil type). Infiltration/percolation testing was conducted in these borings in general accordance with the requirements of the County of Orange.

The percolation tests consisted of drilling an eight-inch diameter test hole to the desired depth and installing approximately two inches of gravel in the bottom of the hole. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the boring. Water was then placed in the borings to presoak the holes and percolation testing was performed the following the pre-soak period. Following presoaking, the percolation tests were performed which consisted of adding water to each test hole and measuring the water drop over a 30-minute period. The water drop was recorded for twelve test intervals. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method. The infiltration rates calculated using the Porchet Method are presented in the following table:

<table>
<tr><th colspan="2">SUMMARY OF RESULTS</th></tr>
<tr><th>Boring</th><th>Measured Infiltration Rate (inches per hour)</th></tr>
<tr><td>I-1</td><td>0.38</td></tr>
<tr><td>I-2</td><td>4.16</td></tr>
<tr><td>I-3</td><td>1.64</td></tr>
</table>

The results of the conversions indicate infiltration rates of 0.38 to 4.16 inch per hour, which indicate highly variable infiltration rates based upon depth and location. Copies of the percolation data sheets and the Porchet infiltration rate conversion calculations are presented in Appendix C. No factors of safety were applied to the rates provided. Over the lifetime of the infiltration areas, the infiltration rates may be affected by sediment build up and biological activities,</td></tr>
</table>

	as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rate in designing the infiltration system. " Refer to Attachment F of this report for a copy of the referenced geotechnical recommendations. Note that further infiltration testing will be conducted during final engineering in the proposed locations and depths of infiltration.
Off-Site Drainage	No off-site drainage enters the property.
Utility and Infrastructure Information	Utilities are proposed to be underground. No special setbacks are needed or proposed. Proposed domestic water, storm drain, sanitary sewer and underground fire water system will be private and maintained by the appointed HOA.

III.3 Watershed Description

Receiving Waters	Site runoff drains towards the surrounding rights-of-way of the site and enters the existing Carbon Creek Channel. Carbon Creek Channel conveys all site runoff in the southwesterly direction and converges with Coyote Creek which drains to San Gabriel River and eventually the Pacific Ocean at San Pedro Bay. The site is located within the San Gabriel-Coyote Creek Watershed.
303(d) Listed Impairments	**Carbon Canyon Creek –** n/a **Coyote Creek –** Ammonia, Dissolved Copper, Diazinon, Indicator Bacteria, Lead, pH, Toxicity **San Gabriel River, Reach 1 –** Coliform Bacteria, pH **San Gabriel River Estuary –** Copper, Dioxin, Nickel, Dissolved Oxygen**,** **San Pedro Bay –** Chlordane, DDT, PCBs, Sediment Toxicity
Applicable TMDLs	**Carbon Canyon Creek –** Chloride, Sulfates **Coyote Creek –** Abnormal Fish, Aluminum, Ammonia, Chloride, Dissolved Copper, Cyanide, Diazinon, Excess Algal Growth, Fluoride, Indicator Bacteria, Lead, Lindane/gamma Hexachlorocyclohexane, Nitrite Nitrogen, Dissolved Oxygen, Pentachlorophenol, pH, Selenium, Toxicity, Zinc **San Gabriel River, Reach 1 –** Abnormal Fish, Ammonia, Coliform Bacteria, Excess Algal Growth, pH, Toxicity **San Gabriel River Estuary –** Abnormal Fish, Ammonia as Nitrogen, Copper, Dioxin, Nickel, Dissolved Oxygen **San Pedro Bay –** Chlordane, Chromium, Copper, DDT, PAHs, PCBs, Sediment Toxicity, Zinc
Pollutants of Concern for the Project	Anticipated and Potential Pollutants of Concern for Attached Residential Development is Suspended Solid/Sediments, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, Oil & Grease and Trash & Debris.
Environmentally Sensitive and Special Biological Significant Areas	The project is not located within any known Environmentally Sensitive Areas (ESA) or Areas of Special Biological Significance (ASBS).

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	There are currently no approved WIHMPs for the Santa Ana Region.	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Per 7.II-2.4.2.2 of the MWQMP, HCOCs exist when the proposed condition of the site generates a decrease in the time of concentration beyond 5% and an increase in runoff volume beyond 5% for the 2-year storm event, thus potentially increasing downstream erosion. The project site drains to the San Gabriel River, the site is located downstream of the unstable portion of the river, therefore no HCOC's apply.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	According to Section 7.II-2.4.3 of the MWQMP Priority Projects must biotreat/biofilter the 85th percentile, 24-hour storm event (Design Capture Volume). A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment be provided for the remaining design capture. This project proposes to utilize infiltration BMPs to treat the required stormwater runoff volume. Biotreatment BMPs will also be utilized as a form of pre-treatment prior to entering the proposed infiltration systems.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	If it is not feasible to meet LID performance criteria through retention and/or biotreatment provided on-site or at a sub-regional/regional scale, then treatment control BMPs shall be provided on-site or off-site prior to discharge to waters of the US. Since the project proposes to satisfy LID performance criteria, therefore treatment control performance criteria is also fully satisfied. Sizing of treatment control BMPs (Biofiltration Systems) shall be based flow-based for the area being redeveloped to medium and high effectiveness for reducing the primary pollutants of concern, which will be considered in compliance. Refer to Attachment C for manufacturer's specifications for the proposed biotreatment BMPs. Refer to Section IV.3.4, Biotreatment BMPs for additional information regarding BMP selection.
Calculate LID design storm capture volume for Project.	Biotreatment BMPs will be utilized for pre-treatment of the required treatment flow rate, and infiltration BMPs will be utilized to retain/infiltrate the required treatment volume. Per the City of Anaheim, BMP Design Guidelines dated November 2019, Design Standard #1 for Pre-Treatment for Focused Infiltration, "if biotreatment is utilized as pre-treatment, it can be sized for… 50% of the design flow-rate in the case of proprietary and flow-based biotreatment BMPs for pre-treatment." The proposed project residential site will generate a total DCV of 3,822 cf. The DCV for each DMA was calculated as follows: DMA 1: V_{design} = 0.90*0.9*1.3 acres*43,560 (sf/acre)*(1 foot/12 inches) = 3,822 cft Sheet flows from proposed drive aisles and parking areas will generate a total design flowrate of 0.1872 cfs. The design flowrate corresponding to surface flows from streets and drive aisles within each DMA was calculated as follows: DMA 1: Q_{design} = 0.90*0.26 (in/hr)*0.8 acres*0.5 = 0.0936 cfs See Attachment A of this report for DCV and treatment flow rate calculations.

IV.2. Site Design and Drainage

The site proposes one (1) Drainage Management Area as indicated on the Preliminary WQMP Exhibit. The DMA is based on the Preliminary Grading and Drainage design. The DMA will have an area drain system to collect and convey runoff from landscape, surface, and roof drainage to the proposed treatment device. Pervious coverage located throughout the site will promote impervious area dispersion from roof and sidewalk runoff.

Street surface runoff will be collected and conveyed through a curb inlet Modular Wetland System (MWS) Biofiltration vault for pretreatment of the DCV. Upon pre-treatment, flows will be conveyed to proposed detention/ infiltration system sized for the onsite retention and infiltrations of the DCV. The Infiltration systems are designed to retain and infiltrate the entire DCV with a drawdown time of 48 hours. During larger storm events and when the proposed infiltration BMP is at capacity, stormwater will back up into the proposed curb inlet catch basin and overflow through a proposed parkway drain to the existing curb and gutter in W. Orange Avenue. In the event the catch basin and/ or parkway drain become clogged, emergency overflow will top the driveway and flow towards W. Orange Avenue.

The Modular Wetland System (MWS) Biofiltration vault is designed to provide a 3-phase treatment train. Initially, when the stormwater enters the system, a trash rack, filter media and settling chamber will capture large trash/ debris and sediment in the stormwater before entering the planting media. This system is designed to treat stormwater flow horizontally. Before the stormwater enters the planting or "wetland" chamber, the runoff flows through the 2nd phase, a pre-filter cartridge which captures fines TSS, metals, nutrients and bacteria. The pre-filter chamber eliminates additional maintenance of the planting area. The wetland chamber is the 3rd phase of the system which provides final treatment through a combination of physical, chemical and biological processes. Refer to Section IV.3.4 of this report for sizing information of the Biofiltration Vaults.

The MaxWell IV Drainage System provides another round of pre-treatment of runoff prior to infiltration. Infiltration will occur below the Settling Chamber. Runoff will enter the Settling Chamber equipped with an absorbent pillow that will contain the pollutants. Runoff is then routed into the drywell portion of the subsurface soils where percolation occurs, recharging the groundwater. A proposed underground detention pipe will provide additional storage in addition to capturing the required design capture volume prior to entry into the Maxwell IV Drainage System. The Maxwell IV Drainage System will be sized to infiltrate the required Design Capture Volume (DCV) within a 71-hour timeframe. Refer to Section IV.3.2 of this report for sizing information for the infiltration system.

The depth of the proposed infiltration system will provide clearance of 10′ between the bottom of the infiltration system and the ground water elevation.

Refer the WQMP Exhibit in Attachment B for the location of the proposed BMPs. Refer to Attachment C for manufacturer's specifications of the selected BMPs.

IV.3 LID BMP Selection and Project Conformance Analysis

IV.3.1 Hydrologic Source Controls (HSCs)

The full Design Capture Volume (DCV) is being treated with LID BMPs, therefore HSCs are not proposed.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

** The entire DCV will be treated with an LID BMP, therefore HSC BMPs are not required.*

IV.3.2 Infiltration BMPs

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☒
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐

The proposed development will utilize one (1) Maxwell IV Drainage System to treat and retain the required Design Capture Volume. The Maxwell IV Drainage System is a chamber system that collects, pre-treats, stores, and directs stormwater runoff underground to promote infiltration and soil percolation to re-charge the groundwater. The Settling Chamber will pre-treat the site runoff which will collect pollutants such as sediment/ silt to settle, oil/grease, nutrients, pathogens, and phosphorus. It will also collect larger trash/debris. Clean runoff is then routed to the drywell. The settling chamber is cast-in-place concrete with perforated holes located in the lower 5 feet to maximize infiltration. An underground detention system will be connected to the drywell to provide storage. Runoff enters the detention system prior to entry into the Maxwell IV Drainage System. The combination of the infiltration system and upstream storm drain detention provide enough static volume to retain the required DCV.

Refer to Attachment C of this report for additional Maxwell Plus Drywell System information.

Infiltration Calculations

Per the Geotechnical and Infiltration Evaluation prepared by GeoTek, Inc. dated September 21, 2021, infiltration rates encountered on the project site range between 0.38 and 4.16 inches per hour. For conservative purposes, 1.64 inches per hour was used for infiltration calculations. During final engineering, additional infiltration testing will be conducted at the location of each proposed BMP, and infiltration calculations will be re-evaluated.

Drywell Calculations:

· A factor of safety of 2 was applied to the measured rate for a design infiltration rate (KDESIGN) = 0.82 in/hr per Worksheet H of the Orange County TGD.
· The proposed Drywell System has been located at least 10' from building foundations and all property lines.
· The volume statically held within the drywell system includes the volume held by the gravel drywell

(void ratio = 0.40) and the volume held within the Primary and Settling Chambers. Upstream Detention system storage will be provided for the required amount of volume not statically held within the drywell system.
· Depth of groundwater is deeper than 50' below existing ground surface per California Water Data Library Site Code 338320N1179624W001 per the Geotechnical Investigation prepared by Alta California Geotechnical, Inc. dated April 23, 2021.

DMA A1
A = 1.30 ac
DCV = 3,822 cf
Maxwell IV Drainage System with the following properties:
*· 20' Settling Chamber depth at 4' diameter (10' static storage depth)**
· 20 Drywell Depth at 6' diameter
· Inlet pipe at invert 10' below FS
·Total Depth (overall depth) = dsettling + ddrywell
= 20' + 20' =40'
Storage Calculations:
*VSETTLING =πr^2(dstatic settling) = π (2 ft)^2(20 ft) = 251 cf **
VDRYWELL = πr^2(ddrywell)(n) = π (3 ft)^2(20 ft)(0.40) = 226 cf
where, r = radius (ft), d = depth (ft), n = Void Space (0.40) per manufacturer's specifications
∑Volume = 251 cf + 226 cf = 477 cf

** Only the portion below the inlet pipe for the Primary and Settling Chambers was included for static storage calculation of drywell system.*

Required Detention Pipe Storage = DCV - ∑V = 3,822 cf – 477 cf = 3,345 cf
Provided → 190 lf of 60" HDPE Detention Pipe (19.63 cf of storage per lf)
V = (19.63 cf/lf)(190 lf)= 3,729 cf > 3,345 cf √*

Infiltration Calculations:
V72-HR = (1 ft/ 12 in)(KDESIGN, in/hr)(SA, sf)(72 hr), where SA = Infiltrating Surface Area of Drywell
SA = πr^2 + 2π (r)(ddrywell infiltration) =π (3 ft)^2 + 2(π)(3 ft)(35 ft+(20f+20ft)) = 782 sf
where, r = radius (ft), ddrywell infiltration = depth of drywell infiltration zone (ft)

V72-HR = (1 ft/12 in)(0.82 in/hr)(782 sf)(72 hr) = 3,847 cf > DCV = 3,822 cf√

Conclusion:
The utilization of one (1) Maxwell Plus Drywell System and Upstream Detention Storage will provide more than the required infiltration surface area and storage volume to meet the required water quality treatment design capture volume.
GIS:
DMA 1 Drywell System 6042335.9167E, 2248137.9856

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Evapotranspiration, Rainwater Harvesting BMPs will not be utilized and have been determined to be infeasible for this site due to development type, density and available amount of landscaped area for irrigation purposes. Refer to Worksheet J for feasibility calculations within Attachment A of this report.

IV.3.4 Biotreatment BMPs

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐

Modular Wetland System (MWS) Biofiltration vaults will be utilized to treat the design capture volume using the treatment flow rate method per the Orange County Technical Guidance Document worksheets. The MWS Biofiltration vaults utilize a 3-phase treatment train by collecting the stormwater runoff in a Pre-Treatment Chamber, Planting or "Wetland" Chamber and Discharge Chamber.

The MWS Biofiltration vaults were sized per DMA requirements. Refer to Worksheet D in Attachment A for calculations.

DMA	Acreage Tributary to Proposed Catch Basins (ac)	Required Treatment Flow Rate, Q (cfs)	MWS Model	Treatment Capacity, Q (cfs)
1	1.30	0.0936	MWS-L-4-8-C	0.115

***Project-specific details will be provided during final engineering. Refer to Attachment C for additional manufacturer information.*

Conclusion:

The utilization of a MWS Biofiltration vault adjacent to the one (1) proposed catch basin will provide more than the required treatment flow rate for their tributary drainage area.

N/E Coordinates of Modular Wetlands Systems:

DMA 1 Modular Wetland System: 6042320.90E, 2248162.26N

IV.3.5 Hydromodification Control BMPs

Hydromodification Control BMPs	
BMP Name	**BMP Description**
n/a	n/a

IV.3.6 Regional/Sub-Regional LID BMPs

Regional/Sub-Regional LID BMPs
Not Applicable for this project.

IV.3.7 Treatment Control BMPs

Treatment Control BMPs	
BMP Name	**BMP Description**
Automatic Retractable Screen (ARS) Device	The proposed MWS System and catch basin adjacent to W. Orange Avenue on the westerly side of the drive aisle will be equipped with an Automatic Retractable Screen (ARS) sized for the 1 year 1 hour storm event. Refer to Attachment C for manufacturer information.

IV.3.8 Non-structural Source Control BMPs

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	
N6	Local Industrial Permit Compliance	☐	☒	Proposed residential project.
N7	Spill Contingency Plan	☐	☒	Proposed residential project.
N8	Underground Storage Tank Compliance	☐	☒	Proposed residential project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	
N10	Uniform Fire Code Implementation	☐	☒	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	Proposed residential project.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Proposed residential project.

N1: Education for Property Owners, Tenants & Occupants

Project conditions of approval will require that the Homeowner's Association (HOA) periodically provide environmental awarness education materials, made available by the municipalities, to all of its members. Among other things, these materials will be descrive the use of chemcials (including household type) that should be limited to the property, with no discharge of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials available from the County of Orange can be downloaded here:

http://www.ocwatersheds.com/PublicEd/resources/default.aspx

N2: Activity Restrictions

Conditions, covenants and restrictions (CC&Rs) must be prepared by the developer for the appointed HOA for the purpose of surface water quality protection. The CC&Rs shall incorporate the restrictions based on the Project WQMP.

N3: Common Area Landscape Management

All common landscaping and/ or open space areas shall have on-going landscape maintenance by an appointed professional landscaping maintenance company as selected by the HOA. Maintenance shall incorporate all current County Water Conservation Resolution usage and follow the Management Guidelines for Use of Fertilizers per the DAMP Section 5.5. Refer to Section 5 of this report for additional landscape maintenance requirements.

N4: BMP Maintenance

Refer to Section 5 and Attachment E of this report for additional non-structural BMP maintenance requirements, responsibility and frequency.

N11: Common Area Litter Control

HOA to implement trash management and litter control procedures in the common areas aimed at reducing pollution of drainage water. HOA to contract with landscape maintenance company to provide this service during regularly scheduled maintenance, which will consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposals violations by homeowners, tenants or occupants and reporting the violations to the HOA for investigation.

N12: Employee Training

HOA to provide Educational Materials and Property Management manuals to all employees upon initial hiring. Any updated information shall be provided to employees within a timely manner along with information on implementation.

N14: Common Area Catch Basin Inspections

HOA to inspect, clean and repair common area catch basins within the development to verify that the private drainage system is working properly. All trash/ debris and sediment build up is removed and any repairs/ replacements are conducted. Cleaning should take place in late summer/ early fall prior to the start of the raining season. Drainage facilities include catch basins (storm drain inlets), detention basins, retention basins,

sediment basins, open drainage channels, area drains, and lift stations. Records shall be kept onsite to document the annual maintenance.

N15: Street Sweeping of Private Streets & Parking Lots

HOA to schedule at a minimum street sweeping of private streets and parking areas prior to the start of the rainy seasons, in late summer or early fall. Additional sweeping may be required to remove landscaping foliage and/ or pollution.

IV.3.9 Structural Source Control BMPs

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No proposed outdoor storage areas.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	No proposed trash enclosure areas.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	No proposed slopes or channels.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not Applicable.
S6	Dock areas	☐	☒	No proposed dock areas.
S7	Maintenance bays	☐	☒	No proposed maintenance bay areas.
S8	Vehicle wash areas	☐	☒	No proposed vehicle wash areas.
S9	Outdoor processing areas	☐	☒	No proposed outdoor processing areas.
S10	Equipment wash areas	☐	☒	No proposed equipment wash areas.
S11	Fueling areas	☐	☒	No proposed fueling areas.
S12	Hillside landscaping	☐	☒	No proposed hillside landscaping areas.
S13	Wash water control for food preparation areas	☐	☒	No wash water control for food preparation areas.
S14	Community car wash racks	☐	☒	No proposed community car washing racks.

S1 (CASQA Fact Sheet SD-13): Storm Drain Stenciling & Signage

HOA to inspect, repair and/ or replace storm drain stenciling and signage immediately. Inspection of stenciling and signage shall occur at least once per month and prior to the start of the raining season. Storm Drain stenciling and signage with a reference that indicates "Drains to Ocean" per CASQA BMP SD-13 Fact Sheet is required.

S4 (CASQA Fact Sheet SD-12): Use Efficient Irrigation Systems & Landscape Design

HOA shall implement the timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm drain systems. HOA to implement the following methods to reduce excessive irrigation water runoff, where applicable:

- Employ rain shutoff devices to prevent irrigation after precipitation
- Utilizing landscape specific irrigation water requirements
- Utilize flow reducers or shutoff valves triggered by pressure drop to control water loss due to broken sprinkler heads
- Implement landscaping practices per the County Water Conservation Resolution or City agency equivalent
- Group plants or landscaping with similar water consumption in order to promote surface infiltration

Refer to CASQA BMP Fact Sheet SD-12 for additional information.

IV.4 Alternative Compliance Plan (Not Applicable)

IV.4.1 Water Quality Credits

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td colspan="5">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td>☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="2">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td>☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="4">Water Quality credits will not be utilized on this development site.</td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

Not applicable for this project.

Section V Inspection/Maintenance Responsibility for BMPs

The property is currently owned by Melia Homes. The Owner will be responsible for the long-term maintenance of the project's storm water facilities and conformance to this WQMP after construction is complete.

A Notice of Transfer of Responsibility is located in Attachment G of this report and should be executed as part of any ownership transfer after construction is complete.

The owner will appoint a Homeowner's Association (HOA) to provide long term BMP maintenance for the proposed development upon completion of construction.

Owner/ Developer:
Melia Homes
8951 Research Drive, Suite 100
Irvine, CA 92618
(949) 759-4367
Chad Brown, Vice President of Planning & Development

Homeowner's Association
To be determined

The owner is aware of the maintenance responsibilities of the proposed BMPs. A funding mechanism is in place to maintain the BMPs at the frequency stated in the WQMP.

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Education for Property Owners, Tenants, Occupants & Employees	Owner/ Future Homeowner's Association (HOA)	Owner/HOA to provide education material, a copy of the approved WQMP and Operation & Maintenance Plan (O&M) to new property owners, tenants, occupants & employees.	At time of hiring, leasing and/ or home purchase.
Activity Restrictions	Owner/HOA	Owner/HOA employees notified of activities that are prohibited by homeowners.	Restrictions identified in Employee Manual and reviewed yearly by employees.
Common Area Landscape Management	Owner/HOA	Owner/HOA to hire professional landscape company to conduct maintenance of landscaping to meet current water efficiency and keep plants healthy and bio areas maintained with proper soil amendments.	Regular maintenance once a week and monthly inspection to determine deficiencies.
BMP Maintenance	Owner/HOA	Owner/HOA to hire professional BMP maintenance company to conduct regular inspections, repairs and cleanings per manufacturer's specifications.	A minimum 2 inspections/ cleanings per year per manufacturer's specifications prior to October 1st (before rainy season)
Common Area Litter Control	Owner/HOA	Owner/HOA to provide litter removal of site parking lot and landscape areas and to empty common area trash bins.	Once per week.

Employee Training	Owner/HOA	The distribution of these materials will be the reasonability of the Owner/HOA at the initial hiring of the employee.	At time of hiring.
Common Area Catch Basin Inspections	Owner/HOA	Owner/HOA shall inspection common areas where catch basins are located within the surrounding area and remove any trash/ debris.	Inspections/ Cleaning shall occur at least twice per month.
Private Street & Parking Lot Sweeping	Owner/HOA	Owner/HOA to provide maintenance of Parking Lot and provide Street Sweeping services.	Weekly basis.
Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	Owner/HOA	Owner/HOA to provide maintenance of landscaping to meet current water efficiency standards, and keep plants healthily.	Regular maintenance once a week and monthly inspection to determine any water deficiencies.
Storm Drain System Stencilling & Signage	Owner/HOA	Owner/HOA to inspect and repair as needed all onsite storm drain stencilling & signage.	Inspection should occur at minimum twice per year.
Modular Wetlands System (MWS) Biofiltration Vaults	Owner/HOA	Owner/HOA will be required to hire a professional maintenance company to provide regular inspections, repairs and cleaning per manufacturer's specifications.	Inspections/ Cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for additional information and manufacturer's specifications.
Automatic Retractable Screen (ARS) Device	Owner/HOA	Owner/HOA to inspect and schedule maintenance to remove debris bluid-up, repair/ replace screen and mechanism, and clean as	Inspections shall occur at least two times per year and once per year for maintenance services before the

		needed within catch basin and screen area.	start of the rainy season (October 1st).
Maxwell Plus Drywell System	Owner/HOA	Owner/HOA will be required to hire a professional maintenance company to provide regular inspection, repairs, and cleaning per manufacturer's specifications. All trash/debris and loose sediment/silt shall be removed routinely.	Inspections should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for manufacturer's specifications.

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Refer to Attachment B of this report for the WQMP Exhibit which provides the location of all proposed BMPs and a site plan of the project.

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) will be submitted.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) will be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.

Section VII Educational Materials

Refer to the Orange County Stormwater Program (www.ocwatersheds.com) for a library of materials available.

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☒	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☒	Proper Maintenance Practices for Your Business	☐
Household Tips	☒	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☒		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☒		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☒		☐

Attachment A
TGD Worksheets & Figures

Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
1	**Would Infiltration BMPs pose significant risk for groundwater related concerns?** Refer to Appendix VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.		X
Provide basis:			
2	Would Infiltration BMPs **pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level**? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert): • The BMP can only be located less than 50 feet away from slopes steeper than 15 percent • The BMP can only be located less than eight feet from building foundations or an alternative setback. • A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.		X
Provide basis:			
3	Would infiltration of the DCV from drainage area **violate downstream water rights**?		X
Provide basis:			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

	Partial Infeasibility Criteria	***Yes***	***No***
4	Is proposed infiltration facility **located on HSG D soils** or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?		X
Provide basis:			
5	Is **measured infiltration rate below proposed facility less than 0.3 inches per hour**? This calculation shall be based on the methods described in Appendix VII.		X
Provide basis:			
6	Would **reduction of over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible:			
7	Would **an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible:			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII) Provide narrative discussion and supporting evidence:	No
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis:	Yes
10	If any answer from row 4-7 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis:	No
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	Infiltration is Feasible

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.90	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.90	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.30	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	1.00	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.90	
4	Calculate runoff volume, $V_{design}= (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	3,822	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate [N/A for Drywells – Refer to Section IV.3.2				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T*	T=		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.00	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	in/hr
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.26	in/hr
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.8*	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	1.00 **	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.90	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.1872	cfs

Supporting Calculations

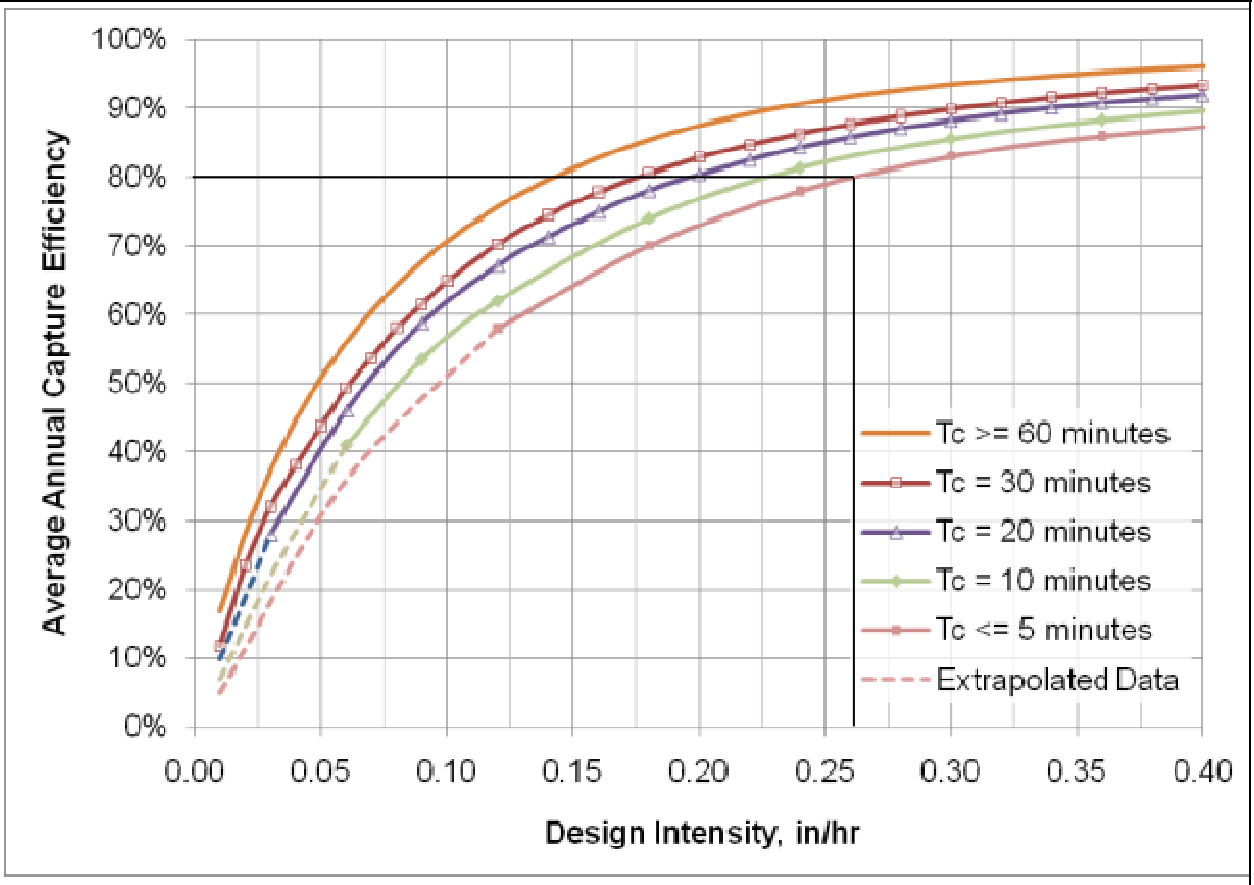
Describe system:
Surface runoff will be conveyed through the private street to proposed curb inlet Biofiltration Vault for water quality treatment before entering the proposed infiltration system.

*The tributary area utilized for design flowrate calculations refers areas contributing to street runoff. Pretreatment for the remaining areas is provided through incorporating landscaping in open-space areas.
**Assumed 100% impervious coverage utilized for preliminary calculations. Actual impervious coverage will be calculated in final engineering.

Provide time of concentration assumptions:
The time of concentration was assumed to be 5 minutes for conservative purposes.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Worksheet H: Factor of Safety and Design Infiltration Rate Worksheet					
DMA 1					
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	2	0.50
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.25
B	Design	Tributary area size	0.25	2	0.50
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	2	0.50
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.5
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				1.875 → use 2	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				1.64	
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} / K_M$				0.82	

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Percolation testing was conducted by GeoTek, Inc. as follows:

In addition to the geotechnical exploratory borings, two (2) borings (I-1 and I-2) were excavated in the area of the anticipated storm water control systems as designated by the project developer. In addition to borings I-1 and I-2, boring B-1 was converted to an infiltration boring by partial backfill of the boring to a depth of about 40 feet, to a depths below the contact between the fine-grained alluvium (ML soil type) and the coarse-grained alluvium (SM soil type). Infiltration/percolation testing was conducted in these borings in general accordance with the requirements of the County of Orange.

The percolation tests consisted of drilling an eight-inch diameter test hole to the desired depth and installing approximately two inches of gravel in the bottom of the hole. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the boring. Water was then placed in the borings to presoak the holes and percolation testing was performed the following the pre-soak period. Following presoaking, the percolation tests were performed which consisted of adding water to each test hole and measuring the water drop over a 30-minute period. The water drop was recorded for twelve test intervals. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method. The infiltration rates calculated using the Porchet Method are presented in the following table:

Worksheet H: Factor of Safety and Design Infiltration Rate Worksheet

DMA 1

Factor Category	Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v

SUMMARY OF RESULTS	
Boring	**Measured Infiltration Rate (inches per hour)**
I-1	0.38
I-2	4.16
B-1	1.64

The results of the conversions indicate infiltration rates of 0.38 to 4.16 inch per hour, which indicate highly variable infiltration rates based upon depth and location. Copies of the percolation data sheets and the Porchet infiltration rate conversion calculations are presented in Appendix C. No factors of safety were applied to the rates provided. Over the lifetime of the infiltration areas, the infiltration rates may be affected by sediment build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rate in designing the infiltration system. "

Additional infiltration testing will be conducted during final engineering at proposed infiltration locations and depths.

Refer to Attachment F of this Preliminary WQMP for the Geotechnical & Infiltration Evaluation, dated September 21, 2021.

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by Table VIII.2) circle one	Large	**Small**	
2	What is the tributary area to the BMP?	A	1.3	acres
3	What type of BMP is proposed?	Drywell Infiltration		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	782	sq-ft
5	What land use activities are present in the tributary area (list all) Multi-Family Residential			
6	What land use-based risk category is applicable?	L	**M**	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all): Proposed MWS System Biofiltration Vaults will provide treatment for the required design flow rate.			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section VIII.2 (circle one)	5 ft	**10 ft**	
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater: Per the TGD Section VIII.2, the following applies to a subsurface infiltration gallery: "Separation to mounded seasonally high groundwater shall be at least 10 feet for infiltration devices that inject water below the subsurface and surface infiltration BMPs with tributary area and land use activities that are considered to pose a more significant risk to groundwater quality."			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	10	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT	n/a	ft
12	Describe assumptions and methods used for mounding analysis: GeoTek, Inc. followed with a Supplemental Information on Site Groundwater Levels, dated June 1, 2022. Upon GeoTek, Inc.'s additional research, the following groundwater conditions are a more appropriate representation of the project site: "As noted in the referenced Geotechnical and Infiltration Evaluation report for the project (GeoTek, 2021), groundwater was not encountered to the maximum depth explored (approximately 51.5 feet for Boring B-1). This is consistent with			

Worksheet I: Summary of Groundwater-related Feasibility Criteria

	data published by GeoTracker (https://geotracker.waterboards.ca.gov/) for a property located about ¼-mile northeast of the site (300 South Brookhurst Street), with a reported groundwater elevation of about 60 feet above mean sea level (amsl) in 2000. Given that the average elevation of this site is approximately 109 feet amsl, the indicated groundwater depth would correspond to a groundwater elevation of about 49 feet amsl. This report indicated that groundwater flow at this site was to the southwest (towards the project site). Review of the California Water Data Library (http://wdl.water.ca.gov/waterdatalibrary/) indicates that one well located approximately 3/4-mile north of the site (Site Code 338320N1179624W001) showed that the highest groundwater elevation was approximately 49 feet amsl in 1970. Based upon review, historic high groundwater level in the project area is greater than 50 feet below the existing ground surface.		
13	Is the site within a plume protection boundary (See Figure VIII.2)?	Y	**N** N/A
14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y	**N** N/A
15	Is the site within 250 feet of a contaminated site?	Y	**N** N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings: n/a		
17	Is the site within 100 feet of a water supply well, spring, septic system?	Y	**N** N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	**Y**	N

Provide rationale for feasibility determination:

Per Worksheet I and the site-specific Geotechnical and Infiltration Evaluation prepared by Geotek Inc. dated September 21, 2021 and the information provided within the Orange County Technical Guidance Document (TGD), the proposed site does not pose potential infiltration infeasibility due to groundwater related concerns, therefore, Infiltration is considered feasible.

Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

Worksheet J: Summary of Harvested Water Demand and Feasibility **Entire Site**

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		□	
3	Landscape irrigation		✓	
4	Other:_____		□	
5	What is the design capture storm depth? (Figure III.1)	d	0.85	inches
6	What is the project size?	A	1.3	ac
7	What is the acreage of impervious area?	* IA	1.3	ac
	For projects with multiple types of demand (toilet flushing, irrigation demand, and/or other demand)			
8	What is the minimum use required for partial capture? (Table X.6)			gpd
9	What is the project estimated wet season total daily use (Section X.2)?			gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)			
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (Table X.7)			
12	What is the project estimated TUTIA?			
13	Is partial capture potentially feasible? (Line 12 > Line 11?)			
	For projects with only irrigation demand			
14	What is the minimum irrigation area required based on conservation landscape design? (Table X.8) [5.3x1.01]	0.26		ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)	0.26		ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)	No		

Provide supporting assumptions and citations for controlling demand calculation:
Due to the proposed development type, density and amount of available landscaping, Harvest and Use BMPs for irrigation purposes will not be feasible.

* For preliminary purposes, an assumed 100% impervious coverage

SUBJECT TO FURTHER REVISION

LEGEND

- Orange County Precipitation Stations
- 24 Hour, 85th Percentile Rainfall (Inches)
- 24 Hour, 85th Percentile Rainfall (Inches) - Extrapolated
- City Boundaries

Rainfall Zones

Design Capture Storm Depth (inches)

- 0.65"
- 0.7
- 0.75
- 0.80
- 0.85
- 0.90
- 0.95
- 1.00
- 1.10"

Note: Events defined as 24-hour periods (calendar days) with greater than 0.1 inches of rainfall.
For areas outside of available data coverage, professional judgment shall be applied.

PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
San Diego County

0.65 0.7 0.75 0.8 0.85 0.9 0.95 1 1.05 1.1

0 3 6 12 Kilometers
0 1.8 3.6 7.2 Miles

TITLE: RAINFALL ZONES

JOB: ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT — ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526.E

PACE Advanced Water Engineering

FIGURE XVI-1

P:\9526E\6-GIS\Mxds\Reports\Infiltration\Feasibility_20110215\9526E_Figure XVI-1_Rainfall Zones_20110215.mxd

SUBJECT TO FURTHER REVISION

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

PROJECT SITE

LEGEND

City Boundaries

Hydrologic Soil Groups

- A Soils
- B Soils
- C Soils
- D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

0 2.5 5 10 Kilometers
0 1.8 3.6 7.2 Miles

TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2a

P:\.9526E\6-GIS\Mxd's\Reports\Infiltration\Reasability_20110215\9526E_FigureXVI2a_HydrosSoilk_20110215.mxd

SUBJECT TO FURTHER REVISION

LEGEND

- Depth To First Groundwater Contours
- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

PROJECT SITE

0 2 4 8 Kilometers
0 1.25 2.5 5 Miles

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TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2d

SUBJECT TO FURTHER REVISION

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

PROJECT SITE

LEGEND

- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Plume Protection Boundaries

- North Basin Groundwater Protection Project
- South Basin Groundwater Protection Project
- El Toro Marine Base
- Tustin Marine Air Base
- Approximate Selenium Contamination Area

Note: Individual contamination sites are not plotted.
See State Water Resources Control Board Geotracker database (http://geotracker.waterboards.ca.gov),
Department of Toxic Substance Control Envirostor database (http://www.envirostor.dtsc.ca.gov) and other applicable sources for current listing of active contaminated sites.

Groundwater basin and plume protection boundaries for South Orange County are not shown on this exhibit at this time

0 2 4 8 Kilometers
0 1.25 2.5 5 Miles

P:\9526E\6-GIS\Mxds\Reports\Infiltration\Feasability_20110215\9526E_FigureXVI-2f_NorthOCGroundwaterProtectionAreas_20110215.mxd

TITLE
NORTH ORANGE COUNTY
GROUNDWATER PROTECTION
AREAS

ORANGE COUNTY
INFILTRATION STUDY

JOB
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2f

Susceptibility

Potential Areas of Erosion, Habitat, & Physical Structure Susceptibility

Channel Type

- Earth (Unstable)
- Earth (Stabilized)
- Stabilized

Tidel Influence

- <= Mean High Water Line (4.28')

Water Body

- Basin
- Lake
- Reservoir

Other Lands

- Airport/Military

Los Angeles County

Humble Reservoir

Orange County

Valencia Reservoir

Fullerton Reservoir

Loftus Diversion Channel Desilting Basin

Brea Creek Reservoir

Fullerton Reservoir

Fullerton Reservoir

Hillcrest Park Reservoir

Fullerton Airport

Brea Park

Fullerton

Miller Retarding Basin

La Jolla Recharge Basin

Placentia Retarding Basin

Kraemer Basin

Raymond Retarding Basin

Gilbert Retarding Basin

Crescent Retarding Basin

Anaheim

Santa River Watershed

Cypress Retarding Basin

Channel in Retarding Basin

Project Site

Anaheim Bay-Huntington Harbor Watershed

Rossmoor Retarding Basin

Los Alamitos Naval Air Station

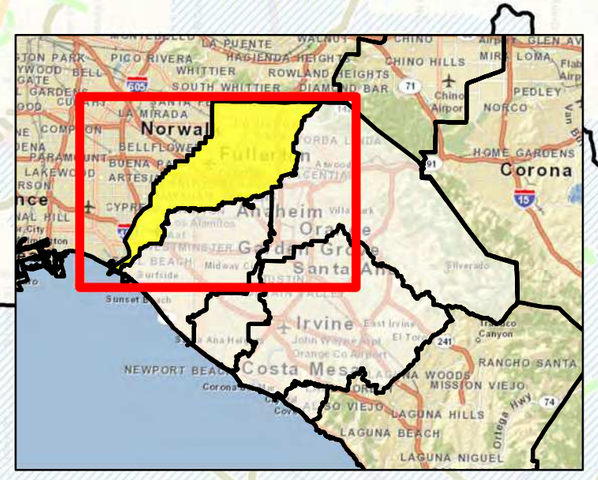
Los Alamitos Retarding Basin

Seal Beach Naval Weapons Station

Seal Beach

Pacific Ocean

Newport Bay-Newport Coastal Streams Watershed



0 8,000 16,000 Feet

TITLE: SUSCEPTIBILITY ANALYIS SAN GABRIEL-COYOTE CREEK

ORANGE COUNTY WATERSHED MASTER PLANNING

JOB: ORANGE CO. CA

SCALE	1" = 8000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

PACE Advanced Water Engineering

1

P:\9526E\6-GIS\Mxds\Susceptability Maps_20100505\9526E_SanGabrielCoyoteCreekSusceptibility_20100430.mxd

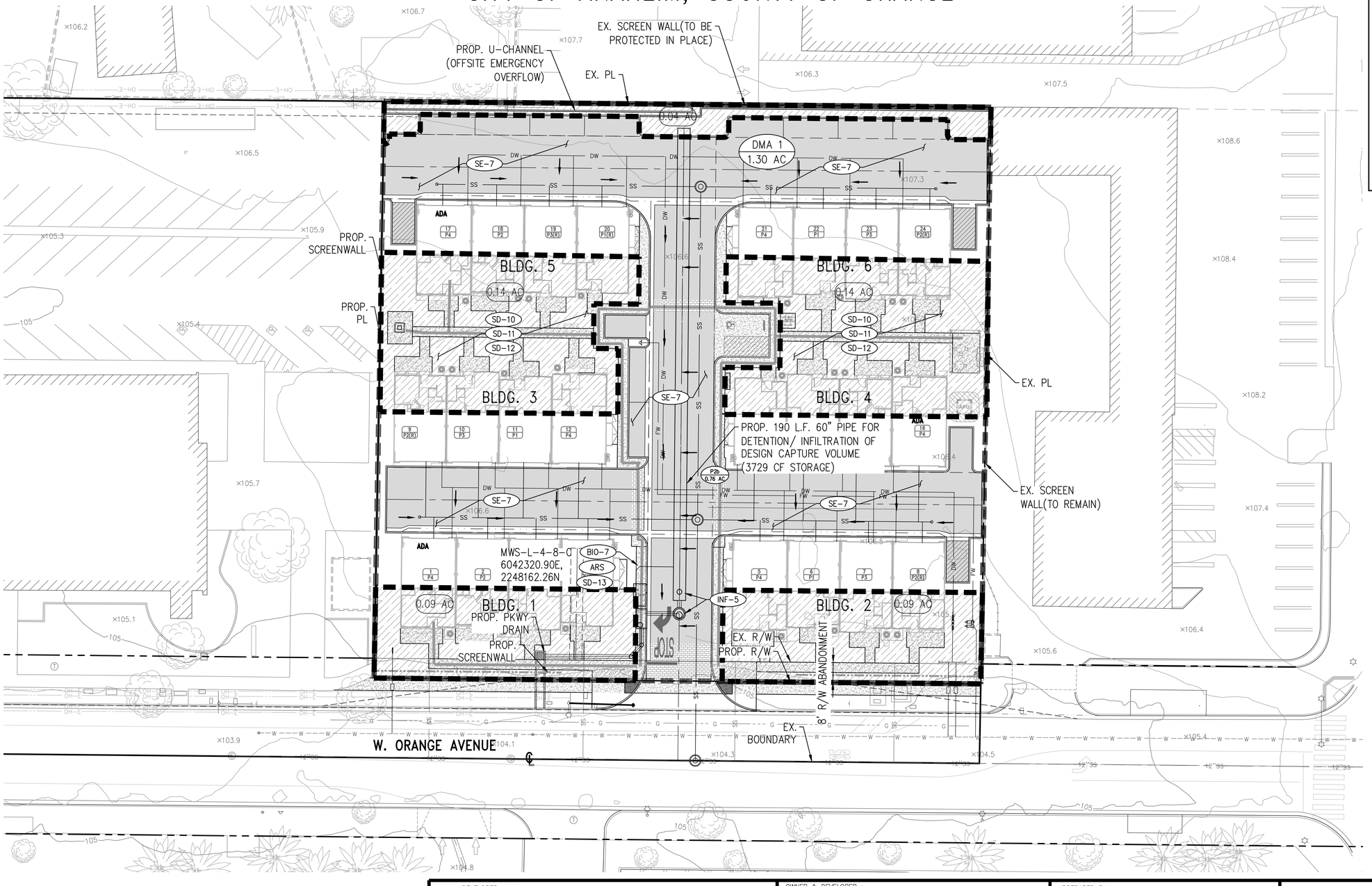
Attachment B
Preliminary WQMP Exhibit

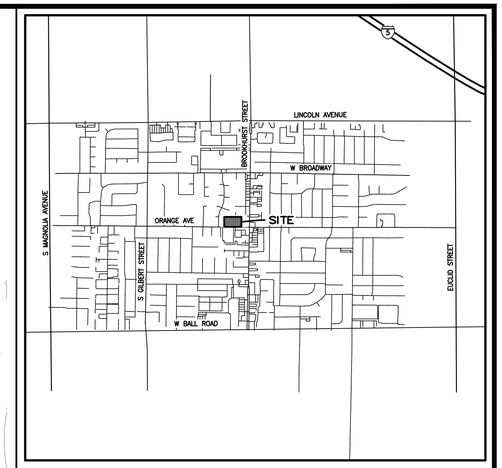
WQMP EXHIBIT

TR 19192

2219 W. ORANGE AVENUE

CITY OF ANAHEIM, COUNTY OF ORANGE





VICINITY MAP

NTS

LEGEND

- EXISTING RIGHT-OF-WAY/ BOUNDARY
- PROPOSED RIGHT-OF-WAY/ BOUNDARY
- DRAINAGE MANAGEMENT AREA (DMA)
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- DRAINAGE FLOW ARROWS
- PROPOSED MWS BIOFILTRATION VAULT
- PROPOSED LANDSCAPING
- PROPOSED ASPHALT CONCRETE (AC) PAVEMENT
- PROPOSED PCC PAVEMENT
- PROPOSED DECORATIVE PAVEMENT
- EXCLUDED FROM MWS SIZING CALCULATIONS, PRETREATED BY LANDSCAPE
- DMA X / X.XX AC — DRAINAGE MANAGEMENT AREA (DMA) / ACREAGE

BEST MANGEMENT PRACTICES (BMPS)

- SD-10 — SITE DESIGN & LANDSCAPE PLANNING
- SD-11 — ROOF RUNOFF CONTROLS
- SD-12 — EFFICIENT IRRIGATION
- SD-13 — STORM DRAIN SIGNAGE
- SE-7 — STREET SWEEPING & VACUUMING
- BIO-7 — PROPRIETARY BIOTREATMENT – MODULAR WETLANDS SYSTEM (MWS) BIOFILTRATION VAULT
- INF-5 — UNDERGROUND INFILTRATION – MAXWELL PLUS DRYWELL SYSTEM
- ARS — AUTOMATIC RETRACTABLE SCREEN (ARS) DEVICE FOR FULL TRASH CAPTURE REQUIREMENTS

SCALE: 1" = 20'

0 10 20 40

NOTES:

1. AREA DRAIN SYSTEM WILL BE DESIGNED DURING FINAL ENGINEERING. AREA DRAINS WILL COLLECT AND CONVEY RUNOFF FROM LANDSCAPED AREAS DIRECTLY TO BIOFILTRATION SYSTEM.
2. ROOF DRAINAGE IS ASSUMED TO BE CONSISTENT WITH THAT OF A PITCHED ROOF. ROOF DOWNSPOUT LOCATIONS TO BE VERIFIED BY ARCHITECT DURING FINAL ENGINEERING.
3. DURING THE CONSTRUCTION PHASE OF THIS PROJECT, THE INFILTRATION SYSTEM SHELL BE PHYSICALLY SEPARATED/ PROTECTED FROM RUNOFF AND/ OR ANY OTHER MATERIAL, LIQUID, OR DEBRIS.

DEVELOPER :

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION	APP	DATE

OWNER & DEVELOPER :

MELIA HOMES
8951 RESEARCH DRIVE, #100
IRVINE, CA 92618
PHONE (949) 759-4367

SOILS ENGINEER :

PREPARED BY :

C&V CONSULTING, INC.
CIVIL ENGINEERING
LAND PLANNING & SURVEYING
9830 IRVINE CENTER DRIVE
IRVINE, CALIFORNIA 92618
(949) 916-3800
INFO@CVC-INC.NET
WWW.CVC-INC.NET

REGISTERED PROFESSIONAL ENGINEER
DANIEL P. McDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

TRACT NO. 19192
WQMP EXHIBIT

DATE: 6/21/2022

SHEET 1 OF 1

SCALE: AS SHOWN | DRAWN BY: SP | CHECKED BY: SP

CITY OF ANAHEIM

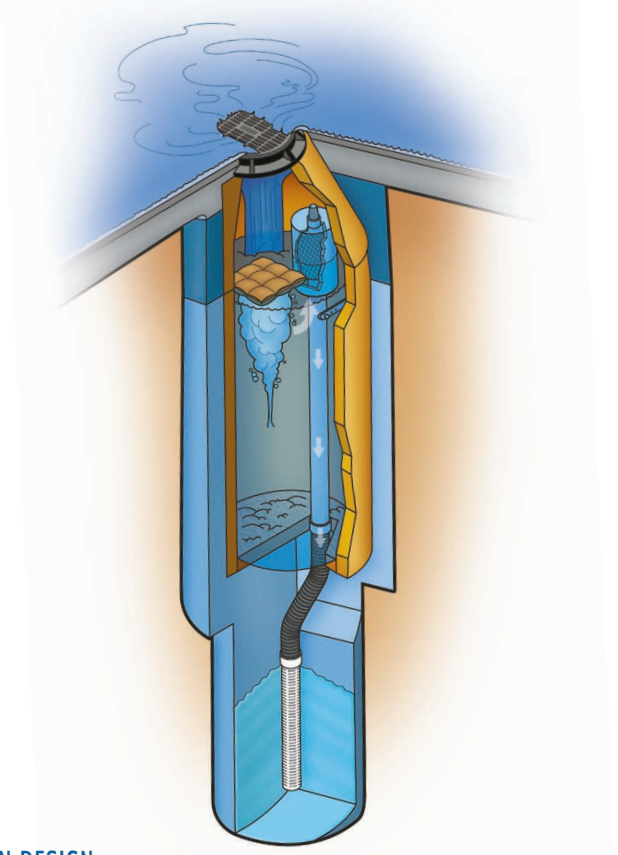
Attachment C
Site BMPs

MaxWell® IV DRAINAGE SYSTEM

Product Information and Design Features

TORRENT® RESOURCES

The ***MaxWell® IV,*** as manufactured and installed exclusively by Torrent Resources Incorporated, is the industry standard for draining landscaped developments and paved areas. This patented system incorporates the latest refinements in pre-treatment technology.



PROVEN DESIGN

Since 1974, nearly 65,000 MaxWell® Systems have proven their value as a cost-effective solution in a wide variety of drainage applications. They are accepted by state and municipal agencies and are a standard detail in numerous drainage manuals.

ADVANCED PRE-TREATMENT

Industry research, together with Torrent Resources' own experience, have shown that initial storm drainage flows have the greatest impact on system performance. This "first flush" occurs during the first few minutes of runoff, and carries the majority of sediment and debris. This results in the need for effective processing of runoff from landscaped and paved surfaces. In the ***MaxWell® IV,*** preliminary treatment is provided through collection and separation in a deep, large-volume chamber where silt and other heavy particles settle to the bottom. The standard MaxWell IV System has over 1,500 gallons of capacity to contain sediment and debris carried by incoming water. Floating trash, paper, pavement oil, etc. are effectively stopped by the **PureFlo®** Debris Shield on top of the overflow pipe. Water is drained from the system by rising up to the top of the overflow pipe and under the Debris Shield. The solid metal shields are equipped with an internal screen to filter suspended matter and are vented to prevent siphoning of floating surface debris. The drainage assembly returns the cleaned water into the surrounding soil through the **FloFast®** Drainage Screen.

ABSORBENT TECHNOLOGY

The MaxWell IV settling chamber is equipped with an absorbent sponge to provide prompt removal of pavement oils. These floating pillow-like devices are 100% water repellent and literally wick petrochemical compounds from the water. Each sponge has a capacity of up to 128 ounces to accommodate effective, long-term treatment. The absorbent is completely inert and will safely remove runoff constituents down to rainbow sheens that are typically no more than one molecule thick.

SECURITY FEATURES

MaxWell IV Systems include bolted, theft-deterrent, cast iron gratings and covers as standard security features. Special inset castings that are resistant to loosening from accidental impact are available for use in landscaped applications. Machined mating surfaces and "Storm Water Only" wording are standard.

THE MAXWELL FIVE-YEAR WARRANTY

Innovative engineering, quality materials and exacting construction are standard with every MaxWell System designed, manufactured and installed by Torrent Resources Incorporated. The MaxWell Drainage System Warranty is the best in the industry and guarantees against failures due to workmanship or materials for a period of five years from date of completion.

Manufactured and Installed Exclusively by Torrent Resources Incorporated

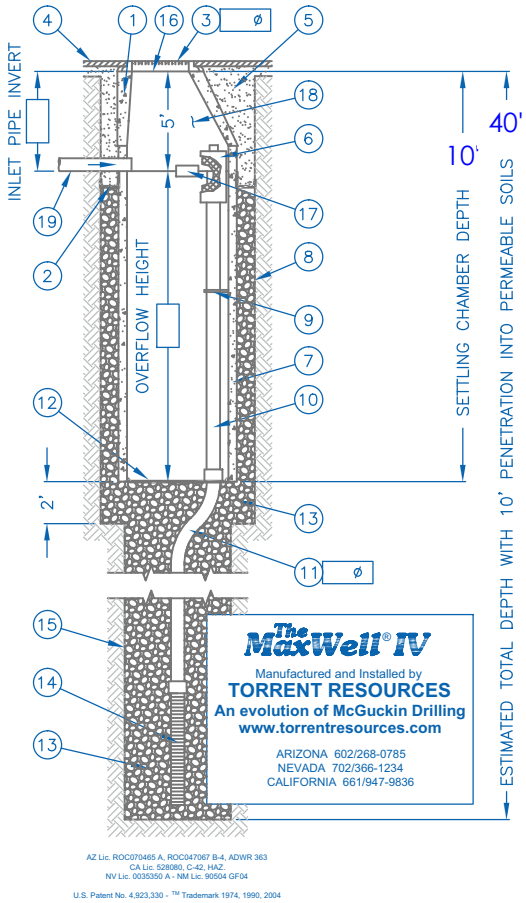
Please see reverse side for additional information

U.S. Patent No. 4,923,330

MAXWELL® IV DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

ITEM NUMBERS

1. **Manhole Cone** - Modified Flat Bottom.
2. **Moisture Membrane** - 6 Mil. Plastic. Applies only when native material is used for backfill. Place membrane securely against eccentric cone and hole sidewall.
3. **Bolted Ring & Grate** - Diameter as shown. Clean cast iron with wording **"Storm Water Only"** in raised letters. **Bolted in 2 locations** and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** - 1-Sack Slurry except in landscaped installtions with no pipe connections.
6. **PureFlo® Debris Shield** - Rolled 16 ga. steel X 24" length with vented anti-siphon and Internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections **to maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile or concrete slurry.
13. **Rock** - Washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast® Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft.Diameter varies 120" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. resistant geotextile - **to be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. to 128 oz. capacity.
18. **Freeboard Depth** Varies with inlet pipe elevation. Increase settling chamber depth as needed to maintain all inlet pipe elevations above overflow pipe inlet.
19. **Optional Inlet Pipe** (Maximum 4", by Others). Extend moisture membrane and compacted base material or 1 sack slurry backfill below pipe invert.



AZ Lic. ROC070465 A, ROC047067 B-4, ADWR 363
CA Lic. 528080, C-42, HAZ.
NV Lic. 0035350 A - NM Lic. 90504 GF04

U.S. Patent No. 4,923,330 - ™ Trademark 1974, 1990, 2004

The referenced drawing and specifications are available on CAD either through our office or web site. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.

CALCULATING MAXWELL IV REQUIREMENTS

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained stormwater, use one standard **MaxWell IV** per the instructions below for up to 3 acres of landscaped contributory area, and up to 1 acre of paved surface. For larger paved surfaces, subdivision drainage, nuisance water drainage, connecting pipes larger than 4" Ø from catch basins or underground storage, or other demanding applications, refer to our **MaxWell® Plus** System. For industrial drainage, including gasoline service stations, our **Envibro® System** may be recommended. For additional considerations, please refer to **"Design Suggestions For Retention And Drainage Systems"** or consult our Design Staff.

COMPLETING THE MAXWELL IV DRAWING

To apply the **MaxWell IV** drawing to your specific project, simply fill in the blue boxes per instructions below. For assistance, please consult our Design Staff.

' ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate depth required to achieve 10 continuous feet of penetration into permeable soils. Torrent utilizes specialized **"crowd"** equipped drill rigs to penetrate difficult, cemented soils and to reach permeable materials at depths up to **180 feet.** Our extensive database of drilling logs and soils information is available for use as a reference. Please contact our Design Staff for site-specific information on your project.

' SETTLING CHAMBER DEPTH

On MaxWell IV Systems of over 30 feet overall depth and up to 0.25cfs design rate, the **standard** Settling Chamber Depth is **18 feet.** For systems exposed to greater contributory area than noted above, extreme service conditions, or that require higher design rates, chamber depths up to 25 feet are recommended.

' OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. For normal drainage applications, an overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet**. Sites with higher design rates than noted above, heavy debris loading or unusual service conditions require greater settling capacities

"Ø DRAINAGE PIPE

This dimension also applies to the **PureFlo®** Debris Shield, the **FloFast®** Drainage Screen, and fittings. The size selected is based upon system design rates, soil conditions, and the need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to "Design Suggestions for Retention and Drainage Systems" for recommendations on which size best matches your application.

"Ø BOLTED RING & GRATE

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

"Ø INLET PIPE INVERT

Pipes up to 4" in diameter from catch basins, underground storage, etc. may be connected into the settling chamber. Inverts deeper than 5 feet will require additional settling chamber depth to maintain effective overflow height.

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TORRENT RESOURCES (CA) INCORPORATED
phone 661~947~9836
CA Lic. 886759 A, C-42
www.TorrentResources.com
An evolution of McGuckin Drilling

The watermark for drainage solutions.®

TORRENT® RESOURCES

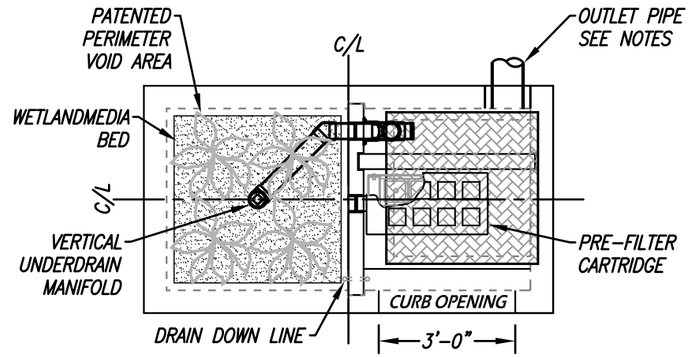
SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	36" x 36"	N/A	N/A
WETLANDMEDIA VOLUME (CY)			2.37
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø1.22"
MAXIMUM PICK WEIGHT (LBS)			16500
NOTES:			

INSTALLATION NOTES

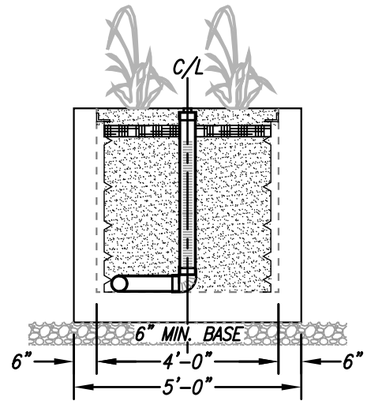
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON–SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

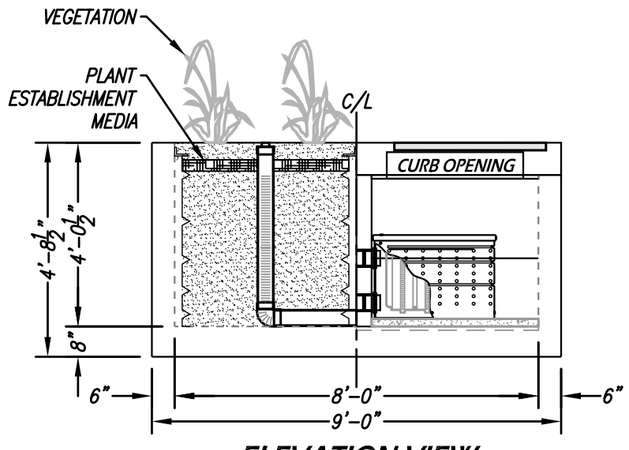
1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.



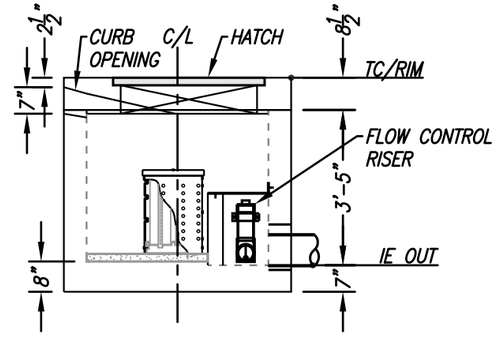
PLAN VIEW



LEFT END VIEW
BIOFILTRATION



ELEVATION VIEW



RIGHT END VIEW
PRETREATMENT/DISCHARGE

TREATMENT FLOW (CFS)	0.115
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

MWS-L-4-8-C
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

5/1/15/JOHN

MWS Linear 2.0 HGL Sizing Calculations

MWS MODEL SIZE	WETLAND PERMITER LENGTH	LOADING RATE GPM/SF	HGL HEIGHT																												
			SHALLOW MODELS																			STANDARD HEIGHT MODEL	HIGH CAPACITY MODELS									
			1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.65	3.70	3.75	3.80	3.85	3.90	3.95
MWS-L-4-4	6.70	1.0	0.022	0.023	0.025	0.026	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.038	0.040	0.042	0.043	0.045	0.046	0.048	0.049	0.051	**0.052**	0.054	0.055	0.056	0.057	0.058	0.058	0.059	0.060	0.061
~~**MWS-L-4-6**~~	~~10.00~~	~~1.0~~	~~0.032~~	~~0.035~~	~~0.037~~	~~0.039~~	~~0.042~~	~~0.044~~	~~0.046~~	~~0.048~~	~~0.051~~	~~0.053~~	~~0.055~~	~~0.058~~	~~0.060~~	~~0.062~~	~~0.065~~	~~0.067~~	~~0.069~~	~~0.072~~	~~0.074~~	~~0.076~~	~~**0.078**~~	~~0.081~~	~~0.083~~	~~0.084~~	~~0.085~~	~~0.087~~	~~0.088~~	~~0.089~~	~~0.090~~	~~0.091~~
MWS-L-4-6	9.30	1.0	0.030	0.032	0.034	0.036	0.038	0.041	0.043	0.045	0.047	0.049	0.051	0.053	0.055	0.058	0.060	0.062	0.064	0.066	0.068	0.070	**0.073**	0.075	0.077	0.078	0.079	0.080	0.081	0.082	0.083	0.084
MWS-L-4-8	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124	0.126	0.127	0.129	0.131	0.132	0.134
MWS-L-4-13	18.40	1.0	0.059	0.063	0.068	0.072	0.076	0.080	0.084	0.089	0.093	0.097	0.101	0.106	0.110	0.114	0.118	0.122	0.127	0.131	0.135	0.139	**0.144**	0.148	0.152	0.154	0.156	0.158	0.160	0.163	0.165	0.167
MWS-L-4-15	22.40	1.0	0.072	0.077	0.082	0.087	0.093	0.098	0.103	0.108	0.113	0.118	0.123	0.129	0.134	0.139	0.144	0.149	0.154	0.159	0.165	0.170	**0.175**	0.180	0.185	0.188	0.190	0.193	0.195	0.198	0.200	0.203
MWS-L-4-17	26.40	1.0	0.085	0.091	0.097	0.103	0.109	0.115	0.121	0.127	0.133	0.139	0.145	0.151	0.158	0.164	0.170	0.176	0.182	0.188	0.194	0.200	**0.206**	0.212	0.218	0.221	0.224	0.227	0.230	0.233	0.236	0.239
MWS-L-4-19	30.40	1.0	0.098	0.105	0.112	0.119	0.126	0.133	0.140	0.147	0.153	0.160	0.167	0.174	0.181	0.188	0.195	0.202	0.209	0.216	0.223	0.230	**0.237**	0.244	0.251	0.255	0.258	0.262	0.265	0.269	0.272	0.276
MWS-L-4-21	34.40	1.0	0.111	0.118	0.126	0.134	0.142	0.150	0.158	0.166	0.174	0.182	0.189	0.197	0.205	0.213	0.221	0.229	0.237	0.245	0.253	0.261	**0.268**	0.276	0.284	0.288	0.292	0.296	0.300	0.304	0.308	0.312
MWS-L-6-8	18.80	1.0	0.060	0.065	0.069	0.073	0.078	0.082	0.086	0.091	0.095	0.099	0.104	0.108	0.112	0.116	0.121	0.125	0.129	0.134	0.138	0.142	**0.147**	0.151	0.155	0.157	0.160	0.162	0.164	0.166	0.168	0.170
MWS-L-8-8	29.60	1.0	0.095	0.102	0.109	0.115	0.122	0.129	0.136	0.143	0.149	0.156	0.163	0.170	0.177	0.183	0.190	0.197	0.204	0.211	0.217	0.224	**0.231**	0.238	0.245	0.248	0.251	0.255	0.258	0.262	0.265	0.268
MWS-L-8-12	44.40	1.0	0.143	0.153	0.163	0.173	0.183	0.194	0.204	0.214	0.224	0.234	0.245	0.255	0.265	0.275	0.285	0.296	0.306	0.316	0.326	0.336	**0.346**	0.357	0.367	0.372	0.377	0.382	0.387	0.392	0.397	0.402
MWS-L-8-16	59.20	1.0	0.190	0.204	0.217	0.231	0.245	0.258	0.272	0.285	0.299	0.312	0.326	0.340	0.353	0.367	0.380	0.394	0.408	0.421	0.435	0.448	**0.462**	0.476	0.489	0.496	0.503	0.509	0.516	0.523	0.530	0.537
MWS-L-8-20	74.00	1.0	0.238	0.255	0.272	0.289	0.306	0.323	0.340	0.357	0.374	0.391	0.408	0.425	0.442	0.459	0.476	0.493	0.509	0.526	0.543	0.560	**0.577**	0.594	0.611	0.620	0.628	0.637	0.645	0.654	0.662	0.671
MWS-L-10-20 or MWS-L-8-24	88.80	1.0	0.285	0.306	0.326	0.346	0.367	0.387	0.408	0.428	0.448	0.469	0.489	0.509	0.530	0.550	0.571	0.591	0.611	0.632	0.652	0.673	**0.693**	0.713	0.734	0.744	0.754	0.764	0.774	0.785	0.795	0.805
4'x'4 media cage	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124						

SPECIFICATIONS

MWS – Linear

Hybrid Stormwater Filtration System

Modular Wetland Systems, Inc.
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Oceanside, CA 92049

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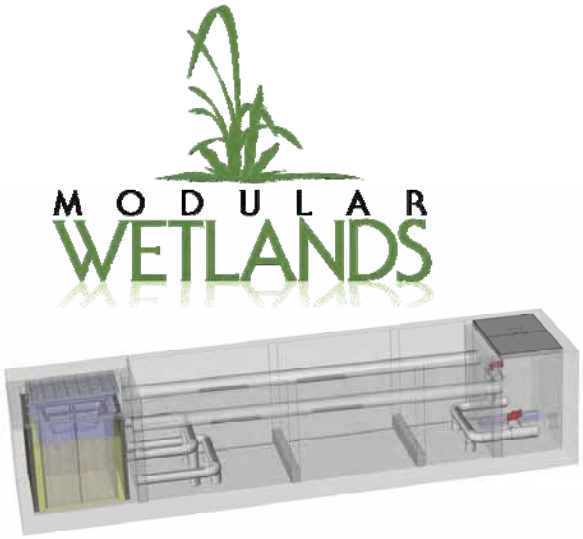
MWS – Linear

Hybrid Stormwater Filtration System



Save valuable space with small footprint for urban sites.

Improve BMP aesthetics with attractive native and tropical landscape plants.

Reduce lifetime costs with safer and less expensive maintenance

"The MWS – Linear hybrid stormwater treatment system is described as a self contained treatment train. This system utilizes an innovative combination of l treatment processes. Stormwater runoff flows into the system via pipe or curb/grate type catch basin opening. Polluted runoff first encounters a screening device to remove larger pollutants and then enters a hydrodynamic separation chamber which settles out the sediments and larger suspended solids. Next the runoff is treated by a revolutionary filter media, BioMediaGREEN that removes fines and associated pollutants, including bacteria. From there runoff enters of bioretention filter in the form of a subsurface flow vegetated gravel wetland. Within the wetland physical, chemical, and biological mechanisms remove the remaining particulate and dissolved pollutants. The purified runoff leaves the system via the discharge chamber. In the discharge chamber the rate of discharge is controlled by valves set to a desired rate".

Tested Pollutant Removal Efficiencies:

TSS Removal	Dissolved Lead Removal	Dissolved Copper Removal	TPH	E. coli Removal	Turbidity Removal
98%	81%	92%	99%	60.2%	92%

"Nature and Harmony Working Together in Perfect Harmony"

SPECIFICATIONS – MWS- LINEAR

Track Record: The MWS- Linear Hybrid Stormwater Treatment System is manufactured by a company whom is regularly engaged in the engineering design and production of treatment systems for stormwater.

Coverage: The MWS- Linear is designed to treat the water quality volume or water quality flow. For flow based design, high flow bypass is internal, for volume based design, high flow bypass is external and prior to pre-detention system. For offline volume based designs the MWS - Linear has the ability to treat the entire water quality volume when used with pre-storage and properly sized.

Non-Corrosive Materials: The MWS – Linear is designed with non-corrosive materials. All internal piping is SD35 PVC. Catch basin filter components, including mounting hardware, fasteners, support brackets, filtration material, and support frame are constructed of non-corrosive materials (316 stainless steel, and UV protected/marine grade fiberglass). Fasteners are stainless steel. Primary filter mesh is 316 stainless steel welded screens. Filtration basket screens for coarse, medium and fine filtration is ¾" x 1 ¾"expanded, 10 x 10 mesh, and 35 x 35 mesh, respectively. No polypropylene, monofilament netting or fabrics shall be used in this system. Media Protective Panels are constructed of UV protected/marine grade fiberglass. Mounts are constructed of stainless steel. BioMediaGREEN is an inert rock substrate and is non-corrosive. Perimeter filter structure is constructed of lightweight injection molded plastic. Mounting brackets are constructed of SD40 PVC and are mounted with 3/8" diameter stainless steel redheads. Drain down filter cover is constructed of UV protected/marine grade fiberglass and stainless steel hinge and mount.

Weight: Each complete unit weighs approximately 29,000 to 40,000 pounds and requires a boom crane to install. Details of this are provided in the installation section of the MWS-Linear Design Kit.

Transportation: The Modular Wetland System – Linear is designed to be transported on a standard flat bed truck. The unit easily fits on a flat bed truck without the need of special permitting.

Alternative Technology Configurations: The Modular Wetland System – Linear is modular is design. Each module will be up to 22 feet long and 5 feet wide. The system can be made in lengths varying from 13 to 100s of feet long. For lengths longer than 22 feet the system will shipped in modules and assembled on site. The Modular Wetland System – Linear has many alternative configurations. This allows the system to be adapted to many site conditions. Runoff can enter the system through a pipe, and/or a built in curb or grate type opening.

Energy Requirements: The Modular Wetland System – Linear is completely passive and requires no external energy sources.

Buoyancy Issues: Buoyancy is only a an issue when ground water levels rise above the bottom of the Modular Wetland System – Linear's concrete structure. With 8.5 cubic yards of wetland media there is no concern of floatation. As a precaution a footing can also be built into the systems concrete structure.

Durability: The structure of the box will be precast concrete. The concrete will be 28 day compressive strength fc = 5,000 psi. Steel reinforcing will be ASTM A – C857. Structure will support an H20 loading as indicted by AASHTO. The joint between the concrete sections will ship lap and joint sealed with ram-nek. Filter (excluding oil absorbent media) and support structures are of proven durability. The filter and mounting structures are of sufficient strength to support water, sediment, and debris loads when the filter is full, with no slippage, breaking, or tearing. All filters are warranted for a minimum of five (5) years.

Oil Absorbent Media: The MWS – Linear utilizes both physical and biological mechanisms to capture and filter oil and grease. A skimmer and boom system will be positioned on the internal perimeter of the catch basin insert. The primary filtration media, BioMediaGreen, utilized in the perimeter and drain down filters, has excellent hydrocarbon removal abilities. Within the wetland filter biological processes capture and

break down oil and grease. Much of the breakdown and transformation of oil and grease is performed by natural occurring bacteria.

Overflow Protection: The grate and curb type MWS – Linear are designed with an internal bypass consisting of two SD PVC pipes which direct high flows around the perimeter and wetland filter, directly into the discharge chamber. For the volume based vault type configuration, bypass should be located prior to the pre-detention system. For peak flows that exceed internal bypass capacity, external bypass is use.

Filter Bypass: Runoff will bypass filtration (BioMediaGREEN and wetland filter) components of the MWS - Linear. The system will still provide screening and settling during higher flow rates for internally bypassed flows. External bypass will bypass of treatment processes.

Pollutant Removal Efficiency: The MWS - Linear is capable of removing over 90% of the net annual total suspended solids (TSS) load based on a 20-micron particle size. Annual TSS removal efficiency models are based on documented removal efficiency performance from full-scale laboratory tests on BioMediaGreen and quarter-scale laboratory tests on the MWS – Linear flow based system.

POLLUTANT	REMOVAL EFFICIENCY
Trash & Litter	99%
TPH (mg/L)	99%
TSS (mg/L)	98%
E. Coli (MPN/100ml)	60%
Turbidity (NTU)	92%
Dissolved Metals (mg/L)	76%

Sil-Co-Sil 106. Mean particle diameter = 19 microns

Non-Scouring: During heavy storm events the runoff bypasses perimeter and wetland filter components. The system will not re-suspend solids at design flows.

Uniqueness: The Modular Wetland System – Linear is a complete self contained treatment train that incorporates capture, screening, sedimentation, filtration, bioretention, high flow bypass, and flow control into a single modular structure. This system provides four stages of treatment making it the only 4 stage treatment train stormwater filtration system, therefore making it unique to the industry. Other systems do not incorporate all the necessary attributes to make it a complete stormwater management device as with the Modular Wetland System – Linear. Therefore, no equal exists for this system.

Pretreatment & Preconditioning: Since the Modular Wetland System – Linear is a complete capture and treatment train stormwater management system no external pretreatment of preconditioning is necessary.

SPECIFICATIONS – BioMediaGREEN

BioMediaGREEN is a proprietary engineered filter media. Made of a unique combination of the inert naturally occurring material this product is non-combustible and do not pose a fire hazard, stable and non-reactive, and is also biodegradable. It is stable with no known adverse environmental effects.

This product has been tested in long-term carcinogenicity studies [inhalation and intraperitoneal injection (i.p.)] with no significant increase in lung tumors or abdominal tumors. Short-term biopersistent (inhalation and intra-tracheal injection) studies have shown that the products disappear very rapidly from the lung.

In October 2001, IARC classified this product as Group 3, "not classifiable as to its carcinogenicity to humans". The 2001 decision was based on the latest epidemiological studies and animal inhalation studies that show no relation between inhalation exposure and the development of tumors.

The product can typically be disposed of in an ordinary landfill (local regulations may apply). If you are unsure of the regulations, contact your local Public Health Department or the local office of the Environmental Protection Agency (EPA).

Coverage: When properly installed BioMediaGREEN Filter Blocks provide sufficient contact time, at rated flows, of passing contaminate water. The BioMediaGREEN material will capture and retain most pollutants that pass through it. The BioMediaGREEN material is made of a proprietary blend of inert substances. The BioMediaGREEN Filter Blocks can be used in different treatment devices, including but not limited to flume filters, trench drain filters, downspout filters, catch basin inserts, water polishing units, and hydrodynamic separators.

Non-Corrosive Materials: The BioMediaGreen material is made of non-corrosive materials.

Durability: The BioMediaGREEN material has been chosen for its proven durability, with an expected life of 2 plus years. The BioMediaGREEN material is of sufficient strength to support water, sediment, and debris loads when the media is at maximum flow; with no slippage, breaking, or tearing. The BioMediaGREEN material has been tested through rigorous flow and loading conditions.

Oil Absorbent Media: The BioMediaGREEN material has been proven to capture and retain hydrocarbons.

Pollutant Removal Efficiency: The BioMediaGREEN Filter Blocks are designed to capture high levels of Hydrocarbons including but not limited to oils & grease, gasoline, diesel, and PAHs. BioMediaGREEN Filter Blocks have the physical ability to block and filter trash and litter, grass and foliage, sediments, TSS, particulate and dissolved metals, nutrients, and bacteria.

BioMediaGREEN technology is based on a proprietary blend of synthetic inert natural substances aimed at removal of various stormwater pollutants. BioMediaGREEN was created to have a very porous structure capable of selectively removing pollutants while

allowing high flow through rates for water. As pollutants are captured by its structure, BioMediaGREEN captures most pollutants and maintains porosity and filtering capabilities.

Field and laboratory tests have confirmed the BioMediaGREEN capability to capture large percentage of TSS, hydrocarbons, nutrients, and heavy metals. Microbial reduction efficiency will vary depending on colony size, flow rates and site specific conditions.

POLLUTANT	REMOVAL EFFICIENCY
Oil & Grease (mg/L)	90%
TPH (mg/L)	99%
TSS (mg/L)	85%
Turbidity (NTU)	99%
Total Phosphorus (mg/L)	69.6%
Dissolved Metals (mg/L)	75.6%

Sil-Co-Sil 106. Mean particle diameter = 19 microns

Replacement: Removal and replacement of the blocks is simple. Remove blocks from filtration system. Replace with new block of equal size.

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*

MWS Linear

Contents

The Urban Impact

For hundreds of years natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as our cities grow and develop, these natural wetlands have perished under countless roads, rooftops, and parking lots.

Plant A Wetland

Without natural wetlands our cities are deprived of water purification, flood control, and land stability. Modular Wetlands and the MWS Linear re-establish nature's presence and rejuvenate water ways in urban areas.

MWS Linear

The Modular Wetland System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pre-treatment, the MWS Linear incorporates an advanced pre-treatment chamber that includes separation and pre-filter cartridges. In this chamber sediment and hydrocarbons are removed from runoff before it enters the biofiltration chamber, in turn reducing maintenance costs and improving performance.

Applications

The MWS Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

Industrial

Many states enforce strict regulations for discharges from industrial sites. The MWS Linear has helped various sites meet difficult EPA mandated effluent limits for dissolved metals and other pollutants.

Residential

Low to high density developments can benefit from the versatile design of the MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.

Streets

Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

Parking Lots

Parking lots are designed to maximize space and the MWS Linear's 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.

Commercial

Compared to bioretention systems, the MWS Linear can treat far more area in less space - meeting treatment and volume control requirements.

Mixed Use

The MWS Linear can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications are available on our website: www.ModularWetlands.com/Applications

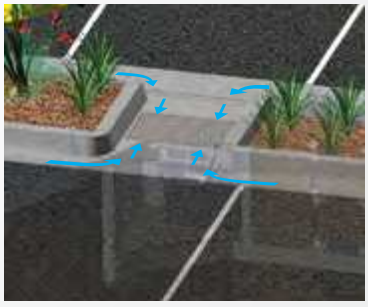
- Agriculture
- Reuse
- Low Impact Development
- Waste Water

Configurations

The MWS Linear is the preferred biofiltration system of Civil Engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your stormdrain design.

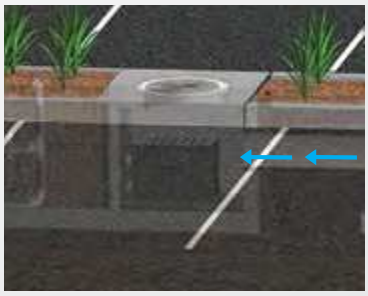
Curb Type

The *Curb Type* configuration accepts sheet flow through a curb opening and is commonly used along road ways and parking lots. It can be used in sump or flow by conditions. Length of curb opening varies based on model and size.



Grate Type

The *Grate Type* configuration offers the same features and benefits as the *Curb Type* but with a grated/drop inlet above the systems pre-treatment chamber. It has the added benefit of allowing for pedestrian access over the inlet. ADA compliant grates are available to assure easy and safe access. The *Grate Type* can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



Vault Type

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pre-treatment chamber, meaning the MWS Linear can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/bioretention systems. Another benefit of the "pipe in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.

Downspout Type

The *Downspout Type* is a variation of the *Vault Type* and is designed to accept a vertical downspout pipe from roof top and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

Advantages & Operation

The MWS Linear is the most efficient and versatile biofiltration system on the market, and the only system with horizontal flow which improves performance, reduces footprint, and minimizes maintenance. Figure-1 and Figure-2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

Featured Advantages

- Horizontal Flow Biofiltration
- Greater Filter Surface Area
- Pre-Treatment Chamber
- Patented Perimeter Void Area
- Flow Control
- No Depressed Planter Area

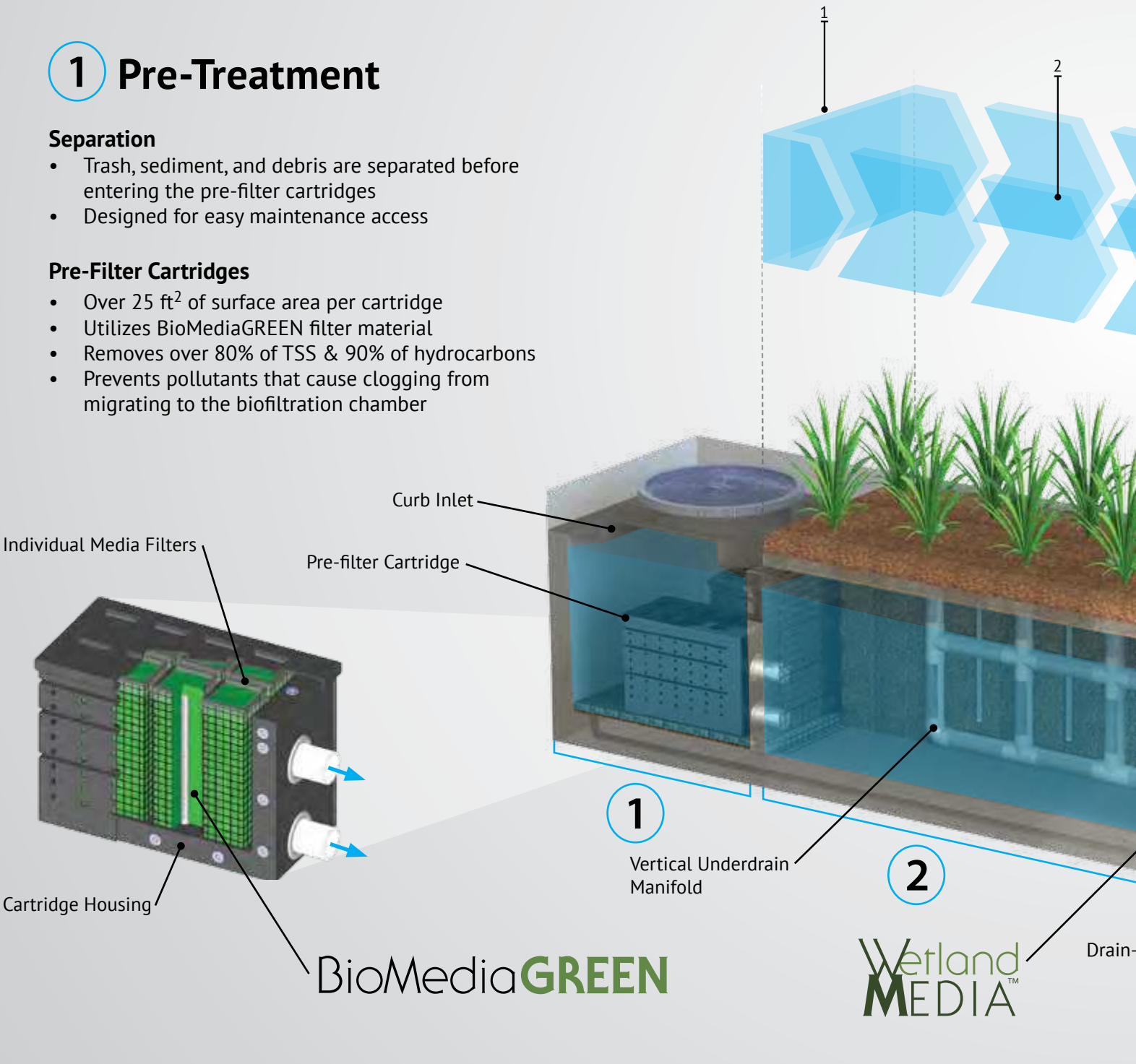
1 Pre-Treatment

Separation

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

Pre-Filter Cartridges

- Over 25 ft^2 of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS & 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber



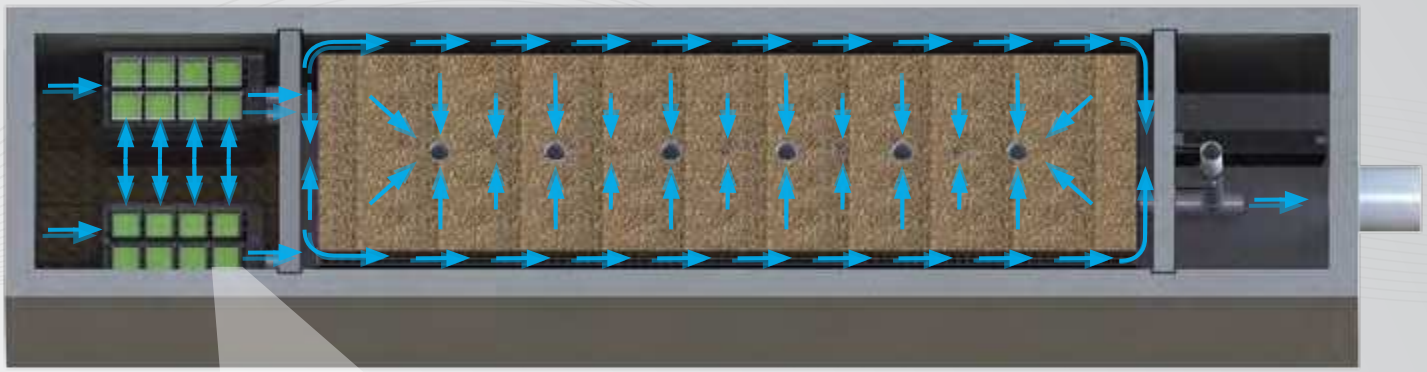


Fig. 2 - Top View

2x to 3x More Surface Area Than Traditional Downward Flow Bioretention Systems.

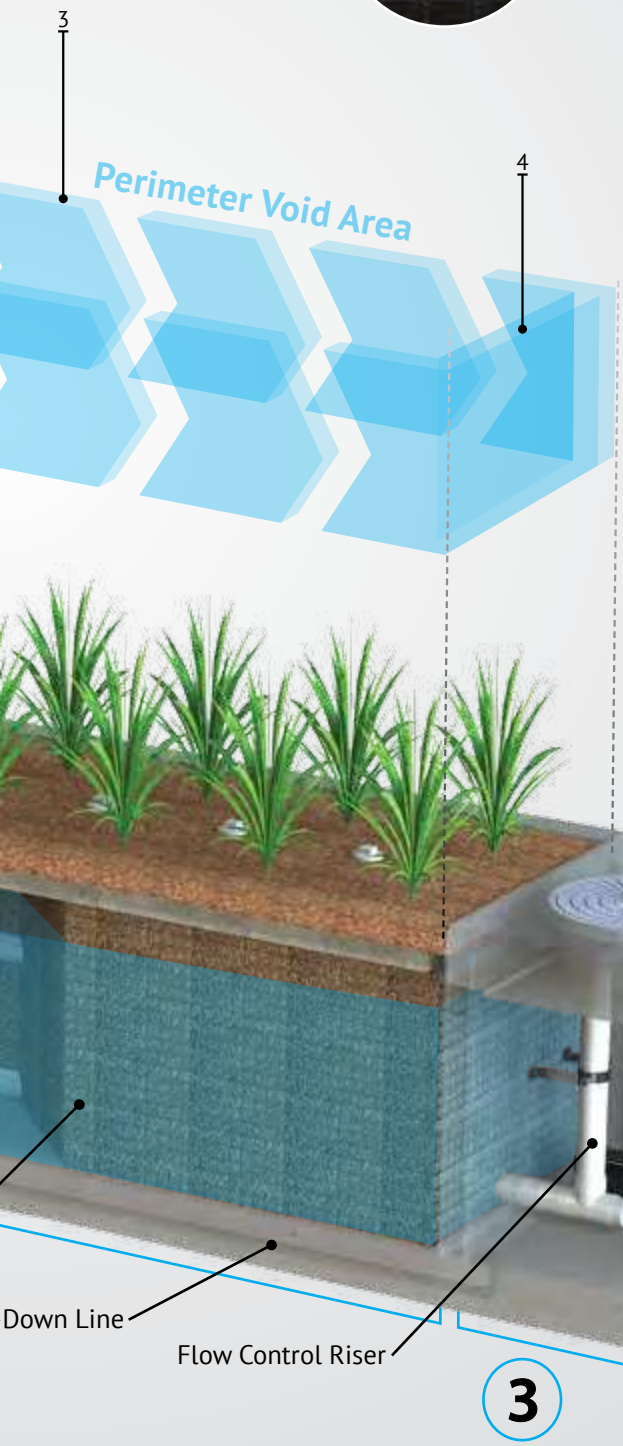


Fig. 1

2 Biofiltration

Horizontal Flow

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

Patented Perimeter Void Area

- Vertically extends void area between the walls and the WetlandMEDIA on all four sides.
- Maximizes surface area of the media for higher treatment capacity

WetlandMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and light weight

3 Discharge

Flow Control

- Orifice plate controls flow of water through WetlandMEDIA to a level lower than the media's capacity.
- Extends the life of the media and improves performance

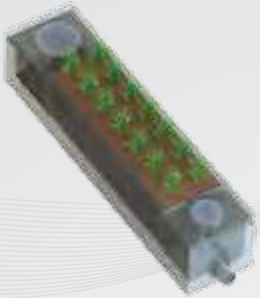
Drain-Down Filter

- The Drain-Down is an optional feature that completely drains the pre-treatment chamber
- Water that drains from the pre-treatment chamber between storm events will be treated

Orientations

Side-By-Side

The *Side-By-Side* orientation places the pre-treatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.



End-To-End

The *End-To-End* orientation places the pre-treatment and discharge chambers on opposite ends of the biofiltration chamber therefore minimizing the width of the system to 5 ft (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is bypass must be external.

Bypass

Internal Bypass Weir (Side-by-Side Only)

The *Side-By-Side* orientation places the pre-treatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pre-treatment chamber directly to the discharge chamber.

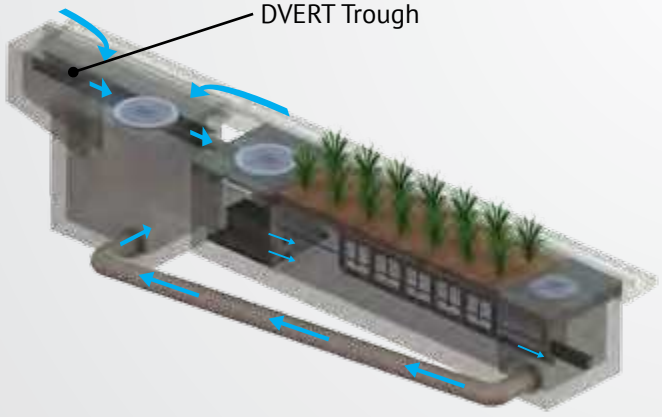
External Diversion Weir Structure

This traditional offline diversion method can be used with the MWS Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

Flow By Design

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

DVERT Low Flow Diversion



This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the MWS Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allows the MWS Linear to be installed anywhere space is available.

Performance

The MWS Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country. With it's advanced pre-treatment chamber and innovative horizontal flow biofilter, the system is able to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. With the same biological processes found in natural wetlands, the MWS Linear harnesses natures ability to process, transform, and remove even the most harmful pollutants.

Approvals

The MWS Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation, and perhaps the world.

Washington State DOE Approved

The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%

DEQ Assignment

The Virginia Department of Environmental Quality assigned the MWS Linear, the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) Technical Criteria.

MASTEP Evaluation

The University of Massachusetts at Amherst – Water Resources Research Center, issued a technical evaluation report noting removal rates up to 84% TSS, 70% Total Phosphorus, 68.5% Total Zinc, and more.

Rhode Island DEM Approved

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% Pathogens, 30% Total Phosphorus for discharges to freshwater systems, and 30% Total Nitrogen for discharges to saltwater or tidal systems.

Flow Based Sizing

The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

Treatment Flow Sizing Table

Model #	Dimensions	WetlandMedia Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4' x 4'	23 ft^2	0.052
MWS-L-4-6	4' x 6'	32 ft^2	0.073
MWS-L-4-8	4' x 8'	50 ft^2	0.115
MWS-L-4-13	4' x 13'	63 ft^2	0.144
MWS-L-4-15	4' x 15'	76 ft^2	0.175
MWS-L-4-17	4' x 17'	90 ft^2	0.206
MWS-L-4-19	4' x 19'	103 ft^2	0.237
MWS-L-4-21	4' x 21'	117 ft^2	0.268
MWS-L-8-8	8' x 8'	100 ft^2	0.230
MWS-L-8-12	8' x 12'	151 ft^2	0.346
MWS-L-8-16	8' x 16'	201 ft^2	0.462

Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.

Treatment Volume Sizing Table

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145

Installation

The MWS Linear is simple, easy to install, and has a space efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles pre-cast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians are available to supervise installations and provide technical support.

Maintenance

Reduce your maintenance costs, man hours, and materials with the MWS Linear. Unlike other biofiltration systems that provide no pre-treatment, the MWS Linear is a self-contained treatment train which incorporates simple and effective pre-treatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pre-treatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pre-treatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long term operation and there is absolutely no need to replace expensive biofiltration media.

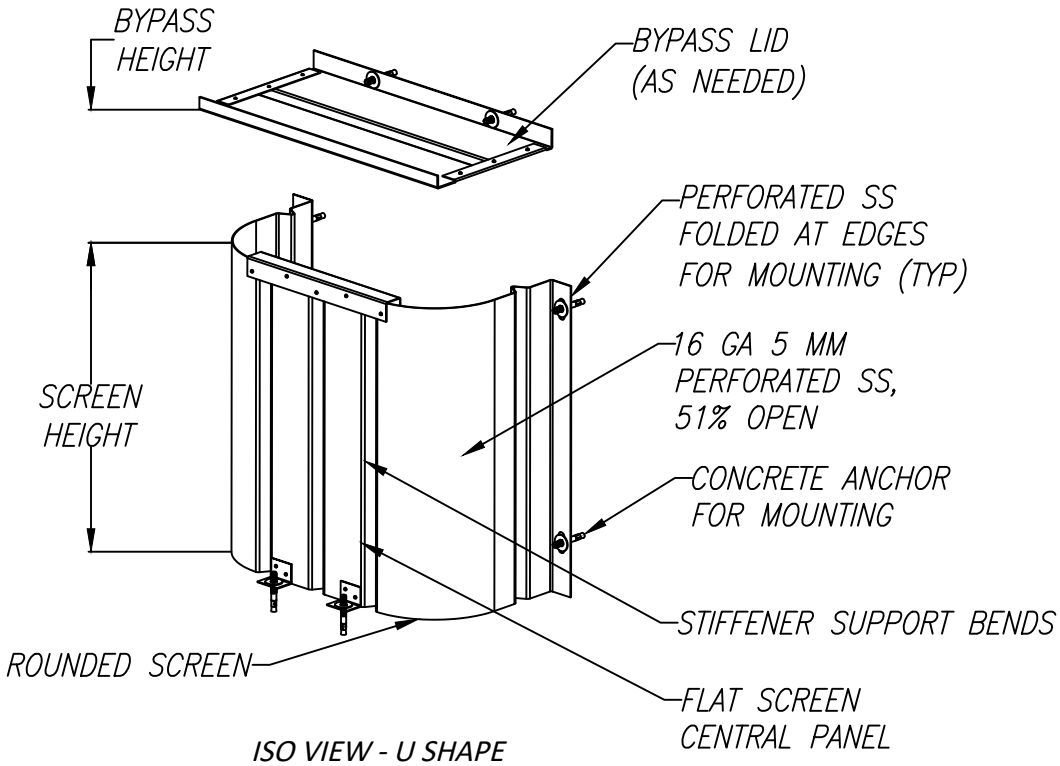
Plant Selection

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the MWS Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the MWS Linear, giving the plants more "contact time" so that pollutants are more successfully decomposed, volatilized and incorporated into the biomass of The MWS Linear's micro/macro flora and fauna.

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by selecting the list relative to your project location's hardy zone.

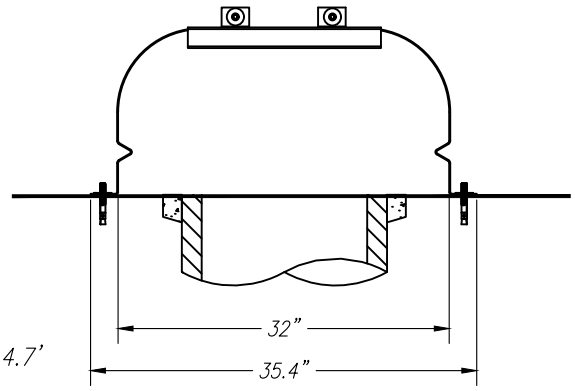
Please visit www.ModularWetlands.com/Plants for more information and various plant lists.

CONNECTOR PIPE SCREEN (CPS)
U 4.7



ISO VIEW - U SHAPE

CPS U WITH 4.7 FT SCREEN LENGTH	
CPS HEIGHT (IN)	SCREEN FLOW (CFS)
12	6.67
18	12.26
24	18.88
30	26.40
36	34.71
NOTE: BYPASS FLOW RATES VARY WITH VAULT DEPTH AND BYPASS HEIGHT. CONTACT BIO CLEAN FOR ADDITIONAL INFORMATION.	



TOTAL SCREEN LENGTH ~ 4.7'
SPAN LENGTH = 32"
COMPATIBLE WITH PIPES UP TO Ø24"

TOP SECTION VIEW - U SHAPE

GENERAL NOTES

1. BIO CLEAN TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS, AND CAPACITIES ARE SUBJECT TO CHANGE.
3. THIS CPS UNIT IS DESIGNED FOR TREATMENT FLOWS THROUGH THE SCREEN. FLOWS GREATER THAN THE TREATMENT FLOW RATE WILL BYPASS OVER THE SCREEN.
4. A BYPASS LID IS REQUIRED WHEN THE OUTLET PIPE IS DIRECTLY BELOW THE CURB OPENING.
5. CPS IS COMPRISED OF 304 STAINLESS STEEL. THICKNESS IS 16 GAUGE. SCREEN PERFORATIONS ARE 5 MILLIMETERS IN DIAMETER. THE SCREEN AREA IS 51% OPEN SPACE.

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS, AND INCIDENTALS REQUIRED TO INSTALL THE CPS UNIT AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURER'S SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. POSITION THE CPS SO IT IS EVENLY SPACED AROUND THE CONNECTOR PIPE, ENSURING A MIN. OF 4" SPACING AWAY FROM ANY CORNERS. SCREEN BOTTOM SHALL BE FLUSH WITH THE CATCH BASIN FLOOR, OR WITH GAPS NO GREATER THAN 5 MM.
3. IF A BYPASS LID IS REQUIRED, VERIFY THE BYPASS HEIGHT NEEDED AND MARK THAT LOCATION ON THE WALL DIRECTLY ABOVE THE BASE UPRIGHTS. LIFT THE LID IN PLACE AND MARK THE HOLE LOCATIONS FOR THE LID MOUNTING BRACKETS. SECURE THE LID WITH STAINLESS STEEL NUTS.

WARRANTY: 3 YEAR MANUFACTURER'S		MEETS FULL CAPTURE REQUIREMENTS	
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE: 760-433-7640		REVISIONS:	DATE:
		REVISIONS:	DATE:
DATE: 1/17/2020	SCALE: NTS	REVISIONS:	DATE:
DRAFTER: G.M.S.	UNITS = INCHES	REVISIONS:	DATE:

Bio Clean
A Forterra Company

Bio Clean

A Forterra Company

Bio Clean ARS

A Stormwater Trash Capture Solution

INSTALLATION MANUAL

5796 Armada Drive Suite 250 | Carlsbad, CA 92008 | 855.566.3938

stormwater@forterrabp.com | biocleanenvironmental.com

INSTALLATION

The Bio Clean ARS requires minimal time and tools for installation. The system is especially designed to be the easiest system on the market in install. Generally, the system can be installed into the basin from the curb opening. The end mounting brackets are adjustable and require only one wedge anchor per side. The center mount is pressure fitted to the top and bottom of the curb opening with now need to drill into the concrete.

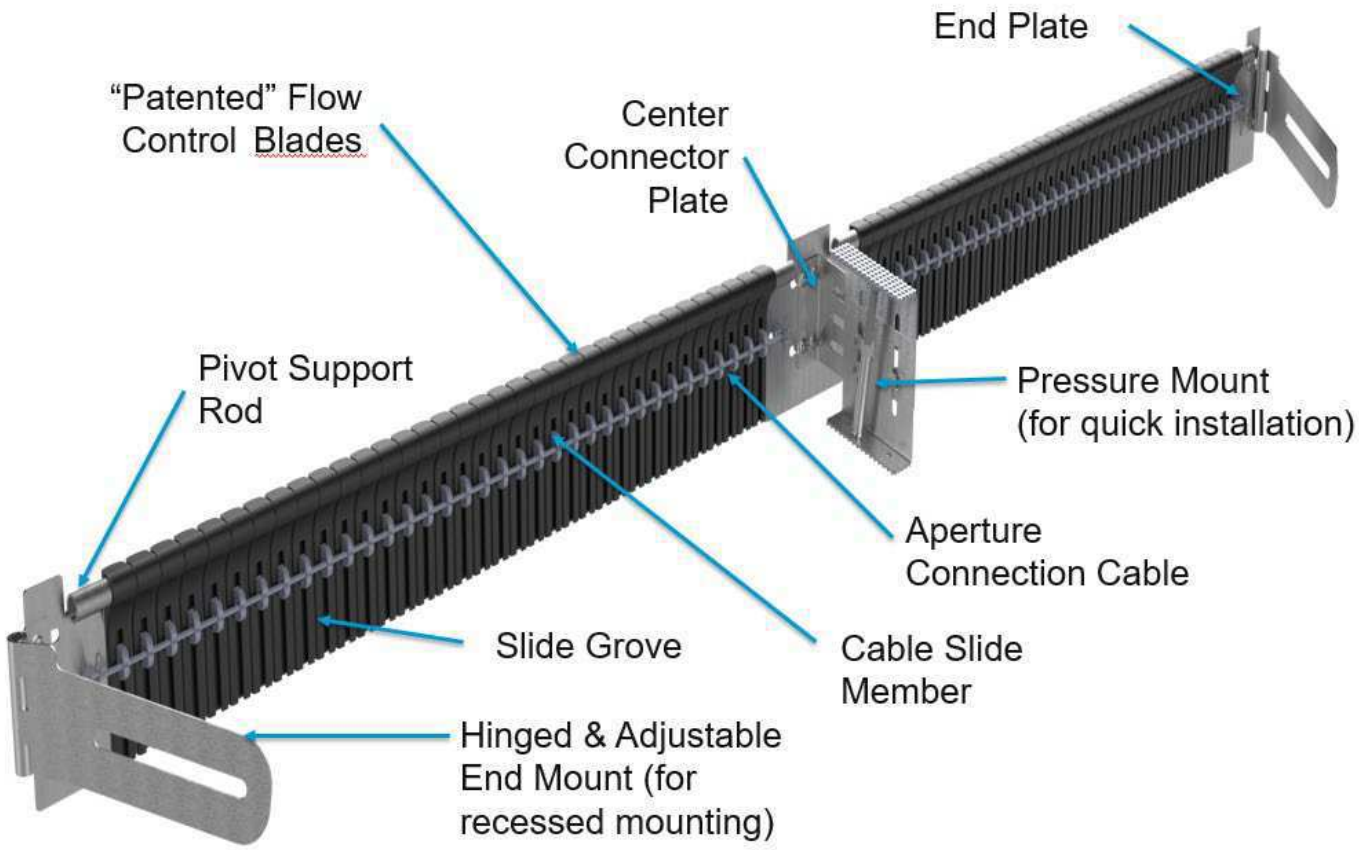
It is recommended that the catch basin be cleaned during time of install as the install can be used as opportunity to do so. Also, this will allow the client to accurately observe the effectiveness of the Bio Clean ARS from preventing trash and debris from entering the basin.

Requirements:

The contractor shall furnish all labor, equipment, materials, and incidentals required to install the ARS and appurtenances in accordance with the contract documents. Any damage to the existing drainage structure (retrofit applications) or surrounding infrastructure that may need to be repaired to allow for proper installation of the ARS shall be considered incidental and to be paid for at no cost to the client. Bio Clean does offer installation services in certain areas. Please contact Bio Clean for more information on pre-authorized 3rd party contractors that can provide install service in your area.

The manufacturer of the Bio Clean ARS does provide a warranty against defects in materials and workmanship for a period of 3 years from the date of acceptance by the Engineer. The Bio Clean ARS also carries a 2-year warranty on installation.

Components:



Tension Regulators

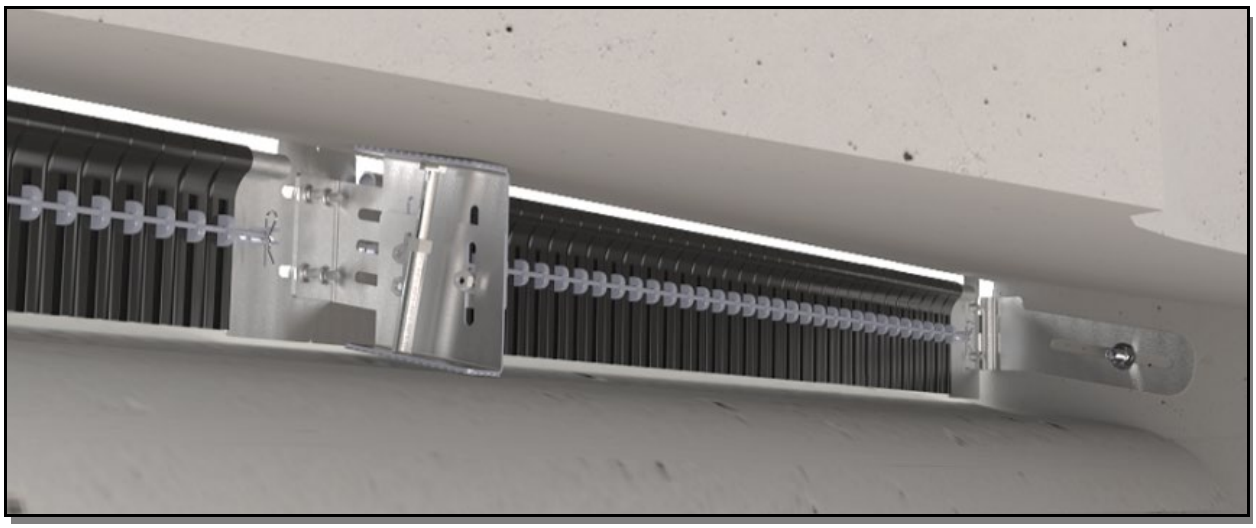
Optional Tension Regulator Allows for Adjustment Based On Catch Basin Flow Conditions

Blade

Hydra Blades Are Plastic Injection Molded Out of Durable UV Resistant Resin

a. Loosen tension bracket so that it can be easily adjusted.
b. Verify length of first unit and slide into place the tension bracket that is included so that front bracket holes line up with the first section of holes on the tension bracket.
c. Add structural caulking adhesive onto the tensioner bracket so that bracket stays in place and tighten the unit to fit the catch basin walls
d. Attach front bracket hex screws to the tension bracket and repeat steps to fully install the complete basin

8. If unit is too long for the catch basin, remove the unsecured bracket from the support rod leaving the curb blades and support rod in the catch basin.
9. Measure the amount that is needed to be removed from the top support bar. Pull off necessary amount of blades to have a clear cut onto the support bar. Cut the top support bar to fit the new sized catch basin and replace the necessary amount of blades to make a seamless front ARS unit.
10. Dethread the retaining pin and cut the spring to the desired amount and tension. Rethread the retaining pin screw and secure tension spring to the back of the unit.
11. Place front bracket onto swiveling bracket and secure using hex wrench.
12. Verify that each blade moves independently and that the desired tension is in the spring.
13. If there is a need to add or remove tension to the system, adjust lateral tension screws on the front bracket to make the unit have more or less tension into the system.



For Installation Support
Please Contact Us At:
760-433-7640
stormwater@forterrabpm.com

INF-5: Drywell

Also known as:

- *Soakaway Pits*
- *Infiltration Sumps*
- *Rock Sumps*
- *Underground Injection Controls*

Drywell
Source: K&A Enterprises

Drywells are similar to infiltration trenches in their design and function, but generally have a greater depth to footprint area ratio and can be installed at relatively large depths. A drywell is a subsurface storage facility designed to temporarily store and infiltrate runoff, primarily from rooftops or other impervious areas with low pollutant loading. A drywell may be either a small excavated pit filled with aggregate or a prefabricated storage chamber or pipe segment. Drywells can be used to reduce the volume of runoff from roofs and other relatively clean surfaces. While roofs are generally not a significant source of stormwater pollutants, they can be a major contributor of runoff volumes. Therefore, drywells can indirectly enhance water quality by reducing the water quality design volume that must be treated by other, downstream stormwater management facilities. *Note: A drywell is considered a "Class V Injection Wells" under the federal Underground Injection Control (UIC) Program regulated in California by U.S. EPA Region 9. A UIC permit may be required (for details see http://www.epa.gov/region9/water/groundwater/uic-classv.html).*

Feasibility Screening Considerations

- Drywells shall pass infiltration infeasibility screening criteria (**TGD Section 2.4.2.4**) to be considered for use.
- Dry wells provide a more direct pathway for stormwater to groundwater, therefore pose a greater risk to groundwater quality than surface infiltration systems.

Opportunity Criteria

- Drywells may be used to infiltrate roof runoff, either directly or from the overflow from a cistern.
- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Space available for pretreatment (biotreatment or treatment control BMP as described below).
- The drywell must be located in native soil; over-excavated by at least one foot in depth and replaced uniformly without compaction.
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.

OC-Specific Design Criteria and Considerations

[X] Must comply with local, state, and federal UIC regulations; a permit may be required.

[X] Minimum set-backs from foundations and slopes should be observed

- [X] Infiltration should not cause geotechnical concerns related to slope stability, liquefaction, or erosion.
- [X] Minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- [ ] Drywells should not receive untreated stormwater runoff, except rooftop runoff. Pretreatment of runoff from other surfaces is necessary to prevent premature failure that results from clogging with fine sediment, and to prevent potential groundwater contamination due to nutrients, salts, and hydrocarbons. Maxwell Drywell Systems contain internal pretreatment systems
- [X] Design infiltration rate should be determined with an infiltration test at each drywell location.
- [ ] Drywell should be encased by 1 foot of coarse (3/4" to 2 ½"), round river rock on sides and bottom of facility. Maxwell Drywell System is encased by its manufacturer specific recommended rock as well as stabilized backfill.
- [X] Maximum facility depth is 25 feet with the approval of a geotechnical professional; preferred depth less than 10 feet does not require geotechnical approval.
- [X] If inlet is an underground pipe, a fine mesh screen should be installed to prevent coarse solids from entering drywell.
- [ ] An overflow route must be installed for flows that overtop facility. Flows will not overtop facility

Sizing Criteria for Drywells

Drywell sizing is highly site-specific. Sizing calculations shall demonstrate via the methods described in **Appendix III** or via project-specific methods that the system captures and fully discharges the DCV within 48 hours following the end of precipitation, or captures and infiltrates 80 percent of average annual runoff volume.

Configuration for Use in a Treatment Train

- Drywells may be preceded in a treatment train by HSCs in the drainage area, which would reduce the required volume of the drywell.
- Drywells treating any areas other than roof tops must be preceded by a robust biotreatment or conventional treatment capable of addressing all potentially generated pollutants.
- Drywells may be used in conjunction with other infiltration BMPs to increase the infiltration capacity of the entire treatment train system.

Additional References for Design Guidance

- Stormwater Management in Western Washington (Volume III: Hydrologic Analysis and Flow Control Design BMPs) **http://www.ecy.wa.gov/pubs/0510031.pdf**
- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**
- City of Portland Stormwater Management Manual (Drywell, page 2-87) **http://www.portlandonline.com/bes/index.cfm?c=47954&a=202883**
- San Diego County LID Handbook Appendix 4 (Factsheet 25): **http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf**
- City of Santa Barbara Storm Water BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

INF-7: Underground Infiltration

Underground infiltration is a vault or chamber with an open bottom that used to store runoff and percolate into the subsurface. A number of vendors offer proprietary infiltration products that allow for similar or enhanced rates of infiltration and subsurface storage while offering durable prefrabricated structures. There are many varieties of proprietary infiltration BMPs that can be used for roads and parking lots, parks and open spaces, single and multi-family residential, or mixed-use and commercial uses.

Also known as:

- *Infiltration vault*
- *Recharge vault*

Underground Infiltration

Source: http://www.contech-cpi.com

Feasibility Screening Considerations

- Infiltration bains shall pass infeasible screening criteria to be considered for use.
- Underground infiltration galleries pose a potential risk of groundwater contamination; pretreatment should be used.

Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Appropriate for sites with limited surface space.
- Can be placed beneath roads, parking lots, parks, and athletic fields.
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.
- Tributary area land uses include mixed-use and commercial, sngle-family and multi-family, roads and parking lots, and parks and open spaces. High pollutant land uses should not be tributary to infiltration BMPs.

OC-Specific Design Criteria and Considerations

- ☑ Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)
- ☑ Minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- ☑ Minimum pretreatment should be provided upstream of the infiltration facility, and water bypassing pretreatment should not be directed to the facility.
- ☑ Underground infiltration should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.
- ☑ Design infiltration rate should be determined as described in **Appendix VII**.
- ☑ Inspection ports or similar design features shall be provided to verify continued system performance and identify need for major maintenance.

For infiltration facilities beneath roads and parking areas, structural requirements should meet H-20 load requirements.

Computing Underground Infiltration Device Size

Underground infiltration devices vary by design and by proprietary designs. The sizing method selected for use must be based on the BMP type it most strongly resembles.

- For underground infiltration devices with open pore volume (e.g., vaults, crates, pipe sections, etc), sizing will be most similar to infiltration basins.
- For underground infiltration devices with pore space (e.g., aggregate reservoirs), sizing will be most similar to permeable pavement.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 5: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

☐ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

☐ Consult proprietors for specific criteria concerning the design and performance.

☐ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.

☐ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3)**.

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. Many propretary biotreatment BMPs will not be able to meet the definition of "biofiltration" that applies in South Orange County. See Section III.7 and Worksheet SOC-1.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- Santa Barbara BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Street Sweeping and Vacuuming SE-7

Objectives

EC	Erosion Control	
SE	Sediment Control	☒
TR	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

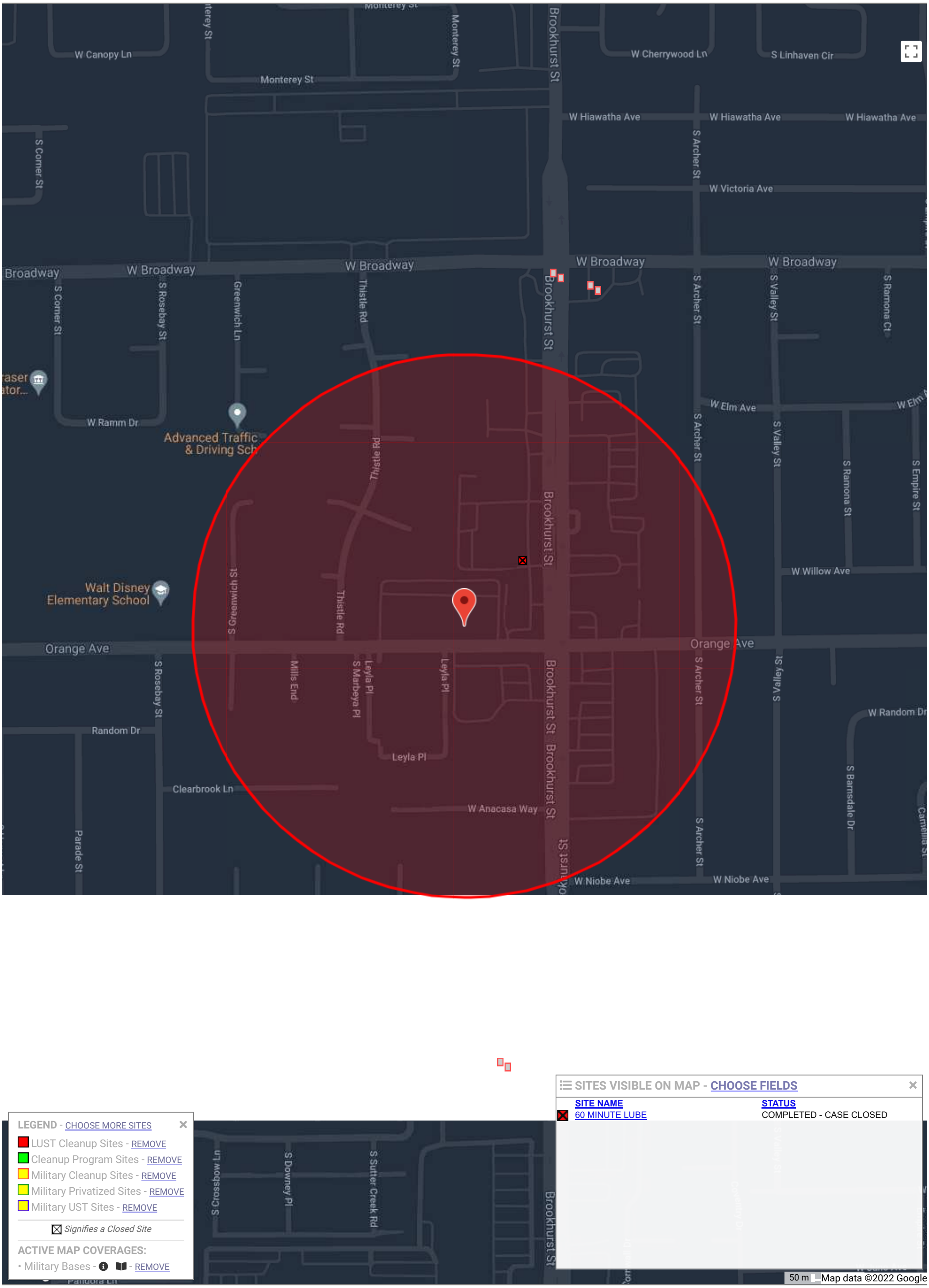
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Attachment D
Reference Material



Sites Shown on Map: 8 Total Sites | 0 Open Sites | 8 Closed Sites | 0 Sites w/Water Quality Data

E 6014906.528

N 2260745.634

E 6036406.802

N 2260745.312

N 2244945.443

E 6014906.665

N 2244945.134

E 6036406.959

5

11

13

12

12

CITY OF LA PALMA

CITY OF BUENA PARK

CITY OF ANAHEIM

CYPRESS

ANAHEIM

BUENA PARK

KNOTTS BERRY FARM

BUENA PARK MALL

LOS ANGELES COUNTY FLOOD CONTROL CHANNEL

LOS ANGELES COUNTY LA.C.F.C.D. CHANNEL

AOI

AO1P03

AO3

AO3S02

B02P03

B02P04

B02P05

B02P06

B02S01

B02S02

BOI

BOIP03

BOIP04

BOIP06

BOIS01

BOIS02

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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	APR 23,2012	12	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G Greenbelt
- P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D.	LOCAL	
		Earth Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Rectangular Channel (base width by height in feet)
		Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
		Reinforced Concrete Pipe (RCP) (diameter in inches)
		Metal Sheet Channel (MSC) (Base width by pile height in feet /Sheet pile total length)
		Corrugated Metal Pipe (CMP) (diameter in inches)
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

0 200 400 600 800 FEET

E 6036406.802 N 2260745.312

E 6057907.005 N 2260745.263

12

14

FULLERTON

ANAHEIM

CITY OF FULLERTON

CITY OF ANAHEIM

ORANGETHORPE

RIVERSIDE

FREEWAY

SOUTHERN

LA PALMA

LINCOLN

BROADWAY

ORANGE

BALL

BROOKHURST

HARBOR

MAGNOLIA

EUCLID

STATE COLLEGE

ANAHEIM BLVD.

DISNEYLAND DR.

A03S02

BOI

BOIBO2
CRESCENT
RETARDING BASIN

BOIPO1

GILBERT RETARDING BASIN
BOIBO1

BOIBO3
RAYMOND
RETARDING
BASIN

BOIPO8

BOIPO3

COUNTY OF ORANGE

C03P15

ALL LATERALS ARE 18" RCP ON BALLAST LANE AND OUTRIGGER WAY.

13

13

0 200 400 600 800
FEET

N

E 6036406.959 N 2244945.134

E 6057907.140 N 2244945.106

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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	DEC. 20 2010	13	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G Greenbelt
- P.S. P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
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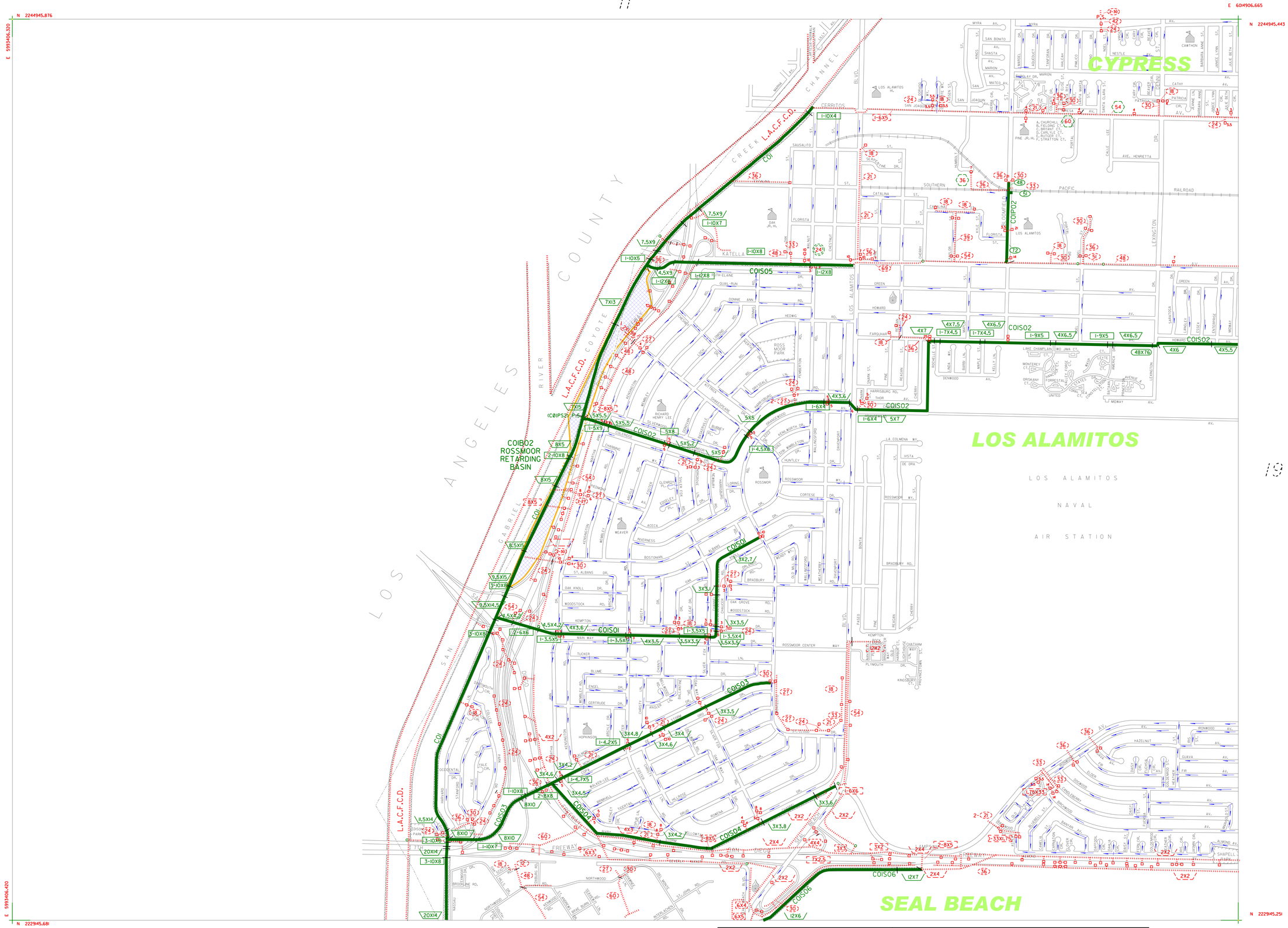
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)



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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	JUN 9, 2008	18	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
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		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

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18

18

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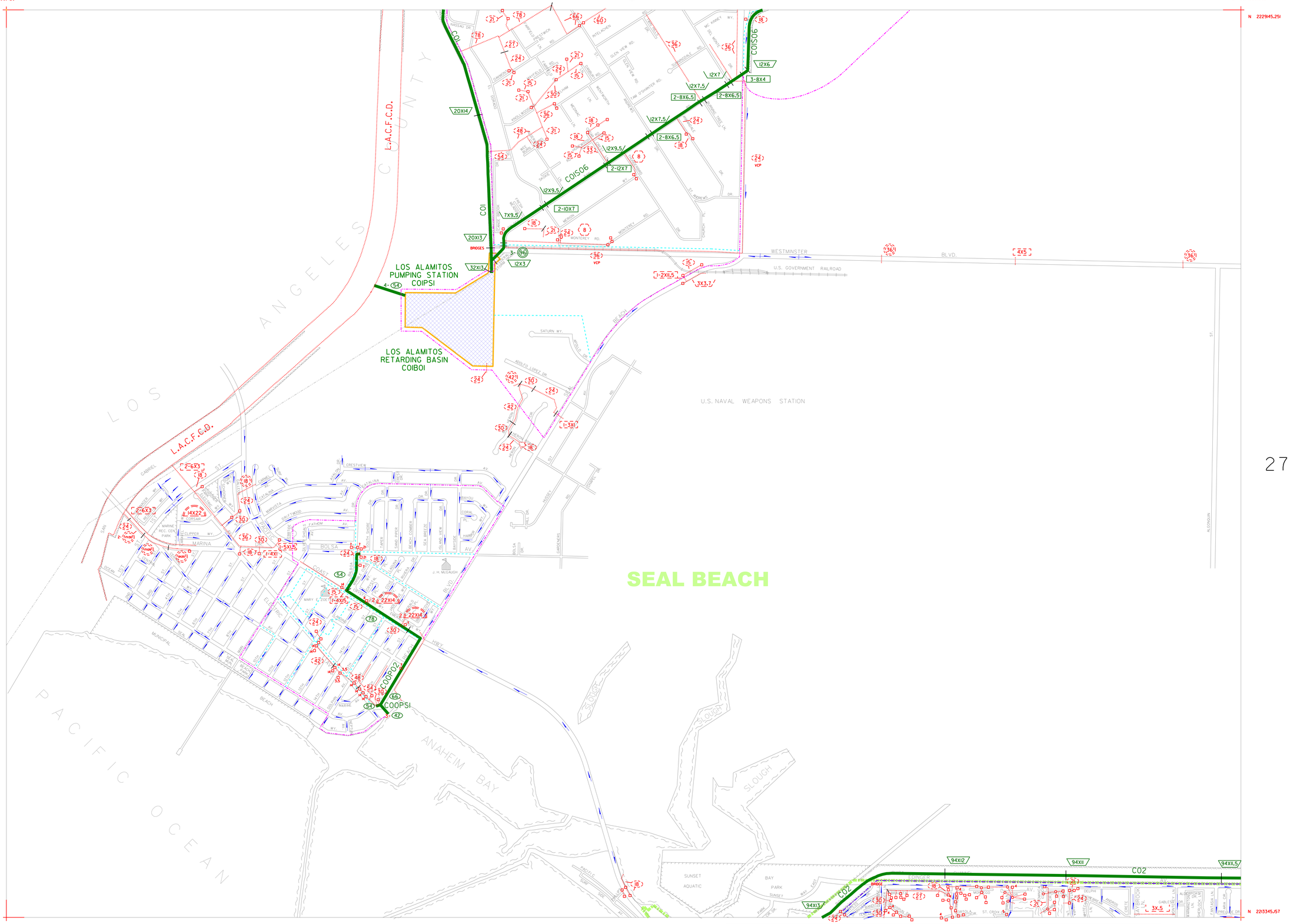

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FEET

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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	MAR. 7, 2007	26	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
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		Corrugated Metal Arch (base span by height in inches)

26

Attachment E

Operation and Maintenance Plan

To be provided during Final Engineering

Attachment F

Geotechnical Report
Groundwater Supplemental Letter

GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED TOWNHOMES PROJECT
2219 WEST ORANGE AVENUE
ANAHEIM, ORANGE COUNTY, CALIFORNIA

PREPARED FOR

MELIA HOMES
8951 RESEARCH DRIVE
IRVINE, CALIFORNIA 92618

PREPARED BY

GEOTEK, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92878

PROJECT NO. 2883-CR **SEPTEMBER 21, 2021**

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

September 21, 2021
Project No. 2883-CR

Melia Homes
8951 Research Drive
Irvine, California 92618

Attention: Mr. Chad Brown

Subject: Geotechnical and Infiltration Evaluation
Proposed Townhomes Project
2219 West Orange Avenue
Anaheim, Orange County, California

Dear Mr. Brown:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this geotechnical and infiltration evaluation for the proposed project located in Anaheim, Orange County, California. This report presents the results of GeoTek's evaluation, discussion of findings, and provides geotechnical recommendations for foundation design and construction.

Based upon review and evaluation, site development appears feasible from a geotechnical viewpoint provided that the recommendations included in this report are incorporated into the design and construction phases of the project.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact our office.

Respectfully
submitted,
GeoTek, Inc.

Bruce A. Hick
GE 2244, Exp. 12/31/22
Geotechnical Engineer

Edward H. LaMont
CEG 1892, Exp. 07/31/22
Principal Geologist

Distribution: (1) Addressee via email (one PDF file)

G:\Projects\2851 to 2900\2883CR Melia Homes Townhomes 2219 W Orange Anaheim\Geotechnical and Infiltration Evaluation\2883CR Geotechnical and Infiltration Evaluation 2219 W Orange Ave Anaheim.doc

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ENCLOSURES

1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical engineering and geologic conditions at the project site, as outlined in GeoTek's proposal P-0700421r2-CR, revised August 19, 2021. Services provided for this study included the following:

- Research and review of available geologic data and general information pertinent to the site,
- Site exploration consisting of the excavation, logging, and sampling of five (5) exploratory test borings extending to depths ranging from about 21.5 to 51.5 feet below grade,
- Excavation of two (2) additional borings to depths of about 5 feet below grade and performing an infiltration test in each boring,
- Laboratory testing of soil samples collected during the field investigation,
- Review and evaluation of site seismicity, and
- Preparation of this geotechnical report which presents GeoTek's findings, conclusions, and recommendations for this site.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The subject project site is addressed as 2219 West Orange Avenue, in the City of Anaheim, Orange County, California (see Figure 1). The approximate 1.28-acre rectangular-shaped project site is bounded to the south by Orange Avenue, to the west by an existing church facility, to the north by single-family residences and a commercial development and to the east by existing commercial businesses. The proposed building site is currently occupied by a school facility which includes various one-story buildings, out-structures, play courts, parking/drive areas, hardscaping, as well as landscaping and pavement improvements.

The site has generally flat topography with a gently fall of about four to five feet to the southwest. Surface drainage is by sheetflow to the south towards Orange Avenue.

2.2 PROJECT DESCRIPTION

According to the Architecture Site Plan, prepared by Summa Architects, dated May 10, 2021, the property will be developed with 24 townhomes with attached garages and related improvements. The structures are anticipated to be up to three stories in height, of wood-framed construction, and will utilize concrete slab-on-grade floors and shallow foundations. For the purposes of this report, it is assumed maximum column and wall loads of about 100 kips and 5 kips per foot, respectively. Once actual loads are known that information should be provided to GeoTek to determine if modifications to the recommendations presented in this report are warranted.

Based upon past experience, grading of the site will involve cuts and fills generally less than about 5 feet in height, not including any recommended remedial grading. Sewage disposal is anticipated to be be provided by a public sewer system. Stormwater at the site may be managed via relatively shallow infiltration systems or a "drywell" system. Specific location and depth of these systems are unknown currently. If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Site development plans should be reviewed by GeoTek when they become available.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

The field exploration for this report was conducted on September 1, 2021 and consisted of excavating five (5) geotechnical exploratory test borings (Borings B-1 through B-5) with a hollow-stem drill rig to depths ranging from about 21.5 to 51.5 feet below grade. The approximate locations of the GeoTek borings are shown on the Exploration Location Map (Figure 2). A geologist from GeoTek logged the excavations and collected soil samples for use in subsequent laboratory testing. The logs of the exploratory borings are included in Appendix A.

Relatively undisturbed soil samples were recovered at various intervals in the geotechnical borings with a California sampler. The California sampler is a 3-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation. The California sampler test data are presented on the logs.

In Boring B-1 standard penetration tests (SPT) were performed with a 2.0-inch outside diameter, 1.5-inch inside diameter, split-barrel sampler. The sampler was 18 inches long. The inside diameter of the sampler shoe was 1.4 inches. The sampler was unlined. The sampler conformed to the requirements of ASTM D 1586. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The sampler penetration test data are presented on the Log for Boring for Boring B-1.

Percolation Testing

In addition to the geotechnical exploratory borings, two (2) borings (I-1 and I-2) were excavated in the area of the anticipated storm water control systems as designated by the project developer. In addition to borings I-1 and I-2, boring B-1 was converted to an infiltration boring by partial backfill of the boring to a depth of about 40 feet, to a depths below the contact between the fine-grained alluvium (ML soil type) and the coarse-grained alluvium (SM soil type). Infiltration/percolation testing was conducted in these borings in general accordance with the requirements of the County of Orange.

The percolation tests consisted of drilling an eight-inch diameter test hole to the desired depth and installing approximately two inches of gravel in the bottom of the hole. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the boring. Water was then placed in the borings to presoak the holes and percolation testing was performed the following the pre-soak period. Following presoaking, the percolation tests were performed which consisted of adding water to each test hole and measuring the water drop over a 30-minute period. The water drop was recorded for twelve test intervals. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method. The infiltration rates calculated using the Porchet Method are presented in the following table:

SUMMARY OF INFILTRATION RATES		
Boring	Depth of Test (Feet)	Infiltration Rate (Inches per hour)
I-1	5.0	0.38
I-2	5.0	4.16
B-1	40.0	1.64

The results of the conversions indicate infiltration rates of 0.38 to 4.16 inch per hour, which indicate highly variable infiltration rates based upon depth and location. Copies of the percolation data sheets and the Porchet infiltration rate conversion calculations are presented in Appendix C. No factors of safety were applied to the rates provided. Over the lifetime of the infiltration areas, the infiltration rates may be affected by sediment build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rate in designing the infiltration system.

It should be noted that the infiltration rates provided above were performed in relatively undisturbed on-site soils. Infiltration rates will vary and are mostly dependent on the underlying consistency of the site soils and relative density. Infiltration rates may be impacted by weight of equipment travelling over the soils, placement of engineered fill and other various factors. GeoTek assumes no responsibility or liability for the ultimate design or performance of the storm water facility.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected relatively undisturbed ring and bulk samples collected during the field exploration. The purpose of the laboratory testing was to confirm the field classification of the materials encountered and to evaluate their physical properties for use in the engineering design and analysis. Results of the laboratory testing program along with a brief description and relevant information regarding testing procedures are included on the exploratory borings logs included in Appendix A.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends approximately 975 miles south of the Transverse Ranges geomorphic province to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, the site is in an area geologically mapped to be underlain by alluvium (Dibblee, T.W. and Minch, J.A., 2003). No active faults are shown in the immediate site vicinity on the maps reviewed for the area.

4.2 GENERAL SOIL CONDITIONS

A brief description of the earth materials encountered is presented in the following section. Based on the site reconnaissance, the exploratory excavations and review of published geologic maps, the area investigated is locally underlain by alluvial soils that is locally overlain by artificial fill.

4.2.1 Artificial Fill

Artificial fill (asphalt concrete pavement sections consisting of asphalt concrete and aggregate base) was encountered in Borings B-1, B-2 and B-3. Borings B-4 and B-5 were conducted within landscape (lawn) areas of the site.

4.2.2 Alluvium

Alluvium was encountered beneath the fill/lawn in all the exploratory borings. The alluvium was found to consist of interbedded layers of silty and sandy clay, sandy and clayey silts, silty sands, and relatively clean sands (CL, ML, and SM soil types based upon the Unified Soil Classification System). The fine-grained alluvial soils (CL and ML soil types) were found to be

medium stiff to hard while the coarse-grained alluvium was found to be medium dense to very dense.

Based on the results of laboratory testing, the upper site soils are considered to have a "low" (21-50) expansion potential (ASTM D 4829). Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The test results are provided in Appendix B.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

If encountered during earthwork operations, surface water on this site is the result of precipitation or possibly some minor surface run-off from the surrounding areas. Overall site area drainage varies due to the site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was not encountered within any of the test borings drilled at the site. Based on review of available data, it is estimated that the depth to high groundwater at the site is greater than about 50 feet below grade. Based on the results of the field exploration, review of site area geomorphology and geology, groundwater is not anticipated to adversely affect the proposed improvements.

4.4 FAULTING AND SEISMICITY

4.4.1 Faulting

The geologic structure of the entire California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. However, the site is not situated within a State of California designated *"Alquist-Priolo"* Earthquake Fault Zone. The nearest known active fault is the Newport-Inglewood fault zone located about 5 miles to the southwest.

4.4.2 Seismic Design Parameters

The site is located at approximately 33.8252 degrees West Latitude and -117.9605 degrees North Longitude. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class "D" site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS

web services and retrieves the seismic design data and presents that information in a report format. Using the ASCE 7-16 option on the SEAOC/OSHPD website results in the values for S_{M1} and S_{D1} reported as "null-See Section 11.4.8" (of ASCE 7-16). As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value S_1 exceeds 0.2. The value S_1 for the subject site exceeds 0.2.

For a site Class D, an exception to performing a site-specific ground motion analysis is allowed in ASCE 7-16 where S_1 exceeds 0.2 provided the value of the seismic response coefficient, Cs, is conservatively calculated by Eq 12.8-2 of ASCE 7-16 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for $T_L \geq T > 1.5T_s$ or Eq. 12.8-4 for $T > T_L$.

The results, based on the 2015 NEHRP and the 2019 CBC, are presented in the following table as it is assumed that the exception as allowed in ASCE 7-16 is applicable. If the exception is deemed not appropriate, a site-specific ground motion analysis will be required.

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	1.458g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.514g
Site Coefficient for Site Class "D", F_a	1
Site Coefficient for Site Class "D", F_v	1.786
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.458g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.918g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	0.972
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.612
Peak Ground Acceleration (PGA_M)	0.682g
Seismic Design Category	D

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

4.5 LIQUEFACTION

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless and some low-plastic silt and clay soils. These soils may thereby acquire a high degree of mobility, which can lead to

lateral movement, sliding, settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction occurs, the liquefied soil/water matrix can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, plasticity, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures and some low plastic silts and clays.

Based on a review of the Orange County Parcel Report, the site is not located within an area mapped as being susceptible to liquefaction.

Based on the current mapping by Orange County and the lack of shallow groundwater, it is GeoTek's opinion that the site is not susceptible to liquefaction during a seismic event. Due to the fine-grained nature of the upper site soils and the dense/stiff nature of the underlying alluvium, seismic induced ("dry sand") settlements are estimated to be minimal.

4.6 OTHER SEISMIC HAZARDS

Due to the general flat terrain, the potential for seismic induced landslides or lateral spreading is considered nil. The potential for secondary seismic hazards such as a seiche and tsunami is considered negligible due to site elevation and distance from an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Development of the site appears feasible from a geotechnical engineering viewpoint. The following recommendations should be incorporated into the design and construction phases of development.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the County of Orange, City of Anaheim, the 2019 California Building Code (CBC), and recommendations contained in this report. The Grading Guidelines included in Appendix D outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix D.

5.2.2 Site Clearing

Initial site preparation should commence with removal of debris, existing structures, pavements, underground utilities, foundations, slabs-on-grade, deleterious materials and vegetation within the limits of the planned improvements. These materials should be properly disposed of off-site. Voids resulting from removing any materials should be replaced with engineered fill materials with expansion characteristics similar to the onsite materials.

5.2.3 Site Preparation

Demolition and removal of the existing on-site structure foundations, slabs and utility lines is anticipated to disturb the upper site soils. Following site demolition it is recommended that the soils be removed beneath the planned building footprint to a depth of at least five (5) feet below existing grade, or three (3) feet below the base of the proposed foundations, whichever is greater. The lateral extent of this recommended over-excavation should extend at least 5 feet beyond the building limits. Removal bottoms should be relatively uniform in soil type which is not visibly porous and having an in-place density of at least 85 percent of the soil's maximum dry density as determined by ASTM D 1557 test procedures.

Following site clearing operations, over-excavation and lowering of site grades, where necessary, it is recommended that the exposed subgrade soils beneath all surface improvements be proof rolled with a heavy rubber-tired piece of construction equipment approved by and in the presence of the geotechnical engineering representative. The proof rolling equipment should possess a minimum weight of 15 tons and proof rolling should include at least 4 passes, two in each perpendicular direction. All soil that ruts or excessively deflects during proof rolling should be removed as recommended by the GeoTek representative. Following proof rolling and removal of any unsuitable bearing soil, the exposed subgrade should be scarified to a depth of about 12 inches, be moisture conditioned to slightly above the soil's optimum moisture content and then be compacted to at least 90 percent of the soil's maximum dry density as determined by ASTM D-1557 test procedures.

5.2.4 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, debris, oversized materials (~6 inches) and other deleterious material. All areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in 6-to-8-inch loose lifts, moisture conditioned to about three percent above the optimum moisture content and compacted to a minimum relative compaction of 90 percent as determined by ASTM D-1557 test procedures.

If wet soils are encountered during remedial grading, methods for drying soils such as stockpiling or mixing with dry soils may be required to bring the soils to the required moisture content for placement as engineered fill. Placement of engineered fill should be observed and tested on a full-time basis by a GeoTek representative during grading activities.

5.2.5 Oversized Rock Disposal

Oversized cobbles, bounders and rock fragments may be encountered during rough grading and utility trench operations. On-site disposal of oversized materials is possible, provided the oversized materials are placed as recommended on Plate 4 within Appendix D. Alternatively, over-sized materials can be exported from the site.

5.2.6 Excavation Characteristics

Excavations in the on-site soils should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition. All excavations should be formed in accordance with current Cal-OSHA requirements.

5.2.7 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at a 1:1 inclination for short durations during construction and where cuts do not exceed 15 feet in height. Deeper temporary excavations should be reviewed by GeoTek prior to their planned excavation to determine if supplemental recommendations or analysis are warranted. It is anticipated that temporary cuts to a maximum height of 4 feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined by ASTM D-1557 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements,

the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than 6 inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be properly moisture conditioned prior to placement in trenches.

5.2.8 Shrinkage and Bulking

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, trench spoil from utilities and footing excavations, as well as the accuracy of topography.

Shrinkage is primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of 0 to 5 percent may be considered for the surficial soils. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of site earthwork construction.

A subsidence loss of up to about 0.1 foot is estimated for the site.

5.2.9 Grading Plan Review

Upon completion of the site grading plans, it is recommended that those plans be provided to GeoTek for review. Based on that review, some modifications to the recommendations provided in this report may be necessary.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

Presented below are post-tensioned foundation design parameters for the proposed structure at the site. These parameters are in general conformance with *Design of Post-Tensioned Slabs-on-Ground*, Third Edition *with 2008 Supplement* (PTI, 2008). These recommendations are minimal recommendations and are not intended to supersede the design by the project structural engineer.

Expansion Index, Atterberg Limits (including plasticity index), soil particle size analysis (including percent passing #200 sieve and clay percentage) and soluble sulfate evaluation of the soils should be performed during construction to evaluate the as-graded conditions. Final recommendations should be based upon the as-graded soils conditions.

DESIGN PARAMTERS FOR POST-TENSIONED SLABS	
Foundation Design Parameter	Design Value
	"Low" Expansion Potential (LL≤27; PI≤10; Passing #200 Sieve ≈ 60%; Clay fines ≈ 28%)
Edge Moisture Variation Distance, e_m -Edge Lift (swelling) -Center Lift (shrinkage)	 5.0 ft 9.0 ft
Soil Differential Movement, y_m -Edge Lift (swelling) -Center Lift (shrinkage)	 ≈1.48 in ≈-1.03 in
Exterior Perimeter Beam Embedment	Three-Story – 18 inches*
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum 11% to a depth of 12 inches

*Required depth of perimeter beam/stiffening rib per structural calculations may govern.
The following assumptions were used to generate e_m and y_m values: Thornthwaite Moisture Index = -20; constant suction value = 3.9pF; post-equilibrium case assumed with wet (swelling) cycle going from 3.9pF to 3.0pF and drying (shrinking) cycle going from 3.9pF to 4.5pF.

Post-tensioned slabs should be designed in accordance with the *2019 CBC* and PTI design methodology.

The bottom of the perimeter edge beam/deepened footing should be designed to resist tension forces using either cable or conventional reinforcement, per the structural engineer.

Foundation design criteria for a conventional foundation system, in general conformance with the 2019 CBC, are presented herein. These are typical design criteria and are not intended to supersede the design by the structural engineer.

A summary of GeoTek's preliminary conventional foundation design recommendations is presented in the table below:

Design Parameter	"Low" Expansion Potential (21≤EI≤50)
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	18 – Three-Story
Minimum Foundation Width (Inches)*	18 – Three-Story
Minimum Slab Thickness (actual)	4 inches (actual)
Minimum Slab Reinforcing	6" x 6" – W2.9/W2.9 welded wire fabric or No. 3 reinforcing bars at 18 inches on center each way placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 Reinforcing Bars, one top and one bottom
Effective Plasticity Index**	35
Presaturation of Subgrade Soil (Percent of Optimum/Depth in inches)	Minimum 110% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

*Code minimums per Table 1809.7 of the 2019 CBC should be complied with.
**Effective Plasticity Index should be verified at the completion of the rough grading

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

The following criteria for design of foundations are preliminary and should be re-evaluated based on the results additional laboratory testing of samples obtained at/near finish pad grade.

5.3.1.1 An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 18 inches deep and 18 inches wide, and pad footings 24 inches square and 24 inches deep. This allowable soil bearing capacity may be increased by 300 psf for each additional foot of footing depth and 150 psf for each additional foot of footing width to a maximum value of 3,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

5.3.1.2 Structural foundations should be designed in accordance with the 2019 CBC, and to withstand a total static settlement of 1 inch and maximum differential static settlement of one-half of the total settlement over a horizontal distance of 40 feet.

5.3.1.3 The passive earth pressure may be computed as an equivalent fluid having a density of 200 psf per foot of depth, to a maximum earth pressure of 2,000 psf for footings founded on engineered fill or competent native soil. A coefficient of friction between soil and concrete of 0.3 may be used with dead load forces. When combining passive

pressure and frictional resistance, the passive pressure component should be reduced by one-third. The upper one foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavements.

5.3.1.4 A grade beam, a minimum of 18 inches wide and 18 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.

5.3.1.5 A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2019 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2019 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g., stake penetrations, tears, punctures from walking on the vapor retarder placed atop the underlying aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limited migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e., thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within the building be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person (or persons) should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and GeoTek's services in general are not intended to address mold prevention; since GeoTek, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

It is recommended that control joints be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

5.3.2 Miscellaneous Foundation Recommendations

5.3.2.1 To reduce moisture penetration beneath the slab on grade areas, utility trench excavations should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.

5.3.2.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.3 Foundation Setbacks

Minimum setbacks for all foundations should comply with the 2019 CBC or County of Orange requirements, whichever is more stringent. Improvements not conforming to these setbacks

are subject to the increased likelihood of excessive lateral movements and/or differential settlements. If large enough, these movements can compromise the integrity of the improvements. The top outside edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least five feet and need not exceed 40 feet.

5.3.4 Soil Corrosivity

The soil resistivity at this site was tested in the laboratory on two (2) samples collected during the field investigation. The results of the testing indicate that the on-site soils are considered "corrosive" (3,350 to 5,360 ohm-cm) (Roberge, 2000) to buried ferrous metal in accordance with current standards used by corrosion engineers. It is recommended that a corrosion engineer be consulted to provide recommendations for the protection of buried ferrous metal at this site.

5.3.5 Soil Sulfate Content

The sulfate content was determined in the laboratory on two (2) samples collected during the field investigation. The results indicate that the water-soluble sulfate result is less than 0.1 percent by weight, which is considered "negligible" as per Table 4.2.1 of ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special recommendations for concrete are required for this project due to soil sulfate exposure.

5.4 RETAINING AND GARDEN WALL DESIGN AND CONSTRUCTION

5.4.1.1 General Design Criteria

Recommendations presented in this report apply to typical masonry or concrete vertical retaining walls to a maximum height of up to six (6) feet. Additional review and recommendations should be requested for higher walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be embedded a minimum of 18 inches into engineered fill and/or competent native soil. Retaining wall foundations should be designed in accordance with Section 5.3 of this report. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization.

Earthwork considerations, site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations are made by the designer. The backfill material placement for all earth retention structures should meet the requirement of Section 5.2.4 in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the earth retention structure, may be designed using the "active" condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the "at-rest" condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (horizontal:vertical) projection from the surcharge on the stem of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

5.4.1.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to six (6) feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, or seismic events.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (horizontal : vertical)	Equivalent Fluid Pressure (pcf) Select Backfill* and Native Soils
Level	42
2:1	65

*The design pressures assume the backfill material has an expansion index less than or equal to 20. Backfill zone includes area between back of the wall to a plane (1:1 horizontal : vertical) up from bottom of the wall foundation (on the backside of the wall) to the ground surface.

For walls with a retained height greater than 6 feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an equivalent fluid pressure of 18 pcf be included into the wall design to account for seismic loading conditions. This pressure may be applied as an inverted triangular distribution.

5.4.1.3 Retaining Wall Backfill and Drainage

The wall backfill should also include a minimum one (1) foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The upper 24 inches should consist of compacted on-site materials. The rock should be separated from the earth with filter fabric. The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. The backfill materials should be placed in lifts no greater than eight (8) inches in thickness and compacted to a minimum of 90% relative compaction as determined by ASTM D 1557 test procedures. Proper surface drainage needs to be provided and maintained.

As an alternative to the drain, rock and fabric, a pre-manufactured wall drainage product (example: Mira Drain 6000 or approved equivalent) may be used behind the retaining wall. The wall drainage product should extend from the base of the wall to within two (2) feet of the ground surface. The subdrain should be placed in direct contact with the wall drainage product.

Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a four (4)-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one (1) cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The drain system should be connected to a suitable outlet. Waterproofing of site walls should be performed where moisture migration through the walls is undesirable.

5.4.1.4 Restrained Retaining Walls

Retaining walls that will be restrained at the top that support level backfill or that have reentrant or male corners, should be designed for an equivalent at-rest fluid pressure of 65 pcf, plus any applicable surcharge loading. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.4.1.5 Other Design Considerations

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts, and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in garden walls at horizontal distances not exceeding 20 feet.

5.5 PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

Although planned final grades beneath the proposed parking, access roads and adjacent street improvements within the site are not yet known, the following preliminary pavement design recommendations are based on assumed Traffic Indexes of 5.0 for car parking areas and 6.0 for access drives. Preliminary pavement thickness design is based on the CalTrans Highway Design Manual (2018). An R-value of 25 was assumed for the determination of preliminary pavement sections for this report. Once the traffic loading information becomes more defined, revision to the pavement design recommendations may be warranted. It is recommended that the final pavement design be based on R-value testing of the as-graded subgrade soils within the pavement areas.

Based on the assumptions noted above, the following preliminary pavement recommendations are provided for the site:

PRELIMINARY MINIMUM PAVEMENT SECTION		
Traffic Index	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.0 (Car Parking Areas)	3	8
6.0 (Automobile Access Lanes)	4	8

Traffic Indices (TIs) used in the pavement design should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the

paving may result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

All base material and the upper 12 inches of subgrade should be compacted to at least 95 percent of the material's maximum dry density as determined by ASTM D 1557 test procedures. All materials and methods of construction should conform to the requirements of the City of Anaheim.

5.6 CONCRETE CONSTRUCTION

5.6.1 General

Concrete construction should follow the 2019 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, GeoTek could provide quality control testing of the concrete during construction.

5.6.2 Concrete Mix Design

As discussed in Section 5.3.5, no special recommendations for concrete are required for this project due to soil sulfate exposure. Additional testing should be performed during grading so that specific recommendations can be formulated based on the as-graded conditions.

5.6.3 Concrete Flatwork

Exterior concrete flatwork is often one of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. Cracking of these features is common due to various factors. While cracking usually does not affect the structural performance of the concrete, it is unsightly. It is recommended that the same standards of care be applied to these features as to the structure itself.

Flatwork should consist of a minimum four-inch (actual) thick concrete and the use of temperature and shrinkage control reinforcement is suggested. The project structural engineer should provide final design recommendations.

5.6.4 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are hairline to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some

cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two orthogonal directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

5.7 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

It is recommended that site grading, specifications, and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. It is also recommended that GeoTek representatives be present during site grading and foundation construction to observe and document for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of all unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trench excavation backfill. Also, test the fill for density, relative compaction and moisture content.
- Observe and probe foundation excavations to confirm suitability of bearing materials with respect to density.

If requested, a construction observation and compaction report can be provided by GeoTek which can comply with the requirements of the governmental agencies having jurisdiction over the project. It is recommended that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. INTENT

It is the intent of this report to aid in the design and construction of the proposed development. Implementation of the advice presented in this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual or variable conditions will not be discovered during or after construction.

The scope of our evaluation is limited to the area explored that is shown on the Exploration Location Map (Figure 2). This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to GeoTek by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-0700421r2-CR) dated August 19, 2021 and geotechnical engineering standards normally used on similar projects in this region.

7. LIMITATIONS

GeoTek's findings are based on site conditions observed and the stated sources. Thus, GeoTek's comments are professional opinions that are limited to the extent of the available data.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering at this time and location and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report.

Since GeoTek's recommendations are based on the site conditions observed and encountered at the stated times and laboratory testing. Thus, GeoTek's conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty of any kind is expressed or implied. Standards of care/practice are subject to change with time.

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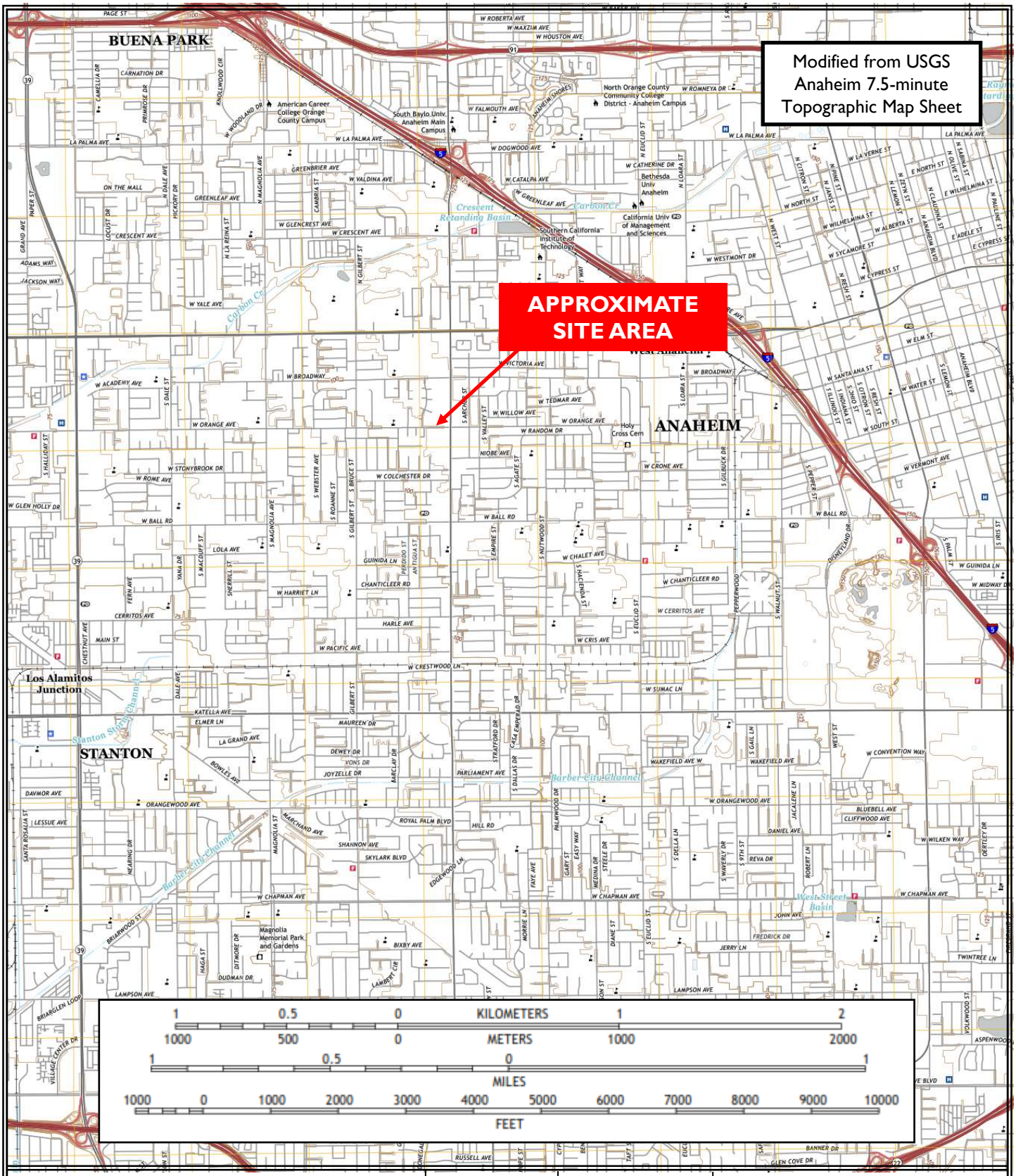


Melia Homes
2219 West Orange Avenue
Anaheim, Orange County, California

Project No. 2883-CR

Figure 1

Site Location Map

GEOTEK

Melia Homes
Proposed Townhomes Project
2219 West Orange Avenue
Anaheim, Orange County, California

GeoTek Project No. 2883-CR

Scale As Shown

Figure 2

Exploration Location Map

GEOTEK

APPENDIX A

LOG OF EXPLORATORY BORINGS

Proposed Townhomes Project
2219 West Orange Avenue
Anaheim, Orange County, California
Project No. 2883-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

The Ring sampler is driven into the ground at various depths in accordance with ASTM D 3550 test procedures. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)

These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

Bulk Samples (Small)

These are plastic bag samples which are normally airtight and contain less than 5 pounds in weight of earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

B - BORING LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the log of borings:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
……..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
———	Thick solid line denotes end of boring

(Additional denotations and symbols are provided on the boring log)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Boring No.: B-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					2 in. asphalt over no base			
					Alluvium:			Expansion Index = 37
		3		CL	Silty CLAY, brown, slightly moist, medium stiff			60% passing #200 Sieve
		5				17.4	106.3	28% Clay
		8						Liquid Limit = 27
								Plastic Limit = 18
		3			Fine sandy CLAY, brown, slightly moist, stiff			Plasticity Index = 9
		7						Corrosion Test
		12						
5		3			Silty CLAY, brown, slightly moist, medium siff			
		9				8.3	115.6	
		6						
		3			Silty CLAY, brown, slightly moist, stiff			
		7				11.5	113.7	
		13						
10		6		ML	Fine sandy SILT with clay, brown, slightly moist, stiff			
		10				11.7	112.9	
		11						
15		11		SM	Silty f SAND, light brown/gray, slightly moist, dense			
		25						
		32						
20		11			Silty f SAND, lightly brown/gray, slightly moist, dense			
		25				5.9	111.9	
		28						
25		6		ML	Fine sandy SILT with clay, brown, slightly moist, hard			
		20				16.7	112.7	
		31						
30		11			Same as above			
		23				16.0		
		26						

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	Boring No.: B-1 (cont.) / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
35		17 19 24		ML	Fine sandy SILT, light brown, slightly moist, hard			
40		17 17 25		SM	Silty f-m SAND, lightly brown, moist, medium dense	13.8		26% Passing #200 Sieve
45		18 25 25		SM	Silty fine SAND, light brown, moist, dense	12.4		22% Passing #200 Sieve
50		16 22 36			Silty f-m SAND, lightly brown, very moist, dense	13.2		14% Passing #200 Sieve
					BORING TERMINATED AT 51.5 FEET No Groundwater Encountered Spoils backfilled 10 feet and boring prepped for infiltration testing at 40 feet			
55								
60								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Boring No.: B-2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					2 inches asphalt over 4 inches base			
					Alluvium:			
				ML	Clayey SILT, light brown, slightly moist, medium stiff			
	■	7 7 8				11.5	109.7	
5	■	8 15 15			Clayey SILT with trace sand, brown, slightly moist, stiff			
	■	2 5 8			Clayey SILT, brown, slightly moist, medium stiff	24.5	101.6	
10	■	5 8 12			Sandy SILT with clay, brown, slightly moist, stiff	16.3	115	
15	■	10 26 32		SM	Silty fine SAND, light brown/gray, slightly moist, dense	4.5	121.3	
20	■	13 27 24			Silty fine SAND, light brown/gray, slightly moist, medium dense	12.4	112.2	
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered Spoils backfilled and surface patched with asphalt concrete			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Boring No.: B-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					2 inches aspalt over no base			
					Alluvium:			
		4		ML	Clayey SILT, dark brown, slightly moist, soft			
		4				22.5	102.4	
		5						
		4			Clayey SILT with trace sand, dark brown, slightly moist, medium stiff			
		6						
		10						
5		4			Clayey SILT, dark brown, slightly moist, medium stiff			
		5						
		6						
10		5		SM	Silty f SAND, light brown, slightly moist, medium dense			
		11				16.3	113	
		17						
15		12			Silty f-m SAND, yellow/brown, slightly moist, medium dense			
		21				3.3	115.5	
		30						
20		13		ML	Fine sandy SILT, brown, slightly moist, loose			
		11				5.2	107.2	
		8						
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered			
					Spoils backfilled and surface patched with asphalt concrete			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Boring No.: B-4

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Alluvium:**			
		14 27 39		ML	Sandy SILT, light brown, dry, very stiff, trace organics	6.0	113.6	
		18 19 13		SM	Silty f SAND, light brown, slightly moist, medium dense	10.4	109.9	
5		3 6 9		CL	Silty CLAY, brown/gray, slightly moist, medium stiff	19.3	103.7	
10		5 5 12		ML	Sandy SILT, light brown, slightly moist, medium stiff			
15		7 13 13		ML	Sandy SILT w/ trace clay, light brown, slightly moist, stiff	14.7	112.9	
20		8 15 16		CL	Silty CLAY, brown, slightly moist, very stiff	16.9	106.9	
					BORING TERMINATED AT 21.5 FEET No groundwater encountered Spoils backfilled			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**Boring No.: B-5** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Alluvium:**			
		10 29 32		ML	Sandy SILT, light brown, slightly moist, very stiff			Expansion Index = 30 Maximum Density Test Remolded Direct Shear Corrosion Test
5		6 10 12			Clayey SILT, brown, slightly moist, stiff	10.7	108.1	
		6 10 16			Sandy SILT, brown, slightly moist, stiff			
10		7 8 10			Sandy SILT, brown, slightly moist, medium stiff	6.6	111	
15		17 22 24		SM	Silty f-m SAND, light brown, slightly moist, medium dense	2.4	109.8	
20		12 14 17		CL	Silty CLAY, brown, slightly moist, medium stiff	13.6	95.6	
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered Spoils backfilled			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**Boring No.: I-1** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					2 inches asphalt over no base			
					Alluvium:			
				ML	Sandy SILT w/ trace clay, brown, slightly moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring prepped with pipe, filter sock and gravel for infiltration testing			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Melia Homes	**DRILLER:**	2R Drilling	**LOGGED BY:**	GP/CD
PROJECT NAME:	2219 W Orange Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Ish/Antonio
PROJECT NO.:	2883-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Anaheim, CA			**DATE:**	9/1/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**Boring No.: I-2** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0				ML	**Alluvium:** Sandy SILT, light brown, slightly moist			
5					**BORING TERMINATED AT 5 FEET** No groundwater encountered Boring prepped with pipe, filter sock and gravel for infiltration testing			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX B

RESULTS OF LABORATORY TESTING

Proposed Townhomes Project
2219 West Orange Avenue
Anaheim, Orange County, California
Project No. 2883-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Atterberg Limits

Atterberg limits testing were performed on a bulk sample collected from the site. The tests were performed in general accordance with ASTM D 4318. Results of these tests are shown on the boring logs at the appropriate sample depths in Appendix A.

Classification

Soils were classified visually in general accordance with the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications are shown on the logs of borings in Appendix A.

Direct Shear

Shear testing was performed on a remolded sample in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080. The rate of deformation is approximately 0.035 inch per minute. The samples were sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The results of the testing are presented in Appendix B.

Expansion Index

Expansion Index testing was performed on two (2) bulk soil samples obtained from the site. Testing was performed in general accordance with ASTM Test Method D 4829. The results of the testing are provided below.

Boring No.	Depth (ft.)	Description	Expansion Index	Classification
B-1	0-5	Silty Clay	37	Low
B-5	0-5	Sand Silt	30	Low

In-Situ Moisture and Density

The natural water content of sampled soils was determined in general accordance with ASTM D 2216 test procedures on samples of the materials recovered from the subsurface exploration. In addition, in-place dry density of the sampled soils was determined in general accordance with ASTM D 2937 test procedures on relatively undisturbed samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the boring logs at the appropriate sample depths in Appendix A.

Moisture-Density Relationship

Laboratory testing was performed on one bulk sample collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for the soil type was determined in general accordance with test method ASTM Test Procedure D 1557. The results of the testing are provided in Appendix B.

Sieve/Hydrometer

Sieve/hydrometer testing was performed on samples collected from the site. The tests were performed in general accordance with ASTM D 6913 and D 7928. The test results are presented Appendix B and on the boring logs at the appropriate sample depths in Appendix A.

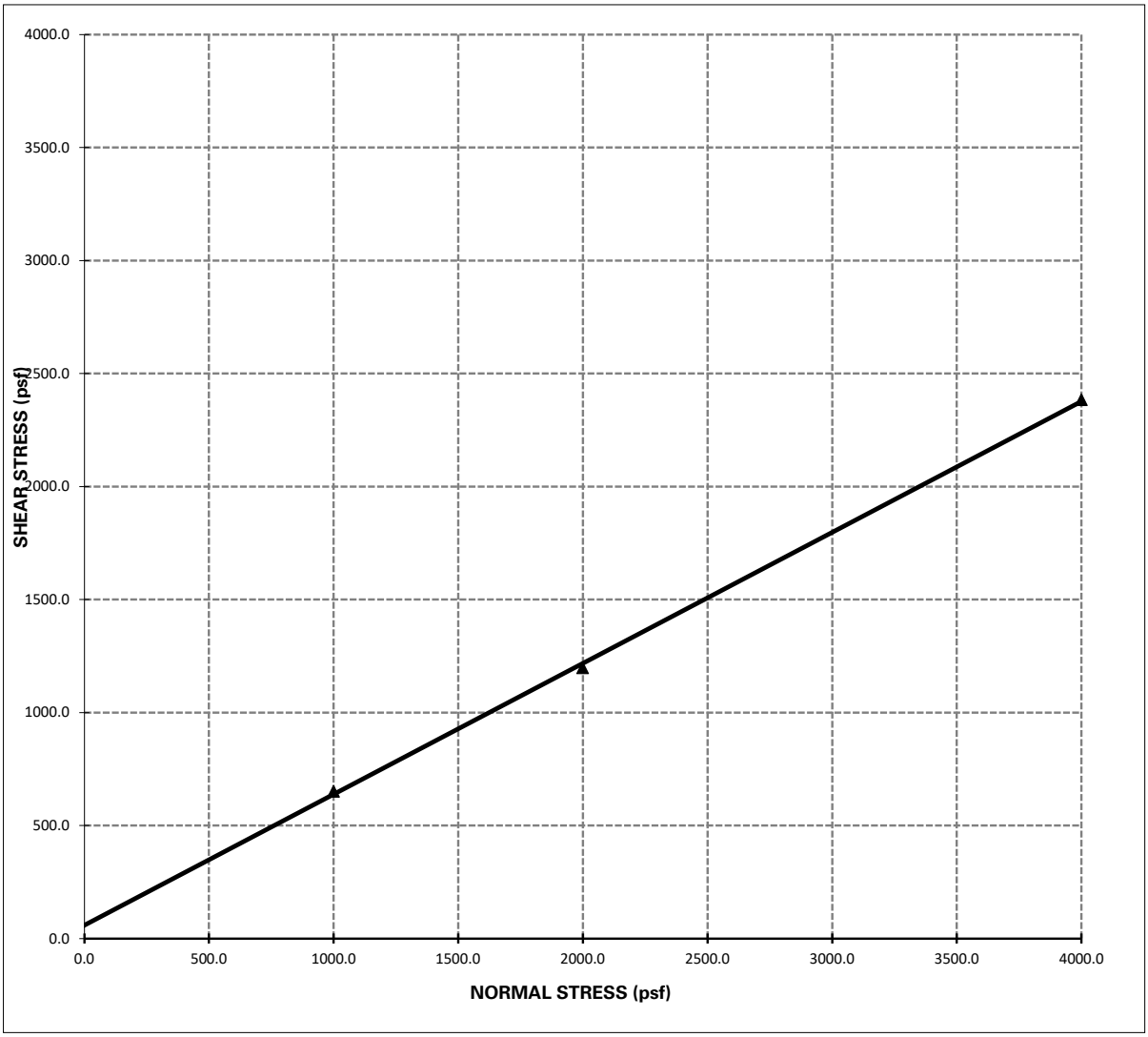
Sulfate Content, Resistivity and Chloride Content

Testing to determine the water-soluble sulfate content was performed by others in general accordance with ASTM D4327 test procedures. Resistivity testing was completed by others in general accordance with ASTM G187 test procedures. Testing to determine the chloride content was performed by others in general accordance with ASTM D4327 test procedures. The results of the testing are provided below and in Appendix B.

Boring No.	Depth (ft.)	pH ASTM D4972	Chloride ASTM D4327 (mg/kg)	Sulfate ASTM D4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
B-1	0-5	9.3	4.8	0.0040	5,360
B-5	0-5	8.4	33.0	0.0076	3,350

DIRECT SHEAR TEST

Project Name:	Melia Homes	***Sample Location:***	B5 @ 0-5'
Project Number:	2883-CR	***Date Tested:***	9/20/2021



Shear Strength: Φ = **30°** , **C = 58 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Melia Homes	***Tested/ Checked By:***	RL Lab No Corona
Project Number:	2883-CR	***Date Tested:***	9/13/2021
Project Location:	West Orange Ave. Townhomes Anaheim	***Sample Source:***	B1 @ 0-5'
		Sample Description:	

Ring #:_____ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	753.1
B	Weight of ring (gm)	366.7
C	Net weight of sample (gm)	**386.4**
D	Wet Density, lb / ft3 (C*0.3016)	**116.5**
E	Dry Density, lb / ft3 (D/1.F)	**105.3**

SATURATION DETERMINATION

F	Moisture Content, %	10.7
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
I	% Saturation	**48.1**

READINGS

DATE	TIME	READING	
9/13/2021		0.1230	Initial
9/13/2021		0.1230	10 min/Dry
9/14/2021		0.1600	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
786.5	**19.3**

EXPANSION INDEX = 37

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Melia Homes	***Tested/ Checked By:***	RL Lab No Corona
Project Number:	2883-CR	***Date Tested:***	9/13/2021
Project Location:	West Orange Ave. Townhomes Anaheim	***Sample Source:***	B5 @ 0-5'
		Sample Description:	

Ring #:_____ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	771.4
B	Weight of ring (gm)	365.4
C	Net weight of sample (gm)	**406.0**
D	Wet Density, lb / ft3 (C*0.3016)	**122.4**
E	Dry Density, lb / ft3 (D/1.F)	**111.8**

SATURATION DETERMINATION

F	Moisture Content, %	9.5
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
I	% Saturation	**50.6**

READINGS

DATE	TIME	READING	
9/13/2021		0.7320	Initial
9/13/2021		0.7320	10 min/Dry
9/14/2021		0.7620	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
789.9	**14.1**

EXPANSION INDEX = 30

GEOTEK

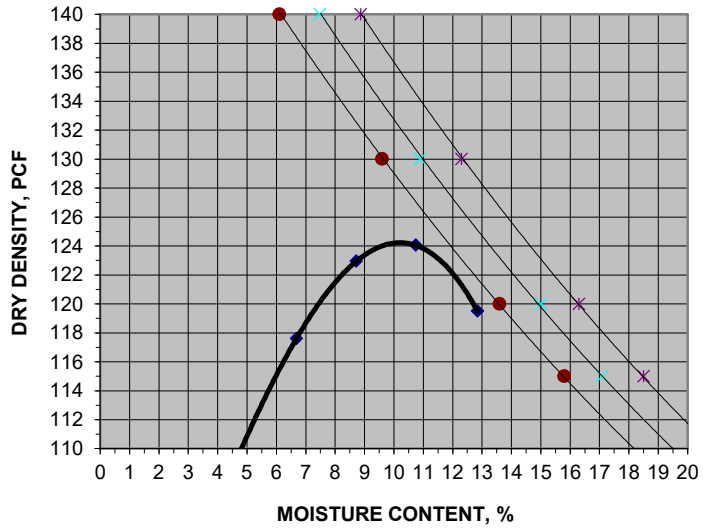
MOISTURE/DENSITY RELATIONSHIP

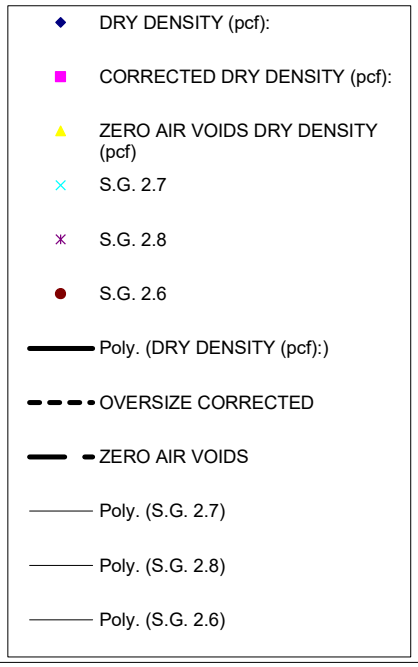
Client:	Melia Homes	**Job No.:**	2883-CR
Project:	2219 W. Orange	**Lab No.:**	Corona
Location:	Anaheim		
Material Type:	Brown Silty Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	B5 @ 0-5'		
	-		
Sampled By:	GP/CD	**Date Sampled:**	9/7/2021
Received By:	RJ	**Date Received:**	9/7/2021
Tested By:	AD	**Date Tested:**	9/16/2021
Reviewed By:	RJ	**Date Reviewed:**	9/17/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 0.3 **Correction Required:** [ ] yes [x] no

MOISTURE/DENSITY RELATIONSHIP CURVE





MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	123.0	**@ Optimum Moisture, %**	10.5
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

Results Only Soil Testing for 2219 W. Orange Ave - Townhomes, Anaheim

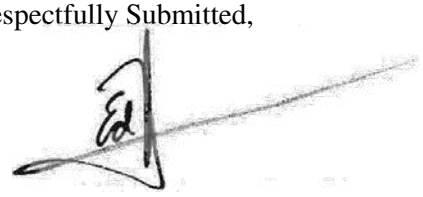
September 9, 2021

Prepared for:

Ed Lamont
GeoTek, Inc.
1548 North Maple Street
Corona, CA 92280
Elamont@geotekusa.com

Project X Job#: S210908F
Client Job or PO#: 2883-CR Melia Homes

Respectfully Submitted,



Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
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ehernandez@projectxcorrosion.com

Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: 2219 W. Orange Ave - Townhomes, Anaheim
Client Job Number: 2883-CR Melia Homes
Project X Job Number: S210908F
September 9, 2021

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	ASTM D4658	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
2883-CR B1	0-5	39.8	0.0040	4.8	0.0005	8,710	5,360	9.3	87	0.02	10.2	5.3	0.03	136.4	47.8	77.1	335.3	8.2	19.9

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

Results Only Soil Testing for 2219 W. Orange Ave, Townhomes Anaheim

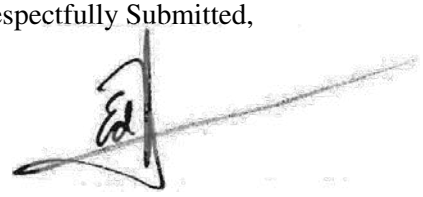
September 15, 2021

Prepared for:

Ed Lamont
GeoTek, Inc.
1548 North Maple Street
Corona, CA 92280
Elamont@geotekusa.com

Project X Job#: S2109010A
Client Job or PO#: 2883-CR Melia Homes

Respectfully Submitted,



Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: 2219 W. Orange Ave, Townhomes Anaheim
Client Job Number: 2883-CR Melia Homes
Project X Job Number: S2109010A
September 15, 2021

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	ASTM D4658	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^-	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
2883-CR B5	0-5	75.5	0.0076	33.0	0.0033	33,500	3,350	8.4	153	<0.01	2.3	3.0	ND	56.4	1.6	21.4	147.8	13.2	1.1

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

APPENDIX C

PERCOLATION DATA SHEETS & PORCHET CALCULATIONS

Proposed Townhomes Project

2219 West Orange Avenue

Anaheim, Orange County, California

Project No. 2883-CR

GEOTEK

Client:	**Melina Homes**
Project:	**2219 West Orange Avenue**
Project No:	**2883-CR**
Date:	**9/1/2021**

Boring No. **I-1**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	42
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	18
$\Delta H = \Delta D = H_O - H_F$ =	2
$H_{avg} = (H_O+H_F)/2$ =	19

I_t = 0.38 **Inches per Hour**

GEOTEK

Client:	**Melia Homes**
Project:	**2219 West Orange Avenue**
Project No:	**2883-CR**
Date:	**9/1/2021**

Boring No. **I-2**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	10
Final Depth to Water, D_F =	46.5
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	13.5
$\Delta H = \Delta D = H_O - H_F$ =	6.5
$H_{avg} = (H_O+H_F)/2$ =	16.75

I_t = 4.16 **Inches per Hour**

GEOTEK

Client:	**Melina Homes**
Project:	**2219 West Orange Avenue**
Project No:	**2883-CR**
Date:	**9/1/2021**

Boring No. **B-1**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	467.5
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	460
Total Test Hole Depth, D_T =	480

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	12.5
$\Delta H = \Delta D = H_O - H_F$ =	7.5
$H_{avg} = (H_O+H_F)/2$ =	16.25

I_t = 1.64 **Inches per Hour**

GEOTEK

PERCOLATION DATA SHEET

Project: 2219 ORANGE AVENUE ANAHEIM, **Job No.:** 2883-CR.

Test Hole No.: I-1 **Tested By:** DVG, **Date:** 9/1,2/2021.

Depth of Hole As Drilled: 60" **Before Test:** 60" **After Test:** 60".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								PRESOAK 5 GAL 9/1/2021
	849 / 914	25	60	20	17	3		BEGIN 9/2/2021 1ST 25 MIN.
	916 / 941	25	60	20	17 1/4	2 3/4		2ND 25 MIN.
	943 / 1013	30	60	20	16	3 1/4		1ST 30 MIN.
	1015 / 1045	30	60	20	17 1/4	2 3/4		2ND 30 MIN.
	1047 / 1117	30	60	20	17 1/4	2 3/4		3RD 30 MIN.
	1119 / 1149	30	60	20	17 1/2	2 1/2		4TH 30 MIN.
	1151 / 1221	30	60	20	17 1/2	2 1/2		5TH 30 MIN.
	1223 / 1253	30	60	20	17 1/2	2 1/2		6TH 30 MIN.
	1255 / 125	30	60	20	17 3/4	2 1/4		7TH 30 MIN.

PERCOLATION DATA SHEET

Project: 2219 ORANGE AVENUE ANAHEIM, Job No.: 2883-CR.

Test Hole No.: P-1 Tested By: DVG, Date: 9/1,2/2021.

Depth of Hole As Drilled: 60" Before Test: 60" After Test: 60".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	127		60	20				
	157	30			17 3/4	2 1/4		8TH 30 MIN.
	159		60	20				
	229	30			17 3/4	2 1/4		9TH 30 MIN.
	231		60	20				
	301	30			18	2		10TH 30 MIN.
	303		60	20				
	333	30			18	2		11TH 30 MIN.
	335		60	20				
	405	30			18	2		12TH 30 MIN.

PERCOLATION DATA SHEET

Project: 2219 ORANGE AVENUE ANAHEIM, Job No.: 2883-CR.

Test Hole No.: I-2 Tested By: DVG, Date: 9/1,2/2021.

Depth of Hole As Drilled: 60 Before Test: 60" After Test: 60".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								PRESOAK 5 GAL 9/1/2021
	651		60	20				BEGIN 9/2/2021
	701	10			12 1/2	7 1/2		1ST 25 MIN.
	703		60	20				
	713	10			13	7		2ND 25 MIN.
	715		60	20				
	725	10			13	7		1ST 10 MIN.
	727		60	20				
	737	10			13	7		2ND 10 MIN.
	739		60	20				
	749	10			13	7		3RD 10 MIN.
	751		60	20				
	801	10			13 1/4	6 3/4		4TH 10 MIN.
	803		60	20				
	813	10			13 1/2	6 1/2		5TH 10 MIN.
	815		60	20				
	825	10			13 1/2	6 1/2		6TH 10 MIN.

PERCOLATION DATA SHEET

Project: 2219 ORANGE AVENUE ANAHEIM, Job No.: 2683-CR.

Test Hole No.: B-1 Tested By: DVG, Date: 9/1,2/2021.

Depth of Hole As Drilled: 480" Before Test: 480" After Test: 480".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								PRESOAK 5 GAL. 9/1/2021
	835 / 900	25	480	20	11 1/4	8 3/4		BEGIN 9/2/2021 1ST 25 MIN.
	902 / 927	25	480	20	11 3/4	8 1/4		2ND 25 MIN.
	929 / 959	30	480	20	10 1/2	9 1/2		1ST 30 MIN.
	1001 / 1031	30	480	20	10 1/2	9 1/2		2ND 30 MIN.
	1033 / 1103	30	480	20	10 3/4	9 1/4		3RD 30 MIN.
	1105 / 1135	30	480	20	10 3/4	9 1/4		4TH 30 MIN.
	1137 / 1207	30	480	20	11	9		5TH 30 MIN.
	1209 / 1239	30	480	20	11	9		6TH 30 MIN.
	1241 / 111	30	480	20	11 1/4	8 3/4		7TH 30 MIN.

PERCOLATION DATA SHEET

Project: 2219 ORANGE AVENUE ANAHEIM, Job No.: 2883-CR.

Test Hole No.: B1 Tested By: DVG, Date: 9/1,2/2021.

Depth of Hole As Drilled: 480'' Before Test: 480'' After Test: 480''.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	113		480	20				
	143	30			11 1/2	8 1/2		8TH 30 MIN.
	145		480	20				
	215	30			11 3/4	8 1/4		9TH 30 MIN.
	217		480	20				
	247	30			12	8		10TH 30 MIN.
	249		480	20				
	319	30			12 1/4	7 3/4		11TH 30 MIN.
	321		480	20				
	351	30			12 1/2	7 1/2		12TH 30 MIN.

APPENDIX D

GENERAL GRADING GUIDELINES

Proposed Townhomes Project
2219 West Orange Avenue
Anaheim, Orange County, California
Project No. 2883-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the Uniform Building Code, CBC (2019) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.

4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
    a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
    b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and artificial should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.

Fill Placement

1. Unless otherwise indicated, all site soil may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
    a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
    b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
    a) They are not placed in concentrated pockets;
    b) There is a sufficient percentage of fine-grained material to surround the rocks;
    c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials

are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.

6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss

them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

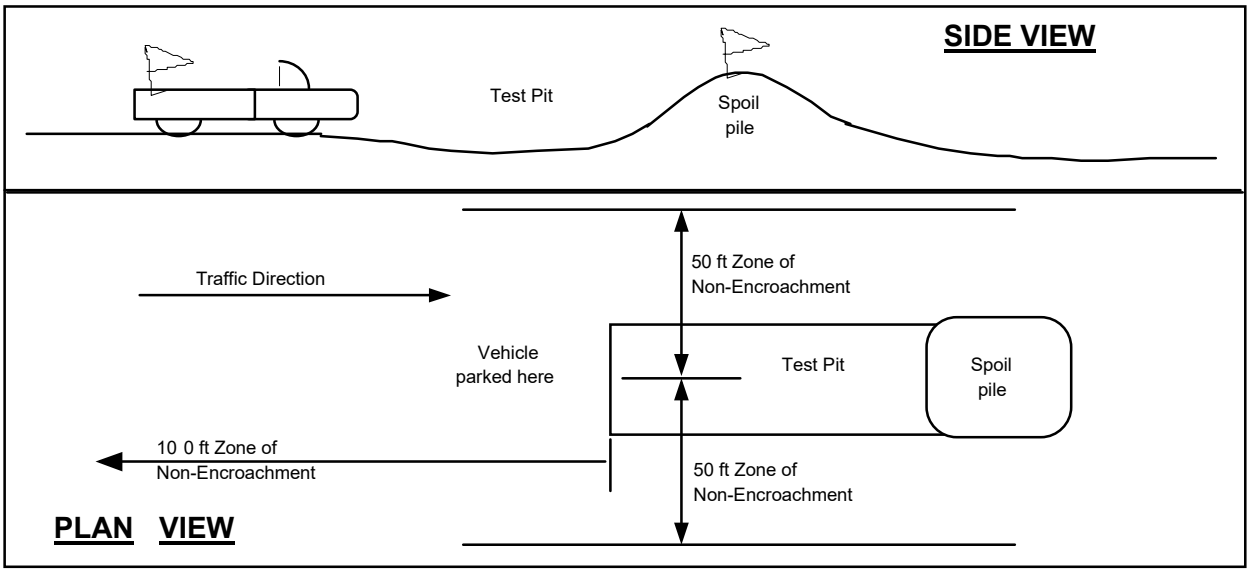
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or

4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

GeoTek, Inc.
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June 1, 2022
Project No. 2883-CR

Melia Homes
8951 Research Drive
Irvine, California 92618

Attention: Mr. Chad Brown

Subject: **Supplemental Information on Site Groundwater Levels**
Proposed Townhomes Project – Tract19192
2219 West Orange Avenue
City of Anaheim, Orange County, California

References: See Page 3

Dear Mr. Brown,

As requested, GeoTek, Inc. (GeoTek) has prepared this letter to provide supplemental information on site groundwater levels and to provide GeoTek's opinion in relation to the need to assess a mounded groundwater condition.

As noted in the referenced *Geotechnical and Infiltration Evaluation* report for the project (GeoTek, 2021), groundwater was not encountered to the maximum depth explored (approximately 51.5 feet for Boring B-1). This is consistent with data published by GeoTracker (https://geotracker.waterboards.ca.gov/) for a property located about ¼-mile northeast of the site (300 South Brookhurst Street), with a reported groundwater elevation of about 60 feet above mean sea level (amsl) in 2000. Given that the average elevation of this site is approximately 109 feet amsl, the indicated groundwater depth would correspond to a groundwater elevation of about 49 feet amsl. This report indicated that groundwater flow at this site was to the southwest (towards the project site).

Review of the California Water Data Library (http://wdl.water.ca.gov/waterdatalibrary/) indicates that one well located approximately 3/4-mile north of the site (Site Code 338320N1179624W001) showed that the highest groundwater elevation was approximately 49 feet amsl in 1970.

Based upon review, historic high groundwater level in the project area is greater than 50 feet below the existing ground surface.

According to Appendix C of the *Orange County Technical Guidance Document* (County of Orange, 2017), a minimum separation of 10 feet is required between the mounded seasonally high groundwater and the bottom of the proposed infiltration system. GeoTek understands that drywell(s) approximately 35 feet in depth are planned for this site for the proposed infiltration system.

Because groundwater at the site is deeper than 50 feet deep and the relatively shallow configuration of the proposed infiltration system, a separation to mounded seasonally high groundwater of more than 10 feet, as required by the City, is expected.

GeoTek appreciates this opportunity to be of continued service on this project. If you have any questions, or if we can be of further service, please contact us at (951) 710-1160.

Respectfully Submitted,
GEOTEK, INC.

Edward H. LaMont
CEG 1892, Exp. 07/31/20
Principal Geologist

Bruce A. Hick
GE 2284, Exp. 12/31/22
Geotechnical Engineer

Distribution: (1) Addressee via email

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REFERENCES

County of Orange, 2017, "Technical Guidance Document, Appendix C", dated September 28.

GeoTek, Inc., 2021, "Geotechnical and Infiltration Evaluation, Proposed Townhomes Project, 2219 West Orange Avenue, Anaheim, Orange County, California", Project No. 2883-CR, dated September 21.

Attachment G

Notice of Transfer of Responsibility

To be signed after construciton is completed

Water Quality Management Plan
Notice of Transfer of Responsibility

Submission of this Notice of Transfer of Responsibility constitutes notice to the City of Anaheim that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/ her agent) of the site (or a portion thereof) to the New Owner, as further described below.

I. Previous Owner/ Previous Responsibility Party Information

Company/ Individual Name		Contact Person	
Street Address		Title	
City	State	Zip	Phone

II. Information about Site Transferred

Name of Project	
Title of WQMP Applicable to Site:	
Street Address of Site	
Tract Number(s) for Site	Lot Numbers
Date WQMP Prepared (or Revised)	

III. New Owner/ New Responsible Party Information

Company/ Individual Name		Contact Person	
Street Address		Title	
City	State	Zip	Phone

IV. Ownership Transfer Information

General Description of Site Transferred to New Owner	General Description of Portion of Project/ Parcel Subject to WQMP Retained by Owner (if any)
Lot/ Tract Number(s) of Site Transferred to New Owner	
Remaining Lot/ Tract Number(s) to WQMP still held by Owner (if any)	
Date of Ownership Transfer	

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/ parcel addressed by the WQMP, as opposed to the entire project/ parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/ parcel no transferred shall be set forth as maps attached to this notice. These maps shall show those portions of the project/ parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by the Previous Owner. Those portions retained by the Previous Owner shall be labeled "Previous Owner," and those portions previously transferred by the Previous Owner shall be labeled as "Previously Transferred."

V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Owner is now the Responsible Party of record for the WQMP for this portions of the site that it owns.

VI. Certifications

A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the New Owner.

Print Name of Previous Owner Representative	Title
Signature of Previous Owner Representative	Date

B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred Site, which the New Owner has acquired from the Previous Owner.

Print Name of New Owner Representative	Title
Signature of New Owner Representative	Date