APPENDIX G

Hydrology and Drainage

APPENDIX G1

Drainage Study

PRELIMINARY TECHNICAL DRAINAGE STUDY

KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER

City of Moreno Valley, California
January 30, 2019

Prepared for:

LST18-0052
PEN18-0228 - 0230

Kaiser Permanente.
27300 Iris Avenue
Moreno Valley, CA 91188
626.405-6333 ph.

Revision History	
1/2019	2nd Submittal

CITY OF MORENO VALLEY CASE # XXXXXXX

Report Prepared By:

Michael Baker INTERNATIONAL

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Engineer of Work/ Contact Person:
Scott Davis, P.E.

JN 169814

Table of Contents

I. INTRODUCTION

This drainage study for Kaiser Permanente Moreno Valley Medical Center accompanies the development plan. It specifically accomplishes the following:

- Determine the peak onsite 10 & 100-year runoff according to the precise grading plan.

- Define design for storm drain systems to convey the offsite and onsite flows.

1. Area Description

The project site is in the City of Moreno Valley in the County of Riverside, California. It is located between Nason Street and Oliver Street and North of Iris Avenue. The project site will be developed in 29.8 acres of combined area of APN 486-310-033 and 486-310-034, with current legal descriptions as parcel 6 and 7 of Parcel Map MB 11/10. These two parcels have full width improvements with curb and within the property limits. Figure 1 shows the location of this project.

2. Project Description

The proposed project will develop three (3) multi-story parking structures, an energy center, emergency department, two (2) medical office buildings, multi-story patient bed towers, new D&T building, driveways, walkways, and landscape areas. It will develop 27.7 acres of the combined area parcel 7 and 6 of Parcel map MB 11/10 with the 2.1 acres of existing parking lot and medical office to remain. All on-site facilities will be privately maintained.

3. Surrounding Projects and Drainage Considerations

The project site is currently a Kaiser Permanente Medical Center and office along with a pharmacy. It has been a medical facility for as long back as two decades. It has moderate vegetation, and it has relatively flat terrain draining from southeast to northwest to the adjacent property to the northwest. There is expected to be no offsite flow oncoming to the property as the perimeter of the worked area contains berms and measures to keep offsite flow away. There is currently no storm drain network located in the site. The report was completed with a conceptual design of the project and will be updated to reflect revisions made to the grading plan or the site plan.

II. HYDROLOGIC/HYDRAULIC METHODOLOGY

The methodology presented in this study is in compliance with the RCFC&WCD 1978 Hydrology Manual (Reference 5), hereinafter referred to as the Manual).

Model Descriptions -The Integrated Rational Method Hydrology System Model Version 8.0, dated January 1, 2006, (Reference 3) within the Advanced Engineering Systems Software (AES) was used to generate the peak 100-year onsite flows.

Soil Type - The Manual utilizes the Soil Conservation Service (SCS) soil classification system, which classifies soils into four (4) hydrological groups (HSG): A through D, with D being the least pervious. The soil Plates C-1.17 of the Manual showing location of project is included in Appendix B. According to this figure, this tract is located within a mixture of HSG “A”, HSG “B”. For this report, HSG “B” was conservatively used in the hydrologic models.

Development Type- For the proposed developed conditions the runoff was calculated considering a commercial development.

Intensity- The 10-minute / 60-minute intensity values (inches/hour) for the 10-year and 100-year storm events, obtained from Plate D-4.1 (6 of 6) of the Manual, are 2.01/0.82 and 2.94/1.20, respectively.

Drainage Areas and Flow Patterns - The drainage areas and flow patterns for existing and proposed conditions were determined using the existing topography (Cad) and the Tentative Tract Map, respectively. The areas were measured using the computer capabilities of AutoCAD.

III. HYDROLOGY/HYDRAULIC ANALYSIS

Figure 3 in Appendix A shows the proposed onsite drainage patterns for this project. The majority of the flows will be conveyed through a storm drain system which travel through various basins and storage facilities to treat the runoff. Velocities in the pipes will vary from 6 fps to 9 fps and are subject to change due to the conceptual nature of the storm drain system that is subject to change. These pipes will outlet to existing storm water overflow paths separated by east and west.

The undeveloped conditions outflows to the west overflow path at 32.58/48.25 CFS for the 10-year and 100-year storm respectively. The eastern overflow path received a flow of 16.22/23.77 CFS for the 10-year and 100-year storm respectively.

The developed conditions of the site outflow to the same over flow paths with the western overflow receiving 19.21/28.18 CFS for the 10-year and 100-year storm respectively. The eastern overflow path will receive 36.56/54.73 CFS for the 10-year and 100-year storm respectively.

Hydraulic analysis was performed on major sections of the storm drain network to size for the 100-year storm event. See Appendix C for data pertaining to the size of the network.

The flow going to the discharge points of the developed site are subject to change as the site plans develops past the conceptual level.

IV. CONCLUSIONS

1. Methodology used in this report is in compliance with the Riverside County Flood Control and Water Conservation District.
2. There are no anticipated negative downstream or upstream impacts.

VI. REFERENCES

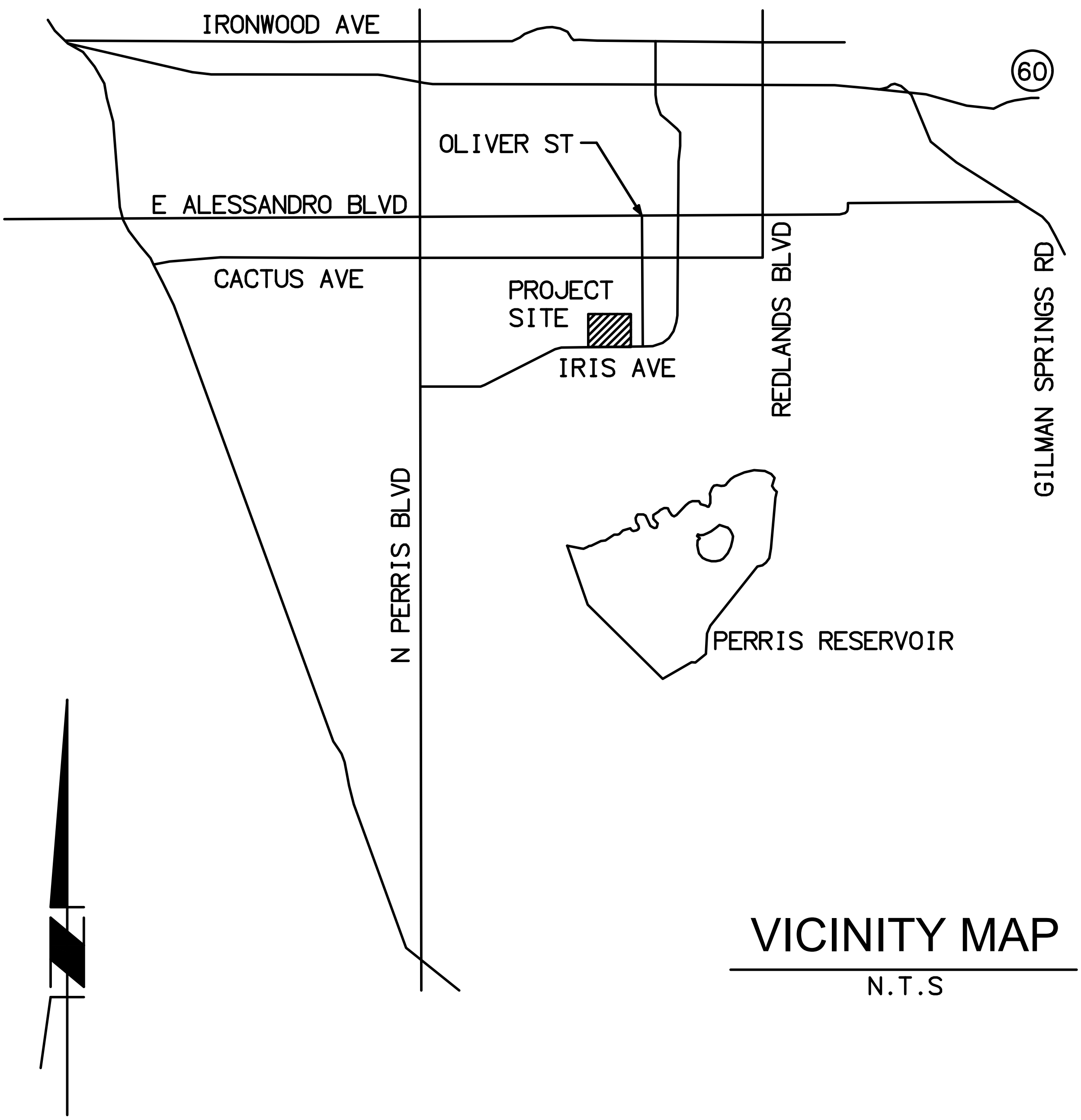
1. AEI-CASC Engineering, Hydrology Study Report for Bluestone Murrieta, October 5, 2001.

2. Riverside Flood Control District and Water Conservation District (RCFC&WCD) *Hydrology Manual*, 1978.

3. Advanced Engineering Systems Software (AES), Rational Method Hydrology System Model Version 8.0, January 1, 2006.

4. Advanced Engineering Systems Software (AES), Hydraulic Elements Program Package (HELE1) Version 8.0, January 1, 2006.

5. Riverside Flood Control District and Water Conservation District, Riverside Design Handbook or Low Impact Development, Best Management Practices, September 2011.



VICINITY MAP

N.T.S

FIGURE 1

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KAISER PERMANENTE MORENO VALLEY AREAMASTER PLAN AND MEDICAL OFFICE BUILDING

VICINITY MAP

APPENDIX A

HYDROLOGY CALCULATIONS

Undeveloped Condition
10 & 100-Year Hydrology
Rational Method Calculations

LEGEND

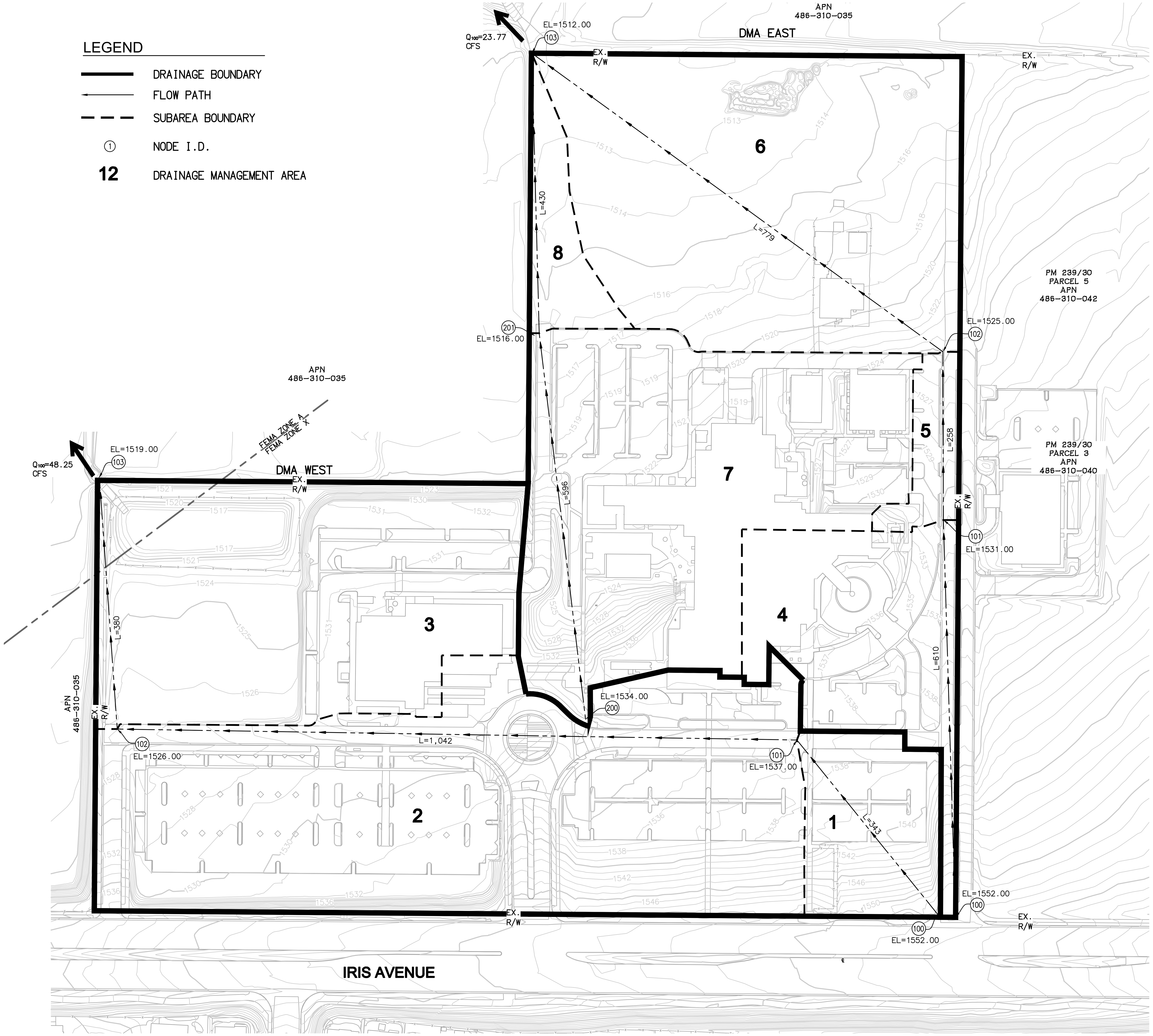
DRAINAGE BOUNDARY

FLOW PATH

SUBAREA BOUNDARY

NODE I.D.

12 DRAINAGE MANAGEMENT AREA



DMA WEST	
DMA	SIZE [ACRE]
1	1.34
2	8.21
3	5.21

DMA EAST	
DMA	SIZE [ACRE]
4	2.36
5	0.48
6	6.05
7	5.69
8	0.67

80 40 0 80 160 240

SCALE: 1"=80'

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FIGURE 2-EXISTING

HYDROLOGY MAP - EXISTING CONDITIONS Q100

KAISER MEDICAL MORENO VALLEY

\\SANDCA1FS1.BKR.MBAKERCORP.COM\HROOT\PDATA\169814\CADD\STRMWATER\FIGURE 2 - EXISTING HYD MAP.DWG JESSICA.JONES 1/30/19 10:46 am

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                 (RCFC&WCD)  1978 HYDROLOGY MANUAL
        (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                 (Rational Tabling Version 20.0)
              Release Date: 06/01/2013  License ID 1264

                     Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 10-YEAR STORM EVENT EXISTING CONDITIONS                                  *
 **************************************************************************

  FILE NAME: PREW10.DAT
  TIME/DATE OF STUDY: 10:25 01/30/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   343.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1537.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  TC = 0.303*[(  343.00**3)/(    15.00)]**.2 =    5.855
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.654
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8745
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      3.11
  TOTAL AREA(ACRES) =      1.34   TOTAL RUNOFF(CFS) =      3.11

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1537.00  DOWNSTREAM(FEET) =   1526.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1042.00   CHANNEL SLOPE =  0.0106
  CHANNEL BASE(FEET) =    1.50   "Z" FACTOR =  12.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.12

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.545
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8738
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      12.25
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  34.03
  AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   0.51
  Tc(MIN.) =    6.37
  SUBAREA AREA(ACRES) =     8.21       SUBAREA RUNOFF(CFS) =   18.26
  TOTAL AREA(ACRES) =        9.6         PEAK FLOW RATE(CFS) =      21.37

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =  59.35

  ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   1526.00
  DOWNSTREAM NODE ELEVATION(FEET) =   1519.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   380.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.500
  PAVEMENT LIP(FEET) =  0.100   MANNING'S N = .0150
```

```
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.10000
  MAXIMUM DEPTH(FEET) =   0.61
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.464
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8732
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     26.97
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  14.98
  AVERAGE FLOW DEPTH(FEET) =   0.61   FLOOD WIDTH(FEET) =    5.20
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.42   Tc(MIN.) =    6.79
  SUBAREA AREA(ACRES) =    5.21       SUBAREA RUNOFF(CFS) =   11.21
  TOTAL AREA(ACRES) =       14.8         PEAK FLOW RATE(CFS) =      32.58

         ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
             NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
             AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
             ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.61   FLOOD WIDTH(FEET) =    5.20
  FLOW VELOCITY(FEET/SEC.) =  18.09   DEPTH*VELOCITY(FT*FT/SEC) =  11.03
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1765.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.8  TC(MIN.) =      6.79
  PEAK FLOW RATE(CFS)   =      32.58
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

♀
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****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                   (RCFC&WCD)  1978 HYDROLOGY MANUAL
       (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                   (Rational Tabling Version 20.0)
                Release Date: 06/01/2013  License ID 1264

                        Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 100-YEAR STORM EVENT EXISTING CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PREW100.DAT
  TIME/DATE OF STUDY: 10:21 01/30/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   343.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1537.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  TC = 0.303*[(  343.00**3)/(    15.00)]**.2 =    5.855
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.842
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8807
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.53
  TOTAL AREA(ACRES) =      1.34   TOTAL RUNOFF(CFS) =      4.53

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1537.00  DOWNSTREAM(FEET) =   1526.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1042.00   CHANNEL SLOPE =  0.0106
  CHANNEL BASE(FEET) =    1.50   "Z" FACTOR =  12.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.12

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.733
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8803
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      18.03
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  50.09
  AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   0.35
  Tc(MIN.) =    6.20
  SUBAREA AREA(ACRES) =     8.21       SUBAREA RUNOFF(CFS) =   26.98
  TOTAL AREA(ACRES) =        9.6         PEAK FLOW RATE(CFS) =      31.52

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =  87.55

  ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   1526.00
  DOWNSTREAM NODE ELEVATION(FEET) =   1519.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   380.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.500
  PAVEMENT LIP(FEET) =  0.100   MANNING'S N = .0150
```

```
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.10000
  MAXIMUM DEPTH(FEET) =   0.61
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.650
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8799
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     39.88
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  22.15
  AVERAGE FLOW DEPTH(FEET) =   0.61   FLOOD WIDTH(FEET) =    5.20
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.29   Tc(MIN.) =    6.49
  SUBAREA AREA(ACRES) =    5.21       SUBAREA RUNOFF(CFS) =   16.73
  TOTAL AREA(ACRES) =       14.8         PEAK FLOW RATE(CFS) =      48.25

         ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
             NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
             AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
             ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.61   FLOOD WIDTH(FEET) =    5.20
  FLOW VELOCITY(FEET/SEC.) =  26.79   DEPTH*VELOCITY(FT*FT/SEC) =  16.34
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1765.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.8  TC(MIN.) =      6.49
  PEAK FLOW RATE(CFS)   =      48.25
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

♀
```

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                 (RCFC&WCD)  1978 HYDROLOGY MANUAL
     (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                 (Rational Tabling Version 20.0)
              Release Date: 06/01/2013  License ID 1264

                      Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 10-YEAR STORM EVENT EXISTING CONDITIONS                                  *
 **************************************************************************

  FILE NAME: PREE10.DAT
  TIME/DATE OF STUDY: 10:43 01/30/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   610.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1531.00
  ELEVATION DIFFERENCE(FEET) =     21.00
  TC = 0.303*[(  610.00**3)/(    21.00)]**.2 =    7.733
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.309
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8719
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.75
  TOTAL AREA(ACRES) =      2.36   TOTAL RUNOFF(CFS) =      4.75

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   1531.00
  DOWNSTREAM NODE ELEVATION(FEET) =   1525.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   258.00
  "V" GUTTER WIDTH(FEET) =   1.50   GUTTER HIKE(FEET) =  0.120
  PAVEMENT LIP(FEET) =  0.120   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.10000
  MAXIMUM DEPTH(FEET) =   0.25
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.274
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8716
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.23
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  18.28
  AVERAGE FLOW DEPTH(FEET) =   0.25   FLOOD WIDTH(FEET) =    1.70
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.24   Tc(MIN.) =    7.97
  SUBAREA AREA(ACRES) =    0.48       SUBAREA RUNOFF(CFS) =    0.95
  TOTAL AREA(ACRES) =        2.8         PEAK FLOW RATE(CFS) =       5.70

        ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
            NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
            AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
            ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOOD WIDTH(FEET) =    1.70
  FLOW VELOCITY(FEET/SEC.) =  19.94   DEPTH*VELOCITY(FT*FT/SEC) =   4.98
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     868.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1525.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   779.00   CHANNEL SLOPE =  0.0167
  CHANNEL FLOW THRU SUBAREA(CFS) =        5.70
  FLOW VELOCITY(FEET/SEC) =   2.81 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   4.62   Tc(MIN.) =   12.59
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
```

```
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.59
  RAINFALL INTENSITY(INCH/HR) =   1.81
  TOTAL STREAM AREA(ACRES) =     2.84
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.70

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   596.00
  UPSTREAM ELEVATION(FEET) =  1534.00
  DOWNSTREAM ELEVATION(FEET) =  1516.00
  ELEVATION DIFFERENCE(FEET) =     18.00
  TC = 0.303*[(  596.00**3)/(    18.00)]**.2 =    7.865
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.289
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8717
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =     11.36
  TOTAL AREA(ACRES) =      5.69   TOTAL RUNOFF(CFS) =     11.36

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1516.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0093
  CHANNEL FLOW THRU SUBAREA(CFS) =      11.36
  FLOW VELOCITY(FEET/SEC) =   2.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.88   Tc(MIN.) =   10.74
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1026.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.74
  RAINFALL INTENSITY(INCH/HR) =   1.96
  TOTAL STREAM AREA(ACRES) =     5.69
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     11.36

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        5.70    12.59        1.809          2.84
      2       11.36    10.74        1.959          5.69

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************
```

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       16.22    10.74       1.959
      2       16.19    12.59       1.809

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      16.22   Tc(MIN.) =   10.74
  TOTAL AREA(ACRES) =        8.5
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.5  TC(MIN.) =     10.74
  PEAK FLOW RATE(CFS)   =      16.22
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

♀
```

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                (RCFC&WCD)  1978 HYDROLOGY MANUAL
     (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                (Rational Tabling Version 20.0)
            Release Date: 06/01/2013  License ID 1264

                    Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
 * KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
 * ON-SITE HYDROLOGY                                                        *
 * 100-YEAR STORM EVENT EXISTING CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PREE100.DAT
  TIME/DATE OF STUDY: 10:38 01/30/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   610.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1531.00
  ELEVATION DIFFERENCE(FEET) =     21.00
  TC = 0.303*[(  610.00**3)/(    21.00)]**.2 =    7.733
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.343
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8785
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      6.93
  TOTAL AREA(ACRES) =      2.36   TOTAL RUNOFF(CFS) =      6.93

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   1531.00
  DOWNSTREAM NODE ELEVATION(FEET) =   1525.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   258.00
  "V" GUTTER WIDTH(FEET) =   1.50   GUTTER HIKE(FEET) =  0.120
  PAVEMENT LIP(FEET) =  0.120   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.10000
  MAXIMUM DEPTH(FEET) =   0.25
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.309
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8784
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      7.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  26.68
  AVERAGE FLOW DEPTH(FEET) =   0.25   FLOOD WIDTH(FEET) =    1.70
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.16   Tc(MIN.) =    7.89
  SUBAREA AREA(ACRES) =    0.48       SUBAREA RUNOFF(CFS) =    1.40
  TOTAL AREA(ACRES) =       2.8         PEAK FLOW RATE(CFS) =       8.33

         ==>>ERROR:FLOW EXCEEDS CAPACITY OF CHANNEL WITH
             NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM ALLOWABLE DEPTH.
             AS AN APPROXIMATION, TRAVEL TIME CALCULATIONS ARE BASED
             ON FLOW DEPTH EQUAL TO THE SPECIFIED MAXIMUM ALLOWABLE DEPTH.


  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOOD WIDTH(FEET) =    1.70
  FLOW VELOCITY(FEET/SEC.) =  29.12   DEPTH*VELOCITY(FT*FT/SEC) =   7.28
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     868.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1525.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   779.00   CHANNEL SLOPE =  0.0167
  CHANNEL FLOW THRU SUBAREA(CFS) =       8.33
  FLOW VELOCITY(FEET/SEC) =   3.08 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   4.21   Tc(MIN.) =   12.10
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
```

```
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   12.10
 RAINFALL INTENSITY(INCH/HR) =   2.67
 TOTAL STREAM AREA(ACRES) =     2.84
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.33

****************************************************************************
 FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   596.00
 UPSTREAM ELEVATION(FEET) =  1534.00
 DOWNSTREAM ELEVATION(FEET) =   1516.00
 ELEVATION DIFFERENCE(FEET) =     18.00
 TC = 0.303*[(  596.00**3)/(    18.00)]**.2 =    7.865
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.315
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8784
 SOIL CLASSIFICATION IS "B"
 SUBAREA RUNOFF(CFS) =     16.57
 TOTAL AREA(ACRES) =      5.69   TOTAL RUNOFF(CFS) =     16.57

****************************************************************************
 FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1516.00  DOWNSTREAM(FEET) =   1512.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0093
 CHANNEL FLOW THRU SUBAREA(CFS) =      16.57
 FLOW VELOCITY(FEET/SEC) =   2.75 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   2.61   Tc(MIN.) =   10.47
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1026.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   10.47
 RAINFALL INTENSITY(INCH/HR) =   2.87
 TOTAL STREAM AREA(ACRES) =     5.69
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     16.57

 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        8.33    12.10        2.672          2.84
     2       16.57    10.47        2.873          5.69

 ********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 *************************************************************************
```

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       23.77    10.47       2.873
      2       23.74    12.10       2.672

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      23.77   Tc(MIN.) =   10.47
  TOTAL AREA(ACRES) =        8.5
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.5  TC(MIN.) =     10.47
  PEAK FLOW RATE(CFS)   =      23.77
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

♀
```

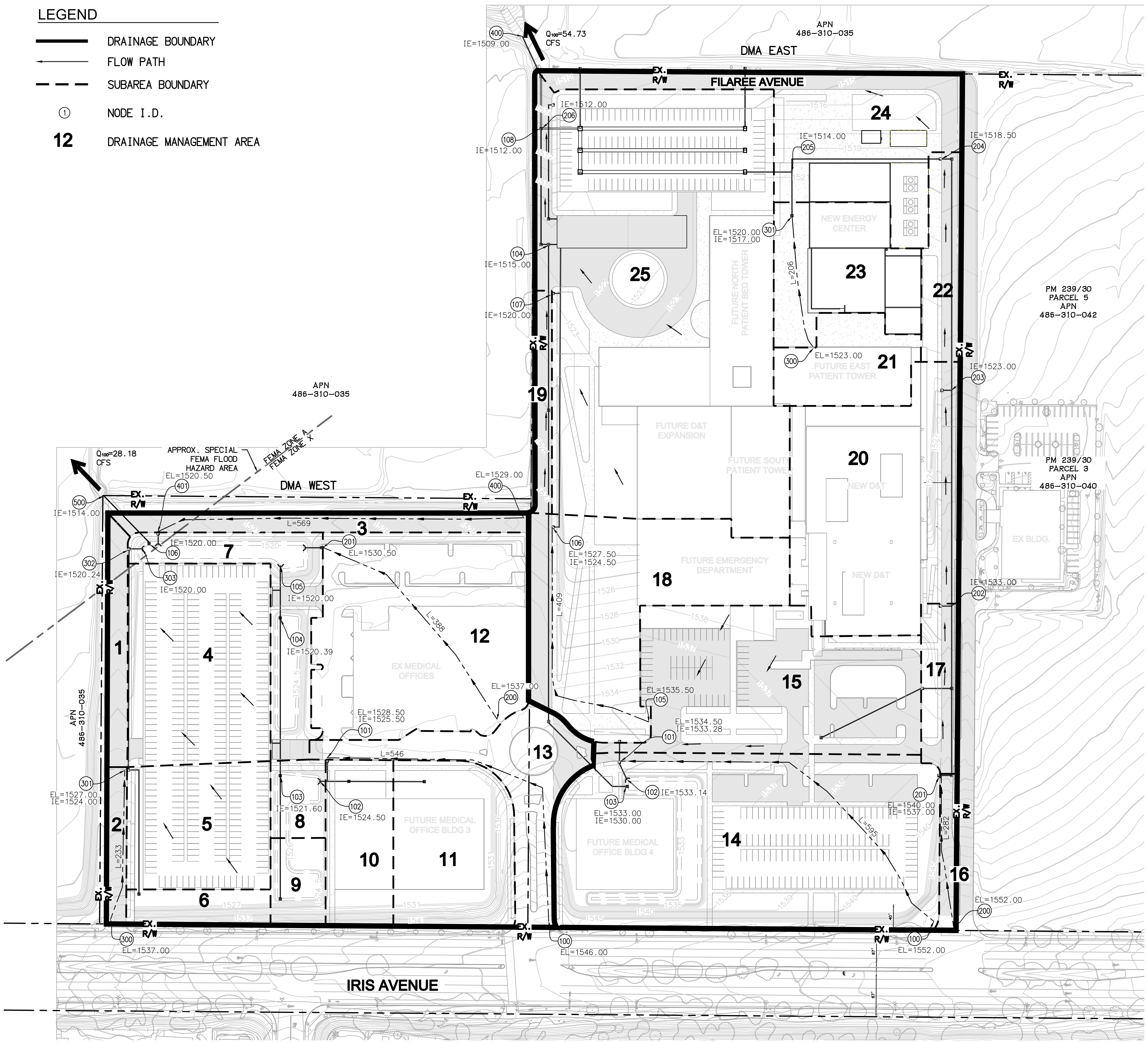
APPENDIX A

HYDROLOGY CALCULATIONS

Developed Condition
10 & 100-Year Hydrology
Rational Method Calculations

LEGEND

- DRAINAGE BOUNDARY
- FLOW PATH
- SUBAREA BOUNDARY
- ① NODE I.D.
- **12** DRAINAGE MANAGEMENT AREA



DMA WEST

DMA	SIZE [ACRE]
1	0.27
2	0.17
3	0.44
4	1.56
5	0.98
6	0.28
7	0.81
8	0.23
9	0.26
10	0.61
11	1.06
12	2.31
13	0.91

DMA EAST

DMA	SIZE [ACRE]
14	3.62
15	2.09
16	0.15
17	0.33
18	1.97
19	0.21
20	2.14
21	0.60
22	0.42
23	0.94
24	1.55
25	5.54

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Phone: (858) 614-5000 · MBAKERINTL.COM

FIGURE 3-PROPOSED

HYDROLOGY MAP - PROPOSED CONDITIONS Q100

KAISER MEDICAL MORENO VALLEY

\\SANDCATFS1.BKR.MBAKERCORP.COM\VROOT\PDATA\169814\CADD\STRMWATER\FIGURE 3 - PROPOSED HYD MAP.DWG JESSICA.JONES 1/29/19 1:23 pm

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
       RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                   (RCFC&WCD)  1978 HYDROLOGY MANUAL
       (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                  (Rational Tabling Version 20.0)
               Release Date: 06/01/2013  License ID 1264

                        Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 10-YEAR STORM EVENT DEVELOPED CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PROPW10.DAT
  TIME/DATE OF STUDY: 12:52 01/28/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   546.00
  UPSTREAM ELEVATION(FEET) =   1546.00
  DOWNSTREAM ELEVATION(FEET) =   1528.50
  ELEVATION DIFFERENCE(FEET) =     17.50
  TC = 0.303*[(  546.00**3)/(    17.50)]**.2 =    7.504
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.344
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8722
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      1.86
  TOTAL AREA(ACRES) =      0.91   TOTAL RUNOFF(CFS) =      1.86

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1525.50  DOWNSTREAM(FEET) =  1524.50
  FLOW LENGTH(FEET) =   100.50   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.49
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.86
  PIPE TRAVEL TIME(MIN.) =   0.37    Tc(MIN.) =    7.88
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     646.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.288
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8717
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.16   SUBAREA RUNOFF(CFS) =    4.31
  TOTAL AREA(ACRES) =        3.1   TOTAL RUNOFF(CFS) =       6.17
  TC(MIN.) =    7.88

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1521.60  DOWNSTREAM(FEET) =  1520.39
  FLOW LENGTH(FEET) =   239.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.85
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.17
  PIPE TRAVEL TIME(MIN.) =   0.51    Tc(MIN.) =    8.38
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     885.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.217
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8711
  SOIL CLASSIFICATION IS "B"
```

```
  SUBAREA AREA(ACRES) =    0.81   SUBAREA RUNOFF(CFS) =    1.56
  TOTAL AREA(ACRES) =        3.9   TOTAL RUNOFF(CFS) =       7.73
  TC(MIN.) =    8.38

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.39  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    77.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.84
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.73
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =    8.51
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     962.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.51
  RAINFALL INTENSITY(INCH/HR) =   2.20
  TOTAL STREAM AREA(ACRES) =     3.88
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.73

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   388.00
  UPSTREAM ELEVATION(FEET) =   1537.00
  DOWNSTREAM ELEVATION(FEET) =   1530.50
  ELEVATION DIFFERENCE(FEET) =      6.50
  TC = 0.303*[(  388.00**3)/(     6.50)]**.2 =    7.453
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.352
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8723
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.74
  TOTAL AREA(ACRES) =      2.31   TOTAL RUNOFF(CFS) =      4.74

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    105.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.45
  RAINFALL INTENSITY(INCH/HR) =   2.35
  TOTAL STREAM AREA(ACRES) =     2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.74
```

```
** CONFLUENCE DATA **
STREAM     RUNOFF       Tc      INTENSITY      AREA
NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
    1        7.73     8.51        2.200         3.88
    2        4.74     7.45        2.352         2.31

*********************************WARNING**********************************
IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

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

** PEAK FLOW RATE TABLE **
STREAM     RUNOFF      Tc      INTENSITY
NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1       11.51     7.45       2.352
    2       12.17     8.51       2.200

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      12.17   Tc(MIN.) =    8.51
TOTAL AREA(ACRES) =        6.2
LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     962.50 FEET.

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

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   233.00
  UPSTREAM ELEVATION(FEET) =   1537.00
  DOWNSTREAM ELEVATION(FEET) =   1527.00
  ELEVATION DIFFERENCE(FEET) =     10.00
  TC = 0.303*[(  233.00**3)/(    10.00)]**.2 =    5.035
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.862
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8759
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.43
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.43

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    301.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.862
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8759
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.26   SUBAREA RUNOFF(CFS) =    3.16
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       3.58
  TC(MIN.) =    5.04
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1520.24
  FLOW LENGTH(FEET) =   337.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.33
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.58
  PIPE TRAVEL TIME(MIN.) =   1.05    Tc(MIN.) =    6.09
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    302.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.602
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8742
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.83   SUBAREA RUNOFF(CFS) =    4.16
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =       7.75
  TC(MIN.) =    6.09

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.24  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    19.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.86
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.75
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    6.12
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     589.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.12
  RAINFALL INTENSITY(INCH/HR) =   2.60
  TOTAL STREAM AREA(ACRES) =     3.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.75

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
```

```
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   569.00
 UPSTREAM ELEVATION(FEET) =   1529.00
 DOWNSTREAM ELEVATION(FEET) =   1520.50
 ELEVATION DIFFERENCE(FEET) =      8.50
 TC = 0.303*[(  569.00**3)/(     8.50)]**.2 =    8.887
   10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.154
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8705
 SOIL CLASSIFICATION IS "B"
 SUBAREA RUNOFF(CFS) =      0.82
 TOTAL AREA(ACRES) =      0.44   TOTAL RUNOFF(CFS) =      0.82

****************************************************************************
 FLOW PROCESS FROM NODE    401.00 TO NODE    303.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.89
 RAINFALL INTENSITY(INCH/HR) =   2.15
 TOTAL STREAM AREA(ACRES) =     0.44
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.82

 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        7.75     6.12        2.595         3.26
     2        0.82     8.89        2.154         0.44

 *********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

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

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        8.32     6.12       2.595
     2        7.25     8.89       2.154

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       8.32   Tc(MIN.) =    6.12
 TOTAL AREA(ACRES) =        3.7
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     589.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    303.00 TO NODE    105.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        8.32     6.12       2.595       3.70
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    105.00 =     589.00 FEET.
```

```
** MEMORY BANK #  1 CONFLUENCE DATA **
STREAM     RUNOFF      Tc      INTENSITY     AREA
NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
    1       12.17     8.51       2.200        6.19
LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     962.50 FEET.

*********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      17.06       6.12        2.595
     2      19.21       8.51        2.200

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      19.21   Tc(MIN.) =    8.51
 TOTAL AREA(ACRES) =        9.9

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    500.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1517.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.87
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       19.21
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    8.67
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    500.00 =    1062.50 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        9.9  TC(MIN.) =      8.67
  PEAK FLOW RATE(CFS)   =      19.21
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS

♀
```

```
____________________________________________________________________________
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
        RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                     (RCFC&WCD)  1978 HYDROLOGY MANUAL
         (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                     (Rational Tabling Version 20.0)
                  Release Date: 06/01/2013  License ID 1264

                          Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
 * KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
 * ON-SITE HYDROLOGY                                                        *
 * 100-YEAR STORM EVENT DEVELOPED CONDITIONS                                *
 **************************************************************************

  FILE NAME: PROPW100.DAT
  TIME/DATE OF STUDY: 12:39 01/28/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   546.00
  UPSTREAM ELEVATION(FEET) =   1546.00
  DOWNSTREAM ELEVATION(FEET) =   1528.50
  ELEVATION DIFFERENCE(FEET) =     17.50
  TC = 0.303*[(  546.00**3)/(    17.50)]**.2 =    7.504
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.394
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8788
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      2.71
  TOTAL AREA(ACRES) =      0.91   TOTAL RUNOFF(CFS) =      2.71

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1525.50  DOWNSTREAM(FEET) =  1524.50
  FLOW LENGTH(FEET) =   100.50   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.88
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        2.71
  PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    7.85
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     646.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.319
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8784
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.16   SUBAREA RUNOFF(CFS) =    6.30
  TOTAL AREA(ACRES) =        3.1   TOTAL RUNOFF(CFS) =       9.01
  TC(MIN.) =    7.85

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1521.60  DOWNSTREAM(FEET) =  1520.39
  FLOW LENGTH(FEET) =   239.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.47
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        9.01
  PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    8.19
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     885.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.248
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8780
  SOIL CLASSIFICATION IS "B"
```

```
  SUBAREA AREA(ACRES) =    0.81   SUBAREA RUNOFF(CFS) =    2.31
  TOTAL AREA(ACRES) =        3.9   TOTAL RUNOFF(CFS) =      11.32
  TC(MIN.) =    8.19

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.39  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    77.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.41
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.32
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    8.28
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     962.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.28
  RAINFALL INTENSITY(INCH/HR) =   3.23
  TOTAL STREAM AREA(ACRES) =     3.88
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     11.32

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   388.00
  UPSTREAM ELEVATION(FEET) =   1537.00
  DOWNSTREAM ELEVATION(FEET) =   1530.50
  ELEVATION DIFFERENCE(FEET) =      6.50
  TC = 0.303*[(  388.00**3)/(     6.50)]**.2 =    7.453
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.406
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8788
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      6.91
  TOTAL AREA(ACRES) =      2.31   TOTAL RUNOFF(CFS) =      6.91

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    105.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.45
  RAINFALL INTENSITY(INCH/HR) =   3.41
  TOTAL STREAM AREA(ACRES) =     2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.91
```

```
 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1       11.32     8.28        3.230          3.88
     2        6.91     7.45        3.406          2.31

*********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

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

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1       17.10     7.45       3.406
     2       17.88     8.28       3.230

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      17.88   Tc(MIN.) =    8.28
 TOTAL AREA(ACRES) =        6.2
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     962.50 FEET.

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

****************************************************************************
 FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   233.00
 UPSTREAM ELEVATION(FEET) =   1537.00
 DOWNSTREAM ELEVATION(FEET) =   1527.00
 ELEVATION DIFFERENCE(FEET) =     10.00
 TC = 0.303*[(  233.00**3)/(    10.00)]**.2 =    5.035
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.144
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8818
 SOIL CLASSIFICATION IS "B"
 SUBAREA RUNOFF(CFS) =      0.62
 TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.62

****************************************************************************
 FLOW PROCESS FROM NODE    301.00 TO NODE    301.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.144
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8818
 SOIL CLASSIFICATION IS "B"
 SUBAREA AREA(ACRES) =    1.26   SUBAREA RUNOFF(CFS) =    4.60
 TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       5.23
 TC(MIN.) =    5.04
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1520.24
  FLOW LENGTH(FEET) =   337.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.65
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.23
  PIPE TRAVEL TIME(MIN.) =   0.84    Tc(MIN.) =    5.88
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    302.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.835
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8807
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.83   SUBAREA RUNOFF(CFS) =    6.18
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =      11.41
  TC(MIN.) =    5.88

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.24  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    19.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.52
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.41
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    5.90
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     589.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.90
  RAINFALL INTENSITY(INCH/HR) =   3.83
  TOTAL STREAM AREA(ACRES) =     3.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     11.41

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
```

```
       DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   569.00
 UPSTREAM ELEVATION(FEET) =   1529.00
 DOWNSTREAM ELEVATION(FEET) =   1520.50
 ELEVATION DIFFERENCE(FEET) =      8.50
 TC = 0.303*[(  569.00**3)/(     8.50)]**.2 =    8.887
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.119
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8774
 SOIL CLASSIFICATION IS "B"
 SUBAREA RUNOFF(CFS) =      1.20
 TOTAL AREA(ACRES) =      0.44   TOTAL RUNOFF(CFS) =      1.20

****************************************************************************
 FLOW PROCESS FROM NODE    401.00 TO NODE    303.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.89
 RAINFALL INTENSITY(INCH/HR) =   3.12
 TOTAL STREAM AREA(ACRES) =     0.44
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.20

 ** CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1       11.41     5.90        3.827          3.26
     2        1.20     8.89        3.119          0.44

 *********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

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

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1       12.20     5.90       3.827
     2       10.50     8.89       3.119

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      12.20   Tc(MIN.) =    5.90
 TOTAL AREA(ACRES) =        3.7
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     589.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    303.00 TO NODE    105.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       12.20     5.90       3.827        3.70
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    105.00 =     589.00 FEET.
```

```
 ** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       17.88     8.28       3.230        6.19
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     962.50 FEET.

*********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      24.94       5.90        3.827
     2      28.18       8.28        3.230

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      28.18   Tc(MIN.) =    8.28
 TOTAL AREA(ACRES) =         9.9

****************************************************************************
 FLOW PROCESS FROM NODE    106.00 TO NODE    500.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1517.00  DOWNSTREAM(FEET) =  1514.00
 FLOW LENGTH(FEET) =   100.00    MANNING'S N =  0.013
 ASSUME FULL-FLOWING PIPELINE
 PIPE-FLOW VELOCITY(FEET/SEC.) =  15.95
 PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       28.18
 PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    8.39
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    500.00 =    1062.50 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        9.9  TC(MIN.) =      8.39
 PEAK FLOW RATE(CFS)   =      28.18
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS

♀
```

```
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
        RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                  (RCFC&WCD)  1978 HYDROLOGY MANUAL
         (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                  (Rational Tabling Version 20.0)
               Release Date: 06/01/2013  License ID 1264

                        Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 10-YEAR STORM EVENT DEVELOPED CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PROPE10.DAT
  TIME/DATE OF STUDY: 13:29 01/29/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   595.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1534.50
  ELEVATION DIFFERENCE(FEET) =     17.50
  TC = 0.303*[(  595.00**3)/(    17.50)]**.2 =    7.901
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.284
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8717
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      7.21
  TOTAL AREA(ACRES) =      3.62   TOTAL RUNOFF(CFS) =      7.21

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    101.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.284
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8717
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.09   SUBAREA RUNOFF(CFS) =    4.16
  TOTAL AREA(ACRES) =        5.7   TOTAL RUNOFF(CFS) =      11.37
  TC(MIN.) =    7.90

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.28  DOWNSTREAM(FEET) =  1533.14
  FLOW LENGTH(FEET) =    27.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.48
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.37
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.93
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     622.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.14  DOWNSTREAM(FEET) =  1533.00
  FLOW LENGTH(FEET) =     8.80   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.48
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.37
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    7.94
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     630.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1530.00  DOWNSTREAM(FEET) =  1515.00
```

```
  FLOW LENGTH(FEET) =   895.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.48
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        11.37
  PIPE TRAVEL TIME(MIN.) =   1.03    Tc(MIN.) =    8.97
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =    1525.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.97
  RAINFALL INTENSITY(INCH/HR) =   2.14
  TOTAL STREAM AREA(ACRES) =     5.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     11.37

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   409.00
  UPSTREAM ELEVATION(FEET) =   1535.50
  DOWNSTREAM ELEVATION(FEET) =   1527.50
  ELEVATION DIFFERENCE(FEET) =      8.00
  TC = 0.303*[(  409.00**3)/(     8.00)]**.2 =    7.379
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.364
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8724
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.06
  TOTAL AREA(ACRES) =      1.97   TOTAL RUNOFF(CFS) =      4.06

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.50  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =   367.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.17
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =         4.06
  PIPE TRAVEL TIME(MIN.) =   1.18    Tc(MIN.) =    8.56
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    107.00 =     776.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.194
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8709
```

```
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    5.75   SUBAREA RUNOFF(CFS) =   10.99
  TOTAL AREA(ACRES) =        7.7   TOTAL RUNOFF(CFS) =      15.05
  TC(MIN.) =    8.56

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.00  DOWNSTREAM(FEET) =  1515.00
  FLOW LENGTH(FEET) =    92.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  19.16
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.05
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.64
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    104.00 =     868.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.64
  RAINFALL INTENSITY(INCH/HR) =   2.18
  TOTAL STREAM AREA(ACRES) =     7.72
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     15.05

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        11.37     8.97        2.143          5.71
     2        15.05     8.64        2.184          7.72

 ********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF       Tc      INTENSITY
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)
     1        26.00     8.64        2.184
     2        26.14     8.97        2.143

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      26.00   Tc(MIN.) =    8.64
  TOTAL AREA(ACRES) =        13.4
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =    1525.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    108.00 IS CODE =  41
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1515.00  DOWNSTREAM(FEET) =  1512.00
  FLOW LENGTH(FEET) =   186.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  33.10
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      26.00
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    8.74
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =    1711.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 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<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1540.00
  ELEVATION DIFFERENCE(FEET) =     12.00
  TC = 0.303*[(  282.00**3)/(    12.00)]**.2 =    5.444
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.752
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8752
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1537.00  DOWNSTREAM(FEET) =  1533.00
  FLOW LENGTH(FEET) =   277.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.26
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.36
  PIPE TRAVEL TIME(MIN.) =   1.42    Tc(MIN.) =    6.86
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     559.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.451
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8731
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.33   SUBAREA RUNOFF(CFS) =    0.71
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       1.07
```

```
  TC(MIN.) =    6.86

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1523.00
  FLOW LENGTH(FEET) =   332.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.80
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.07
  PIPE TRAVEL TIME(MIN.) =   0.95    Tc(MIN.) =    7.82
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     891.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.297
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8718
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.14   SUBAREA RUNOFF(CFS) =    4.28
  TOTAL AREA(ACRES) =        2.6   TOTAL RUNOFF(CFS) =       5.35
  TC(MIN.) =    7.82

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1523.00  DOWNSTREAM(FEET) =  1518.50
  FLOW LENGTH(FEET) =   372.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.81
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.35
  PIPE TRAVEL TIME(MIN.) =   0.91    Tc(MIN.) =    8.73
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =    1263.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.173
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8707
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    0.79
  TOTAL AREA(ACRES) =        3.0   TOTAL RUNOFF(CFS) =       6.15
  TC(MIN.) =    8.73

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =  1518.50  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   180.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.83
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.15
  PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =    9.11
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1443.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.11
  RAINFALL INTENSITY(INCH/HR) =   2.13
  TOTAL STREAM AREA(ACRES) =     3.04
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.15

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   206.00
  UPSTREAM ELEVATION(FEET) =   1523.00
  DOWNSTREAM ELEVATION(FEET) =   1520.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  TC = 0.303*[(  206.00**3)/(     3.00)]**.2 =    5.950
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.632
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8744
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      2.16
  TOTAL AREA(ACRES) =      0.94   TOTAL RUNOFF(CFS) =      2.16

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    301.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.632
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8744
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.60   SUBAREA RUNOFF(CFS) =    1.38
  TOTAL AREA(ACRES) =        1.5   TOTAL RUNOFF(CFS) =       3.54
  TC(MIN.) =    5.95

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    205.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1517.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.38
```

```
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        3.54
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    6.07
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    205.00 =     271.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    205.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.07
  RAINFALL INTENSITY(INCH/HR) =   2.61
  TOTAL STREAM AREA(ACRES) =     1.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.54

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1         6.15     9.11        2.127          3.04
     2         3.54     6.07        2.607          1.54

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1         7.64     6.07       2.607
     2         9.04     9.11       2.127

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.04   Tc(MIN.) =    9.11
  TOTAL AREA(ACRES) =        4.6
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1443.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    206.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1514.00  DOWNSTREAM(FEET) =  1512.00
  FLOW LENGTH(FEET) =   453.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.51
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        9.04
  PIPE TRAVEL TIME(MIN.) =   0.66    Tc(MIN.) =    9.76
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =    1896.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.054
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8696
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.55   SUBAREA RUNOFF(CFS) =    2.77
  TOTAL AREA(ACRES) =        6.1   TOTAL RUNOFF(CFS) =      11.81
  TC(MIN.) =    9.76

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    108.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        11.81     9.76       2.054        6.13
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    108.00 =    1896.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        26.00     8.74       2.172       13.43
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =    1711.80 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1       36.56       8.74        2.172
     2       36.40       9.76        2.054

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      36.56   Tc(MIN.) =    8.74
  TOTAL AREA(ACRES) =       19.6

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    400.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1512.00  DOWNSTREAM(FEET) =  1509.00
  FLOW LENGTH(FEET) =   148.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  20.69
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       36.56
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    8.85
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    400.00 =    2044.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =       19.6  TC(MIN.) =      8.85
  PEAK FLOW RATE(CFS)    =      36.56
============================================================================
```

==
END OF RATIONAL METHOD ANALYSIS

♀

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
         RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                      (RCFC&WCD)  1978 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                      (Rational Tabling Version 20.0)
                 Release Date: 06/01/2013  License ID 1264

                         Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
 * KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
 * ON-SITE HYDROLOGY                                                        *
 * 100-YEAR STORM EVENT DEVELOPED CONDITIONS                                *
 **************************************************************************

  FILE NAME: PROPE100.DAT
  TIME/DATE OF STUDY: 13:20 01/29/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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

```
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   595.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1534.50
  ELEVATION DIFFERENCE(FEET) =     17.50
  TC = 0.303*[(  595.00**3)/(    17.50)]**.2 =    7.901
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.308
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8784
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =     10.52
  TOTAL AREA(ACRES) =      3.62   TOTAL RUNOFF(CFS) =     10.52

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    101.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.308
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8784
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.09   SUBAREA RUNOFF(CFS) =    6.07
  TOTAL AREA(ACRES) =        5.7   TOTAL RUNOFF(CFS) =      16.59
  TC(MIN.) =    7.90

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.28  DOWNSTREAM(FEET) =  1533.14
  FLOW LENGTH(FEET) =    27.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.12
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.59
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    7.92
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     622.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.14  DOWNSTREAM(FEET) =  1533.00
  FLOW LENGTH(FEET) =     8.80   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.12
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.59
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    7.93
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     630.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1530.00  DOWNSTREAM(FEET) =  1515.00
```

```
  FLOW LENGTH(FEET) =   895.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.12
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       16.59
  PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =    8.64
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =    1525.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.64
  RAINFALL INTENSITY(INCH/HR) =   3.16
  TOTAL STREAM AREA(ACRES) =     5.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     16.59

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   409.00
  UPSTREAM ELEVATION(FEET) =   1535.50
  DOWNSTREAM ELEVATION(FEET) =   1527.50
  ELEVATION DIFFERENCE(FEET) =      8.00
  TC = 0.303*[(  409.00**3)/(     8.00)]**.2 =    7.379
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.423
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8789
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      5.93
  TOTAL AREA(ACRES) =      1.97   TOTAL RUNOFF(CFS) =      5.93

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.50  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =   367.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.55
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        5.93
  PIPE TRAVEL TIME(MIN.) =   0.81    Tc(MIN.) =    8.19
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    107.00 =     776.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.249
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8781
```

```
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    5.75   SUBAREA RUNOFF(CFS) =   16.40
  TOTAL AREA(ACRES) =       7.7   TOTAL RUNOFF(CFS) =      22.33
  TC(MIN.) =    8.19

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    104.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.00  DOWNSTREAM(FEET) =  1515.00
  FLOW LENGTH(FEET) =    92.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  28.43
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      22.33
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    8.24
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    104.00 =     868.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.24
  RAINFALL INTENSITY(INCH/HR) =   3.24
  TOTAL STREAM AREA(ACRES) =     7.72
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     22.33

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        16.59     8.64        3.164          5.71
     2        22.33     8.24        3.238          7.72

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        38.16     8.24       3.238
     2        38.40     8.64       3.164

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      38.16   Tc(MIN.) =    8.24
  TOTAL AREA(ACRES) =       13.4
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =    1525.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    108.00 IS CODE =  41
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1515.00  DOWNSTREAM(FEET) =  1512.00
  FLOW LENGTH(FEET) =   186.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  48.59
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       38.16
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    8.31
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =   1711.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 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<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1540.00
  ELEVATION DIFFERENCE(FEET) =     12.00
  TC = 0.303*[(  282.00**3)/(    12.00)]**.2 =    5.444
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.985
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8813
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.53
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.53

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1537.00  DOWNSTREAM(FEET) =  1533.00
  FLOW LENGTH(FEET) =   277.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.62
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        0.53
  PIPE TRAVEL TIME(MIN.) =   1.28    Tc(MIN.) =    6.72
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =    559.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.586
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8797
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.33   SUBAREA RUNOFF(CFS) =    1.04
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       1.57
```

```
  TC(MIN.) =    6.72

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1523.00
  FLOW LENGTH(FEET) =   332.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.44
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        1.57
  PIPE TRAVEL TIME(MIN.) =   0.86    Tc(MIN.) =    7.58
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     891.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.377
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8787
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.14   SUBAREA RUNOFF(CFS) =    6.35
  TOTAL AREA(ACRES) =        2.6   TOTAL RUNOFF(CFS) =       7.92
  TC(MIN.) =    7.58

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1523.00  DOWNSTREAM(FEET) =  1518.50
  FLOW LENGTH(FEET) =   372.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.08
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        7.92
  PIPE TRAVEL TIME(MIN.) =   0.61    Tc(MIN.) =    8.19
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =    1263.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.248
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8780
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    1.20
  TOTAL AREA(ACRES) =        3.0   TOTAL RUNOFF(CFS) =       9.12
  TC(MIN.) =    8.19

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =  1518.50  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   180.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.61
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.12
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =    8.45
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1443.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.45
  RAINFALL INTENSITY(INCH/HR) =   3.20
  TOTAL STREAM AREA(ACRES) =     3.04
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.12

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   206.00
  UPSTREAM ELEVATION(FEET) =   1523.00
  DOWNSTREAM ELEVATION(FEET) =   1520.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  TC = 0.303*[(  206.00**3)/(     3.00)]**.2 =    5.950
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.812
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8806
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      3.16
  TOTAL AREA(ACRES) =      0.94   TOTAL RUNOFF(CFS) =      3.16

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    301.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.812
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8806
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.60   SUBAREA RUNOFF(CFS) =    2.01
  TOTAL AREA(ACRES) =        1.5   TOTAL RUNOFF(CFS) =       5.17
  TC(MIN.) =    5.95

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    205.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1517.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.25
```

```
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        5.17
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =    6.06
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    205.00 =     271.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    205.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.06
  RAINFALL INTENSITY(INCH/HR) =   3.78
  TOTAL STREAM AREA(ACRES) =     1.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.17

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        9.12     8.45        3.198         3.04
      2        5.17     6.06        3.778         1.54

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       11.70     6.06       3.778
      2       13.49     8.45       3.198

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.49   Tc(MIN.) =    8.45
  TOTAL AREA(ACRES) =        4.6
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1443.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    206.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1514.00  DOWNSTREAM(FEET) =  1512.00
  FLOW LENGTH(FEET) =   453.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.18
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       13.49
  PIPE TRAVEL TIME(MIN.) =   0.44    Tc(MIN.) =    8.89
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =    1896.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.118
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8774
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.55   SUBAREA RUNOFF(CFS) =    4.24
  TOTAL AREA(ACRES) =        6.1   TOTAL RUNOFF(CFS) =      17.73
  TC(MIN.) =    8.89

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    108.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       17.73     8.89       3.118        6.13
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    108.00 =    1896.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       38.16     8.31       3.226       13.43
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =    1711.80 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1       54.73       8.31        3.226
     2       54.62       8.89        3.118

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      54.73   Tc(MIN.) =    8.31
  TOTAL AREA(ACRES) =       19.6

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    400.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1512.00  DOWNSTREAM(FEET) =  1509.00
  FLOW LENGTH(FEET) =   148.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  30.97
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        54.73
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.39
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    400.00 =    2044.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)       =       19.6  TC(MIN.) =      8.39
  PEAK FLOW RATE(CFS)     =      54.73
============================================================================
```

==
END OF RATIONAL METHOD ANALYSIS

♀

APPENDIX B

RCFC&WCD Reference Material

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	Soil Group B	Soil Group C	Soil Group D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparrel, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparrel, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		76	85	90	92

RCFC & WCD
HYDROLOGY MANUAL

RUNOFF INDEX NUMBERS FOR PERVIOUS AREAS

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	Soil Group B	Soil Group C	Soil Group D
AGRICULTURAL COVERS (cont.) -					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Deciduous (Apples, apricots, pears, walnuts, etc.)		See Note 4			
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small Grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87
Vineyard		See Note 4			

Notes:

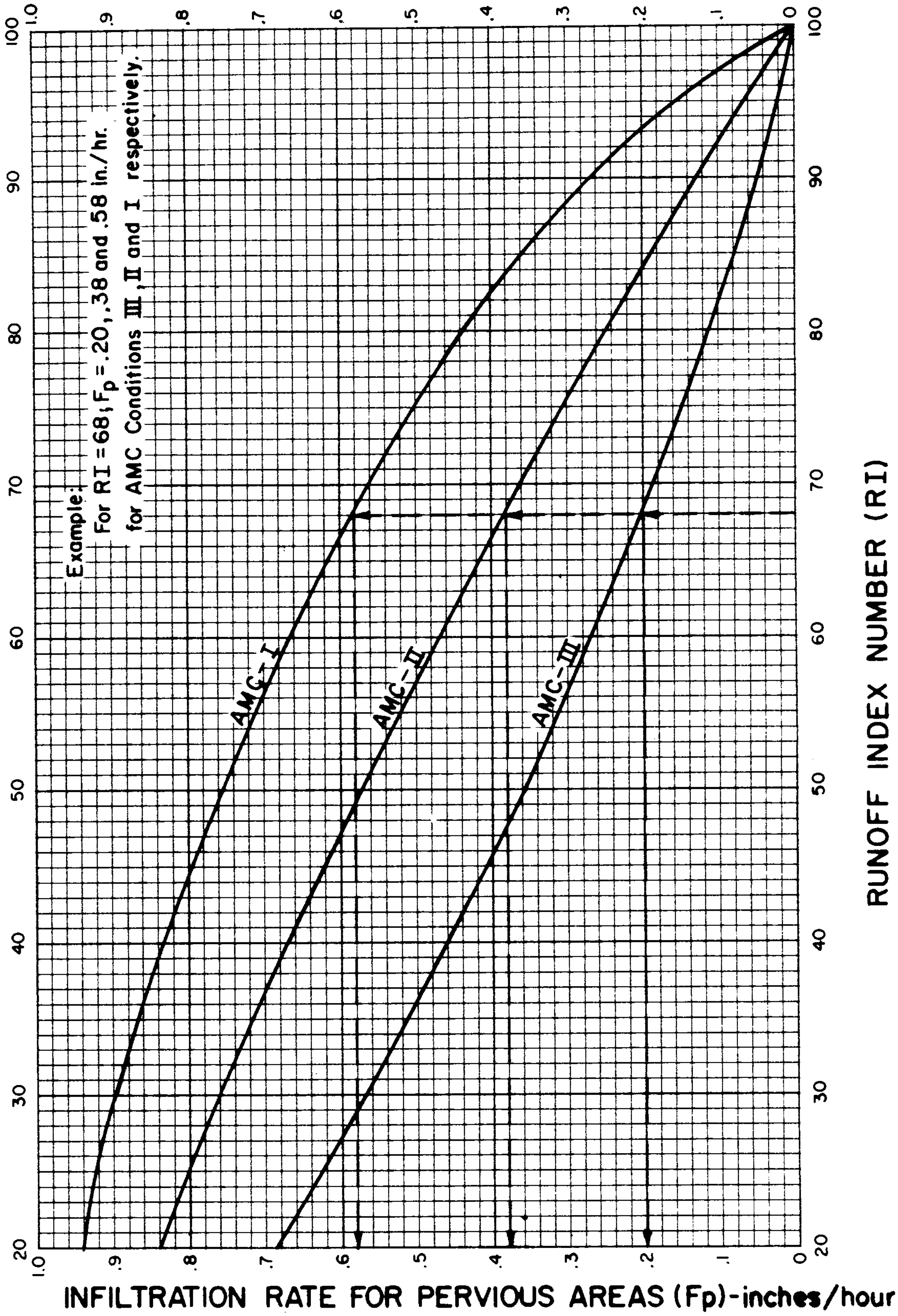
1. All runoff index (RI) numbers are for Antecedent Moisture Condition (AMC) II.

2. Quality of cover definitions:
   Poor-Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.
   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.
   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.

3. See Plate C-2 for a detailed description of cover types.

4. Use runoff index numbers based on ground cover type. See discussion under "Cover Type Descriptions" on Plate C-2.

5. Reference Bibliography item 17.



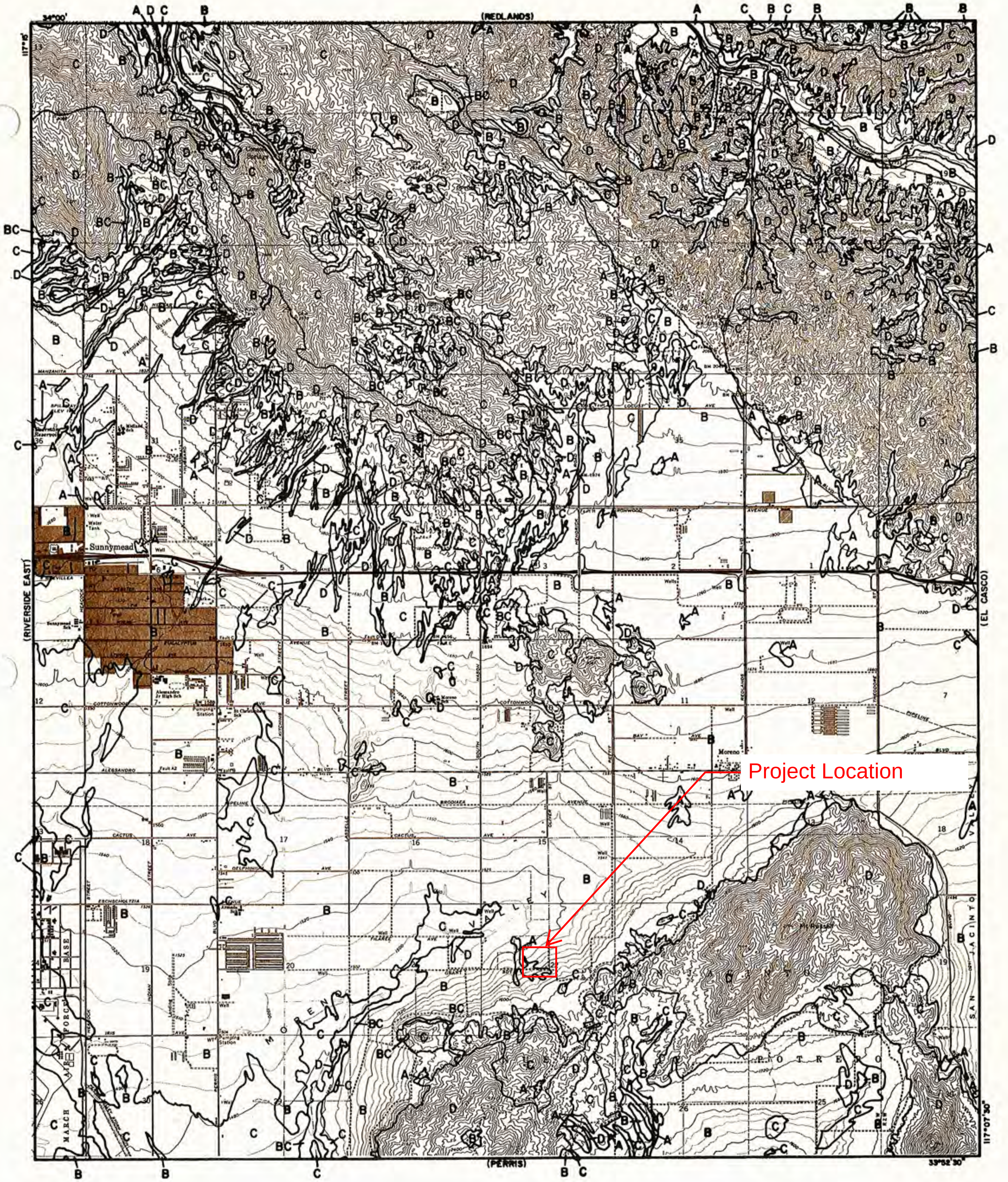
NOTES:

1. R.I. Number - Infiltration relationships are derived from rainfall-runoff relationships in Bibliography item No. 36.

RCFC & WCD

HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS RUNOFF INDEX NUMBERS



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC & WCD

HYDROLOGY MANUAL

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR SUNNYMEAD

PLATE C-1.17

RCFC & WCD
HYDROLOGY MANUAL

RAINFALL INTENSITY–INCHES PER HOUR

SUNNYMEAD - MORENO			WOODCREST		
DURATION MINUTES	FREQUENCY 10 YEAR	FREQUENCY 100 YEAR	DURATION MINUTES	FREQUENCY 10 YEAR	FREQUENCY 100 YEAR
5	2.84	4.16	5	3.37	5.30
6	2.59	3.79	6	3.05	4.79
7	2.40	3.51	7	2.80	4.40
8	2.25	3.29	8	2.60	4.09
9	2.12	3.10	9	2.44	3.83
10	2.01	2.94	10	2.30	3.62
11	1.92	2.80	11	2.19	3.43
12	1.83	2.68	12	2.08	3.27
13	1.76	2.58	13	1.99	3.13
14	1.70	2.48	14	1.91	3.01
15	1.64	2.40	15	1.84	2.89
16	1.59	2.32	16	1.78	2.79
17	1.54	2.25	17	1.72	2.70
18	1.50	2.19	18	1.67	2.62
19	1.46	2.13	19	1.62	2.54
20	1.42	2.08	20	1.57	2.47
22	1.35	1.98	22	1.49	2.34
24	1.30	1.90	24	1.42	2.23
26	1.25	1.82	26	1.36	2.14
28	1.20	1.76	28	1.31	2.05
30	1.16	1.70	30	1.26	1.98
32	1.12	1.64	32	1.22	1.91
34	1.09	1.59	34	1.18	1.85
36	1.06	1.55	36	1.14	1.79
38	1.03	1.51	38	1.11	1.74
40	1.00	1.47	40	1.07	1.69
45	.95	1.39	45	1.01	1.58
50	.90	1.31	50	.95	1.49
55	.86	1.25	55	.90	1.42
60	.82	1.20	60	.86	1.35
65	.79	1.15	65	.82	1.29
70	.76	1.11	70	.79	1.24
75	.73	1.07	75	.76	1.19
80	.71	1.04	80	.73	1.15
85	.69	1.01	85	.71	1.11
SLOPE = .500			SLOPE = .550		

STANDARD
INTENSITY–DURATION
CURVES DATA

APPENDIX C

HYDRAULIC CALCULATIONS


PVC/HPDE PIPE DIAMETER (INCH)
12”
18”
24”
30”
36”
DMA EAST
DMA WEST
EXISTING 30" PIPE
IRIS AVENUE
NOT TO SCALE
1
2
3
4
5
6
7
8
9
10
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303
400
401
500
Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM
STORM DRAIN NETWORK
KAISER MEDICAL MORENO VALLEY
JESSICA.JONES 1/30/19 12:06 pm

Node 301 West to 302 West

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01577	ft/ft
Diameter	1.50	ft
Discharge	5.23	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	0.74	ft²
Wetted Perimeter	2.17	ft
Hydraulic Radius	0.34	ft
Top Width	1.49	ft
Critical Depth	0.88	ft
Percent Full	43.8	%
Critical Slope	0.00587	ft/ft
Velocity	7.03	ft/s
Velocity Head	0.77	ft
Specific Energy	1.42	ft
Froude Number	1.75	
Maximum Discharge	14.19	ft³/s
Discharge Full	13.19	ft³/s
Slope Full	0.00248	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	43.78	%
Downstream Velocity	Infinity	ft/s

Node 301 West to 302 West

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.88	ft
Channel Slope	0.01577	ft/ft
Critical Slope	0.00587	ft/ft

Node 302 West to Basin A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	11.43	ft³/s

Results

Normal Depth	1.01	ft
Flow Area	1.58	ft²
Wetted Perimeter	3.15	ft
Hydraulic Radius	0.50	ft
Top Width	2.00	ft
Critical Depth	1.21	ft
Percent Full	50.3	%
Critical Slope	0.00547	ft/ft
Velocity	7.22	ft/s
Velocity Head	0.81	ft
Specific Energy	1.82	ft
Froude Number	1.43	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00255	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.30	%
Downstream Velocity	Infinity	ft/s

Node 302 West to Basin A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.21	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00547	ft/ft

Node 103 West to Basin A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01040	ft/ft
Diameter	2.00	ft
Discharge	13.45	ft³/s

Results

Normal Depth	1.10	ft
Flow Area	1.76	ft²
Wetted Perimeter	3.34	ft
Hydraulic Radius	0.53	ft
Top Width	1.99	ft
Critical Depth	1.32	ft
Percent Full	54.8	%
Critical Slope	0.00591	ft/ft
Velocity	7.62	ft/s
Velocity Head	0.90	ft
Specific Energy	2.00	ft
Froude Number	1.43	
Maximum Discharge	24.82	ft³/s
Discharge Full	23.07	ft³/s
Slope Full	0.00354	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	54.84	%
Downstream Velocity	Infinity	ft/s

Node 103 West to Basin A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	1.32	ft
Channel Slope	0.01040	ft/ft
Critical Slope	0.00591	ft/ft

Node 201 East to 204 East

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02037	ft/ft
Diameter	1.50	ft
Discharge	8.36	ft³/s

Results

Normal Depth	0.80	ft
Flow Area	0.96	ft²
Wetted Perimeter	2.46	ft
Hydraulic Radius	0.39	ft
Top Width	1.50	ft
Critical Depth	1.12	ft
Percent Full	53.4	%
Critical Slope	0.00770	ft/ft
Velocity	8.72	ft/s
Velocity Head	1.18	ft
Specific Energy	1.98	ft
Froude Number	1.92	
Maximum Discharge	16.13	ft³/s
Discharge Full	14.99	ft³/s
Slope Full	0.00633	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	53.37	%
Downstream Velocity	Infinity	ft/s

Node 201 East to 204 East

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.80	ft
Critical Depth	1.12	ft
Channel Slope	0.02037	ft/ft
Critical Slope	0.00770	ft/ft

Node 204 East to Pipe Storage

Project Description

Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient		0.013	
Channel Slope		0.02251	ft/ft
Diameter		2.00	ft
Discharge		14.32	ft^3/s

Results

Normal Depth		0.91	ft
Flow Area		1.38	ft^2
Wetted Perimeter		2.95	ft
Hydraulic Radius		0.47	ft
Top Width		1.99	ft
Critical Depth		1.36	ft
Percent Full		45.3	%
Critical Slope		0.00613	ft/ft
Velocity		10.35	ft/s
Velocity Head		1.66	ft
Specific Energy		2.57	ft
Froude Number		2.19	
Maximum Discharge		36.51	ft^3/s
Discharge Full		33.94	ft^3/s
Slope Full		0.00401	ft/ft
Flow Type	SuperCritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Average End Depth Over Rise		0.00	%
Normal Depth Over Rise		45.33	%
Downstream Velocity		Infinity	ft/s

Node 204 East to Pipe Storage

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.91	ft
Critical Depth	1.36	ft
Channel Slope	0.02251	ft/ft
Critical Slope	0.00613	ft/ft

Node 101 East-Basin B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	16.57	ft³/s

Results

Normal Depth	1.27	ft
Flow Area	2.11	ft²
Wetted Perimeter	3.69	ft
Hydraulic Radius	0.57	ft
Top Width	1.92	ft
Critical Depth	1.47	ft
Percent Full	63.6	%
Critical Slope	0.00679	ft/ft
Velocity	7.87	ft/s
Velocity Head	0.96	ft
Specific Energy	2.23	ft
Froude Number	1.33	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00537	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.56	%
Downstream Velocity	Infinity	ft/s

Node 101 East-Basin B

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	1.47	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00679	ft/ft

Basin B to Vault Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02405	ft/ft
Diameter	1.00	ft
Discharge	3.23	ft^3/s

Results

Normal Depth	0.55	ft
Flow Area	0.44	ft^2
Wetted Perimeter	1.67	ft
Hydraulic Radius	0.26	ft
Top Width	1.00	ft
Critical Depth	0.77	ft
Percent Full	54.9	%
Critical Slope	0.00932	ft/ft
Velocity	7.31	ft/s
Velocity Head	0.83	ft
Specific Energy	1.38	ft
Froude Number	1.93	
Maximum Discharge	5.94	ft^3/s
Discharge Full	5.52	ft^3/s
Slope Full	0.00822	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	54.93	%
Downstream Velocity	Infinity	ft/s

Basin B to Vault Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.77	ft
Channel Slope	0.02405	ft/ft
Critical Slope	0.00932	ft/ft

Node 104 East to 105 East

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02249	ft/ft
Diameter	1.50	ft
Discharge	5.59	ft³/s

Results

Normal Depth	0.62	ft
Flow Area	0.69	ft²
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.33	ft
Top Width	1.48	ft
Critical Depth	0.91	ft
Percent Full	41.2	%
Critical Slope	0.00603	ft/ft
Velocity	8.15	ft/s
Velocity Head	1.03	ft
Specific Energy	1.65	ft
Froude Number	2.11	
Maximum Discharge	16.94	ft³/s
Discharge Full	15.75	ft³/s
Slope Full	0.00283	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	41.16	%
Downstream Velocity	Infinity	ft/s

Node 104 East to 105 East

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.91	ft
Channel Slope	0.02249	ft/ft
Critical Slope	0.00603	ft/ft

Node 105 East to Vault

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	6.18	ft³/s

Results

Normal Depth	0.83	ft
Flow Area	1.00	ft²
Wetted Perimeter	2.51	ft
Hydraulic Radius	0.40	ft
Top Width	1.49	ft
Critical Depth	0.96	ft
Percent Full	55.2	%
Critical Slope	0.00631	ft/ft
Velocity	6.18	ft/s
Velocity Head	0.59	ft
Specific Energy	1.42	ft
Froude Number	1.33	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00346	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	55.15	%
Downstream Velocity	Infinity	ft/s

Node 105 East to Vault

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.83	ft
Critical Depth	0.96	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00631	ft/ft

Node 106 East to Vault

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	2.50	ft
Discharge	15.38	ft³/s

Results

Normal Depth	1.29	ft
Flow Area	2.57	ft²
Wetted Perimeter	4.02	ft
Hydraulic Radius	0.64	ft
Top Width	2.50	ft
Critical Depth	1.32	ft
Percent Full	51.8	%
Critical Slope	0.00465	ft/ft
Velocity	6.00	ft/s
Velocity Head	0.56	ft
Specific Energy	1.85	ft
Froude Number	1.04	
Maximum Discharge	31.20	ft³/s
Discharge Full	29.00	ft³/s
Slope Full	0.00141	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	51.78	%
Downstream Velocity	Infinity	ft/s

Node 106 East to Vault

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.29	ft
Critical Depth	1.32	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00465	ft/ft

Vault to Basin B Connection

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	16.32	ft³/s

Results

Normal Depth	1.26	ft
Flow Area	2.08	ft²
Wetted Perimeter	3.66	ft
Hydraulic Radius	0.57	ft
Top Width	1.93	ft
Critical Depth	1.46	ft
Percent Full	62.9	%
Critical Slope	0.00671	ft/ft
Velocity	7.84	ft/s
Velocity Head	0.96	ft
Specific Energy	2.21	ft
Froude Number	1.33	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00520	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	62.91	%
Downstream Velocity	Infinity	ft/s

Vault to Basin B Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.46	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00671	ft/ft

Vault/Basin B to Storage Pipes Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	19.55	ft³/s

Results

Normal Depth	1.44	ft
Flow Area	2.41	ft²
Wetted Perimeter	4.04	ft
Hydraulic Radius	0.60	ft
Top Width	1.80	ft
Critical Depth	1.59	ft
Percent Full	71.8	%
Critical Slope	0.00792	ft/ft
Velocity	8.10	ft/s
Velocity Head	1.02	ft
Specific Energy	2.46	ft
Froude Number	1.23	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00747	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	71.75	%
Downstream Velocity	Infinity	ft/s

Vault/Basin B to Storage Pipes Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.44	ft
Critical Depth	1.59	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00792	ft/ft

Storage Pipes to Vault/Basin B Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.50	ft
Discharge	21.08	ft³/s

Results

Normal Depth	1.27	ft
Flow Area	2.51	ft²
Wetted Perimeter	3.97	ft
Hydraulic Radius	0.63	ft
Top Width	2.50	ft
Critical Depth	1.56	ft
Percent Full	50.8	%
Critical Slope	0.00520	ft/ft
Velocity	8.41	ft/s
Velocity Head	1.10	ft
Specific Energy	2.37	ft
Froude Number	1.48	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.00264	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.81	%
Downstream Velocity	Infinity	ft/s

Storage Pipes to Vault/Basin B Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	1.56	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00520	ft/ft

Basin B/Vault/Storage Pipes to Node 400 East

Project Description

Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient		0.013	
Channel Slope		0.01000	ft/ft
Diameter		3.00	ft
Discharge		40.63	ft³/s

Results

Normal Depth		1.69	ft
Flow Area		4.11	ft²
Wetted Perimeter		5.10	ft
Hydraulic Radius		0.81	ft
Top Width		2.98	ft
Critical Depth		2.08	ft
Percent Full		56.4	%
Critical Slope		0.00546	ft/ft
Velocity		9.90	ft/s
Velocity Head		1.52	ft
Specific Energy		3.21	ft
Froude Number		1.49	
Maximum Discharge		71.74	ft³/s
Discharge Full		66.69	ft³/s
Slope Full		0.00371	ft/ft
Flow Type	SuperCritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Average End Depth Over Rise		0.00	%
Normal Depth Over Rise		56.36	%
Downstream Velocity		Infinity	ft/s

Basin B/Vault/Storage Pipes to Node 400 East

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.69	ft
Critical Depth	2.08	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00546	ft/ft

Node 301 West to 302 West

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01577	ft/ft
Diameter	1.50	ft
Discharge	5.23	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	0.74	ft²
Wetted Perimeter	2.17	ft
Hydraulic Radius	0.34	ft
Top Width	1.49	ft
Critical Depth	0.88	ft
Percent Full	43.8	%
Critical Slope	0.00587	ft/ft
Velocity	7.03	ft/s
Velocity Head	0.77	ft
Specific Energy	1.42	ft
Froude Number	1.75	
Maximum Discharge	14.19	ft³/s
Discharge Full	13.19	ft³/s
Slope Full	0.00248	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	43.78	%
Downstream Velocity	Infinity	ft/s

Node 301 West to 302 West

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.88	ft
Channel Slope	0.01577	ft/ft
Critical Slope	0.00587	ft/ft

Node 302 West to Basin A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	11.43	ft³/s

Results

Normal Depth	1.01	ft
Flow Area	1.58	ft²
Wetted Perimeter	3.15	ft
Hydraulic Radius	0.50	ft
Top Width	2.00	ft
Critical Depth	1.21	ft
Percent Full	50.3	%
Critical Slope	0.00547	ft/ft
Velocity	7.22	ft/s
Velocity Head	0.81	ft
Specific Energy	1.82	ft
Froude Number	1.43	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00255	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.30	%
Downstream Velocity	Infinity	ft/s

Node 302 West to Basin A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.21	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00547	ft/ft

Node 103 West to Basin A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01040	ft/ft
Diameter	2.00	ft
Discharge	13.45	ft³/s

Results

Normal Depth	1.10	ft
Flow Area	1.76	ft²
Wetted Perimeter	3.34	ft
Hydraulic Radius	0.53	ft
Top Width	1.99	ft
Critical Depth	1.32	ft
Percent Full	54.8	%
Critical Slope	0.00591	ft/ft
Velocity	7.62	ft/s
Velocity Head	0.90	ft
Specific Energy	2.00	ft
Froude Number	1.43	
Maximum Discharge	24.82	ft³/s
Discharge Full	23.07	ft³/s
Slope Full	0.00354	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	54.84	%
Downstream Velocity	Infinity	ft/s

Node 103 West to Basin A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	1.32	ft
Channel Slope	0.01040	ft/ft
Critical Slope	0.00591	ft/ft

Node 201 East to 204 East

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02037	ft/ft
Diameter	1.50	ft
Discharge	8.36	ft³/s

Results

Normal Depth	0.80	ft
Flow Area	0.96	ft²
Wetted Perimeter	2.46	ft
Hydraulic Radius	0.39	ft
Top Width	1.50	ft
Critical Depth	1.12	ft
Percent Full	53.4	%
Critical Slope	0.00770	ft/ft
Velocity	8.72	ft/s
Velocity Head	1.18	ft
Specific Energy	1.98	ft
Froude Number	1.92	
Maximum Discharge	16.13	ft³/s
Discharge Full	14.99	ft³/s
Slope Full	0.00633	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	53.37	%
Downstream Velocity	Infinity	ft/s

Node 201 East to 204 East

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.80	ft
Critical Depth	1.12	ft
Channel Slope	0.02037	ft/ft
Critical Slope	0.00770	ft/ft

Node 204 East to Pipe Storage

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02251	ft/ft
Diameter	2.00	ft
Discharge	14.32	ft³/s

Results

Normal Depth	0.91	ft
Flow Area	1.38	ft²
Wetted Perimeter	2.95	ft
Hydraulic Radius	0.47	ft
Top Width	1.99	ft
Critical Depth	1.36	ft
Percent Full	45.3	%
Critical Slope	0.00613	ft/ft
Velocity	10.35	ft/s
Velocity Head	1.66	ft
Specific Energy	2.57	ft
Froude Number	2.19	
Maximum Discharge	36.51	ft³/s
Discharge Full	33.94	ft³/s
Slope Full	0.00401	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	45.33	%
Downstream Velocity	Infinity	ft/s

Node 204 East to Pipe Storage

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.91	ft
Critical Depth	1.36	ft
Channel Slope	0.02251	ft/ft
Critical Slope	0.00613	ft/ft

Node 101 East-Basin B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	16.57	ft³/s

Results

Normal Depth	1.27	ft
Flow Area	2.11	ft²
Wetted Perimeter	3.69	ft
Hydraulic Radius	0.57	ft
Top Width	1.92	ft
Critical Depth	1.47	ft
Percent Full	63.6	%
Critical Slope	0.00679	ft/ft
Velocity	7.87	ft/s
Velocity Head	0.96	ft
Specific Energy	2.23	ft
Froude Number	1.33	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00537	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.56	%
Downstream Velocity	Infinity	ft/s

Node 101 East-Basin B

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	1.47	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00679	ft/ft

Basin B to Vault Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02405	ft/ft
Diameter	1.00	ft
Discharge	3.23	ft³/s

Results

Normal Depth	0.55	ft
Flow Area	0.44	ft²
Wetted Perimeter	1.67	ft
Hydraulic Radius	0.26	ft
Top Width	1.00	ft
Critical Depth	0.77	ft
Percent Full	54.9	%
Critical Slope	0.00932	ft/ft
Velocity	7.31	ft/s
Velocity Head	0.83	ft
Specific Energy	1.38	ft
Froude Number	1.93	
Maximum Discharge	5.94	ft³/s
Discharge Full	5.52	ft³/s
Slope Full	0.00822	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	54.93	%
Downstream Velocity	Infinity	ft/s

Basin B to Vault Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.77	ft
Channel Slope	0.02405	ft/ft
Critical Slope	0.00932	ft/ft

Node 104 East to 105 East

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02249	ft/ft
Diameter	1.50	ft
Discharge	5.59	ft³/s

Results

Normal Depth	0.62	ft
Flow Area	0.69	ft²
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.33	ft
Top Width	1.48	ft
Critical Depth	0.91	ft
Percent Full	41.2	%
Critical Slope	0.00603	ft/ft
Velocity	8.15	ft/s
Velocity Head	1.03	ft
Specific Energy	1.65	ft
Froude Number	2.11	
Maximum Discharge	16.94	ft³/s
Discharge Full	15.75	ft³/s
Slope Full	0.00283	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	41.16	%
Downstream Velocity	Infinity	ft/s

Node 104 East to 105 East

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.91	ft
Channel Slope	0.02249	ft/ft
Critical Slope	0.00603	ft/ft

Node 105 East to Vault

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	6.18	ft³/s

Results

Normal Depth	0.83	ft
Flow Area	1.00	ft²
Wetted Perimeter	2.51	ft
Hydraulic Radius	0.40	ft
Top Width	1.49	ft
Critical Depth	0.96	ft
Percent Full	55.2	%
Critical Slope	0.00631	ft/ft
Velocity	6.18	ft/s
Velocity Head	0.59	ft
Specific Energy	1.42	ft
Froude Number	1.33	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00346	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	55.15	%
Downstream Velocity	Infinity	ft/s

Node 105 East to Vault

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.83	ft
Critical Depth	0.96	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00631	ft/ft

Node 106 East to Vault

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	2.50	ft
Discharge	15.38	ft³/s

Results

Normal Depth	1.29	ft
Flow Area	2.57	ft²
Wetted Perimeter	4.02	ft
Hydraulic Radius	0.64	ft
Top Width	2.50	ft
Critical Depth	1.32	ft
Percent Full	51.8	%
Critical Slope	0.00465	ft/ft
Velocity	6.00	ft/s
Velocity Head	0.56	ft
Specific Energy	1.85	ft
Froude Number	1.04	
Maximum Discharge	31.20	ft³/s
Discharge Full	29.00	ft³/s
Slope Full	0.00141	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	51.78	%
Downstream Velocity	Infinity	ft/s

Node 106 East to Vault

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.29	ft
Critical Depth	1.32	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00465	ft/ft

Vault to Basin B Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	16.32	ft³/s

Results

Normal Depth	1.26	ft
Flow Area	2.08	ft²
Wetted Perimeter	3.66	ft
Hydraulic Radius	0.57	ft
Top Width	1.93	ft
Critical Depth	1.46	ft
Percent Full	62.9	%
Critical Slope	0.00671	ft/ft
Velocity	7.84	ft/s
Velocity Head	0.96	ft
Specific Energy	2.21	ft
Froude Number	1.33	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00520	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	62.91	%
Downstream Velocity	Infinity	ft/s

Vault to Basin B Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.46	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00671	ft/ft

Vault/Basin B to Storage Pipes Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	19.55	ft³/s

Results

Normal Depth	1.44	ft
Flow Area	2.41	ft²
Wetted Perimeter	4.04	ft
Hydraulic Radius	0.60	ft
Top Width	1.80	ft
Critical Depth	1.59	ft
Percent Full	71.8	%
Critical Slope	0.00792	ft/ft
Velocity	8.10	ft/s
Velocity Head	1.02	ft
Specific Energy	2.46	ft
Froude Number	1.23	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00747	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	71.75	%
Downstream Velocity	Infinity	ft/s

Vault/Basin B to Storage Pipes Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.44	ft
Critical Depth	1.59	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00792	ft/ft

Storage Pipes to Vault/Basin B Connection

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.50	ft
Discharge	21.08	ft³/s

Results

Normal Depth	1.27	ft
Flow Area	2.51	ft²
Wetted Perimeter	3.97	ft
Hydraulic Radius	0.63	ft
Top Width	2.50	ft
Critical Depth	1.56	ft
Percent Full	50.8	%
Critical Slope	0.00520	ft/ft
Velocity	8.41	ft/s
Velocity Head	1.10	ft
Specific Energy	2.37	ft
Froude Number	1.48	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.00264	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.81	%
Downstream Velocity	Infinity	ft/s

Storage Pipes to Vault/Basin B Connection

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	1.56	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00520	ft/ft

Basin B/Vault/Storage Pipes to Node 400 East

Project Description

Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient		0.013	
Channel Slope		0.01000	ft/ft
Diameter		3.00	ft
Discharge		40.63	ft³/s

Results

Normal Depth		1.69	ft
Flow Area		4.11	ft²
Wetted Perimeter		5.10	ft
Hydraulic Radius		0.81	ft
Top Width		2.98	ft
Critical Depth		2.08	ft
Percent Full		56.4	%
Critical Slope		0.00546	ft/ft
Velocity		9.90	ft/s
Velocity Head		1.52	ft
Specific Energy		3.21	ft
Froude Number		1.49	
Maximum Discharge		71.74	ft³/s
Discharge Full		66.69	ft³/s
Slope Full		0.00371	ft/ft
Flow Type	SuperCritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Average End Depth Over Rise		0.00	%
Normal Depth Over Rise		56.36	%
Downstream Velocity		Infinity	ft/s

Basin B/Vault/Storage Pipes to Node 400 East

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.69	ft
Critical Depth	2.08	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00546	ft/ft

APPENDIX G2

Project Specific Water Quality Management Plan

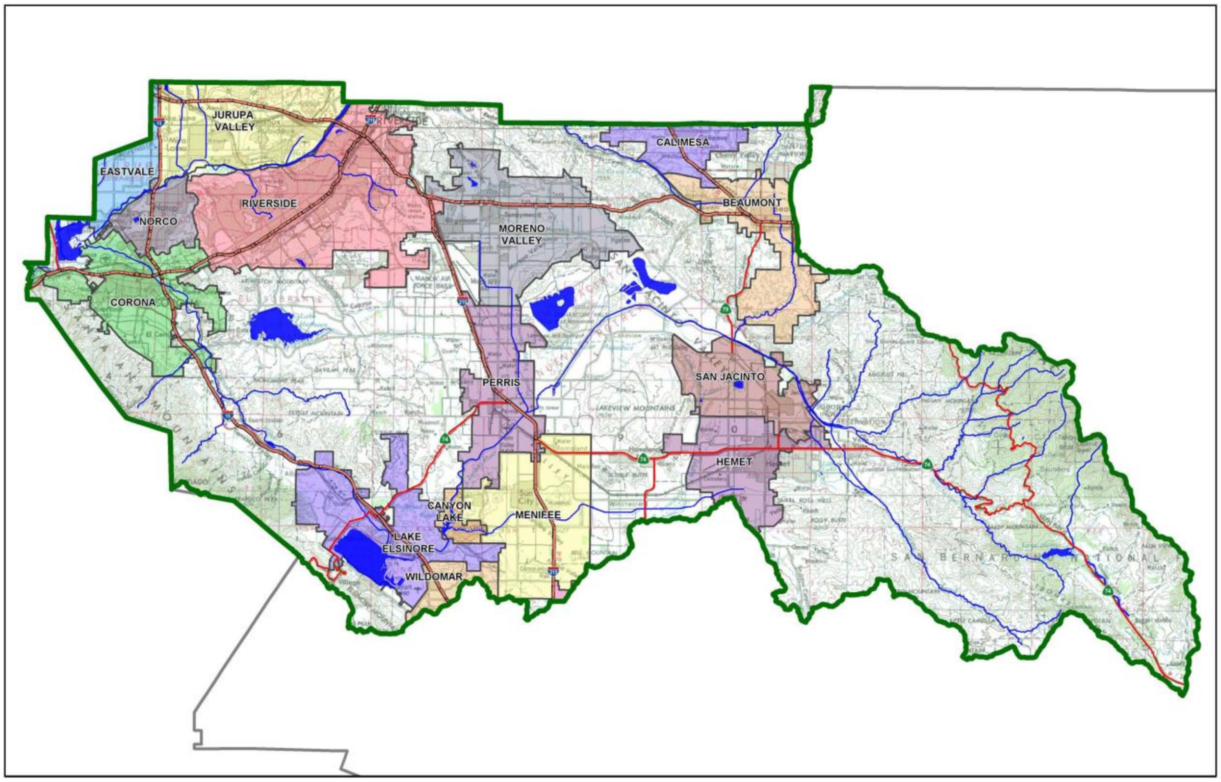
Project Specific Water Quality Management Plan

*A Template for Projects located within the **Santa Ana Watershed** Region of Riverside County*

Project Title: Kaiser Permanente Moreno Valley

Development No: PEN18-0228 thru 0230

Design Review/Case No: LWQ 18-0037



Contact Information:

Prepared for: Kaiser Permanente
27300 Iris Avenue, Moreno Valley, CA 92555

Prepared by: Scott Davis, Project Manager
9755 Clairemont Mesa Blvd, Suite 100
Phone: (858) 614-5000

☒ **Preliminary**
☐ **Final**

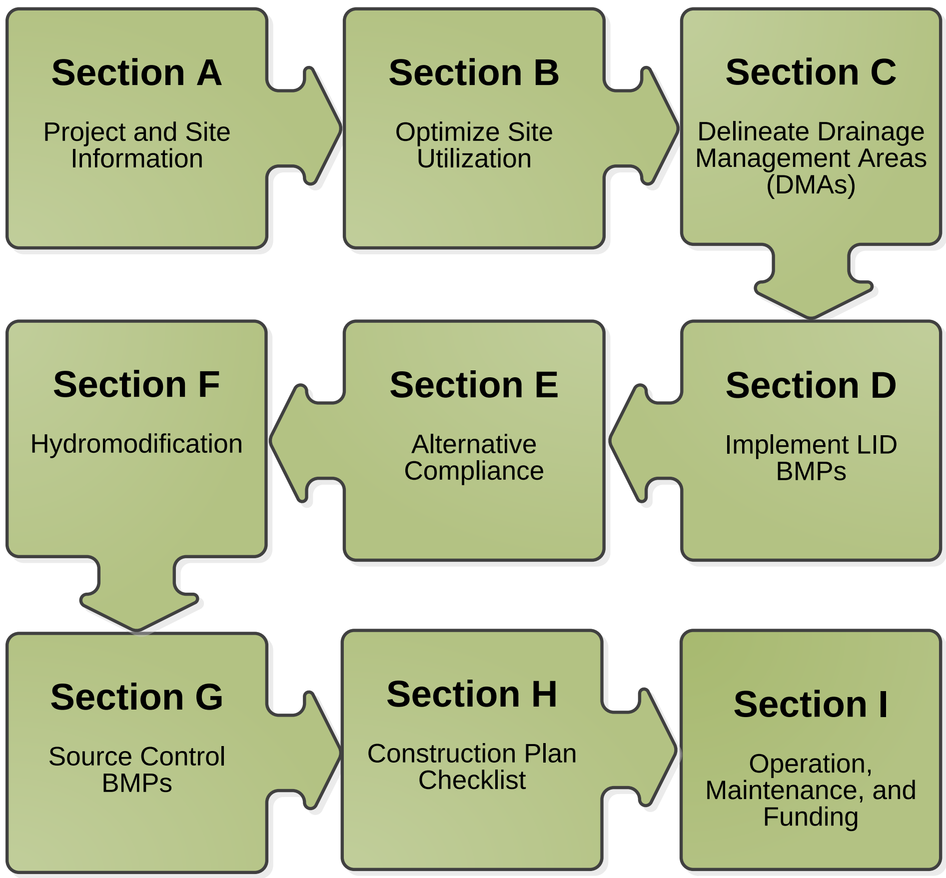
Original Date Prepared: November 2018

Revision Date(s): January 2019

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**

A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your "how-to" manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for Kaiser Permanente by Michael Baker International Company for the Kaiser Permanente Moreno Valley Medical Center project.

This WQMP is intended to comply with the requirements of The City of Moreno Valley for Order No. R8-2010-0033 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under The City of Moreno Valley Water Quality Ordinance (Municipal Code Section 8.21.170).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

Preparer's Signature	Date
Scott Davis	Project Manager
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:

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Section A: Project and Site Information

PROJECT INFORMATION			
Type of Project:	Medical Center		
Planning Area:	N/A		
Community Name:	N/A		
Development Name:	N/A		
Project Description:	The Kaiser Permanente Moreno Valley Medical Center site is comprised of a 29.8-acre dual parcel (APN 486-310-033 and APN 486-310-034) that is currently developed with a hospital, patient tower, medical offices and onsite parking. The proposed project will be an expansion to the existing medical campus. This study addresses the total ultimate development which will include four (4) patient bed towers, a Diagnostics and Treatment Center (D&T), and an Emergency Department. The project will also include a Central Utility Plant (CUP) and two Parking Structures. Several LID and Alternative Compliance BMPs will be implemented onsite to mitigate for water quality impacts. The subject study area encompasses the total combined parcel area of 29.8-acres.		
PROJECT LOCATION			
Latitude & Longitude (DMS): N33° 53' 48" & W117° 11' 08"			
Project Watershed and Sub-Watershed: Santa Ana River Watershed and San Jacinto Sub-Watershed			
APN(s): 486-310-033 & 486-310-034			
Map Book and Page No.: Book 486 Page 31			
PROJECT CHARACTERISTICS			
Proposed or Potential Land Use(s)		Medical Center	
Proposed or Potential SIC Code(s)		8011, 8050, 8051, 8071	
Area of Impervious Project Footprint (SF)		623,435	
Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement		979,365	
Does the project consist of offsite road improvements?		☐ Y	☒ N
Does the project propose to construct unpaved roads?		☐ Y	☒ N
Is the project part of a larger common plan of development (phased project)?		☒ Y	☐ N
EXISTING SITE CHARACTERISTICS			
Total area of <u>existing</u> Impervious Surfaces within the project limits (SF)		623,435	
Is the project located within any MSHCP Criteria Cell?		☐ Y	☒ N
If so, identify the Cell number:		N/A	
Are there any natural hydrologic features on the project site?		☐ Y	☒ N
Is a Geotechnical Report attached?		☒ Y	☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)		See attached report	
What is the Water Quality Design Storm Depth for the project?		0.66 inches	

A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

A.2 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris Valley Storm Drain	N/A	N/A	Not classified
San Jacinto River, Reach 3	N/A	AGR, GWR, REC1, REC2, WARM, WILD	Not classified
Railroad Canyon Reservoir- San Jacinto River, Reach 2	Nutrients (No TMDL date has been recorded by EPA for this waterbody)	N/A	Not classified
San Jacinto River, Reach 1	N/A	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not classified
Lake Elsinore	DDT, Nutrients, Organic Enrichment/Low Dissolved Oxygen, Polychlorinated Biphenyls (PCBs), Toxicity (No TMDL date has been recorded by EPA for this waterbody)	COMM, WARM	Not classified

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☒ Y	☐ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)*	☐ Y	☒ N

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

The proposed master grading preserves existing drainage patterns entirely. Under existing conditions, the site generally drains northwest towards Nason Street to an existing canal which conveys onsite flows southwest to San Jacinto River, Canyon Lake (Railroad Canyon Reservoir) and discharges to Lake Elsinore. The existing project site covers two parcels, each parcel is contained individually with a single stormwater outlet via concrete spillway. The master site plan will maintain the same two outlet locations and improved as deemed based on ultimate site design. There is offsite flow contribution from the eastern undeveloped parcel. These offsite flows where not accounted on the sizing of onsite permanent BMPs. Offsite flows shall be evaluated during ultimate site design. Iris Avenue is a public paved road with curb, gutter and storm drain infrastructure conveying offsite flows from the south. There's an existing earthen berm along the western property line.

Did you identify and protect existing vegetation? If so, how? If not, why?

Minimal existing vegetation will remain undisturbed under ultimate buildout. New landscape will be provided wherever applicable and to the maximum extend feasible.

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

Michael Baker International (MBI) obtained available infiltration data from the existing Medical Office Building development at Kaiser Permanente Moreno Valley. Infiltration rates were documented in the geotechnical report titled: Geotechnical Investigation, Kaiser Permanente, Iris MOB 2 – Phase I, 27300 Iris Avenue, Moreno Valley, California, dated May 24, 2011. Two infiltration tests were performed for the MOB project revealing infiltration rates of 0.05 inches/hour. Soils encountered during testing were Sandy Silt

(ML). Similar soils were encountered during recent geotechnical investigations, therefore assumed percolation rates are consistent across the project site. Based on the above infiltration rate, infiltration BMPs should not be used for the project.

Did you identify and minimize impervious area? If so, how? If not, why?

Impervious areas have been minimized to the maximum extend practicable. However, due to the nature of the project (Medical Center) substitution of impervious areas for landscaping is not feasible. The runoff of impervious areas drains to proposed BMP when possible. The entire Design Capture Volume (DCV) is handled by the proposed BMPs.

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

The runoff of impervious areas drain to pervious landscaped areas to improve infiltration to the maximum extent possible.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
DMA A	Mix (Concrete, Asphalt, Roof, Landscape)	196,295	Type D
DMA B	Mix (Concrete, Asphalt, Roof, Landscape)	100,683	Type D
DMA C	Mix (Concrete, Asphalt, Roof, Landscape)	134,070	Type D
DMA D	Mix (Concrete, Asphalt, Roof, Landscape)	248,740	Type D
DMA E	Mix (Concrete, Asphalt, Roof, Landscape)	336,250	Type D
DMA F	Mix (Concrete, Asphalt, Roof, Landscape)	266,877	Type D

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
N/A			

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]
N/A						

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					**Receiving Self-Retaining DMA**		
DMA Name/ ID	Area (square feet)	Post-project surface type	Runoff factor	Product	DMA name /ID	Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]		[D]	[C]/[D]
N/A							

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
DMA A	Sand Filter Basin A (SFB A)
DMA B	Sand Filter Basin B (SFB B)
DMA C	Sand Filter Basin C (SFB C)
DMA D	Sand Filter Basin D (SFB D)
DMA E	Underground Storage Vault
DMA F	Underground Storage Pipe System

Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D.1 Infiltration Feasibility

Does the project site…	YES	NO
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour?	X	
If Yes, list affected DMAs: Potentially all DMAs. The assumed infiltration rate is less than 1.6 inches/hour.		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

☐The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Irrigation Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

Total Area of Irrigated Landscape: 7.5 acres

Type of Landscaping (Conservation Design or Active Turf): Conservative Design

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: 22.5 acres

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

Enter your EIATIA factor: 1.05

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

Minimum required irrigated area: 23.6 acres

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

Minimum required irrigated area (Step 4)	**Available Irrigated Landscape (Step 1)**
23.6 acres	7.5 acres

Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

Projected Number of Daily Toilet Users: TBD

Project Type: Commercial

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: 22.5 acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-2 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: 141 tu/ac

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

Minimum number of toilet users: 3,172

Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required Toilet Users (Step 4)	**Projected number of toilet users (Step 1)**
3,172	TBD

Other Non-Potable Use Feasibility

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

N/A

Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

Average Daily Demand: N/A

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: 22.5 acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-4 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-3: 1,018 gpd/acre

Step 4: Multiply the unit value obtained from Step 4 by the total of impervious areas from Step 3 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use: 22,905 gpd

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**
22,905 gpd	N/A

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

☐ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☒ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
A	☐	☐	☐	☐	☒
B	☐	☐	☐	☐	☒
C	☐	☐	☐	☐	☒
D	☐	☐	☐	☐	☒
E	☐	☐	☐	☐	☒
F	☐	☐	☐	☐	☒

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

Infiltration – Infiltration testing revealed rates of 0.05 inches/hour. Per WQMP guidelines, infiltration BMPs should not be used for the project if rates are less than 1.6 inches/hour.

Harvest and Use - The minimum required irrigated area is 3 times larger compared to the available irrigated landscape under the ultimate phase.

Bioretention – Planters allow for maximum ponding depth of 6 inches. Due to the nature of the project (Medical Center) substitution of impervious areas for landscaping is not feasible.

Biotreatment – A minimum tributary area of 5 acres is required per DMA. The tributary area of DMA A through C are below 5 acres. DMA D though F are in congested areas with multiple above and below ground utilities/structures that service the Medical Campus reducing available area for LID BMP implementation.

D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First**,** calculate the Design Capture Volume for each LID BMP using the V_{BMP} worksheet in Appendix F of the LID BMP Design Handbook. Second**,** design the LID BMP to meet the required V_{BMP} using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Enter BMP Name / Identifier Here*		
N/A						*Design Storm Depth (in)*	*Design Capture Volume,* V_{BMP} *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	A_T =				Σ=		V_{BMP} =	*V=*

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

☐ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

\- *Or* -

☒ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

LID BMP's are not feasible for DMA A-F.

E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
☐ Detached Residential Development	P	N	P	P	N	P	P	P
☐ Attached Residential Development	P	N	P	P	N	P	P	P(2)
☒ Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	P	P
☐ Automotive Repair Shops	N	P	N	N	P(4, 5)	N	P	P
☐ Restaurants (>5,000 ft²)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft²)	P	N	P	P	N	P	P	P
☒ Parking Lots (>5,000 ft²)	P(6)	P	P(1)	P(1)	P(4)	P(1)	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☐	☐	☒	☒	☒	☐	☐	☐

P = Potential

N = Not Potential

(1) *A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected*

(2) *A potential Pollutant if the project includes uncovered parking areas; otherwise not expected*

(3) *A potential Pollutant is land use involving animal waste*

(4) *Specifically petroleum hydrocarbons*

(5) *Specifically solvents*

(6) *Bacterial indicators are routinely detected in pavement runoff*

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
N/A	
Total Credit Percentage[1]	

[1]Cannot Exceed 50%

[2]Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

Table E.3-1 Treatment Control BMP Sizing

DMA Type/ID	**DMA Area (square feet)** [A]	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f** [B]	**DMA Runoff Factor** [C]	**DMA Area x Runoff Factor** [A] x [C]		***Enter BMP Name / Identifier Here***		
A Imp	148,585	*Concrete /Asphalt*	1.0	0.89	132,537.8				
A Perv	47,710	*Mix Surface Types*	0.15	0.14	6,748.4				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
A_T =	196,295			Σ=	139,286.2	0.66	$\mathbf{V_{BMP}}$ =7,660.7		***V***=*10,806*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12

[H] is from the Total Credit Percentage as Calculated from Table E.2 above

[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

Table E.4-2 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Area x Runoff Factor [A] x [C]		*Enter BMP Name / Identifier Here*		
B Imp	93,772	*Concrete /Asphalt*	1.0	0.89	83,644.6				
B Perv	6,911	*Mix Surface Types*	0.15	0.14	977.5				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
A_T =	100,683			Σ=	84,622.1	0.66	$\mathbf{V_{BMP}}$ =4,654.2		***V=****5,925*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

Table E.5-3 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Area x Runoff Factor [A] x [C]		*Enter BMP Name / Identifier Here*		
C Imp	73,734	*Concrete /Asphalt*	1.0	0.89	65,770.7				
C Perv	60,336	*Mix Surface Types*	0.15	0.14	8,534.3				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
A_T =	134,070			Σ=	74,305	0.66	$\mathbf{V_{BMP}}$ =4,086.8		***V=****7,470*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

Table E.6-4 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Area x Runoff Factor [A] x [C]		*Enter BMP Name / Identifier Here*		
D Imp	170,775	*Concrete /Asphalt*	1.0	0.89	152,331.3				
D Perv	77,965	*Mix Surface Types*	0.15	0.14	11,027.8				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
	A_T = 248,740			Σ=	163,359.1	0.66	V_{BMP} =8,984.8		***V=**13,357*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

Table E.7-5 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Area x Runoff Factor [A] x [C]		*Enter BMP Name / Identifier Here*		
E Imp	256,382	*Concrete /Asphalt*	1.0	0.89	228,692.7				
E Perv	79,868	*Mix Surface Types*	0.15	0.14	11,297				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
	A_T = 336,250			Σ=	239,989.7	0.66	V_{BMP} =13,199.4		***V=**15,000*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

Table E.3-6 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Area x Runoff Factor [A] x [C]		*Enter BMP Name / Identifier Here*		
F Imp	236,116	*Concrete /Asphalt*	1.0	0.89	210,615.5				
F Perv	30,761	*Mix Surface Types*	0.15	0.14	4,351				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
A_T =	266,877			Σ=	214,966.5	0.66	**V_{BMP}** =11,823.2		***V=****15,875*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12

[H] is from the Total Credit Percentage as Calculated from Table E.2 above

[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High**: equal to or greater than 80% removal efficiency
- **Medium**: between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table E.8 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
Sand Filter Basin	Oil and Grease	High /
Sand Filter Basin	Trash and Debris	High /
Sand Filter Basin	Trash and Debris	High /
Sand Filter Basin	Trash and Debris	High /
Biofiltration Structural BMP	Oil and Grease	High /
Biofiltration Structural BMP	Oil and Grease	High /

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.
[2] Cross Reference Table E.1 above to populate this column.
[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration	N/A	N/A	N/A
Volume (Cubic Feet)	N/A	N/A	N/A

[1] Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Sensitivity Maps.

Does the project qualify for this HCOC Exemption? ☒ Y ☐ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

The project location is in a HCOC exempt area. The site generally drains northwest towards Nason Street to an existing canal which conveys onsite flows southwest to San Jacinto River, Canyon Lake (Railroad Canyon Reservoir) and Lake Elsinore. Canyon Lake and Lake Elsinore are engineered and regularly maintained. No sensitive stream habitat areas will be adversely affected. Refer to Appendix 7 for HCOC Applicability Map.

F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

Be sure to include all pertinent documentation used in your analysis of the items a, b or c in Appendix 7.

Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. ***Identify Pollutant Sources***: Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit***: Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative***: Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site storm drains	See Appendix 8	See Appendix 8
Interior floor drain and elevator shaft sump pumps	See Appendix 8	See Appendix 8
Landscape/outdoor pesticide use	See Appendix 8	See Appendix 8
Refuse areas	See Appendix 8	See Appendix 8
Fire Sprinkler Test Water	See Appendix 8	See Appendix 8
Roof, Gutters, Trim	See Appendix 8	See Appendix 8
Plaza, sidewalks, and parking lots	See Appendix 8	See Appendix 8

Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
SFB A	Sand Filter Basin located north of parking structure 2	WQMP Map / Preliminary Drawings
SFB B	Sand Filter Basin located east of parking structure 2	WQMP Map / Preliminary Drawings
SFB C	Sand Filter Basin located east of parking structure 2	WQMP Map / Preliminary Drawings
SFB D	Sand Filter Basin located east of medical office building 4	WQMP Map / Preliminary Drawings
Underground Storage Vault E	Underground storage vault south of parking structure 1	WQMP Map / Preliminary Drawings
Underground Pipe Storage F	Underground pipe storage system under parking structure 1 footprint	WQMP Map / Preliminary Drawings

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

Maintenance Mechanism: Maintained by property owner

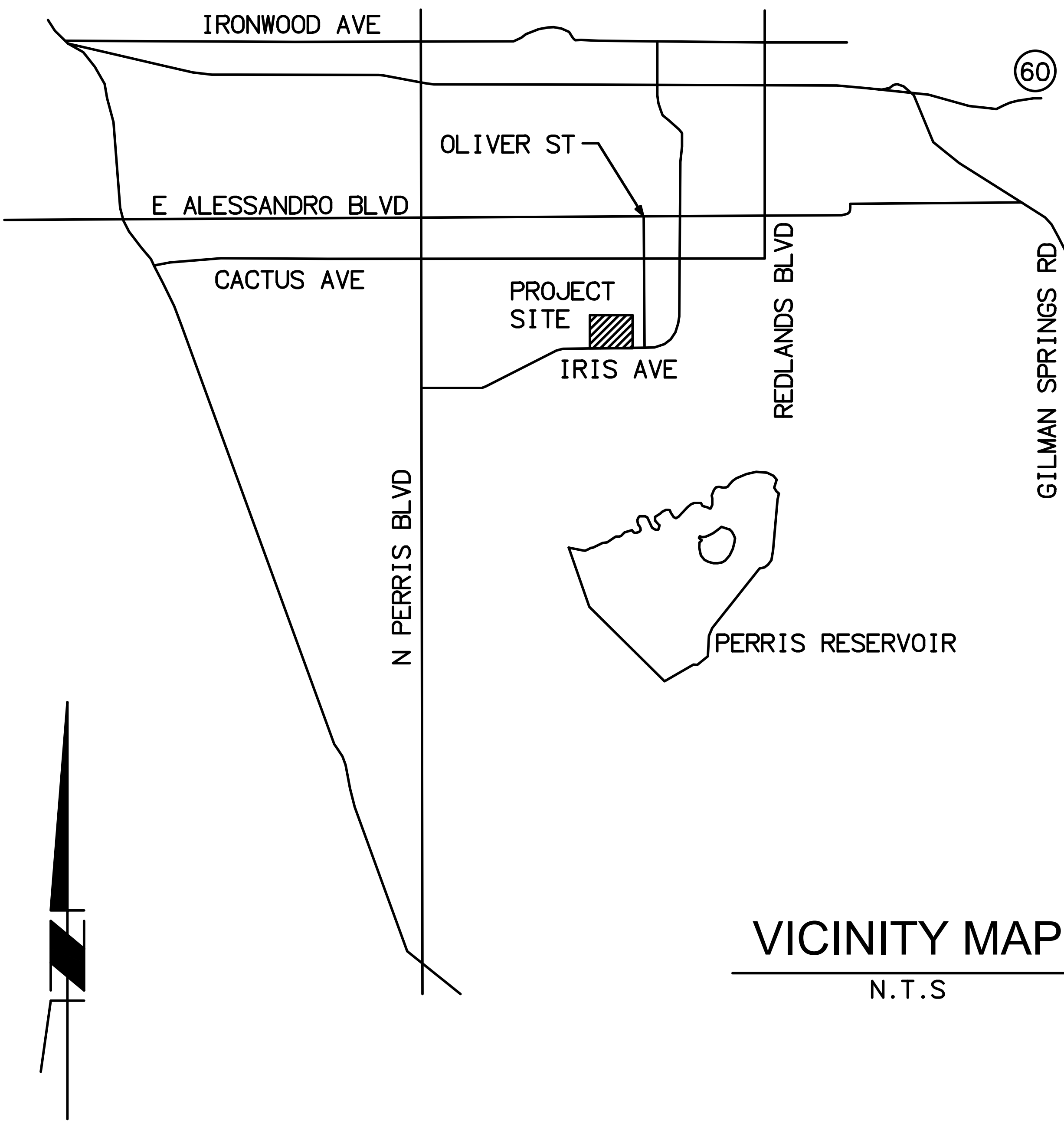
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☐ Y ☒ N

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



VICINITY MAP

N.T.S

FIGURE 1

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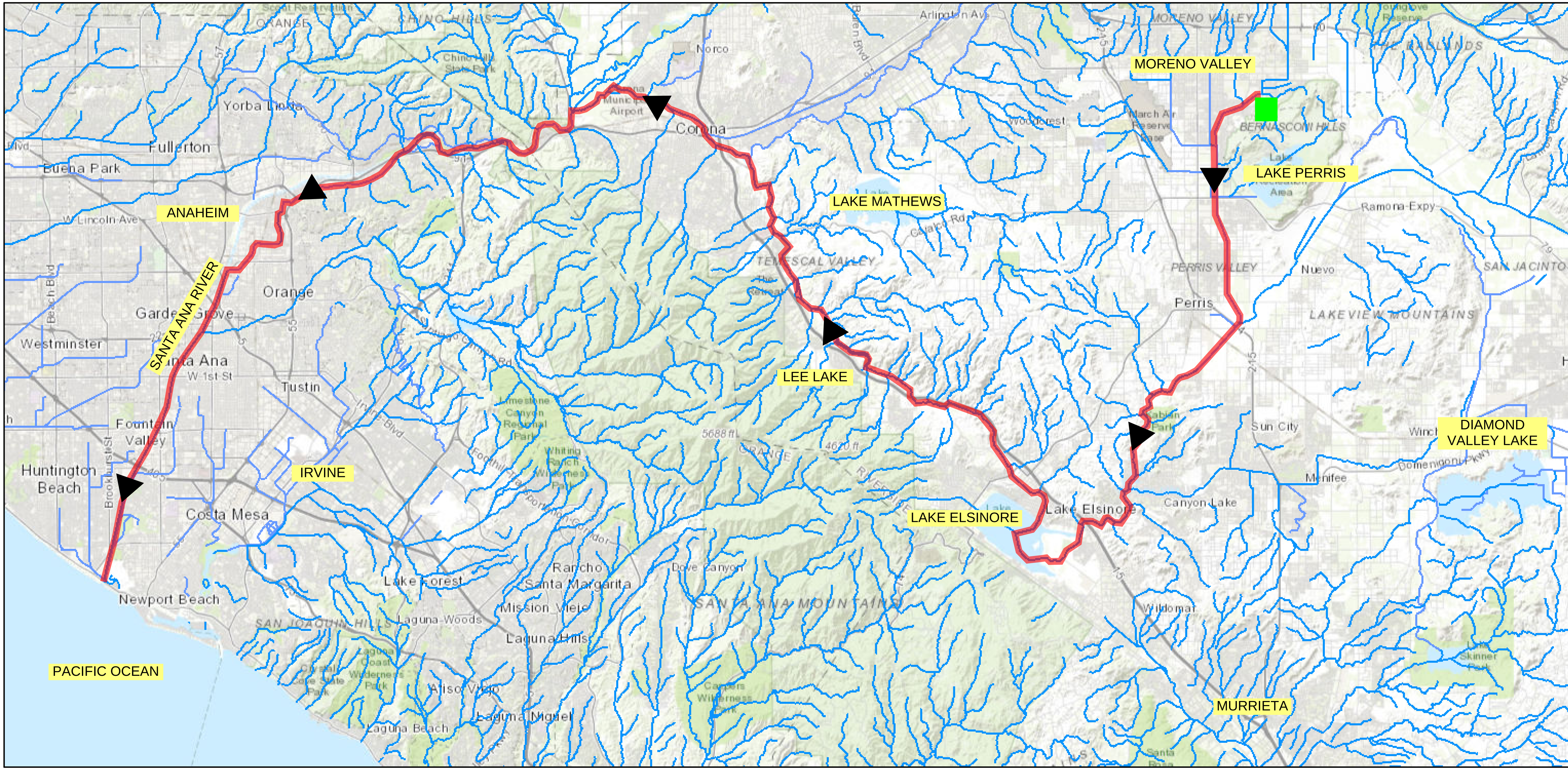
KAISER PERMANENTE MORENO VALLEY AREAMASTER PLAN AND MEDICAL OFFICE BUILDING

VICINITY MAP

KAISER PERMANENTE MORENO VALLEY
RECEIVING WATERS MAP



CANALS/STREAMS

FLOW DIRECTION

PROJECT SITE LOCATION

1:288,895

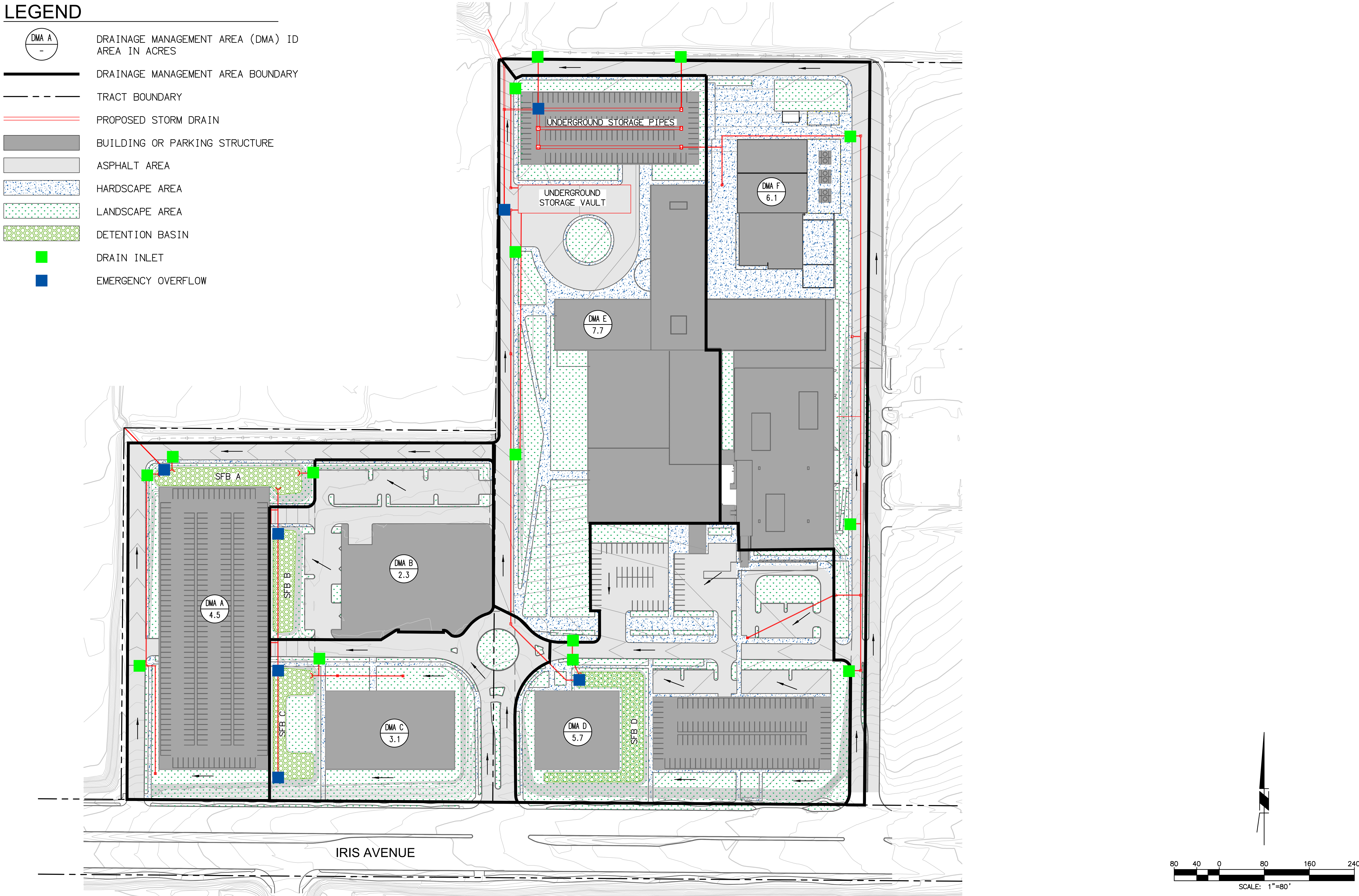
0 2.75 5.5 11 mi

0 4.5 9 18 km

US EPA, Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the

US Environment Protection Agency

US EPA | County of Riverside, Bureau of Land Management, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS |



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WQMP EXHIBIT
MASTER SITE PLAN

KAISER MEDICAL MORENO VALLEY

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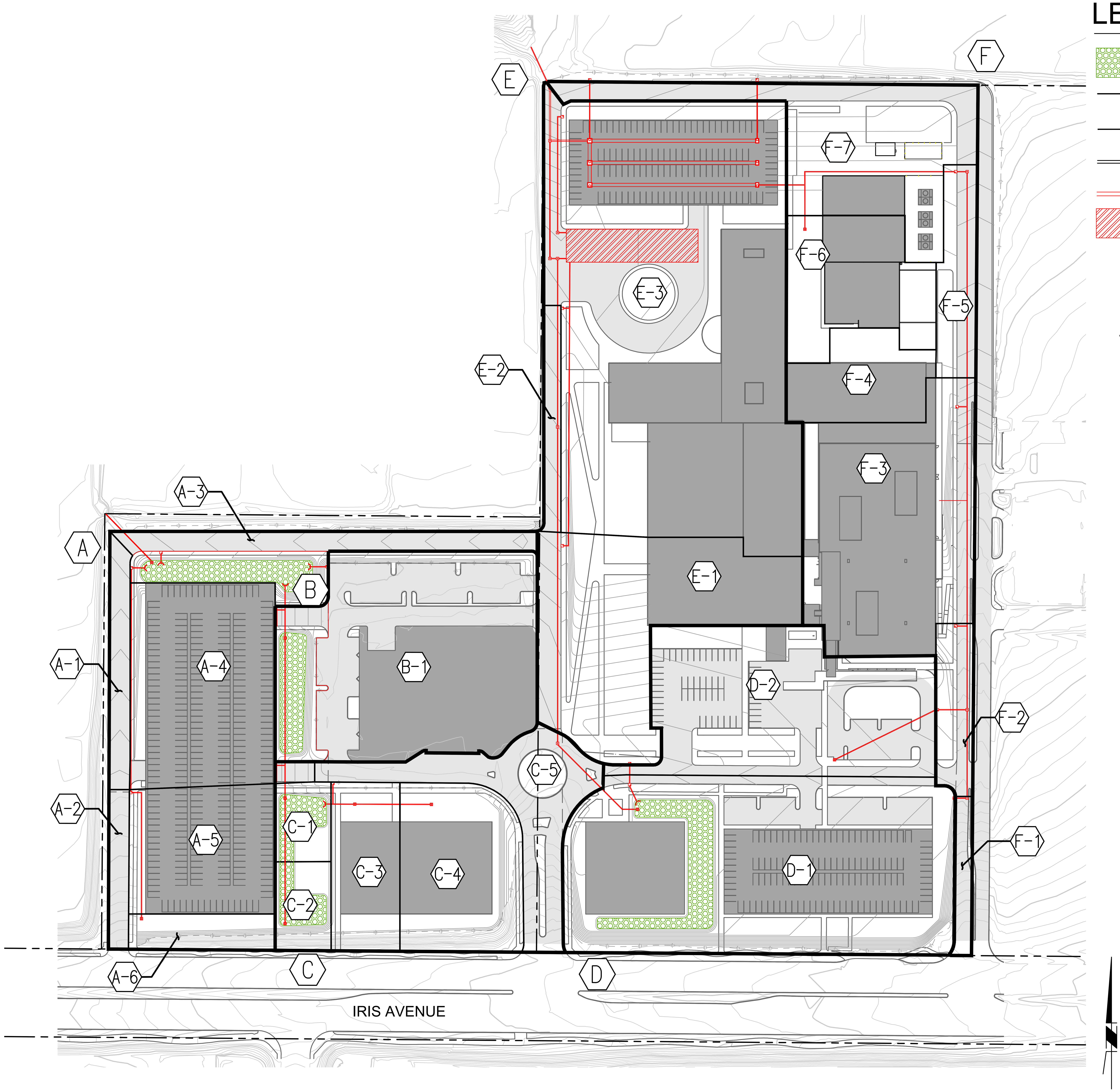

LEGEND

- BIORETENTION BASIN
- EXISTING RIGHT-OF-WAY
- DMA SUB-AREA BOUNDARY
- PROPOSED STORM DRAIN
- STORAGE PIPES
- UNDERGROUND STORAGE VAULT
- A — DMA NUMBER
- A-1 — DMA SUB-AREA NUMBER

DRAINAGE MANAGEMENT AREA - A		
DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
A-1	11,670.75	0
A-2	7,381.86	0
A-3	19,103.80	0
A-4	63,246.65	4,791.16
A-5	39,320.37	3,526.01
A-6	400.88	11,656.02
A-7	7,461.53	27,736.55
TOTAL	148,585.84	47,709.74

DRAINAGE MANAGEMENT AREA - B		
DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
B-1	93,772.34	6910.46

DRAINAGE MANAGEMENT AREA - C		
DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
C-1	693.50	9494.15
C-2	0.00	11425.41
C-3	17,527.16	9185.08
C-4	22,419.58	23,809.76
C-5	33,094.58	6,421.48
TOTAL	73,734.58	60,335.88

DRAINAGE MANAGEMENT AREA - D		
DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
D-1	95,611.77	61,887.43
D-2	75,163.77	11,425.41
TOTAL	170,775.51	60,335.88

DRAINAGE MANAGEMENT AREA - E		
DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
E-1	53,279.49	32,593.43
E-2	9,007.09	0.00
E-3	194,095.47	47,273.93
TOTAL	256,382.05	79,867.22

DRAINAGE MANAGEMENT AREA - F		
DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
F-1	6,003.13	32,593.43
F-2	8,436.36	0.00
F-3	80,275.68	47,273.93
F-4	26,189.21	79,867.22
F-5	14,574.19	3,606.02
F-6	40,763.89	0.00
F-7	59,873.62	7,819.92
TOTAL	236.116.08	30,761.27

80 40 0 80 160 240

SCALE: 1"=80'

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WQMP EXHIBIT
MASTER SITE PLAN

KAISER MEDICAL MORENO VALLEY

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Setbacks

The bottom of the sand filter should remain above the seasonal high groundwater level. Always consult your geotechnical engineer for additional site specific recommendations.

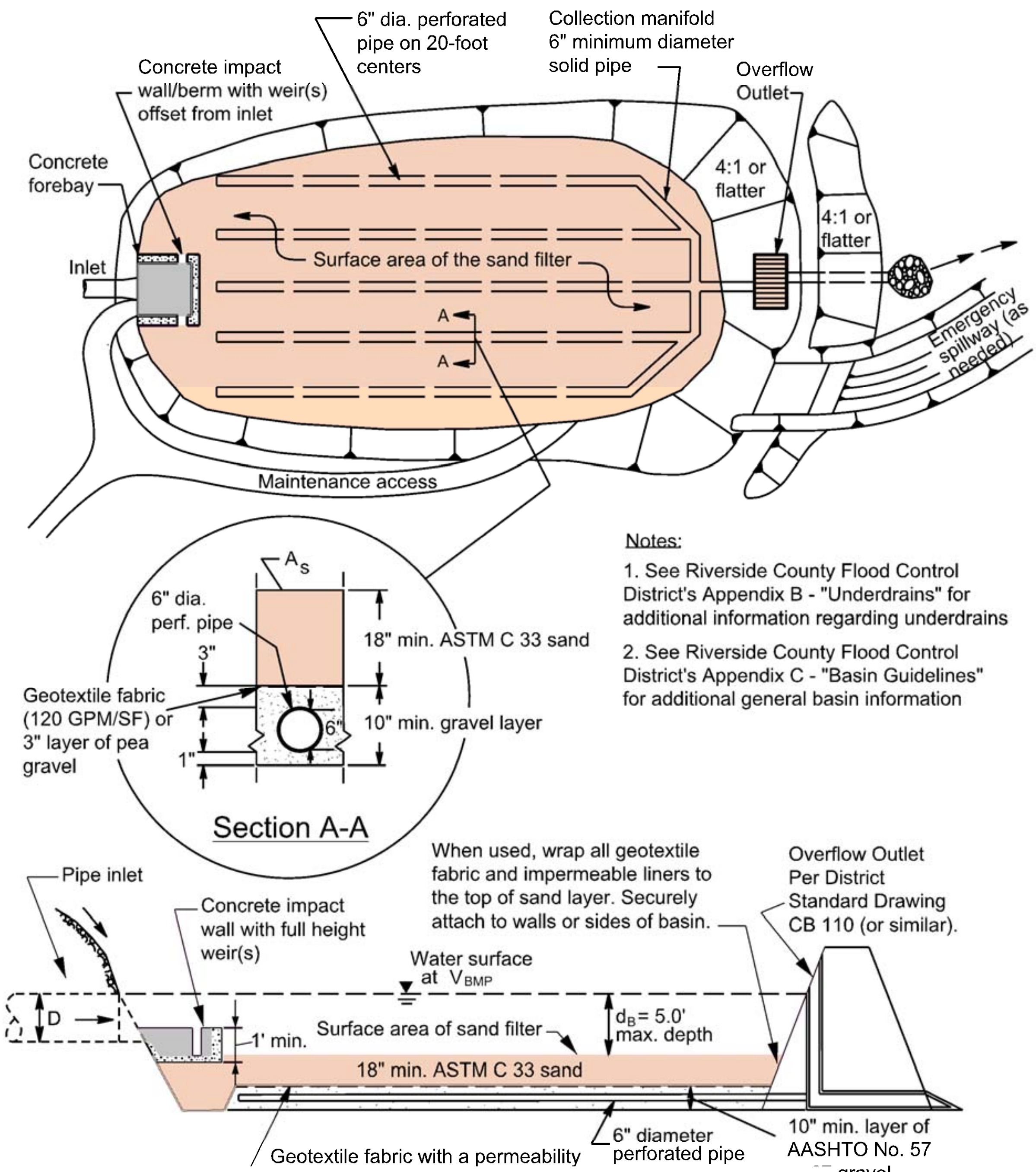
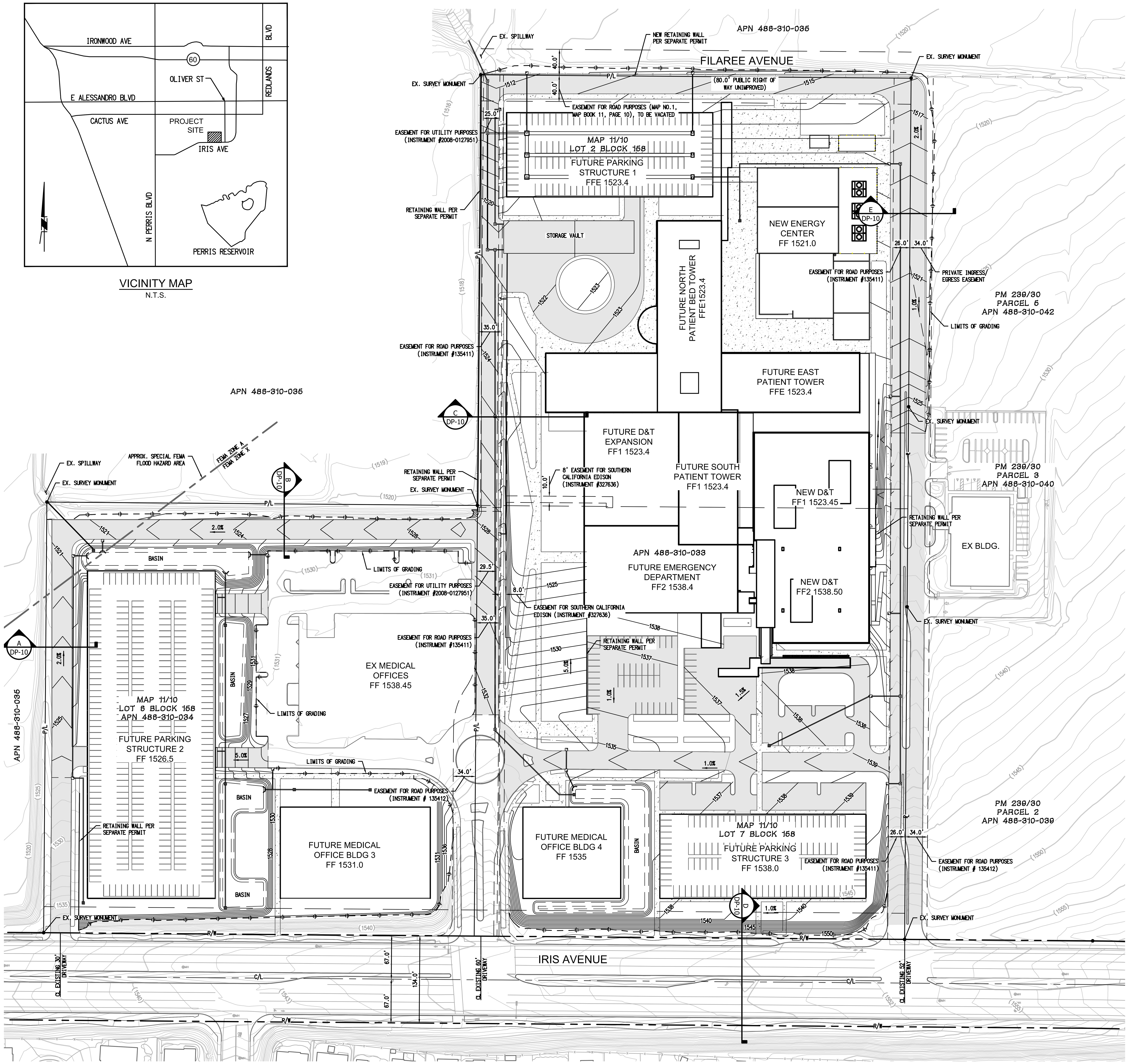


Figure 1 – Plan and Profile Views of SFB Basin

Appendix 2: Construction Plans

Grading and Drainage Plans



LEGEND

- RIGHT-OF-WAY
- PROPERTY LINE
- EASEMENT
- MAJOR CONTOUR — 420
- MINOR CONTOUR — 420
- CURB
- CURB AND GUTTER
- RETAINING WALL
- AC PAVING
- CONCRETE PAVEMENT
- DIRECTION OF FLOW
- WING HEADWALL
- PRECAST CATCH BASIN
- CURB INLET
- STORM DRAIN/SEWER TYPE CLEANOUT
- STORM DRAIN LINE
- WING HEADWALL

OWNER/DEVELOPER

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393 E. WALNUT STREET, 4TH FLOOR
CONTACT PERSON: SKYLER DENNISTON
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PHONE NO. (323) 525-0500

CIVIL ENGINEER

MICHAEL BAKER INTERNATIONAL
9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CA 92124
PHONE NO. (858) 614-5000

EXISTING UTILITY NOTE

EXISTING UTILITIES HAVE BEEN SHOWN BASED ON THE BEST AVAILABLE INFORMATION. CONTRACTOR SHALL LOCATE AND MARK OUT ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. CONTRACTOR SHALL CONTACT THE ENGINEER IF ANY UTILITIES ARE LOCATED THAT ARE NOT IDENTIFIED ON THESE PLANS.

STORM WATER NOTE

A STORMWATER POLLUTION PREVENTION PLAN (SWPPP), WHICH INCLUDES BEST MANAGEMENT PRACTICES TO REDUCE POLLUTANTS REACHING DOWNSTREAM WATER BODIES, WILL BE PREPARED PRIOR TO ISSUANCE OF GRADING PERMIT AND A NOTICE OF INTENT SUBMITTED TO THE STATE REGIONAL WATER QUALITY CONTROL BOARD.

LEGAL DESCRIPTION

APN 486-310-033
LOT/PARCEL: LOTS 2 AND 7 OF PARCEL 1

APN 486-310-034
LOT/PARCEL: LOT 6 OF PARCEL 1

PARCEL 1: LOTS 2,6 AND 7 IN BLOCK 158 OF MAP NO.1 BEAR VALLEY AND ALESSANDRO DEVELOPMENT COMPANY AS PER MAP RECORDED IN BOOK 11, PAGE 10 OF MAPS, RECORDS OF THE COUNTY OF SAN BERNARDINO, IN THE CITY OF MORENO VALLEY, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA.

ABOVE LEGAL DESCRIPTION IS PURSUANT TO LOT LINE ADJUSTMENT NO. 1015/AND CERTIFICATE OF COMPLIANCE RECORDED JANUARY 19, 2012, AS INSTRUMENT NO. 2012-0023631 OF OFFICIAL RECORDS OF SAID COUNTY RECORDS.

SITE ADDRESS

27300 IRIS AVENUE
MORENO VALLEY, CA 92555

LAND USE

EXISTING: COMMERCIAL AND OFFICE
PROPOSED: COMMERCIAL AND OFFICE

FEMA ZONE

FEMA ZONE X AND A. MAJORITY ZONE X

DISTURBED AREA

GROSS DISTURBED AREA: 28.23 ACRES

TOPOGRAPHY SOURCE

AEROTECH MAPPING, INC.
29970 TECHNOLOGY DRIVE, SUITE 220-C
MURRIETA, CA 92563
PHONE NO. (619) 606-5020
TOPO SOURCE: AERIAL TOPO
TOPO SOURCE DATE: JULY 21, 2017

UTILITY COMPANIES

BOX SPRINGS MUTUAL WATER COMPANY	(951) 653-6419
CHARTER SPECTRUM	(877) 906-9121
EASTERN MUNICIPAL WATER DISTRICT	(951) 928-3777
EDGEMONT COMMUNITY SERVICE DISTRICT	(951) 784-2632
FRONTIER COMMUNICATION	(800) 921-8101
SOUTHERN CALIFORNIA EDISON COMPANY	(800) 655-4555
SOUTHERN CALIFORNIA GAS COMPANY	(800) 427-2200
SUNESYS	(951) 278-0400
RIVERSIDE TRANSIT AGENCY	(951) 565-5164
UNDERGROUND SERVICE ALERT	(800) 227-2600
MORENO VALLEY UTILITY ADMINISTRATION	(951) 413-3500
SPECIAL DISTRICTS ADMINISTRATION	(951) 413-3480
VERIZON WIRELESS	(800) 922-0204

80 40 0 80 160 240
SCALE: 1"=80'

CO ARCHITECTS

5055 Wilshire Boulevard, 9th Floor
Los Angeles, California 90036
323.525.0500 phone, 323.525.0955 fax

PROFESSIONAL STAMP

Stamp & Signature

Stamp & Signature

AGENCY STAMP

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

REVISIONS

KAISER PERMANENTE
MORENO VALLEY MEDICAL CENTER
DIAGNOSTIC & TREATMENT ADDITION
27300 IRIS AVENUE MORENO VALLEY, CA 92555
KAISER Proj: K0130 OSHPD FACILITY: 106334048
OSHPD PROJECT #

KEY PLAN

N

MASTER SITE PLAN - PRELIMINARY GRADING AND DRAINAGE PLAN

SCALE: AS INDICATED
DATE OF ISSUE: 25 JANUARY 2019

CONDITIONAL USE PERMIT AND
PLANNED DEVELOPMENT PERMIT
CO - PROJECT NO.: 17009.000

DP-08

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

GEOBASE, INC.
SOIL/ROCK MECHANICS AND FOUNDATION ENGINEERING

KAISER FOUNDATION HEALTH PLAN, INC.
Moreno Valley Community Hospital
– CONSTRUCTION TRAILER --
27300 Iris Avenue
Moreno Valley, California 92555

May 24, 2011

Project Number: C.314.38.01

Attention: Mr. Scott L. Drane, Senior Project Manager
National Facilities Services - Capital Projects
Riverside and Moreno Valley Medical Centers

Dear Mr. Drane

Subject: **SUPPLEMENTAL GEOTECHNICAL REPORT**
Moreno Valley Iris MOB II
27300 Iris Avenue
Moreno Valley, California

References: See page 4 of 4.

In May 2010, GEOBASE, INC. (GEOBASE) completed a geotechnical investigation for the proposed Moreno Valley Iris MOB II. The results of this investigation were presented in a report titled "Geotechnical Investigation, Kaiser Permanente, Iris MOB 2 - Phase I, 27300 Iris Avenue, Moreno Valley, California", prepared for Kaiser Permanente, Moreno Valley, California, by GEOBASE, INC., dated May 2010, project number C.314.38.00 (GEOBASE, May 2010). The aforementioned report was based on CBC 2007 which was applicable at the time.

The objectives of this supplemental geotechnical report are to: update the above noted May 2010 geotechnical investigation to meet the requirements of CBC 2010; and, provide the percolation rate of the subsoils at the existing infiltration basin.

GEOBASE was retained by Kaiser Foundation Hospitals to complete this supplemental geotechnical report.

The recommendations presented in this report are supplemental and all other recommendations provided in the geotechnical investigation report (GEOBASE, May 2010) should be adhered to.

23362 Peralta Drive, Unit 4 • Laguna Hills, CA 92653-1711 • (949) 588-3744 · FAX (949) 588-3749
E-mail: geobase@geobase.com Website: http://www.geobase.com

C.H.J. Incorporated
1355 E. Cooley Drive, Colton, CA 92324 ♦ Phone (909) 824-7210 ♦ Fax (909) 824-7209
15345 Anacapa Road, Suite D, Victorville, CA 92392 ♦ Phone (760) 243-0506 ♦ Fax (760) 243-1225
77-564A Country Club Drive, Suite 122, Palm Desert, CA 92211 ♦ Phone (760) 772-8234 ♦ Fax (909) 824-7209

April 29, 2011

GEOBASE, Inc.
23362 Peralta Drive, Unit 4
Laguna Hills, California 92653
Attention: Mr. John Chevallier

Job No. 11237-2

Subject: Double-Ring Infiltrometer Testing
Kaiser Moreno Valley Iris MOB
27300 Iris Avenue
Moreno Valley, California

Dear Mr. Chevallier:

Thank you for the opportunity to perform infiltrometer testing for the Kaiser Moreno Valley Iris MOB located at 27300 Iris Avenue, in Moreno Valley, California. We have completed two double-ring infiltrometer tests as requested. At the time of our investigation the site was relatively level and appeared to include previously graded pads. A moderate growth of short grasses and weeds was present at the test locations. An Index Map (Enclosure "A-1") is included that depicts the site location.

Testing of the native soils was performed utilizing the double-ring infiltrometer method described in ASTM D 3385. Infiltration tests were conducted at the existing ground surface after removal of shallow rooted weeds with limited disturbance of the upper soils. The test locations are indicated on the attached Site Plan, (Enclosure "A-2"). Representative bulk samples of the soils at the test locations were returned to our laboratory for grain size analysis. The results are presented in Enclosure "B-1".

Following preparation of the test locations, two infiltrometer rings were driven into the ground, one inside of the other. The cylinders were partially filled with water. The water level in each ring was maintained at a constant elevation using a float valve and water source for each ring. The elapsed time and volume of water added to the rings were recorded. The graduated cylinder corresponding to the inner ring is readable to increments of 25 ml.

The data collected was used to calculate the infiltration rate of the soil. The infiltration tests were performed until a steady-state infiltration velocity was reached. The steady-state infiltration velocity is presented as the infiltration rate.

The measured infiltration rate and field moisture content (prior to infiltration of water) for each test location are presented in the following table.

Test Location	**Infiltration Rate**		**Field Moisture**	**Soil Type**
	(cm. / hr.)	**(in. / hr.)**	**(%)**	
P-1 (west)	0.13	0.05	6.5	(ML) Sandy Silt
P-2 (east)	0.13	0.05	4.5	(ML) Sandy Silt

Based on grain size analysis of bulk soil samples obtained from the test locations, the soils in the test area consist of Sandy Silt (ML) and were relatively consistent between the two locations. Based on our experience, the infiltration rates measured for the test locations appear to be consistent with the soil type.

It should be noted that infiltration rates determined by testing are ultimate rates based on short-duration field test results utilizing clear water. Infiltration rates can be affected by silt build-up, debris, degree of soil saturation, and other factors. An appropriate safety factor should be applied prior to use in design to account for subsoil inconsistencies, possible compaction related to site grading, and potential silting of the percolating soils. The safety factor should also be determined with consideration to other factors in the storm water detention system design, particularly storm water volume estimates and the safety factors associated with those design components.

C.H.J., Incorporated has striven to perform our services within the limits prescribed by our client, and in a manner consistent with the usual thoroughness and competence of reputable geotechnical engineers and engineering geologists practicing under similar circumstances. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents, or otherwise supplied.

This report reflects the testing conducted on the site as the site existed during the investigation, which is the subject of this report. However, changes in the conditions of a property can occur with the passage of time, due to natural processes or the works of man on this or adjacent properties. Changes in applicable or appropriate standards may also occur whether as a result of legislation, application, or the broadening of knowledge. Therefore, this report is indicative of only those conditions tested at the time of the subject investigation, and the findings of this report may be invalidated fully or partially by changes outside of the control of C.H.J., Incorporated. This report is therefore subject to review and should not be relied upon after a period of one year.

The conclusions and recommendations in this report are based upon observations performed and data collected at separate locations, and interpolation between these locations, carried out for the project and the scope of services described. It is assumed and expected that the conditions between locations observed and/or sampled are similar to those encountered at the individual locations where observation and sampling was performed. However, conditions between these locations may vary significantly. Should conditions be encountered in the field, by the client or any firm performing services for the client or the client's assign, that appear different than those described herein, this firm should be contacted immediately in order that we might evaluate their effect.

If this report or portions thereof are provided to contractors or included in specifications, it should be understood by all parties that they are provided for information only and should be used as such.

The report and its contents resulting from this investigation are not intended or represented to be suitable for reuse on extensions or modifications of the project, or for use on any other project.

We appreciate this opportunity to be of service and trust this report provides the information desired at this time. Should questions arise, please do not hesitate to contact this office.

Respectfully submitted,

C.H.J., INCORPORATED

John S. McKeown

John S. McKeown, C.E.G. 2396
Project Geologist

REGISTERED GEOLOGIST
JOHN S. McKEOWN
No. 2396
CERTIFIED ENGINEERING GEOLOGIST
Exp. 06-30-11
STATE OF CALIFORNIA

05-04-11

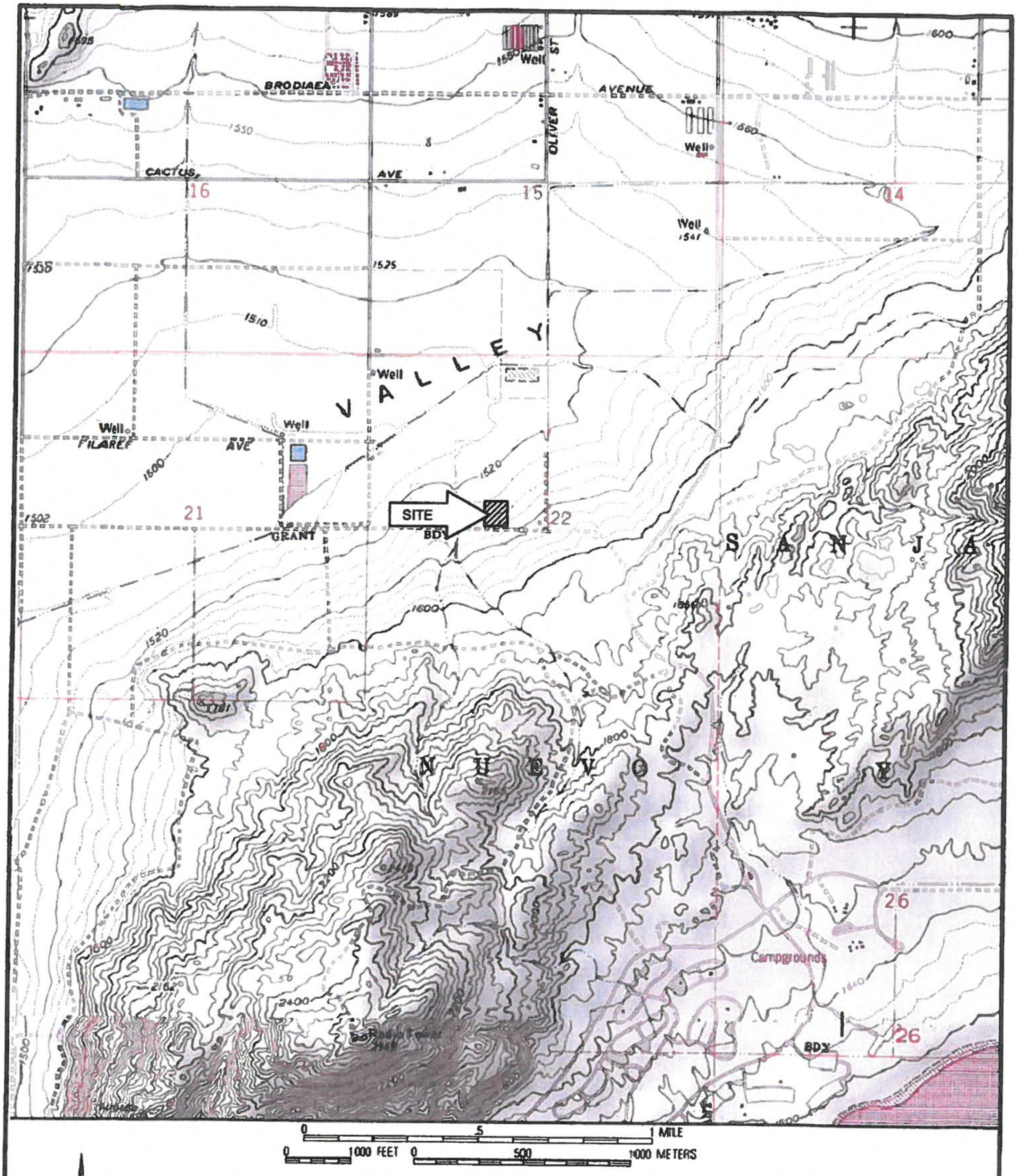
Allen D. Evans, G.E. 2060
Vice President

REGISTERED PROFESSIONAL ENGINEER
ALLEN D. EVANS
No. 2060
Exp. 03-31-13
GEOTECHNICAL
STATE OF CALIFORNIA

05-04-11

JSM/ADE:ndt

Enclosures: "A-1" - Index Map
"A-2" - Site Map
"B-1" - Grain Size Analysis

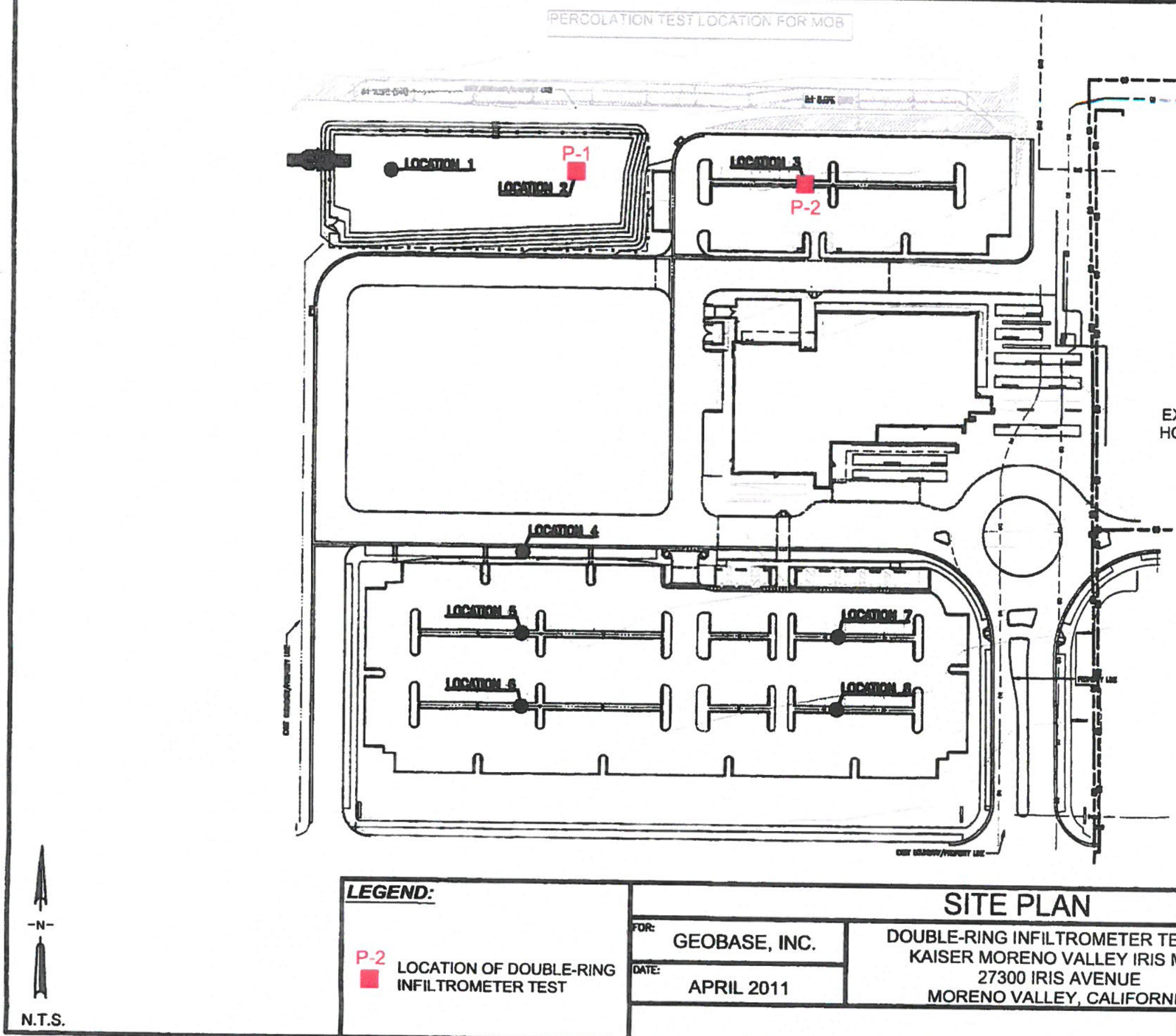


INDEX MAP

FOR: GEOBASE, INC.	DOUBLE-RING INFILTROMETER TESTING KAISER MORENO VALLEY IRIS MOB 27300 IRIS AVENUE MORENO VALLEY, CALIFORNIA	ENCLOSURE "A-1"
DATE: APRIL 2011		JOB NUMBER 11237-2

SCALE: 1" = 2,000'

C.H.J. Incorporated

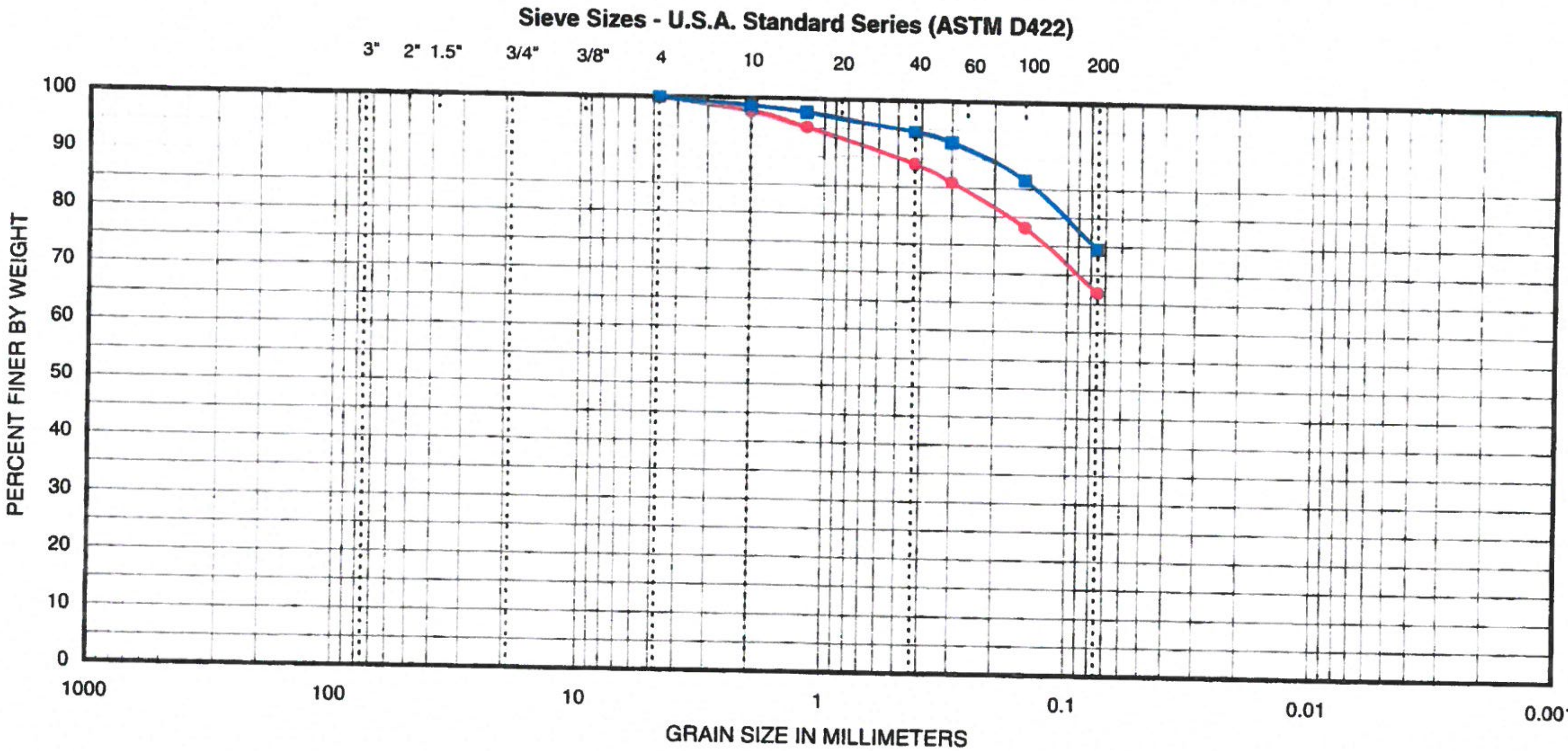


LEGEND:

P-2 ■ LOCATION OF DOUBLE-RING INFILTROMETER TEST

SITE PLAN			
FOR: GEOBASE, INC.	DOUBLE-RING INFILTROMETER TESTING KAISER MORENO VALLEY IRIS MOB 27300 IRIS AVENUE MORENO VALLEY, CALIFORNIA	ENCLOSURE "A-2"	
DATE: APRIL 2011		JOB NUMBER 11237-2	

C.H.J. Incorporated



Cobbles & Boulders	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		

Symbol	Sample No.	Depth (ft)	Classification	D_{10} (mm)	D_{30} (mm)	D_{50} (mm)	D_{60} (mm)	C_u	C_c	SE
●	P-1	0	(ML) Sandy Silt, with fine and medium sand (6.5 % moisture)							
■	P-2	0	(ML) Sandy Silt, with fine and medium sand (4.5 % moisture)							

C.H.J. Incorporated

GRAIN SIZE DISTRIBUTION

Project:	Kaiser Moreno Valley Medical Office Building		
Location:	27300 Iris Avenue, Moreno Valley, CA		
Job Number:	11237-2	Enclosure:	B-1

GEOTECHNICAL REPORT

KAISER PERMANENTE

MORENO VALLEY MEDICAL CENTER
CENTRAL UTILITY PLANT (CUP)
27300 IRIS AVENUE
MORENO VALLEY, CALIFORNIA

Prepared for:

Kaiser Foundation Health Plan, Inc.
Moreno Valley, California

By:
GEOBASE, INC.
23362 Peralta Drive, Unit 4
Laguna Hills, California 92653
(949) 588-3744

August 2017
Project No. C.314.82.00

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LIST OF APPENDICES

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APPENDIX C

APPENDIX C continued...

APPENDIX C continued...

APPENDIX D

I. INTRODUCTION

1.1 General

Kaiser Foundation Health Plan, Inc. is planning the construction of a new Central Utility Plant (CUP) on the Moreno Valley Medical Center (MVMC) campus, located at 27300 Iris Avenue, in the City of Moreno Valley, California. The MVMC campus location is shown on Figure A-1, Appendix A and the proposed new CUP location is shown on Figure A-2, Appendix A. GEOBASE, INC. (GEOBASE) was retained by Kaiser Foundation Health Plan, Inc. to complete a geotechnical investigation for the proposed new CUP.

For this geotechnical investigation we were provided with:

- A site plan, prepared by CO Architects, showing the existing Hospital and existing CUP, and proposed new CUP. This plan is reproduced herein as Figure A-2, Appendix A, Site, Boring and CPT Locations Plan.
- Topographic Survey Plan prepared by SB&O Inc. dated October 27, 2009 showing the layout of the existing buildings and site features. The location of the proposed New CUP, borings, CPT's and geophysical survey lines have been added to this plan which is presented herein as Figure A-3, Appendix A, Site Topographic Survey Plan.
- Geotechnical reports pertinent to the site (see references).

This geotechnical report incorporates results of the field and laboratory testing, and the geologic-seismic study, as required by the guidelines prepared by the Department of Conservation, California Geological Survey (CGS) and the California Office of Statewide Health and Planning Department (OSHPD). Both general and specific recommendations pertinent to suitable site development and foundation design, respectively, are provided. Construction guidelines related to the geotechnical aspects of the project are also addressed.

1.2 Objectives of the Geotechnical Investigation

The objectives of the geotechnical investigation are to obtain soil parameters and an understanding of site geologic conditions in order to provide recommendations pertinent to suitable site development and foundation design. These recommendations will assist with final design and construction of the project as planned.

1.3 Scope of Services

To achieve the objectives of the geotechnical investigation, stated above, the services provided during the course of this investigation included:

- a review of available published and unpublished geotechnical, geological and seismological reports, and maps pertinent to the site.
- Field exploration program consisting of advancing eleven (11) borings, fourteen (14) Cone Penetration Tests (CPT) and one (1) test pit;
- Logging the borings and test pit, and selection of samples representative of the materials encountered for laboratory testing;
- Field testing consisting of the Standard Penetration Test (SPT) and CPT, including shear wave velocity measurements;
- Field testing consisting of two (2) geophysical survey lines, utilizing multi–channel array surface wave (MASW) methods.
- Selection of appropriate laboratory tests and laboratory testing;
- Evaluation of data obtained from the above, and engineering analyses; and,
- Preparation of this report describing the field investigation, summarizing the results of field testing, laboratory testing and engineering analyses, and providing appropriate recommendations for site development and foundation design.

II. PREVIOUS RELEVANT REPORT

GEOBASE has completed a geotechnical investigation of the existing hospital addition and existing CUP for Kaiser Foundation Health Plan, Inc. The results of this investigation were presented in a report titled "Geotechnical Investigation, Kaiser Permanente MVCH, Hospital Addition and CUP, 27300 Iris Avenue, Moreno Valley, California" (GEOBASE, 2010). This report was approved by the regulating agencies and the Emergency Room Expansion was built. Relevant field boring logs, CPT's and laboratory test results of the aforementioned geotechnical investigation have been evaluated and are incorporated in this investigation as supplemental data.

The locations of the pertinent borings and CPT's are shown on Figures A-2 and A-3, Appendix A. Relevant laboratory test data are presented in Appendices B and C.

III. SITE AND PROJECT DESCRIPTIONS

3.1 Site Description

The Kaiser Permanente - Moreno Valley Medical Center (MVMC) site is located on an approximately twenty (20) acre site at 27300 Iris Avenue, in the City of Moreno Valley, California. The MVMC site is bounded by medical office buildings to the east and west, Iris Avenue to the south, and an empty/vacant lot to the north. The site is gently sloping to the north and is occupied by the Hospital, the CUP, a medical office building (MOB), and at-grade parking and driveways.

3.2 Project Description

The proposed new CUP is located at the northeast corner of the MVMC site, as shown on the Site, Boring and CPT Locations Plan, Figure A-2, Appendix A.

The new CUP project area consists of vacant land and slopes gently to the northwest, approximately two (2) percent. Proposed construction is anticipated to consist of a three (3) storey at-grade structure. Column loads were not available at the time of writing this report.

IV. SITE INVESTIGATION

4.1 Field Program

The field investigation for the proposed MVMC site was carried out on June 07, 08, 09 and 22, 2017 by advancing eleven (11) borings using a truck-mounted CME-75 drill rig fitted with hollow-stem augers, fourteen (14) CPT's and one (1) test pit. The borings, CPT's and test pit were located in the field by utilizing a Trumeter 550SE (roll-a-tape) and elevations were estimated from Site, Boring, CPT Locations Plan and Site Topographic Survey Plan (Figures A-2 and A-3, respectively, Appendix A). Therefore, the locations and elevations should be considered accurate only to the degree implied by the methods used.

Geophysical survey lines, utilizing multi-channel array surface wave (MASW) methods, were conducted by GeoVision Geophysical Services, Inc. on July 10, 2017.

Three (3) borings (B-9 thru B-11, inclusive) and four (4) CPT's (CPT-6 and CPT-12 thru CPT-14, inclusive) advanced during this investigation are considered relevant to the proposed new CUP. All borings and CPT's at the MVMC site were advanced to maximum penetration depths of seventy-one and one-half (71.5) feet and seventy-five (75) feet, respectively, except for CPT-2 and CPT-5 locations where refusal was obtained at shallow depths. In this respect, the test pit was excavated at CPT-5 location and advanced to eighteen (18) feet depth, beyond the depth at which refusal was obtained, to confirm that refusal was due to a hard soil layer. Two (2) seismic CPT's (SCPT-4 and SCPT-12) were advanced to a depth of 100 feet to determine shear wave velocities of the subsoils. All borings were hand-augered in the upper five (5) feet.

The Log of Borings, together with the Explanation of Terms and Symbols used are shown on Figures B-1 thru B-12, inclusive, CPT plots are presented on Figures B-13 thru B-26, inclusive, and the Log of Test Pit on Figure B-27, Appendix B. Relevant borings and CPT's from a previous investigation (GEOBASE, 2010) are presented herein as Figures B-28 thru B-31, inclusive, Appendix B.

Field testing consisted of: Standard Penetration Test (SPT); Cone Penetration Tests (CPT's), including Seismic Cone Penetration Testing at two (2) CPT locations (SCPT-4 and SCPT-12) to determine the shear wave velocities of the subsoils; and, geophysical survey lines to determine shear wave velocities of the subsoils.

- The SPT test (ASTM D 1586) involves failure of the soil around the tip of a split spoon sampler for a condition of constant energy transmittal. The split spoon, two (2) inches outside diameter and one and three-eights (1-3/8) inches inside diameter, is driven eighteen (18) inches and the number of blows required to drive the sampler the last foot is recorded as the "N" value, or SPT blow count. The driving energy is provided by a 140-pound weight dropping thirty (30) inches.

- The Cone Penetration Tests (CPT's) were performed in accordance with ASTM D 3441. The CPT equipment consists of a cone assembly mounted at the end of a series of hollow sounding rods. A set of hydraulic rams is used to push the cone and rods into the soil, and a continuous record of cone tip resistance, friction resistance and pore water pressures versus depth is obtained in digital form at the ground surface. A specially designed truck is used to transport and house the test equipment and to provide a ten (10) ton reaction to the thrust of the hydraulic rams. Near-continuous CPT records provide: approximate correlations with soil classification; relatively accurate definition of the thickness of various soil layers; subsoils data for liquefaction and seismic settlement analyses; and, engineering properties of the subsoils for static settlement analyses.

- Shear wave velocity measurements were carried out at five (5) foot intervals at two (2) CPT locations, SCPT-4 and SCPT-12.

- Two (2) geophysical survey lines utilizing multi-channel array surface wave (MASW) methods were completed to obtain the shear wave velocity profile of the subsoils. A discussion of field procedures, geophysical techniques, data processing and interpretation, and the results of the geophysical survey are given in Appendix B.

Sampling consisted of:

- Collection of bulk samples at selected locations retrieved from the auger;

- Collection of samples retrieved from the Standard Penetration Test (SPT) split spoon sampler; and,

- Collection of soil samples at selected locations using a Modified California Sampler. The soil samples were retained in a series of brass rings, each having an inside diameter of 2.41 inches and a height of one (1) inch. These ring samples were placed in close- fitting, moisture-tight containers for shipment to the laboratory.

4.2 Laboratory Testing

The samples obtained during the field program were returned to the laboratory for visual examination and testing. The soils were classified in accordance with ASTM D 2487 and D 2488.

The laboratory testing program consisted of the following:

- Laboratory determination of water (moisture) content of soils, rock, and soil-aggregate mixtures (ASTM D 2216), and dry density (ASTM D 2937);

- Particle size analysis of soils (ASTM D 422);
- Standard test methods for amount of material in soils finer than the No. 200 Sieve (ASTM D1140); and,
- Atterberg Limits (ASTM D 4318);
- Direct shear test of soils (ASTM D 3080);
- Consolidation tests (ASTM D 2435);
- Maximum dry density and optimum moisture content (ASTM D 1557);
- Expansion potential of soils (ASTM D 4829);
- Resistance R-Value (CT 301); and,
- Water soluble sulfate content of soils (CT 417); pH and electrical resistivity (CT 643); and water soluble chlorides (CT 422).

The laboratory test results from this investigation and previous investigation (GEOBASE, 2010) are presented on the Log of Borings, Figures B-2 thru B-12, inclusive, and B-28 and B-29, Appendix B, where applicable and in Appendix C.

V. GEOLOGIC SETTING

5.1 Regional Geology

The MVMC site is located in the Northern portion of the Peninsular Ranges Physiographic Province of California on a structural unit known as the Perris Block (CGS, 2002). The Perris Block is bounded on the northeast by the San Jacinto Fault Zone, on the southwest by the Elsinore Fault Zone, and on the north by the Cucamonga Fault Zone. The southern boundary of the Perris Block is not as distinct, but is believed to coincide with a complex group of faults trending southeast from the Murrieta, California area (Kennedy, 1977 and Mann, 1955). The Peninsular Ranges are characterized by northwest trending elongated alluvial valleys and by elevated Mesozoic age intrusive rock masses of the California batholith, flanked by metavolcanic and metasedimentary rocks that form the mountainous portions of the province. Various thicknesses of alluvial sediments derived from the erosion of the elevated portions of the region fill the low-lying areas such as the Moreno Valley where the site is located. According to Morton and Matti (2001), the sediments that infill the Moreno Valley have been differentiated into Holocene and late Pleistocene age young alluvial fan and alluvial valley deposits and into very old alluvial fan deposits of early Pleistocene age. Maximum depths of valley fill in the area are reported to reach approximately 900 feet in the western and northern portions of the San Jacinto Groundwater Basin, where the site is located, but may exceed 5,000 feet in the eastern part of the same basin between the Casa Loma and Claremont faults (CDWR, 2006). Morton and Matti (2001) indicate that the young alluvial fan and valley deposits consist predominantly of sandy materials with silty, gravelly and cobbly interbeds. The very old alluvial fan deposits are reported to consist of mostly well-dissected, well-indurated sand deposits that typically flank the bedrock outcrops in the immediate vicinity. Very old alluvium underlies the subject site whereas Cretaceous age quartz diorite constitutes the hilly areas of the Perris State Recreational area to the south. The alluvial sequence at the site is inferred to rest unconformably on Cretaceous age crystalline bedrock. Figure A-4, Appendix A, presents the Regional Geology Map.

5.2 Site Geology

The MVMC is located near the foothills of the mountains that constitute the Perris State Recreational area to the south. The site is located at an approximate elevation of 1,530 feet above mean sea level (amsl) on a gently northwest sloping surface that grades down towards the Moreno Valley (Figures A-1 and A-4, Appendix A). Drainage at the site area is presently controlled by storm run-off sewers, street and/or natural drainages.

GEOBASE advanced four (4) exploratory soil borings and three (3) cone penetration tests (CPT's) at the site in 2010, and an additional eleven (11) borings, fourteen (14) CPT's and one (1) test pit in June 2017 (Figure A-2, Appendix A, Site, Boring and CPT Locations Plan). Soil borings were drilled to a maximum depth of seventy-one and one-half (71.5) feet, whereas the CPT's had a maximum depth that ranged up to 100 feet.

All the soil borings and CPT's advanced by GEOBASE to a maximum depth of seventy-one and one-half (71.5) and 100 feet below ground surface (bgs), respectively, confirm that the MVMC site is underlain by unconsolidated Quaternary alluvial fan deposits covered by a thin mantle of man-made fill (Figures B-2 thru B-31, inclusive, Appendix B). The man-made fill materials consist of approximately up to eight (8.0) feet of predominantly brown, silty sands (SM) at the boring locations. The unconsolidated alluvium consists predominantly of medium-grained brown silty sands with a five (5.0) to ten (10.0) foot thick orange to brown, silt (ML) interbed in the upper twenty-five (25) feet. This silt (ML) interbed was not encountered at soil boring location B-4. A five (5) foot thick silty layer was also encountered at fifty (50) to fifty-five (55) and fifty-five (55) to sixty (60) feet bgs at boring locations B-6 and B-3, respectively. The density of the alluvial materials at the site generally increases with depth. Unconsolidated alluvial materials were encountered to the total depth of penetration of all the soil borings that have been advanced at the site.

Our interpreted surface distribution of geologic materials encountered during the site investigations is illustrated in Figure A-2, Appendix A. Geologic Sections A-A' and B-B' across the new CUP site are given on Figures A-5 and A-6, Appendix A, respectively.

VI. SUBSURFACE CONDITIONS

6.1 Subsoil Conditions

At the boring and CPT locations within paved areas, the pavement section consisted of approximately four (4) to six (6) inches of asphaltic concrete overlying approximately four (4) to five (5) inches of aggregate base.

The generalized stratigraphic profile, at the boring locations relevant to the new CUP, consisted of up to five (5) feet of fill soils overlying native silty sands and sands with traces of gravel to the maximum depth of exploration, sixty-one and one-half (61.5) feet. The fill soils may be thicker at other locations. Unless a compaction report is made available, these fills are considered "undocumented fills".

The SPT test results and CPT data indicate that the native silts and silty sands can be generally inferred to be in a "stiff" to "hard" and "medium dense" to "very dense" state, respectively; however, very loose silts and silty sands were encountered at shallow depths.

The silty samples tested showed non-plastic behavior, and the soil natural moisture contents ranged from four (4) to thirteen (13) percent, with the higher values measured in the siltier samples. Expansion potential of the samples tested showed "very low" potential for expansion(Expansion Indices = 4 at the new CUP location; and, 0 to 12 at the MVMC site).

6.2 Regional Groundwater Conditions

The MVMC site is located in the western portion of the San Jacinto Groundwater Basin. The San Jacinto Groundwater Basin underlies San Jacinto, Perris, Moreno, and Menifee Valleys in western Riverside County. This basin is bounded by the San Jacinto Mountains on the east, the San Timoteo Badlands on the northeast, the Box Mountains on the north, the Santa Rosa Hills and Bell Mountain on the south, and unnamed hills on the west. The valleys are drained by the San Jacinto River and its tributaries.

According to the CDWR (2006), groundwater in the western portion of the San Jacinto Basin occurs under confined conditions. The primarily source of recharge for the confined aquifers is found where the San Jacinto River and the Baustita Creek enter the San Jacinto Valley CDWR (2006). Percolation of water stored in Lake Perris has been an additional source of recharge along with reclaimed water percolation by means of storage ponds administered by Eastern Municipal Water District.

6.3 Site Groundwater Conditions

During our exploratory investigations, groundwater was not encountered to the maximum depth of boring penetration, seventy-one and one-half (71.5) feet. The exploratory soil borings drilled by GEOBASE at the MVMC site did not encounter groundwater; that is in general agreement with the conditions reported by the CDWR (2017).

6.4 Historic High Groundwater Level

Historical groundwater level data was obtained online from the Water Data Library operated by the CDWR (2017). There are five (5) monitoring wells within a two (2) kilometer radius of the site. Monitoring well locations are shown on Figure A-4, Appendix A, and pertinent data is summarized in Table I.

TABLE I
HIGHEST GROUNDWATER LEVEL OBSERVED AT MONITORING WELLS

Point	Well No.	Period of Measurements	Date of Highest Recorded Groundwater (mm/dd/yr)	Highest Recorded Groundwater Below Existing Grade (ft.)	Ground Elevation* (ft.)	Groundwater Elevation Above Mean Sea Level (ft)
1	EMWD12077	10/04/2011 to 04/11/2017	04/11/2017	34.9	1507.4	1472.5
2	EMWD25696	11/07/2011 to 04/11/2017	04/11/2017	41.0	1506.2	1465.2
3	EMWD25695	11/07/2011 to 04/11/2017	04/11/2017	44.5	1507.4	1462.9
4	EMWD10141	11/03/2011 to 04/11/2017	04/07/2017	59.8	1545.8	1486.0
5	03S03W15F001S	05/29/1951 to 09/15/1986	04/01/1952	99.8	1539.0	1439.2

* Existing Ground Surface Elevation at the Well Location

Reference : California Department of Water Resources (CDWR); http://www.well.water.ca.gov/cgi-shl/gwater.

Groundwater level reading for water well number EMWD12077 are available for the time period of 2011 to 2017. Ground surface elevation for this well is reported to be 1,507.4 feet above mean sea level (amsl), whereas the approximate elevation for the new CUP site was estimated at approximately 1,525 feet amsl (an approximate difference in elevation of 18 feet). The shallowest ground water level condition of 1,472.5 feet amsl (depth of 34.9 below ground surface [bgs]) at this well occurred on April 11, 2017. Therefore, it can be concluded that the MVMC site is located on a confined aquifer that appears to have been recharged since 2014. No historical groundwater data is available prior to 2011. Well number 03S03W115F001S has historical data dating back to 1951. Unfortunately, the data ends in 1986.

Projecting the higher groundwater elevation noted above across the MVMC site, the highest groundwater elevation is obtained to be at approximately fifty-three (53) feet bgs based on current well data. For design purposes, historic highest groundwater level in excess of fifty (50) feet bgs shall be considered for the site.

VII. SEISMOLOGY

7.1 Regional Faulting

The two principal seismic considerations for most properties in Southern California are ground surface rupture along fault traces and damage to structures due to seismically induced ground shaking. The fault classification system adopted by the California Geological Survey (CGS), relative to the State legislation, delineates Earthquake Fault Zones along active or potentially active faults (Alquist-Priolo Act). Such Earthquake Fault Zones are in turn used to establish setbacks of structures from active fault zones. An active fault is defined by the CGS as a "sufficiently active and well defined fault" that has exhibited surface displacement within Holocene time (approximately the last 11,000 years). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago). Any fault proven not to have moved within the last 1.6 million years is considered inactive.

The closest known active faults to the site are the San Jacinto, San Andreas and Elsinore faults. A California Fault Map, showing the geographic relationship of these faults to the site is presented as Figures A-7 and A-8, Appendix A. A brief description of these faults is provided below.

7.1.1 *San Jacinto Fault – San Jacinto Valley Segment*

The San Jacinto Fault is one of the most active faults in California, having been an important source of moderate- to large-magnitude earthquakes during this century. What makes the San Jacinto Fault of extreme interest to scientists and state building engineers is that the fault is remarkably long and has a potential of hundreds of kilometers of rupture length, thus creating larger magnitude earthquakes and potentially affecting larger areas. This fault, over approximately 210 kilometers in total length, extends to the southern border of California and joins the San Andreas Fault west of the city of San Bernardino. The sense of movement is right-lateral strike-slip. According to the Southern California Earthquake Center (SCEC,1995), slip is regularly released on this fault in the form of small earthquakes (M_L 3 and 4). Historically, this fault has experienced numerous medium sized earthquakes (M_L of upper 4's and 5's) and several large earthquakes (larger than M_L 6). In the early 1900s large earthquakes in the Hemet and San Jacinto areas produced surface rupture. Using information on fault geometry, historical seismicity, and slip-rate data, Petersen et al (1996) divided this fault into eight segments. These segments, from north to south are: San Bernardino Valley, San Jacinto Valley, Anza, Coyote Creek, Borrego

Mountain, Superstition Hills, Superstition Mountains, and Imperial.

The closest active fault segment of the San Jacinto Fault to the MVMC site is the northwest-trending, right-lateral strike-slip San Jacinto Valley fault segment, located approximately 4.8 kilometers (km) to the northeast of the site. The San Jacinto Valley fault segment extends approximately 43.0 km from the northern end of the San Jacinto Valley to the junction of the Claremont and Casa Loma faults to the south.

The San Jacinto Valley segment may have been the source of the December 25, 1899 and April 21, 1918 earthquakes with magnitudes of 6.4 and 6.8 that occurred on the Casa Loma and Claremont faults, respectively (SCEC, 1995 and Treiman and Lundbergh, 1999). Petersen et al (1996) and SCEC (1995) assigned a slip-rate of 12+/- 6 millimeters/year (mm/yr), a M_W 6.9 and a recurrence interval of sixty-five (65) to ninety-eight (98) years. Similarly, the estimate of characteristics displacement was assigned at 1.0 +/- 0.2 meters (m).

7.1.2 *San Andreas Fault – San Bernardino Mountains Segment*

The San Andreas Fault extends for several hundred miles from the Gulf of California in the south to Cape Mendocino in northern California and it is the main element of the boundary between the Pacific and North American tectonic plates. The San Andreas Fault extends as a continuous trace from Cape Mendocino to San Bernardino, bends eastward, and continues southeast near Indio. The central and southern San Andreas Fault was divided by SCEC (1995) and Petersen et al (1996) into the following five (5) fault segments: Cholame, Carrizo, Mojave, San Bernardino Mountains, and Coachella Valley. It is important to emphasize that although these segments are treated as independent sources of earthquakes, historical and paleoseismological observations show that ruptures may overlap and that some segments may both produce their own earthquakes and fail when large ruptures nucleate in an adjacent segment and propagate into them. The fault segments are composed of numerous subparallel right-lateral, strike-slip faults that range from 0.5 to 11 km in length. The Fort Tejon earthquake of approximately Mw 8, one of the greatest earthquakes ever recorded in the United States, occurred along the San Andreas Fault in January 9, 1857 and produced a surface rupture of approximately 350 km in length from Cholame on the north to the Cajon Pass on the south.

The closest significant San Andreas Fault segment to the MVMC site is the northwest-trending, right-lateral strike-slip San Bernardino Mountains segment, located approximately 23.7 km to the northeast of the site. The San Bernardino Mountains segment is approximately 103 km long and extends from a few kilometers northwest of Cajon Creek southeast to the area between Thousand Palms and Myoma. The San Bernardino Mountains segment is characterized by a large left-restraining step between the Mojave segment to the northwest and the Coachella segment to the southeast. The San Andreas Fault Zone is very complex in this restraining step, consisting of dextral strike-slip, thrust, and oblique slip faults (Bryant and Lundbergh, 2002). According to the SCEC (1995), the past five ground surface rupture events at Wrightwood occurred approximately in 1812, 1693, 1587, 1452, and 1192 of the current era. In addition, displacements of 4 m during the 1812 event, and a cumulative offset of 7 to 8 m of right slip for the 1812 and 1693 earthquakes, have been measured in the Cajon Pass area. Therefore, based on paleoseismic studies, the San Bernardino Mountains segment is believed to have last ruptured in 1812. The Wrightwood site has averaged one surface-rupturing earthquake every 124 years since 1192. The most recent three events have been closer together, averaging 112 years between events.

Petersen et al (1996) and the SCEC (1995) assigned a slip rate of 24+/- 6 mm/yr, a M_w 7.5, and a recurrence interval of 14 (+91, -60) years to this segment.

7.1.3 *Elsinore Fault – Glen Ivy and Temecula Segments*

The Elsinore fault zone forms the northeast boundary of the Santa Ana Mountains and extends nearly 200 km from Whittier to the Mexican border. Individual segments within the Los Angeles region are three (3) to forty (40) km long and display reverse right oblique, right-lateral strike-slip, and normal-right-oblique-slip late Quaternary or Holocene offsets. Petersen et al (1996) divided this fault into six segments which from north to south are: Whittier, Glen Ivy, Temecula, Julian, Coyote Mountain, and Laguna Salada. In addition, several of the fault segments possess locally their own names. For example, the Glen Ivy North and Glen Ivy South branches are located Northwest of Lake Elsinore. Heading southeast from Lake Elsinore, the two parallel fault strands are denominated Wildomar Fault (the more easterly) and Willard Fault. At its northern end, the Glen Ivy segment splays into two (2) fault segments, the Chino – Central Avenue and the Whittier faults.

The closest significant Elsinore Fault segments to the MVMC site are the northwest-trending, right-lateral strike-slip Glen Ivy and Temecula segments, located approximately 32.1 km to the southwest of the site.

The Glen Ivy fault segment extends for approximately 38 km. According to the SCEC (1995), this segment at Glen Ivy marsh shows that five (5) and probably six (6) earthquakes have disrupted the sediments there since approximately 1060, yielding an average recurrence interval of 150 to 200 years. These events occurred in 1910, post-1660, 1360 to 1660, about 1300, 1260, and about 1060. The most recent surface rupture is associated with the 1910 Temescal Valley earthquake with an estimated magnitude MW6.0 (Ziony and Jones, 1989). The surface displacement in this event was approximately 250 to 300 millimeters (mm). This fault segment has been assigned a probable MW6.8 with a slip rate of 5 mm/yr and a recurrence interval of 340 years (Petersen et al, 1996).

The Temecula Fault segment extends for approximately 62 km. Trenching across the Wildomar Fault in the Temecula segment has yielded a late Holocene slip rate for the principal strand. A fluvial channel, dated by C-14 at about 2000 to 2400 years, is laterally displaced approximately 10+/- 1 m and yields a slip rate of about 4.2 mm/yr (SCEC, 1995). This rate is considered as minimum since several minor strands of the fault also have a geomorphic expression. Nevertheless, it is similar to the rates determined at other locations along the Elsinore Fault. SCEC (1995) concluded a maximum average recurrence interval of between 250 and 600 years and a slip rate of 5.0+/- 2.0 mm/yr for this segment. Because no measurements of characteristic displacements are available, SCEC (1995) calculated a value of 1.2+/- 0.3 m using the segment length and empirical relations postulated by Wells and Coppersmith in 1994. According to SCEC (1995), this yields an average recurrence interval of 240 (+260, -111) years.

7.2 Historic Earthquakes

A map of recorded earthquake epicenters is provided as Figure A-9, Appendix A. This map can be accessed online by the Southern California Earthquake Data Center at Cal Tech. The Southern California Earthquake Data Center identifies three major earthquakes magnitude 6.0 or greater that have occurred on the San Jacinto fault since 1899, within a fifty (50) mile radius of the subject site: North San Jacinto Fault Earthquake near Loma Linda occurred July 22, 1923 with a magnitude of 6.3; the San Jacinto Earthquake just east of Hemet occurred April 21, 1918 with a magnitude of 6.8; and, the San Jacinto Fault (Terwilliger Valley) Earthquake also known as the Borrego Springs Fault, occurred in 1937 with a magnitude of 6.0.

The only large historical earthquake that can be attributed to the Elsinore Fault is a magnitude 6.0 that occurred in 1910 in the Temescal Valley area.

Four (4) other earthquakes of magnitude 4.0 or greater are identified within this fifty (50) mile radius: the Anza Gap Earthquake M 4.8; the White Wash Earthquake east of Anza occurred on February 25, 1980, M 5.5; the Chino Hills Earthquake in 2008, M 5.4; and, the Upland Earthquake of 1990, M 5.4.

7.3 Site Accelerations

7.3.1 *Site Coordinates*

The site latitude and longitude are 33.898 degrees north and 117.186 degrees west, respectively.

7.3.2 *Site Classification*

The site classification procedure recommended by CBC 2016, subsection 1613A.3.2, which references ASCE 7-10, Chapter 20, was adhered to.

The Cone Penetration Tests (CPT's) and geophysical surveys results provided measured average shear wave velocities at a minimum 402 m/s within the top 100 feet. The shear wave velocity profiles of the CPT's and geophysical surveys presented on Figure A-10, Appendix A, show good correlation. Based on the aforementioned measured shear wave velocities, to develop seismic design criteria, the site subsoils within the top 100 feet are judged to be Site Class C.

7.3.3 *Seismic Design Criteria*

Based on CBC 2016, subsection 1616A.1.3, which references and modifies ASCE 7-10, subsection 11.4.7, since the structure is assigned to Seismic Design Category D and S_1 is less than 0.75g (see subsection 7.3.3.2), a site-specific GMHA was not completed. The following subsections present the seismic design parameters based on mapped parameters.

7.3.3.1 Mapped Accelerations Response Spectra

Mapped, risk-targeted maximum considered earthquake, MCE_R, spectral response accelerations for 0.2 and 1.0 second periods are provided in maps published in the ASCE 7-10, which is the reference used in the CBC 2016. These maps are prepared by the USGS and the California portion of the map was prepared jointly with the CGS. These maps use results of seismic hazard analyses from both probabilistic and deterministic procedures, and are applicable to Site Class

B and five (5) percent of critical damping. The mapped site accelerations are adjusted for site class effects using parameters Fa and Fv, which are functions of site class and mapped site spectral accelerations.

The mapped design horizontal spectral accelerations were evaluated in accordance with ASCE 7-10, using the US Seismic Design Maps Application (USGS, 2017) available at the USGS website: http://geohazards.gov/designmaps/us/application.php. This web application requires the inputs of site location (coordinates) and site soil classification.

The project site is Site Class C and coefficient values Fa and Fv of 1.0 and 1.3, respectively, are obtained for the site. Mapped MCE_R accelerations obtained for the project site are summarized in Table II, below.

TABLE II

MCE_R MAPPED ACCELERATIONS

PERIOD (SECONDS)	MAPPED ACCELERATION PARAMETERS (g)	Site Class C MCE_R ACCELERATIONS ADJUSTED FOR SITE CLASS EFFECTS (g)	Site Class C RISK COEFFICIENTS
0.2	S_s: 1.673	1.673	C_{RS} = 1.008
1.0	S_1: 0.729	0.948	C_{R1} = 0.976

Based on Table II, the mapped spectral response accelerations, adjusted for Site Class C, S_{MS} and S_{M1} are 1.673g and 0.948g, respectively.

7.3.3.2 Seismic Design Category

The mapped spectral response acceleration parameter at one (1) second period (S_1) is 0.729g which is less than 0.75g. The design spectral response acceleration coefficients S_{DS} and S_{D1} are 1.115 and 0.632g, respectively. Therefore, a Seismic Design Category D should be used for the design of the proposed structure per Section 1613A.3.5 of CBC 2016.

7.3.3.3 Design Spectra Based on Mapped Parameters

Section 11.4.5 of ASCE 7-10 describes a procedure to obtain a design response spectra curve for use in cases where a design response spectrum is required by the ASCE 7-10 standard, and site-specific ground motion procedures are not used. This procedure is based on the use of the mapped spectral response accelerations adjusted for site class effects in the determination of the design response spectra curve. Using this procedure, numerical values of the design spectral response accelerations based on the mapped parameters for the project site are provided in Table III, below.

TABLE III

MAPPED DESIGN RESPONSE SPECTRUM

Period (Seconds)	Mapped Design Spectral Response Acceleration (g)
0.00	0.446
0.113	1.115
0.20 (S_{DS})	1.115
0.500	1.115
0.566	1.115
0.700	0.903
0.800	0.790
0.900	0.702
1.00 (S_{D1})	0.632
2.00	0.316
3.00	0.211
4.00	0.158
5.00	0.126

7.3.3.4 Maximum Considered Earthquake Geometric Mean (MCE_G) Peak Ground Accelerations

From Figure 22-7 of ASCE 7-10, PGA = 0.657g is multiplied by the site coefficient F_{PGA} = 1.0 (Table 11.8-1) to obtain the mapped MCE Geometric Mean Peak Ground Acceleration (PGA_M). For Site Class C, $PGA_M = F_{PGA} \times PGA$. Therefore, PGA_M = 0.657 may be used for evaluation of liquefaction, lateral spreading, seismic settlement and soil-related issues.

7.3.3.5 Seismic Hazard Deaggregation

Relative contributions of various combinations of earthquake magnitudes and distances to a particular seismic hazard at a site are determined using deaggregation of the seismic hazards. Magnitude-distance deaggregation, obtained from the Unified Hazard Tool "Dynamic: Conterminous US 2008 (V.3.3.1)" edition that is available on the USGS website, indicates that the deaggregated mode magnitude and distance for the peak ground acceleration at the project site are M7.5 and 7.0 kilometers, respectively.

7.4 Earthquake Effects

7.4.1 *Liquefaction*

Liquefaction occurs when the pore pressures generated within a soil mass equals the overburden pressure. This results in a loss of strength and the soil then possesses a certain degree of mobility.

Factors considered to evaluate liquefaction potential include groundwater conditions, soil type, particle size distribution, earthquake magnitude and acceleration, and soil density obtained through the Standard Penetration Test (SPT) or Cone Penetration Test (CPT). Soils subject to liquefaction comprise saturated fine-grained sands to low-plasticity silts and clays. Coarser-grained soils are considered free-draining and therefore dissipate excess pore pressures, while fine-grained soils possess undrained shear strength and are therefore less subject to liquefaction.

The liquefaction susceptibility map, Figure A-11, Appendix A, of the County of Riverside General Plan, indicates that the project site is located in an area that is subject to "low" liquefaction potential. Furthermore, the subsoils are considered "dense" to "very dense" or "stiff" to "hard" with a historic highest groundwater table at a depth greater than fifty (50) feet; therefore, the site is considered to possess a "very low" potential for liquefaction.

7.4.2 *Seismically Induced Settlements*

Based on an examination of the subsoils conditions, seismic settlement analyses were conducted at CPT-12 and CPT-13 locations. For these analyses, a PGA_M of 0.657g and an earthquake magnitude of 7.5 based on the deaggregation results, described in subsection 7.3.3.5, were used. Seismic settlements for the unsaturated cohesionless soils were estimated using the Tokimatsu and Seed (1987) Method. The results of the seismic settlement analyses are provided in Appendix D.

Based on our evaluation of the analyses results at the CPT locations, seismically induced settlements at the site are not anticipated to exceed one-half (0.5) inch for the New CUP.

7.4.3 *Seismically Induced Landsliding*

Due to the relatively flat existing topographic conditions, the MVMC site is not located within a designated area where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacement such that mitigation would be required (RCIT, 2017). In addition, based on our field reconnaissance and field investigations, there are no known landslides near or at the MVMC site, nor is the site on the path of any known or potential landslides.

7.4.4 *Ground Surface Rupture*

Ground surface displacement along a fault, although more limited in area than the ground shaking associated with it, can have disastrous consequences when structures are located straddling the fault or near the fault zone. Fault displacement involves forces so great that in most cases it is not practically feasible (structurally or economically) to design and build structures to accommodate rapid displacement and remain intact. Amounts of movement during a single earthquake can range from several inches to tens of feet. Another aspect of fault displacement comes not from the violent movement associated with earthquakes, but the barely perceptible movement along a fault called "fault creep". Damage by fault creep is usually expressed by the rupture or bending of buildings, fences, railroad tracks, streets, pipelines, curbs, and other linear features.

No faulting was observed during our field reconnaissance. In addition, active, potentially active, and other major inactive faults noted on regional geologic and fault maps do not cross nor project toward the site. Furthermore, the site is not located within any APEQFZ Map as designated by the CGS (Bryant and Hart, 2007; CDMG, 2000 and CGS, 2017). The County of Riverside (RCIT, 2017) and the USGS (2017) indicate that the closest active fault to the site is the San Jacinto Fault Zone located approximately 4.8 km to the northeast. Cracking due to shaking from distant events is not considered a significant hazard, although it is a possibility at any site.

7.4.5 *Lateral Spreading*

Seismically induced lateral spreading involves primarily movement of earth materials due to ground shaking. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. Such spreads can occur on gently sloping ground or where nearby drainage or stream channels can lead to static shear stress biases on essentially horizontal ground. The potential for liquefaction at the site is considered very low. Therefore, the potential for lateral spreading of the subject site is very low.

7.4.6 *Subsidence*

Subsidence refers to the sudden sinking or gradual downward settling and compaction of soil and other surface material with little or no horizontal motion. It may be caused by a variety of human and natural activities, including changes in groundwater level, soil moisture and earthquakes. Alluvial valley regions are especially susceptible and according to RCIT (2017), the site is located within an area that is susceptible to subsidence (Figure A-12, Appendix A) .

7.4.7 *Tsunamis*

A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic event. The MVMC site is not located within a coastal area; instead, it is located several tens of miles inland from the Pacific Ocean at an approximate elevation of 1525 feet amsl (GoogleEarth, 2017). Therefore, a tsunami hazard at the property is considered negligible.

7.4.8 *Seiches*

A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. Resulting oscillations could cause waves up to tens of feet high, which in turn could cause extensive damage along the shoreline. The most serious consequence of a seiche would be the overtopping and failure of a dam. Based on Figure 5.5-2, Floodplains and High Fire Hazard Areas, included in the Moreno Valley General Plan (2006), the site is not located downstream of any large bodies of water that could adversely affect the site in the event of earthquake-induced failures or seiches.

7.4.9 *Flooding*

According to the Federal Emergency Management Agency (FEMA, 2017) flood map 06065C0770G, Figure A-13, Appendix A, the City of Moreno Valley (2006a) and RCIT (2017), the MVMC is located within a "Zone X", which corresponds to an area determined to be outside of a

0.2 percent annual chance of floodplain (FEMA, 2017).

It should be noted that the northwestern corner of the property is located within "Zone A", which corresponds to a 1.0 percent annual chance of flood hazard (FEMA, 2017), areas of flooding sensitivity (RCIT, 2017) and a 100-year flood plain (City of Moreno Valley, 2006a). The extent of the affected area varies according to the different agencies.

VIII. SITE DEVELOPMENT RECOMMENDATIONS

8.1 General

The proposed development, described in subsection 3.2, is feasible from a geotechnical engineering standpoint. Project plans and specifications should take into account the appropriate geotechnical features of the site and conform to the geotechnical recommendations.

8.2 Clearing

All surface vegetation, asphaltic concrete, trash, debris, underground pipes, and concrete pieces after demolishing the existing structures should be cleared and removed from the proposed site. Topsoil and soils with organic inclusions are ***not*** considered suitable for reuse as structural fill, but may be stockpiled for future use in landscape areas.

Underground facilities such as utilities, pipes or underground storage tanks may exist at the site. Removal of underground tanks is subject to state law as regulated by County or City Health and/or Fire Department agencies. If storage tanks containing hazardous or unknown substances are encountered, the proper authorities must be notified prior to any attempts at removing such objects.

Septic tanks should be removed in their entirety. Cesspools or seepage pits should be pumped of their contents and backfilled with a minimum two-sack sand-cement slurry. Any water wells, if encountered during construction, should be exposed and capped in accordance with the requirements of the regulating agencies.

Depressions resulting from the removal of buried obstructions, existing building foundations, tunnels and pipes should be backfilled with properly compacted material.

8.3 Subgrade Preparation

8.3.1 *Building Pad*

In the new CUP area, undocumented fills and "very loose" to "medium dense" silty sands to sandy silts layers were observed at the boring locations and can be observed on the data from relevant CPT's as well. These materials are not suitable for structural support and they extend to approximate elevation 1510 amsl, as shown on Figures A-5 and A-6, Appendix A. These materials may also extend deeper at other locations and, where encountered, should be removed and replaced as properly compacted fill. Notwithstanding the aforementioned, a compacted fill blanket, a minimum of five (5) feet in thickness, should be constructed below the footing bottoms. The lateral extent of overexcavation beyond the footing limits should be at least equal to the depth of fill.

Exposed bottoms of overexcavation should be observed by GEOBASE to verify the removal of all unsuitable materials.

8.3.2 *Minor Structures, Walkways, Flatwork and Pavement Areas*

In order to minimize the potential for excessive settlement of minor structures which are structurally separated from the new CUP, the footing subgrade areas should be over excavated to provide a uniform compacted fill blanket a minimum three (3) feet in thickness below adjacent grade, or at least two (2) feet below footing bottoms, whichever is greater. The lateral extent of removal beyond the footing limits should be equal to at least the depth of overexcavation. The fill should be compacted to a minimum of ninety (90) percent relative compaction (ASTM D 1557).

The subsoils within the concrete walkways, flatwork and parking areas, and within two (2) feet of their proposed limits, should be over excavated at least two (2) feet and replaced as properly compacted fills.

The above subgrade preparation recommendations may only be considered if future maintenance as a result of settlement of underlying undocumented fills can be tolerated. Alternatively, all undocumented fills should be removed and replaced as properly compacted fills.

8.4 Fill Placement

8.4.1 *Preparation of Bottom of Excavations*

Prior to placing any fill, the exposed soils at the bottom of excavations should be scarified to a minimum depth of six (6) to eight (8) inches, moisture conditioned (wetted or dried) to at least optimum moisture content and compacted to a minimum of ninety (90) percent relative compaction, based on ASTM D1557.

8.4.2 *Compaction*

Cohesive soils should be placed in loose lifts not exceeding six (6) inches, moisture-conditioned to approximately two (2) to four (4) percentage points above optimum, and compacted to the minimum relative compaction listed in Table IV below.

Granular fill materials should be placed in loose lifts of six (6) to eight (8) inches, moisture-conditioned to near optimum, and compacted to the minimum relative compaction listed in Table IV.

TABLE IV

COMPACTION REQUIREMENTS

Type of Fill/Area	Relative Compaction (ASTM D1557) Minimum Percent
Fills within building pad area	95
All other structural fill	90

8.4.3 *Fill Material*

The upper ten (10) feet of on-site soils are predominantly "very low" expansive soils (EI = 0-12). These soils may be reused as compacted fill provided they are free of organics, deleterious materials, debris and particles over six (6) inches in largest dimension.

Any soils imported to the site for use as fill for subgrade materials should be predominantly granular and "very low" expansive (Expansion Index less than twenty [20])and should contain sufficient fines (approximately twenty [20] percent passing the No. 200 sieve) so as to be relatively impermeable when compacted. The imported soils should be approved by GEOBASE prior to importing.

8.5 Drainage

To enhance future site performance, it is recommended that all pad drainage be collected and directed away from proposed structures and slopes to disposal areas off site. For soil areas, we recommend that a minimum of five (5) percent gradient away from foundation elements be maintained. It is important that drainage be directed away from foundations and that proper drainage patterns be established at the time of construction and maintained through the life of the structures. Roof gutter discharge should be directed away from the building to suitable discharge points.

All slopes should be properly drained and maintained to help control erosion. Care should be exercised in controlling surface runoff onto temporary slopes. The area back of the slope crest should be graded such that water will not be allowed to flow freely onto the slope face. If excavations of temporary slopes are carried out in the rainy season, appropriate erosion protection measures may be required to minimize erosion of the slope cuts.

8.6 Temporary Excavations

Temporary construction excavations are anticipated for construction of utility trenches, footings and overexcavation.

Temporary construction excavations to depths of approximately four (4) feet below grade may be cut vertically without shoring. Where the necessary space is available, temporary unsurcharged excavations up to fifteen (15) feet high in level ground surface may be sloped back at 1H:1V (Horizontal:Vertical) or flatter in native soils. No surcharge loads should be permitted within a horizontal distance equal to the height of cut from crest of the excavation unless the cut is properly shored. Excavations that extend below a plane drawn at 1H:1V (Horizontal:Vertical) downward from the the edge of foundations of existing buildings and underground pipelines should be properly shored to maintain foundation support of adjacent structures and utilities.

The exposed slope face should be kept moist (but not saturated) during construction to reduce local sloughing.

All excavations and shoring systems should meet, as a minimum, the requirements given in the State of California Occupational Safety and Health Administration (OSHA) and Trench Safety

Standards. Stability of temporary slopes is the responsibility of the contractor.

8.7 Trench Backfill

Underground utility trenches could be backfilled and properly compacted by mechanical means. Pipe bedding, shading, and trench backfill should conform to the requirements of appropriate utility authorities.

If utility contractors indicate that it is undesirable to use compaction equipment in close proximity to a buried conduit, other methods of utility trench compaction may also be appropriate as approved by GEOBASE at the time of construction. Jetting or flooding of backfill material is not recommended.

IX. FOUNDATION RECOMMENDATIONS

9.1 General

The following recommendations have been formulated from visual, physical and analytical considerations of the existing site conditions and are believed to be applicable for the proposed development.

The on-site soils have a "very low" expansion potential. The recommendations presented in the following subsections are based on a "very low" expansion potential for the subgrade soils. Foundations and slab reinforcement configurations should meet, as a minimum, the requirements of the regulating agencies and the 2016 CBC.

9.2 Footings

Spread or continuous footings may be used for support of the proposed new CUP. Footings should be based a minimum of three (3) feet below the lowest adjoining grade.

9.2.1 *Soil Bearing Pressures*

Footings with a minimum width of two (2) feet and maximum width of twelve (12) feet, founded on a minimum of five (5) feet of compacted fill (subsection 8.3.1), may be designed for an allowable bearing pressure of 4,000 psf. The maximum edge pressures induced by eccentric loading or overturning moments should not be allowed to exceed the aforementioned allowable bearing value.

Footings placed closer than one (1) width apart should be structurally tied.

9.2.2 *Footings Adjacent to Trenches or Existing Footings*

Where footings are located adjacent to utility trenches, they should extend below a one-to-one plane projected upward from the inside bottom corner of the trench. Footing excavations adjacent to the footings of existing buildings should be carried out such that the existing footings are not undermined.

9.2.3 *Settlement*

For allowable dead-plus-live load bearing pressures of 4,000 psf, the total and differential settlements of the footings are not anticipated to exceed one (1.0) inch and one-half (0.5) inch, respectively. Total seismic settlements are anticipated not to exceed one-half (0.5) inch and differential seismic settlements are estimated at three-tenths (0.3) of an inch over a distance of thirty (30.0) feet.

Notwithstanding the preceding, the static settlement of the footings foundation system should be reviewed by GEOBASE once the configuration of the footings is finalized.

9.2.4 *Lateral Load Resistance*

Lateral loads (wind or seismic) against structures may be resisted by friction between the bottom of foundations and the supporting soils. An allowable friction coefficient of 0.35 between spread footing and the underlying compacted soil is recommended. An allowable lateral bearing pressure equal to an equivalent fluid weight of 200 pounds per cubic foot to a maximum of 3,000 pounds per square foot acting against the foundations may also be used, provided the foundations are poured tight against compacted fill.

9.2.5 *Footing Observations*

All foundation excavations should be observed by GEOBASE prior to the placement of forms, reinforcement, or concrete, for verification of conformance with the intent of these recommendations and confirmation of the bearing capacities. All loose or unsuitable materials should be removed prior to the placement of concrete. Materials from footing excavations should not be spread in slab-on-grade areas unless compacted.

9.3 Minor Structures

Minor structures may be designed using the presumptive load-bearing values outlined in CBC 2016, provided that the risk of future settlements and associated maintenance can be tolerated.

9.4 Ultimate Values

The recommended design values presented in this report are for use with loading determined by a conventional working stress design. When considering an ultimate design approach, the recommended design values may be multiplied by the factors given in Table V.

TABLE V
LOAD FACTORS FOR ULTIMATE DESIGN

Foundation Loading	Ultimate Design Loading
Bearing Value	3.0
Passive Pressure	1.33
Coefficient of Friction	1.25

In no event, however, should the footing sizes be reduced from those required for support of dead-plus-live loads when using the working stress values.

9.5 Floor Slabs

Concrete slab-on-grade may be used for the proposed new CUP. The subgrade of the slab-on-grade should be prepared in accordance with the recommendations provided in subsections 8.3 and 8.4.

In moisture sensitive areas, as a minimum, the floor slabs should be damproofed per CBC 2016, subsection 1805A.2; specific recommendations can be provided by a Waterproofing Consultant.

A subgrade modulus of 150 pounds per cubic inch may be used for slab design. The slab should be designed by the Structural Engineer using applicable CBC requirements, and the various anticipated loading conditions including shrinkage, temperature stresses, construction and operation conditions.

X. SOIL CORROSIVITY -- IMPLICATIONS

Electrical conductivity, pH, chloride and water soluble sulfate tests were conducted on representative samples by Anaheim Test Labs, and the results are provided in Appendix C. The tests results indicate that the subsoils at the site have a "low" corrosive potential with respect to concrete and "corrosive" potential with respect to steel and other metals. Therefore, Type II Portland Cement may be used for construction of concrete structures in contact with subgrade soils.

XI. PAVEMENT RECOMMENDATIONS

11.1 Asphaltic Concrete Pavement

Based on an R-value of fifty (50), the following alternative preliminary minimum pavement sections may be used. The traffic index assumed in Table VI, below, **should be confirmed by the Civil Engineer** and R-value tests should be performed during grading, prior to finalizing the pavement sections.

TABLE VI

ASPHALTIC CONCRETE PAVEMENT SECTIONS

PAVEMENT UTILIZATION	TRAFFIC INDEX	ASPHALTIC CONCRETE (INCHES)	CLASS II BASE (INCHES)
Automobile parking areas	5	3	3
Truck and bus loading/unloading areas and driveways	6	4	3

The upper twelve (12) inches of subgrade soils, below the aggregate base, should be scarified, moisture conditioned and recompacted to a minimum of ninety-five (95) percent relative compaction, at to slightly above optimum moisture content, based on ASTM D 1557.

The aggregate base must meet CALTRANS "Class 2 Base" specifications and should be compacted to at least ninety-five (95) percent relative compaction based on ASTM D 1557. Asphaltic concrete should be compacted to at least ninety five (95) percent of the density obtained with the California Kneading Compactor (CAL 304).

11.2 Rigid Pavement

A Portland Cement concrete (PCC) pavement may also be used. In the design of the PCC pavement section shown in Table VII, below, the following design parameters were used:

- Modulus of subgrade reaction of the soil, k -- 240 pci
- Modulus of rupture of concrete, MR -- 500 psi
- Traffic Category, TC -- C
- Average daily truck traffic, ADTT -- 100

TABLE VII
PCC PAVEMENT SECTION

PAVEMENT UTILIZATION	PCC Minimum Thickness (inches)
Truck loading/unloading areas (TC = C)	6

The traffic category and average daily truck traffic should be confirmed by the civil engineer and R-value tests should be performed during grading, prior to finalizing PCC thickness.

Based on the design parameters presented above, the following rigid pavement section, calculated in general conformance with the procedure recommended by ACI 330R-01, may be used.

The upper twelve (12) inches of subgrade soils below the PCC should be scarified, moisture conditioned and recompacted to a minimum of ninety-five (95) percent relative compaction, at to slightly above optimum moisture content, based on ASTM D 1557.

The PCC pavement reinforcement should be designed by the structural engineer for shrinkage, temperature stresses and loading conditions including vehicular traffic. A thickened edge should be constructed on the outside of concrete pavements subject to wheel loads. Control joints should be included in the design of the PCC by the structural engineer at a maximum spacing of fifteen (15) feet each way.

XII. PLAN REVIEW, OBSERVATIONS AND TESTING

Post-investigation services are an important and integrated part of this investigation and should be carried out by GEOBASE. The project foundation and grading plans, and specifications should be forwarded to GEOBASE for review for conformance with the intent of the soils recommendations.

Geotechnical observations of excavation bases should be carried out prior to fill placement. Observations and testing of all fill placement should be carried out on a continuous basis to verify the design assumptions and conformance with the intent of the recommendations. Observations of footings bases should be carried out prior to concrete pour.

XIII. LIMITATIONS

This investigation was performed in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is intended for use by the client and its representatives, and with regard to the specific project discussed herein. Any changes in the design or location of the proposed new structure, however slight, should be brought to our attention so that we may determine how they may affect our conclusions. The conclusions and recommendations contained in this report are based on the data relating only to the specific project and location discussed herein. This report does not relate any conclusions or recommendations about the potential for hazardous and/or contaminated materials existing at the site.

The analyses and recommendations submitted in this report are based upon the observations noted during drilling of the borings, interpretation of laboratory test results, and geological evidence. This report does not reflect any variations which may occur away from the borings and which may be encountered during construction. If conditions observed during construction are at variance with the preliminary findings, we should be notified so that we may modify our conclusions and recommendations, or provide alternate recommendations, if necessary.

The recommendations presented herein assume that the plan review, observations and testing services, outlined in Section XII of the report, will be provided by GEOBASE. During execution of the aforementioned services, GEOBASE can finalize the report recommendations based on observations of actual subsurface conditions evident during construction. GEOBASE cannot assume liability for the adequacy of the recommendations if another party is retained to observe construction.

This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project, and incorporated into the plans and specifications. In this respect, it is recommended that we be allowed the opportunity to review the project plans and the specifications for conformance with the geotechnical recommendations.

This office does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site. Therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

This report is subject to review by the appropriate regulating agencies.

Respectfully submitted
GEOBASE, INC.

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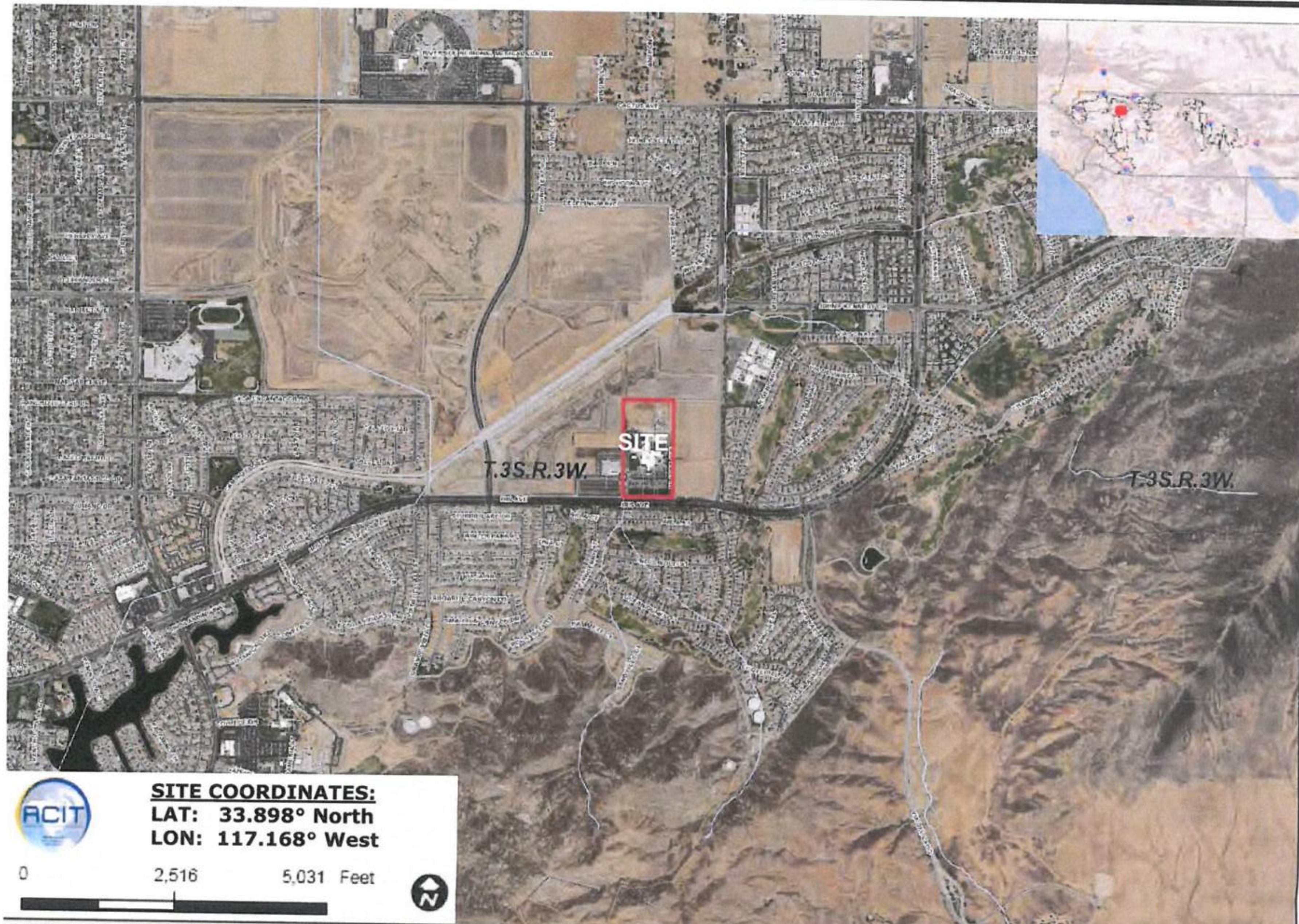
APPENDIX A

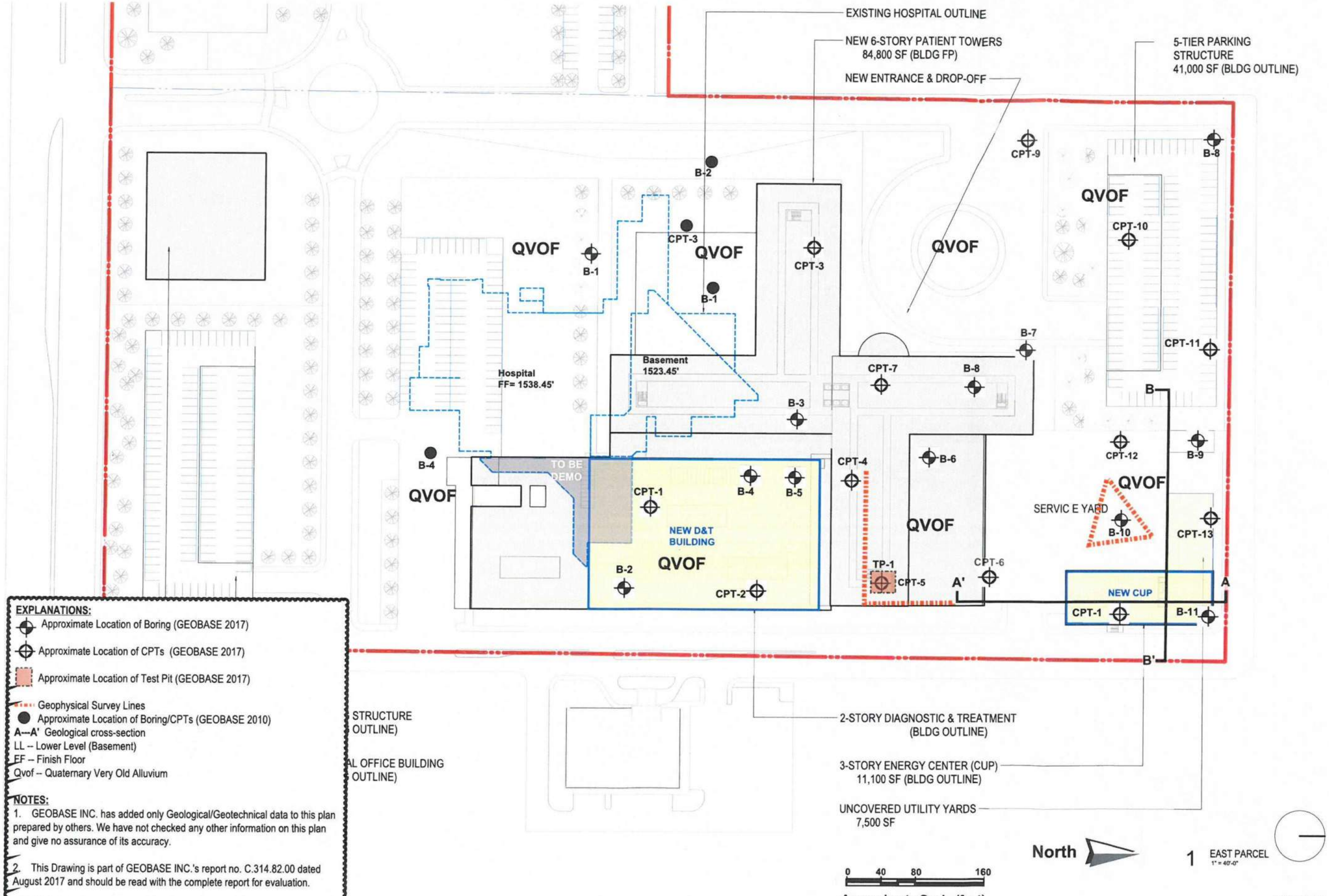


GEOBASE

C.314.82.00

SITE LOCATION MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-1



EXPLANATIONS:

Approximate Location of Boring (GEOBASE 2017)

Approximate Location of CPTs (GEOBASE 2017)

Approximate Location of Test Pit (GEOBASE 2017)

Geophysical Survey Lines

Approximate Location of Boring/CPTs (GEOBASE 2010)

A---A' Geological cross-section

LL -- Lower Level (Basement)

FF -- Finish Floor

Qvof -- Quaternary Very Old Alluvium

NOTES:

1. GEOBASE INC. has added only Geological/Geotechnical data to this plan prepared by others. We have not checked any other information on this plan and give no assurance of its accuracy.
2. This Drawing is part of GEOBASE INC.'s report no. C.314.82.00 dated August 2017 and should be read with the complete report for evaluation.

CO ARCHITECTS

KAISER PERMANENTE

C.314.82.00

Site, Boring and CPT Locations Plan

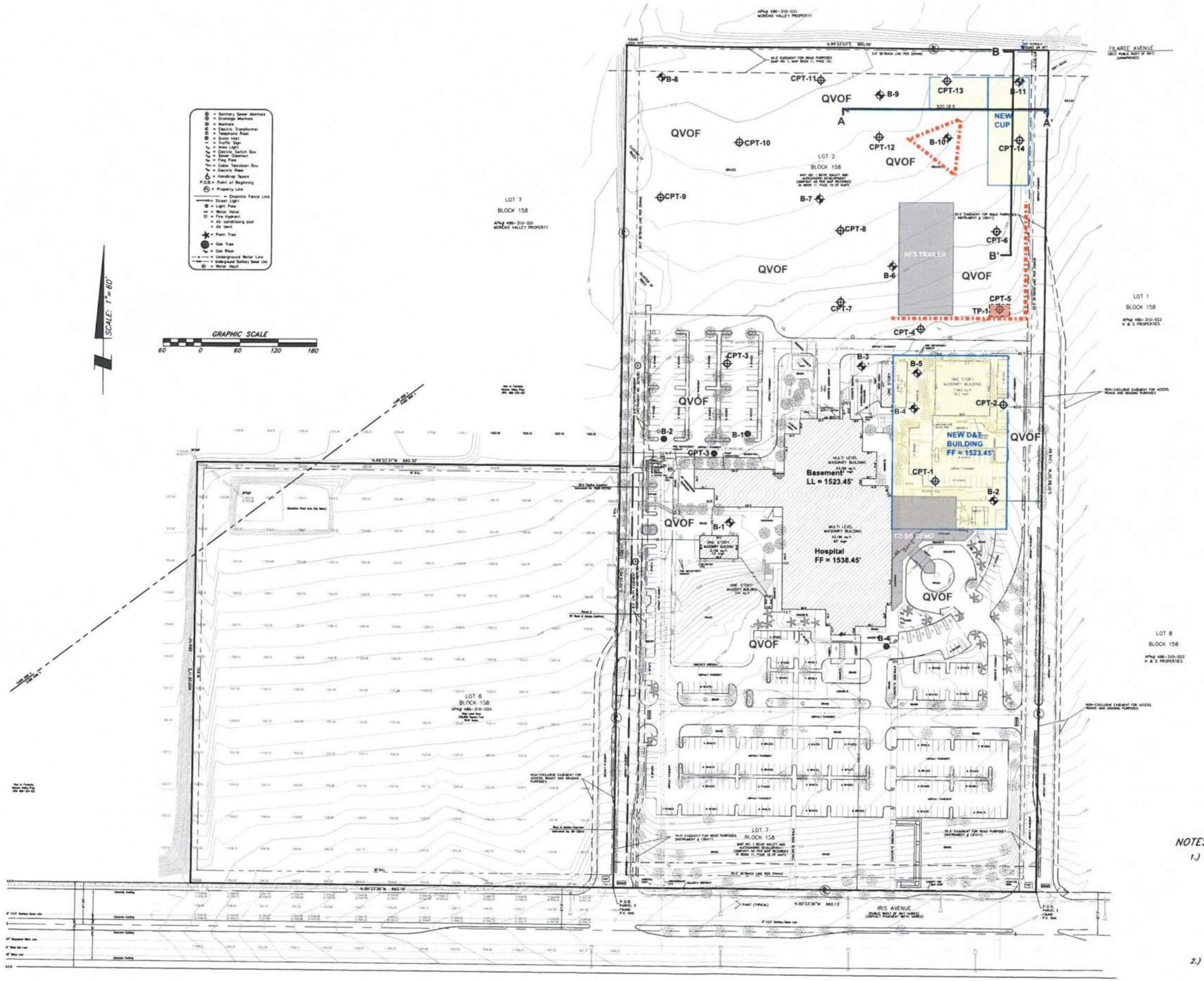
MORENO VALLEY MEDICAL CENTER

SITE PLAN

07/05/17

Figure A-2

SD-10



EXPLANATIONS:

- Approximate Location of Boring (GEOBASE 2017)
- Approximate Location of CPTs (GEOBASE 2017)
- Approximate Location of Test Pit (GEOBASE 2017)
- Geophysical Survey Lines (GEOBASE 2017)
- Approximate Location of Boring/CPTs (GEOBASE 2010)

A---A' Geological cross-section
LL -- Lower Level (Basement)
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2. This Drawing is part of GEOBASE INC.'s report no. C.314.82.00 dated August 2017 and should be read with the complete report for evaluation.

NOTES:

1.) THIS TOPOGRAPHIC SURVEY MAP HAS BEEN COMPILED FROM THE FOLLOWING SURVEYS PROVIDED TO S.B.&O., INC. BY KAISER PERMANENTE:

A.) A 10 ACRE ALTA SURVEY WITH A FIELD DATE OF 07/07/08

ISSUED BY: INTERNATIONAL LAND SERVICES, INC.
PREPARED BY: J.V. SURVEYING, LLC

B.) A 20 ACRE ALTA SURVEY WITH A FIELD DATE OF 02/22/08

ISSUED BY: (UNKNOWN)
PREPARED BY: (UNKNOWN)

2.) S.B.&O., INC. MAKES NO REPRESENTATION TO THE COMPLETENESS OR ACCURACY OF THE DATA PROVIDED AND SHOWN HEREON.

SB&O INC.
PLANNING ENGINEERING SURVEYING
41889 Enterprise Circle North, Suite 126
Temecula, Ca 92590
951-695-8900
951-695-8901 Fax

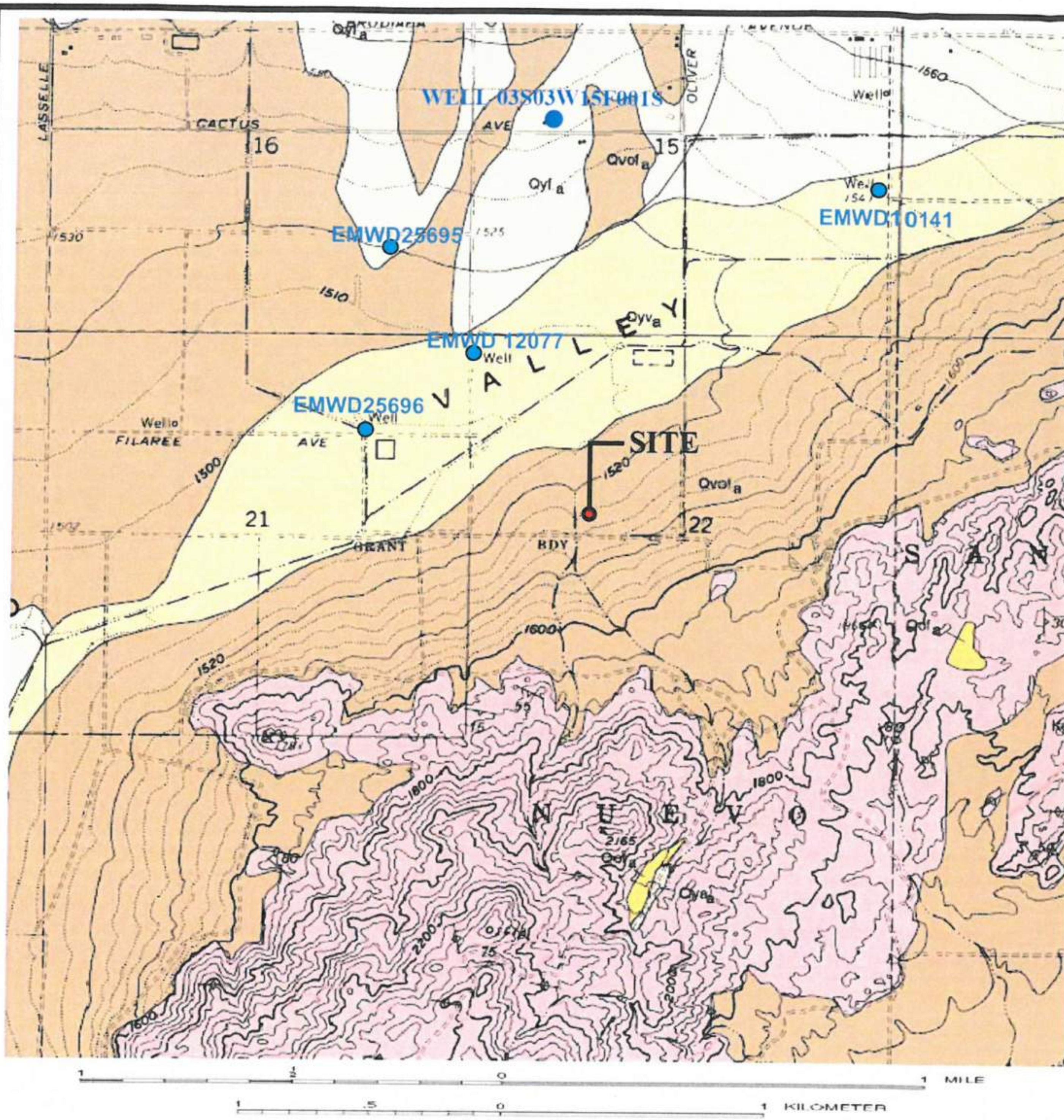
KAISER HOSPITAL
CITY OF MORENO VALLEY
TOPOGRAPHIC SURVEY

OCTOBER 27, 2009 JN 68222

C.314.82.00

SITE TOPOGRAPHIC SURVEY PLAN

FIGURE A-3

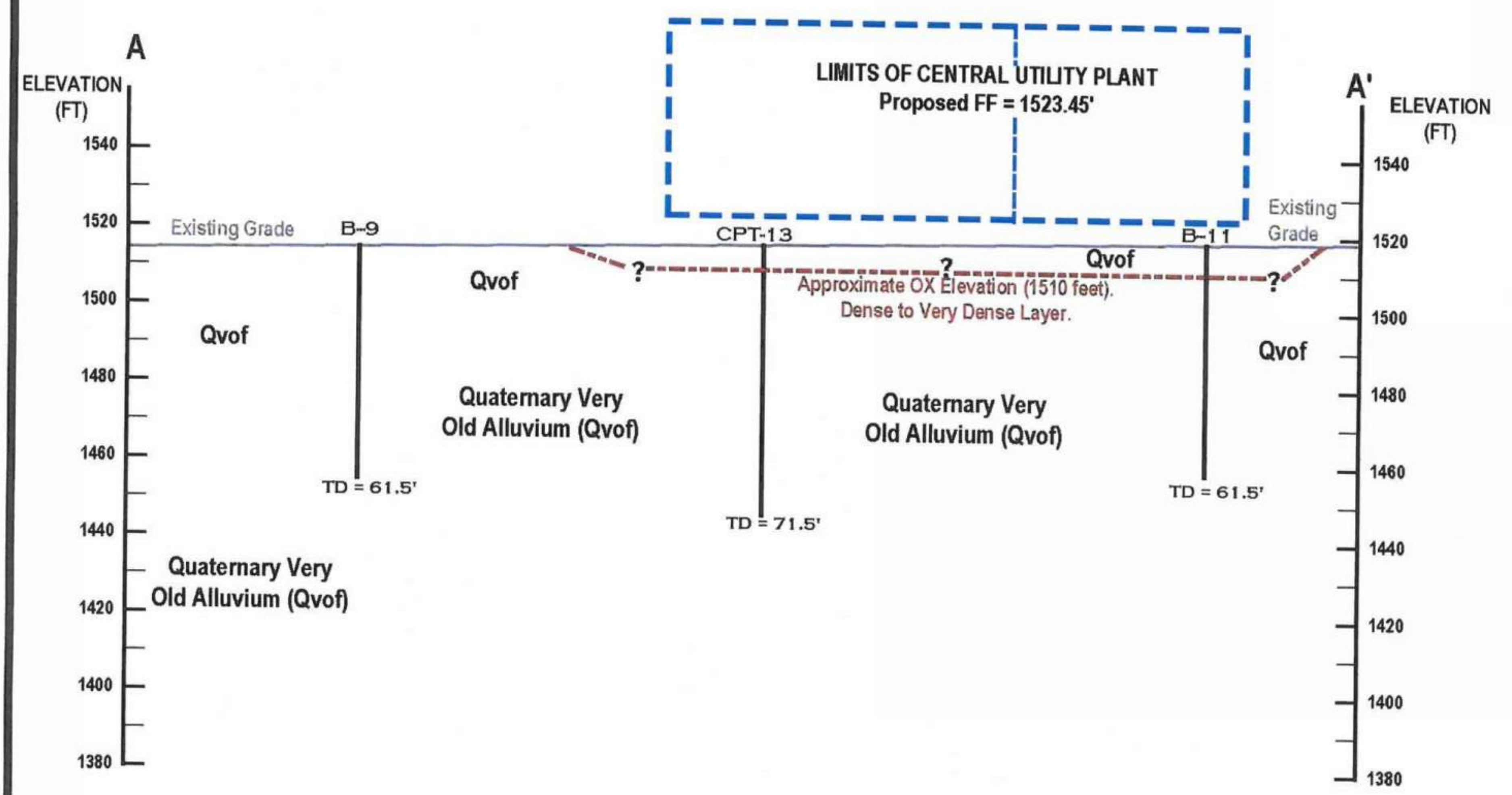


EXPLANATION

Qyf	Qyf - Quaternary Young Alluvial Fan Deposits (Holocene and late Pleistocene)
Qyv	Qyv - Quaternary Young Alluvial Valley Deposits (Holocene and late Pleistocene)
Qvof	Qvof - Quaternary Very Old Alluvial Fan Deposits (early Pleistocene)
Kqd	Kgd - Quatz Diorite, Undifferentiated (Cretaceous)

Source: Morton, D. M., and Matti, J C., 2001, Geologic Map of the Sunnymead Quadrangle, Riverside County, California: Version 1.0. Scale 1:24,000. Open File Report 01-450, Published by the United States Geological Survey in Cooperation with the California Geological Survey and the United States Air Force.

GEOBASE	REGIONAL GEOLOGIC MAP Kaiser Permanente MVMC – CUP 27300 Iris Avenue Moreno Valley, California
	C.314.82.00 — FIGURE A-4



EXPLANATIONS:

Qvof -- Quaternary Very Old Alluvium

TD -- Total depth of borehole

dense to very dense layer, overexcavation bottom

NOTES:

1. Locations of the cross section are shown on Figures A-2 & A-3
2. Soil profiles are known with accuracy only at the locations observed.

The subsoil condition between borehole locations has been inferred from geological or geotechnical evidence and may vary from that shown.

SCALE AS SHOWN:

HORIZONTAL 1 IN. = 40 Feet

VERTICAL 1 IN. = 40 Feet

NORTH

GEOBASE

GEOLOGIC CROSS-SECTION A-A'

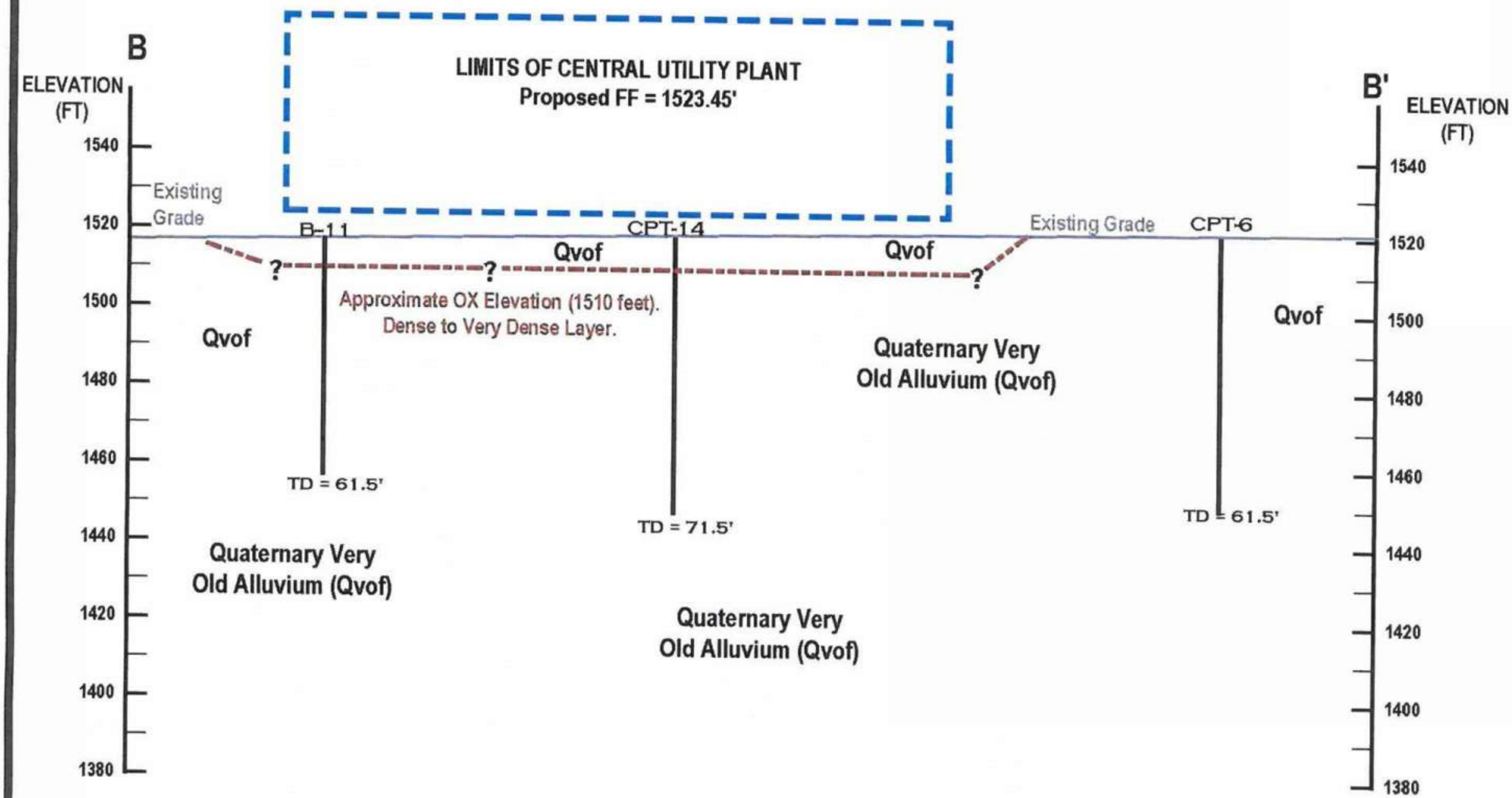
Kaiser Permanente MVMC -- CUP

27300 Iris Avenue

Moreno Valley, California

C.314.82.00

FIGURE A-5



EXPLANATIONS:

Qvof -- Quaternary Very Old Alluvium

TD -- Total depth of borehole

dense to very dense layer, overexcavation bottom

NOTES:

1. Locations of the cross section are shown on Figures A-2 & A-3
2. Soil profiles are known with accuracy only at the locations observed.

The subsoil condition between borehole locations has been inferred from geological or geotechnical evidence and may vary from that shown.

SCALE AS SHOWN:

HORIZONTAL 1 IN. = 40 Feet

VERTICAL 1 IN. = 40 Feet

NORTH

GEOBASE

GEOLOGIC CROSS-SECTION B-B'

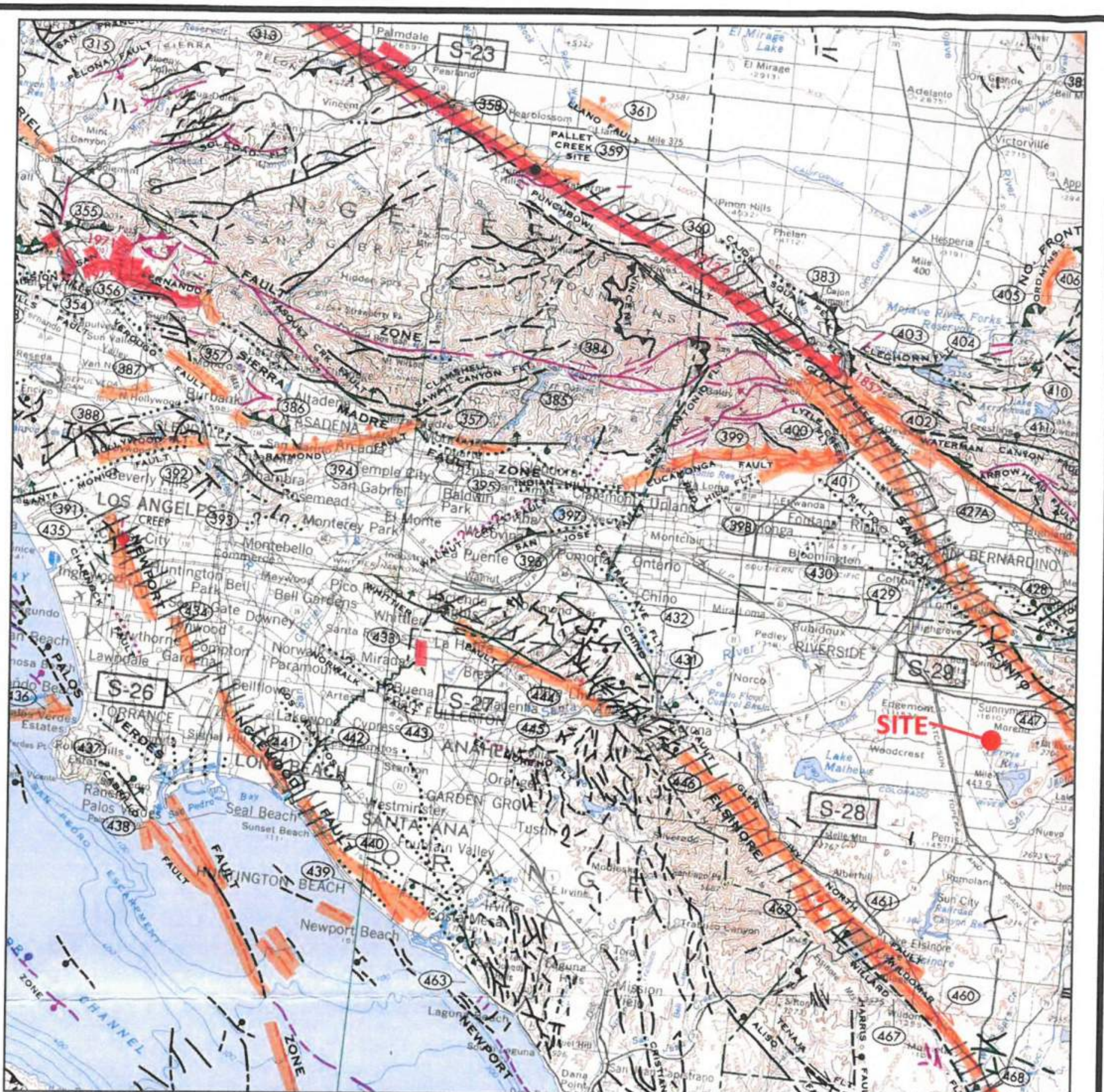
Kaiser Permanente MVMC -- CUP

27300 Iris Avenue

Moreno Valley, California

C.314.82.00

FIGURE A-6



EXPLANATION

Fault along which historic (last 200 years) displacement has occurred.

Holocene fault displacement (during past 10,000 years).

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

Late Cenozoic faults within the Sierra Nevada.

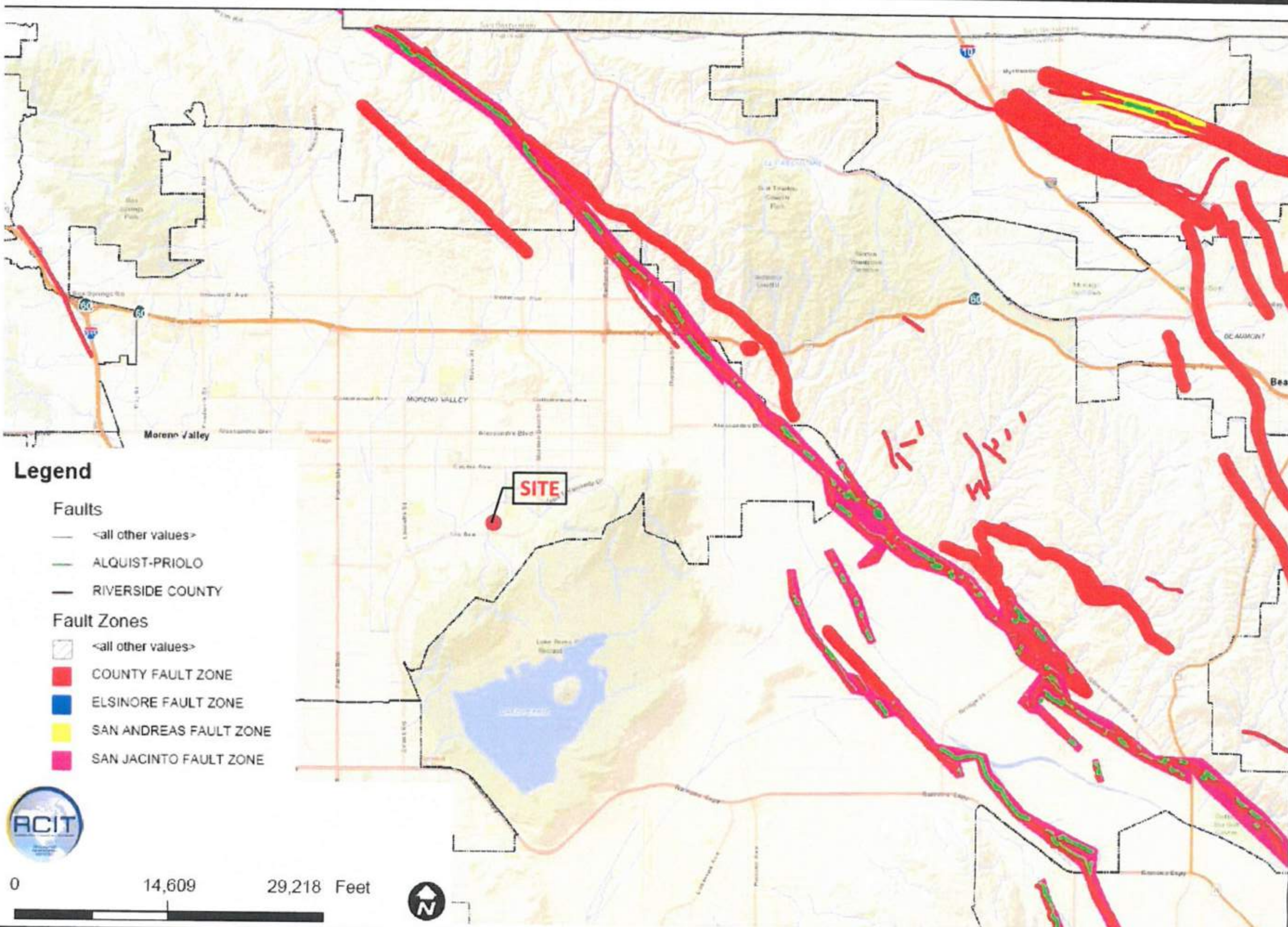
Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement.

Pink band added to emphasize location of historic fault displacement.

Approximate Scale 1 Inch Equals 10.89 Miles

Source: Jennings, C.W., 1994. Fault Activity map of California and Adjacent Areas with Location and Ages of Recent Volcanic Eruptions: California Division of Mines and Geology, Geologic Data Map Series, Map No. 6, Scale 1 : 750,000.

GEOBASE	C.314.82.00	**REGIONAL FAULT MAP** **Kaiser Permanente MVMC – CUP** **27300 Iris Avenue** **Moreno Valley, California** **FIGURE A-7**

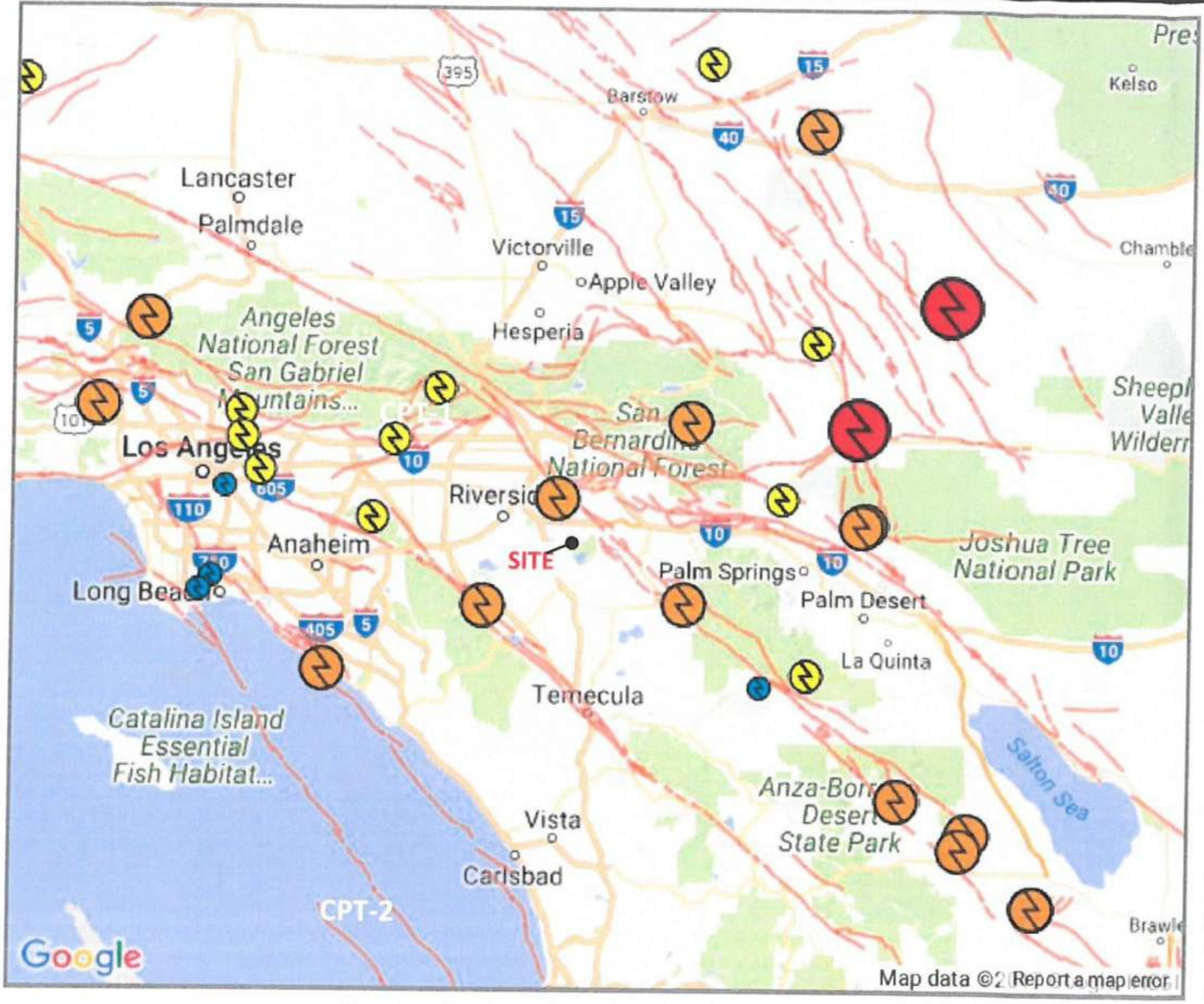


GEOBASE

C.314.82.00

VICINITY FAULT MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-8



Sources: Southern CA Earthquake Center, Division of Geological and Planetary Sciences | California Institute of Technology.

Note: Fault traces are in red as shown.

Magnitude

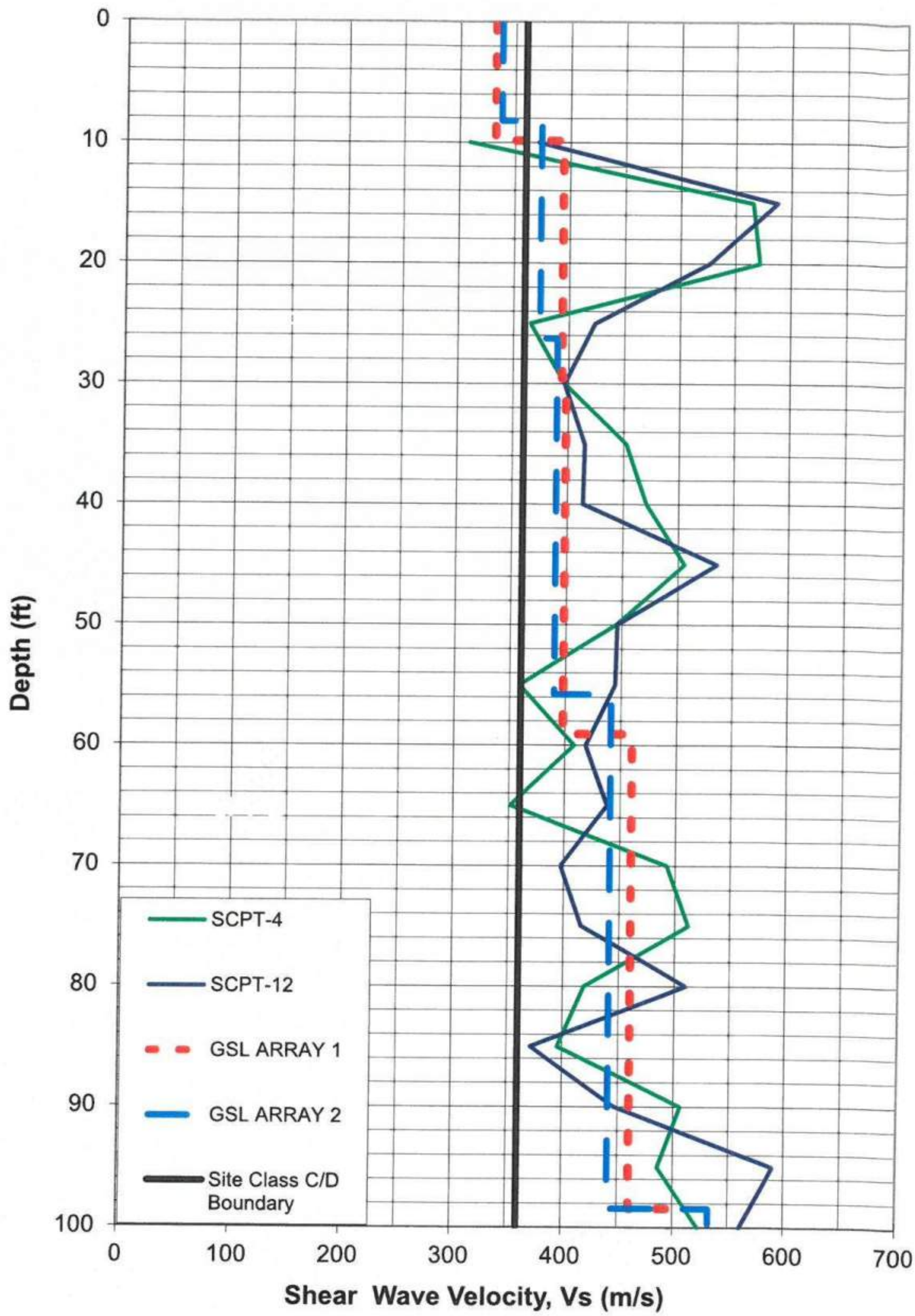
Marker	Magnitude
(blue)	✔ 4 ≤ 4.9
(yellow)	✔ 5 ≤ 5.9
(orange)	✔ 6 ≤ 6.9
(red)	✔ 7 ≤ 9.0

GEOBASE

HISTORICAL EARTHQUAKES MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-9

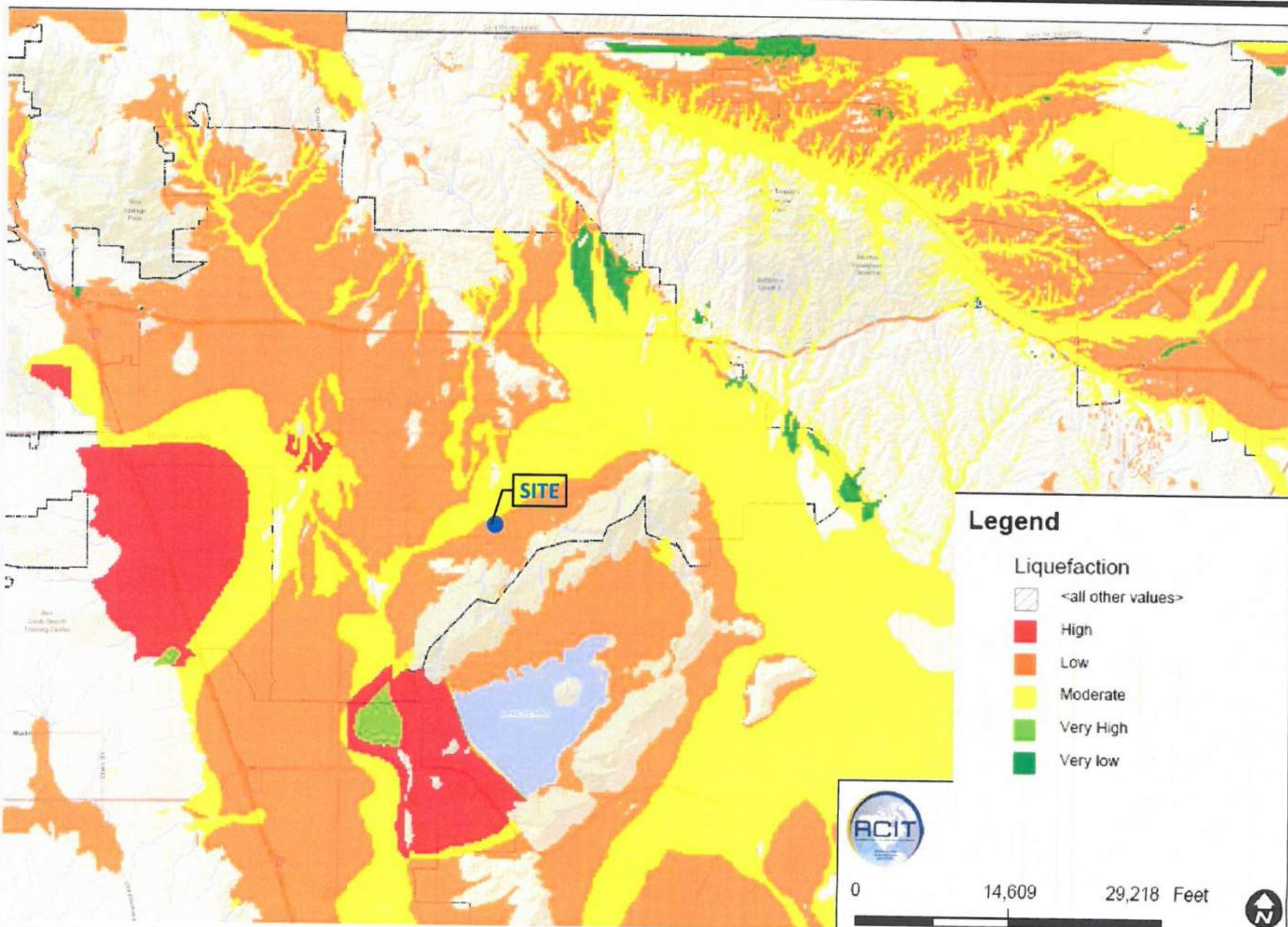


GEOBASE

SHEAR WAVE VELOCITY PROFILES
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-10

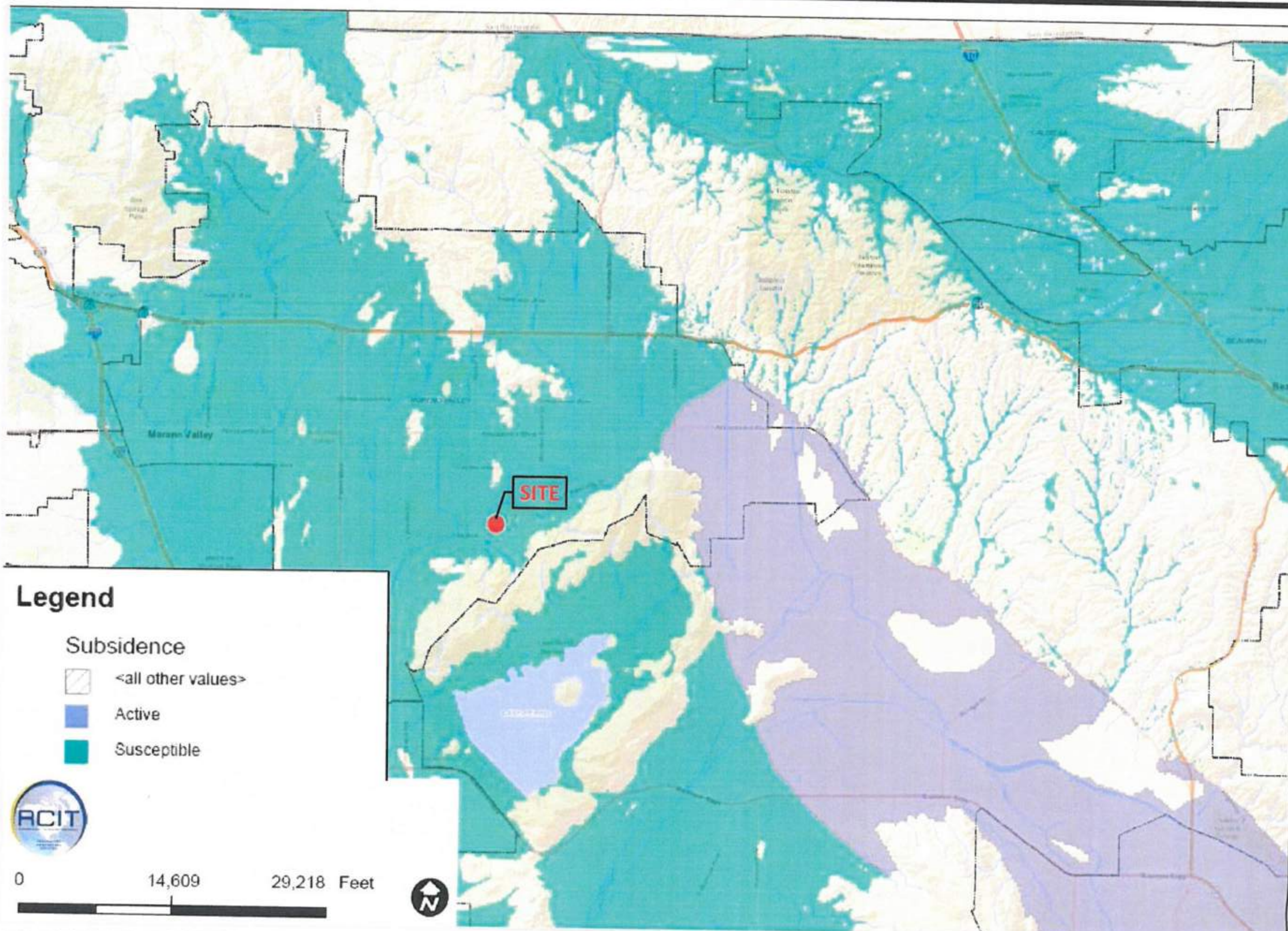


GEOBASE

C.314.82.00

LIQUEFACTION SUSCEPTIBILTY MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-11

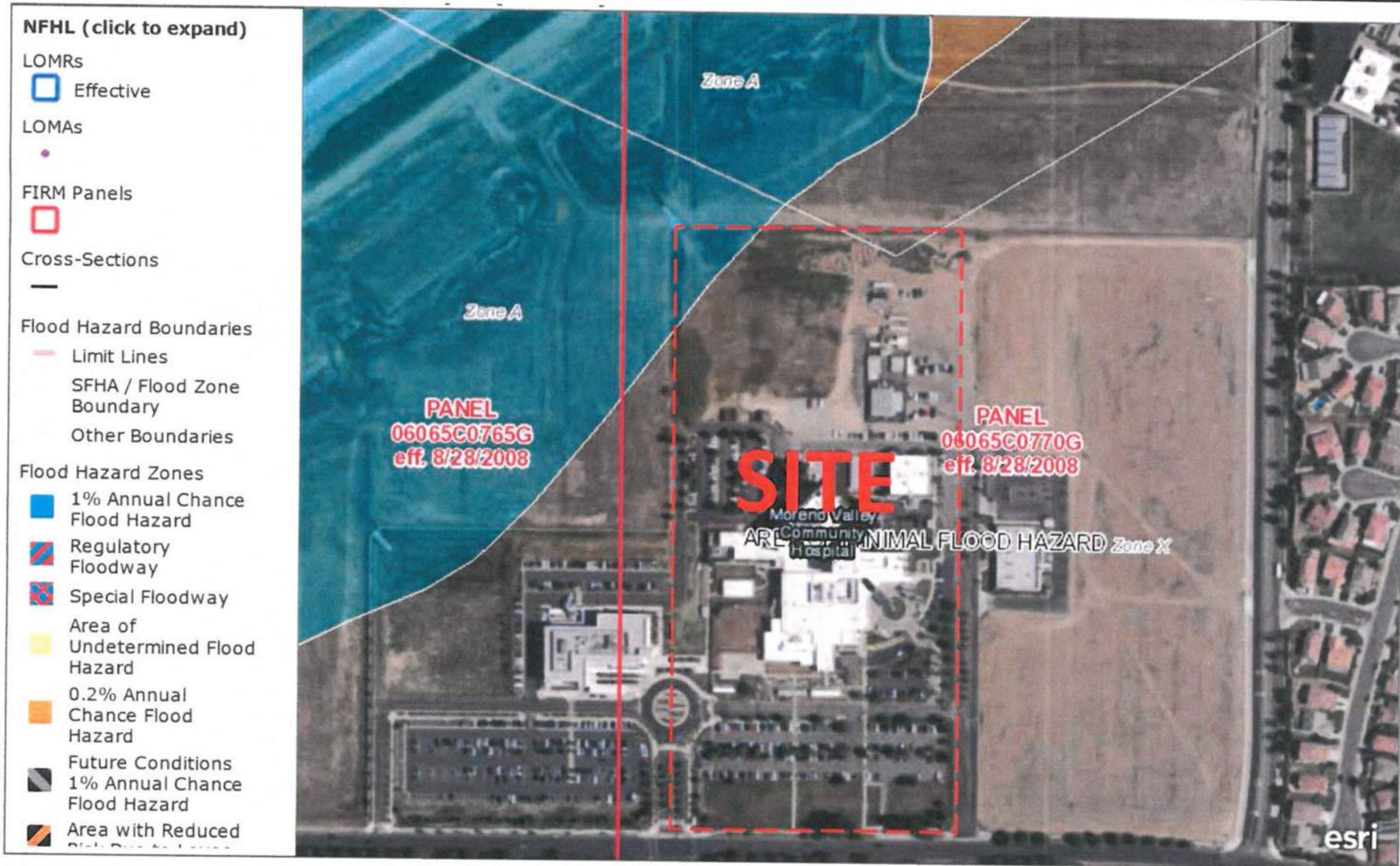


GEOBASE

SUBSIDENCE SUSCEPTIBILTY MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

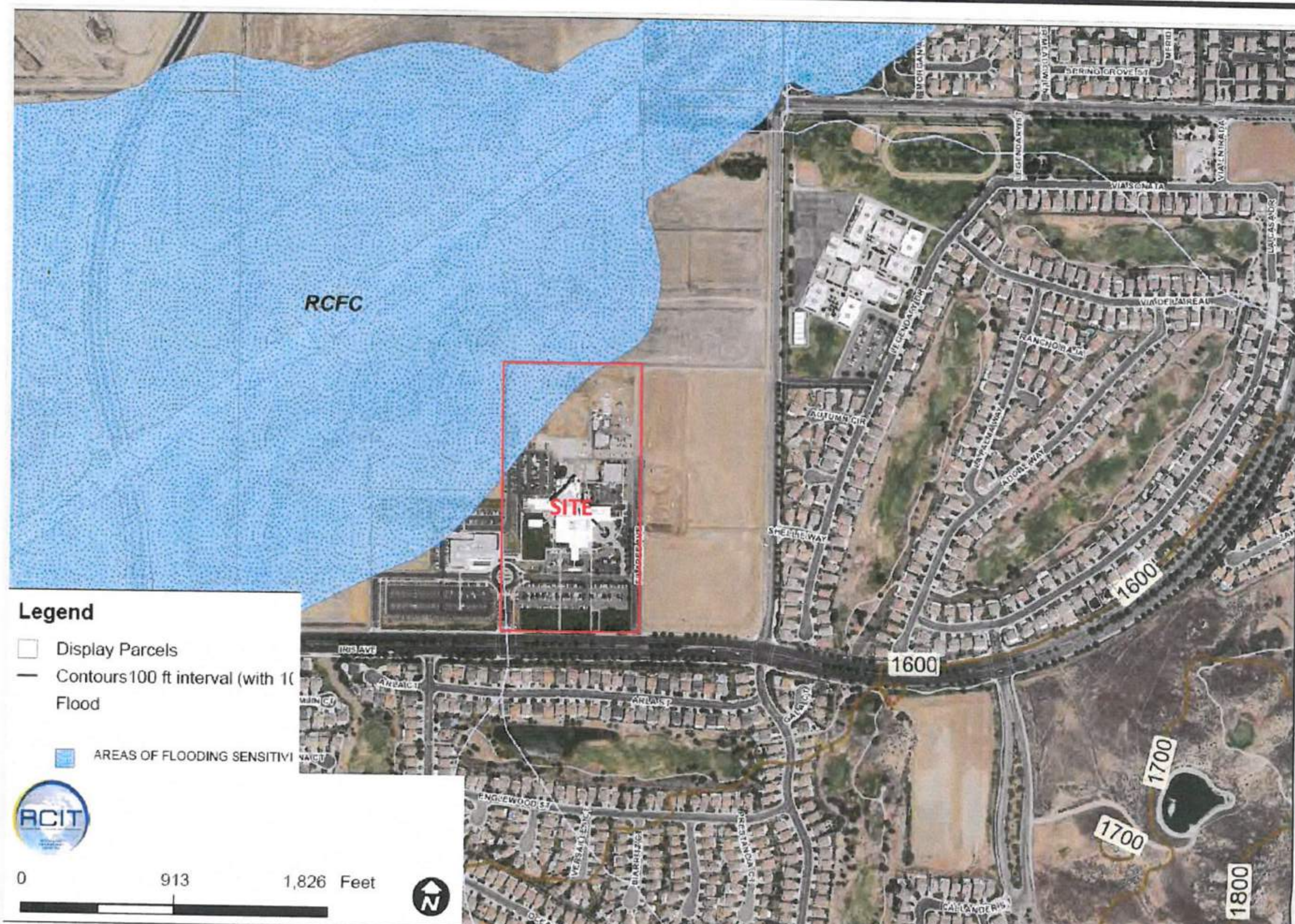
FIGURE A-12



Data from Flood Insurance Rate Maps (FIRMs) where available digitally. New NFHL FIRMette Print app available:

The **SITE** is in Zone X – Area determined to be outside of 0.2% annual chance of floodplain.
Zone A – 1% Annual Chance Flood Hazard

GEOBASE	C.314.82.00	**FEMA FLOOD MAP** **Kaiser Permanente MVMC – CUP** **27300 Iris Avenue** **Moreno Valley, California**	**FIGURE A-13** **Page 1 of 2**



GEOBASE

C.314.82.00

RCIT FLOOD MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-13
Page 2 of 2

APPENDIX B

GEOBASE INC (June 2010)

GeoVision Geophysical Services, Inc. (July 21, 2017)

The terms and symbols used on the Log of Borings to summarize the results of the field investigation and subsequent laboratory testing are described in the following:

It should be noted that materials, boundaries, and conditions have been established only at the boring locations, and are not necessarily representative of subsurface conditions elsewhere across the site.

A. PARTICLE SIZE DEFINITION (ASTM D2487 AND D422)

Boulder	-- larger than 12-inches	Sand, medium	-- No.40 to No. 10 sieves
Cobble	-- 3-inches to 12-inches	Sand, fine	-- No.200 to No. 40 sieves
Gravel, coarse	-- 3/4-inch to 3-inches	Silt	-- 5μm to No. 200 sieves
Gravel, fine	-- No.4 sieve to 3/4 -inch	Clay	-- smaller than 5 μm
Sand, coarse	-- No.10 to No.4 sieve		

B. SOIL CLASSIFICATION

Soils and bedrock are classified and described according to their engineering properties and behavioral characteristics. The soil of each stratum is described using ASTM D2487 and D2488.

The following adjectives may be employed to define percentage ranges by weight of minor components:

trace	--	1-10%	some	--	20-35%
little	--	10-20%	"and" or "y"	--	35-50%

The following descriptive terms may be used for stratified soils:

parting	--	0 to 1/16-in. thickness;	layer	--	½-in. to 12-in. thickness;
seam	--	1/16 to ½-in. thickness;	stratum	--	greater than 12-in. thickness.

C. SOIL DENSITY AND CONSISTENCY

The density of coarse grained soils and the consistency of fine grained soils are described on the basis of the Standard Penetration Test:

COARSE GRAINED SOILS		FINE GRAINED SOILS		
DENSITY	SPT BLOWS PER FOOT	ESTIMATED CONSISTENCY	SPT BLOWS PER FOOT	ESTIMATED RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TSF)
very loose	less than 4	very soft	less than 2	less than 0.25
loose	5 to 10	soft	2 to 4	0.25 to 0.50
medium	11 to 30	firm (medium)	5 to 8	0.50 to 1.0
dense	31 to 50	stiff	9 to 15	1.0 to 2.0
very dense	over 50	very stiff	16 to 30	2.0 to 4.0
		hard	over 30	over 4.0

D. STANDARD PENETRATION TEST (SPT) -- D1586

The SPT test involves failure of the soil around the tip of a split spoon sampler for a condition of constant energy transmittal. The split spoon, 2-inches outside diameter and 1 3/8-inches inside diameter, is driven eighteen (18) inches. The sampler is seated in the first six (6) inches and the number of blows required to drive the sampler the last foot is recorded as the "N" value or SPT blow count. The driving energy is provided by a 140 pound weight dropping thirty (30) inches.

E. ABBREVIATION OF LABORATORY TEST DESIGNATIONS

C	Consolidation	pH	pH
CBR	California Bearing Ratio	pp	Pocket Penetrometer
Ch	Water Soluble Chlorides	PS	Particle Size
DS	Direct Shear	RV	R-Value
EI	Expansion Index	SE	Sand Equivalent
ER	Electrical Resistivity	SG	Specific Gravity
k	Permeability	SO_4	Water Soluble Sulfates
MD	Moisture	TX	Triaxial Compression
MP	Modified Proctor Compaction Test	TV	Torvane Shear
O	Organic Content	U	Unconfined Compression

F. STRATIFICATION LINES

The stratification lines indicated on the boring logs and profiles represent the ***approximate*** boundary between material types and the transition may be gradual.

SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISION			GROUP SYMBOL	GRAPHIC SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt		Peat and other highly organic soils	Strong color or odor and often fibrous texture
COARSE-GRAINED SOILS (More than half by weight larger than No. 200 sieve size)	GRAVELS (More than half coarse fraction larger than No. 4 sieve size)	CLEAN GRAVELS	GW		Well-graded Gravels, Gravel-Sand mixtures (<5% fines)	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP		Poorly-graded Gravels and Gravel-Sand mixtures (<5% fines)	Not meeting all above requirements
		DIRTY GRAVELS	GM		Silty Gravels, Gravel-Sand-Silt mixtures (>12% fines)	Atterberg limits below "A" line or $I_p < 4$
			GC		Clayey Gravels, Gravel-Sand-Clay mixtures (>12% fines)	Atterberg limits above "A" line or $I_p > 7$
	SANDS (More than half coarse fraction smaller than No. 4 sieve size)	CLEAN SANDS	SW		Well-graded Sands, Gravelly Sands (<5% fines)	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP		Poorly-graded Sands or Gravelly Sands (<5% fines)	Not meeting all above requirements
		DIRTY SANDS	SM		Silty Sands, Sand-Silt mixtures (>12% fines)	Atterberg limits below "A" line or $I_p < 4$
			SC		Clayey Sands, Sand-Clay mixtures (>12% fines)	Atterberg limits above "A" line or $I_p > 7$
FINE-GRAINED SOILS (More than half by weight passes No. 200 sieve size)	SILTS Below "A" line on plasticity chart: negligible organic content		ML		Inorganic Silts and very fine Sands, Rock Flour, Silty Sands of slight plasticity	$W_L < 50$
			MH		Inorganic Silts micaceous or diatomaceous, fine Sandy or Silty soils	$W_L > 50$
	CLAYS Above "A" line on plasticity chart: negligible organic content		CL		Inorganic Clays of low plasticity, Gravelly, Sandy, or Silty Clays, lean Clays	$W_L < 30$
			CI		Inorganic Clays of medium plasticity, Silty Clays	$W_L > 30, < 50$ See chart below
			CH		Inorganic Clays of high plasticity, fat Clays	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS Below "A" line on plasticity chart		OL		Organic Silts and organic Silty Clays of low plasticity	$W_L < 50$
			OH		Organic Clays of high plasticity	$W_L > 50$

The soil of each stratum is described using ASTM D2487 and D2488 modified slightly so that an inorganic clay of "medium plasticity" is recognized.

ADDITIONAL SOIL CLASSIFICATION

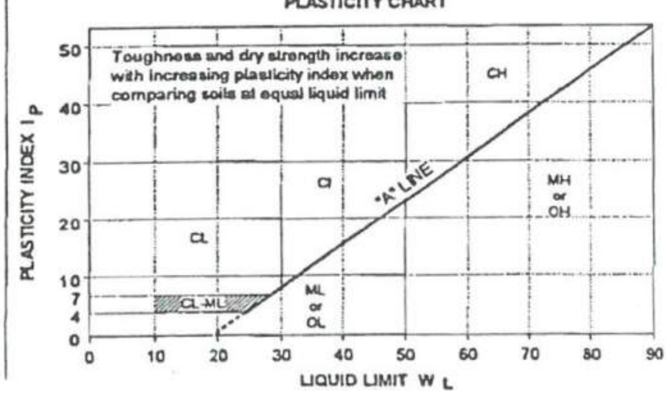
Fill Soil

Ss Sandstone

Cs Claystone

Ms Siltstone

PLASTICITY CHART



GEOBASE

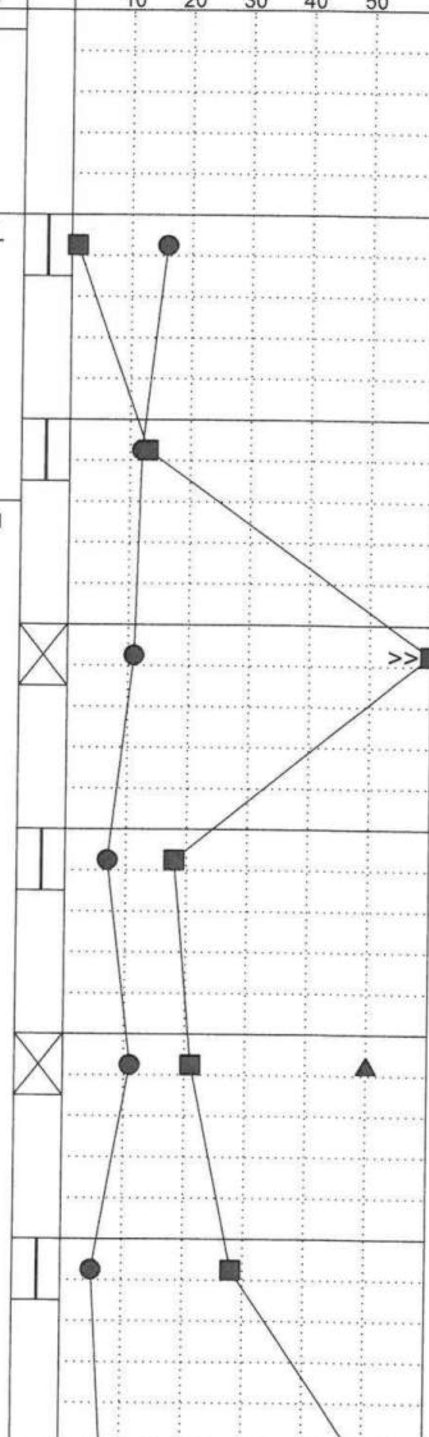
EXPLANATION OF TERMS AND SYMBOLS USED

Figure B-1

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		GRASS AND ROOTS, GRASS				
		SAND (FILL), brown, clayey, very loose.				
5		SILT, brown, fined-sands, little clay, very soft.	ML			N = PUSH 200 Wash
10		...stiff				
		SAND, brown, fine- to medium-grained, some silt.	SM			
15		...coarse-grained, little gravels, very dense			>>	Blowcount = 94/12 in.
20		...medium- to coarse-grained, silty, medium dense				
25		...trace of gravels, medium dense				Blowcount = 32/12 in.
30		...poorly graded, trace to little silt, little gravels, medium dense				
35						



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017	FIGURE NO. B- 2

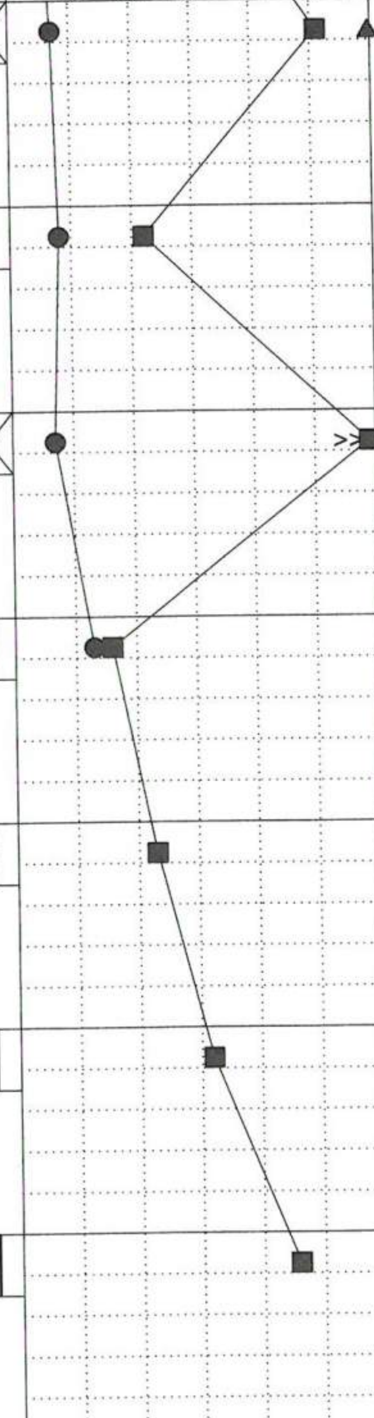
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DRY DENSITY (PCF): 80 90 100 110 120
Water Content (%): ●
Plastic Limit (W_P) |—| Liquid Limit (W_L)
Penetration, blows/foot: ■ 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
	SAND, light brown, medium- to coarse-grained, trace to little silt, little gravels, very dense.	SM	California Modified	Blowcount = 78/12 in. 200 Wash
40	...silty, medium dense		SPT	200 Wash
45	...coarse-grained, some silt and fine-gravels, very dense		California Modified	Blowcount = 90/12 in. 200 Wash
50	SAND, brown, little silt, trace of gravel, medium dense.	SM	SPT	
	SAND, light brown, medium- to coarse-grained, little pea gravels, trace of silt, medium dense.	SP		
55	...minor seepage at 56.5 ft		SPT	
	SAND, light brown, medium- to coarse grained, some gravels, dense	SM		
60			SPT	PS
65	...little silt, trace of gravels, dense		SPT	PS
70	End of Boring at 66.5 feet. Boring dry at completion of drilling.. Backfilled with soil cuttings.			



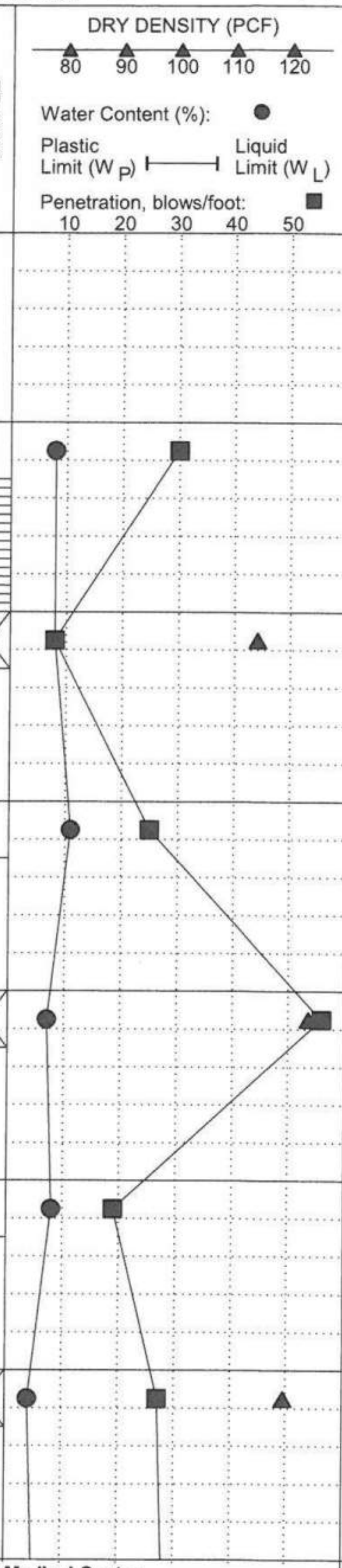
GEOBASE, INC.	PROJECT: KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/07/2017	FIGURE NO. B-2

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	GRASS AND ROOTS, GRASS		
	SILT (FILL), brown, little sand and clay, soft.		
5	...some sands, very stiff		
	SAND, brown, fine- to medium-grained, sandy SILT with little clay.	SM-ML	Bulk Sample 5-10 ft. EI, MP, 95 RC, Ch, ER, pH, SO_4
10	...firm, some clay		Blowcount = 11/12 in. C, DS
15	...coarse-grained, little gravels, medium dense.		
	SAND, brown,.medium- to coarse-grained, silty, cementation, very dense	SM	
20			Blowcount = 86/12 in. C, DS
25	...trace of gravels, medium dense		
30	...poorly graded, trace to little silt, little gravels, medium dense		Blowcount = 41/12 in. C, DS
35			



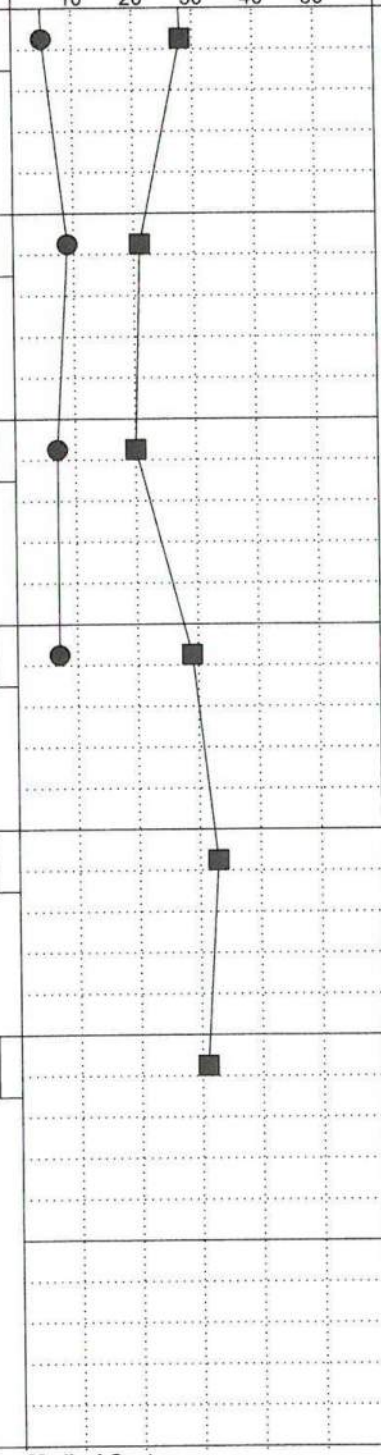
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA**	**BORING NO. B-2**
	DEPTH TO WATER feet	SURFACE ELEV. **1535 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/07/2017**	FIGURE NO. B- **3**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) — Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, medium- to coarse-grained, trace to little silt, little gravels, medium dense.	SP-SM			
40		...silty, white streak rock				
45		...silty				200 Wash
50		...fine-grained, silty				
55		...dense, minor seepage at 56 ft				
60		SAND, light brown, coasrse-grained, trace of silt, little gravel, dense.	SP			
65		End of Boring at 66.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
70						



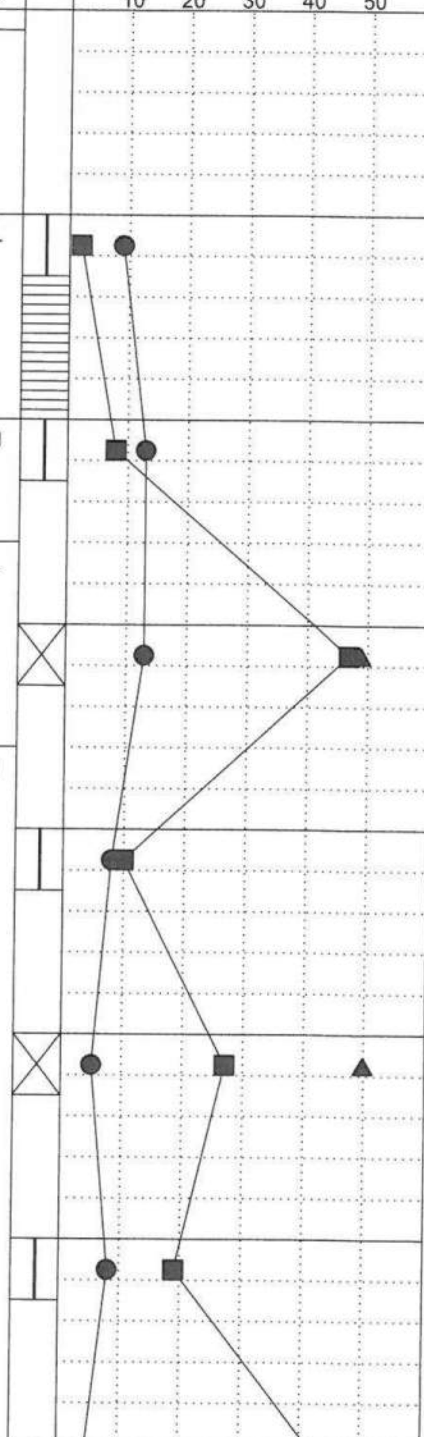
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center** **27300 Iris Avenue, Moreno Valley, CA**	BORING NO. **B-2**
	DEPTH TO WATER feet	SURFACE ELEV. **1535 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** / DRILLER **Martini Drilling** / DATE LOGGED **06/07/2017**	FIGURE NO. B- **3**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		GRASS AND ROOTS, GRASS				
		SAND (FILL), brown, silty, very loose.				
5		SILT, brown, some fine-grained sand, soft.	ML			Bulk Sample 5-10 ft. EI, MP, 95 RC Ch, ER, pH, SO_4
10		SAND, brown, fine-grained, silty, loose.	SM			
		SILT, brown, little fine-grained sand, cementation, hard.	ML			
15						Blowcount = 72/12 in. DS, 200 Wash
		SAND, ...medium- to coarse-grained, silty.	SM			
20		...some silt, loose				
25		...trace of gravels, medium dense				Blowcount = 42/12 in.
30		...micaceous, fine- to medium-grained, silty and little gravels				
35						



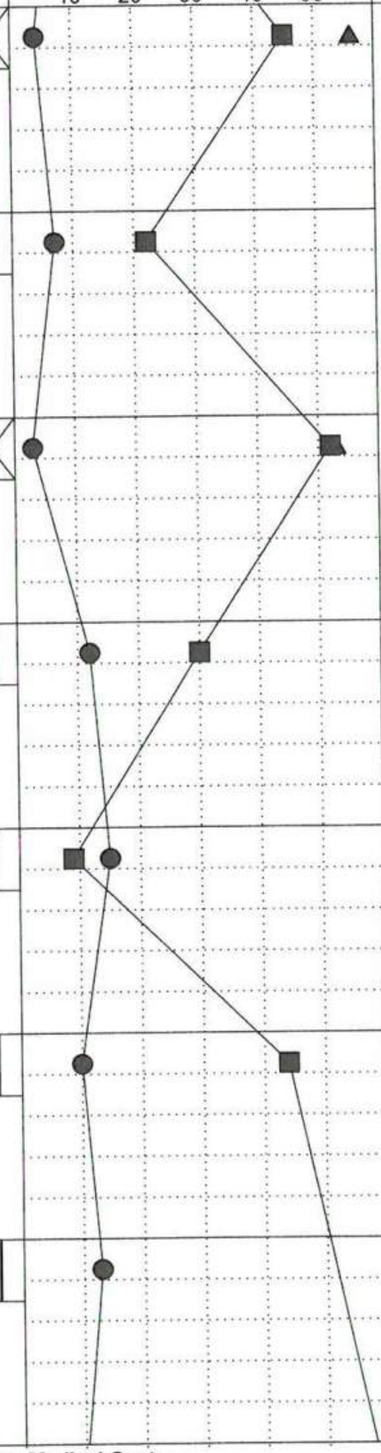
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-3
	DEPTH TO WATER feet	SURFACE ELEV. 1525 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017	FIGURE NO. B- 4

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, medium- to coarse-grained, siltyt, trace of gravels, dense.	SM			Blowcount = 69/12 in. DS, 200 Wash
40		...medium dense				
45		SAND, light brown, trace of silt and gravel, dense to very dense.	SP			Blowcount = 80/12 in.
50		...coasrse-grained, little gravels, dense ...minor seepage at 51 ft				
55		SILT, brown, little sands, stiff.	ML			
60		SAND, brown, medium-grained, little silt and trace of gravel, dense.	SM			
65		SAND, brown, coarse-grained, little gravel, trace of silt, medium dense.	SP			
70						



GEOBASE, INC.	PROJECT: KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-3
	DEPTH TO WATER feet	SURFACE ELEV. 1525 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/07/2017	FIGURE NO. B- 4

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, trace of silt, some gravels, very dense.	SP			
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

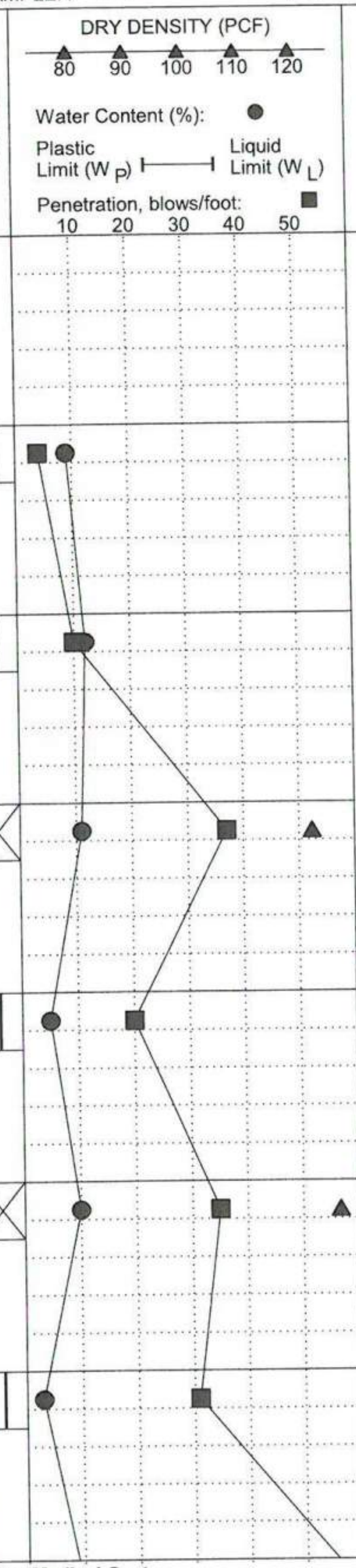
GEOBASE, INC.				
PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA			BORING NO. B-3
DEPTH TO WATER feet	SURFACE ELEV. 1525 feet	LOGGED BY HDN		PROJECT NO. C.314.81.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017		FIGURE NO. B-4

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
0	SAND (FILL), brown, silty, very loose.	SM		
5	SILT, brown, little fine- to coarse-grained sand, soft.	ML	SPT	
10	...stiff		SPT	
12	SAND, brown, silty, medium- to coarse grained, micaceous.	SM		
15	...dense		California	Blowcount = 37/12 in. C, DS, 200 Wash
20	...fine- to medium grained, little silt, medium dense		SPT	200 Wash
25	...silty, dense		California	Blowcount = 54/12 in.
30	SAND, light brown, fine- to medium grained, little silt, micaceous, dense.	SP	SPT	



DEPTH (feet): 5, 10, 15, 20, 25, 30, 35

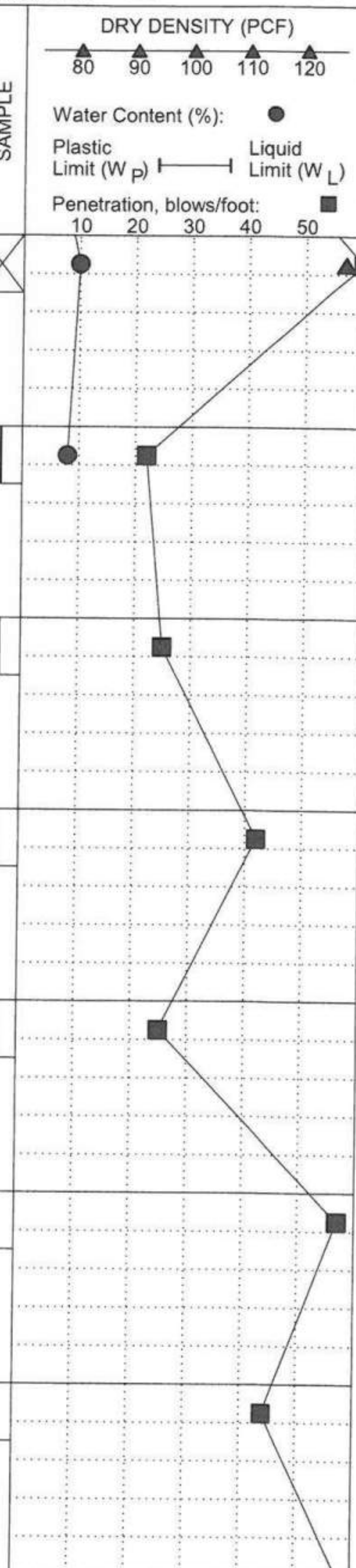
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling / DATE LOGGED 06/08/2017	FIGURE NO. B- 5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) / Water Content (%) / Plastic Limit (W_P) – Liquid Limit (W_L) / Penetration, blows/foot	REMARKS/ OTHER TESTS
		SAND, brown, medium- to coarse-grained, little silt, very dense.	SP-SM			Blowcount = 91/10 in.
40		...silty medium dense				
45		...fine-grained, silty, medium dense				
50		...little silt, trace of gravel, dense				PS
55		SAND, brown, silty, fine-grained, medium dense. ...minor seepage at 56 ft	SM			
60		SAND, light brown, coarse-grained, trace of silt, very dense.	SP			
65		...fine- to medium-grained, dense				
70						



GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA**	**BORING NO. B-4**
	DEPTH TO WATER feet	SURFACE ELEV. **1526 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/08/2017**	FIGURE NO. B- **5**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, coarse grained, little silt, trace of fined-gravels, very dense.	SM			N = 79, PS
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

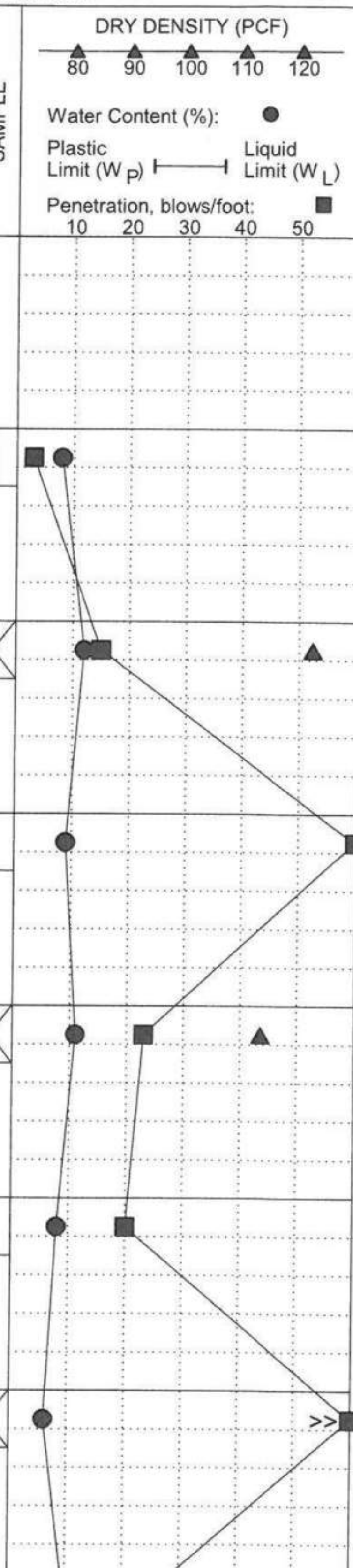
GEOBASE, INC.	PROJECT **KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA**		BORING NO. **B-4**
	DEPTH TO WATER feet	SURFACE ELEV. **1526 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/08/2017**	FIGURE NO. B- **5**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	SAND (FILL), brown, silty, very loose.	SM	
5	SILT, brown, fine-grained sands, soff	ML	
10	...sandy, stiff		Blowcount = 23/12 in.
	SAND, brown, silty, cementation, micaceous, trace of gravels.	SM	
15	...white streak, very dense		N = 83
	SILT, ...some sands, very stiff.	ML	
20			Blowcount = 35/12 in.
	SAND, brown, silty, fine-grained, medium dense.	SM	
25			200 Wash
30	...light brown, silty, very dense.		Blowcount = 98/11 in. 200 Wash
35			



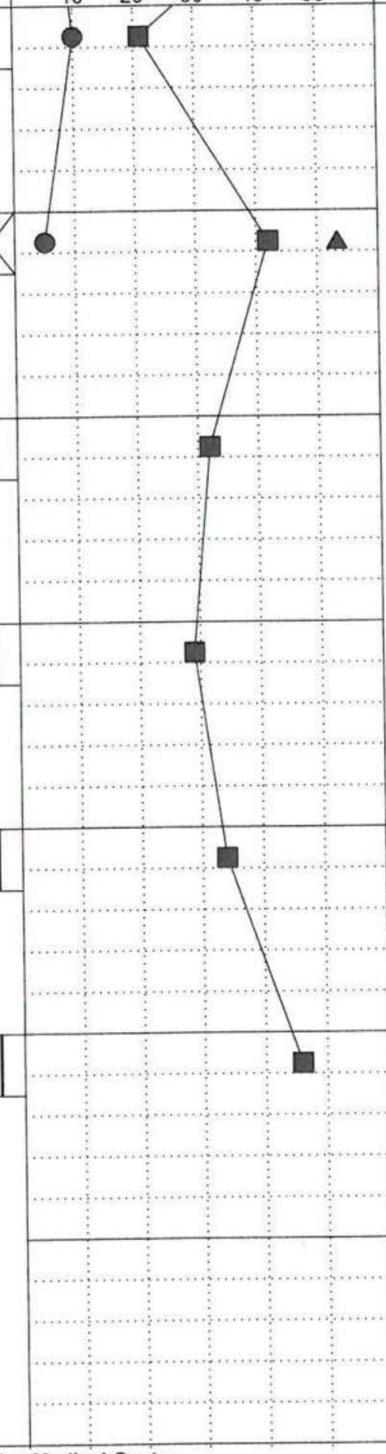
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA**	BORING NO. **B-5**
	DEPTH TO WATER feet	SURFACE ELEV. **1527 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/08/2017**	FIGURE NO. B- **6**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, medium- to coarse-grained, silty, medium dense.	SM			
40		...dense				Blowcount = 65/12 in.
45		...fine-grained, little gravels, dense				
50		SAND, light brown, fine- to medium-grained, little fine-gravels, medium dense.	SP			
55		...silty, dense ...minor seepage at 56 ft				
60		SAND, light brown, coarse-grained, little fine-gravel, dense.	SP			
65		End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
70						



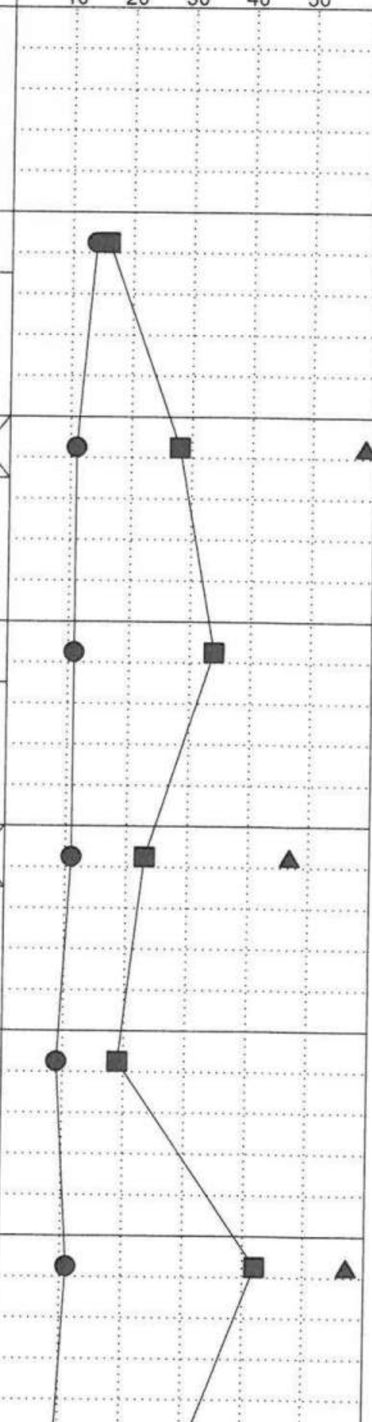
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-5
	DEPTH TO WATER feet	SURFACE ELEV. 1527 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-6

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%): ● / Plastic Limit (W_P) ├─┤ Liquid Limit (W_L) / Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
0		SAND (FILL), brown, silty, very loose.	SM			
5		SILT, brown, fine-grained sands, stiff.	ML			
10		...some sands, very stiff				Blowcount = 43/12 in.
15		...little micaceous sands, white streak, cementation,, hard.				
20		...some sands, very stiff.				Blowcount = 35/12 in.
		SAND, brown, silty, fine-grained, medium dense.	SM			
25						
30		...little fine-gravel, dense				Blowcount = 64/12 in.
35						



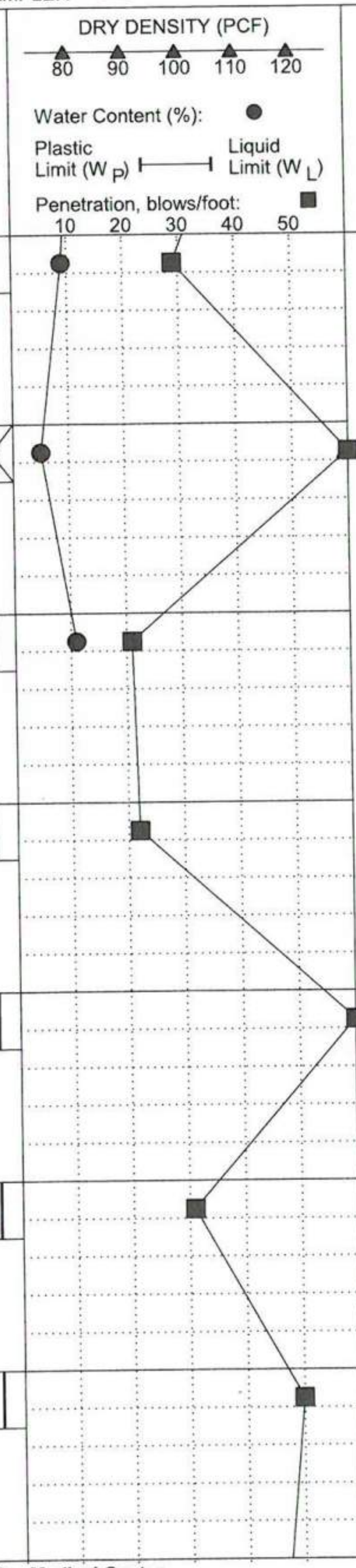
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. **B-6**
	DEPTH TO WATER feet	SURFACE ELEV. **1520 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/08/2017**	FIGURE NO. B-7

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, brown, medium- to coarse-grained, little silt and gravels, medium dense.	SM	
40	...well-graded, trace of silt, some fine-gravels, very dense		Blowcount = 85/11 in.
45	...fine-grained, little gravels, medium dense		
50	SILT, brown, some sands, very stiff.	ML	
	...minor seepage at 51.5 ft		
55	SAND, light brown, coarse-grained, micaceous, fined-gravels, very dense.	SW	N = 66 PS
60			
	SAND, brown, coarse-grained, little fine-gravel and silt, dense.	SM	
	SAND, light brown, coarse-grained, trace of silt and gravels, very dense.	SP	
65			PS
70			



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. **B-6**
	DEPTH TO WATER feet	SURFACE ELEV. **1520 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/08/2017**	FIGURE NO. B- **7**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, silty, trace of gravels, dense.	SM			
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

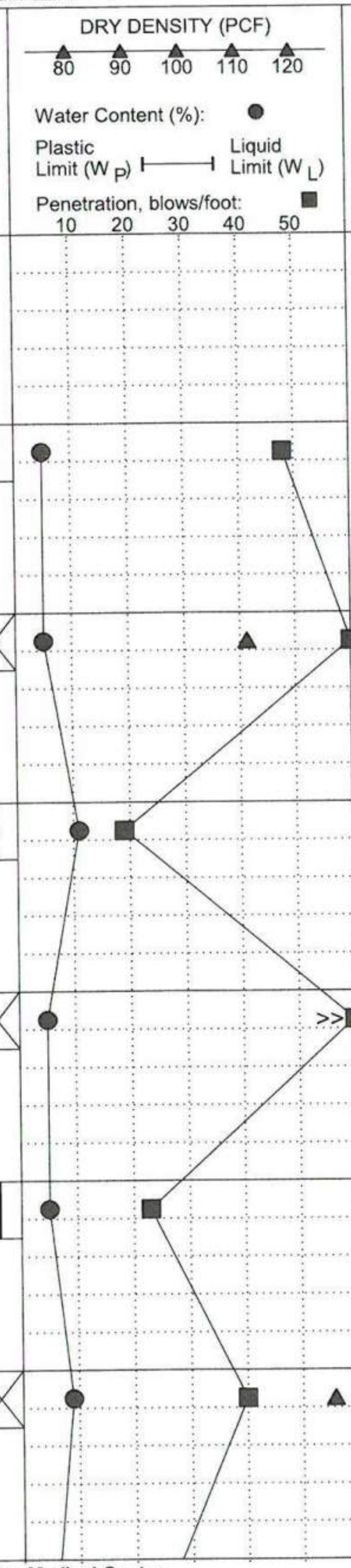
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. B-6
	DEPTH TO WATER feet	SURFACE ELEV. 1520 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/08/2017	FIGURE NO. B-7

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	GRASS AND ROOTS,		
	SAND, brown, silty, very loose.	SM	
5	SILT, brown, little fine-grained sands, hard.	ML	
10	...cementation, sandy, hard		Blowcount = 50/5 in. C, DS
15	...trace of sands, stiff		
20	SAND, brown, silty, fine-grained, very dense.	SM	Blowcount = 85/11 in.
25	...micaceous, some silt, medium dense		
30	...silty, dense		Blowcount = 60/12 in.
35			



GEOBASE, INC.	PROJECT: KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-7
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/08/2017	FIGURE NO. B-8

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

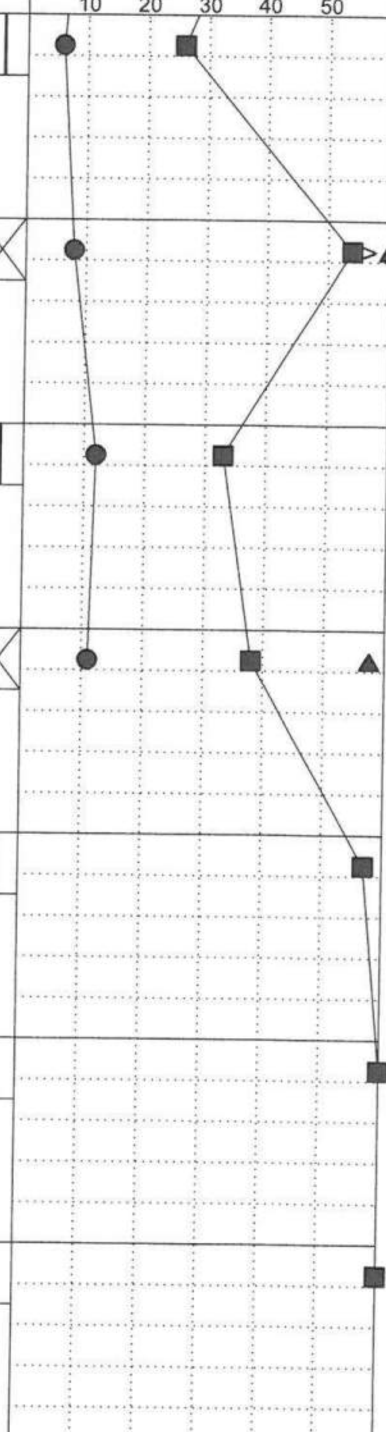
DRY DENSITY (PCF): 80 90 100 110 120

Water Content (%): ●

Plastic Limit (W_P) — Liquid Limit (W_L)

Penetration, blows/foot: ■ 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, brown, medium- to coarse-grained, little silt and gravels, medium dense.	SM	PS
40	...little silt, trace of fine-gravels, very dense		Blowcount = 83/12 in.
45	SAND, light, brown, little fine-gravels, trace of silt, dense.	SP	
50	SAND, brown, some silt, little gravels, dense.	SM	Blowcount = 54/12 in.
	...minor seepage at 51.5 ft		
55	SAND, light brown, micaceous, litte silt and fine-gravels, very dense.	SP-SM	
60	...silty, little gravels, very dense		
65	...coarse-grained to fine-gravels		N = 79
70			



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-7
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-8

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, little silt, some fine-gravels, very dense.	SP			N = 74
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center** **27300 Iris Avenue, Moreno Valley, CA**		**BORING NO. B-7**
	DEPTH TO WATER feet	SURFACE ELEV. **1517 feet**	LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling**	DATE LOGGED **06/08/2017**	FIGURE NO. B-**8**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

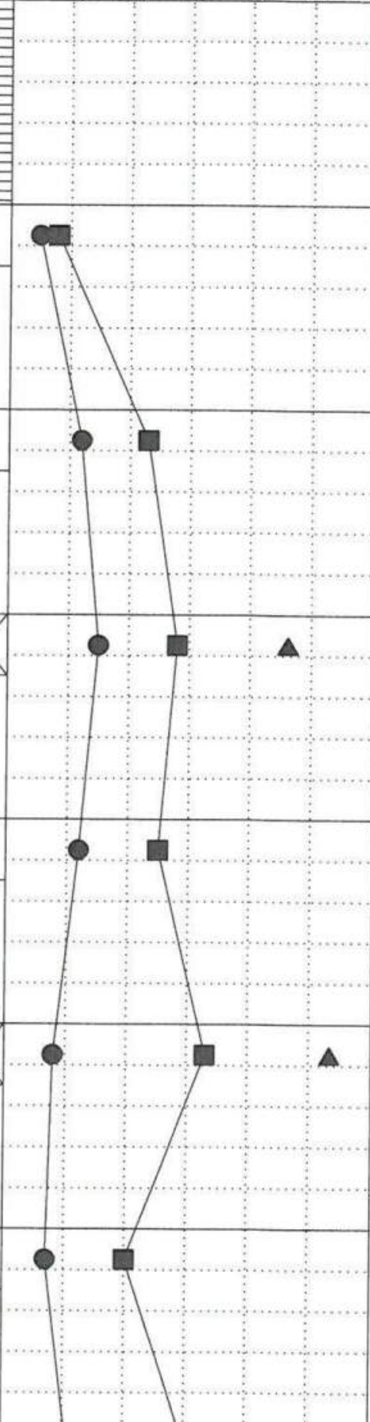
DRY DENSITY (PCF): 80 90 100 110 120

Water Content (%): ●

Plastic Limit (W_P) ├──┤ Liquid Limit (W_L)

Penetration, blows/foot: ■ 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	GRASS AND ROOTS,		
	SAND, brown, silty, very loose.	SM	Bulk Sample 0-5 ft. EI, MP, RV, 200 Wash, 95 RC, Ch, ER, pH, SO_4
5	SILT, brown, some fine-grained sands, firm.	ML	
10	...little sands, very stiff		
15	...trace of sand		Blowcount = 43/12 in.
20	...little sands		
25	SAND, brown, fine-grained, silty, dense.	SM	Blowcount = 50/12 in.
30	...fine-grained, medium dense		
35			



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-8
	DEPTH TO WATER feet	SURFACE ELEV. 1514 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B-9

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE; SPT SPLIT SPOON; CALIFORNIA MODIFIED SAMPLER; DISTURBED; NO RECOVERY; CORE

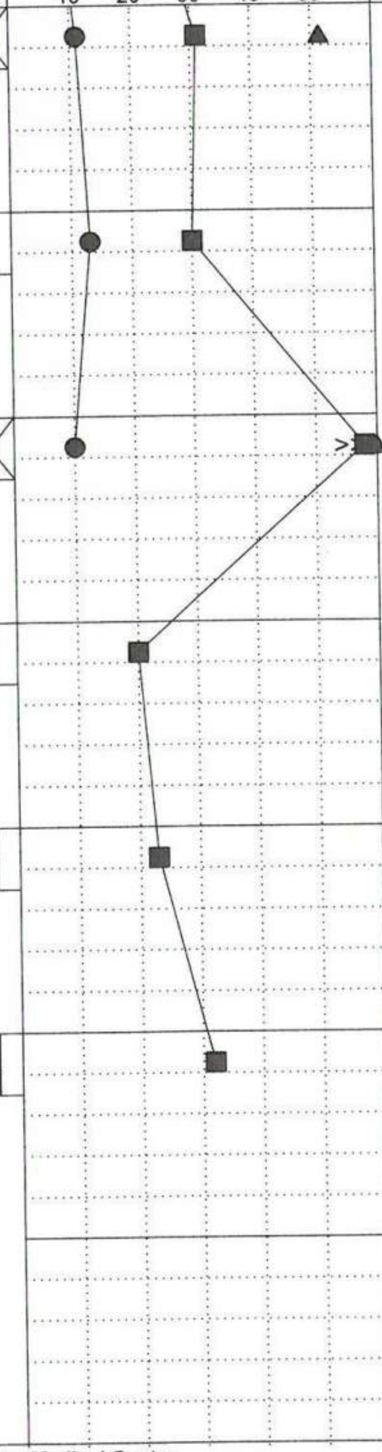
DRY DENSITY (PCF): 80 90 100 110 120

Water Content (%): ●

Plastic Limit (W_P) ├──┤ Liquid Limit (W_L)

Penetration, blows/foot: ■ 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, brown, medium- to coarse-grained, little silt and gravels, dense.	SM	Blowcount = 48/12 in.
40	...light gray, fine- to medium-grained		
45	... little fine-gravels and silt, very dense.		Blowcount = 89/12 in. PS
50	brown, some silt, trace of gravels, medium dense.		
55	...silty ...minor seepage at 56 ft		
60	...silty, fine- to medium-grained, dense		
65	End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.		
70			



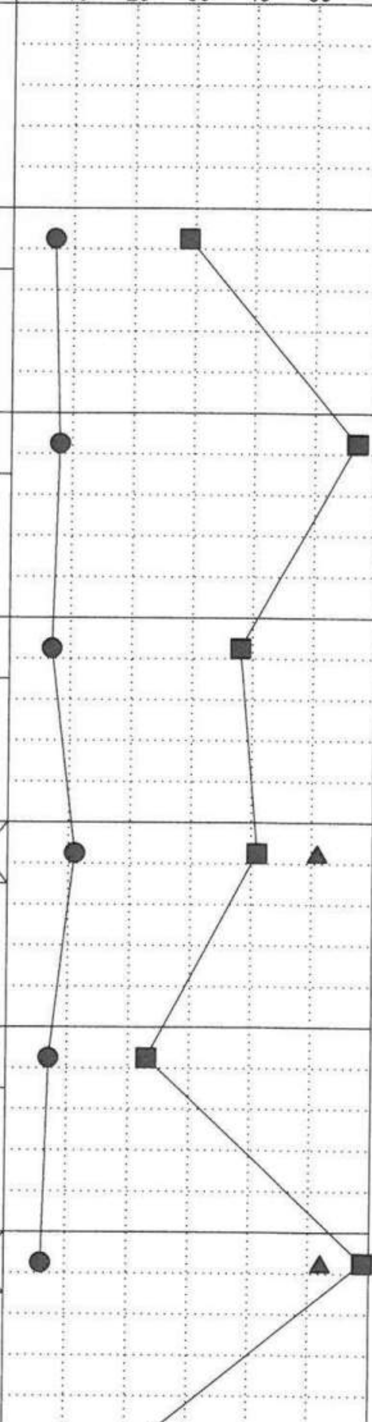
GEOBASE, INC.	PROJECT: KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-8
	DEPTH TO WATER feet	SURFACE ELEV. 1514 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/09/2017	FIGURE NO. B-9

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) — Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		GRASS AND ROOTS,				
		SAND (FILL), brown, silty, very loose.	SM			
		SILT, brown, little fine-grained sands.	ML			
5		...very stiff				
10		...some sands, cementation, hard				
15		...hard				
20		SAND, brown, silty, fine-grained, dense.	SM			Blowcount = 63/12 in. C, DS
25		...silty, trace of gravels, medium dense				200 Wash
30		...little fine-gravels, very dense.				Blowcount = 80/11 in.
35						



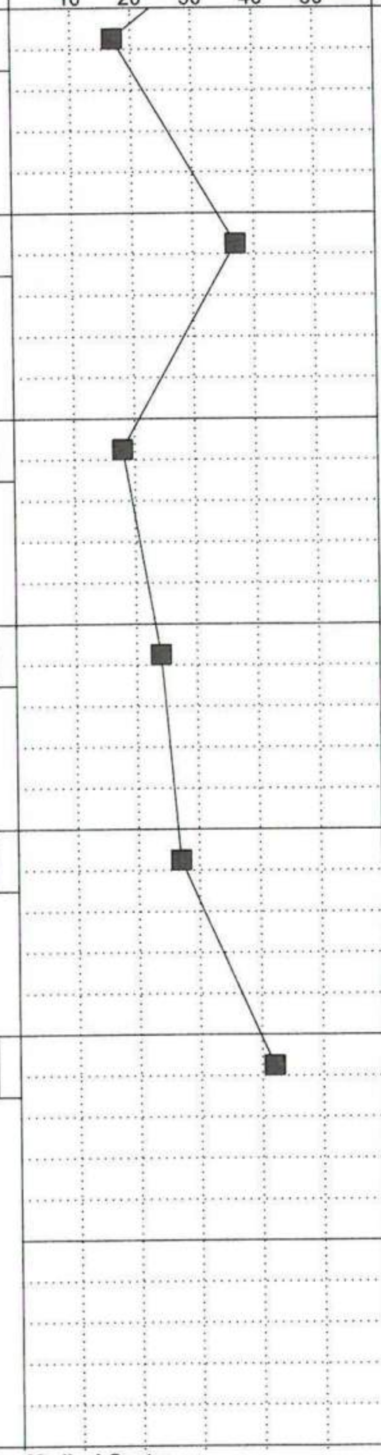
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. **B-9**
	DEPTH TO WATER feet	SURFACE ELEV. **1516 feet**	LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling**	DATE LOGGED **06/09/2017**	FIGURE NO. B- **10**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) / Plastic Limit (W_P) — Liquid Limit (W_L) / Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, some gravels, little silt, medium dense	SM			
40		SAND, light brown, fine-grained, trace of silt, dense.	SP			
45		SAND, brown, little to some silt, medium dense.	SM			
50		...silty,				
		...seepage at 51.5 ft				
55		...medium-grained				
60		SAND, light brown, coarse-grained, some gravels, trace of silt, dense.	SW			PS
65		End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
70						



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-9
	DEPTH TO WATER feet	SURFACE ELEV. 1516 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B-10

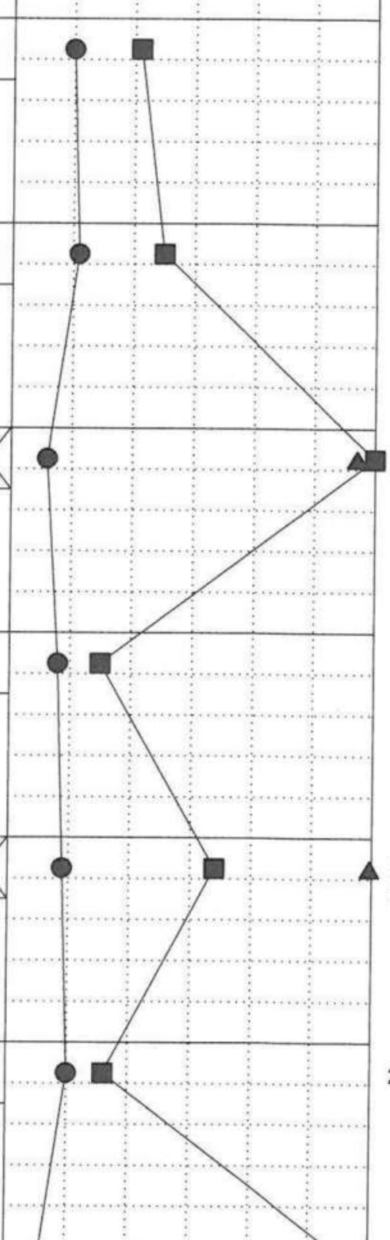
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DRY DENSITY (PCF): 80, 90, 100, 110, 120
Water Content (%): ●
Plastic Limit (W_P) |——| Liquid Limit (W_L)
Penetration, blows/foot: ■ 10, 20, 30, 40, 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	SAND (FILL), brown, silty, medium dense	SM	Bulk Sample 0-5 ft. EI, RV, 200 Wash, Ch, ER, pH, SO_4
5	SILT, brown, little fine-grained sands, very stiff.	ML	200 Wash
10	...very stiff		200 Wash
13	SAND, brown, silty interlayers, fine- to medium-grained, cementation.	SM	
15	...very dense layer.		Blowcount = 100/11 in. 200 Wash, C, DS
20	...fine-grained, medium dense		
25	...medium-grained, dense		Blowcount = 52/12 in. C, DS
30	...silty, little fine-gravels, medium dense.		200 Wash
35			



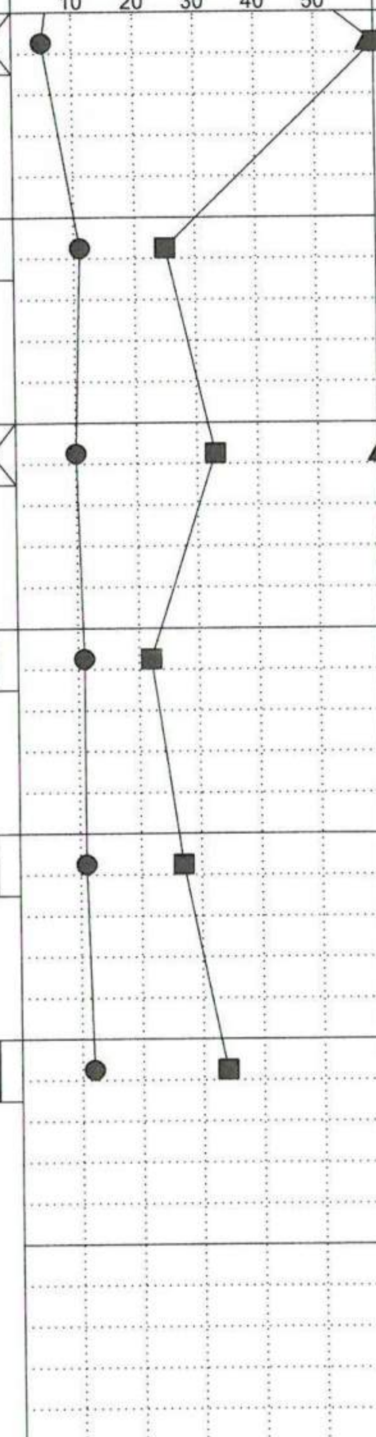
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. B-10
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling / DATE LOGGED 06/09/2017	FIGURE NO. B-11

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, silty interlayer, coarse-grained, trace of fine-gravels, very dense.	SM			Blowcount = 85/11 in. PS
40		...some silt, some fine-gravels up to 1/2 in fragments, medium dense.				PS
45		...silty, little gravels, dense				Blowcount = 51/12 in.
50		...coarse-grained, some fine-gravels , medium dense.				PS
		...seepage at 51.5 ft				
55		...fine-grained, little silt, medium dense.				PS
60		...silty, fine- to medium-grained, dense.				
65		End of Boring at 61.5 feet. Boring dry at completion of drilling.. Backfilled with soil cuttings.				
70						



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. B-10
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/09/2017	FIGURE NO. B-11

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

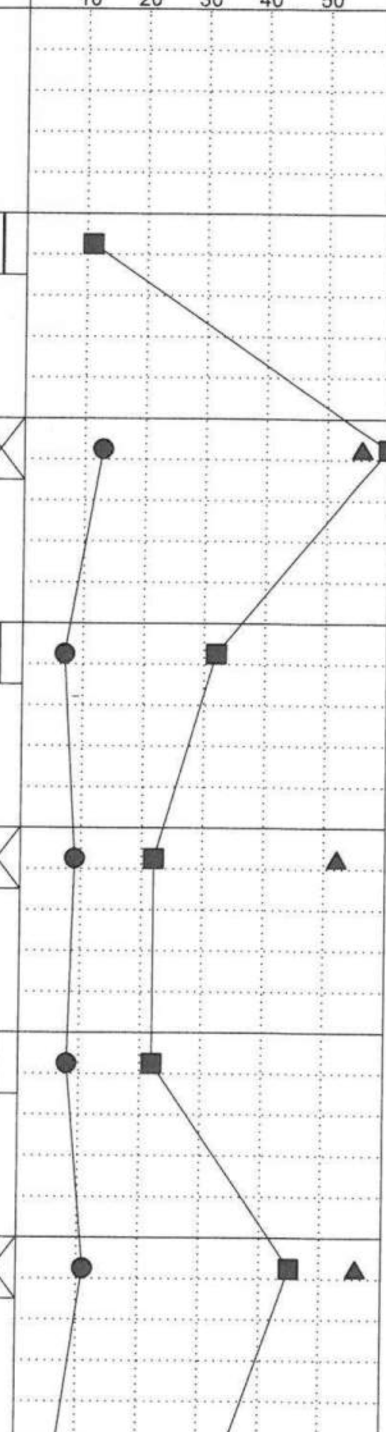
DRY DENSITY (PCF): 80 90 100 110 120

Water Content (%): ●

Plastic Limit (W_P) |——| Liquid Limit (W_L)

Penetration, blows/foot: ■ 10 20 30 40 50

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
0		SAND (FILL), brown, silty, medium dense	SM		
5		SILT, brown, little fine-grained sands, stiff.	ML	SPT	
10		...hard		CALIFORNIA	Blowcount = 50/6 in.
15		SAND, brown, silt interlayer, coarse-grained, some gravels, dense.	SM	SPT	200 Wash
20		...fine-grained sands, medium dense		CALIFORNIA	Blowcount = 33/12 in. 200 Wash
25		...silty, medium dense.		SPT	
30		...silty, dense		CALIFORNIA	Blowcount = 69/12 in.200 Wash
35					



GEOBASE, INC.			
PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-11
DEPTH TO WATER feet	SURFACE ELEV. 1517 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B- 12

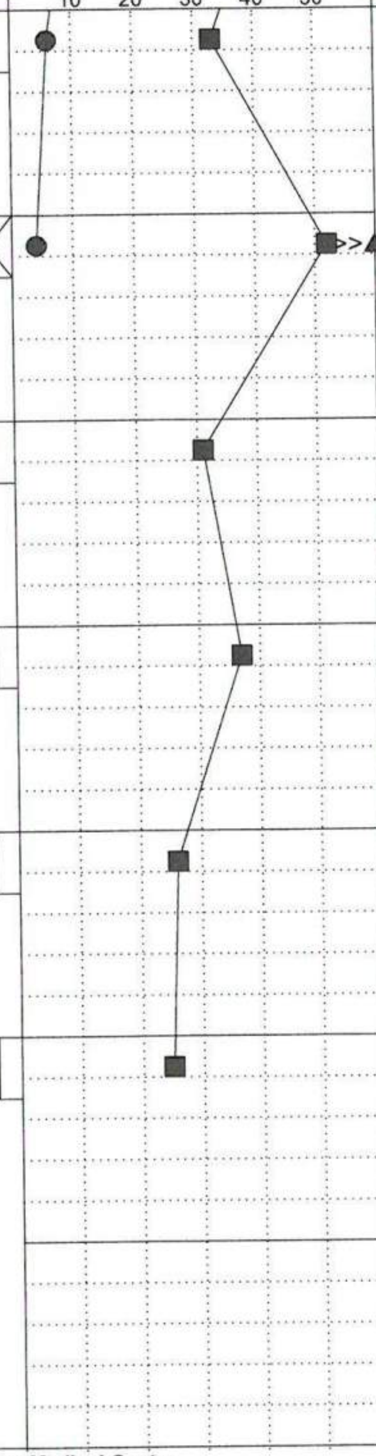
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, brown, fine- to medium-grained, trace of silt, dense.	SM	200 Wash
40	SAND, light brown, coarse-grained, little silt, some fine-gravels, very dense.	SP	Blowcount = 80/12 in. PS
45	...fine-to medium-grained, silty, dense		
50	SAND, brown, silty, fine-to medium grained, trace of gravel, dense.	SM	PS
55	...medium dense ...seepage at 56 ft		
60	...trace of gravels, medium dense		
65	End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.		
70			

DRY DENSITY (PCF): 80 90 100 110 120
Water Content (%): ●
Plastic Limit (W_P) — Liquid Limit (W_L)
Penetration, blows/foot: ■ 10 20 30 40 50



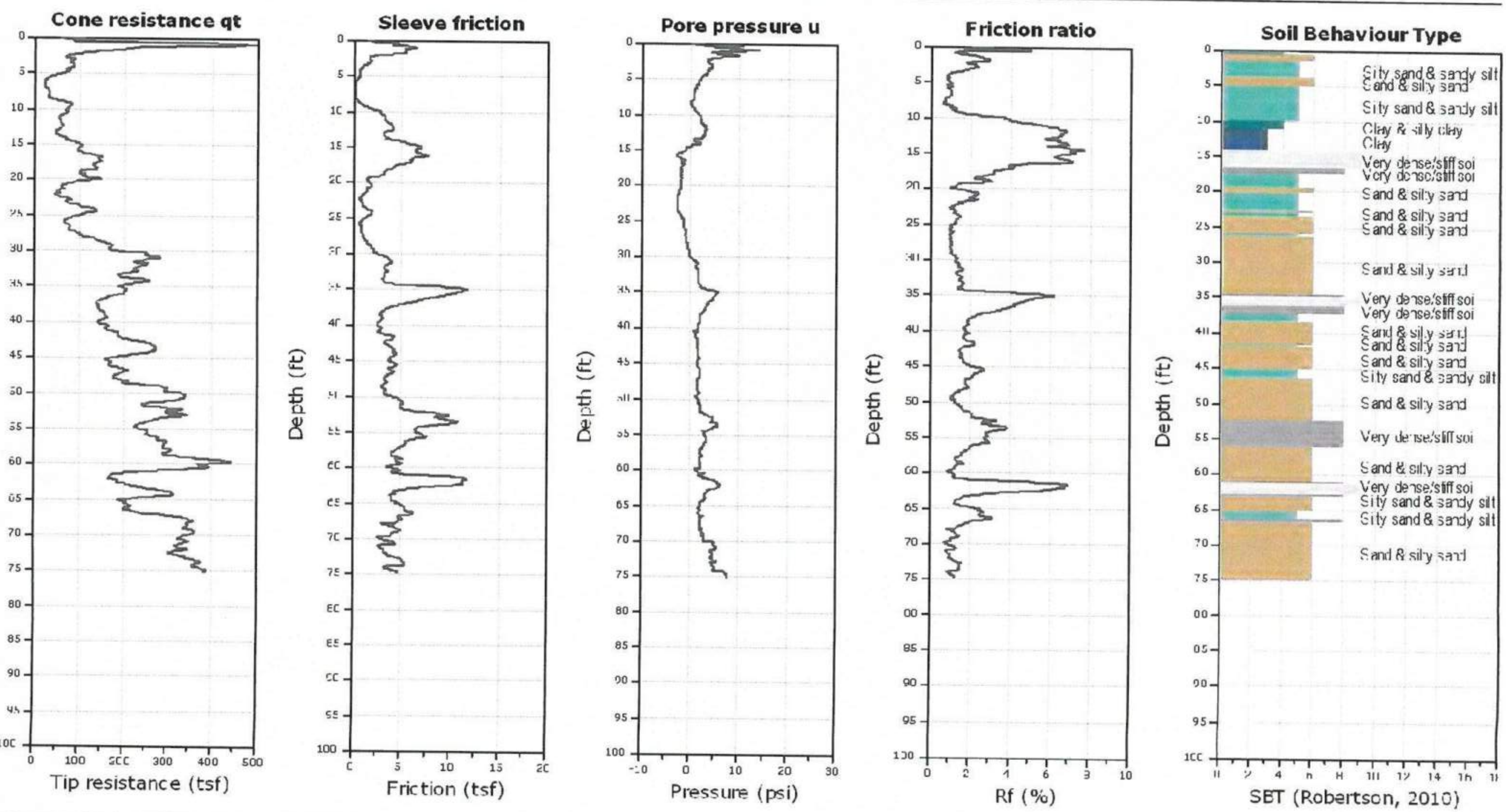
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-11
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B-12

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-1
Total depth: 75.14 ft, Date: 6/8/2017
Cone Type: Vertek



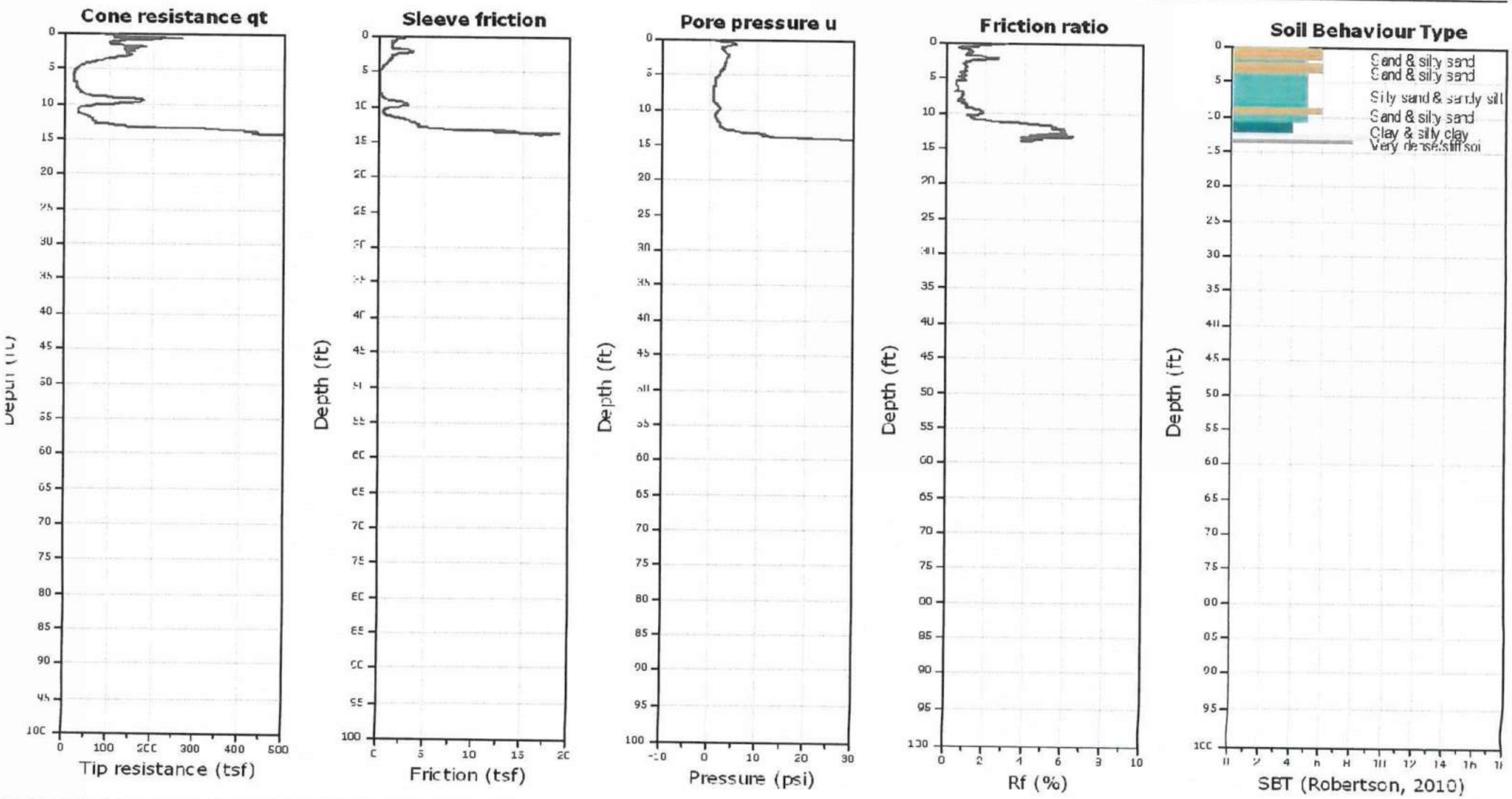
C.314.81.00

Figure B-13

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-2
Total depth: 14.30 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:33:28 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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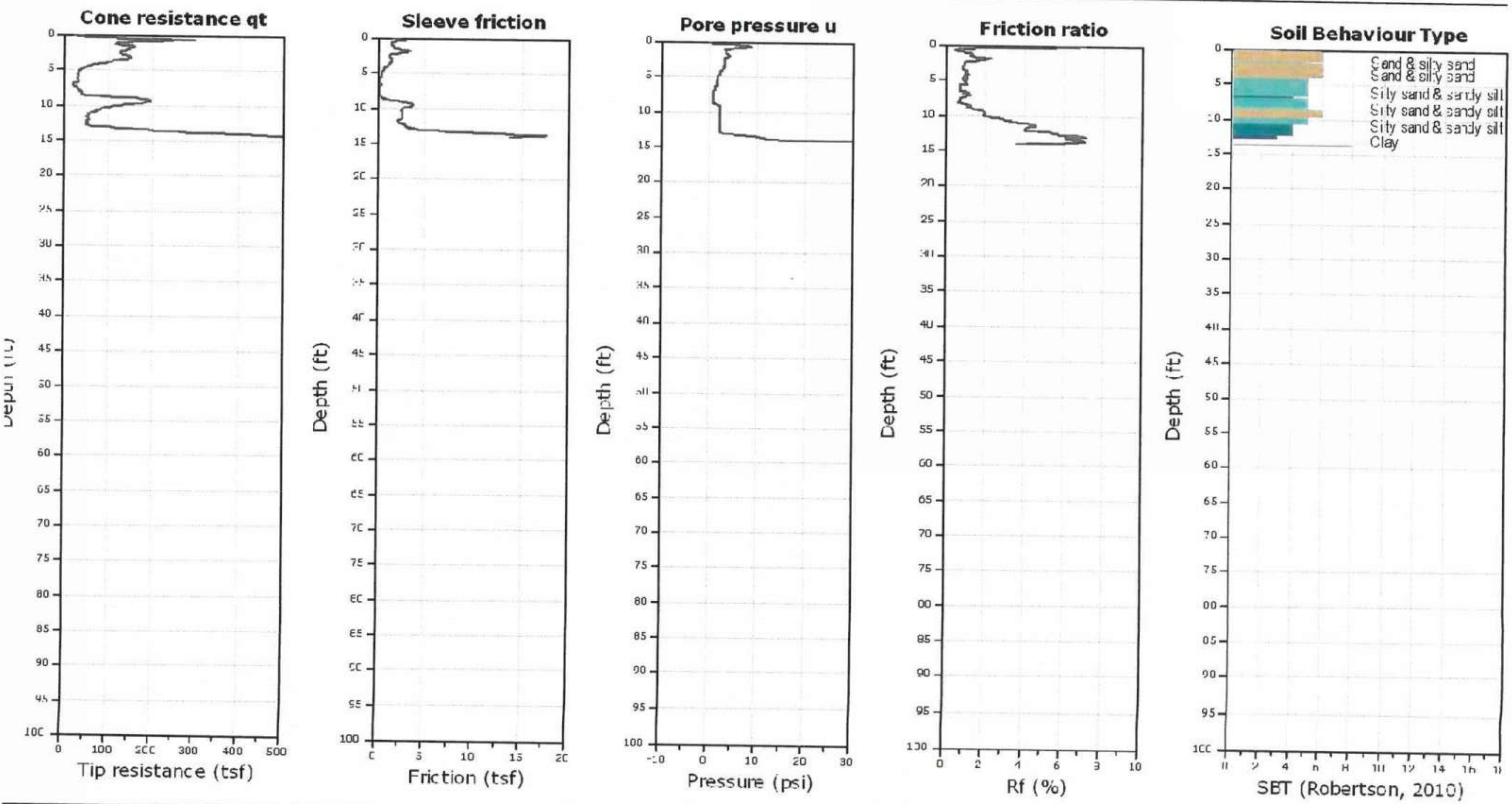
Figure B-14, page 1 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-2A
Total depth: 14.33 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:33:53 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

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C.314.81.00

Figure B-14, page 2 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-3
Total depth: 70.16 ft, Date: 6/8/2017
Cone Type: Vertek

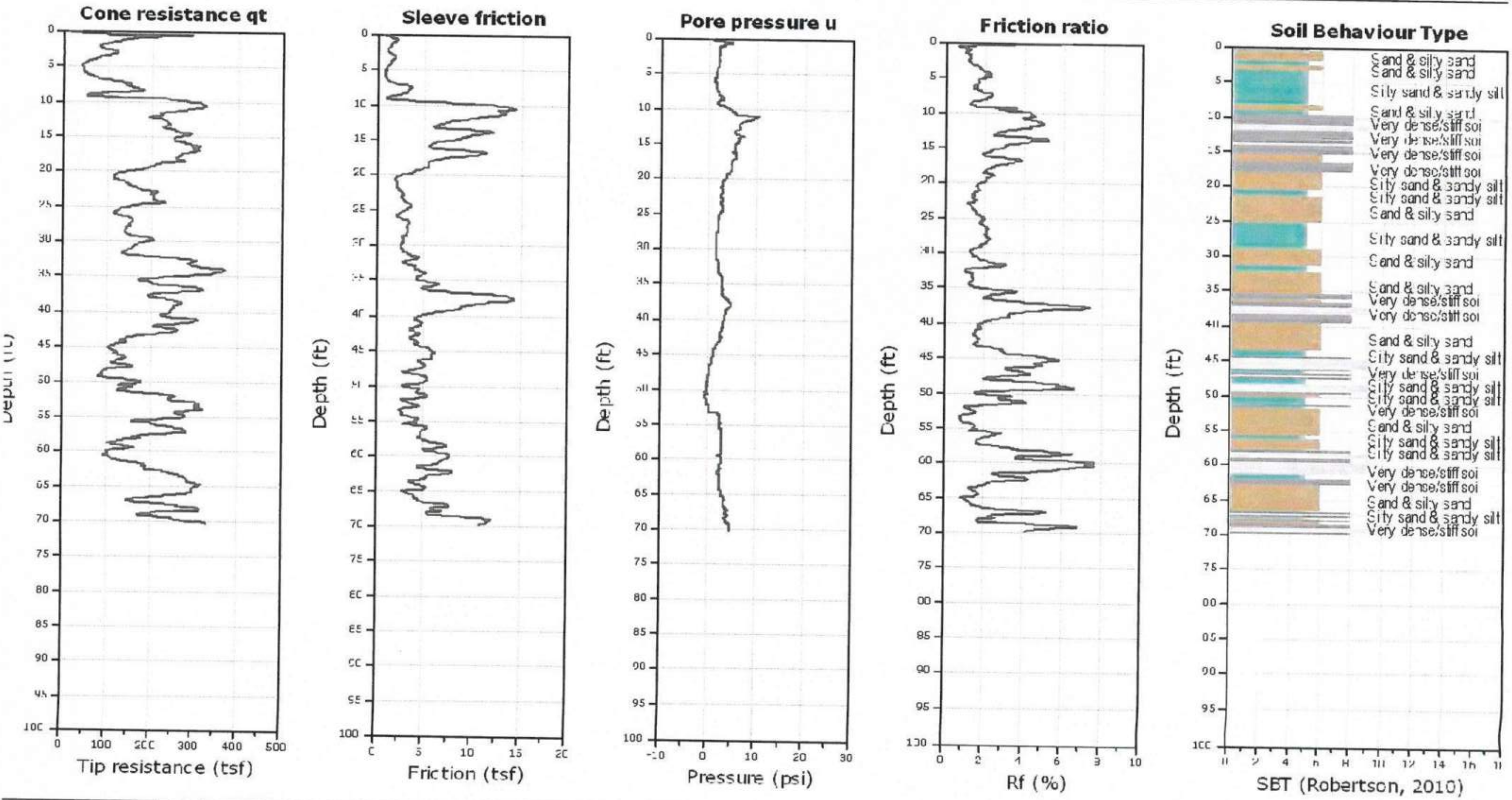
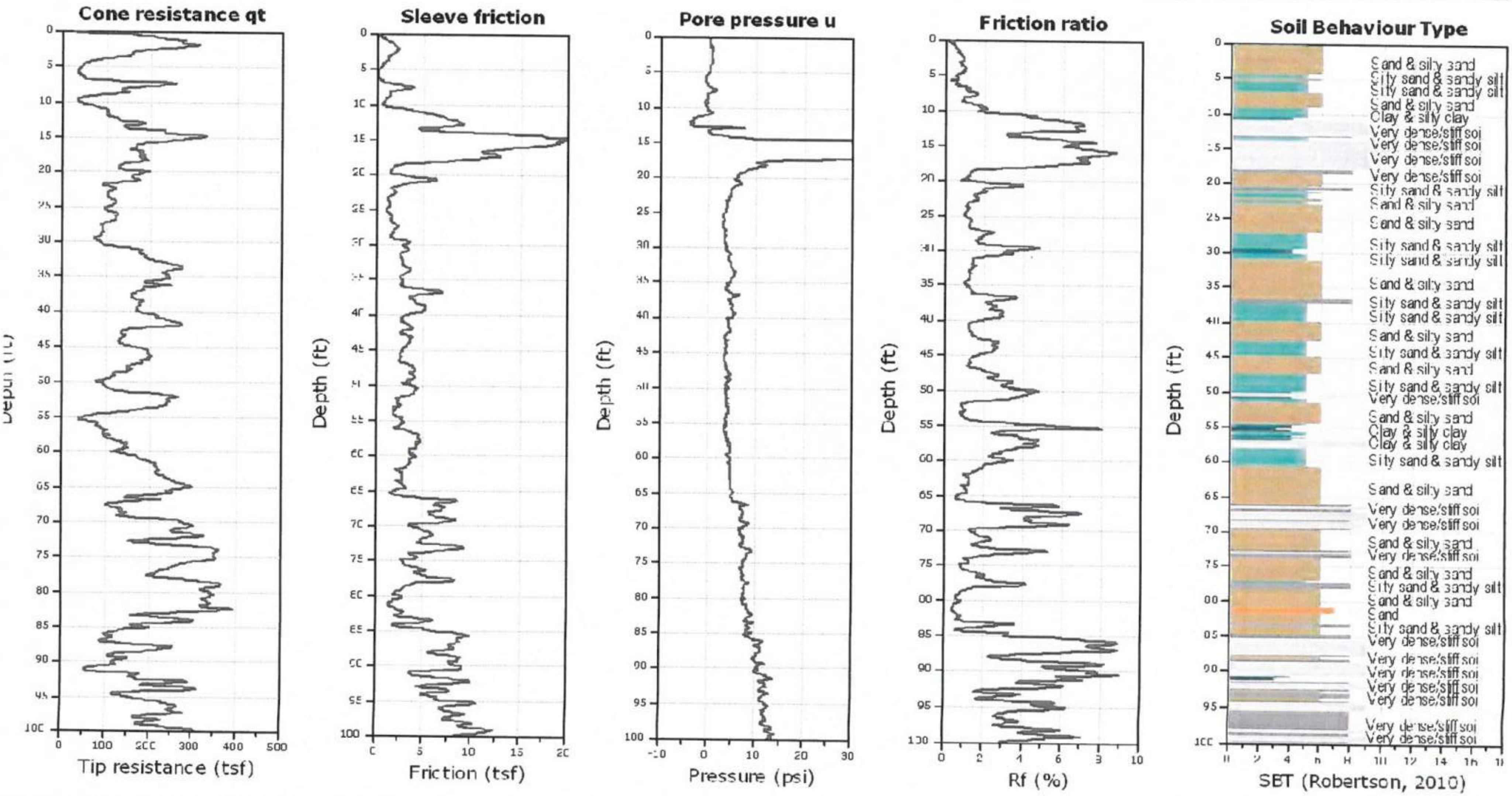


Figure B-15

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

SCPT-4
Total depth: 100.15 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:37:36 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

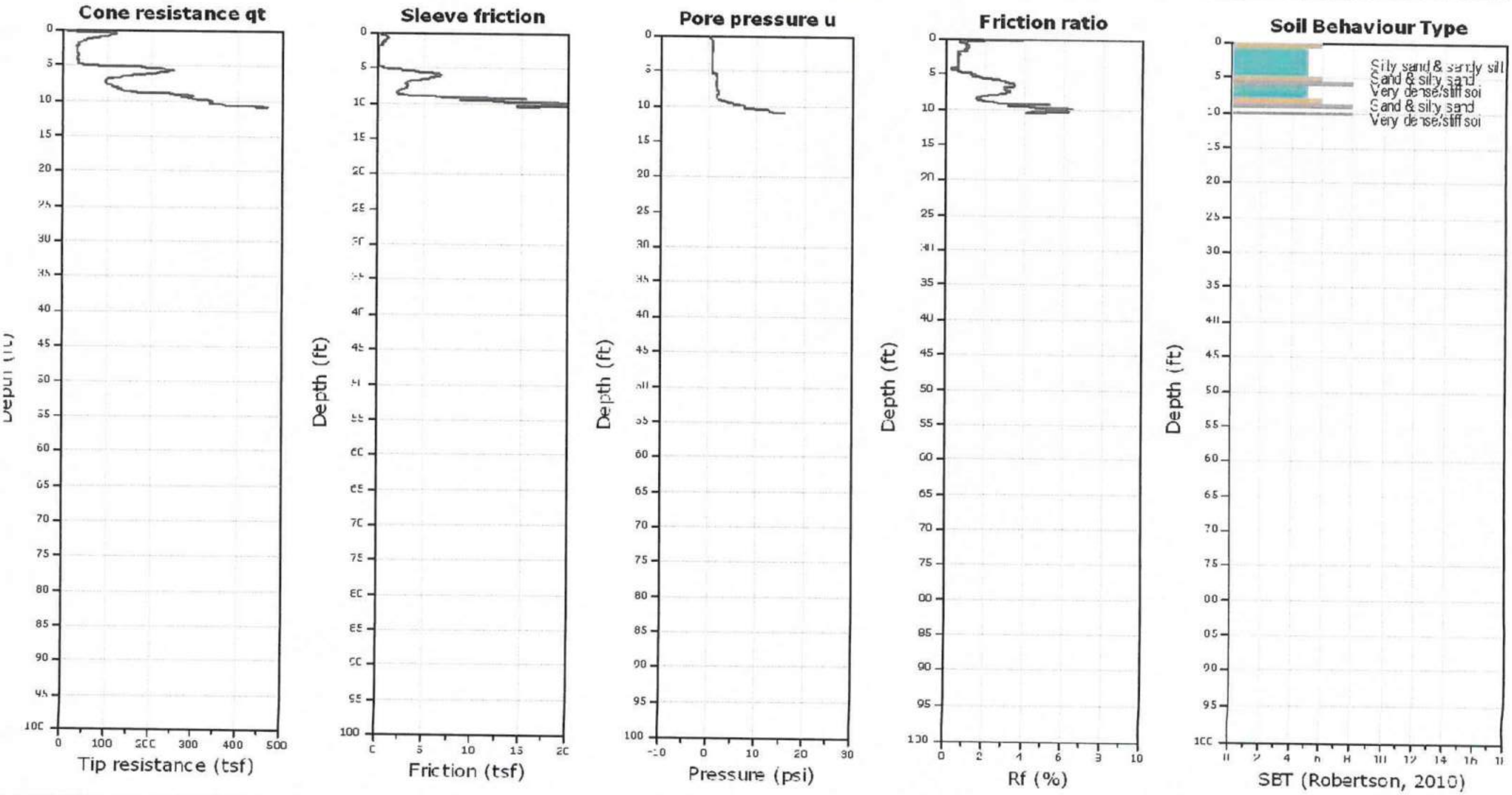
C.314.81.00

Figure B-16

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-5
Total depth: 10.90 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:34:54 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

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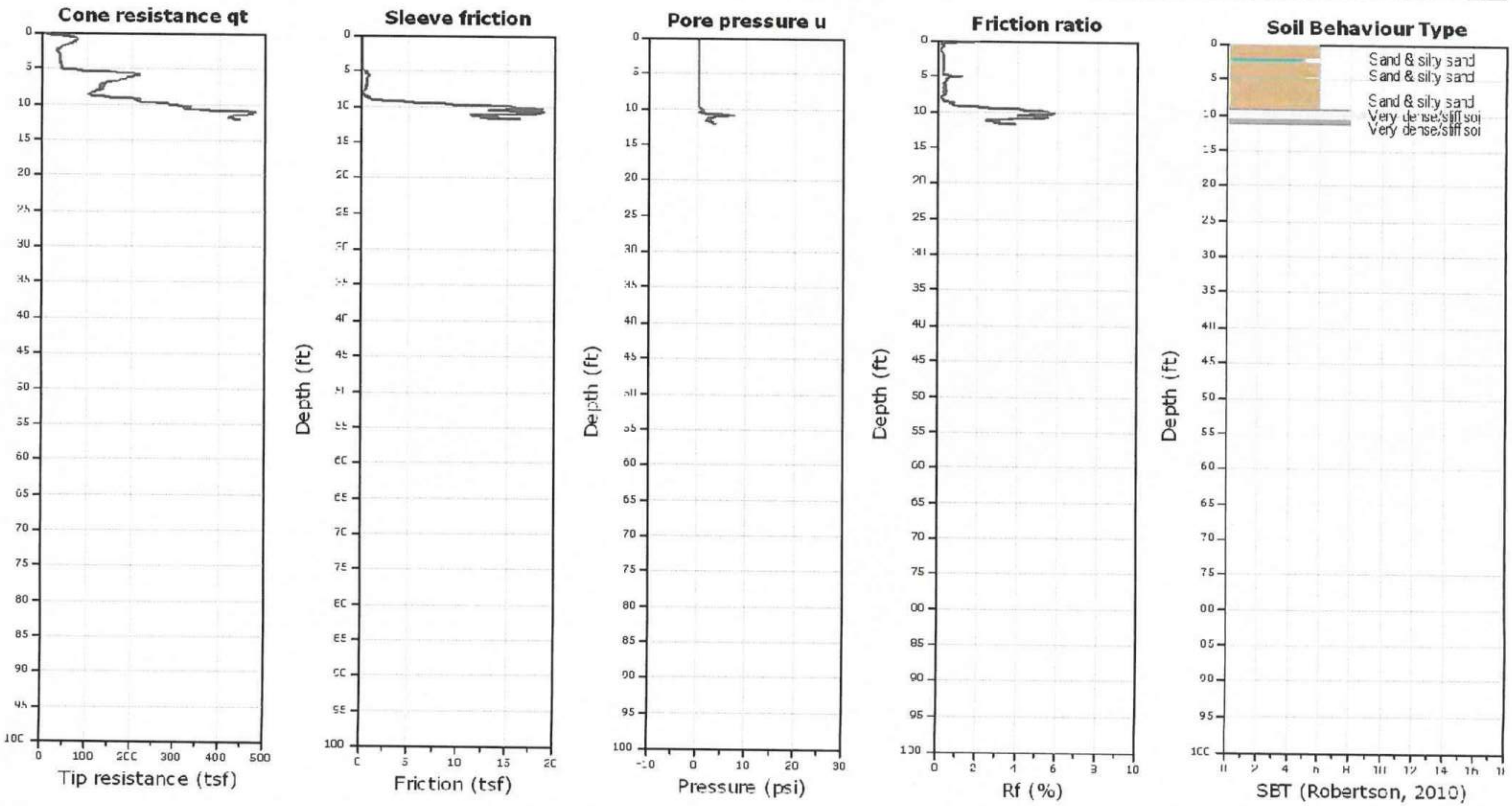
C.314.81.00

Figure B-17, page 1 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-5A
Total depth: 12.01 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:35:12 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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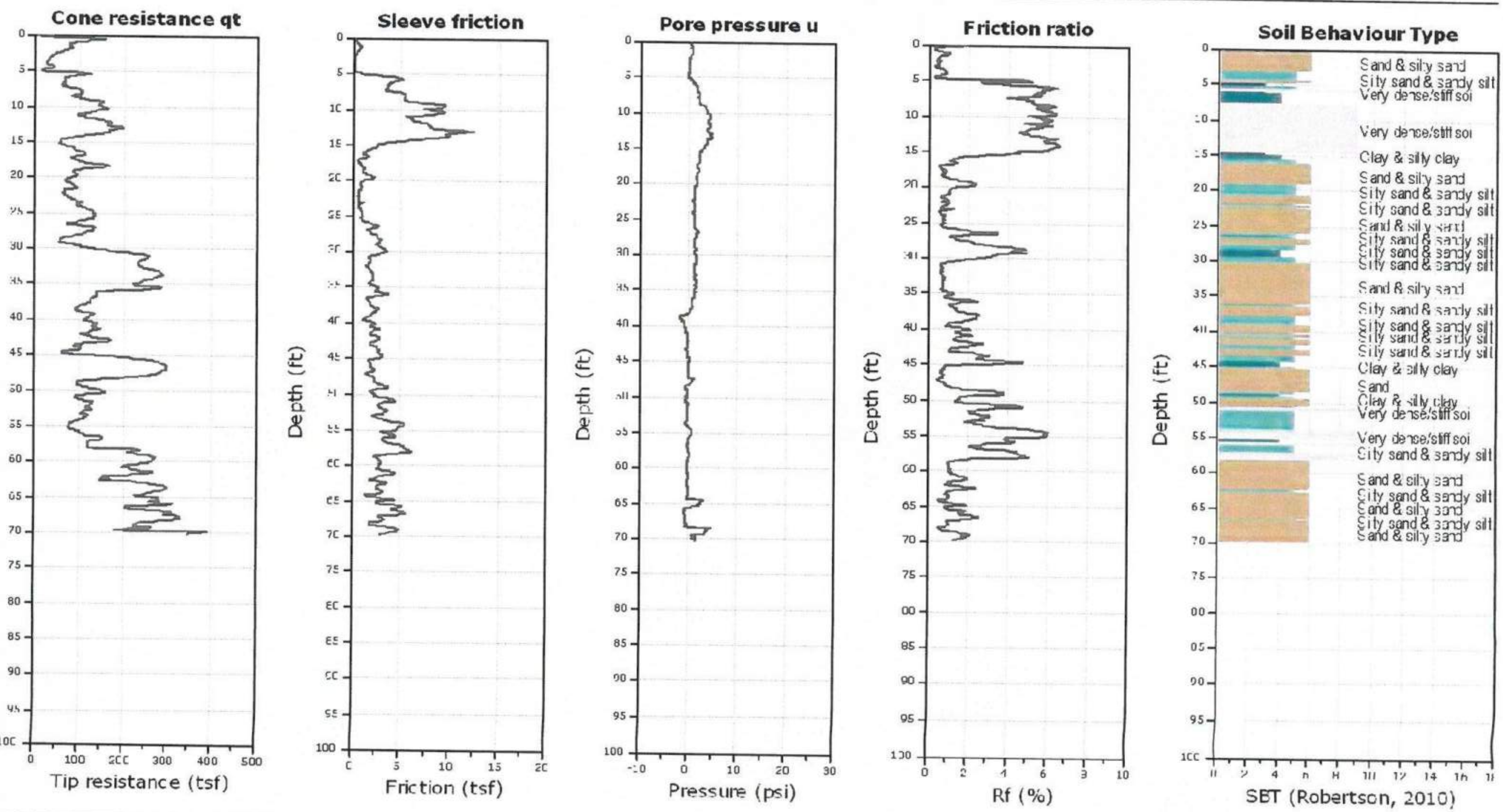
Figure B-17, page 2 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-6
Total depth: 70.15 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:35:28 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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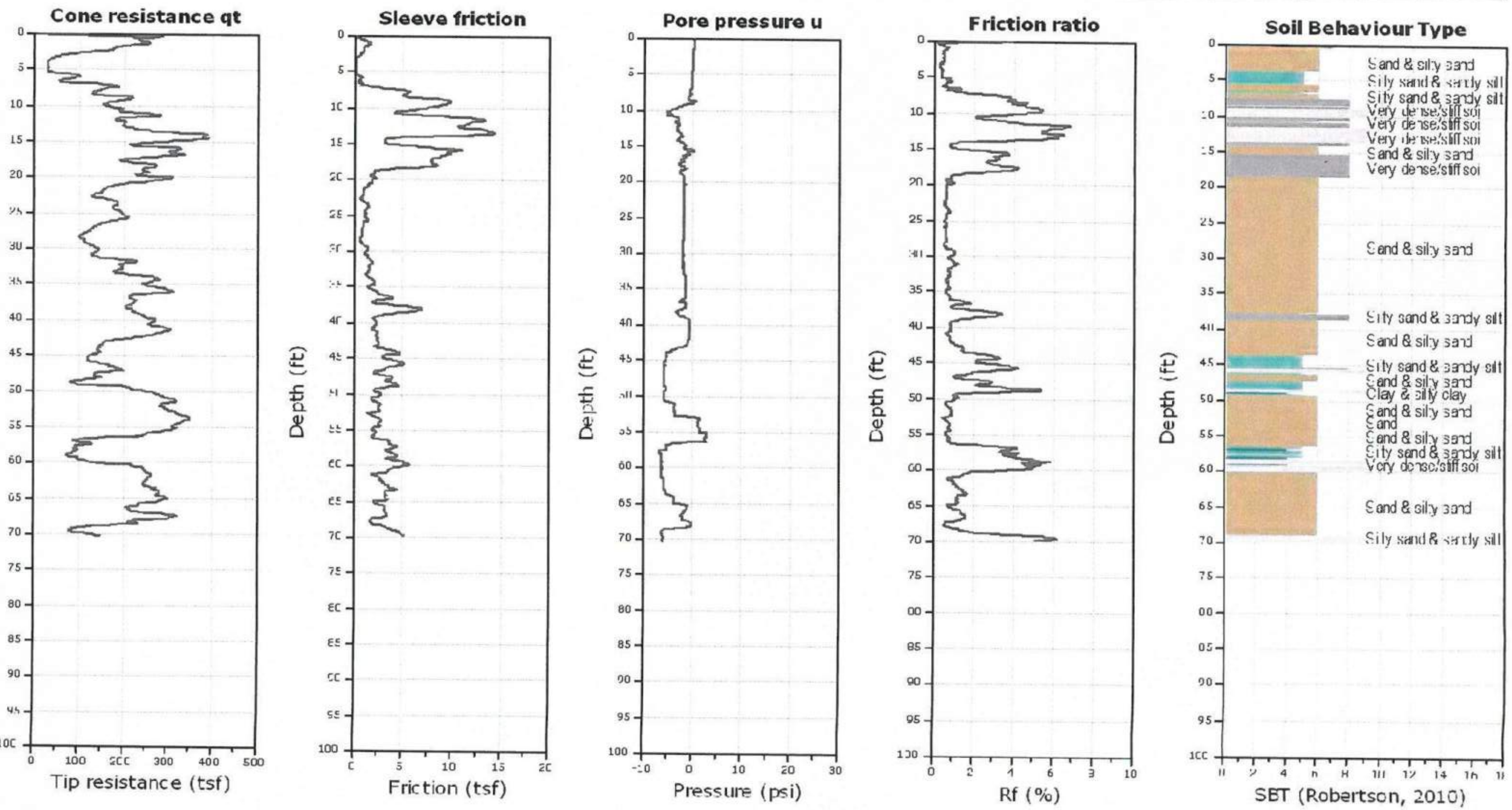
Figure B-18

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-7
Total depth: 70.22 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:35:47 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

Figure B-19

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-8
Total depth: 70.15 ft, Date: 6/9/2017
Cone Type: Vertek

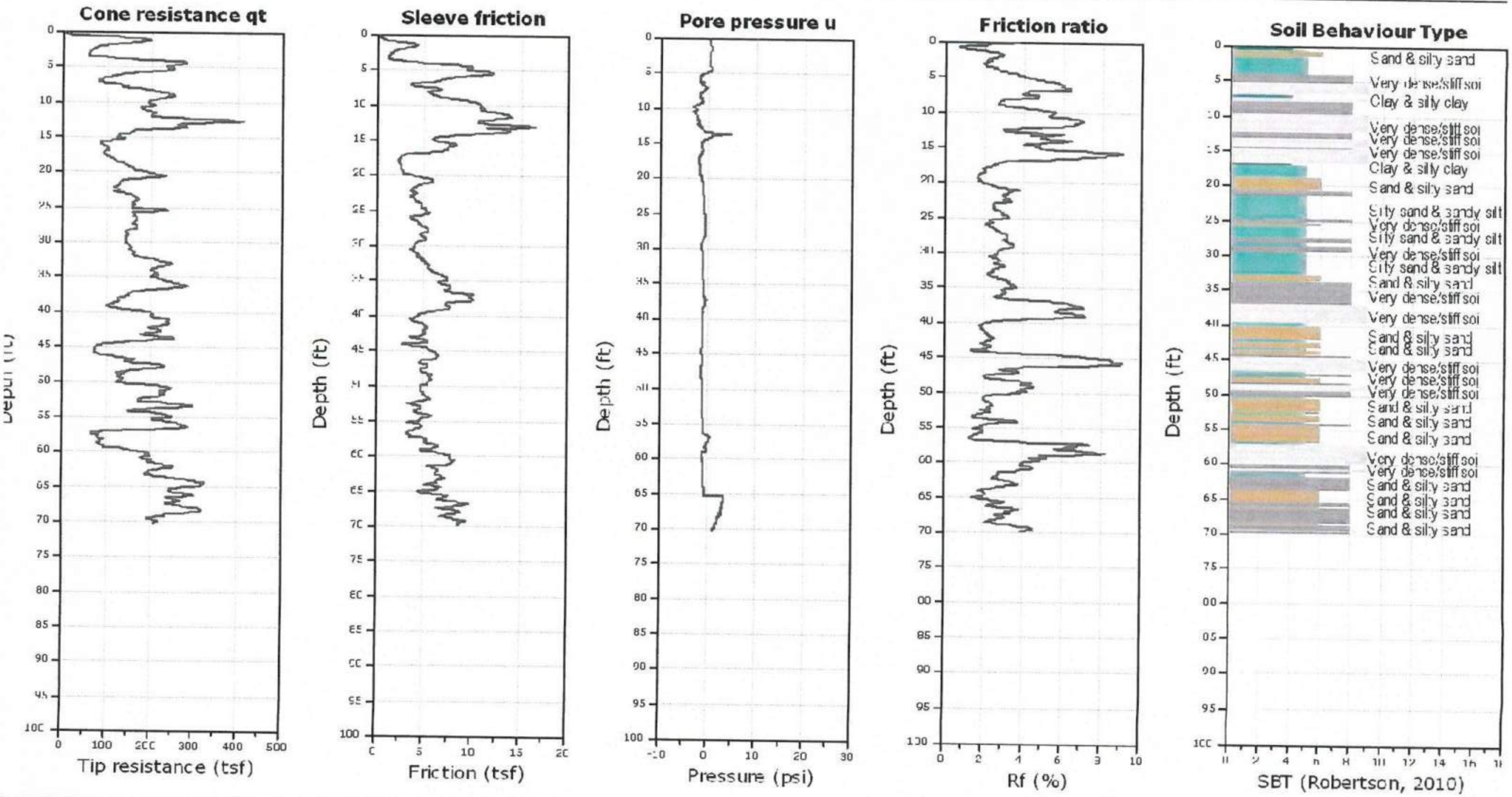
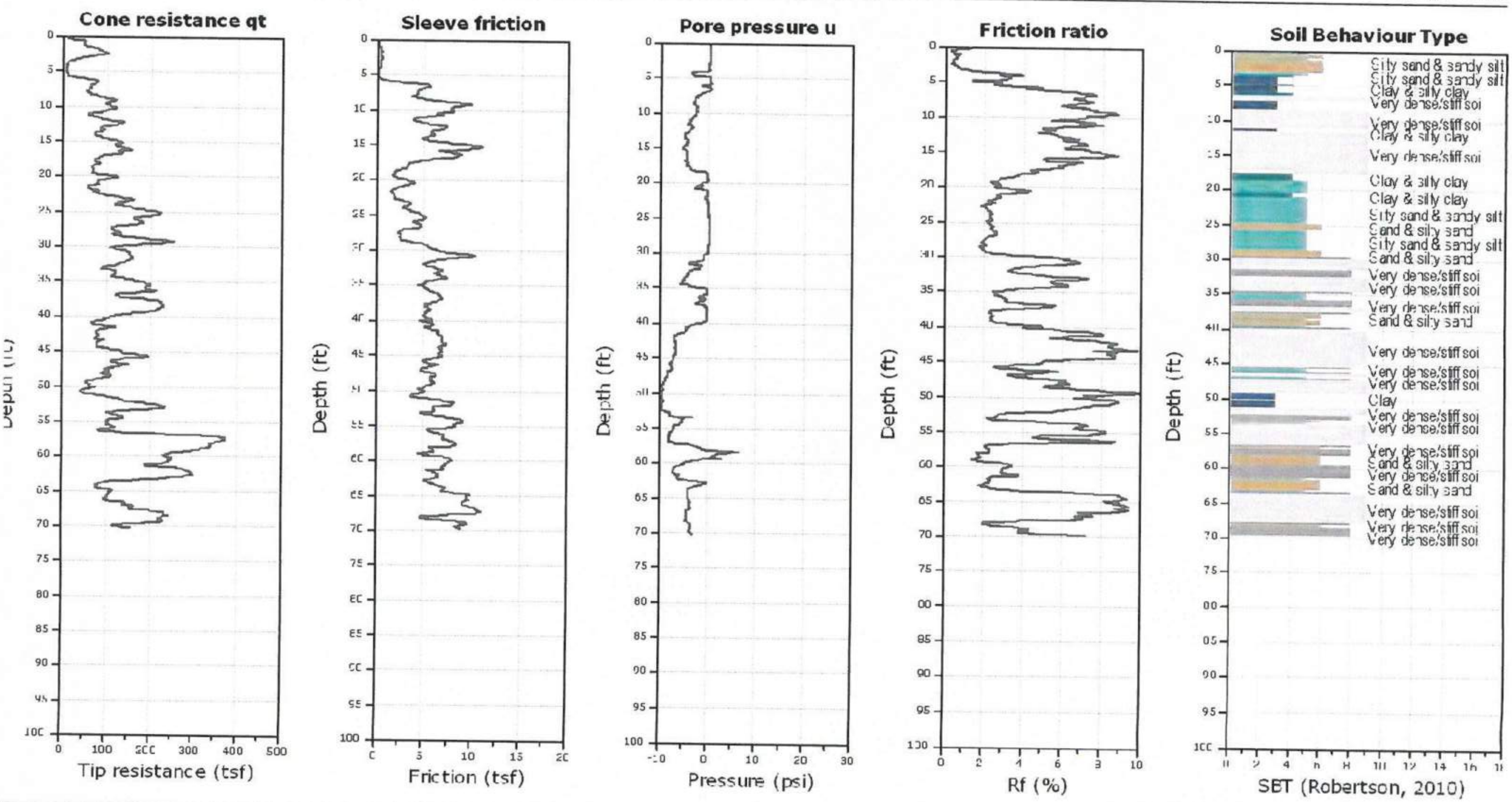


Figure B-20

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-9
Total depth: 70.24 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:36:16 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

0

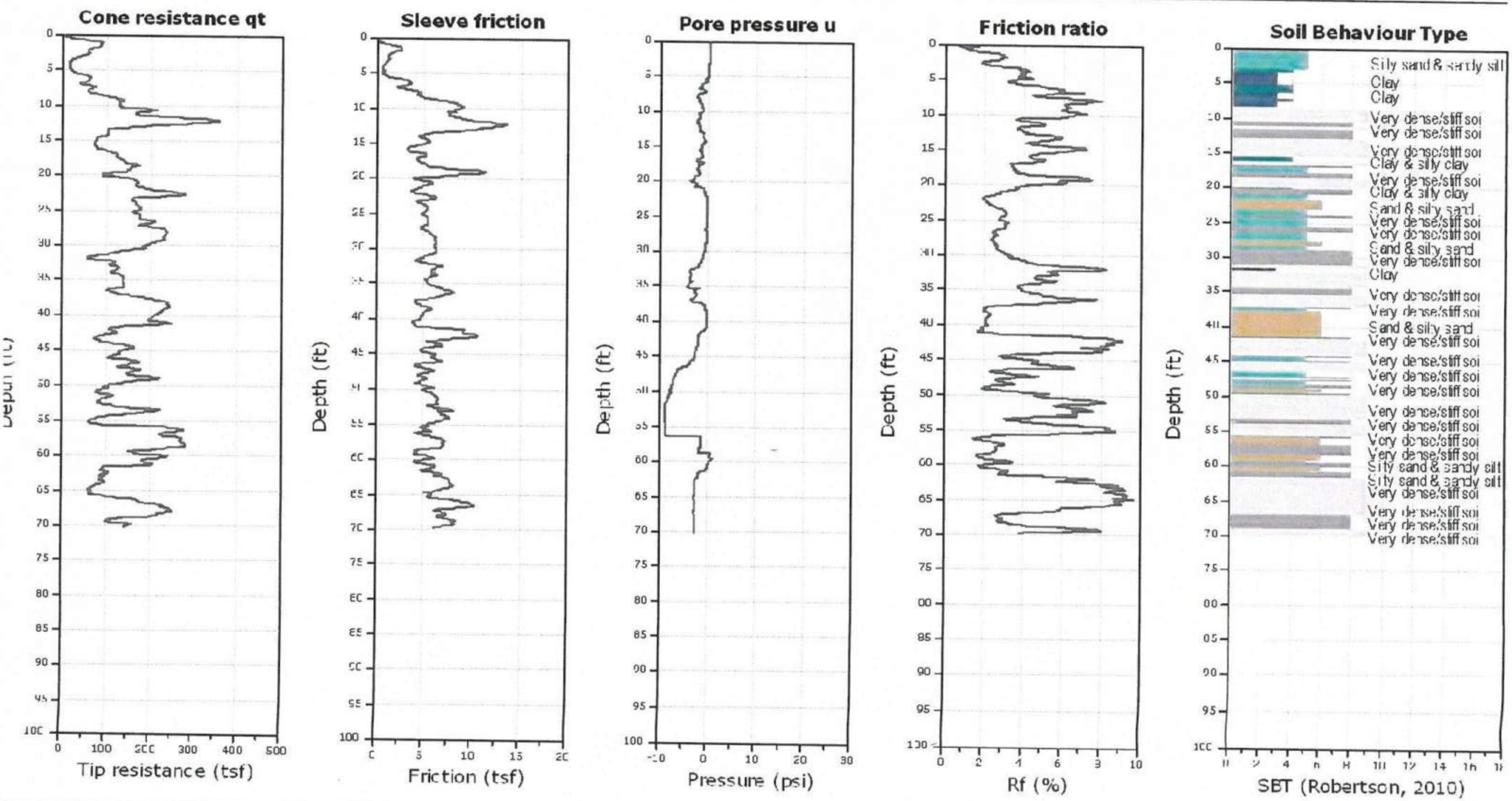
C.314.81.00

Figure B-21

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-10
Total depth: 70.15 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:36:33 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

0

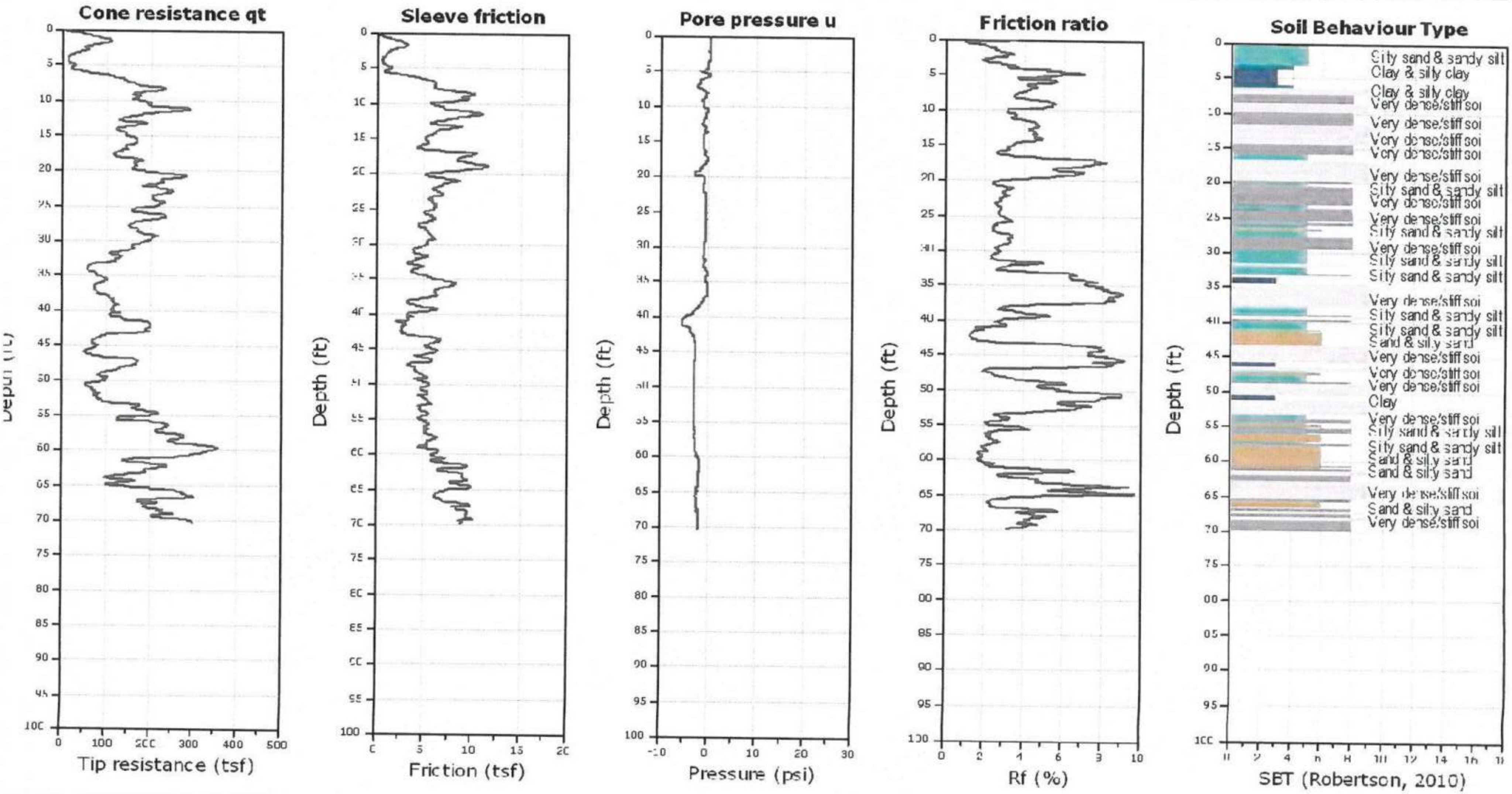
C.314.81.00

Figure B-22

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-11
Total depth: 70.22 ft, Date: 6/9/2017
Cone Type: Vertek



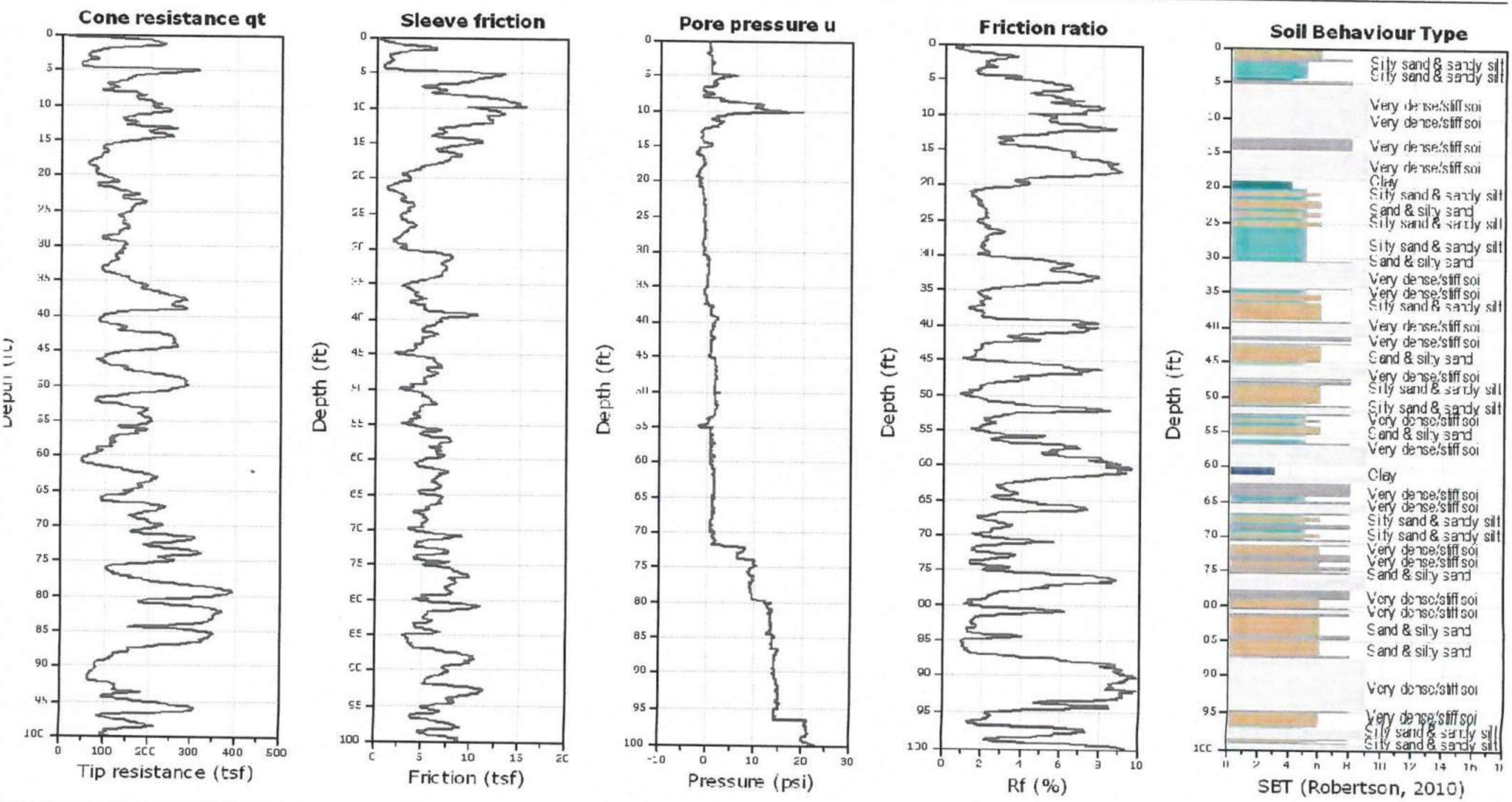
C.314.81.00

Figure B-23

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

SCPT-12
Total depth: 100.13 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:38:00 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

Figure B-24

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-13
Total depth: 70.22 ft, Date: 6/9/2017
Cone Type: Vertek

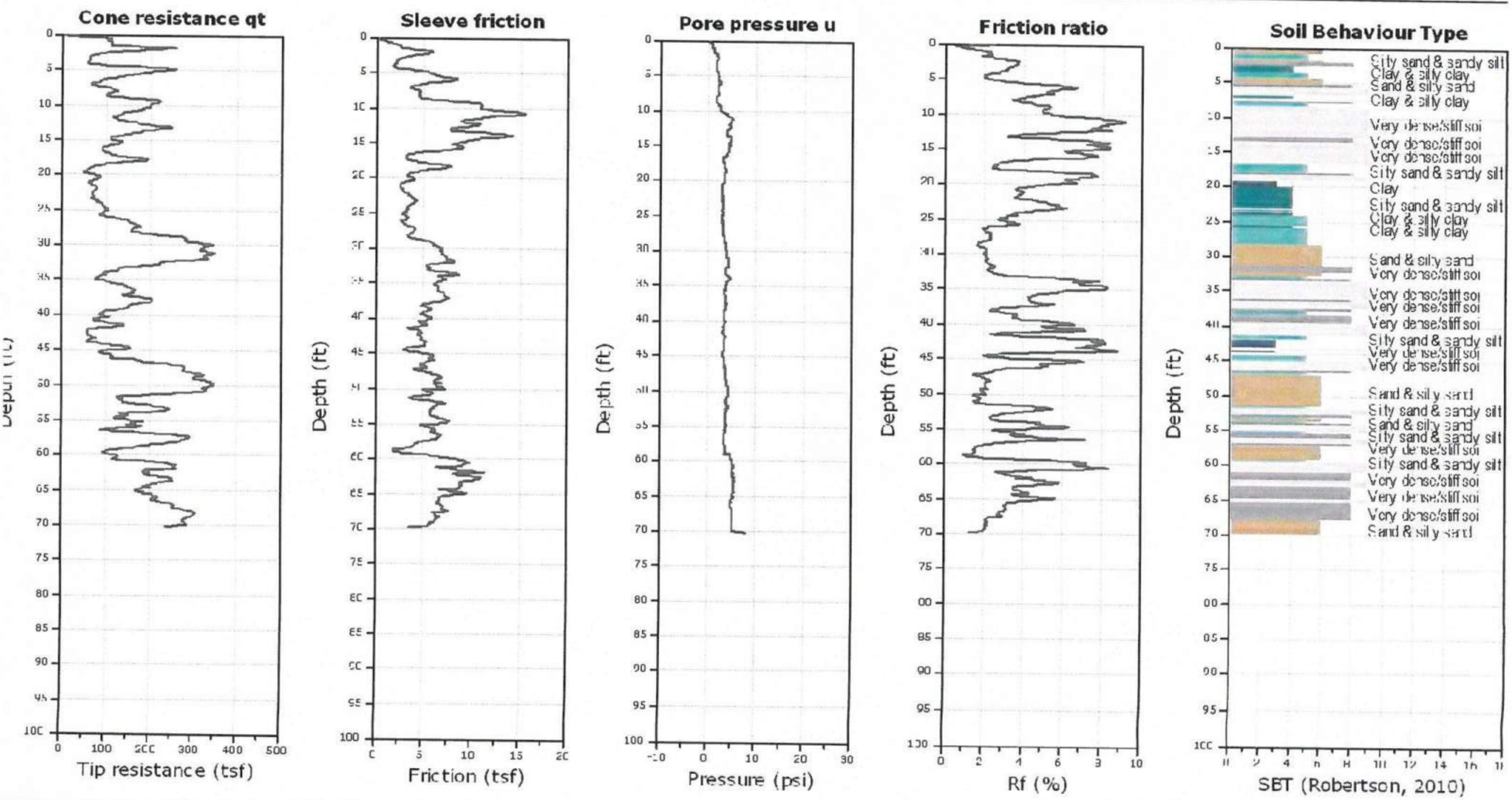


Figure B-25

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-14
Total depth: 70.21 ft, Date: 6/9/2017
Cone Type: Vertek

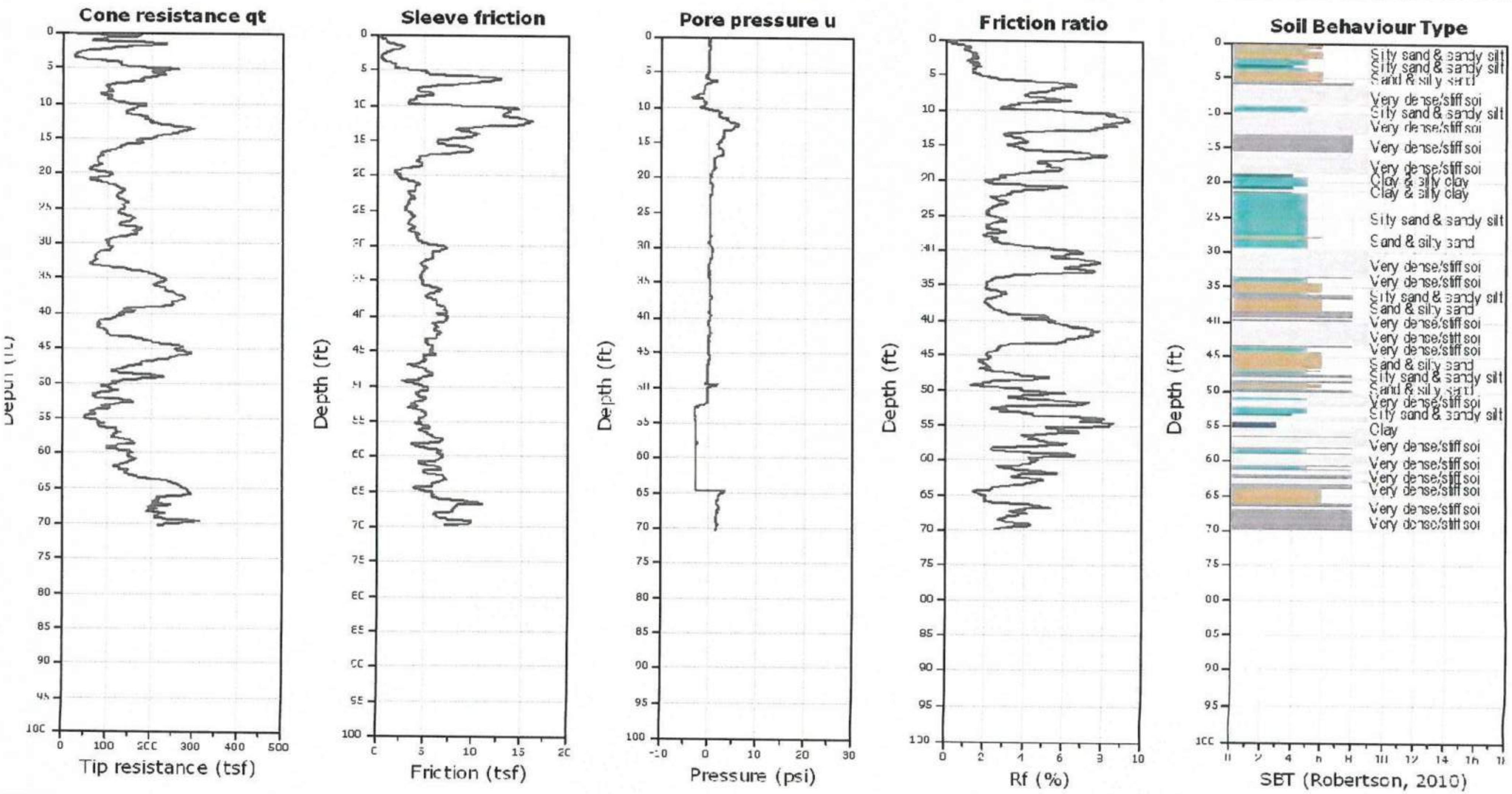


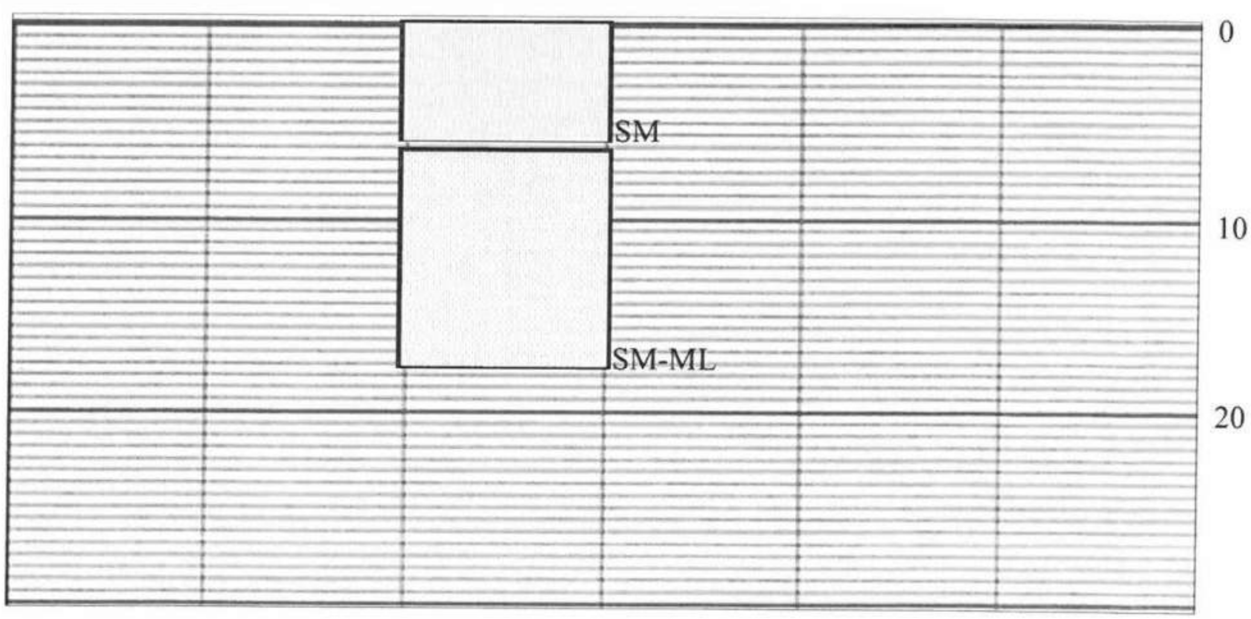
Figure B-26

LOG OF TEST PIT: TP - 1

Soil Interval	Soil Interval Depth (Feet bgs)	Soil Sample Depth (Feet bgs)	SOIL DESCRIPTION
A	0.0 – 1.0		FILL- Aggregate Bases
B	1.0 - 5.0		SAND (SM), light brown, fine- to medium grained, little to some silt, trace of gravels, moist, loose to medium dense.
C	5.0-14.0		SAND TO SILT (SM-ML), brown, fine-grained, white streak and concretion, cementation, medium dense to very stiff.
D	14.0-18.0		SAND TO SILT (SM-ML), brown, very distinct white streak, concretion, cementation, stratified, very dense. Difficult to excavate.

GRAPHIC REPRESENTATION

SCALE: 1 inch = 10 Feet **BEARING**: N **WALL**: FRONT (North)



Project Number: **C.314.81.00** Date: 5/7/2015

GEOBASE INC.

Location: Figures A-2 & A-3, Appendix A Equipment: JD410

Approx. Elevation: 1525 feet AMSL (Top) Logged By: HDN

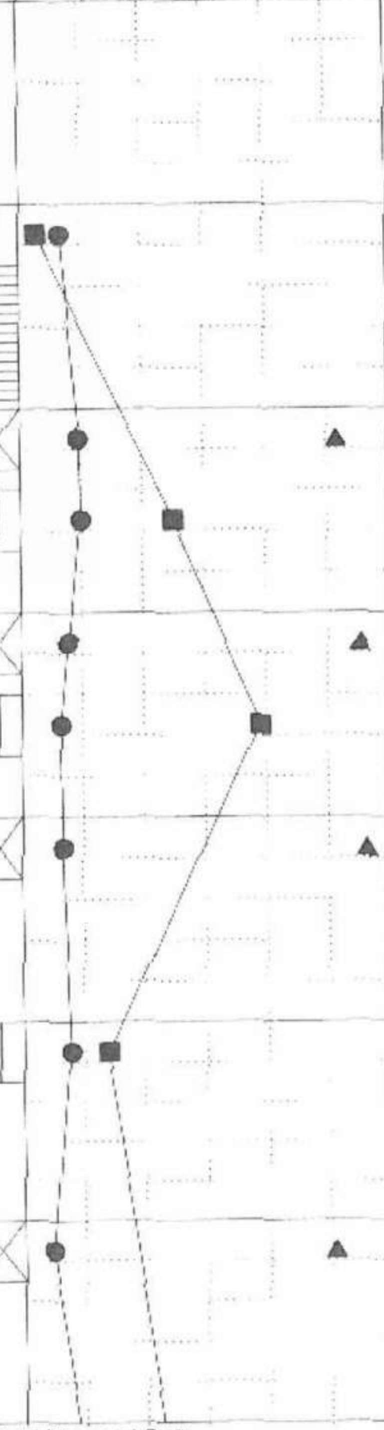
Project: KP Moreno Valley Medical Center

FIGURE B-27

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%) ●; Plastic Limit (W_P) — Liquid Limit (W_L); Penetration, blows/foot ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		PAVEMENT, AC = 5 in. and AB = 5 in.				
		SAND (FILL), brown, silty, moist	SM			
5		SILT, brown, sandy, trace of gravels, very loose, damp.	ML			PS
						Bulk Sample 5-10 FT: EI, Ch, ER, pH, SO_4
10		dense, moist				C*, DS
		SAND, brown, silty, trace of gravels, medium dense, moist	SM			
15		...orange to brown, damp				PS
		dense				
20		...sandy, trace of gravels				PS
25		...orange to brown, silty, medium dense				
30		some gravels, damp				
35						



GEOBASE, INC.	PROJECT	MVCH – Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1524.5 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO. B-2

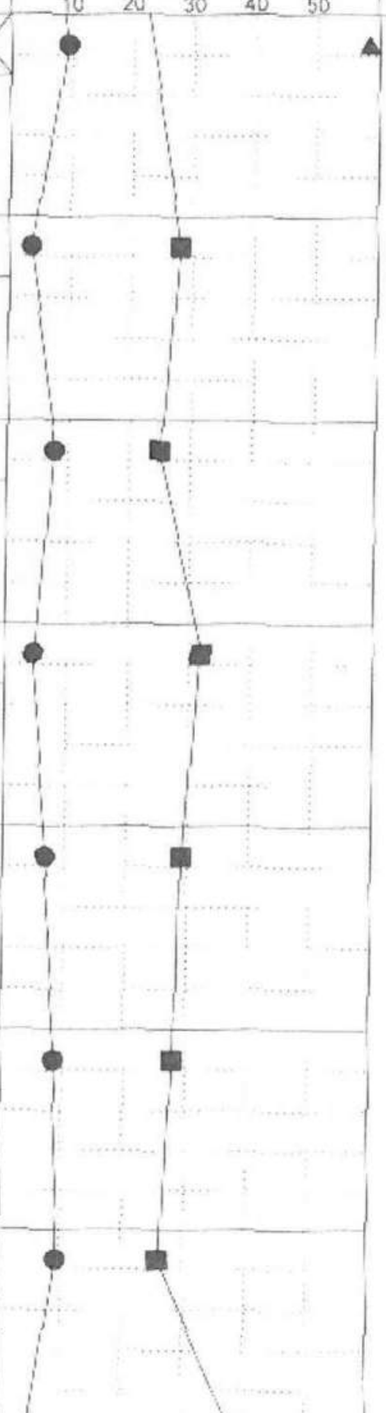
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

page 1 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE; SPT SPLIT SPOON; CALIFORNIA MODIFIED SAMPLER; DISTURBED; NO RECOVERY; CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) / Plastic Limit (W_p) — Liquid Limit (W_L) / Penetration blows/foot 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, silty, little gravels, moist.	SM			
40		SAND, brown, white streak, trace of silt, medium dense damp	SP			
45		SAND, tan brown, silty, little gravels, medium dense, damp.	SM			
50		SAND, brown, white streak, trace of silt, dense, moist	SP			
55		SAND, brown, some silt, medium dense, damp	SM			
60		...silty, greyish brown, slightly moist				
65		brown, little silt, moist				
70						



GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV 1524.5 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO. B-2

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated

page 2 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) — Liquid Limit (W_L); Penetration, blows/foot ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, gray to brown, little of silt, dense, moist	SM			
75		* End of Boring at 71.5 feet. * Boring dry at completion of drilling.				
80						
85						
90						
95						
100						
105						

GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1524.5 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO. B-2

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

page 3 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

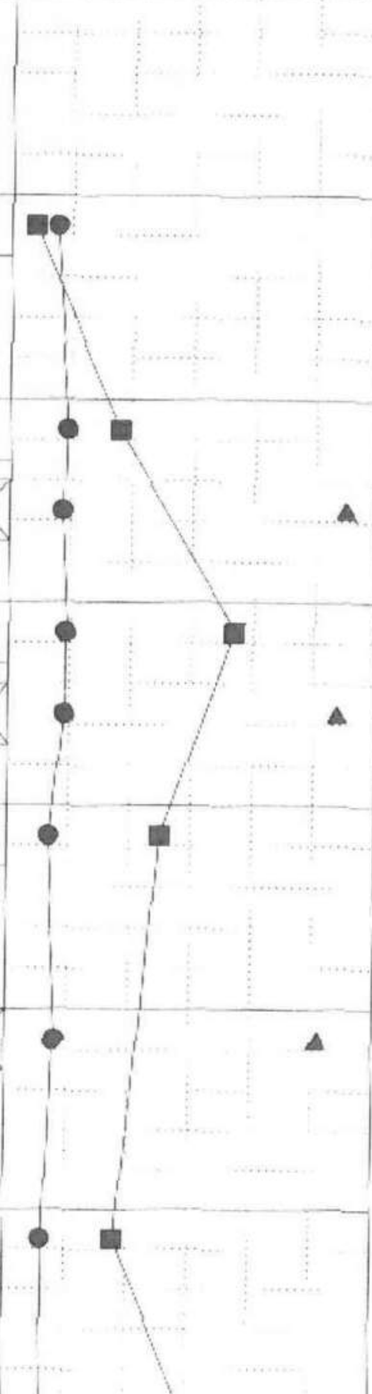
DRY DENSITY (PCF): 80 90 100 110 120

Water Content (%) ●

Plastic Limit (W_P) |——| Liquid Limit (W_L)

Penetration blows/foot ■: 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	PAVEMENT, AC = 4.5 in. and AB = 5 in		
	SAND (FILL), brown, silty, moist.	SM	
5	SILT, brown, sandy, trace of gravels, very soft, moist.	ML	200 Wash
10	...very stiff		PS
	...hard		PS, C*
15	SAND, olive to brown, white streak, silty, trace of gravels, dense	SM	PS
	...brown, some silt, slightly moist.		PS
20	...orange brown, silty, medium dense.		PS
25			PS
30	...light brown, some silt		200 Wash
35			



GEOBASE, INC.			
PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-2
DEPTH TO WATER feet ▼	SURFACE ELEV 1523 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
DEPTH TO SLOUGH ▲	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/31/2010	FIGURE NO. B-3

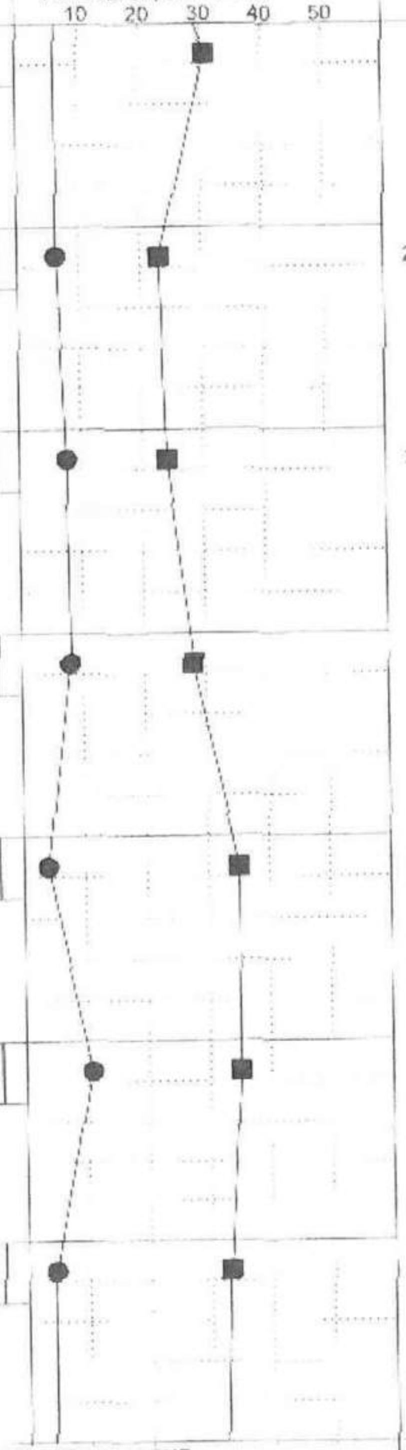
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring *represents conditions observed at the specific boring location and at the date indicated.*

page 1 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%) ●; Plastic Limit (W_p) ├──┤ Liquid Limit (W_L); Penetration, blows/foot ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND: light brown, little silt, dense, damp	SM			
40		...medium dense				200 Wash
45		...greyish-brown, silty, medium dense, moist.				200 Wash
50		...light brown				200 Wash
55		...medium-grained				200 Wash
60		...tan brown, silty				200 Wash
65		...fined grained, little silt.				200 Wash
70						



GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-2
	DEPTH TO WATER feet	SURFACE ELEV. 1523 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/31/2010	FIGURE NO. B-3

Note. This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SP1 SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_p) – Liquid Limit (W_L); Penetration, blows/foot 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, trace of silt, medium dense, moist.	SP			200 Wash
75		* End of Boring at 71.5 feet. * Boring dry at completion of drilling				
80						
85						
90						
95						
100						
105						

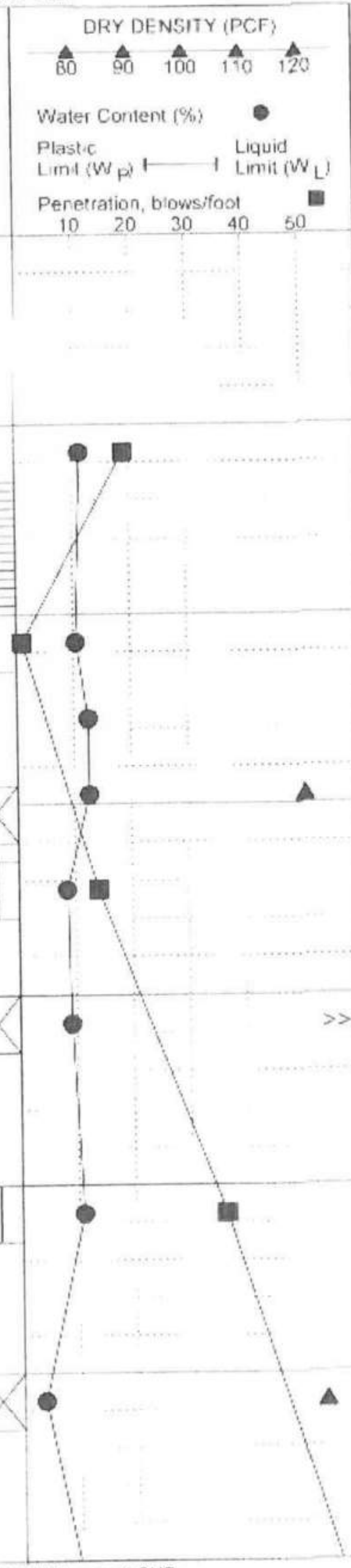
GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-2
	DEPTH TO WATER feet	SURFACE ELEV. 1523 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/31/2010	FIGURE NO. B-3

Note. This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	PAVEMENT, AC = 6 in and AB = 4 in.		
	SAND (FILL), brown, silty, moist	SM	
5	SAND, light brown, little silt, medium dense	SM	200 Wash
	SILT, reddish brown, sandy, little gravels, very moist.	ML	Bulk Sample 5-10 FT. 200 Wash, Ch, ER, pH, SO_4
10	... very loose		200 Wash
15	... little clay, sandy, moist		200 Wash, C*
	SAND, light brown, some silt, little gravels, medium dense, moist	SM	200 Wash
20	... reddish brown, trace of gravels		>> 200 Wash, C*, DS
25	SILT, brown, sandy, hard, moist	ML	200 Wash
30	SAND, light brown, coarse grained, trace of silt and gravels.	SP	200 Wash
35			



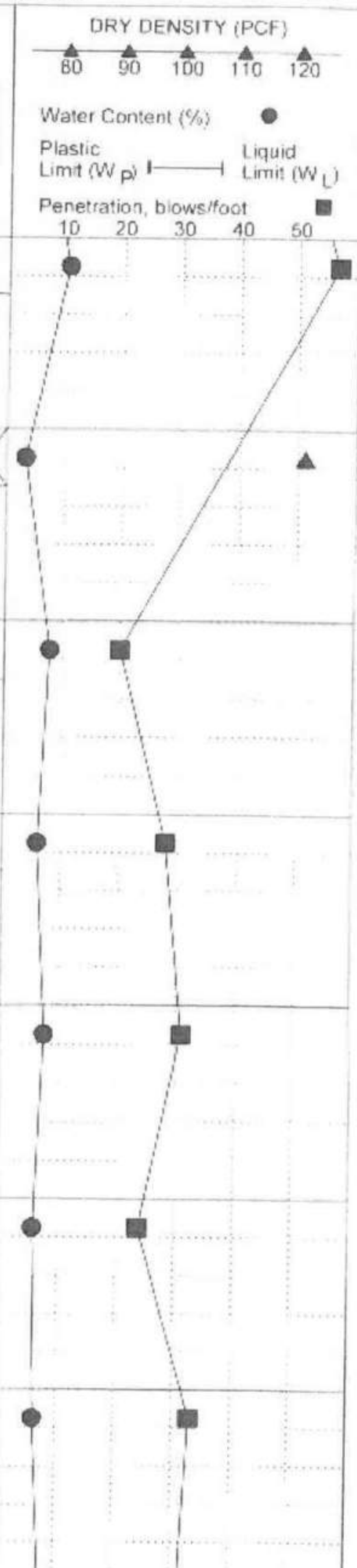
GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California	BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV 1540 feet / LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER MARTINI / DATE LOGGED 03/30/2010	FIGURE NO. B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
		SAND light brown, little silt and gravels, very dense moist	SM		200 Wash
40		SAND brown, coarsed grained, trace of silt damp	SP		200 Wash
45		SAND, light brown, some silt, trace of gravels, medium dense damp	SM		200 Wash
50					200 Wash
55		...tan, little silt, dense, moist			200 Wash
60		...little silt.			200 Wash
65		...moist.			200 Wash
70					



GEOBASE, INC.	PROJECT	MVCH – Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV. 1540 feet	LOGGED BY HDN	PROJECT NO C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) / Plastic Limit (W_P) – Liquid Limit (W_L) / Penetration, blows/foot 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, some silt, trace of gravels, dense, moist.	SM			200 Wash
75		* End of Boring at 71.5 feet * Boring dry at completion of drilling				
80						
85						
90						
95						
100						
105						

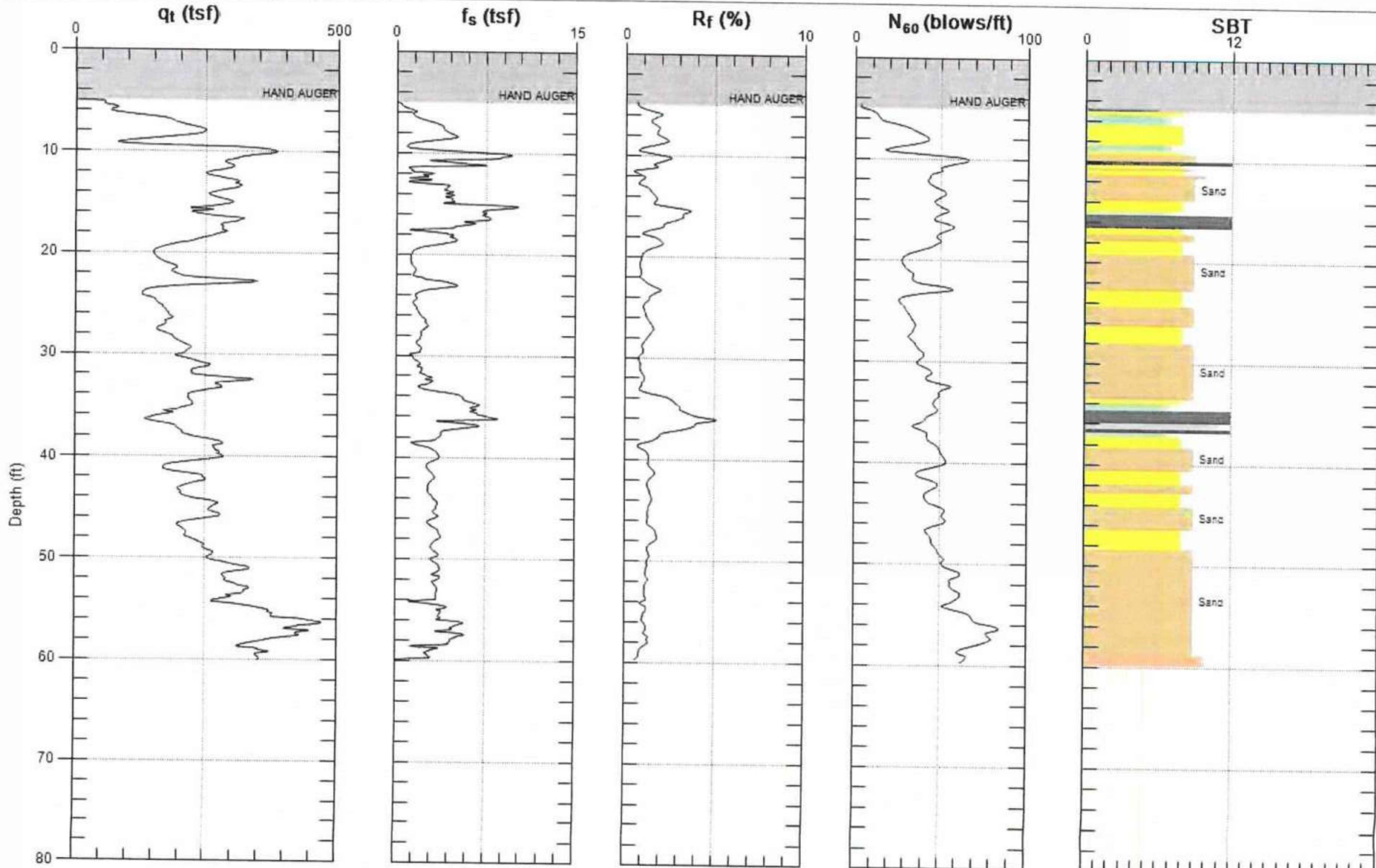
GEOBASE, INC.				
PROJECT	MVCH – Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California			BORING NO. B-4
DEPTH TO WATER feet	SURFACE ELEV. 1540 feet	LOGGED BY HDN		PROJECT NO. C.314.39.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010		FIGURE NO. B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

GREGG **GEOBASE**

Site: KAISER MORENO VALLEYEngineer: H.NGUYEN

Sounding: CPT-3 Date: 2010-03-31 10:36



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

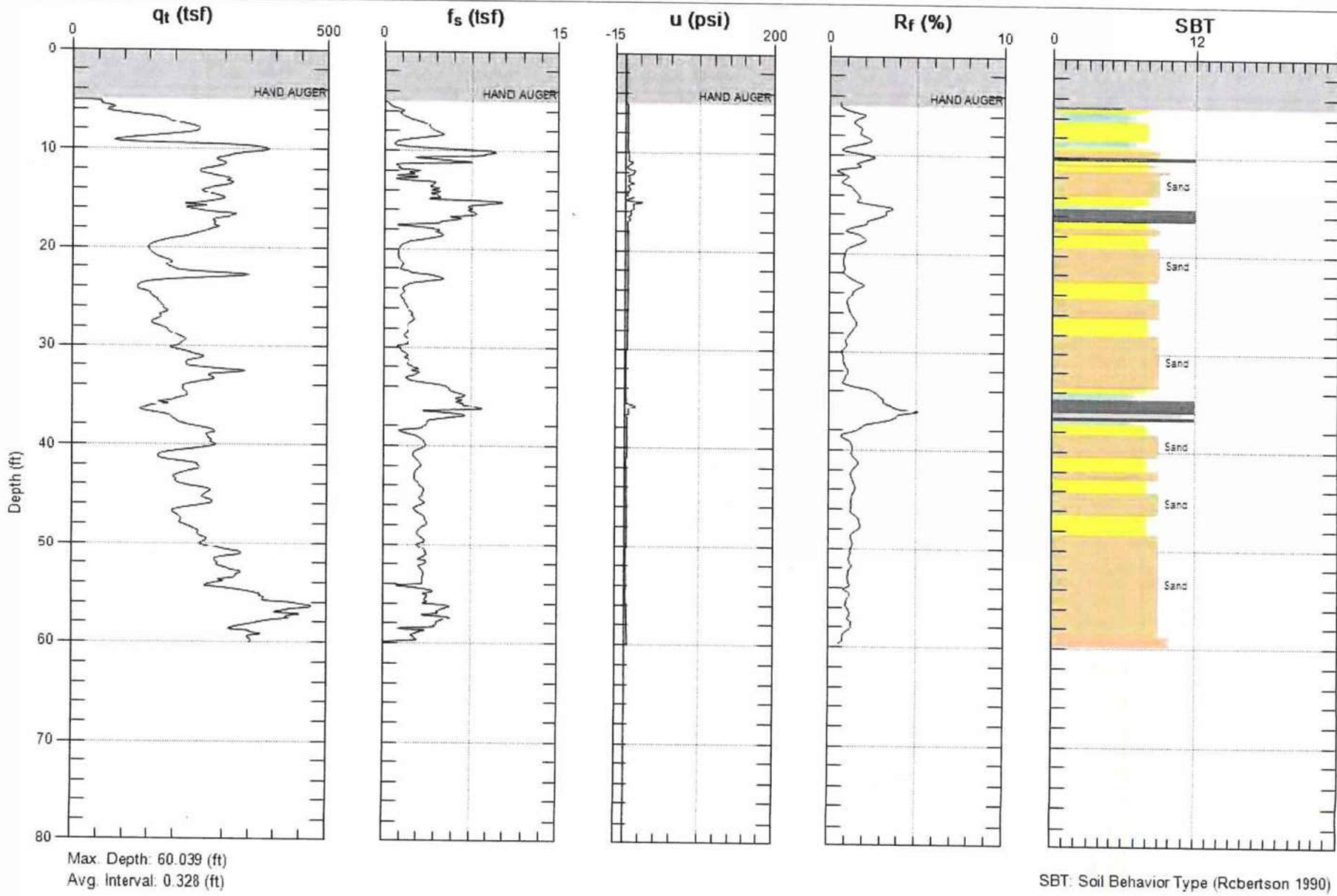
C.314.81.00

Figure B-31, page 1 of 2

GEOBASE

Site: KAISER MORENO VALLEY Engineer: H.NGUYEN

Sounding: CPT-3 Date: 2010-03-31 10:36



C.314.81.00

Figure B-31, page 2 of 2

Appendix 4: Historical Site Conditions

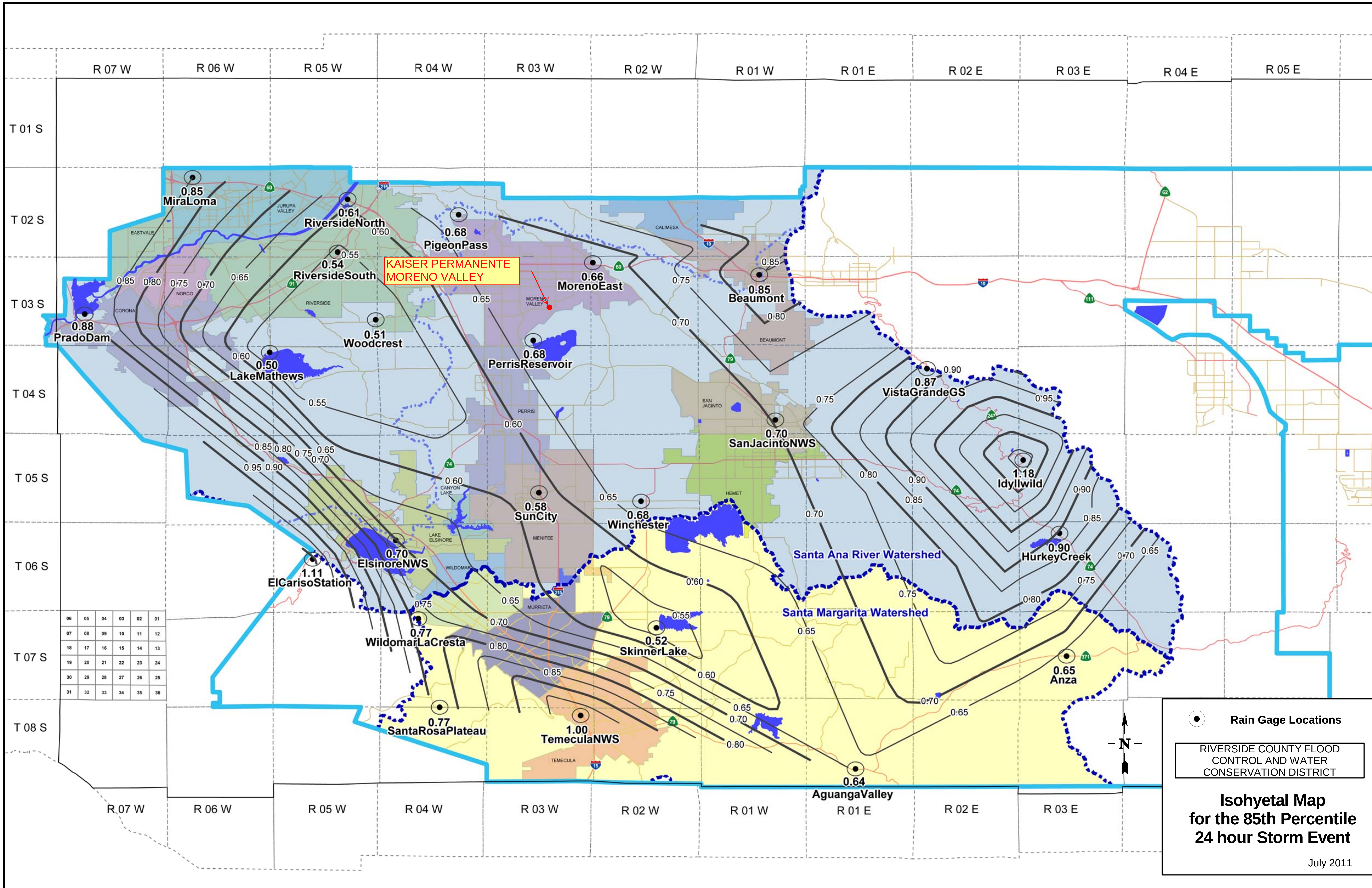
Phase I Environmental Site Assessment or Other Information on Past Site Use

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation


R 07 W
R 06 W
R 05 W
R 04 W
R 03 W
R 02 W
R 01 W
R 01 E
R 02 E
R 03 E
R 04 E
R 05 E
T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S
KAISER PERMANENTE
MORENO VALLEY
0.85
MiraLoma
0.61
RiversideNorth
0.68
PigeonPass
0.54
RiversideSouth
0.66
MorenoEast
0.85
Beaumont
0.88
PradoDam
0.51
Woodcrest
0.68
PerrisReservoir
0.50
LakeMathews
0.87
VistaGrandeGS
0.70
SanJacintoNWS
1.18
Idyllwild
0.58
SunCity
0.68
Winchester
0.70
ElsinoreNWS
1.11
ElCarisoStation
0.90
HurkeyCreek
Santa Ana River Watershed
Santa Margarita Watershed
0.77
WildomarLaCresta
0.52
SkinnerLake
0.65
Anza
0.77
SantaRosaPlateau
1.00
TemeculaNWS
0.64
AguangaValley
N
Rain Gage Locations
RIVERSIDE COUNTY FLOOD
CONTROL AND WATER
CONSERVATION DISTRICT
Isohyetal Map
for the 85th Percentile
24 hour Storm Event
July 2011

Effective Impervious Fraction

Developed Cover Types	Effective Impervious Fraction
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

Mixed Surface Types

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International — Date: 1/24/2019
Designed by: Pedro Arias — Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Sand Filter Basin A (SFB A)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
A Imp	*148585*	*Concrete or Asphalt*	*1*	*0.89*	*132537.8*			
A Per	*47710*	*Mixed Surface Types*	*0.15*	*0.141446*	*6748.4*			
	196295	**Total**			**139286.2**	**0.66**	**7660.7**	**10,806**

Notes:

Sand Filter Basin (SFB) - Design Procedure	BMP ID	Legend:	Required Entries
	SFB A		Calculated Cells

Company Name: Michael Baker International — Date: 1/24/2019

Designed by: Pedro Arias — County/City Case No.:

Design Volume

Total Tributary area	A_{TRIB} =	4.5	ac
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	7660.7	ft^3

Basin Geometry

Basin side slopes (no steeper than 4:1)	z =	4	:1
Proposed basin depth (see Figure 1)	d_B =	1.5	ft
Depth of freeboard (if used)	d_{fb} =	0.5	ft
Minimum bottom surface area of basin ($As = V_{BMP}/d_B$)	A_s =	5107	ft^2
Minimum total depth required (includes freeboard, filter media and subdrains)	d_{req} =	4.5	ft
Proposed Surface Area		5500	ft^2

Forebay

Forebay volume (minimum 0.5% V_{BMP})	Volume =	38	ft^3
Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
Forebay surface area (minimum)	Area =	38	ft^2
Full height notch-type weir	Width (W) =	1.5	in

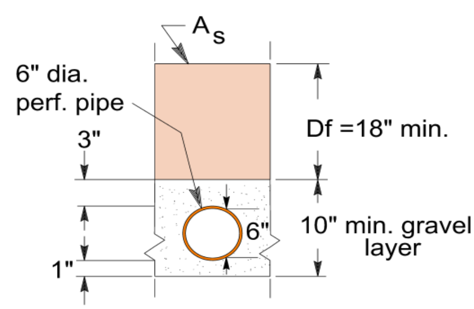
Filter Media

Description of filter media

X Sand (ASTM C-33)

Other (Clarify in "Notes" below)

Media depth, df = 18 inches



Underdrains

Diameter of perforated underdrain		6	in
Spacing of underdrains (maximum 20 feet on center)	OK	10	ft

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International
Date: 1/24/2019
Designed by: Pedro Arias
Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Sand Filter Basin B (SFB B)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
B Imp	*93772*	*Concrete or Asphalt*	*1*	*0.89*	*83644.6*			
B Per	*6911*	*Mixed Surface Types*	*0.15*	*0.141446*	*977.5*			
	100683	**Total**			**84622.1**	**0.66**	**4654.2**	**5925**

Notes:

Sand Filter Basin (SFB) - Design Procedure	BMP ID: SFB B	Legend: Required Entries / Calculated Cells

Company Name:	Michael Baker International	Date:	1/24/2019
Designed by:	Pedro Arias	County/City Case No.:	

Design Volume

Total Tributary area	A_{TRIB} =	2.3	ac
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	4654.2	ft^3

Basin Geometry

Basin side slopes (no steeper than 4:1)	z =	4	:1
Proposed basin depth (see Figure 1)	d_B =	1	ft
Depth of freeboard (if used)	d_{fb} =	0.5	ft
Minimum bottom surface area of basin ($As = V_{BMP}/d_B$)	A_s =	4654.2	ft^2
Minimum total depth required (includes freeboard, filter media and subdrains)	d_{req} =	4	ft
Proposed Surface Area		5100	ft^2

Forebay

Forebay volume (minimum 0.5% V_{BMP})	Volume =	23	ft^3
Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
Forebay surface area (minimum)	Area =	23	ft^2
Full height notch-type weir	Width (W) =	1.5	in

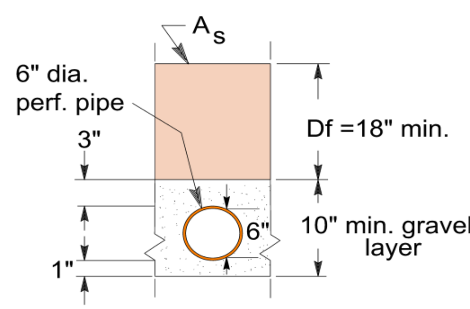
Filter Media

Description of filter media

X Sand (ASTM C-33)

Other (Clarify in "Notes" below)

Media depth, df = 18 inches



Underdrains

Diameter of perforated underdrain		6	in
Spacing of underdrains (maximum 20 feet on center)	OK	10	ft

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}	Legend:	Required Entries
		Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	Michael Baker International	Date	1/24/2019
Designed by	Pedro Arias	Case No	
Company Project Number/Name	Kaiser Permanente Moreno Valley Medical Center		

BMP Identification

BMP NAME / ID: Sand Filter Basin C (SFB C)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
C Imp	*73734*	*Concrete or Asphalt*	*1*	*0.89*	*65770.7*			
C Per	*60336*	*Mixed Surface Types*	*0.15*	*0.141446*	*8534.3*			
	134070	***Total***			**74305**	**0.66**	***4086.8***	***7,470***

Notes:

Sand Filter Basin (SFB) - Design Procedure	BMP ID	Legend:	Required Entries
	SFB C		Calculated Cells

Company Name:	Michael Baker International	Date:	1/24/2019
Designed by:	Pedro Arias	County/City Case No.:	

Design Volume

Total Tributary area	A_{TRIB} =	3.1	ac
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	4086.8	ft^3

Basin Geometry

Basin side slopes (no steeper than 4:1)	z =	4	:1
Proposed basin depth (see Figure 1)	d_B =	1	ft
Depth of freeboard (if used)	d_{fb} =	0.5	ft
Minimum bottom surface area of basin ($As = V_{BMP}/d_B$)	A_s =	4086.8	ft^2
Minimum total depth required (includes freeboard, filter media and subdrains)	d_{req} =	4	ft
Proposed Surface Area		6288	ft^2

Forebay

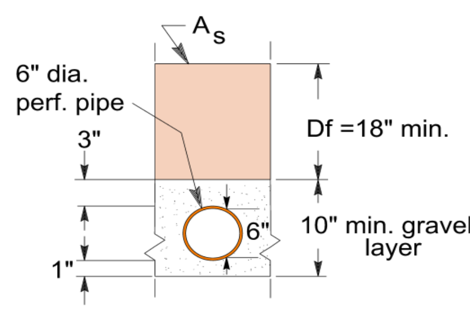
Forebay volume (minimum 0.5% V_{BMP})	Volume =	21	ft^3
Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
Forebay surface area (minimum)	Area =	21	ft^2
Full height notch-type weir	Width (W) =	1.5	in

Filter Media

Description of filter media

X	Sand (ASTM C-33)
	Other (Clarify in "Notes" below)

Media depth, df = 18 inches



Underdrains

Diameter of perforated underdrain		6	in
Spacing of underdrains (maximum 20 feet on center)	OK	10	ft

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International — Date: 11/19/2018
Designed by: Pedro Arias — Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Sand Filter Basin D (SFB D)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D Imp	*170775*	*Concrete or Asphalt*	*1*	*0.89*	*152331.3*			
D Per	*77965*	*Mixed Surface Types*	*0.15*	*0.141446*	*11027.8*			
	248740	***Total***			163359.1	**0.66**	***8984.8***	***13357***

Notes:

Sand Filter Basin (SFB) - Design Procedure	BMP ID	Legend:	Required Entries
	SFB D		Calculated Cells

Company Name:	Michael Baker International	Date:	1/24/2019
Designed by:	Pedro Arias	County/City Case No.:	

Design Volume

Total Tributary area	A_{TRIB} =	5.7	ac
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	8984.8	ft^3

Basin Geometry

Basin side slopes (no steeper than 4:1)	z =	4	:1
Proposed basin depth (see Figure 1)	d_B =	1.5	ft
Depth of freeboard (if used)	d_{fb} =	0.5	ft
Minimum bottom surface area of basin (As = V_{BMP}/d_B)	A_s =	5990	ft^2
Minimum total depth required (includes freeboard, filter media and subdrains)	d_{req} =	4.5	ft
Proposed Surface Area		6326	ft^2

Forebay

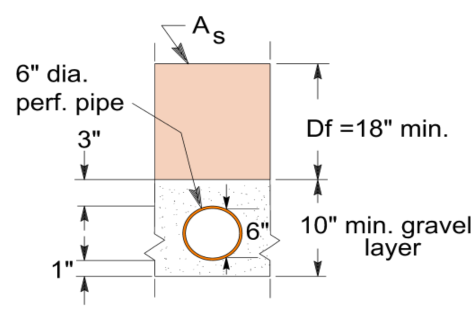
Forebay volume (minimum 0.5% V_{BMP})	Volume =	45	ft^3
Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
Forebay surface area (minimum)	Area =	45	ft^2
Full height notch-type weir	Width (W) =	1.5	in

Filter Media

Description of filter media

X	Sand (ASTM C-33)
	Other (Clarify in "Notes" below)

Media depth, df = 18 inches



Underdrains

Diameter of perforated underdrain		6	in
Spacing of underdrains (maximum 20 feet on center)	OK	10	ft

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International | Date: 11/19/2018
Designed by: Pedro Arias | Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Underground Storage Vault E

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
E Imp	*256382*	*Concrete or Asphalt*	*1*	*0.89*	*228692.7*			
E Per	*79868*	*Mixed Surface Types*	*0.15*	*0.141446*	*11297*			
	336250	***Total***			**239989.7**	**0.66**	***13199.4***	***15000***

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries; Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International
Date: 11/19/2018
Designed by: Pedro Arias
Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Underground Pipe Storage System F

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 inches

Drainage Management Area Tabulation

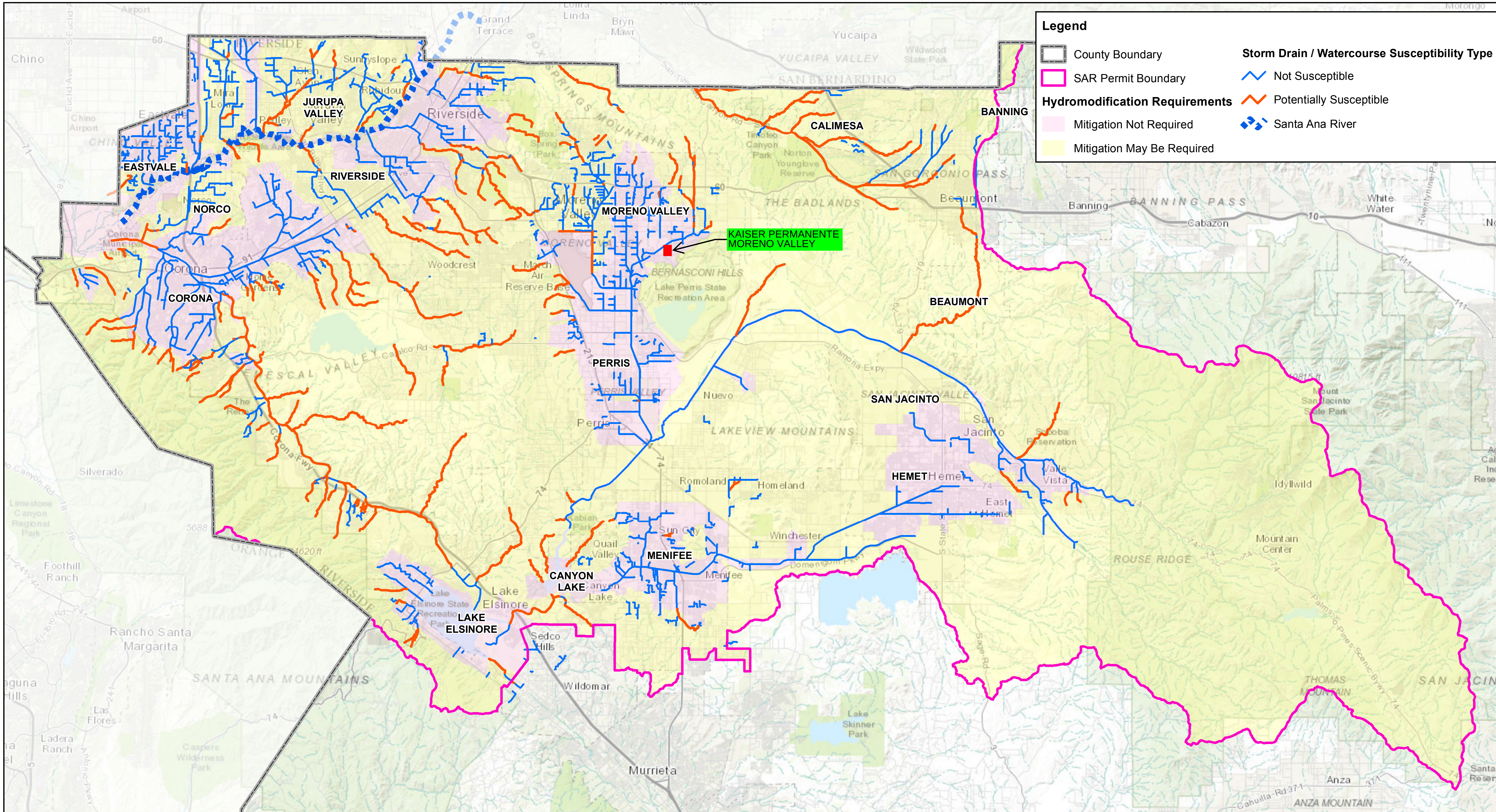
Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
F Imp	*236116*	*Concrete or Asphalt*	*1*	*0.89*	*210615.5*			
F Per	*30761*	*Mixed Surface Types*	*0.15*	*0.141446*	*4351*			
	266877	***Total***			**214966.5**	**0.66**	***11823.2***	***15875***

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern



N

0 2.5 5 10 Miles

Updated February 2017

HCOC Applicability Map
SAR Permittees

Map 2

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.

2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.

3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X A. **On-site storm drain inlets**	X **Locations of inlets.**	X **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	X **Maintain and periodically repaint or replace inlet markings.** X **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** X **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** X **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
X B. **Interior floor drains and elevator shaft sump pumps**		X **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	X **Inspect and maintain drains to prevent blockages and overflow.**
❑ C. **Interior parking garages**		❑ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ D1. Need for future indoor & structural pest control		❑ Note building design features that discourage entry of pests.	❑ Provide Integrated Pest Management information to owners, lessees, and operators.
X D2. Landscape/ Outdoor Pesticide Use	X Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ❑ Show self-retaining landscape areas, if any. X Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)	State that final landscape plans will accomplish all of the following. ❑ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ❑ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ❑ X Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ❑ Consider using pest-resistant plants, especially adjacent to hardscape. ❑ X To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	X Maintain landscaping using minimum or no pesticides. X See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at http://rcflood.org/stormwater/Error! Hyperlink reference not valid. ❑ Provide IPM information to new owners, lessees and operators.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. Pools, spas, ponds, decorative fountains, and other water features.	❑ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)	If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	❑ See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
❑ F. Food service	❑ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ❑ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	❑ Describe the location and features of the designated cleaning area. ❑ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	❑ See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ Provide this brochure to new site owners, lessees, and operators.
X G. Refuse areas	X Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ❑ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. ❑ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	❑ State how site refuse will be handled and provide supporting detail to what is shown on plans. X State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	X State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** Refer to “Outdoor Cleaning Activities and Professional Mobile Service Providers” for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑**Car dealerships and similar may rinse cars with water only.**

S T O R M W A T E R   P O L L U T A N T   S O U R C E S / S O U R C E   C O N T R O L   C H E C K L I S T

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

S T O R M W A T E R   P O L L U T A N T   S O U R C E S / S O U R C E   C O N T R O L   C H E C K L I S T

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X N. **Fire Sprinkler Test Water**		X **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	X **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ❑ **Boiler drain lines** ❑ **Condensate drain lines** ❑ **Rooftop equipment** ❑ **Drainage sumps** X **Roofing, gutters, and trim.** ❑ **Other sources**		❑ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ❑ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ❑ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** X **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** ❑ **Include controls for other sources as specified by local reviewer.**	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

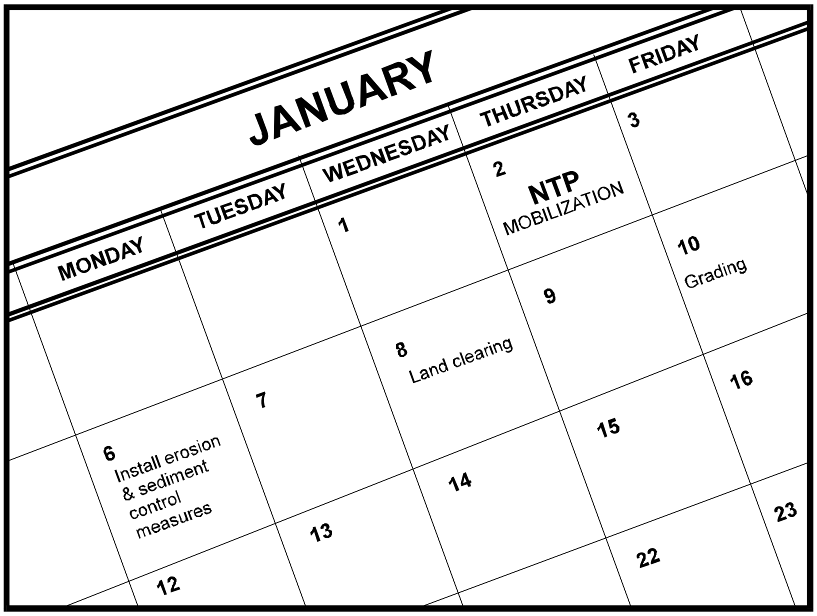
IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X P. **Plazas, sidewalks, and parking lots.**			X **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information



Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.

- Plan the project and develop a schedule showing each phase

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	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

of construction. Clearly show how the rainy season relates to soil disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

Inspection and Maintenance

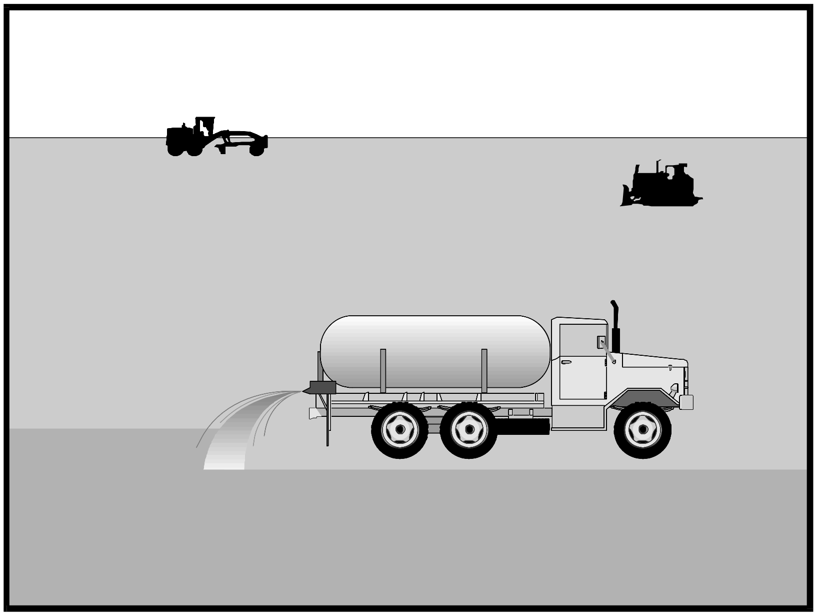
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

References

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

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

Soil Binders



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

Description and Purpose

Soil binding consists of application and maintenance of a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water and wind induced erosion of exposed soils on construction sites.

Suitable Applications

Soil binders are typically applied to disturbed areas requiring temporary protection. Because soil binders, when used as a stand-alone practice, can often be incorporated into the soil, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are commonly used in the following areas:

- Rough graded soils that will be inactive for a short period of time
- Soil stockpiles
- Temporary haul roads prior to placement of crushed rock
- Compacted soil road base
- Construction staging, materials storage, and layout areas

Limitations

- Soil binders are temporary in nature and may need reapplication.

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- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time may be 24 hours or longer. Soil binders may need reapplication after a storm event.

- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.

- Plant-material-based soil binders do not generally hold up to pedestrian or vehicular traffic across treated areas as well as polymeric emulsion blends or cementitious-based binders.

- Soil binders may not sufficiently penetrate compacted soils.

- Some soil binders are soil texture specific in terms of their effectiveness. For example, polyacrylamides (PAMs) work very well on silt and clayey soils but their performance decreases dramatically in sandy soils.

- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.

- Soil binders may not cure if low temperatures occur within 24 hours of application.

- The water quality impacts of some chemical soil binders are relatively unknown and some may have water quality impacts due to their chemical makeup.

Implementation

General Considerations

- Soil binders should conform to local municipality specifications and requirements.

- Site soil types will dictate appropriate soil binders to be used.

- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater when cured. Obtain a Material Safety Data Sheet (MSDS) from the manufacturer to ensure non-toxicity.

- Stormwater runoff from PAM treated soils should pass through one of the following sediment control BMP prior to discharging to surface waters.

  - When the total drainage area is greater than or equal to 5 acres, PAM treated areas should drain to a sediment basin.

  - Areas less than 5 acres should drain to sediment control BMPs, such as a sediment trap, or a series of check dams. The total number of check dams used should be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam should be spaced evenly in the drainage channel through which stormwater flows are discharged off site.

- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.

- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this Fact Sheet. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application is related to the functional longevity of the binder, which can be affected by subgrade conditions, surface type, climate, and maintenance schedule.
- Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

Plant-Material-Based (Short Lived, <6 months) Binders

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

Application Rates for Guar Soil Stabilizer

Slope (H:V):	Flat	4:1	3:1	2:1	1:1
lb/acre:	40	45	50	60	70

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together, but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

Plant-Material-Based (Long Lived, 6-12 months) Binders

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1 part emulsion
- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

Polymeric Emulsion Blend Binders

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound typically requires 12 to 24 hours drying time. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with the manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

Slope Gradient (H:V)	lb/acre
Flat to 5:1	3.0 – 5.0
5:1 to 3:1	5.0 – 10.0
2:1 to 1:1	10.0 – 20.0

Poly-Acrylamide (PAM) and Copolymer of Acrylamide**:** Linear copolymer polyacrylamide for use as a soil binder is packaged as a dry flowable solid, as a liquid. Refer to the manufacturer's recommendation for dilution and application rates as they vary based on liquid or dry form, site conditions and climate.

- Limitations specific to PAM are as follows:

- Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.

- The specific PAM copolymer formulation must be anionic. Cationic PAM should not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, should be used for soil applications.

- PAM designated for erosion and sediment control should be "water soluble" or "linear" or "non-cross linked".

- PAM should not be used as a stand-alone BMP to protect against water-based erosion. When combined with mulch, its effectiveness increases dramatically.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

Cementitious-Based Binders

Gypsum: This is a formulated gypsum based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

Applying Soil Binders

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.

- Prior to application, roughen embankment and fill areas.

- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.

- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.

- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.

- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.

- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.

- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd^2 or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 6 to 12 in.
  - Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd^2.

Costs

Costs vary according to the soil stabilizer selected for implementation. The following are approximate installed costs:

Soil Binder	Cost per Acre (2000)[1]	Estimated Cost per Acre (2009)[2]
Plant-Material-Based (Short Lived) Binders	\$700-\$900	\$770-\$990
Plant-Material-Based (Long Lived) Binders	\$1,200-\$1,500	\$1,320-\$1,650
Polymeric Emulsion Blend Binders	\$700 -\$1,500	\$770-\$1,650
Cementitious-Based Binders	\$800-\$1,200	\$880-\$1,350

1. Source: Erosion Control Pilot Study Report, Caltrans, June 2000.
2. 2009 costs reflect a 10% escalation over year 2000 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

Table 1 Properties of Soil Binders for Erosion Control

Evaluation Criteria	Binder Type			
	Plant Material Based (Short Lived)	**Plant Material Based (Long Lived)**	**Polymeric Emulsion Blends**	**Cementitious-Based Binders**
Relative Cost	Low	Moderate to High	Low to High	Low to Moderate
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies (1)	Varies (1)	Varies (1)	4,000 to 12,000 lbs/acre

(1) See Implementation for specific rates.

References

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

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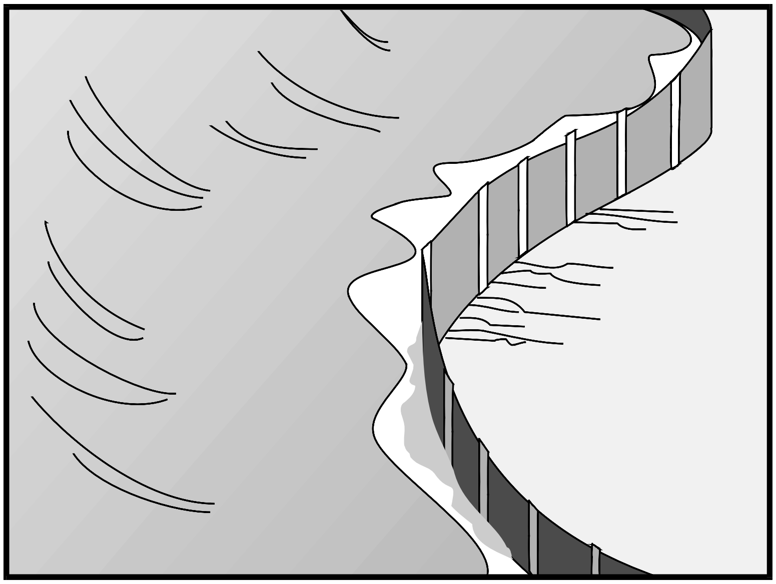
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment (coarse sediment)	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm SE-12 Manufactured Linear Sediment Controls

SE-13 Compost Socks and Berms

SE-14 Biofilter Bags

Description and Purpose

A silt fence is made of a woven geotextile that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains water, promoting sedimentation of coarse sediment behind the fence. Silt fence does not retain soil fine particles like clays or silts.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They could also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion and around inlets within disturbed areas (SE-10). Silt fences should not be used in locations where the flow is concentrated. Silt fences should always be used in combination with erosion controls. Suitable applications include:

- At perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Around inlets.
- Below other small cleared areas.

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Do not use in locations where ponded water may cause a flooding hazard.
- Do not use silt fence to divert water flows or place across any contour line.
- Improperly installed fences are subject to failure from undercutting, overtopping, or collapsing.
- Must be trenched and keyed in.
- Not intended for use as a substitute for Fiber Rolls (SE-5), when fiber rolls are being used as a slope interruption device.
- Do not use on slopes subject to creeping, slumping, or landslides.

Implementation

General

A silt fence is a temporary sediment barrier consisting of woven geotextile stretched across and attached to supporting posts, trenched-in, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap coarse sediment by intercepting and detaining sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

The following layout and installation guidance can improve performance and should be followed:

- Silt fence should be used in combination with erosion controls up-slope in order to provide the most effective sediment control.
- Silt fence alone is not effective at reducing turbidity. (Barrett and Malina, 2004)
- Designers should consider diverting sediment laden water to a temporary sediment basin or trap. (EPA, 2012)
- Use principally in areas where sheet flow occurs.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Efficiency of silt fences is primarily dependent on the detention time of the runoff behind the control. (Barrett and Malina, 2004)
- The drainage area above any fence should not exceed a quarter of an acre. (Rule of Thumb-100-feet of silt fence per 10,000 square feet of disturbed area.) (EPA 2012)

- The maximum length of slope draining to any point along the silt fence should be 100 ft per foot of silt fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area draining to the silt fence is permanently stabilized, after which, the silt fence fabric and posts should be removed and properly disposed.
- J-Hooks, which have ends turning up the slope to break up long runs of fence and provide multiple storage areas that work like mini-retention areas, may be used to increase the effectiveness of silt fence.
- Be aware of local regulations regarding the type and installation requirements of silt fence, which may differ from those presented in this fact sheet.

Design and Layout

In areas where high winds are anticipated the fence should be supported by a plastic or wire mesh. The geotextile fabric of the silt fence should contain ultraviolet inhibitors and stabilizers to provide longevity equivalent to the project life or replacement schedule.

- Layout in accordance with the attached figures.
- For slopes that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to protect silt fence from rocks (e.g., rockfall netting) ensure the integrity of the silt fence installation.

Standard vs. Heavy Duty Silt Fence

Standard Silt Fence

- Generally applicable in cases where the area draining to fence produces moderate sediment loads.

Heavy Duty Silt Fence

- Heavy duty silt fence usually has 1 or more of the following characteristics, not possessed by standard silt fence.
  - Fabric is reinforced with wire backing or additional support.
  - Posts are spaced closer than pre-manufactured, standard silt fence products.
- Use is generally limited to areas affected by high winds.
- Area draining to fence produces moderate sediment loads.

Materials

Standard Silt Fence

- Silt fence material should be woven geotextile with a minimum width of 36 in. The fabric should conform to the requirements in ASTM designation D6461.
- Wooden stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the

thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

Heavy-Duty Silt Fence

- Some silt fence has a wire backing to provide additional support, and there are products that may use prefabricated plastic holders for the silt fence and use metal posts instead of wood stakes.

Installation Guidelines – Traditional Method

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line of the proposed silt fence (trenches should not be excavated wider or deeper than necessary for proper silt fence installation).
- Bottom of the silt fence should be keyed-in a minimum of 12 in.
- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.
- When standard strength geotextile is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench.
- When extra-strength geotextile and closer post spacing are used, the mesh support fence may be eliminated.
- Woven geotextile should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, geotextile should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.
- The trench should be backfilled with native material and compacted.
- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.
- Cross barriers should be a minimum of 1/3 and a maximum of ½ the height of the linear barrier.
- See typical installation details at the end of this fact sheet.

Installation Guidelines - Static Slicing Method

- Static Slicing is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 inches into the soil while at the same time pulling silt geotextile fabric into the ground through the opening created by the blade to the depth of the blade. Once the geotextile is installed, the soil is compacted using tractor tires.
- This method will not work with pre-fabricated, wire backed silt fence.
- Benefits:
    - Ease of installation (most often done with a 2 person crew).
    - Minimal soil disturbance.
    - Better level of compaction along fence, less susceptible to undercutting
    - Uniform installation.
- Limitations:
    - Does not work in shallow or rocky soils.
    - Complete removal of geotextile material after use is difficult.
    - Be cautious when digging near potential underground utilities.

Costs

- It should be noted that costs vary greatly across regions due to available supplies and labor costs.
- Average annual cost for installation using the traditional silt fence installation method (assumes 6 month useful life) is $7 per linear foot based on vendor research. Range of cost is $3.50 - $9.10 per linear foot.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches 1/3 of the barrier height.
- Silt fences should be left in place until the upgradient area is permanently stabilized. Until then, the silt fence should be inspected and maintained regularly.

- Remove silt fence when upgradient areas are stabilized. Fill and compact post holes and anchor trench, remove sediment accumulation, grade fence alignment to blend with adjacent ground, and stabilize disturbed area.

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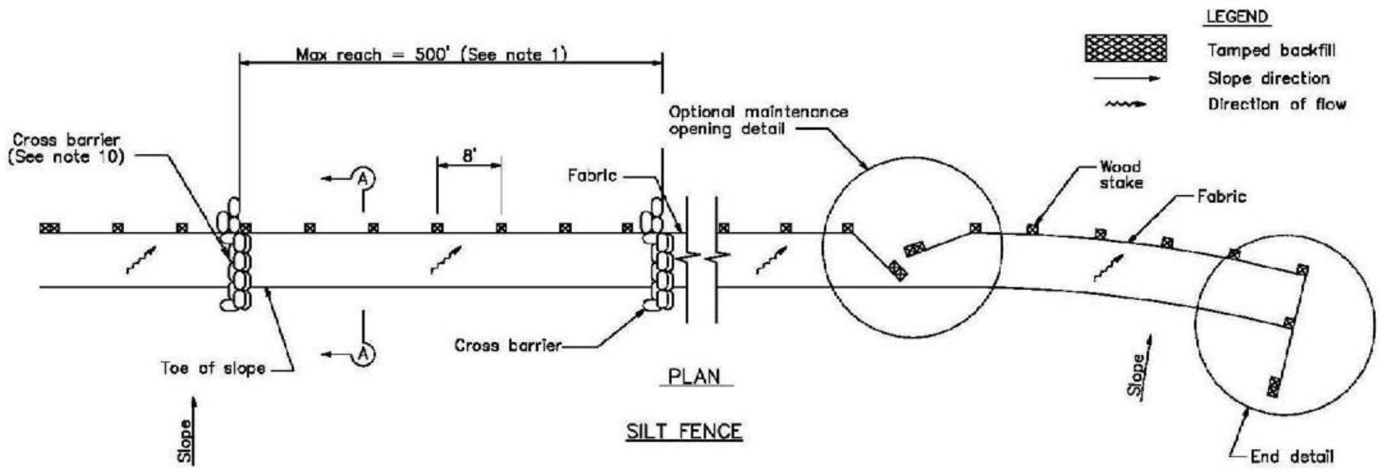
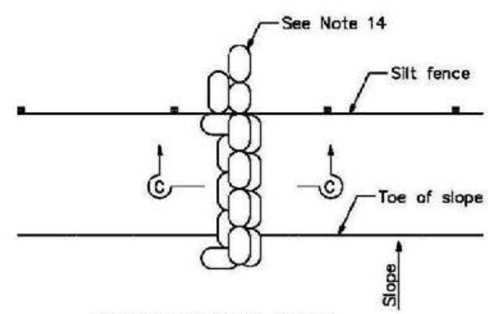
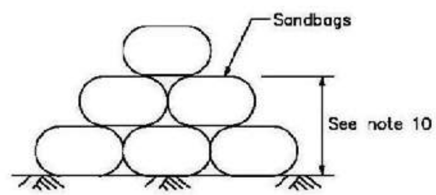




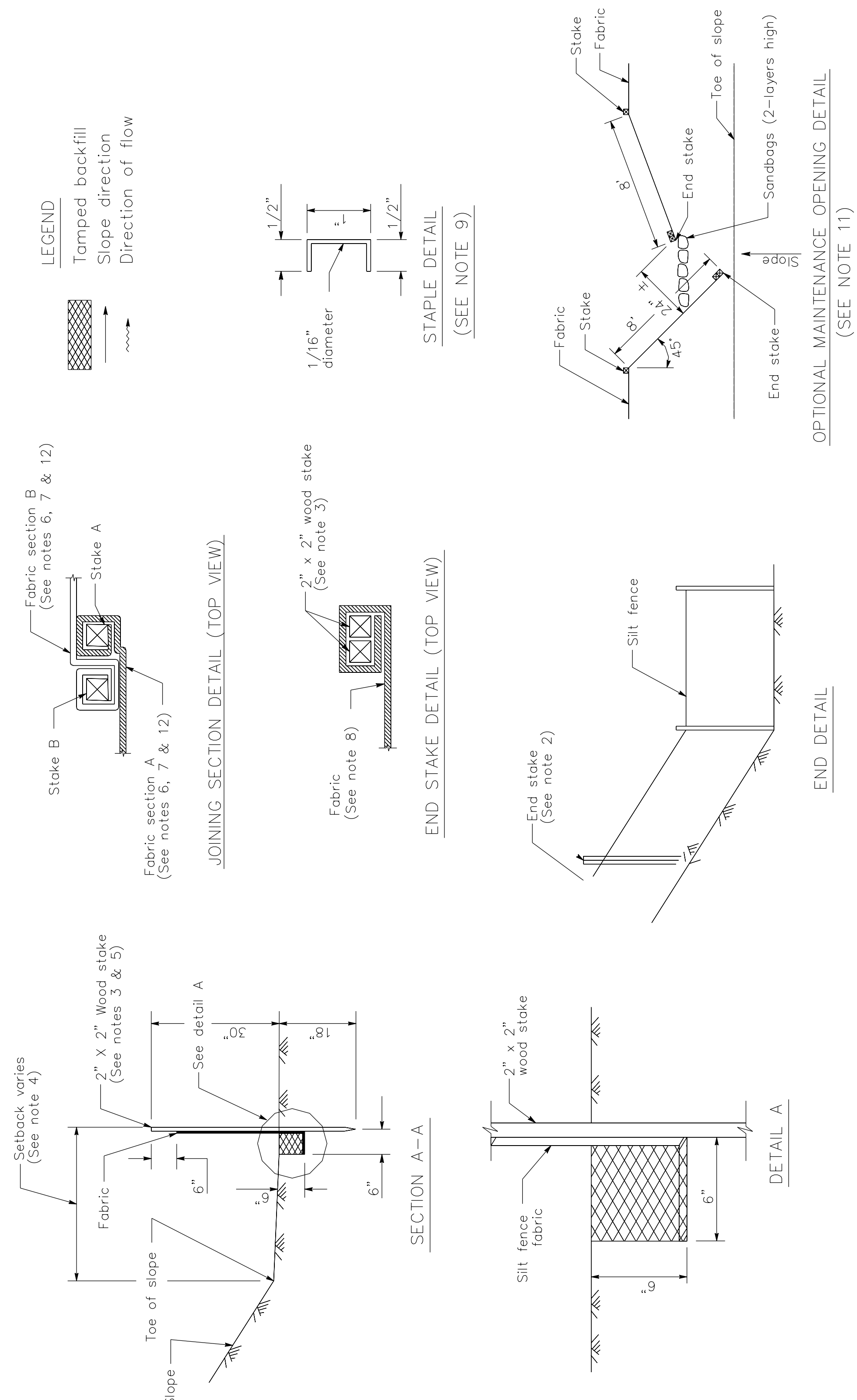
CROSS BARRIER DETAIL



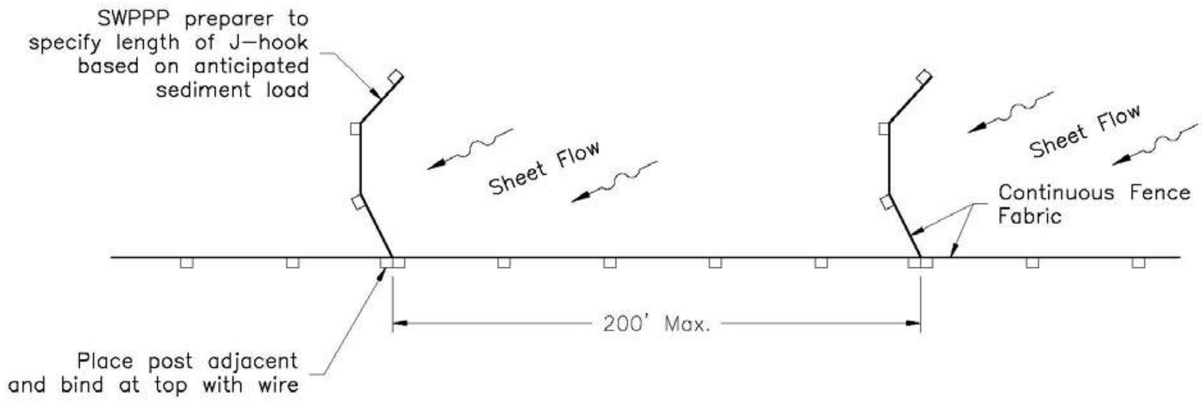
SECTION C–C

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier, in no case shall the reach length exceed 500'.
2. The last 8'–0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'–0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow-through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.
14. Add 3–4 bags to cross barrier on downgradient side of silt fence as needed to prevent bypass or undermining and as allowable based on site limits of disturbance.



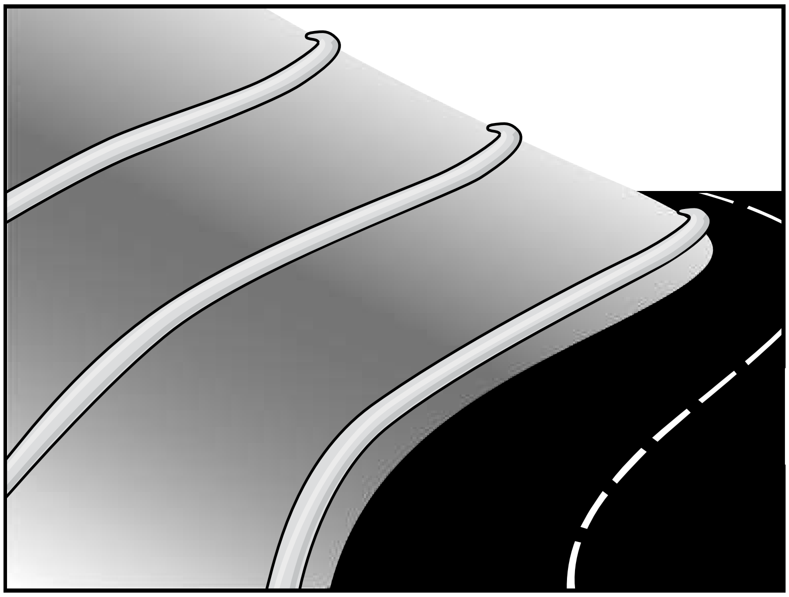
LEGEND
Tamped backfill
Slope direction
Direction of flow
Fabric section B
(See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A
(See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake
(See note 3)
Fabric
(See note 8)
END STAKE DETAIL (TOP VIEW)
1/2"
1"
1/2"
1/16" diameter
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
Toe of slope
Sandbags (2-layers high)
End stake
8'
4'
2'
45°
Slope
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Setback varies
(See note 4)
2" X 2" Wood stake
(See notes 3 & 5)
See detail A
30"
18"
6"
Fabric
Toe of slope
Slope
SECTION A-A
2" x 2" wood stake
Silt fence fabric
DETAIL A
End stake
(See note 2)
Silt fence
END DETAIL



SWPPP preparer to specify length of J–hook based on anticipated sediment load
Sheet Flow
Sheet Flow
Continuous Fence Fabric
200' Max.
Place post adjacent and bind at top with wire

Plan

J–HOOK



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

Description and Purpose

A fiber roll consists of straw, coir, or other biodegradable materials bound into a tight tubular roll wrapped by netting, which can be photodegradable or natural. Additionally, gravel core fiber rolls are available, which contain an imbedded ballast material such as gravel or sand for additional weight when staking the rolls are not feasible (such as use as inlet protection). When fiber rolls are placed at the toe and on the face of slopes along the contours, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff (through sedimentation). By interrupting the length of a slope, fiber rolls can also reduce sheet and rill erosion until vegetation is established.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- At the end of a downward slope where it transitions to a steeper slope.
- Along the perimeter of a project.
- As check dams in unlined ditches with minimal grade.
- Down-slope of exposed soil areas.
- At operational storm drains as a form of inlet protection.

- Around temporary stockpiles.

Limitations

- Fiber rolls are not effective unless trenched in and staked.
- Not intended for use in high flow situations.
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.
- Rolls typically function for 12-24 months depending upon local conditions.

Implementation

Fiber Roll Materials

- Fiber rolls should be prefabricated.
- Fiber rolls may come manufactured containing polyacrylamide (PAM), a flocculating agent within the roll. Fiber rolls impregnated with PAM provide additional sediment removal capabilities and should be used in areas with fine, clayey or silty soils to provide additional sediment removal capabilities. Monitoring may be required for these installations.
- Fiber rolls are made from weed free rice straw, flax, or a similar agricultural material bound into a tight tubular roll by netting.
- Typical fiber rolls vary in diameter from 9 in. to 20 in. Larger diameter rolls are available as well.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Prepare the slope before beginning installation.
- Dig small trenches across the slope on the contour. The trench depth should be ¼ to 1/3 of the thickness of the roll, and the width should equal the roll diameter, in order to provide area to backfill the trench.

- It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.

- Start building trenches and installing rolls from the bottom of the slope and work up.

- It is recommended that pilot holes be driven through the fiber roll. Use a straight bar to drive holes through the roll and into the soil for the wooden stakes.

- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.

- Stake fiber rolls into the trench.

  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.

  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.

- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.

- See typical fiber roll installation details at the end of this fact sheet.

Removal

- Fiber rolls can be left in place or removed depending on the type of fiber roll and application (temporary vs. permanent installation). Typically, fiber rolls encased with plastic netting are used for a temporary application because the netting does not biodegrade. Fiber rolls used in a permanent application are typically encased with a biodegradeable material and are left in place. Removal of a fiber roll used in a permanent application can result in greater disturbance.

- Temporary installations should only be removed when up gradient areas are stabilized per General Permit requirements, and/or pollutant sources no longer present a hazard. But, they should also be removed before vegetation becomes too mature so that the removal process does not disturb more soil and vegetation than is necessary.

Costs

Material costs for regular fiber rolls range from $20 - $30 per 25 ft roll.

Material costs for PAM impregnated fiber rolls range between 7.00-$9.00 per linear foot, based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Repair or replace split, torn, unraveling, or slumping fiber rolls.

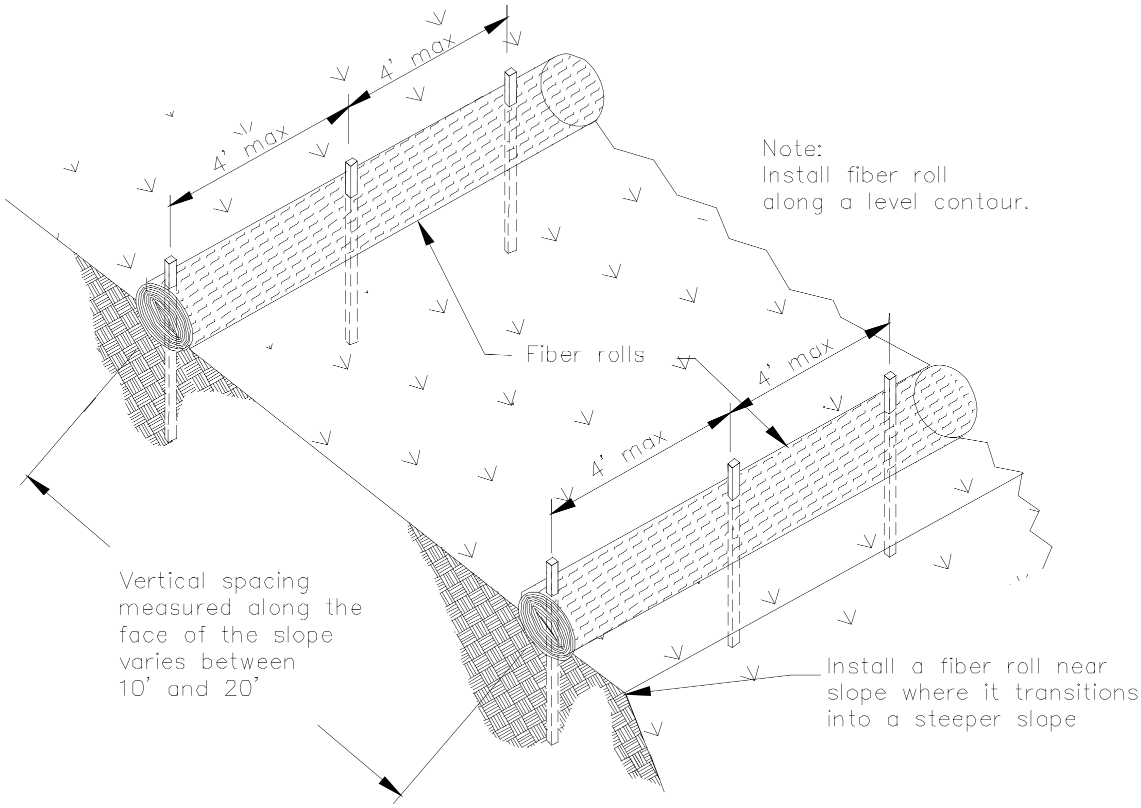
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-third the designated sediment storage depth.

- If fiber rolls are used for erosion control, such as in a check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.
- Repair any rills or gullies promptly.

References

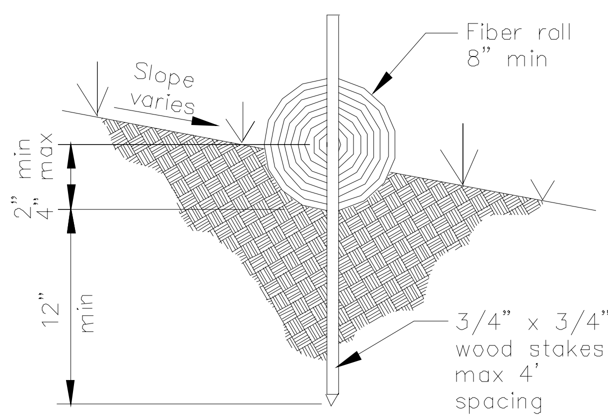
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



TYPICAL FIBER ROLL INSTALLATION

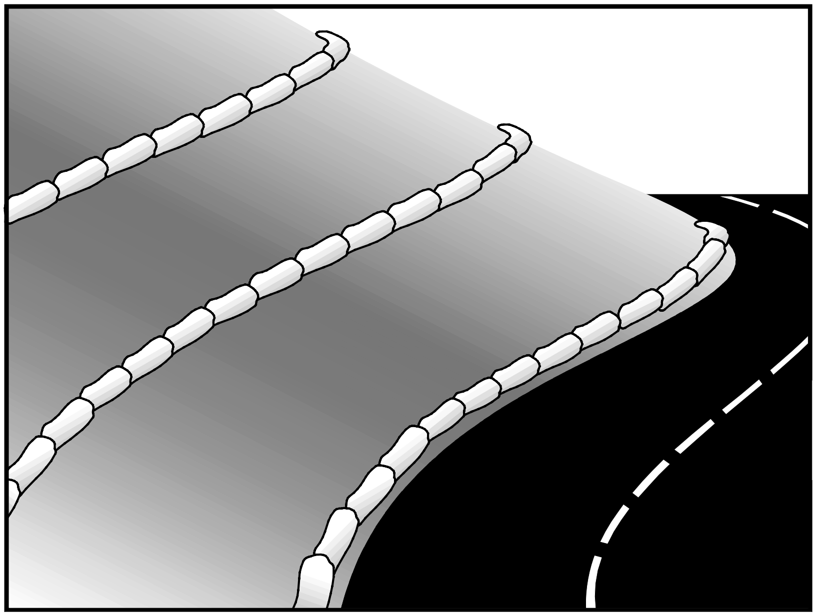
N.T.S.



ENTRENCHMENT DETAIL

N.T.S.

Gravel Bag Berm SE-6



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-12 Temporary Silt Dike

SE-14 Biofilter Bags

Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flow, preventing erosion.

Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As a linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

- At the top of slopes to divert runoff away from disturbed slopes.

- As chevrons (small check dams) across mildly sloped construction roads. For use check dam use in channels, see SE-4, Check Dams.

Limitations

- Gravel berms may be difficult to remove.

- Removal problems limit their usefulness in landscaped areas.

- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.

- Runoff will pond upstream of the berm, possibly causing flooding if sufficient space does not exist.

- Degraded gravel bags may rupture when removed, spilling contents.

- Installation can be labor intensive.

- Durability of gravel bags is somewhat limited and bags may need to be replaced when installation is required for longer than 6 months.

- Easily damaged by construction equipment.

- When used to detain concentrated flows, maintenance requirements increase.

Implementation

General

A gravel bag berm consists of a row of open graded gravel-filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous. Generally, gravel bag berms should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate gravel bag berms on level contours.

- When used for slope interruption, the following slope/sheet flow length combinations apply:

  - Slope inclination of 4:1 (H:V) or flatter: Gravel bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.

  - Slope inclination between 4:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

Slope inclination 2:1 (H:V) or greater: Gravel bags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, gravel bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the gravel bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 (H:V) or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- Butt ends of bags tightly.
- On multiple row, or multiple layer construction, overlap butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

Materials

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** Fill material should be 0.5 to 1 in. crushed rock, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

Costs
Material costs for gravel bags are average and are dependent upon material availability. $2.50-3.00 per filled gravel bag is standard based upon vendor research.

Inspection and Maintenance
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.

- Reshape or replace gravel bags as needed.

- Repair washouts or other damage as needed.

- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.

- Remove gravel bag berms when no longer needed and recycle gravel fill whenever possible and properly dispose of bag material. Remove sediment accumulation and clean, re-grade, and stabilize the area.

References
Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Street Sweeping and Vacuuming SE-7

Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	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

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CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

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.

- 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.

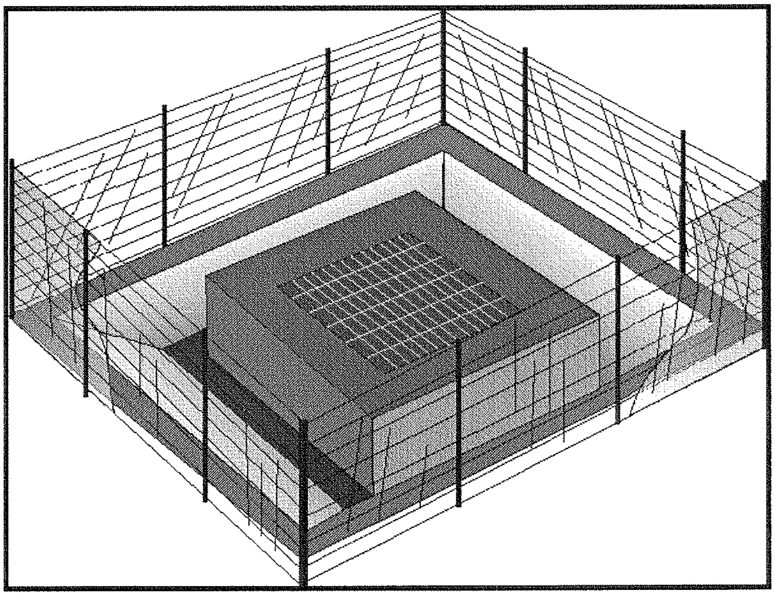
Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- 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.



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

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction.

Suitable Applications

Every storm drain inlet receiving sediment-laden runoff should be protected.

Limitations

- Drainage area should not exceed 1 acre.
- Straw bales, while potentially effective, have not produced in practice satisfactory results, primarily due to improper installation.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Inlet protection usually requires other methods of temporary protection to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.
- Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are

expected, use other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

Implementation

General

Large amounts of sediment may enter the storm drain system when storm drains are installed before the upslope drainage area is stabilized, or where construction is adjacent to an existing storm drain. In cases of extreme sediment loading, the storm drain itself may clog and lose a major portion of its capacity. To avoid these problems, it is necessary to prevent sediment from entering the system at the inlets.

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Inlet protection methods not presented in this handbook should be approved by the local stormwater management agency.

Design and Layout

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- Limit upstream drainage area to 1 acre maximum. For larger drainage areas, use SE-2, Sediment Basin, or SE-3, Sediment Trap, upstream of the inlet protection device.
- The key to successful and safe use of storm drain inlet protection devices is to know where runoff will pond or be diverted.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the

inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.

- Four types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.
  - Filter Fabric Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.
  - Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).
  - Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.
  - Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.
- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.
- Provide area around the inlet for water to pond without flooding structures and property.
- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.
- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

Installation

- ***DI Protection Type 1 - Filter Fabric Fence*** - The filter fabric fence (Type 1) protection is shown in the attached figure. Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.
  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.
  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes must be at least 48 in.
  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.
  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.
  5. Backfill the trench with gravel or compacted earth all the way around.
- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap*** - The excavated drop inlet sediment trap (Type 2) is shown in the attached figures. Install filter fabric fence in

accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 yd^3/acre of drainage area.

- ***DI Protection Type 3 - Gravel bag*** - The gravel bag barrier (Type 3) is shown in the figures. Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability.

  1. Use sand bag made of geotextile fabric (not burlap) and fill with 0.75 in. rock or 0.25 in. pea gravel.
  2. Construct on gently sloping street.
  3. Leave room upstream of barrier for water to pond and sediment to settle.
  4. Place several layers of sand bags – overlapping the bags and packing them tightly together.
  5. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter*** - The block and gravel filter (Type 4) is shown in the figures. Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place filter fabric over the wire mesh.
  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.
  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.
  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

Costs

- Average annual cost for installation and maintenance (one year useful life) is $200 per inlet.

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.

- Filter Fabric Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.

- Gravel Filters. If the gravel becomes clogged with sediment, it must be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

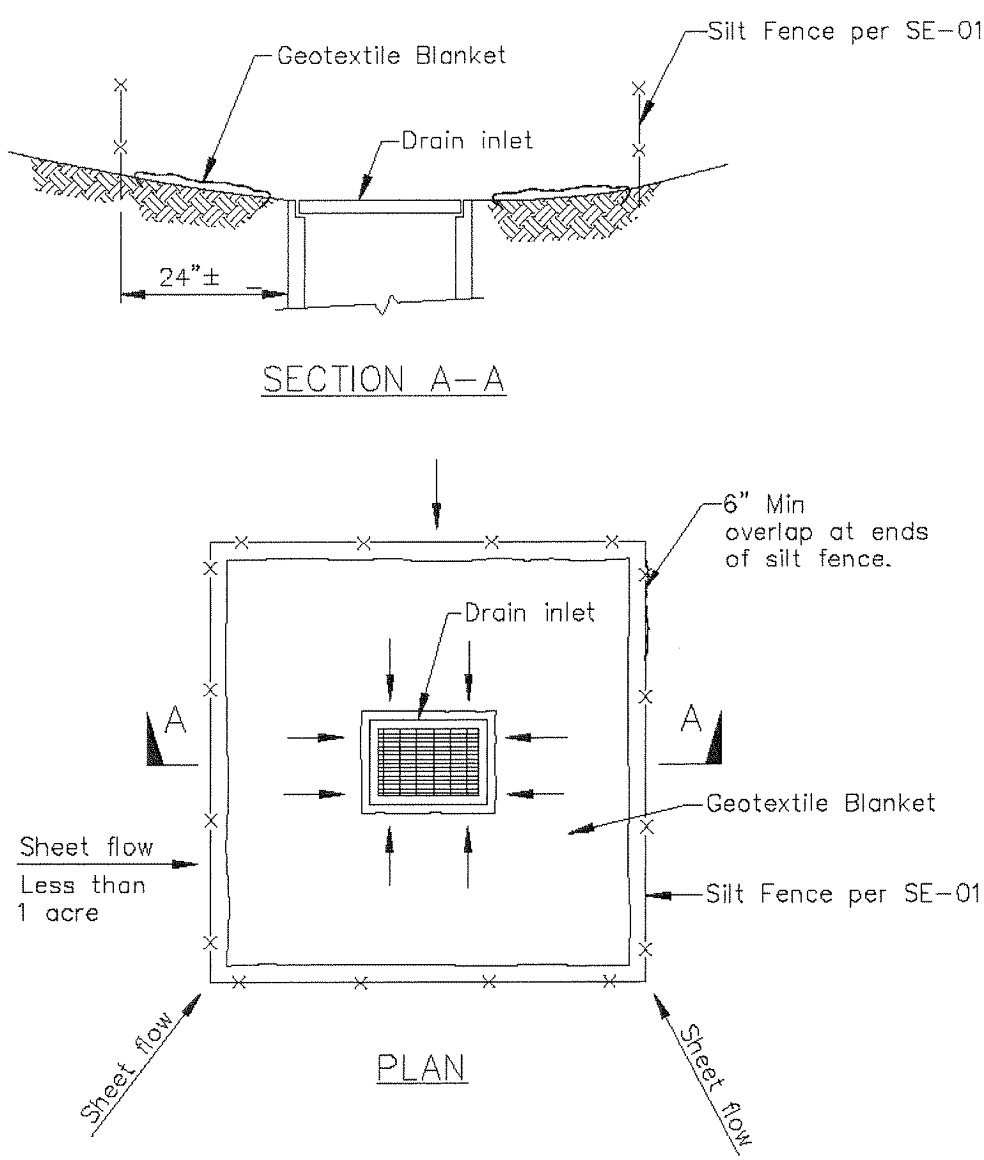
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site ore disposed at an appropriate location.

- Remove storm drain inlet protection once the drainage area is stabilized.
  - Clean and regrade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

References

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

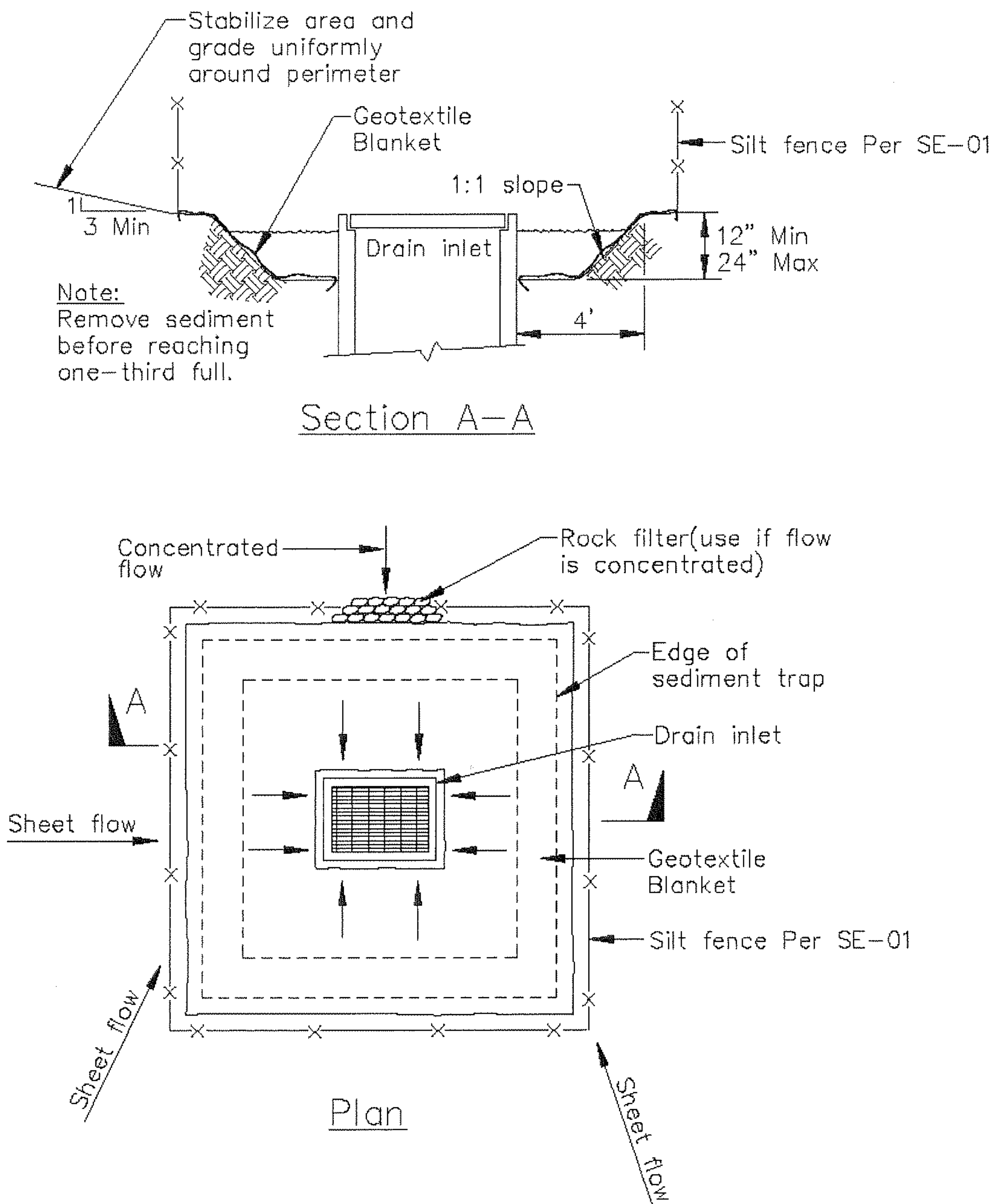
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.



DI PROTECTION TYPE 1
NOT TO SCALE

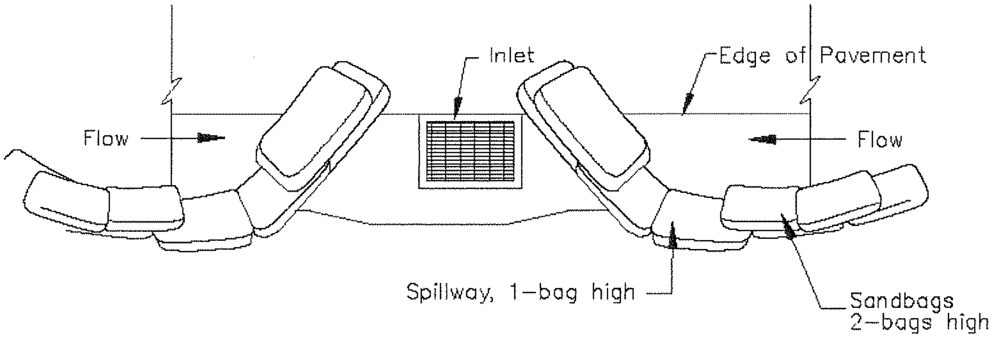
NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.

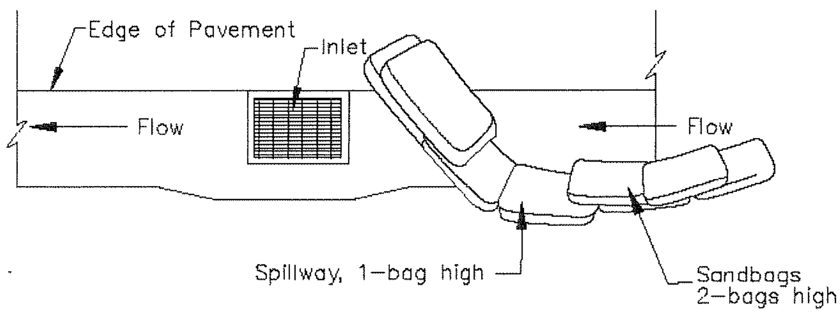


DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

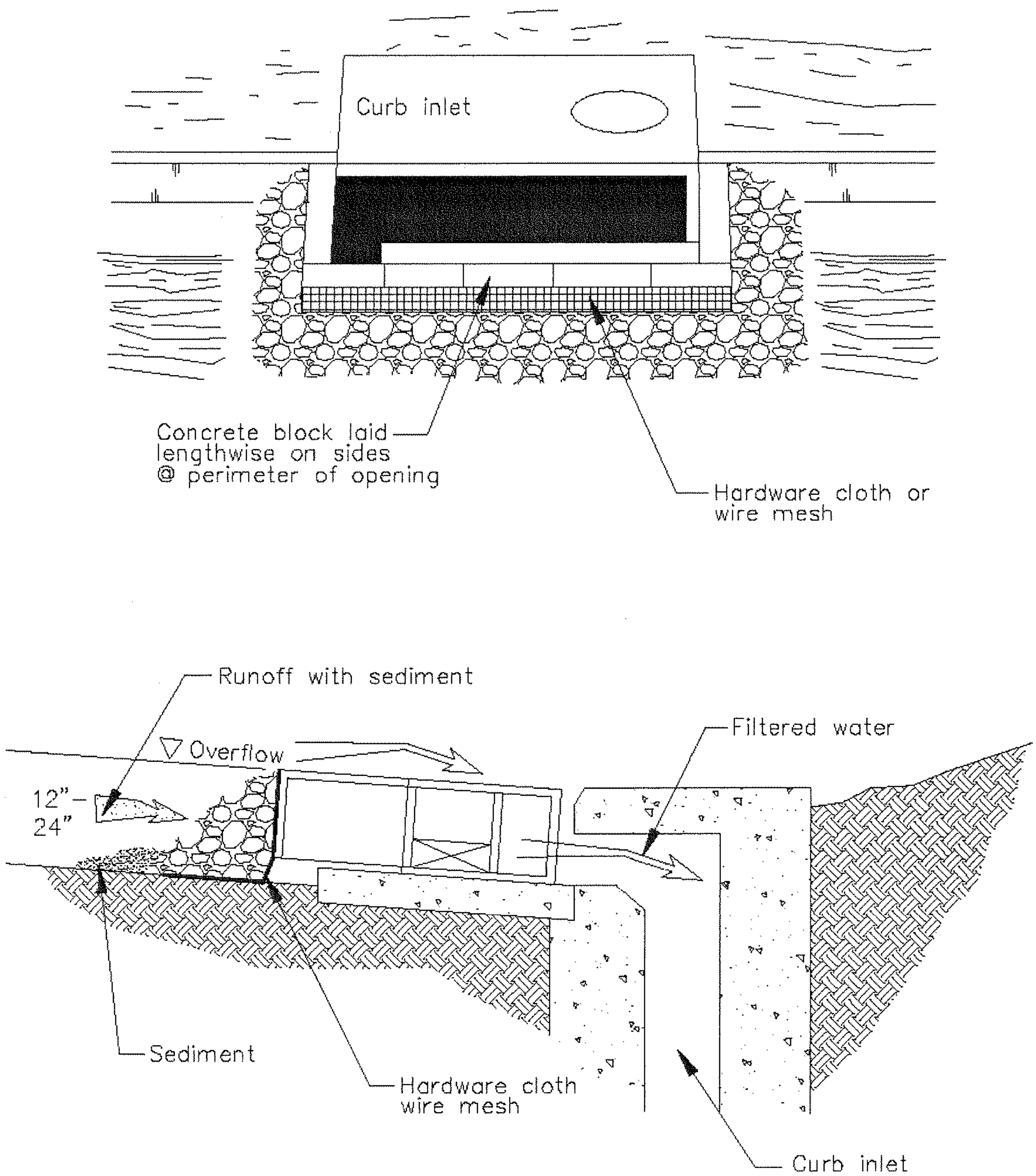


TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

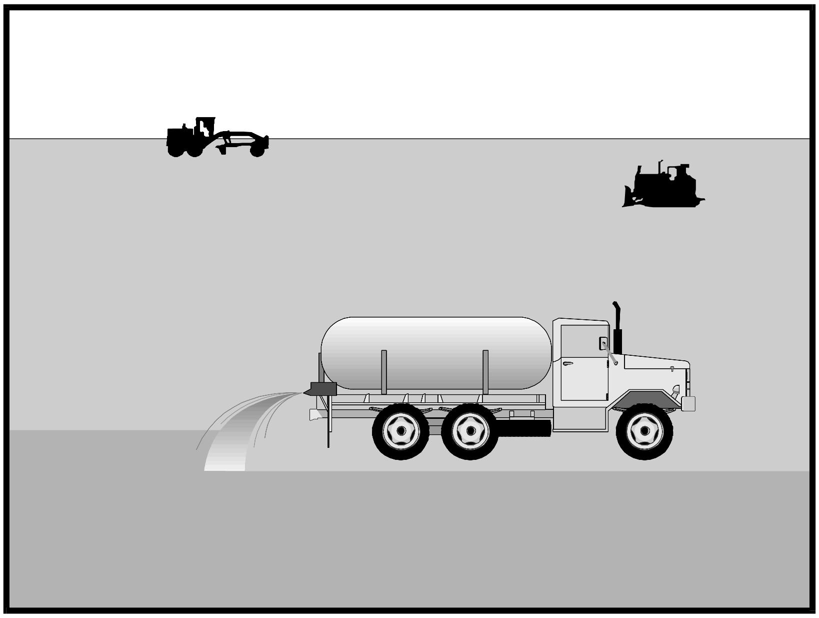
1. Intended for short–term use.
2. Use to inhibit non–storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.

DI PROTECTION TYPE 3
NOT TO SCALE



DI PROTECTION – TYPE 4
NOT TO SCALE

Wind Erosion Control WE-1



Description and Purpose

Wind erosion or dust control consists of applying water or other chemical dust suppressants as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

California's Mediterranean climate, with a short "wet" season and a typically long, hot "dry" season, allows the soils to thoroughly dry out. During the dry season, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment. Site conditions and climate can make dust control more of an erosion problem than water based erosion. Additionally, many local agencies, including Air Quality Management Districts, require dust control and/or dust control permits in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. Wind erosion control is required to be implemented at all construction sites greater than 1 acre by the General Permit.

Suitable Applications

Most BMPs that provide protection against water-based erosion will also protect against wind-based erosion and dust control requirements required by other agencies will generally meet wind erosion control requirements for water quality protection. Wind erosion control BMPs are suitable during the following construction activities:

Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-5 Soil Binders

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

Limitations

- Watering prevents dust only for a short period (generally less than a few hours) and should be applied daily (or more often) to be effective.
- Over watering may cause erosion and track-out.
- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Chemical dust suppression agents may have potential environmental impacts. Selected chemical dust control agents should be environmentally benign.
- Effectiveness of controls depends on soil, temperature, humidity, wind velocity and traffic.
- Chemical dust suppression agents should not be used within 100 feet of wetlands or water bodies.
- Chemically treated subgrades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.
- If the soil surface has minimal natural moisture, the affected area may need to be pre-wetted so that chemical dust control agents can uniformly penetrate the soil surface.

Implementation

Dust Control Practices

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table presents dust control practices that can be applied to varying site conditions that could potentially cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph or less, and controlling the number and activity of vehicles on a site at any given time.

Chemical dust suppressants include: mulch and fiber based dust palliatives (e.g. paper mulch with gypsum binder), salts and brines (e.g. calcium chloride, magnesium chloride), non-petroleum based organics (e.g. vegetable oil, lignosulfonate), petroleum based organics (e.g. asphalt emulsion, dust oils, petroleum resins), synthetic polymers (e.g. polyvinyl acetate, vinyls, acrylic), clay additives (e.g. bentonite, montimorillonite) and electrochemical products (e.g. enzymes, ionic products).

Site Condition	Dust Control Practices							
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt	Temporary Gravel Construction Entrances/Equipment Wash Down	Synthetic Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	X	X	X	X	X			X
Disturbed Areas Subject to Traffic			X	X	X	X		X
Material Stockpiles		X	X	X			X	X
Demolition			X			X	X	
Clearing/ Excavation			X	X				X
Truck Traffic on Unpaved Roads			X	X	X	X	X	
Tracking					X	X		

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (see EC-1, Scheduling).
- Quickly treat exposed soils using water, mulching, chemical dust suppressants, or stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Restrict construction traffic to stabilized roadways within the project site, as practicable.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.
- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality

Control Board (RWQCB) requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."

- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and wheel wash areas.
- Stabilize inactive areas of construction sites using temporary vegetation or chemical stabilization methods.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater and should meet all applicable regulatory requirements.

Costs

Installation costs for water and chemical dust suppression vary based on the method used and the length of effectiveness. Annual costs may be high since some of these measures are effective for only a few hours to a few days.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check areas protected to ensure coverage.
- Most water-based dust control measures require frequent application, often daily or even multiple times per day. Obtain vendor or independent information on longevity of chemical dust suppressants.

References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

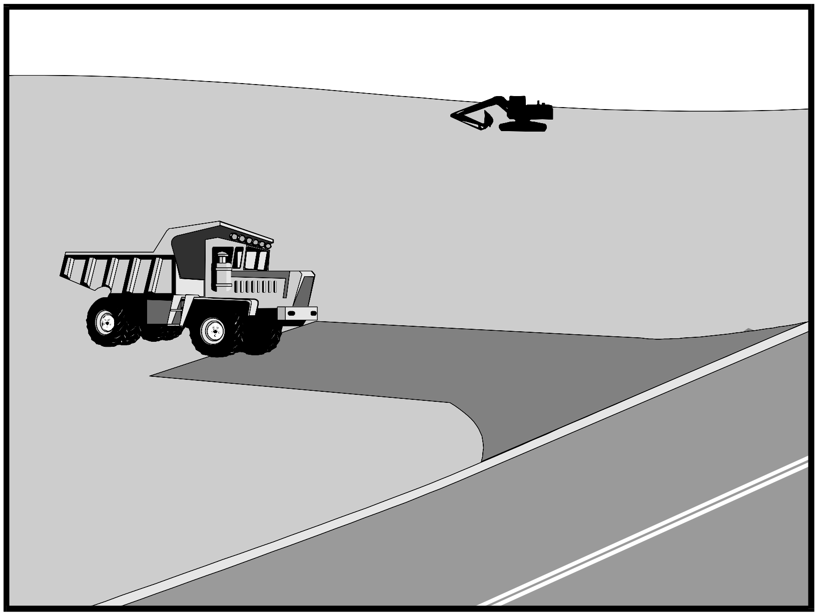
California Air Pollution Control Laws, California Air Resources Board, updated annually.

Construction Manual, Chapter 4, Section 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative", California Department of Transportation (Caltrans), July 2001.

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stabilized Construction Entrance/Exit TC-1



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	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

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

Implementation

General

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

Design and Layout

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft or maximum site will allow, and 10 ft minimum width or to accommodate traffic.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.

- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

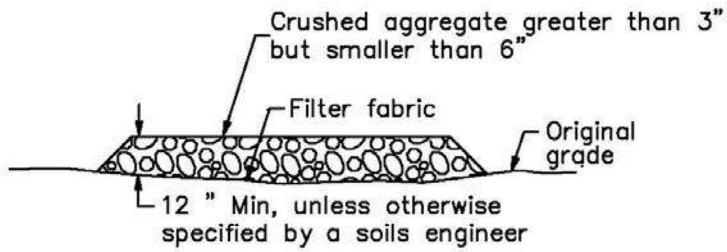
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

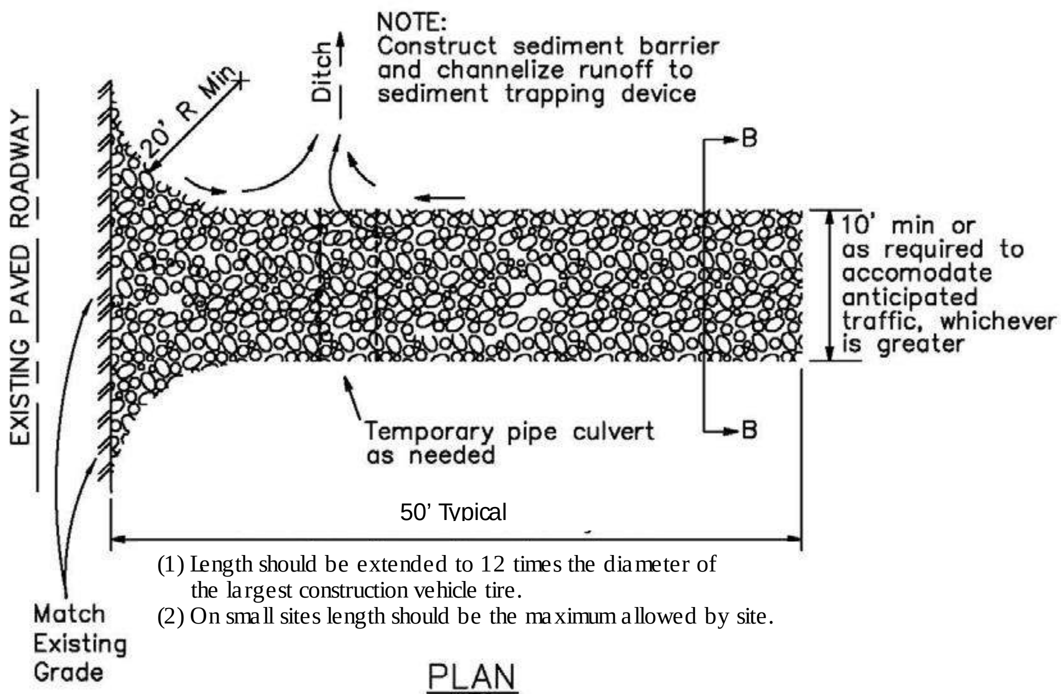
Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

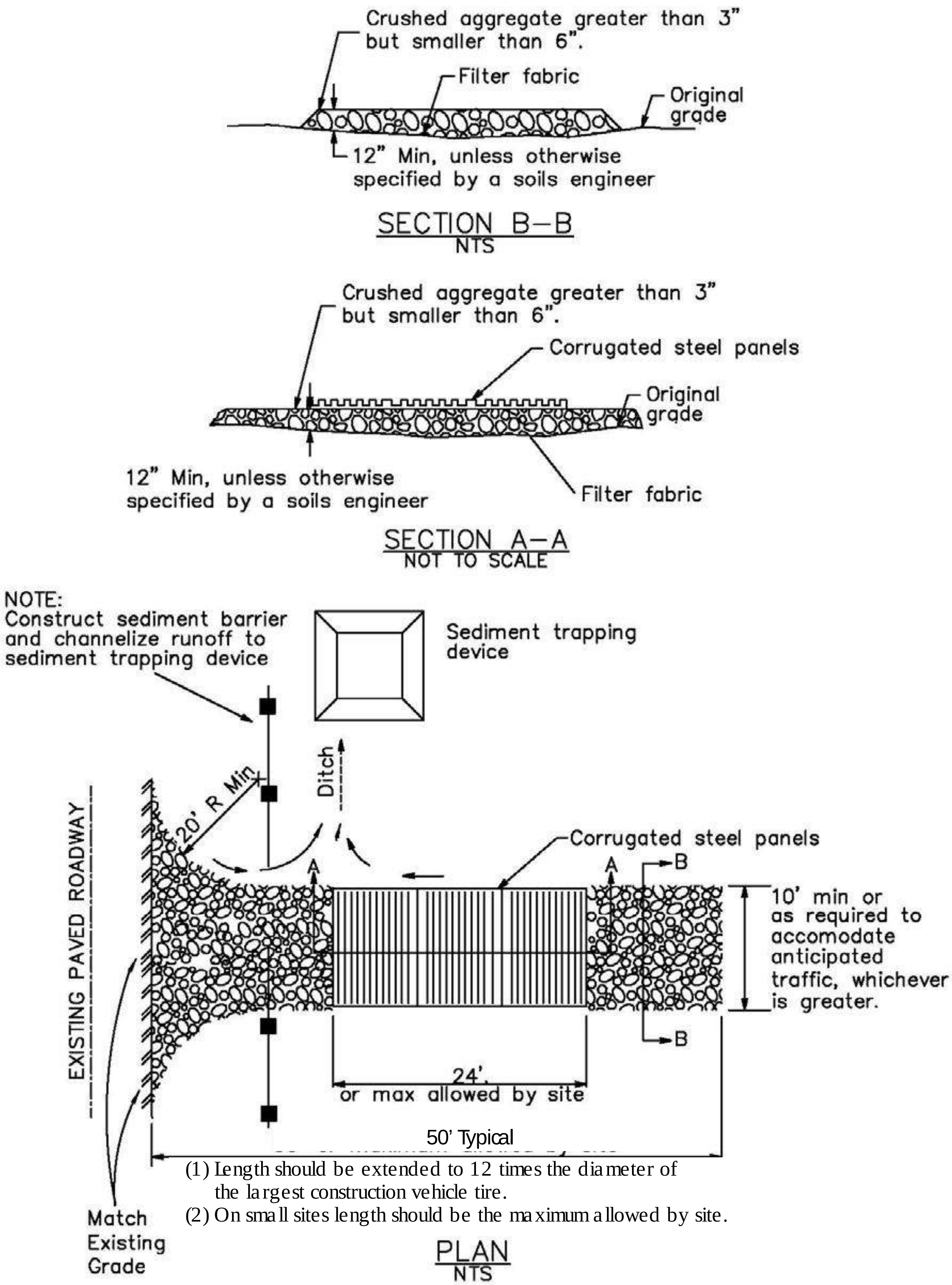
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



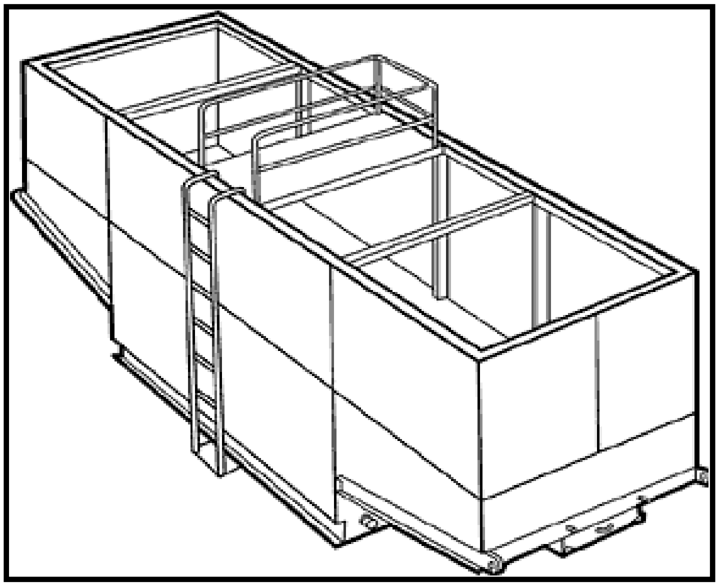
SECTION B–B
NTS



PLAN
NTS


Crushed aggregate greater than 3" but smaller than 6".
Filter fabric
Original grade
12" Min, unless otherwise specified by a soils engineer
SECTION B–B
NTS
Crushed aggregate greater than 3" but smaller than 6".
Corrugated steel panels
Original grade
12" Min, unless otherwise specified by a soils engineer
Filter fabric
SECTION A–A
NOT TO SCALE
NOTE:
Construct sediment barrier and channelize runoff to sediment trapping device
Sediment trapping device
Ditch
20' R Min
EXISTING PAVED ROADWAY
Corrugated steel panels
A
A
B
B
10' min or as required to accomodate anticipated traffic, whichever is greater.
24' or max allowed by site
50' Typical
(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.
Match Existing Grade
PLAN
NTS

Dewatering Operations NS-2



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation (stormwater) must be removed from a work location to proceed with construction work or to provide vector control.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Discharges from dewatering operations can contain high levels of fine sediment that, if not properly treated, could lead to exceedences of the General Permit requirements.

Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area to facilitate construction.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated precipitation (stormwater) from depressed areas at a construction site.

Stormwater mixed with non-stormwater should be managed as non-stormwater.

Limitations

- Dewatering operations will require, and should comply with applicable local and project-specific permits and regulations. In some areas, all dewatering activities, regardless of the discharge volume, require a dewatering permit.

- Site conditions will dictate design and use of dewatering operations.

- The controls discussed in this fact sheet primarily address sediment. Other secondary pollutant removal benefits are discussed where applicable.

- The controls detailed in this fact sheet only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.

- Avoid dewatering discharges where possible by using the water for dust control.

Implementation

- A Construction Site Monitoring Plan (CSMP) should be included in the project Stormwater Pollution Prevention Plan (SWPPP).

- Regional Water Quality Control Board (RWQCB) Regions may require notification and approval prior to any discharge of water from construction sites.

- The destination of discharge from dewatering activities will typically determine the type of permit required by the discharger. For example, when discharging to a water of the U.S., a groundwater extraction permit will be required through the site's governing RWQCB. When discharging to a sanitary sewer or Municipal Separate Storm Sewer System (MS4), a permit may need to be obtained through the owner of the sanitary sewer or MS4 in addition to obtaining an RWQCB dewatering permit. Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.

- Dewatering discharges should not cause erosion at the discharge point. Appropriate BMPs should be implemented to maintain compliance with all applicable permits.

- Maintain dewatering records in accordance with all local and project-specific permits and regulations.

Sediment Treatment

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The sediment particle size and permit or receiving water limitations on sediment are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate. Use of other enhanced treatment methods (i.e., introduction of chemicals or electric current to enhance flocculation and removal of sediment) must comply with: 1) for storm drain or surface water discharges, the requirements for Active Treatment Systems (SE-11); or 2) for sanitary sewer discharges, the requirements of applicable sanitary sewer discharge permits.

Sediment Basin (see also SE-2)

Description:

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3) and have a designed outlet structure.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, silt, some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.

- Temporary sediment basins should be fenced if safety is a concern.

- Outlet protection is required to prevent erosion at the outfall location.

Maintenance:

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outlet, as well as other features.

- Removal of sediment is required when the storage volume is reduced by one-third.

Sediment Trap (See also SE-3)

Description:

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2) and do not have a designed outlet (but do have a spillway or overflow).

Appropriate Applications:

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.

- Trap inlets should be located to maximize the travel distance to the trap outlet.

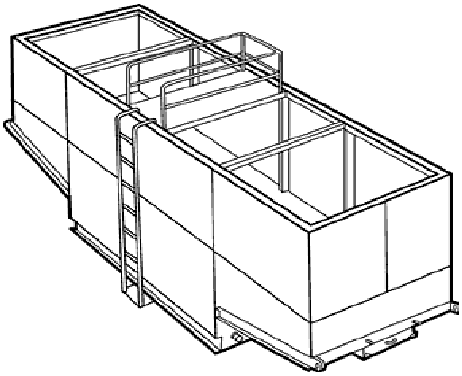
- Use rock or vegetation to protect the trap outlets against erosion.

Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.

- Removal of sediment is required when the storage volume is reduced by one-third.

Weir Tanks



Description:

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

Appropriate Applications:

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.

- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

- Treatment capacity (i.e., volume and number of tanks) should provide at a minimum the required volume for discrete particle settling for treatment design flows.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.

- Oil and grease disposal should be conducted by a licensed waste disposal company.

Dewatering Tanks

Description:

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

Appropriate Applications:

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.

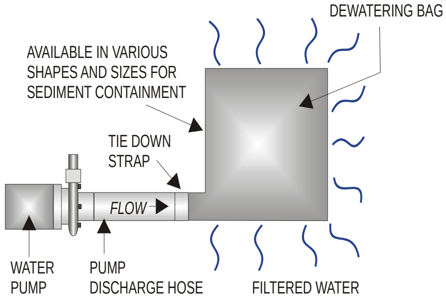
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.

- Oil and grease disposal should be conducted by licensed waste disposal company.

Gravity Bag Filter



Description:

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects gravel, sand, silt, and fines.

Appropriate Applications:

- Effective for the removal of sediments (gravel, sand, silt, and fines). Some metals are removed with the sediment.

Implementation:

- Water is pumped into one side of the bag and seeps through the top, bottom, and sides of the bag.

- Place filter bag on pavement or a gravel bed or paved surface. Avoid placing a dewatering bag on unprotected bare soil. If placing the bag on bare soil is unavoidable, a secondary barrier should be used, such as a rock filter bed placed beneath and beyond the edges of the bag to, prevent erosion and capture sediments that escape the bag.

- Perimeter control around the downstream end of the bag should be implemented. Secondary sediment controls are important especially in the initial stages of discharge, which tend to allow fines to pass through the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier (as applicable) is required.

- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.

- Caution should be taken when removing and disposing of the bag, to prevent the release of captured sediment

- Properly dispose of the bag offsite. If sediment is removed from the bag prior to disposal (bags can potentially be reused depending upon their condition), dispose of sediment in accordance with the general maintenance procedures described at the end of this BMP Fact Sheet.

Sand Media Particulate Filter

Description:

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.

- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.

- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.

- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.

- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

Pressurized Bag Filter

Description:

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

Appropriate Applications:

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Cartridge Filter

Description:

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

Appropriate Applications:

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Costs

- Sediment control costs vary considerably depending on the dewatering and sediment treatment system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

Inspection and Maintenance

- Inspect and verify that dewatering BMPs are in place and functioning prior to the commencement of activities requiring dewatering.

- Inspect dewatering BMPs daily while dewatering activities are being conducted.

- Inspect all equipment before use. Monitor dewatering operations to ensure they do not cause offsite discharge or erosion.
- Sample dewatering discharges as required by the General Permit.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants should be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

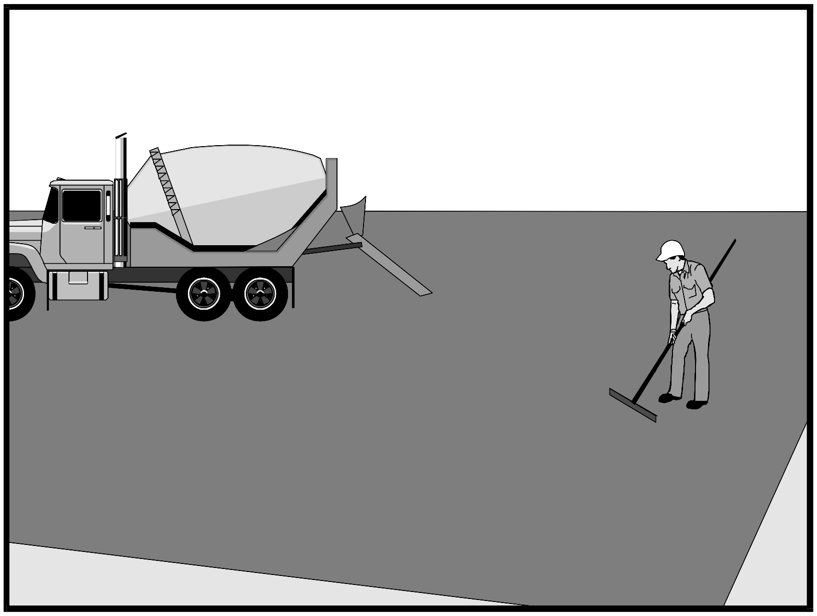
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003; Updated March 2004.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

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

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Paving and Grinding Operations NS-3



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH and turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials associated with paving and grinding operations, including mortar, concrete, and cement and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute stormwater runoff or discharge to the storm drain system or watercourses.

Limitations

- Paving opportunities may be limited during wet weather.
- Discharges of freshly paved surfaces may raise pH to environmentally harmful levels and trigger permit violations.

Implementation

General

- Avoid paving during the wet season when feasible.
- Reschedule paving and grinding activities if rain is forecasted.
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent stormwater runon (see WM-1, Material Delivery and Storage).
- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses. These materials should be stored consistent with WM-3, Stockpile Management.
- Disposal of PCC (Portland cement concrete) and AC (asphalt concrete) waste should be in conformance with WM-8, Concrete Waste Management.

Saw Cutting, Grinding, and Pavement Removal

- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.
- When paving involves AC, the following steps should be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:
  - AC grindings, pieces, or chunks used in embankments or shoulder backing should not be allowed to enter any storm drains or watercourses. Install inlet protection and perimeter controls until area is stabilized (i.e. cutting, grinding or other removal activities are complete and loose material has been properly removed and disposed of)or permanent controls are in place. Examples of temporary perimeter controls can be found in EC-9, Earth Dikes and Drainage Swales; SE-1, Silt Fence; SE-5, Fiber Rolls, or SE-13 Compost Socks and Berms
  - Collect and remove all broken asphalt and recycle when practical. Old or spilled asphalt should be recycled or disposed of properly.
- Do not allow saw-cut slurry to enter storm drains or watercourses. Residue from grinding operations should be picked up by a vacuum attachment to the grinding machine, or by sweeping, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement. See also WM-8, Concrete Waste Management, and WM-10, Liquid Waste Management.
- Pavement removal activities should not be conducted in the rain.
- Collect removed pavement material by mechanical or manual methods. This material may be recycled for use as shoulder backing or base material.

- If removed pavement material cannot be recycled, transport the material back to an approved storage site.

Asphaltic Concrete Paving

- If paving involves asphaltic cement concrete, follow these steps:
  - Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks. Vacuum or sweep loose sand and gravel and properly dispose of this waste by referring to WM-5, Solid Waste Management.
  - Old asphalt should be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.

Portland Cement Concrete Paving

- Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect waste materials by dry methods, such as sweeping or shoveling, and return to aggregate base stockpile or dispose of properly. Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in WM-8, Concrete Waste Management, or pump the water to the sanitary sewer if authorized by the local wastewater authority.

Sealing Operations

- During chip seal application and sweeping operations, petroleum or petroleum covered aggregate should not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls until structure is stabilized (i.e. all sealing operations are complete and cured and loose materials have been properly removed and disposed).
- Inlet protection (SE-10, Storm Drain Inlet Protection) should be used during application of seal coat, tack coat, slurry seal, and fog seal.
- Seal coat, tack coat, slurry seal, or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.

Paving Equipment

- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials and dispose of in accordance with the applicable regulations. See NS-10, Vehicle and Equipment Maintenance, WM-4, Spill Prevention and Control, and WM-10, Liquid Waste Management.
- Substances used to coat asphalt transport trucks and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.
- Paving equipment parked onsite should be parked over plastic to prevent soil contamination.
- Clean asphalt coated equipment offsite whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in WM-5, Solid Waste Management. Any cleaning onsite should follow NS-8, Vehicle and Equipment Cleaning.

Thermoplastic Striping

- Thermoplastic striper and pre-heater equipment shutoff valves should be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.
- Pre-heaters should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move.
- Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.
- Clean truck beds daily of loose debris and melted thermoplastic. When possible, recycle thermoplastic material.

Raised/Recessed Pavement Marker Application and Removal

- Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.
- Melting tanks should be loaded with care and not filled to beyond six inches from the top to leave room for splashing.
- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.
- On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

Costs

- All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of paving and grinding operations.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sample stormwater runoff required by the General Permit.
- Keep ample supplies of drip pans or absorbent materials onsite.
- Inspect and maintain machinery regularly to minimize leaks and drips.

References

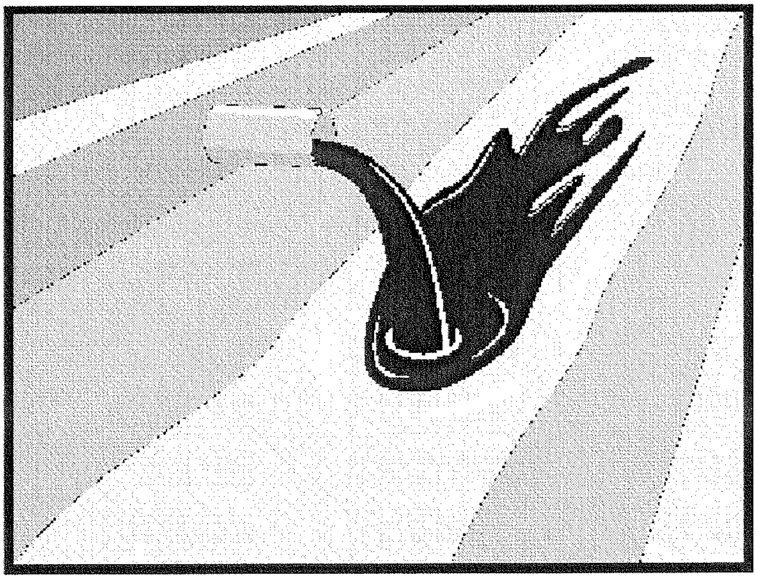
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Hot Mix Asphalt-Paving Handbook AC 150/5370-14, Appendix I, U.S. Army Corps of Engineers, July 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Illicit Connection/Discharge NS-6



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

Procedures and practices designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Illicit connection/discharge and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.

Limitations

Illicit connections and illegal discharges or dumping, for the purposes of this BMP, refer to discharges and dumping caused by parties other than the contractor. If pre-existing hazardous materials or wastes are known to exist onsite, they should be identified in the SWPPP and handled as set forth in the SWPPP.

Implementation

Planning

- Review the SWPPP. Pre-existing areas of contamination should be identified and documented in the SWPPP.

- Inspect site before beginning the job for evidence of illicit connections, illegal dumping or discharges. Document any pre-existing conditions and notify the owner.

- Inspect site regularly during project execution for evidence of illicit connections, illegal dumping or discharges.
- Observe site perimeter for evidence for potential of illicitly discharged or illegally dumped material, which may enter the job site.

Identification of Illicit Connections and Illegal Dumping or Discharges

- **General** – unlabeled and unidentifiable material should be treated as hazardous.
- **Solids** - Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- **Liquids** - signs of illegal liquid dumping or discharge can include:
  - Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Abnormal water flow during the dry weather season
- **Urban Areas** - Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:
  - Abnormal water flow during the dry weather season
  - Unusual flows in sub drain systems used for dewatering
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Excessive sediment deposits, particularly adjacent to or near active offsite construction projects
- **Rural Areas** - Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:
  - Abnormal water flow during the non-irrigation season
  - Non-standard junction structures
  - Broken concrete or other disturbances at or near junction structures

Reporting

Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery. For illicit connections or discharges to the storm drain system, notify the local stormwater management agency. For illegal dumping, notify the local law enforcement agency.

Cleanup and Removal

The responsibility for cleanup and removal of illicit or illegal dumping or discharges will vary by location. Contact the local stormwater management agency for further information.

Costs

Costs to look for and report illicit connections and illegal discharges and dumping are low. The best way to avoid costs associated with illicit connections and illegal discharges and dumping is to keep the project perimeters secure to prevent access to the site, to observe the site for vehicles that should not be there, and to document any waste or hazardous materials that exist onsite before taking possession of the site.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect the site regularly to check for any illegal dumping or discharge.
- Prohibit employees and subcontractors from disposing of non-job related debris or materials at the construction site.
- Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

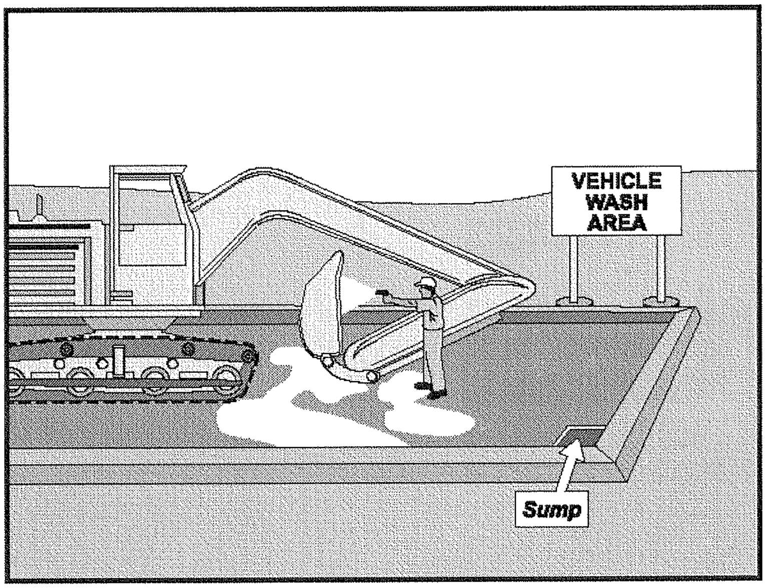
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

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

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle and Equipment Cleaning NS-8



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

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

Inspection and Maintenance

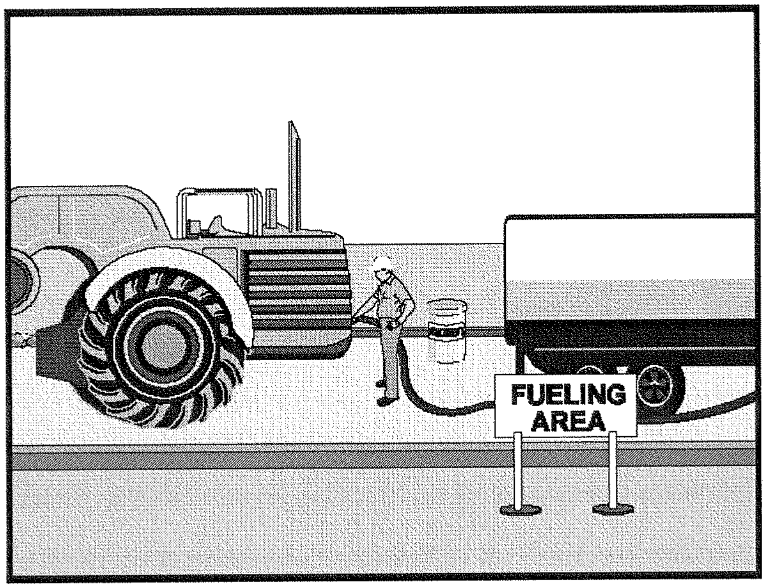
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

References

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

Swisher, R.D. Surfactant Biodegradation, Marcel Decker Corporation, 1987.

Vehicle and Equipment Fueling NS-9



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

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/ Exit.

Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.
- Discourage "topping-off" of fuel tanks.

- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should be disposed of properly after use.
- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

Inspection and Maintenance

- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

References

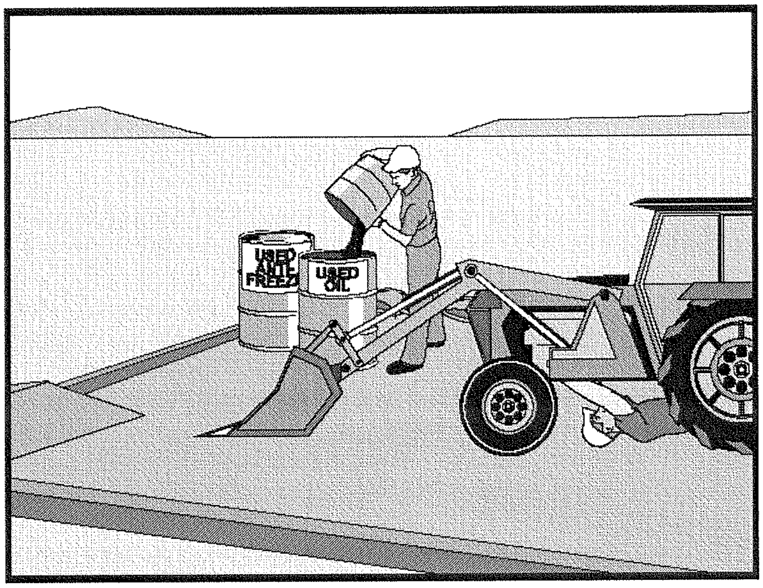
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

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

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle & Equipment Maintenance NS-10



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

CASQA

Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8, Vehicle and Equipment Cleaning, and NS-9, Vehicle and Equipment Fueling.

Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.
- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

Safer Alternative Products

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.

- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.

- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

Recycling and Disposal

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

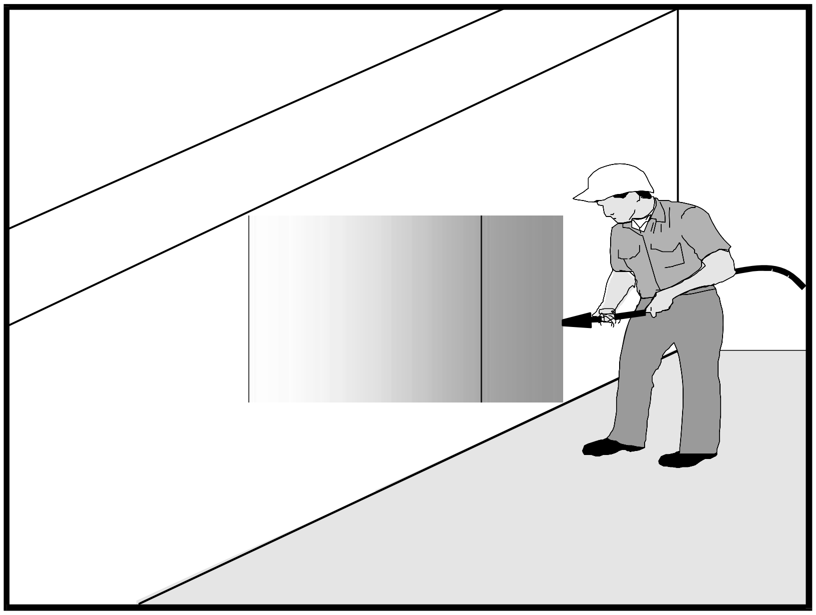
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

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

Concrete Curing NS-12



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Concrete curing is used in the construction of structures such as bridges, retaining walls, pump houses, large slabs, and structured foundations. Concrete curing includes the use of both chemical and water methods.

Concrete and its associated curing materials have basic chemical properties that can raise the pH of water to levels outside of the permitted range. Discharges of stormwater and non-stormwater exposed to concrete during curing may have a high pH and may contain chemicals, metals, and fines. The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Proper procedures and care should be taken when managing concrete curing materials to prevent them from coming into contact with stormwater flows, which could result in a high pH discharge.

Suitable Applications

Suitable applications include all projects where Portland Cement Concrete (PCC) and concrete curing chemicals are placed where they can be exposed to rainfall, runoff from other areas, or where runoff from the PCC will leave the site.

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Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

Chemical Curing

- Avoid over spray of curing compounds.
- Minimize the drift by applying the curing compound close to the concrete surface. Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.
- Use proper storage and handling techniques for concrete curing compounds. Refer to WM-1, Material Delivery and Storage.
- Protect drain inlets prior to the application of curing compounds.
- Refer to WM-4, Spill Prevention and Control.

Water Curing for Bridge Decks, Retaining Walls, and other Structures

- Direct cure water away from inlets and watercourses to collection areas for evaporation or other means of removal in accordance with all applicable permits. See WM-8 Concrete Waste Management.
- Collect cure water at the top of slopes and transport to a concrete waste management area in a non-erosive manner. See EC-9 Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

Education

- Educate employees, subcontractors, and suppliers on proper concrete curing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete curing procedures.

Costs

All of the above measures are generally low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Sample non-stormwater discharges and stormwater runoff that contacts uncured and partially cured concrete as required by the General Permit.
- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect cure containers and spraying equipment for leaks.

References

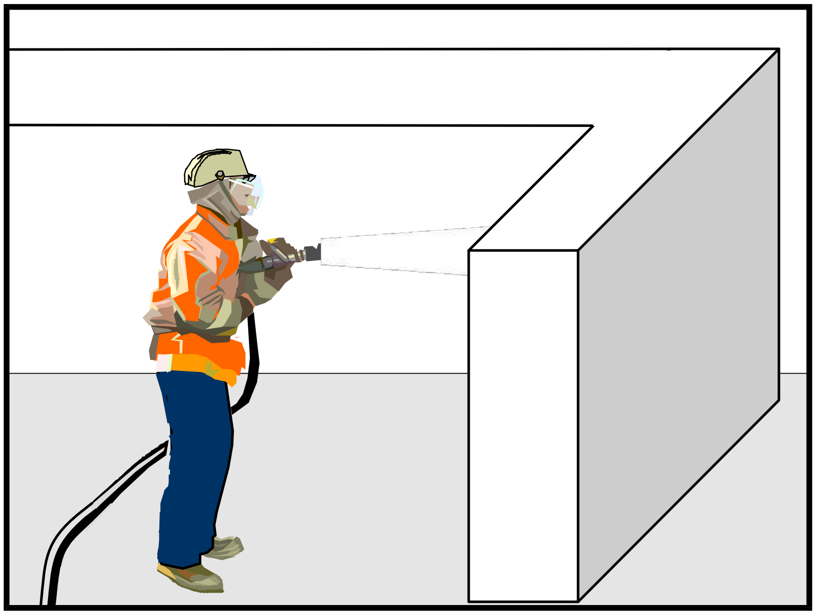
Blue Print for a Clean Bay-Construction-Related Industries: Best Management Practices for Stormwater Pollution Prevention; Santa Clara Valley Non Point Source Pollution Control Program, 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Concrete Finishing NS-13



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
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Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Concrete finishing methods are used for bridge deck rehabilitation, paint removal, curing compound removal, and final surface finish appearances. Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Stormwater and non-stormwater exposed to concrete finishing by-products may have a high pH and may contain chemicals, metals, and fines. Proper procedures and implementation of appropriate BMPs can minimize the impact that concrete-finishing methods may have on stormwater and non-stormwater discharges.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Concrete and its associated curing materials have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures apply to all construction locations where concrete finishing operations are performed.

Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

- Collect and properly dispose of water from high-pressure water blasting operations.
- Collect contaminated water from blasting operations at the top of slopes. Transport or dispose of contaminated water while using BMPs such as those for erosion control. Refer to EC-9, Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Direct water from blasting operations away from inlets and watercourses to collection areas for infiltration or other means of removal (dewatering). Refer to NS-2 Dewatering Operations.
- Protect inlets during sandblasting operations. Refer to SE-10, Storm Drain Inlet Protection.
- Refer to WM-8, Concrete Waste Management for disposal of concrete debris.
- Minimize the drift of dust and blast material as much as possible by keeping the blasting nozzle close to the surface.
- When blast residue contains a potentially hazardous waste, refer to WM-6, Hazardous Waste Management.

Education

- Educate employees, subcontractors, and suppliers on proper concrete finishing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete finishing procedures.

Costs

These measures are generally of low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Sample non-stormwater discharges and stormwater runoff that contacts concrete dust and debris as required by the General Permit.

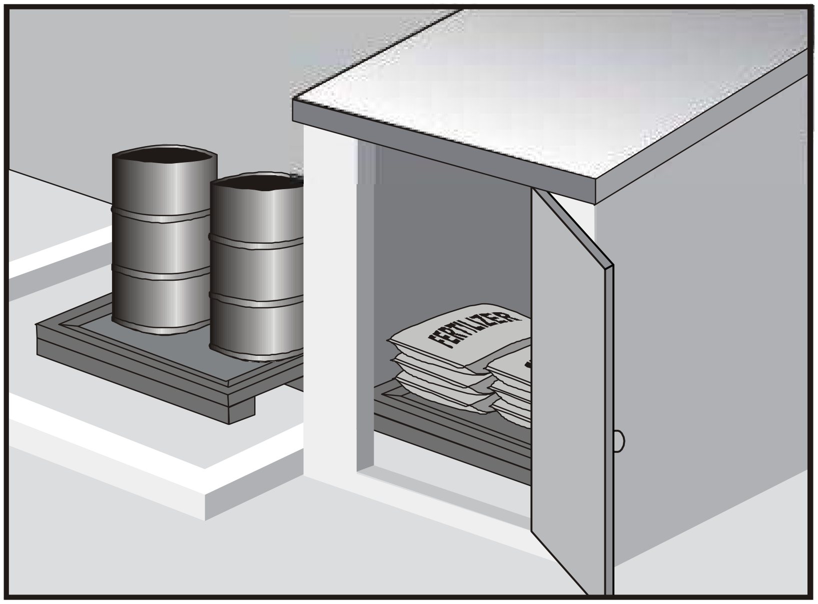
- Sweep or vacuum up debris from sandblasting at the end of each shift.
- At the end of each work shift, remove and contain liquid and solid waste from containment structures, if any, and from the general work area.
- Inspect containment structures for damage prior to use and prior to onset of forecasted rain.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

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

Potential Alternatives

None

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Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease

- Asphalt and concrete components
- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

Implementation

The following steps should be taken to minimize risk:

- Chemicals must be stored in water tight containers with appropriate secondary containment or in a storage shed.
- When a material storage area is located on bare soil, the area should be lined and bermed.
- Use containment pallets or other practical and available solutions, such as storing materials within newly constructed buildings or garages, to meet material storage requirements.
- Stack erodible landscape material on pallets and cover when not in use.
- Contain all fertilizers and other landscape materials when not in use.
- Temporary storage areas should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be available on-site for all materials stored that have the potential to effect water quality.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located away from waterways, if possible.
    - Avoid transport near drainage paths or waterways.
    - Surround with earth berms or other appropriate containment BMP. See EC-9, Earth Dikes and Drainage Swales.
    - Place in an area that will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.

- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- Keep ample spill cleanup supplies appropriate for the materials being stored. Ensure that cleanup supplies are in a conspicuous, labeled area.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove and dispose of materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Materials should be covered prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.

- Stockpiles should be protected in accordance with WM-3, Stockpile Management.

- Materials should be stored indoors within existing structures or completely enclosed storage sheds when available.

- Proper storage instructions should be posted at all times in an open and conspicuous location.

- An ample supply of appropriate spill clean up material should be kept near storage areas.

- Also see WM-6, Hazardous Waste Management, for storing of hazardous wastes.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.

- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

Spill Cleanup

- Contain and clean up any spill immediately.

- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.

- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.

- If spills or leaks of materials occur that are not contained and could discharge to surface waters, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Keep storage areas clean and well organized, including a current list of all materials onsite.

- Inspect labels on containers for legibility and accuracy.

- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

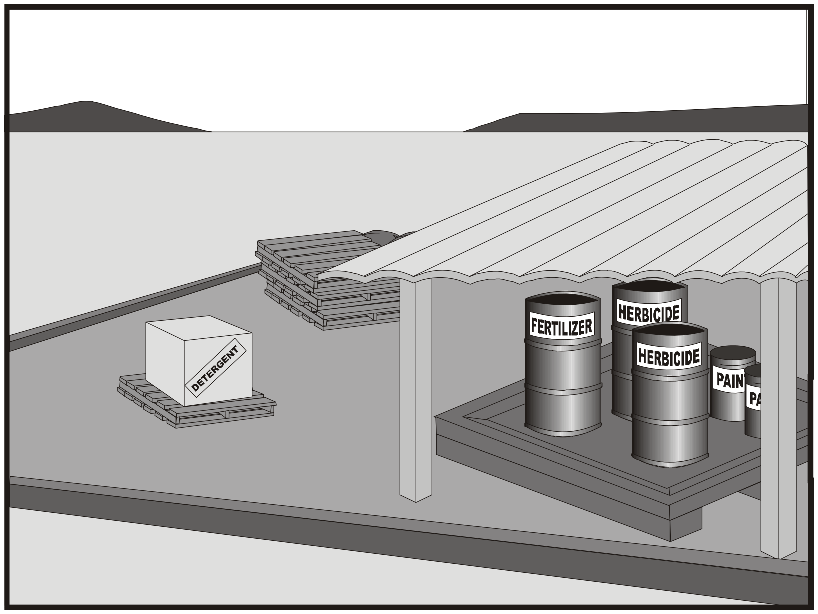
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Other materials that may be detrimental if released to the environment

Limitations
Safer alternative building and construction products may not be available or suitable in every instance.

Implementation
The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.

- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.

- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.

- The preferred method of termiticide application is soil injection near the existing or proposed structure foundation/slab; however, if not feasible, soil drench application of termiticides should follow EPA label guidelines and the following recommendations (most of which are applicable to most pesticide applications):

  - Do not treat soil that is water-saturated or frozen.

  - Application shall not commence within 24-hours of a predicted precipitation event with a 40% or greater probability. Weather tracking must be performed on a daily basis prior to termiticide application and during the period of termiticide application.

  - Do not allow treatment chemicals to runoff from the target area. Apply proper quantity to prevent excess runoff. Provide containment for and divert stormwater from application areas using berms or diversion ditches during application.

  - Dry season: Do not apply within 10 feet of storm drains. Do not apply within 25 feet of aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds).

  - Wet season: Do not apply within 50 feet of storm drains or aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds) unless a vegetative buffer is present (if so, refer to dry season requirements).

  - Do not make on-grade applications when sustained wind speeds are above 10 mph (at application site) at nozzle end height.

  - Cover treatment site prior to a rain event in order to prevent run-off of the pesticide into non-target areas. The treated area should be limited to a size that can be backfilled and/or covered by the end of the work shift. Backfilling or covering of the treated area shall be done by the end of the same work shift in which the application is made.

  - The applicator must either cover the soil him/herself or provide written notification of the above requirement to the contractor on site and to the person commissioning the application (if different than the contractor). If notice is provided to the contractor or the person commissioning the application, then they are responsible under the Federal Insecticide Fungicide, and Rodenticide Act (FIFRA) to ensure that: 1) if the concrete slab cannot be poured over the treated soil within 24 hours of application, the treated soil is covered with a waterproof covering (such as polyethylene sheeting), and 2) the treated soil is covered if precipitation is predicted to occur before the concrete slab is scheduled to be poured.

- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydraulic application. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals before predicted rainfall.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or contain for proper disposal off site. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.
- Document the location, time, chemicals applied, and applicator's name and qualifications.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.
- Discontinue use of erodible landscape material within 2 days prior to a forecasted rain event and materials should be covered and/or bermed.

- Provide containment for material use areas such as masons' areas or paint mixing/preparation areas to prevent materials/pollutants from entering stormwater.

Costs
All of the above are low cost measures.

Inspection and Maintenance
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Ensure employees and subcontractors throughout the job are using appropriate practices.

References
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

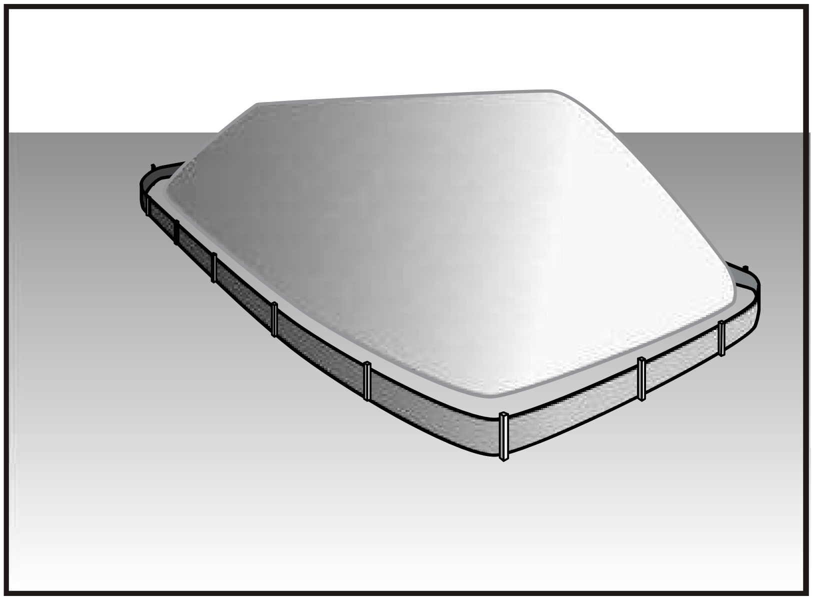
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Comments on Risk Assessments Risk Reduction Options for Cypermethrin: Docket No. OPP–2005–0293; California Stormwater Quality Association (CASQA) letter to USEPA, 2006.Environmental Hazard and General Labeling for Pyrethroid Non-Agricultural Outdoor Products, EPA-HQ-OPP-2008-0331-0021; USEPA, 2008.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Stockpile Management WM-3



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Stockpile management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, soil amendments, sand, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called “cold mix” asphalt), and pressure treated wood.

Suitable Applications

Implement in all projects that stockpile soil and other loose materials.

Limitations

- Plastic sheeting as a stockpile protection is temporary and hard to manage in windy conditions. Where plastic is used, consider use of plastic tarps with nylon reinforcement which may be more durable than standard sheeting.
- Plastic sheeting can increase runoff volume due to lack of infiltration and potentially cause perimeter control failure.
- Plastic sheeting breaks down faster in sunlight.
- The use of Plastic materials and photodegradable plastics should be avoided.

Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

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- On larger sites, a minimum of 50 ft separation from concentrated flows of stormwater, drainage courses, and inlets is recommended.
- All stockpiles are required to be protected immediately if they are not scheduled to be used within 14 days.
- Protect all stockpiles from stormwater runon using temporary perimeter sediment barriers such as compost berms (SE-13), temporary silt dikes (SE-12), fiber rolls (SE-5), silt fences (SE-1), sandbags (SE-8), gravel bags (SE-6), or biofilter bags (SE-14). Refer to the individual fact sheet for each of these controls for installation information.
- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.
- Ensure that stockpile coverings are installed securely to protect from wind and rain.
- Some plastic covers withstand weather and sunlight better than others. Select cover materials or methods based on anticipated duration of use.

Protection of Non-Active Stockpiles

Non-active stockpiles of the identified materials should be protected further as follows:

Soil stockpiles

- Soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- Temporary vegetation should be considered for topsoil piles that will be stockpiled for extended periods.

Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base

- Stockpiles should be covered and protected with a temporary perimeter sediment barrier at all times.

Stockpiles of "cold mix"

- Cold mix stockpiles should be placed on and covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Stockpiles of fly ash, stucco, hydrated lime

- Stockpiles of materials that may raise the pH of runoff (i.e., basic materials) should be covered with plastic and surrounded by a berm.

Stockpiles/Storage of wood (Pressure treated with chromated copper arsenate or ammoniacal copper zinc arsenate

- Treated wood should be covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Protection of Active Stockpiles

Active stockpiles of the identified materials should be protected as follows:

- All stockpiles should be covered and protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" and treated wood, and basic materials should be placed on and covered with plastic sheeting or comparable material and surrounded by a berm prior to the onset of precipitation.
- The downstream perimeter of an active stockpile should be protected with a linear sediment barrier or berm and runoff should be diverted around or away from the stockpile on the upstream perimeter.

Costs

For cost information associated with stockpile protection refer to the individual erosion or sediment control BMP fact sheet considered for implementation (For example, refer to SE-1 Silt Fence for installation of silt fence around the perimeter of a stockpile.)

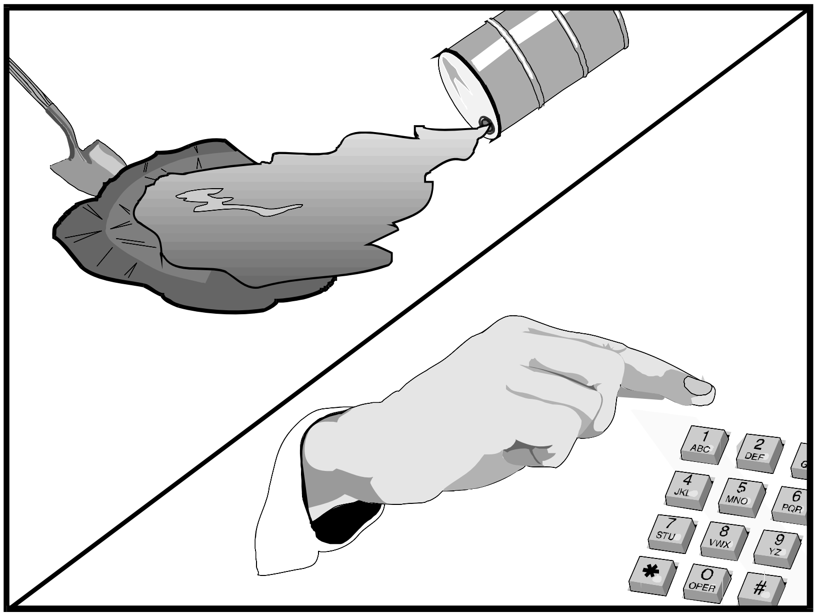
Inspection and Maintenance

- Stockpiles must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- It may be necessary to inspect stockpiles covered with plastic sheeting more frequently during certain conditions (for example, high winds or extreme heat).
- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.
- Sediment shall be removed when it reaches one-third of the barrier height.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Spill Prevention and Control WM-4



Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

Categories

EC	Erosion Control	
SE	Sediment Control	
TC	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

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- Fuels
- Lubricants
- Other petroleum distillates

Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.

- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.

- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.

- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.

- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

- Clean up leaks and spills immediately.

- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.

- Use absorbent materials on small spills rather than hosing down or burying the spill.

- Absorbent materials should be promptly removed and disposed of properly.

- Follow the practice below for a minor spill:

  - Contain the spread of the spill.

  - Recover spilled materials.

  - Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

Reporting

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

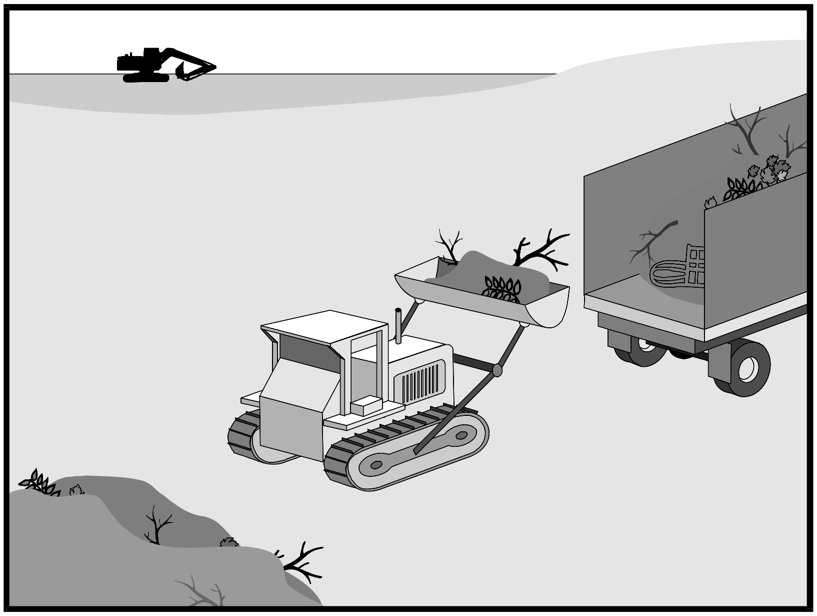
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

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

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Solid Waste Management WM-5



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	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

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction

- Packaging materials including wood, paper, and plastic

- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products

- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes

- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials

- Highway planting wastes, including vegetative material, plant containers, and packaging materials

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

Education

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

Collection, Storage, and Disposal

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

- Arrange for regular waste collection.

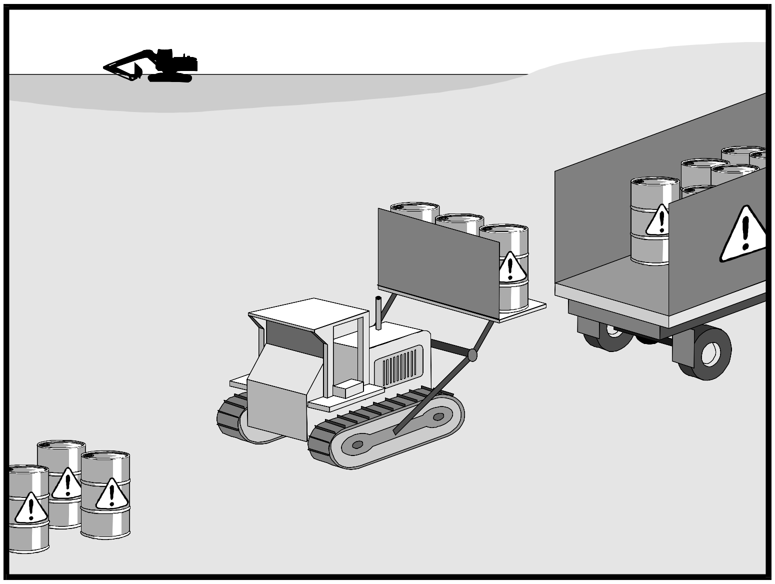
References

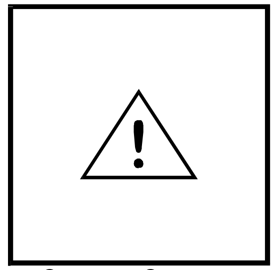
Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

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

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Hazardous Waste Management **WM-6**





Standard Symbol

BMP Objectives
- ○ Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ● Non-Storm Water Management
- ● Materials and Waste Management

Definition and Purpose

These are procedures and practices to minimize or eliminate the discharge of pollutants from construction site hazardous waste to the storm drain systems or to watercourses.

Appropriate Applications

- This best management practice (BMP) applies to all construction projects.
- Hazardous waste management practices are implemented on construction projects that generate waste from the use of:
  - Petroleum Products,
  - Asphalt Products,
  - Concrete Curing Compounds,
  - Pesticides,
  - Acids,
  - Paints,
  - Stains,
  - Solvents,
  - Wood Preservatives,
  - Roofing Tar, or
  - Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302.

Limitations

- Nothing in this BMP relieves the Contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.

- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to BMP WM-7, “Contaminated Soil Management,” and the project special provisions.

Standards and Specifications

Education

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.

- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.

- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.

- Instruct employees and subcontractors in identification of hazardous and solid waste.

- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).

- The Contractor’s Water Pollution Control Manager (WPCM) shall oversee and enforce proper hazardous waste management procedures and practices.

- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

Storage Procedures

- Wastes shall be stored in sealed containers constructed of a suitable material and shall be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172,173, 178, and 179.

- All hazardous waste shall be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.

- Waste containers shall be stored in temporary containment facilities that shall comply with the following requirements:

  – Temporary containment facility shall provide for a spill containment volume able to contain precipitation from a 24-hour, 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.

- Temporary containment facility shall be impervious to the materials stored there for a minimum contact time of 72 hours.

- Temporary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks accumulated rainwater and spills shall be placed into drums after each rainfall. These liquids shall be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids shall be sent to an approved disposal site.

- Sufficient separation shall be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, shall not be stored in the same temporary containment facility.

- Throughout the rainy season, temporary containment facilities shall be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs. A storage facility having a solid cover and sides is preferred to a temporary tarp. Storage facilities shall be equipped with adequate ventilation.

■ Drums shall not be overfilled and wastes shall not be mixed.

■ Unless watertight, containers of dry waste shall be stored on pallets.

■ Paint brushes and equipment for water and oil based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soils, watercourses or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused shall be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths shall be disposed of as solid waste.

■ Ensure that adequate hazardous waste storage volume is available.

■ Ensure that hazardous waste collection containers are conveniently located.

■ Designate hazardous waste storage areas on site away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.

■ Minimize production or generation of hazardous materials and hazardous waste on the job site.

■ Use containment berms in fueling and maintenance areas and where the potential for spills is high.

- Segregate potentially hazardous waste from non-hazardous construction site debris.
- Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.
- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.

Disposal Procedures

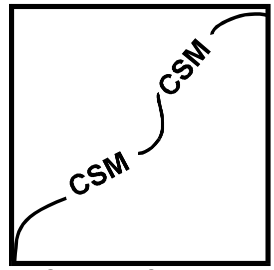
- Waste shall be disposed of outside the highway right-of-way within 90 days of being generated, or as directed by the Resident Engineer (RE). In no case shall hazardous waste storage exceed requirements in Title 22 CCR, Section 66262.34.
- Waste shall be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services (DHS) certified laboratory shall sample waste and classify it to determine the appropriate disposal facility.
- Make sure that toxic liquid wastes (e.g., used oils, solvents, and paints) and chemicals (e.g., acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for solid waste construction debris.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Recycle any useful material such as used oil or water-based paint when practical.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

Maintenance and Inspection

- A foreman and/or construction supervisor shall monitor on-site hazardous waste storage and disposal procedures.
- Waste storage areas shall be kept clean, well organized, and equipped with ample clean-up supplies as appropriate for the materials being stored.
- Storage areas shall be inspected in conformance with the provisions in the contract documents.
- Perimeter controls, containment structures, covers, and liners shall be repaired or replaced as needed to maintain proper function.
- Hazardous spills shall be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.
- The National Response Center, at (800) 424-8802, shall be notified of spills of Federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302.
- Copy of the hazardous waste manifests shall be provided to the RE.

Contaminated Soil Management

WM-7



Standard Symbol

BMP Objectives

- ○ Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ● Non-Storm Water Management
- ● Materials and Waste Management

Definition and Purpose

These are procedures and practices to minimize or eliminate the discharges of pollutants to the drainage system or to watercourses from contaminated soil.

Appropriate Applications

- Contaminated soil management is implemented on construction projects in highly urbanized or industrial areas where soil contamination may have occurred due to spills, illicit discharges, and leaks from underground storage tanks.

- It may also apply to highway widening projects in older areas where median and shoulder soils may have been contaminated by aerially deposited lead (ADL).

Limitations

- The procedures and practices presented in this best management practice (BMP) are general. The contractor shall identify appropriate practices and procedures for the specific contaminants known to exist or discovered on site.

Standards and Specifications

Identifying Contaminated Areas

- Contaminated soils are often identified during project planning and development with known locations identified in the plans and specifications. The contractor shall review applicable reports and investigate appropriate call-outs in the plans and specifications.

- The contractor may further identify contaminated soils by investigating:

  – Past site uses and activities.

  – Detected or undetected spills and leaks.

  – Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline forming elements.

– Look for contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris. Test suspected soils at a certified laboratory.

Education

- Prior to performing any excavation work at the locations containing material classified as hazardous, employees and subcontractors shall complete a safety training program which meets 29 CFR 1910.120 and 8 CCR 5192 covering the potential hazards as identified.
- Educate employees and subcontractors in identification of contaminated soil and on contaminated soil handling and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

Handling Procedures for Material with Aerially Deposited Lead (ADL)

- Materials from areas designated as containing (ADL) may, if allowed by the contract special provisions, be excavated, transported, and used in the construction of embankments and/or backfill.
- Excavation, transportation, and placement operations shall result in no visible dust.
- Use caution to prevent spillage of lead containing material during transport.
- Monitor the air quality during excavation of soils contaminated with lead.

Handling Procedures for Contaminated Soils

- To minimize on-site storage, contaminated soil shall be disposed of properly in accordance with all applicable regulations. All hazardous waste storage will comply with the requirements in Title 22, CCR, Sections 6626.250 to 66265.260.
- Test suspected soils at a DHS approved certified laboratory.
- If the soil is contaminated, work with the local regulatory agencies to develop options for treatment and/or disposal.
- Avoid temporary stockpiling of contaminated soils or hazardous material.
- If temporary stockpiling is necessary:

  (1) Cover the stockpile with plastic sheeting or tarps.

  (2) Install a berm around the stockpile to prevent runoff from leaving the area.

  (3) Do not stockpile in or near storm drains or watercourses.

- Contaminated material and hazardous material on exteriors of transport vehicles shall be removed and placed either into the current transport vehicle or the excavation prior to the vehicle leaving the exclusion zone.
- Monitor the air quality continuously during excavation operations at all locations containing hazardous material.
- Procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying the contaminated material and the hazardous material.
- Collect water from decontamination procedures and treat and/or dispose of it at an appropriate disposal site.
- Collect non-reusable protective equipment, once used by any personnel, and dispose of at an appropriate disposal site.
- Install temporary security fence to surround and secure the exclusion zone. Remove fencing when no longer needed.
- Excavation, transport, and disposal of contaminated material and hazardous material shall be in accordance with the rules and regulations of the following agencies (the specifications of these agencies supersede the procedures outlined in this BMP):
  - United States Department of Transportation (USDOT).
  - United States Environmental Protection Agency (USEPA).
  - California Environmental Protection Agency (CAL-EPA).
  - California Division of Occupation Safety and Health Administration (CAL-OSHA).
  - Local regulatory agencies.

Procedures for Underground Storage Tank Removals

- Prior to commencing tank removal operations, obtain the required underground storage tank removal permits and approval from the federal, state, and local agencies, which have jurisdiction over such work.
- Arrange to have tested, as directed by the Resident Engineer (RE), any liquid or sludge found in the underground tank prior to its removal to determine if it contains hazardous substances.
- Following the tank removal, take soil samples beneath the excavated tank and perform analysis as required by the local agency representative(s).

- The underground storage tank, any liquid and/or sludge found within the tank, and all contaminated substances and hazardous substances removed during the tank removal shall be transported to disposal facilities permitted to accept such waste.

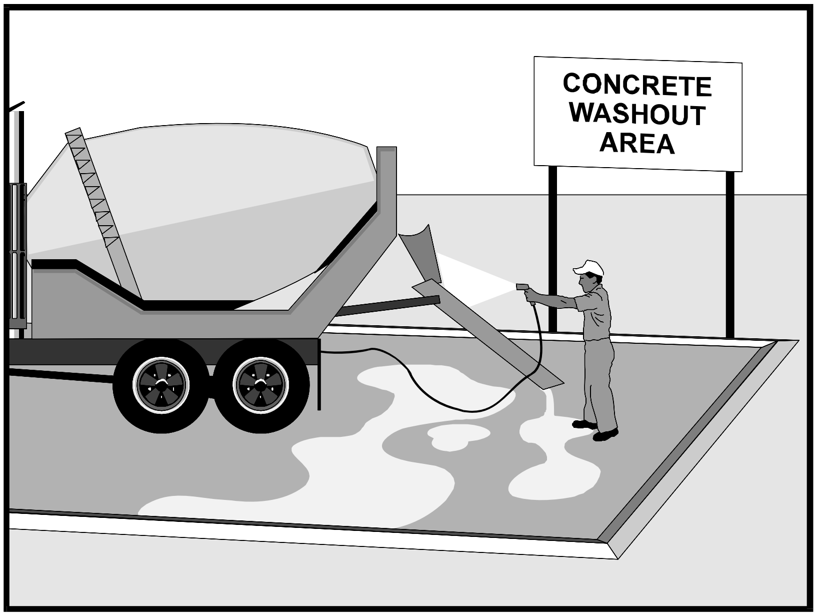
Water Control

- Take all necessary precautions and preventive measures to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventative measures may consist of, but are not limited to: berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.
- If water does enter an excavation and becomes contaminated, such water, when necessary to proceed with the work, shall be dewatered consistent with BMP NS-2, "Dewatering Operations."

Maintenance and Inspection

- The Contractor's Water Pollution Control Manager, foreman, and/or construction supervisor shall monitor on-site contaminated soil storage and disposal procedures.
- Monitor air quality continuously during excavation operations at all locations containing hazardous material.
- Coordinate contaminated soils and hazardous substances/waste management with the appropriate federal, state, and local agencies.
- Inspect hazardous waste receptacles and areas regularly.

Concrete Waste Management WM-8



Description and Purpose

Prevent the discharge of pollutants to stormwater from concrete waste by conducting washout onsite or offsite in a designated area, and by employee and subcontractor training.

The General Permit incorporates Numeric Effluent Limits (NEL) and Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials, including mortar, concrete, stucco, cement and block and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows and raising pH to levels outside the accepted range.

Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result from demolition activities.
- Slurries containing portland cement concrete (PCC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition.

Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

- Concrete trucks and other concrete-coated equipment are washed onsite.
- Mortar-mixing stations exist.
- Stucco mixing and spraying .
- See also NS-8, Vehicle and Equipment Cleaning.

Limitations

- Offsite washout of concrete wastes may not always be possible.
- Multiple washouts may be needed to assure adequate capacity and to allow for evaporation.

Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas. Refer to WM-1, Material Delivery and Storage for more information.
- Avoid mixing excess amounts of concrete.
- Perform washout of concrete trucks in designated areas only, where washout will not reach stormwater.
- Do not wash out concrete trucks into storm drains, open ditches, streets, streams or onto the ground. Trucks should always be washed out into designated facilities.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - On larger sites, it is recommended to locate washout areas at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Washout wastes into the temporary washout where the concrete can set, be broken up, and then disposed properly.
  - Washout should be lined so there is no discharge into the underlying soil.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
- See typical concrete washout installation details at the end of this fact sheet.

Education

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.

- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.
- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.

Concrete Demolition Wastes

- Stockpile concrete demolition waste in accordance with BMP WM-3, Stockpile Management.
- Dispose of or recycle hardened concrete waste in accordance with applicable federal, state or local regulations.

Concrete Slurry Wastes

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below).
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut concrete slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine or by sweeping. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Concrete slurry residue should be disposed in a temporary washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.

- Temporary washout facilities should be lined to prevent discharge to the underlying ground or surrounding area.

- Washout of concrete trucks should be performed in designated areas only.

- Only concrete from mixer truck chutes should be washed into concrete wash out.

- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of or recycled offsite.

- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of or recycle hardened concrete on a regular basis.

- Temporary Concrete Washout Facility (Type Above Grade)

  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft; however, smaller sites or jobs may only need a smaller washout facility. With any washout, always maintain a sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.

  - Materials used to construct the washout area should conform to the provisions detailed in their respective BMPs (e.g., SE-8 Sandbag Barrier).

  - Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

  - Alternatively, portable removable containers can be used as above grade concrete washouts. Also called a "roll-off"; this concrete washout facility should be properly sealed to prevent leakage, and should be removed from the site and replaced when the container reaches 75% capacity.

- Temporary Concrete Washout Facility (Type Below Grade)

  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.

  - Lath and flagging should be commercial type.

  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- The base of a washout facility should be free of rock or debris that may damage a plastic liner.

Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and properly disposed or recycled in accordance with federal, state or local regulations. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and properly disposed or recycled in accordance with federal, state or local regulations..

- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

Costs

All of the above are low cost measures. Roll-off concrete washout facilities can be more costly than other measures due to removal and replacement; however, provide a cleaner alternative to traditional washouts. The type of washout facility, size, and availability of materials will determine the cost of the washout.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and properly disposed or recycled in accordance with federal, state or local regulations.

- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

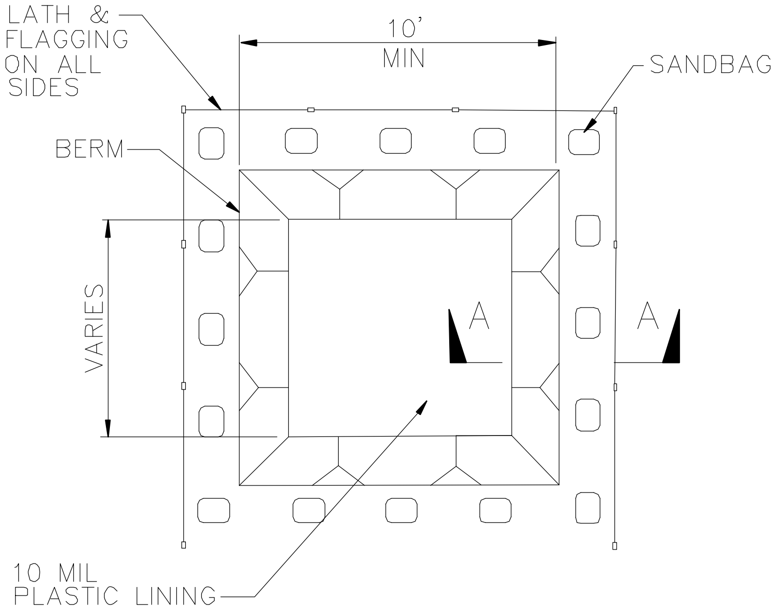
- Inspect washout facilities for damage (e.g. torn liner, evidence of leaks, signage, etc.). Repair all identified damage.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000, Updated March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



PLAN
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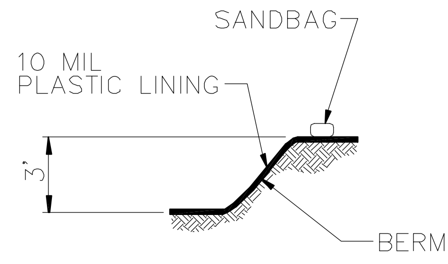
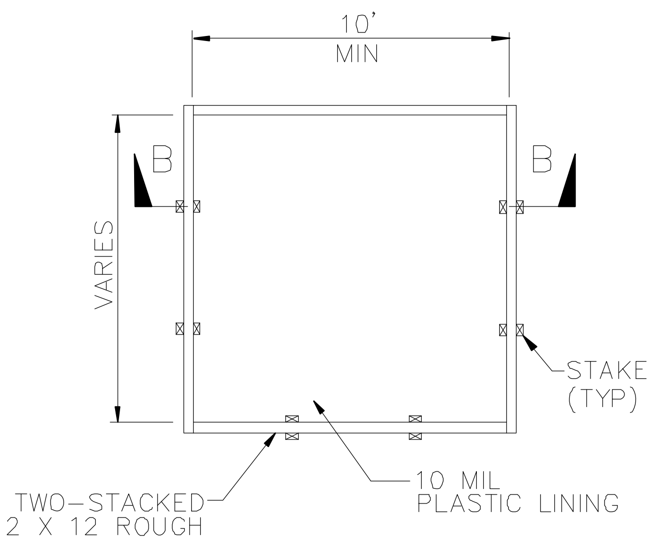
TYPE "BELOW GRADE"



SECTION A–A
NOT TO SCALE



PLAN
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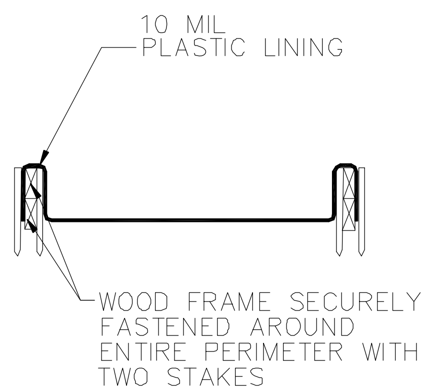
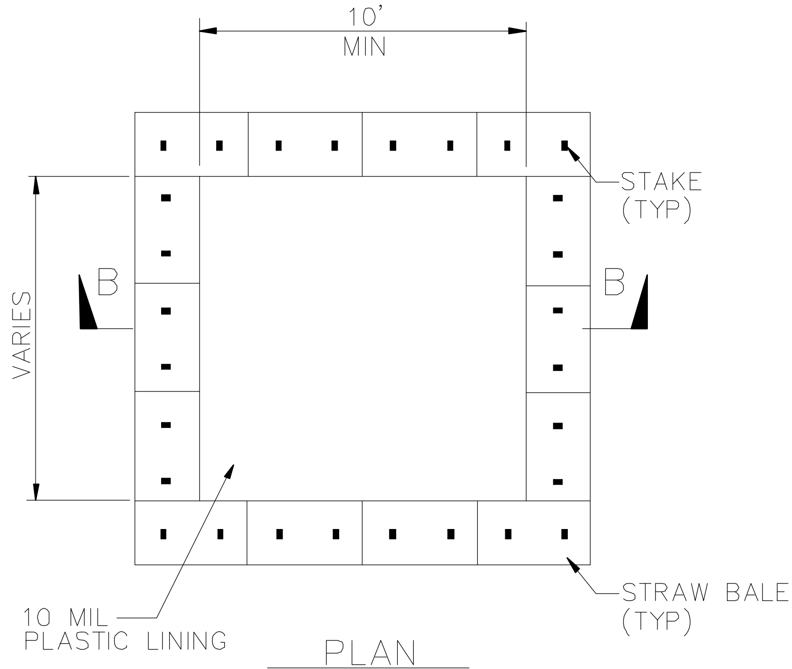
TYPE "ABOVE GRADE"



SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



PLAN
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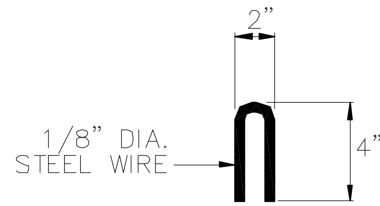
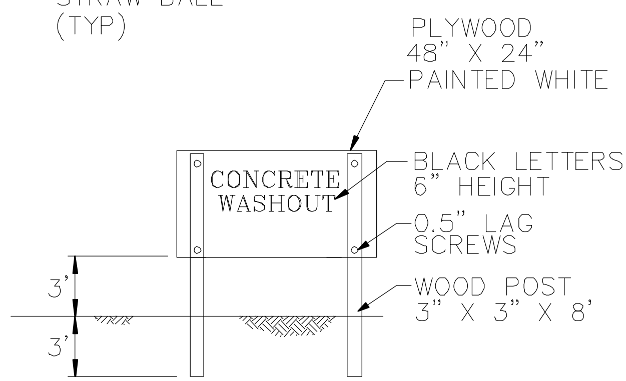
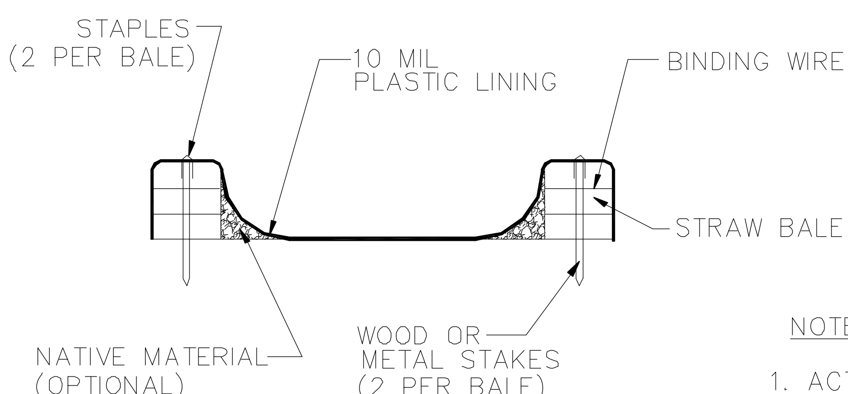
TYPE "ABOVE GRADE" WITH STRAW BALES



STAPLE DETAIL



CONCRETE WASHOUT SIGN DETAIL (OR EQUIVALENT)

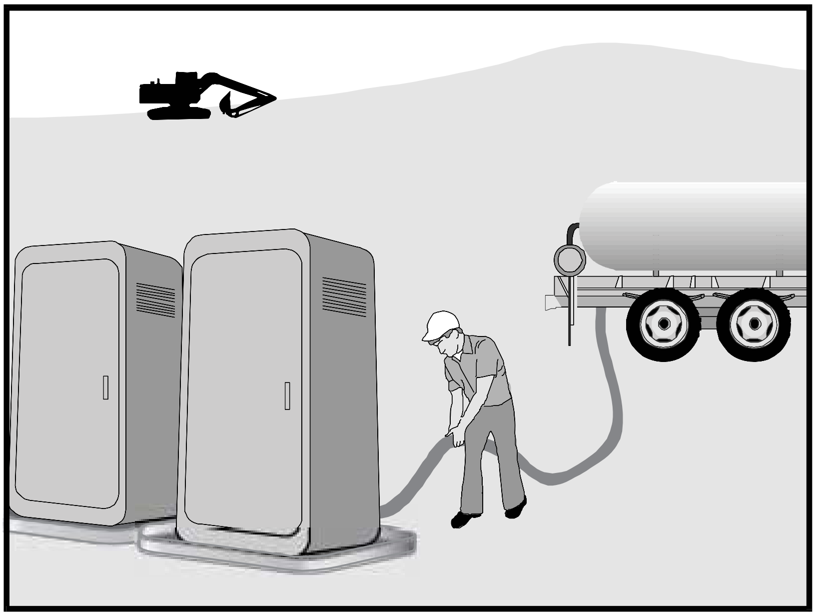


SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

Sanitary/Septic Waste Management WM-9



Categories

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

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

Limitations

None identified.

Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

Storage and Disposal Procedures

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. If site conditions allow, place portable facilities a minimum of 50 feet from drainage conveyances and traffic areas. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Temporary sanitary facilities must be equipped with containment to prevent discharge of pollutants to the stormwater drainage system of the receiving water.
- Consider safety as well as environmental implications before placing temporary sanitary facilities.
- Wastewater should not be discharged or buried within the project site.
- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.
- If a spill does occur from a temporary sanitary facility, follow federal, state and local regulations for containment and clean-up.

Education

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce the use of sanitary facilities (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.
- If spills or leaks from sanitary or septic facilities occur that are not contained and discharge from the site, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Adopt a pet from your local animal shelter or adoption centers at pet stores. A variety of animals, from purebred tomixe d breed are waiting for loving arms and good homes. Consider volunteering at your local animal shelters. Volunteers, donations, food, newspapers, old towels and linens are needed to help the animals.

RIVERSIDE COUNTY ANIMAL SHELTER LOCATIONS:

BLYTHE
16450 West Hobson Way
Blythe, CA 92225
760-921-7857

HEMET
800 South Sanderson
Hemet, CA 92545
909 925-8025

INDIO
45-355 Van Buren
Indio, CA 92201
760-347-2319

RIVERSIDE
5950 Wilderness Avenue
Riverside, CA 92504
909-358-7387

FOR ALL OTHER AREAS CALL 1-888-636-7387

Riverside County gratefully acknowledges the City of Los Angeles Stormwater Program for the design concept of this brochure.

What's the Scoop?

TIPS FOR A HEALTHY PET AND A HEALTHIER ENVIRONMENT

CREATE A HEALTHY ENVIRONMENT in and around your home by following these simple pet practices. Your pet, family and neighbors will appreciate their clean comfortable surroundings.

HOUSEHOLD PETS

We all love our pets, but pet waste is a subject everyone likes to avoid. Pet waste left on trails, sidewalks, streets, and grassy areas is immediately flushed into the nearest waterway when it rains. Even if you can't see water near you, the rain or waste water WASHES all that PET WASTE and BACTERIA INTO THE STORMDRAIN, where it travels to your neighborhood creek or lake untreated. These animal droppings also contain nutrients that can promote the growth of algae, if they enter our streams and lakes. The risk of STORMWATER CONTAMINATION INCREASES, if pet wastes is allowed to accumulate in animal pen areas or left on sidewalks, streets, or driveways where runoff can carry them to storm sewers.

Some of the DISEASES THAT CAN SPREAD from pet waste are:
Campylobacteriosis — a bacterial infection that causes diarrhea in humans.
Salmonellosis — the most common bacterial infection transmitted to humans from animals.
Toxocarisis — roundworms transmitted from animals to humans.

Flies and other pest insects can also increase when pet waste is disposed of improperly, becoming a nuisance and adding yet another vector for disease transmission.

WHAT CAN YOU DO?

- SCOOP up pet waste and flush it down the toilet.
- NEVER DUMP pet waste into a storm drain or catch basin.
- USE the complimentary BAGS or mutt mitts offered in dispensers at local parks.
- CARRY EXTRA BAGS when walking your dog and make them available to other pet owners who are without.
- TEACH CHILDREN how to properly clean up after a pet.
- TELL FRIENDS AND NEIGHBORS about the ill effects of animal waste on the environment. Encourage them to clean up after pets.

Did You Know . . .
that Californians illegally dump about 80 million gallons of motor oil each year?

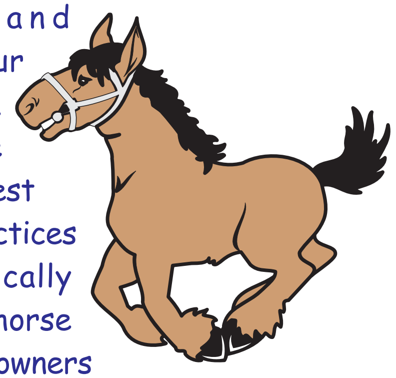
Many communities have "Scoop the Poop" laws that govern pet waste cleanup. Some of these laws specifically require anyone who walks an animal off of their property to carry a bag, shovel, or scooper. Any waste left by the animal must be cleaned up immediately. CALL YOUR LOCAL CODE ENFORCEMENT OFFICER to find out more about pet waste regulations.

Pets are only one of the many fixtures of suburban America that add to water pollution. Lawn fertilizers, rinse water from driveways and motor oil commonly end up in streams and lakes. **CALL 1-800-506-2555 FOR HOUSEHOLD HAZARDOUS WASTE COLLECTION LOCATION AND DATES.** Maintain your automobile to avoid leaks. Dispose of used vehicle fluids properly. Your pets can be poisoned if they ingest gas, oil or antifreeze that drips onto the pavement or is stored in open containers.

NEVER HOSE VEHICLE FLUIDS into the street or gutter. USE ABSORBENT MATERIALS such as cat litter to clean-up spills. SWEEP UP used absorbent materials and place in the trash.

HORSES AND LIVESTOCK

Fortunate enough to own a horse or livestock? You, too, can play a part in protecting and cleaning up our water resources. The following are a few simple Best Management Practices (BMPs) specifically designed for horse owners and landowners with horses.



- STORE your manure properly. Do not store unprotected piles of manure in places where runoff may enter streams, or flood waters may wash the manure away. Place a cover or tarp over the pile to keep rainwater out.
- CHECK with your local conservation district to design manure storage facilities to protect water quality. These structures usually consist of a concrete pad to protect ground water and a short wall on one or two sides to make manure handling easier.
- TRY composting – A vegetative cover placed around buildings or on steeper slopes can help minimize erosion and absorb nutrients while improving the appearance of your property. In addition, avoid costlier erosion controls, vegetative covers will provide animals with better traction during wet or icy conditions.

- KEEP animals out of steams – Designed stream crossings provide a safe, easy way for horses and livestock to ford streams. Fencing encourages the use of the crossing instead of the streambed to navigate streams. This will allow vegetation to stabilize stream banks and reduce sediment pollution.
- MOW pastures to proper height, six inches is typically recommended.
- Material STORAGE SAFETY TIPS – Many of the chemicals found in barns require careful handling and proper disposal. When using these chemicals, be certain to follow these common sense guidelines:
  - Buy only what you need.
  - Treat spills of hoof oils like fuel spill. Use kitty litter to soak up the oil and dispose in a tightly sealed plastic bag.
  - Store pesticides in a locked, dry, well-ventilated area.
  - Protect stored fertilizer and pesticides from rain and surface water.

Call 1-800-506-2555 to locate your local conservation district to find out what to do with your current backyard manure pile, how to re-establish a healthy pasture, what to do about weeds, and what grasses grow best in your soils.

Thank you for doing your part to protect your watershed, the environment, and the equestrian way of life in your community!

After the Storm

A Citizen's Guide to Understanding Stormwater

For more information contact:

or visit

www.epa.gov/npdes/stormwater

www.epa.gov/nps

United States Environmental Protection Agency

EPA 833-B-03-002

January 2003

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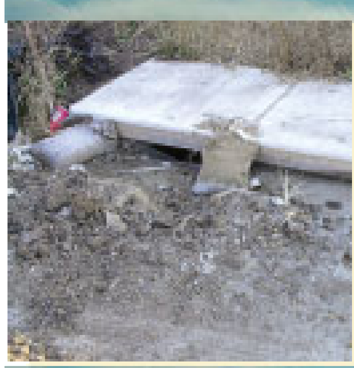
What is stormwater runoff?

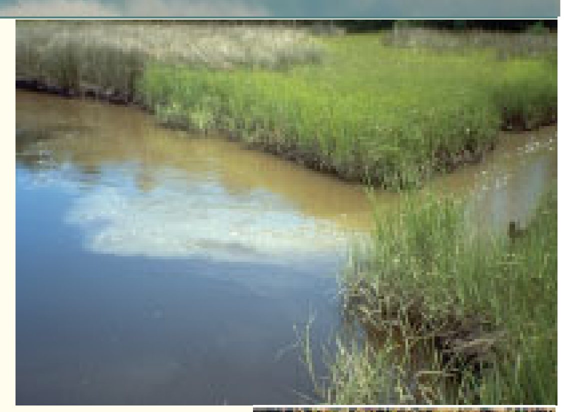


Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?

Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution



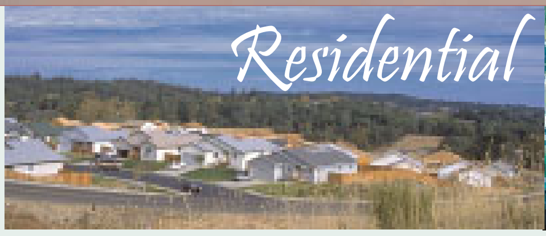
Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.

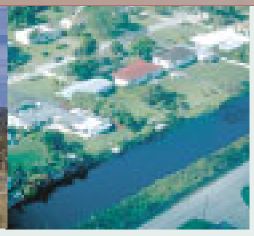
- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.

- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.

Stormwater Pollution Solutions



Residential



Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

Pet waste

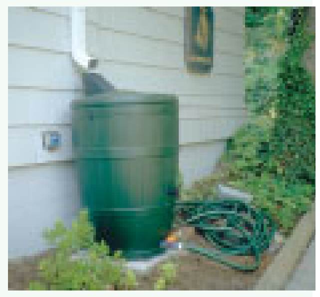
Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.



Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Commercial

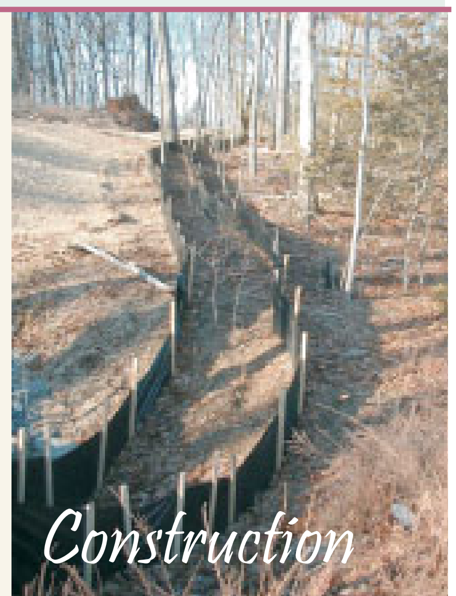
Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction

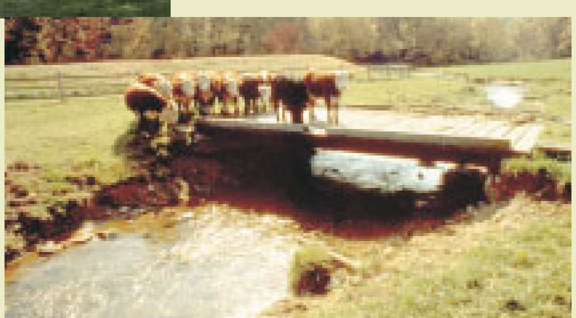
Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.



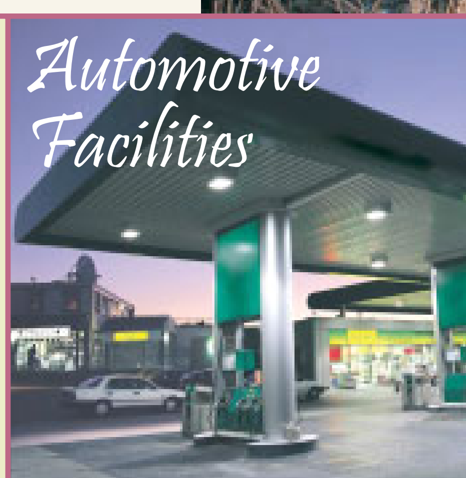
Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.



- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

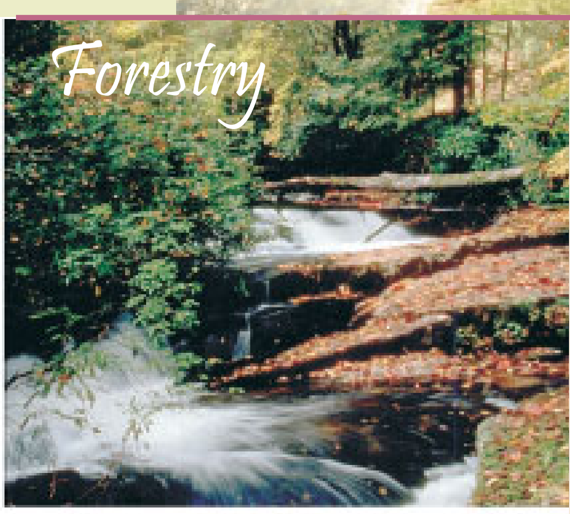
Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

Forestry



Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

AUTO MAINTENANCE

Oil and grease from cars, asbestos worn from brake linings, zinc from tires, and toxics from spilled fluids often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

Cleanin' Work Sites...

Avoid hosing down your garage floor and driveway; instead, sweep regularly. Also, use non-toxic cleaning products. A water and baking soda mixture works great on removing corrosion from battery terminals and cleaning chrome; mix the soda with a mild, biodegradable dishwashing soap to clean wheels and tires. Additionally, a mixture of white vinegar or lemon juice with water can be used to clean windows.

Spills...

Avoid accidental spills by using a drip pan and funnel when draining or pouring fluids. Be ready for unexpected spills by preparing and using spill containment and cleanup kits. Kits should include safety equipment and cleanup materials such as kitty litter, sawdust or cornmeal. Furthermore, prevent leaks from stored vehicles by draining gas, hydraulic oil, and transmission, brake & radiator fluid. To report serious spills, call 1-800-33-TOXIC.

Recycling...

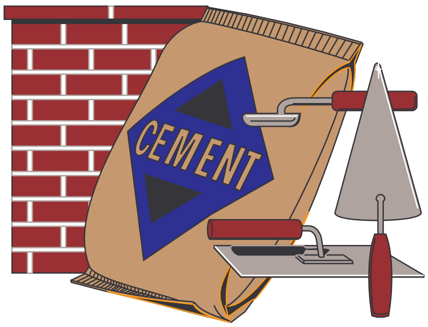
The law requires people to recycle motor oil and lead acid batteries. REMEMBER: Never dump them down storm drains. Other items which can be recycled include oil filters, antifreeze, cleaning solutions, hydraulic & transmission fluids, metal scraps, water-based paints, and used tires. For recycling information, call 386-8401.

Washin' Vehicles...

Take vehicles to a washing facility to prevent oil & grease, suspended solids and other toxics from washing into our storm drains. Otherwise, use bermed wash areas to prevent contact with stormwater. Discharge wash water to sewer only after contacting local sewer authority to find out if pretreatment is required. At home, vehicles should be washed on the lawn, which can absorb unwanted runoff.

For more information, call your city's stormwater representative

FRESH CONCRETE & MORTAR APPLICATION



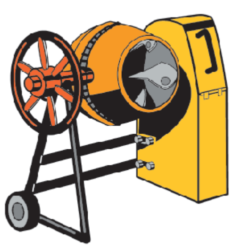
Cement, cement wash, gravel, asphalt, solvents, and motor oil from fresh concrete and mortar activities often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

General Business Practices...

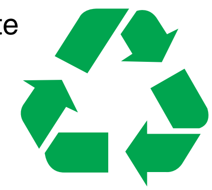
Schedule excavation and grading work during dry weather, and in case it rains, prevent materials from contacting stormwater by storing them under cover. Also, secure open bags of cement to keep wind-blown cement powder away from streets, gutters and storm drains.

During Construction...



Prevent mortar and cement from entering the storm drains by placing erosion controls (i.e., berms or temporary vegetation) down-slope to capture runoff. When breaking up paving, be sure to pick up all pieces and recycle them at a crushing company; small amounts of excess dry concrete, grout and mortar can be disposed of in the trash. Setup small mixers on tarps or heavy drop cloths to allow for easy cleanup of debris. REMEMBER: Never bury waste material -- recycle or dispose of it as hazardous waste. Call 386-8401 for recycling and disposal information.

Handling Materials & Wastes...



Minimize wastes when ordering materials by ordering only the amounts needed to complete the job. Whenever possible, use recycled or recyclable materials. Recycle broken asphalt, concrete, wood, and cleared vegetation. Unrecyclable materials must be taken to an appropriate landfill or disposed of as hazardous waste. For recycling and disposal information, call 386-8401.

Cleaning up...

When cleaning up after driveway or sidewalk construction, wash concrete dust onto designated dirt areas, not down the driveway or into the street or storm drain. Also, wash out concrete mixers and equipment only in specified wash-out areas, where the water flows into containment ponds. Cement washwater can be recycled by pumping it back into cement mixers for reuse. REMEMBER: Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.

For more information, call your city's stormwater representative

For Information:

For more information on the General Industrial Storm Water Permit contact:

State Water Resources Control Board (SWRCB) (916) 657-1146 or www.swrcb.ca.gov/ or, at your Regional Water Quality Control Board (RWQCB).

Santa Ana Region (8)
California Tower
3737 Main Street, Ste. 500
Riverside, CA 92501-3339
(909) 782-4130

San Diego Region (9)
9771 Clairemont Mesa Blvd., Ste. A
San Diego, CA 92124
(619) 467-2952

Colorado River Basin Region (7)
73-720 Fred Waring Dr., Ste. 100
Palm Desert, CA 92260
(760) 346-7491

SPILL RESPONSE AGENCY:

HAZ-MAT:	(909) 358-5055
HAZARDOUS WASTE DISPOSAL:	(909) 358-5055
RECYCLING INFORMATION:	1-800-366-SAVE
TO REPORT ILLEGAL DUMPING OR A CLOGGED STORM DRAIN:	1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, call: (909) 955-1111.

StormWater CleanWater PROTECTION PROGRAM

Riverside County gratefully acknowledges the State Water Quality Control Board and the American Public Works Association, Storm Water Quality Task Force for the information provided in this brochure.

DID YOU KNOW . . .

YOUR FACILITY MAY NEED A STORM WATER PERMIT?

Many industrial facilities and manufacturing operations must obtain coverage under the Industrial Activities Storm Water General Permit

FIND OUT
IF YOUR FACILITY MUST OBTAIN A PERMIT

StormWater Pollution . . . What you should know

Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to help prevent flooding by carrying excess rainwater away from streets. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our waterways.

Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.

In recent years, awareness of the need to protect water quality has increased. As a result, federal, state, and local programs have been established to reduce polluted stormwater discharges to our waterways. The emphasis of these programs is to prevent stormwater pollution since it's much easier, and less costly, than cleaning up "after the fact."

National Pollutant Discharge Elimination System (NPDES)

In 1987, the Federal Clean Water Act was amended to establish a framework for regulating industrial stormwater discharges under the NPDES permit program. In California, NPDES permits are issued by the State Water Resources Control Board (SWRCB) and the nine (9) Regional Water Quality Control Boards (RWQCB). In general, certain industrial facilities and manufacturing operations must obtain coverage under the Industrial Activities Storm Water General Permit if the type of facilities or operations falls into one of the several categories described in this brochure.

How Do I Know If I Need A Permit?

Following are ***general descriptions*** of the industry categories types that are regulated by the Industrial Activities Storm Water General Permit. Contact your local Region Water Quality Control Board to determine if your facility/operation requires coverage under the Permit.

➜ Facilities such as cement manufacturing; feedlots; fertilizer manufacturing; petroleum refining; phosphate manufacturing; steam electric power generation; coal mining; mineral mining and processing; ore mining and dressing; and asphalt emulsion;

➜ Facilities classified as lumber and wood products (except wood kitchen cabinets); pulp, paper, and paperboard mills; chemical producers (except some pharmaceutical and biological products); petroleum and coal products; leather production and products; stone, clay and glass products; primary metal industries; fabricated structural metal; ship and boat building and repairing;

➜ Active or inactive mining operations and oil and gas exploration, production, processing, or treatment operations;

➜ Hazardous waste treatment, storage, or disposal facilities;

➜ Landfills, land application sites and open dumps that receive or have received any industrial waste; unless there is a new overlying land use such as a golf course, park, etc., and there is no discharge associated with the landfill;

➜ Facilities involved in the recycling of materials, including metal scrap yards, battery reclaimers, salvage yards, and automobile junkyards;

➜ Steam electric power generating facilities, facilities that generate steam for electric power by combustion;

➜ Transportation facilities that have vehicle maintenance shops, fueling facilities, equipment cleaning operations, or airport deicing operations. This includes school bus maintenance facilities operated by a school district;

➜ Sewage treatment facilities;

➜ Facilities that have areas where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water.

How do I obtain coverage under the Industrial Activities Storm Water General Permit?

Obtain a permit application package from your local Regional Water Quality Control Board listed on the back of this brochure or the State Water Resources Control Board (SWRCB). Submit a completed Notice of Intent (NOI) form, site map and the appropriate fee ($250 or $500) to the SWRCB. Facilities must submit an NOI thirty (30) days prior to beginning operation. Once you submit the NOI, the State Board will send you a letter acknowledging receipt of your NOI and will assign your facility a waste discharge identification number (WDID No.). You will also receive an annual fee billing. These billings should roughly coincide with the date the State Board processed your original NOI submittal.

What are the requirements of the Industrial Activities Storm Water General Permit?

The basic requirements of the Permit are:

1. The facility must eliminate any non-stormwater discharges or obtain a separate permit for such discharges.

2. The facility must develop and implement a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must identify sources of pollutants that may be exposed to stormwater. Once the sources of pollutants have been identified, the facility operator must develop and implement Best Management Practices (BMPs) to minimize or prevent polluted runoff.

   Guidance in preparing a SWPPP is available from a document prepared by the California Storm Water Quality Task Force called the California Storm Water Best Management Practice Handbook.

3. The facility must develop and implement a Monitoring Program that includes conducting visual observations and collecting samples of the facility's storm water discharges associated with industrial activity. The General Permit requires that the analysis be conducted by a laboratory that is certified by the State of California.

4. The facility must submit to the Regional Board, every July 1, an annual report that includes the results of its monitoring program.

A Non-Storm Water Discharge is... *any discharge to a storm drain system that is not composed entirely of storm water. The following non-storm water discharges are authorized by the General Permit: fire hydrant flushing; potable water sources, including potable water related to the operation, maintenance, or testing of potable water systems; drinking fountain water; atmospheric condensates including refrigeration, air conditioning, and compressor condensate; irrigation drainage; landscape watering; springs; non-contaminated ground water; foundation or footing drainage; and sea water infiltration where the sea waters are discharged back into the sea water source.*

A BMP is . . . *a technique, process, activity, or structure used to reduce the pollutant content of a storm water discharge. BMPs may include simple, non-structural methods such as good housekeeping, staff training and preventive maintenance. Additionally, BMPs may include structural modifications such as the installation of berms, canopies or treatment control (e.g. setting basins, oil/water separators, etc.)*

WARNING*: There are significant penalties for non-compliance: a minimum fine of $5,000 for failing to obtain permit coverage, and, up to $10,000 per day, per violation plus $10 per gallon of discharge in excess of 1,000 gallons.*

HOME & GARDEN

Yard waste and household toxics such as paints, solvents, and pesticides often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

In Your Home...

Household products such as paints, paint thinners, drain openers, motor oil, wood polishes, insecticides & herbicides, oven cleaners, and many other general cleaners frequently get dumped on the ground, or into a gutter, street or storm drain. Instead of polluting our stormwaters, take these items to a household hazardous waste collection facility. Call 1-800-OILY-CAT for a facility in your area.

Fertilizers and Pesticides...

Fertilizers and pesticides are often carried into our storm drains by sprinkler runoff. To minimize stormwater pollution, use organic or non-toxic pesticides and fertilizers as directed, and keep them away from ditches, gutters and storm drains. Store them in a covered area, off the ground, to prevent contact with water. For additional gardening questions, call the San Bernardino Master Gardeners at 387-2182.

Trimmin' the Garden...

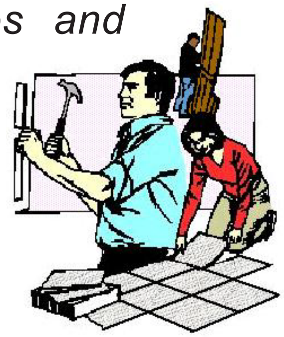
Decaying organic materials that enter our storm drains, such as grass, leaves, yard clippings, and pet waste, will use up oxygen in nearby streams, stressing aquatic life. Prevent stormwater pollution by not blowing, sweeping, raking or hosing yard waste into the street, gutter, or storm drain. Alternatively, leave grass clippings on your lawn after mowing, or compost your clippings and yard waste. Pet waste should not be composted, but rather disposed of in the trash to prevent the potential spread of diseases.

Planting In The Yard

Produce less yard waste and save water by planting low maintenance trees and shrubs. Also, conserve water and minimize unwanted runoff by using drip irrigation, soaker hoses, or micro-spray systems to water vegetation.

For more information, call your city's stormwater representative

HOME REPAIR & REMODELING



Paints, solvents, adhesives, dusts, sediments, pesticides and household toxics commonly associated with home repair and remodeling activities often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

Household Hazardous Wastes...

Common household cleaners, paint products, and wallpaper & tile adhesives contain toxic substances. Dispose of these products properly. REMEMBER: Toxic wastes should never enter the storm drain system. For disposal information, call 1-800-OILY-CAT.

Construction...

Keep all construction debris away from the street, gutter and storm drain, and if possible, schedule grading and excavation projects for dry weather. Cover excavated material and stockpiles of asphalt, sand, etc. with plastic tarps, and prevent erosion by planting fast-growing annual and perennial grasses, which will shield and bind the soil.

Landscape & Gardening...

Use fertilizers and pesticides as directed. Keep them away from ditches, gutters and storm drains, and store them in a covered area to prevent contact with rain water. Also, minimize runoff and conserve water by using drip irrigation, soaker hoses, or micro-spray systems. REMEMBER: Do not deposit leaves into the street, gutter, or storm drain.

Painting...

CLEANUP... Avoid cleaning brushes or rinsing paint containers into a street, gutter, or storm drain. For water-based paints, "brush out" as much paint as possible, and rinse in the sink. For oil-based paints, "brush out" as much paint as possible, clean with thinner, and then filter and reuse thinner or solvent.

REMOVAL... Paint stripping residue, chips & dust from marine paints, and paints containing lead or tributyl tin are hazardous wastes. Sweep them up and call 1-800-OILY-CAT for disposal information.

RECYCLING... Recycle or reuse leftover paint by using it for touch-ups, or by giving it to someone who can us it, such as a theatre group, school, city or other community organization. If you're unable to give it away, contact 1-800-OILY-CAT for disposal information.

Concrete & Masonry...

Store bags of cement and plaster away from gutters and storm drains, and under cover, protected from rainfall, runoff and wind. REMEMBER: Never dispose of cement washout or concrete dust onto driveways, streets, gutters or storm drains.

San Bernardino County STORMWATER PROGRAM

For more information, call your city's stormwater representative

San Bernardino County STORMWATER PROGRAM

Helpful telephone numbers and links:

Riverside County Water Agencies

City of Banning	(951) 922-3130
City of Beaumont/Cherry Valley	(951) 845-9581
City of Blythe	(760) 922-6161
City of Coachella	(760) 398-3502
City of Corona	(951) 736-2263
City of Hemet	(951) 765-3710
City of Norco	(951) 270 5607
City of Riverside Public Works	(951) 351-6140
City of San Jacinto	(951) 654-4041
Coachella Valley Water District	(760) 398-2651
Desert Water Agency (Palm Springs)	(760) 323-4971
Eastern Municipal Water District	(951) 928-3777
Elsinore Valley Municipal Water District	(951) 674 3146
Elsinore Water District	(951) 674-2168
Farm Mutual Water Company	(951) 244-4198
Idyllwild Water District	(951) 659-2143
Indio Water Authority	(760) 391-4129
Jurupa Community Services District	(951) 685-7434
Lee Lake Water	(951) 658-3241
Mission Springs Water	(760) 329-6448
Rancho California Water District	(951) 296-6900
Ripley, CSA #62	(760) 922-4951
Riverside Co. Service Area #51	(760) 227-3203
Rubidoux Community Services District	(951) 684-7580
Valley Sanitary District	(760) 347-2356
Western Municipal Water District	(951) 789-5000
Yucaipa Valley Water District	(909) 797-5117

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers

Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

Storm drains are NOT connected to sanitary sewer systems and treatment plants!

The primary purpose of storm drains is to carry rain water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** *Always* have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555

Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is *PROHIBITED* by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. *Each of us* can do our part to keep storm water clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do...consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do...prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water <u>away</u> from the gutters and storm drains.

Do...use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do...obtain the property owner's permission to dispose of ***small amounts*** of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do...check your local sanitary sewer agency's policies on wash water disposal regulations before disposing wash water to the sewer. (See list on reverse side)

Do...be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do...check to see if local ordinances prevent certain activities.

Do not let...wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.

...ONLY RAIN... DOWN THE STORM DRAIN

Report illegal storm drain disposal,
Call Toll Free
1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them for being toxic free. Soapy water entering the storm drain system <u>can</u> impact the delicate aquatic environment.

When cleaning surfaces with a ***high-pressure washer*** or ***steam cleaner***, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks ***with loose paint***, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlet by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

For Information:

Local Sewering Agencies in Riverside County:

City of Beaumont	(909) 769-8520
Belair Homeowners Association	(909) 277-1414
City of Banning	(909) 922-3130
City of Blythe	(760) 922-6161
City of Coachella	(760) 391-5008
Coachella Valley Water District	(760) 398-2651
City of Corona	(909) 736-2259
Desert Center, CSA #51	(760) 227-3203
Eastern Municipal Water District	(909) 928-3777
Elsinore Valley MWD	(909) 674-3146
Farm Mutual Water Company	(909) 244-4198
Idyllwild Water District	(909) 659-2143
Jurupa Community Services Dist.	(909) 685-7434
Lake Hemet MWD	(909) 658-3241
Lee Lake Water District	(909) 277-1414
March Air Force Base	(909) 656-7000
Mission Springs Water District	(760) 329-6448
City of Palm Springs	(760) 323-8242
Rancho Caballero	(909) 780-9272
Rancho California Water Dist.	(909) 676-4101
Ripley, CSA #62	(760) 922-4909
Rubidoux Community Services Dist.	(909) 684-7580
City of Riverside	(909) 782-5341
Silent Valley Club, Inc	(909) 849-4501
Valley Sanitary District	(760) 347-2356
Western Municipal Water District	(909) 780-4170

Spill Response Agency:

Haz-Mat:	(909) 358-5055
Hazardous Waste Disposal:	(909) 358-5055
To Report Illegal Dumping or a Clogged Storm Drain:	1-800-506-2555

StormWater CleanWater PROTECTION PROGRAM

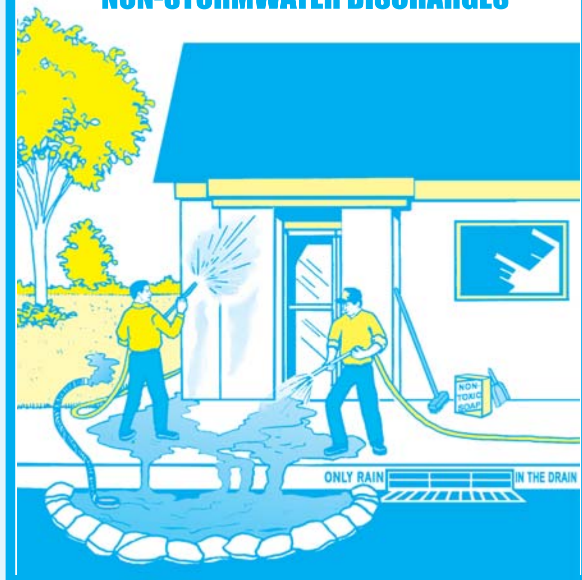
Riverside County gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

StormWater Pollution

What you should know for...

OUTDOOR CLEANING ACTIVITIES

NON-STORMWATER DISCHARGES



GUIDELINES for disposal of washwater from:

- Sidewalk, plaza or parking lot cleaning
- Vehicle washing or detailing
- Building exterior cleaning
- Waterproofing
- Equipment cleaning or degreasing

Do you know . . . where the water should go?

Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to prevent flooding by carrying excess rainwater away from streets. . . it's <u>not</u> designed to be a waste disposal system. Since the storm drain system does not provide for water treatment, it often serves the unintended function of transporting pollutants directly to our waterways.

Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.

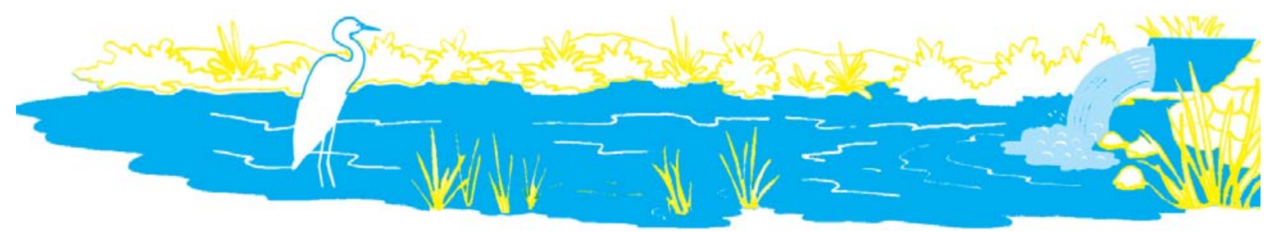
Non-stormwater discharges such as washwater generated from outdoor cleaning projects often transport harmful pollutants into storm drains and our local waterways. Polluted runoff contaminates local waterways and poses a threat to groundwater resources.

Soaps, degreasers, automotive fluids, litter, and a host of other materials washed off buildings, sidewalks, plazas, parking areas, vehicles, and equipment can all pollute our waterways.

The Cities and County of Riverside StormWater/CleanWater Protection Program

Since preventing pollution is much easier, and less costly than cleaning up "after the fact," the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses of pollution prevention activities such as those described in this pamphlet.

The Cities and County of Riverside have adopted ordinances for stormwater management and discharge control. In accordance with state and federal law, these local stormwater ordinances **prohibit** the discharge of wastes into the storm drain system or local surface waters. This includes non-stormwater discharges containing oil, grease, detergents, degreasers, trash, or other waste materials.



PLEASE NOTE: The discharge of pollutants into the street, gutters, storm drain system, or waterways - without a Regional Water Quality Control Board permit or waiver - is ***strictly prohibited*** by local ordinances and state and federal law.

Help Protect Our Waterways!

Use These Guidelines For Outdoor Cleaning Activities and Washwater Disposal

DO . . . Dispose of **small amounts** of **washwater from cleaning building exteriors, sidewalks, or plazas** onto landscaped or unpaved surfaces provided you have the owner's permission and the discharge will not cause flooding or nuisance problems, or flow into a storm drain.

DO NOT . . . Discharge **large amounts** of these types of washwater onto landscaped areas or soil where water may run to a street or storm drain. Wastewater from exterior cleaning may be pumped to a sewer line with specific permission from the local sewering agency.

DO . . . Check with your local sewering agency's policies and requirements concerning waste water disposal. **Water from many outdoor cleaning activities** may be acceptable for disposal to the sewer system. See the list on the back of this flyer for phone numbers of the sewering agencies in your area.

DO NOT . . . Pour **hazardous wastes** or toxic materials into the storm drain or sewer system . . . properly dispose of it instead. When in doubt, contact the local sewering agency! The agency will tell you what types of liquid wastes can be accepted.

DO . . . Understand that **water (without soap) used to remove dust from clean vehicles** may be discharged to a street or storm drain. **Washwater from sidewalk, plaza, and building surface cleaning** may go into a street or storm drain if ALL of the following conditions are met:

1) The surface being washed is free of residual oil stains, debris and similar pollutants by using dry cleanup methods (sweeping, and cleaning any oil or chemical spills with rags or other absorbent materials before using water).
2) Washing is done with water only - no soap or other cleaning materials.
3) You have not used the water to remove paint from surfaces during cleaning.

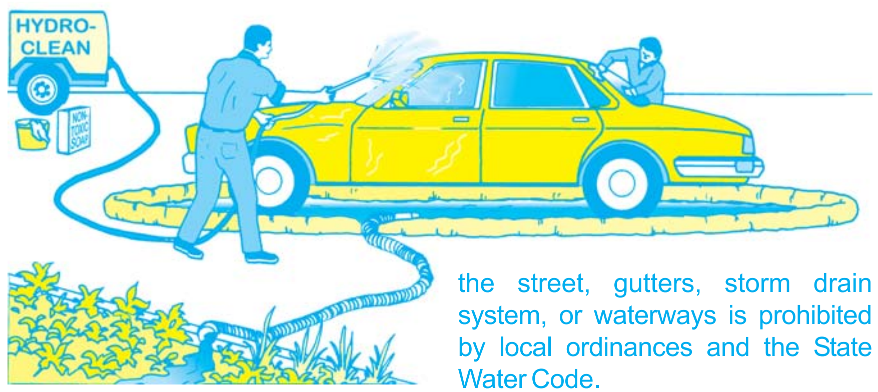
DO NOT . . . Dispose of water containing **soap or any other type of cleaning agent** into a storm drain or water body. This is a direct violation of state and/or local regulations. Because **wastewater from cleaning parking areas or roadways** normally contains metallic brake pad dust, oil and other automotive fluids, it should never be discharged to a street, gutter, or storm drain.

DO . . . Understand that **mobile auto detailers** should divert washwater to landscaped or dirt areas. Note: Be aware that soapy washwater may adversely affect landscaping; consult with the property owner. Residual washwater may remain on paved surfaces to evaporate; sweep up any remaining residue. If there is sufficient water volume to reach the storm drain, collect the runoff and obtain permission to pump it into the sanitary sewer. Follow local sewering agency's requirements for disposal.

DO NOT . . . Dispose of left over cleaning agents into the gutter, storm drain or sanitary sewer.

Regarding Cleaning Agents:

If you must use soap, use biodegradable/phosphate free cleaners. Avoid use of petroleum based cleaning products. Although the use of nontoxic cleaning products is strongly encouraged, ***do*** understand that these products can still degrade water quality and, therefore, the discharge of these products into



the street, gutters, storm drain system, or waterways is prohibited by local ordinances and the State Water Code.

Note: When cleaning surfaces with a high pressure washer or steam cleaning methods, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning, as compared to the use of a low pressure hose, can remove additional materials that can contaminate local waterways.

OTHER TIPS TO HELP PROTECT OUR WATER . . .

SCREENING WASH WATER

A thorough dry cleanup before washing (without soap) surfaces such as building exteriors and decks without loose paint, sidewalks, or plaza areas, *should be sufficient to protect storm drains.* **However**, if any debris (solids) could enter storm drains or remain in the gutter or street after cleaning, washwater should first pass through a "20 mesh" or finer screen to catch the solid material, which should then be disposed of in the trash.

DRAIN INLET PROTECTION/ CONTAINING & COLLECTING WASH WATER

- Sand bags can be used to create a barrier around storm drain inlets.
- Plugs or rubber mats can be used to temporarily seal storm drain openings.
- You can also use vacuum booms, containment pads, or temporary berms to keep wash water away from the street, gutter, or storm drain.

EQUIPMENT AND SUPPLIES

Special materials such as absorbents, storm drain plugs and seals, small sump pumps, and vacuum booms are available from many vendors. For more information check catalogs such as New Pig (800-468-4647), Lab Safety Supply (800-356-0783), C&H (800-558-9966), and W.W. Grainger (800-994-9174); or call the Cleaning Equipment Trade Association (800-441-0111) or the Power Washers of North America (800-393-PWNA).

PAINTING

Paints, solvents, adhesives, and toxic chemicals from painting operations often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

General Business Practices...

Keep all paint products and wastes away from the street, gutter, and storm drains. Reuse paint thinner by setting used thinner aside in a closed, labeled jar to settle out paint particles, and then pouring off the clear liquid for future use. Wrap dried paint residue in newspaper and dispose of it in the trash.

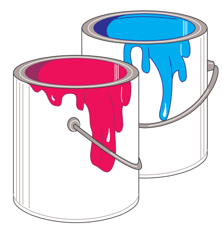
Water-Based Paints...

Purchase water-based paints whenever possible. Look for products labeled “latex” or “clean up with water.”

Recycle or Reuse Paints...

Recycle/reuse leftover paint by using it for touch-ups, or by giving it to someone who can use it, such as a theatre group, school, city or other community organization. If you’re unable to give it away, contact 386-8401 for information on hazardous waste pick-up.

Paint Cleanup...



Avoid cleaning brushes and rinsing paint containers in a street, gutter, or storm drain. For water-based paints, “brush out” as much paint as possible and and rinse in the sink. For oil-based paints, “brush out” as much paint as possible, clean with thinner, and then filter and reuse thinner or solvent.

Paint Removal...

Chemical paint stripping residue, chips & dust from marine paints, and paints containing lead or tributyl tin are hazardous wastes. For disposal information, call 386-8401. Also, when stripping or cleaning building exteriors with high-pressure water, block storm drains and divert the washwater onto a designated dirt area. Check with your local wastewater treatment authority to find out if you can collect building cleaning water and discharge it to the sewer.

For more information, call your city’s stormwater representative

Helpful telephone numbers and links:

RIVERSIDE COUNTY WATER AGENCIES:

City of Banning	(951) 922-3130
City of Beaumont	(951) 769-8520
City of Blythe	(760) 922-6161
City of Coachella	(760) 398-3502
Coachella Valley Water District	(760) 398-2651
City of Corona	(951) 736-2259
Desert Center, CSA #51	(760) 227-3203
Eastern Municipal Water District	(951) 928-3777
Elsinore Valley MWD	(951) 674-3146
Farm Mutual Water Company	(951) 244-4198
City of Hemet	(951) 765-3712
Idyllwild Water District	(951) 659-2143
Jurupa Community Services District	(951) 360-8795
Lake Hemet MWD	(951) 658-3241
Lee Lake Water District	(951) 277-1414
March Air Force Base	(951) 656-7000
Mission Springs Water District	(760) 329-6448
City of Palm Springs	(760) 323-8253
Rancho Caballero	(951) 780-9272
Rancho California Water District	(951) 296-6900
Ripley, CSA #62	(760) 922-4951
City of Riverside	(951) 351-6170
Rubidoux Community Services District	(951) 684-7580
Silent Valley Club, Inc	(951) 849-4501
Valley Sanitary District	(760) 347-2356
Western Municipal Water District	(951) 789-5000
Yucaipa Valley Water District	(909) 797-5117

CALL 1-800-506-2555 to:

- Report clogged storm drains or illegal storm drain disposal from residential, industrial, construction and commercial sites into public streets, storm drains and/or water bodies.
- Find out about our various storm drain pollution prevention materials.
- Locate the dates and times of Household Hazardous Waste (HHW) Collection Event.
- Request adult, neighborhood, or classroom presentations.
- Locate other County environmental services.
- Receive grasscycling information and composting workshop information.

Or visit our (Riverside County Flood Control District website at: **www.floodcontrol.co.riverside.ca.us**

Other links to additional storm drain pollution information:

- County of Riverside Environmental Health: www.rivcoeh.org
- California State Water Resource Conservation Board: www.swrcb.ca.gov/stormwtr/links.html
- California Water Quality Task Force: www.cabmphandbooks.com/
- United State Environmental Protection Agency (EPA): www.epa.gov/opptintr/p2home/programs/busprc.htm (compliance assistance information)

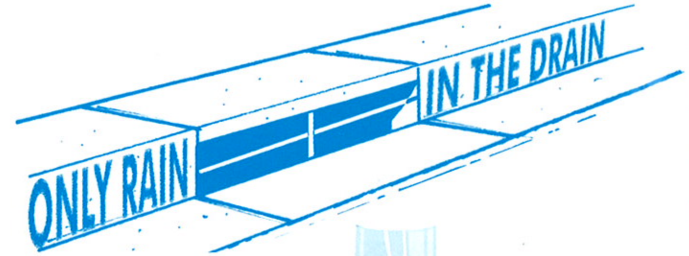
Riverside County Only Rain in the Storm Drain Pollution Protection Program gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

StormWater Pollution

What you should know for...

Swimming Pool, Jacuzzi and Fountain Maintenance

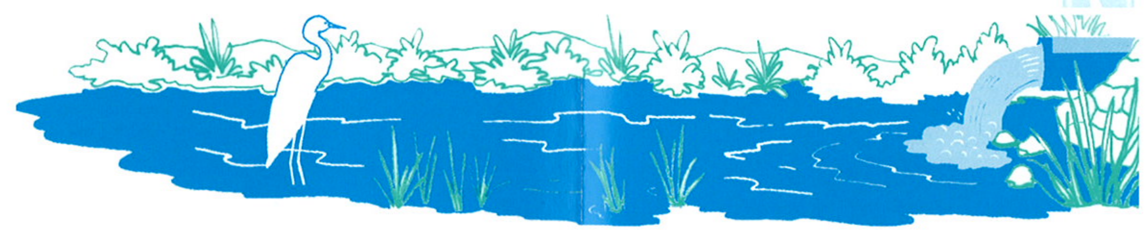
Do you know . . . where the water actually goes?



Storm Drains are not connected to sanitary sewer systems and treatment plants!

The primary purpose of storm drains is to carry rain water away from developed areas to prevent flooding. Untreated storm water and the pollutants it carries flow directly into rivers, lakes, and streams. Wastewater from residential swimming pools, jacuzzis, fishponds, and fountains often contain chemicals used for sanitizing or cleansing purposes. Toxic chemicals (such as chlorine or copper-based algaecides) can damage the environment when wastewater is allowed to flow into our local rivers, lakes, and streams by way of the storm drain system. Each of us can do our part to help clean our water, and that adds up to a pollution solution.

The Cities and County of Riverside have adopted ordinances for storm drain pollution management to maintain discharge control and prevent illegal storm drain discharge. In accordance with state and federal law, these local storm water ordinances prohibit the discharge of pollutants into the storm drain system or local surface waters. The Only Rain in the Storm Drain Pollution Program informs residents and businesses of storm drain pollution prevention activities such as those described in this brochure.



PLEASE NOTE: The discharge of pollutants into the street, gutters, storm drain system, or waterways – without a Regional Water Quality Control board permit or waiver – is strictly prohibited by local ordinances and state and federal law.

Do Your Part to Protect Our Waterways!

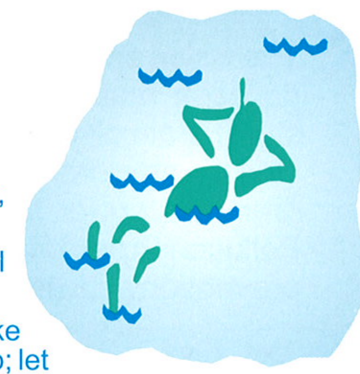
Use These Guidelines For Proper Draining of Your Swimming Pool, Jacuzzi and Fountain Water

Discharge Regulations

Requirements for pool draining may differ from city to city. Check with your water agency to see if disposal to the sanitary sewer line is allowed for pool discharges (see reverse side for Riverside County water purveyors).

If sewer discharge is allowed, a hose can be run from your swimming pool pump to the washing machine drain or a sink or bathtub. If sewer discharge is not allowed, or if your house is served by a septic tank, review the options presented below.

Discharge Options



If your local sewer agency will not accept pool water into their system, or if you are on a septic tank system, follow these guidelines:

1. Reduce or eliminate solids (e.g., debris, leaves or dirt) in the pool water.
2. Allow the chemicals in the pool water to dissipate. This could take up to seven (7) days depending on the time of year. Create a co-op; let your neighbor share your pool while theirs is being prepared for draining, then use their pool while yours is being drained. Chlorinated water should not be discharged into the storm drain or surface waters. This includes large pools such as community swimming pools or spas.
3. When the pool water is free of all chemicals (verify by a home pool water test kit) drain pool water to landscaped areas, lawns, yards, or any areas that will absorb the water.
4. You may have to drain the pool water over a period of a few days to allow the landscape areas to absorb most of the water.
5. Control the flow of the draining pool water to prevent soil erosion. Do not allow sediment to enter the street, gutter or storm drain.
6. Avoid discharging pool water into the street and storm drain system. Water runoff that enters the street can pick up motor oil, pet waste, trash and other pollutants, eventually carrying them into the storm drain system and local surface waters.

Refinishing Pool Surfaces

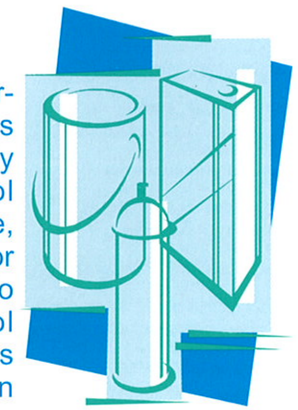
If you are resurfacing your pool, or resurfacing the pool patio area, be sure to hose down mixers, tools and trailers in a dirt area where rinse water won't flow into the street, gutter or storm drain. Local storm water ordinances strictly prohibit the discharge of pollutants into the storm drain system.

Residues from acid washing and similar activities require special handling. Never discharge low or high pH wastewater into the street, gutter or storm drain.

Cleaning Filters

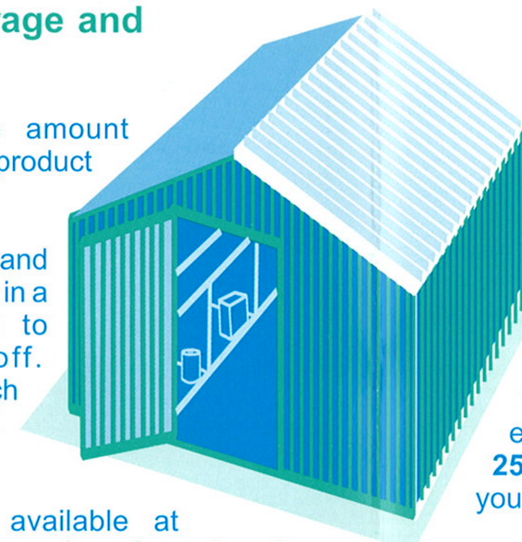
Discharge of pool filter rinse water and backflush to a stream, ditch, or storm drain is prohibited. Backflush from pool filters must be discharged to the sanitary sewer, on-site septic tank and drainfield system (if properly designed and adequately sized), or a seepage pit. Alternatively, pool filter rinse water and backwash may be diverted to dirt or landscaped areas. Filter media and other solids should be picked up and disposed of in the trash.

Algaecides



Avoid using copper-based algaecides unless absolutely necessary. Control algae with chlorine, organic polymers or other alternatives to copper-based pool chemicals. Copper is a heavy metal that can be toxic to aquatic life.

Chemical Storage and Handling



- Use only the amount indicated on product labels.
- Store chlorine and other chemicals in a covered area to prevent runoff. Keep out of reach of children and pets.
- Chlorine kits, available at retail swimming pool equipment and supply stores, should be used to monitor the chlorine and pH levels.
- Chlorine and other pool chemicals should never be allowed to flow into the gutter or the storm drain system.

Proper Disposal of Pool Chemicals

If you need to dispose of unwanted pool chemicals, first try giving them to a neighbor with a pool. If that doesn't work, bring unwanted pool chemicals to a Household Hazardous Waste (HHW) Collection Event. There's no cost for bringing HHW items to collection events - it's FREE! Call **1-800-506-2555** for a schedule of HHW events in your community.

<u>NEVER</u> put unused chemicals into the trash, onto the ground or down a storm drain.