APPENDIX I

Preliminary Hydrology Report and Preliminary Water Quality Management Plan

Kimley»Horn

PRELIMINARY HYDROLOGY REPORT

For

Hillwood – 11171 Cherry Avenue Industrial

PROJECT LOCATION

On the North side of Jurupa Avenue and East of Cherry Avenue
in the city of Fontana, CA.
APN's: 0236 – 191 – 14, 0236 – 191 – 25

DEVELOPER

Hillwood Enterprises
901 Via Piemonte, Suite 175
Ontario, CA 91764

PREPARED BY

Huitt-Zollars, Inc.
3990 Concours Suite 330
Ontario, CA 91764
Ph: 909.941.7799
Fax: 909.941.7789

Final to be signed
____
Manuel Gonzales, P.E.
C65195, Exp 09/30/2023

PREPARATION DATE

May 10th, 2023
Revised: _________

HZ PROJECT NUMBER

R315884.01

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List of Appendices

Introduction
This preliminary hydrology analysis has been prepared for Hillwood. The project is a new development of two industrial warehouse facilities located on the northeast corner of Cherry Avenue and Jurupa Avenue, in Fontana, CA. The proposed building (Building 1) on the east side of Cherry Avenue is approximately 477,480 square feet and Building 2, on the west side of Redwood Avenue, is approximately 224,315 square feet in size, on approximately 19.2 acres and 10.3 acres, respectively.

Purpose
The purpose of this report is to present the drainage concept for the project and to determine the design flow rates for the project site. The hydrology maps and calculations reflect the tributary areas along with 100-year storm event runoff flows.

Existing Condition
The project site is currently undeveloped and mostly used as storage yard. A few warehouses can be seen along the west side of the property, near Cherry Avenue. The project site generally slopes from the northeast corner to the southwest corner of the property at approximately 0.9%. The maximum site elevation, located at the northeast property line, is 958.6± feet mean sea level (MSL). The minimum site elevation located at the southwest right-of-way, is 938.7± feet MSL.

Proposed Condition
Under the proposed condition for Building 1, the area runoff will be directed to the on-site underground infiltration system located in the southeast section of the property. Area runoff for Building 2 will be directed to the on-site underground infiltration system located on the southwest section of the property. Both underground infiltration systems have been sized for underground treatment. It is our understanding that peak storm mitigation is not required because the existing storm drain infrastructure. See Appendix A for proposed on-site hydrology map.

The westerly half of Building 1 including the northerly and southerly parking lots will be intercepted by catch basins (CB#1-9) and conveyed through SD Line A to the underground infiltration system. The easterly half of Building 1 including runoff from the truck dock area, roof, and east trailer parking will be collected by catch basins #10 and 11. The collected runoff will then be conveyed to the underground infiltration system through the proposed storm drain Line B.

The northwest half of Building 2 including the truck dock area, roof and west trailer parking will be collected by catch basins #12 and 13. The collected runoff will then be conveyed to the underground infiltration system through the proposed storm drain line D. The easterly half of Building 2 including runoff from the east and southwest parking lots as well as the southwest portion of the building, will be intercepted by catch basins (CB#14-21) and conveyed through SD Line C to the underground infiltration system.

Peak Storm Mitigation
The underground infiltration systems have been sized for water quality treatment only, but will naturally provide some storm detention. However, it does not appear that mitigation is required due to the existing storm drain infrastructure. We understand that the existing 78-inch public

storm drain in Jurupa Avenue allows us to discharge full flow beyond the WQMP DCV (Design Capture Volume). Building 1 will discharge approximately 52.0 cfs through a proposed 36-inch storm drain outlet and Building 2 will discharge approximately 32.0 cfs through a 30-inch storm drain outlet. The proposed 36-inch outlet will convey both flows to the existing 78-inch public storm drain system in Jurupa Avenue and will discharge approximately 84 cfs. See Appendix A for proposed on-site hydrology map.

Hydrologic Analysis

A hydrologic analysis was prepared using the methodology outlined in the San Bernardino County Flood Control District (SBCFCD) Hydrology Manual. A rational method analysis was completed for the 100-year return events using Civild software.

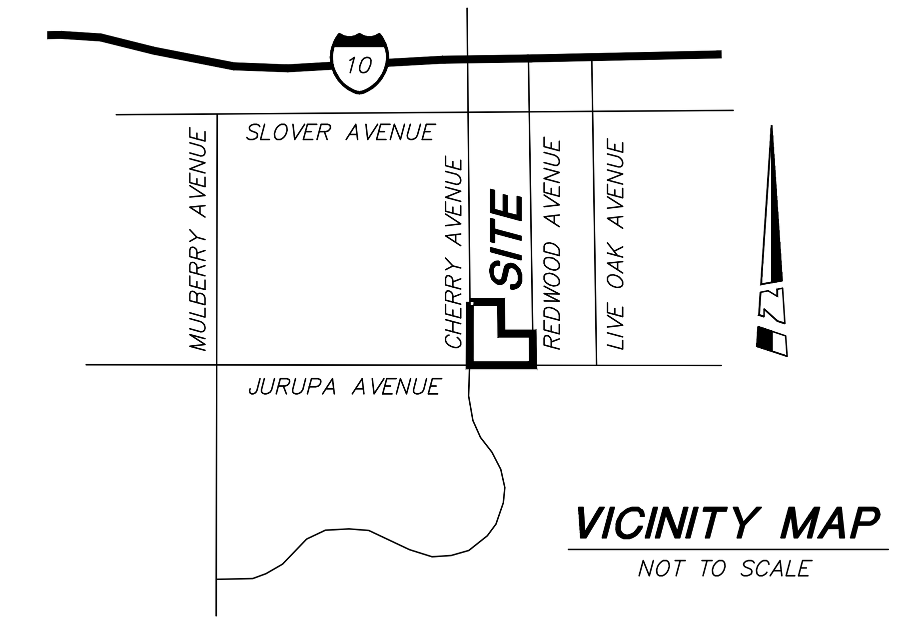
The 100-year (Q_{100}) 1-hour rainfall rate was taken from the NOAA precipitation estimates which match the isohyetal maps in the County of San Bernardino Hydrology Manual. The hydrologic soils type for the site is type "A" and was taken from the soil map in the Hydrology Manual (see Appendix C for reference maps). For the existing condition, "undeveloped" land use cover was used with an AMC of III for the 100-year storm even. For the proposed condition, a "commercial" land use was used with an AMC of III for the 100-year storm event.

Results

The underground infiltration system has been sized for water quality and detention purposes. The proposed condition resulted in a peak 100-year flow (Q_{100}) of approximately 52.0 cfs for Building 1 and approximately 32.0 cfs for Building 2. The detention system in Building 1 will release 52.0 cfs and the detention system in Building 2 will release 32.0 cfs for a total of 84 cfs discharging into Jurupa Avenue storm drain system.

All proposed drainage and storm drain facilities will be sized adequately for Q_{100}. Additional calculations will be provided in the final report including storm drain hydraulics and catch basin sizing.

Appendix A
Preliminary Hydrology Maps



VICINITY MAP
NOT TO SCALE

N

0 40 80 160 240
SCALE 1" = 80'

LEGEND

A-1 5.2 AC	TRIBUTARY AREA IN ACRES
L=600'	LENGTH OF FLOW
DP	DISCHARGE POINT
— · · —	DRAINAGE BOUNDARY
— · · · —	FLOWLINE
⇐	FLOW DIRECTION

OWNER

INDUSTRIAL VI ENTERPRISES, LLC
A DELAWARE LIMITED LIABILITY COMPANY
901 VIA PIEMONTE, SUITE 175
ONTARIO, CA 91764
PHONE: (909) 382-0033
CONTACT: KATHY HOFFER

ENGINEER

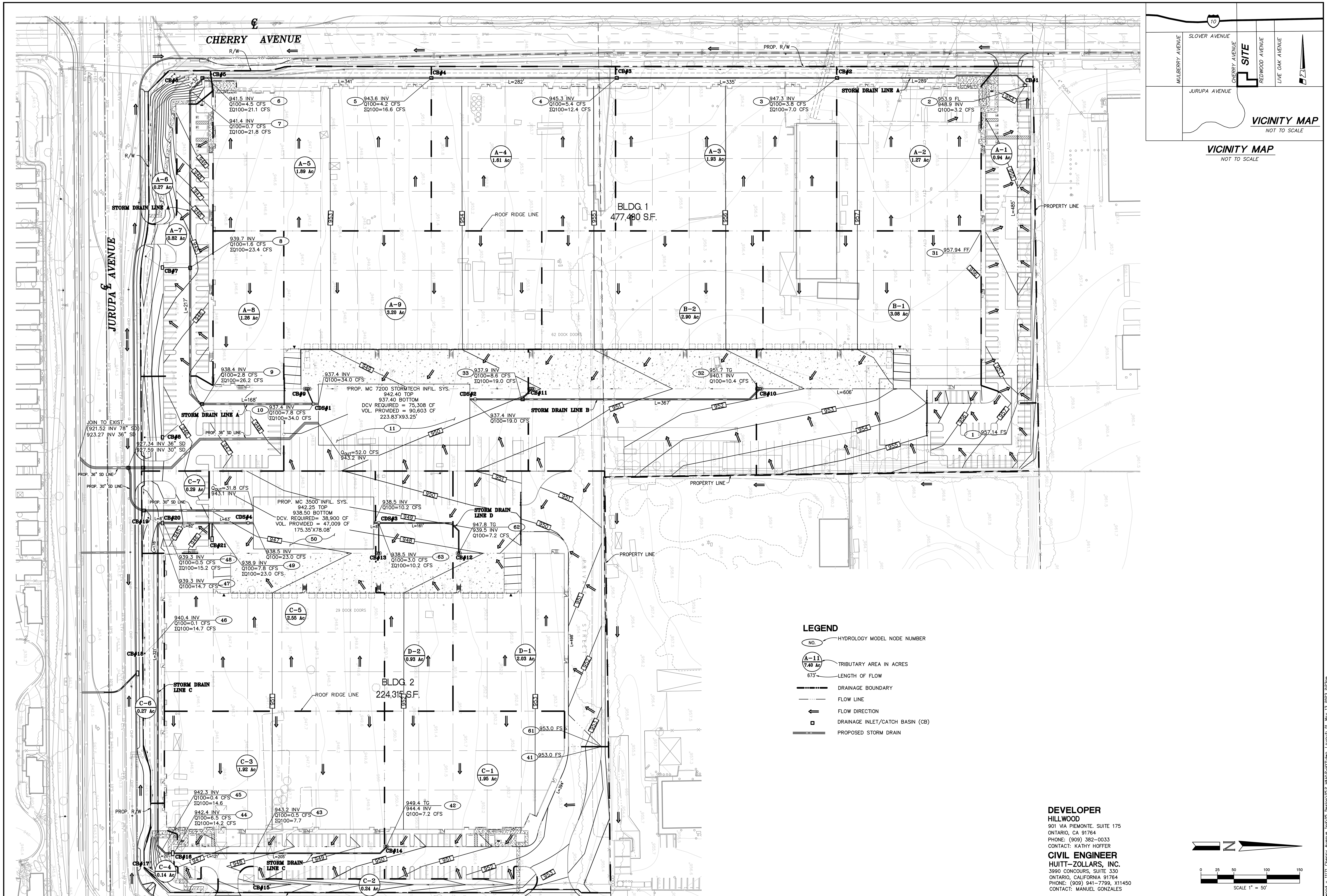
HUITT-ZOLLARS
3990 CONCOURS, SUITE 330
ONTARIO, CA 91764
PHONE: (909) 941-7799
CONTACT: JOHNNY MURAD OR
MANNY GONZALES

HUITT-ZOLLARS
Huitt-Zollars, Inc. Ontario
3990 CONCOURS, SUITE 330 • ONTARIO, CALIFORNIA 91764 • (909) 941-7799

CITY OF FONTANA

EXISTING CONDITION HYDROLOGY MAP
11171 CHERRY AVENUE IND.

SHEET 1 OF 1



REGISTERED PROFESSIONAL ENGINEER JOHNNY MURAD NO. 67512 EXPIRATION 6-30-2025 CIVIL STATE OF CALIFORNIA

PRELIMINARY HYDROLOGY MAP
FOR
HILLWOOD - CHERRY INDUSTRIAL
NE CORNER OF CHERRY AVENUE AND JURUPA AVEUNE
CITY OF FONTANA

HUITT-ZOLLARS

HUITT-ZOLLARS, INC.
3990 CONCOURSE, SUITE 330 * ONTARIO, CALIFORNIA 91764 * (909) 941-7799

DESIGNED BY	MG
DRAWN BY	HZ STAFF
CHECKED BY	J.M.
FIELD BOOK	
SHEET	1 OF 1 SHEETS
JOB NO.	R315884.01

Appendix B
100-year Rational Method Hydrologic Analysis

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                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2019 Version 9.1
       Rational Hydrology Study        Date: 05/12/23
------------------------------------------------------------------------
HILLWOOD - CHERRY AVE INDUSTRIAL
100 YEAR STORM EVENT - EXISTING CONDITION BUILDING 1
5884Q100EB1
BP
------------------------------------------------------------------------


Program License Serial Number 6530

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.310 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   656.000(Ft.)
Top (of initial area) elevation =   964.500(Ft.)
Bottom (of initial area) elevation =   951.400(Ft.)
Difference in elevation =    13.100(Ft.)
Slope =    0.01997  s(%)=       2.00
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   20.677 min.
Rainfall intensity =      2.482(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.707
Subarea runoff =      6.019(CFS)
Total initial stream area =        3.430(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)


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Process from Point/Station       2.000 to Point/Station       3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Depth of flow =   0.188(Ft.), Average velocity =   1.695(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              0.50
      2             50.00              0.00
      3            100.00              0.50
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      6.019(CFS)
  '     '     flow top width =     37.690(Ft.)
  '     '    velocity=    1.695(Ft/s)
  '     '     area =      3.551(Sq.Ft)
  '     '     Froude number =     0.973

Upstream point elevation =   951.400(Ft.)
Downstream point elevation =   949.400(Ft.)
Flow length =   390.000(Ft.)
Travel time  =    3.83 min.
Time of concentration =   24.51 min.
Depth of flow =   0.188(Ft.)
Average velocity =   1.695(Ft/s)
Total irregular channel flow =     6.019(CFS)
Irregular channel normal depth above invert elev. =   0.188(Ft.)
Average velocity of channel(s) =   1.695(Ft/s)


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Process from Point/Station       3.000 to Point/Station       3.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Time of concentration =    24.51 min.
Rainfall intensity =      2.241(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.686
Subarea runoff =      3.732(CFS) for    2.910(Ac.)
Total runoff =      9.752(CFS)
Effective area this stream =        6.34(Ac.)
Total Study Area (Main Stream No. 1) =        6.34(Ac.)
Area averaged Fm value =    0.532(In/Hr)


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Process from Point/Station       3.000 to Point/Station       4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Depth of flow =   0.181(Ft.), Average velocity =   2.968(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              0.50
      2             50.00              0.00
      3            100.00              0.50
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      9.752(CFS)
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 '     '      flow top width =     36.252(Ft.)
 '     '    velocity=    2.968(Ft/s)
 '     '      area =      3.285(Sq.Ft)
 '     '      Froude number =     1.737

Upstream point elevation =   949.400(Ft.)
Downstream point elevation =   938.700(Ft.)
Flow length =   646.000(Ft.)
Travel time  =    3.63 min.
Time of concentration =   28.14 min.
Depth of flow =   0.181(Ft.)
Average velocity =   2.968(Ft/s)
Total irregular channel flow =     9.752(CFS)
Irregular channel normal depth above invert elev. =   0.181(Ft.)
Average velocity of channel(s) =   2.968(Ft/s)


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Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      6.340(Ac.)
Runoff from this stream =      9.752(CFS)
Time of concentration =   28.14 min.
Rainfall intensity =     2.063(In/Hr)
Area averaged loss rate (Fm) =    0.5325(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   431.000(Ft.)
Top (of initial area) elevation =   960.500(Ft.)
Bottom (of initial area) elevation =   955.400(Ft.)
Difference in elevation =     5.100(Ft.)
Slope =    0.01183  s(%)=       1.18
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   19.408 min.
Rainfall intensity =      2.579(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.714
Subarea runoff =      4.861(CFS)
Total initial stream area =        2.640(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)


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Process from Point/Station       11.000 to Point/Station       12.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
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________________________________________________________________________
Depth of flow =   0.134(Ft.), Average velocity =   2.688(Ft/s)
       ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              0.50
       2             50.00              0.00
       3            100.00              0.50
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      4.862(CFS)
  '     '     flow top width =     26.899(Ft.)
  '     '    velocity=    2.688(Ft/s)
  '     '     area =      1.809(Sq.Ft)
  '     '     Froude number =     1.826

Upstream point elevation =   955.400(Ft.)
Downstream point elevation =   938.700(Ft.)
Flow length =   826.000(Ft.)
Travel time  =    5.12 min.
Time of concentration =   24.53 min.
Depth of flow =   0.134(Ft.)
Average velocity =   2.688(Ft/s)
Total irregular channel flow =     4.861(CFS)
Irregular channel normal depth above invert elev. =   0.134(Ft.)
Average velocity of channel(s) =   2.688(Ft/s)


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Process from Point/Station       4.000 to Point/Station       4.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Time of concentration =    24.53 min.
Rainfall intensity =      2.240(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.686
Subarea runoff =     14.846(CFS) for   10.180(Ac.)
Total runoff =     19.707(CFS)
Effective area this stream =       12.82(Ac.)
Total Study Area (Main Stream No. 2) =       19.16(Ac.)
Area averaged Fm value =    0.532(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       4.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     12.820(Ac.)
Runoff from this stream =     19.707(CFS)
Time of concentration =   24.53 min.
Rainfall intensity =     2.240(In/Hr)
Area averaged loss rate (Fm) =    0.5325(In/Hr)
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Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min)  (In/Hr)      (In/Hr)


1       9.75     6.340     28.14    0.532      2.063
2      19.71    12.820     24.53    0.532      2.240
Qmax(1) =
          1.000 *    1.000 *     9.752) +
          0.896 *    1.000 *    19.707) + =      27.415
Qmax(2) =
          1.116 *    0.872 *     9.752) +
          1.000 *    1.000 *    19.707) + =      29.192

Total of 2 main streams to confluence:
Flow rates before confluence point:
      10.752      20.707
Maximum flow rates at confluence using above data:
       27.415       29.192
Area of streams before confluence:
        6.340       12.820
Effective area values after confluence:
       19.160       18.347


Results of confluence:
Total flow rate =     29.192(CFS)
Time of concentration =    24.530 min.
Effective stream area after confluence  =     18.347(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.532(In/Hr)
Study area total =      19.16(Ac.)
End of computations, Total Study Area =          19.16 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  50.0
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                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2019 Version 9.1
      Rational Hydrology Study        Date: 05/12/23
------------------------------------------------------------------------
HILLWOOD - CHERRY AVE INDUSTRIAL
100 YEAR STORM EVENT - EXISTING CONDITION BUILDING 2
5884Q100EB2
BP
------------------------------------------------------------------------


Program License Serial Number 6530

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.310 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   357.000(Ft.)
Top  (of initial area) elevation =   955.400(Ft.)
Bottom  (of initial area) elevation =   950.100(Ft.)
Difference in elevation =     5.300(Ft.)
Slope =    0.01485  s(%)=       1.48
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   17.201 min.
Rainfall intensity =      2.772(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.727
Subarea runoff =     10.502(CFS)
Total initial stream area =        5.210(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)


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Process from Point/Station       21.000 to Point/Station       22.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Depth of flow =   0.192(Ft.), Average velocity =   2.864(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
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```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00               0.50
       2             50.00               0.00
       3            100.00               0.50
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =     10.502(CFS)
  '     '      flow top width =     38.301(Ft.)
  '     '    velocity=    2.864(Ft/s)
  '     '      area =      3.668(Sq.Ft)
  '     '      Froude number =     1.631

Upstream point elevation =   950.100(Ft.)
Downstream point elevation =   945.200(Ft.)
Flow length =   342.000(Ft.)
Travel time  =    1.99 min.
Time of concentration =   19.19 min.
Depth of flow =   0.192(Ft.)
Average velocity =   2.864(Ft/s)
Total irregular channel flow =    10.502(CFS)
Irregular channel normal depth above invert elev. =   0.192(Ft.)
Average velocity of channel(s) =   2.864(Ft/s)


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Process from Point/Station       22.000 to Point/Station       22.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Time of concentration =    19.19 min.
Rainfall intensity =      2.596(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.715
Subarea runoff =      8.682(CFS) for    5.120(Ac.)
Total runoff =      19.184(CFS)
Effective area this stream =       10.33(Ac.)
Total Study Area (Main Stream No. 1) =       10.33(Ac.)
Area averaged Fm value =    0.532(In/Hr)
End of computations, Total Study Area =           10.33 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  50.0
```

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                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2019 Version 9.1
       Rational Hydrology Study        Date: 05/09/23
------------------------------------------------------------------------
HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL
100 YEAR STORM EVENT - PROPOSED CONDITION BUILDING 1
5884Q100PB1
BP
------------------------------------------------------------------------


Program License Serial Number 6530

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.300 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   485.000(Ft.)
Top (of initial area) elevation =   957.140(Ft.)
Bottom (of initial area) elevation =   953.940(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.00660  s(%)=       0.66
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.847 min.
Rainfall intensity =      3.845(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff =      3.186(CFS)
Total initial stream area =        0.940(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   948.940(Ft.)
Downstream point/station elevation =   947.280(Ft.)
Pipe length  =   289.00(Ft.)   Manning's N = 0.013
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No. of pipes = 1  Required pipe flow  =     3.186(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.186(CFS)
Normal flow depth in pipe =    8.81(In.)
Flow top width inside pipe =   14.77(In.)
Critical Depth =    8.63(In.)
Pipe flow velocity =      4.25(Ft/s)
Travel time through pipe =    1.13 min.
Time of concentration (TC) =    10.98 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       3.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    10.98 min.
Rainfall intensity =      3.601(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.880
Subarea runoff =      3.821(CFS) for    1.270(Ac.)
Total runoff =      7.007(CFS)
Effective area this stream =        2.21(Ac.)
Total Study Area (Main Stream No. 1) =        2.21(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   947.280(Ft.)
Downstream point/station elevation =   945.270(Ft.)
Pipe length  =   335.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.007(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.007(CFS)
Normal flow depth in pipe =   12.88(In.)
Flow top width inside pipe =   16.24(In.)
Critical Depth =   12.30(In.)
Pipe flow velocity =      5.18(Ft/s)
Travel time through pipe =    1.08 min.
Time of concentration (TC) =    12.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       4.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
```

```
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    12.06 min.
Rainfall intensity =      3.405(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.879
Subarea runoff =      5.386(CFS) for    1.930(Ac.)
Total runoff =     12.393(CFS)
Effective area this stream =        4.14(Ac.)
Total Study Area (Main Stream No. 1) =        4.14(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   945.270(Ft.)
Downstream point/station elevation =   943.580(Ft.)
Pipe length  =   282.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    12.393(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    12.393(CFS)
Normal flow depth in pipe =   14.91(In.)
Flow top width inside pipe =   23.29(In.)
Critical Depth =   15.19(In.)
Pipe flow velocity =      6.05(Ft/s)
Travel time through pipe =    0.78 min.
Time of concentration (TC) =    12.84 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        5.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    12.84 min.
Rainfall intensity =      3.279(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff =      4.171(CFS) for    1.610(Ac.)
Total runoff =     16.564(CFS)
Effective area this stream =        5.75(Ac.)
Total Study Area (Main Stream No. 1) =        5.75(Ac.)
Area averaged Fm value =    0.079(In/Hr)


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Process from Point/Station        5.000 to Point/Station        6.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   943.580(Ft.)
Downstream point/station elevation =   941.540(Ft.)
Pipe length  =   341.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    16.564(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    16.564(CFS)
```

```
Normal flow depth in pipe =   18.61(In.)
Flow top width inside pipe =   20.03(In.)
Critical Depth =   17.61(In.)
Pipe flow velocity =      6.34(Ft/s)
Travel time through pipe =    0.90 min.
Time of concentration (TC) =    13.73 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       6.000 to Point/Station       6.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    13.73 min.
Rainfall intensity =      3.149(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff =      4.549(CFS) for    1.890(Ac.)
Total runoff =     21.113(CFS)
Effective area this stream =        7.64(Ac.)
Total Study Area (Main Stream No. 1) =        7.64(Ac.)
Area averaged Fm value =    0.079(In/Hr)


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Process from Point/Station       6.000 to Point/Station       7.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   941.540(Ft.)
Downstream point/station elevation =   941.350(Ft.)
Pipe length  =    32.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.113(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    21.113(CFS)
Normal flow depth in pipe =   19.73(In.)
Flow top width inside pipe =   23.95(In.)
Critical Depth =   19.30(In.)
Pipe flow velocity =      6.78(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =    13.81 min.


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Process from Point/Station       7.000 to Point/Station       7.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    13.81 min.
Rainfall intensity =      3.138(In/Hr) for a   100.0 year storm
```

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Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff =      0.669(CFS) for    0.270(Ac.)
Total runoff =     21.782(CFS)
Effective area this stream =        7.91(Ac.)
Total Study Area (Main Stream No. 1) =        7.91(Ac.)
Area averaged Fm value =    0.079(In/Hr)


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Process from Point/Station       7.000 to Point/Station       8.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   941.350(Ft.)
Downstream point/station elevation =   939.740(Ft.)
Pipe length  =   268.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.782(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    21.782(CFS)
Normal flow depth in pipe =   20.16(In.)
Flow top width inside pipe =   23.49(In.)
Critical Depth =   19.60(In.)
Pipe flow velocity =      6.84(Ft/s)
Travel time through pipe =    0.65 min.
Time of concentration (TC) =    14.46 min.


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Process from Point/Station       8.000 to Point/Station       8.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    14.46 min.
Rainfall intensity =      3.052(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff =      1.584(CFS) for    0.820(Ac.)
Total runoff =     23.366(CFS)
Effective area this stream =        8.73(Ac.)
Total Study Area (Main Stream No. 1) =        8.73(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       8.000 to Point/Station       9.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   939.740(Ft.)
Downstream point/station elevation =   938.400(Ft.)
Pipe length  =   217.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    23.366(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    23.366(CFS)
Normal flow depth in pipe =   21.23(In.)
Flow top width inside pipe =   22.13(In.)
Critical Depth =   20.29(In.)
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Pipe flow velocity =      6.97(Ft/s)
Travel time through pipe =    0.52 min.
Time of concentration (TC) =    14.98 min.


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Process from Point/Station       9.000 to Point/Station       9.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    14.98 min.
Rainfall intensity =      2.989(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =      2.798(CFS) for    1.260(Ac.)
Total runoff =     26.164(CFS)
Effective area this stream =        9.99(Ac.)
Total Study Area (Main Stream No. 1) =        9.99(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       9.000 to Point/Station      10.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   938.400(Ft.)
Downstream point/station elevation =   937.400(Ft.)
Pipe length  =   168.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.164(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    26.164(CFS)
Normal flow depth in pipe =   20.81(In.)
Flow top width inside pipe =   27.66(In.)
Critical Depth =   20.93(In.)
Pipe flow velocity =      7.20(Ft/s)
Travel time through pipe =    0.39 min.
Time of concentration (TC) =    15.37 min.


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Process from Point/Station      10.000 to Point/Station      10.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    15.37 min.
Rainfall intensity =      2.943(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =      7.840(CFS) for    3.200(Ac.)
```

```
Total runoff =     34.004(CFS)
Effective area this stream =       13.19(Ac.)
Total Study Area (Main Stream No. 1) =       13.19(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   937.400(Ft.)
Downstream point/station elevation =   937.380(Ft.)
Pipe length  =     8.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    34.004(CFS)
Nearest computed pipe diameter  =     39.00(In.)
Calculated individual pipe flow  =    34.004(CFS)
Normal flow depth in pipe =   26.95(In.)
Flow top width inside pipe =   36.04(In.)
Critical Depth =   22.18(In.)
Pipe flow velocity =      5.56(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    15.40 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       11.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     13.190(Ac.)
Runoff from this stream =     34.004(CFS)
Time of concentration =   15.40 min.
Rainfall intensity =     2.940(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       31.000 to Point/Station       32.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   606.000(Ft.)
Top (of initial area) elevation =   957.940(Ft.)
Bottom (of initial area) elevation =   951.660(Ft.)
Difference in elevation =     6.280(Ft.)
Slope =    0.01036  s(%)=       1.04
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.835 min.
Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff =     10.448(CFS)
Total initial stream area =       3.080(Ac.)
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Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


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Process from Point/Station       32.000 to Point/Station       33.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   940.050(Ft.)
Downstream point/station elevation =   937.900(Ft.)
Pipe length  =   367.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.448(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    10.448(CFS)
Normal flow depth in pipe =   15.02(In.)
Flow top width inside pipe =   18.95(In.)
Critical Depth =   14.45(In.)
Pipe flow velocity =      5.67(Ft/s)
Travel time through pipe =    1.08 min.
Time of concentration (TC) =    10.91 min.


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Process from Point/Station       33.000 to Point/Station       33.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    10.91 min.
Rainfall intensity =      3.615(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.880
Subarea runoff =      8.584(CFS) for    2.900(Ac.)
Total runoff =     19.031(CFS)
Effective area this stream =        5.98(Ac.)
Total Study Area (Main Stream No. 2) =       19.17(Ac.)
Area averaged Fm value =    0.079(In/Hr)


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Process from Point/Station       33.000 to Point/Station       11.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   937.900(Ft.)
Downstream point/station elevation =   937.380(Ft.)
Pipe length  =    79.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    19.031(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    19.031(CFS)
Normal flow depth in pipe =   17.58(In.)
Flow top width inside pipe =   25.74(In.)
Critical Depth =   18.31(In.)
Pipe flow velocity =      6.95(Ft/s)
Travel time through pipe =    0.19 min.
Time of concentration (TC) =    11.10 min.
```

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Process from Point/Station       11.000 to Point/Station       11.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      5.980(Ac.)
Runoff from this stream =     19.031(CFS)
Time of concentration =   11.10 min.
Rainfall intensity =     3.577(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.     (CFS)   (Ac.)       (min)  (In/Hr)      (In/Hr)


1     34.00    13.190     15.40    0.079      2.940
2     19.03     5.980     11.10    0.079      3.577
Qmax(1) =
          1.000 *    1.000 *    34.004) +
          0.818 *    1.000 *    19.031) + =      49.569
Qmax(2) =
          1.223 *    0.721 *    34.004) +
          1.000 *    1.000 *    19.031) + =      49.013

Total of 2 main streams to confluence:
Flow rates before confluence point:
      35.004      20.031
Maximum flow rates at confluence using above data:
       49.569       49.013
Area of streams before confluence:
       13.190        5.980
Effective area values after confluence:
       19.170       15.492


Results of confluence:
Total flow rate =      49.569(CFS)
Time of concentration =    15.396 min.
Effective stream area after confluence  =     19.170(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total =      19.17(Ac.)
End of computations, Total Study Area =           19.17 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number =  32.0
```

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                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2019 Version 9.1
       Rational Hydrology Study        Date: 05/09/23
------------------------------------------------------------------------
HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL
100 YEAR STORM EVENT - PROPOSED CONDITION BUILDING 2
5884Q100PB2
BP
------------------------------------------------------------------------


Program License Serial Number 6530

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.300 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       42.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   394.000(Ft.)
Top  (of initial area) elevation =   953.000(Ft.)
Bottom  (of initial area) elevation =   949.400(Ft.)
Difference in elevation =     3.600(Ft.)
Slope =    0.00914  s(%)=       0.91
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.490 min.
Rainfall intensity =      4.202(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.883
Subarea runoff =      7.237(CFS)
Total initial stream area =        1.950(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       43.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   944.400(Ft.)
Downstream point/station elevation =   943.200(Ft.)
Pipe length  =   205.00(Ft.)   Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =     7.237(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.237(CFS)
Normal flow depth in pipe =   13.36(In.)
Flow top width inside pipe =   15.75(In.)
Critical Depth =   12.50(In.)
Pipe flow velocity =      5.15(Ft/s)
Travel time through pipe =    0.66 min.
Time of concentration (TC) =     9.15 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       43.000 to Point/Station       43.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     9.15 min.
Rainfall intensity =      4.017(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      0.525(CFS) for    0.240(Ac.)
Total runoff =      7.762(CFS)
Effective area this stream =        2.19(Ac.)
Total Study Area (Main Stream No. 1) =        2.19(Ac.)
Area averaged Fm value =    0.079(In/Hr)


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Process from Point/Station       43.000 to Point/Station       44.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   943.200(Ft.)
Downstream point/station elevation =   942.400(Ft.)
Pipe length  =   121.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.762(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.762(CFS)
Normal flow depth in pipe =   13.45(In.)
Flow top width inside pipe =   15.64(In.)
Critical Depth =   12.95(In.)
Pipe flow velocity =      5.48(Ft/s)
Travel time through pipe =    0.37 min.
Time of concentration (TC) =     9.52 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       44.000 to Point/Station       44.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
```

```
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     9.52 min.
Rainfall intensity =      3.923(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      6.458(CFS) for    1.920(Ac.)
Total runoff =     14.220(CFS)
Effective area this stream =        4.11(Ac.)
Total Study Area (Main Stream No. 1) =        4.11(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       44.000 to Point/Station       45.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   942.400(Ft.)
Downstream point/station elevation =   942.300(Ft.)
Pipe length  =    20.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.220(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    14.220(CFS)
Normal flow depth in pipe =   17.63(In.)
Flow top width inside pipe =   21.20(In.)
Critical Depth =   16.29(In.)
Pipe flow velocity =      5.75(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     9.58 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       45.000 to Point/Station       45.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     9.58 min.
Rainfall intensity =      3.909(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      0.430(CFS) for    0.140(Ac.)
Total runoff =     14.650(CFS)
Effective area this stream =        4.25(Ac.)
Total Study Area (Main Stream No. 1) =        4.25(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       45.000 to Point/Station       46.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   942.300(Ft.)
Downstream point/station elevation =   940.400(Ft.)
Pipe length  =   321.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.650(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    14.650(CFS)
```

```
Normal flow depth in pipe =   16.88(In.)
Flow top width inside pipe =   21.93(In.)
Critical Depth =   16.56(In.)
Pipe flow velocity =      6.21(Ft/s)
Travel time through pipe =    0.86 min.
Time of concentration (TC) =    10.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       46.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    10.44 min.
Rainfall intensity =      3.712(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =      0.130(CFS) for    0.270(Ac.)
Total runoff =     14.780(CFS)
Effective area this stream =        4.52(Ac.)
Total Study Area (Main Stream No. 1) =        4.52(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       47.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   940.400(Ft.)
Downstream point/station elevation =   939.340(Ft.)
Pipe length  =   178.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.780(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    14.780(CFS)
Normal flow depth in pipe =   16.95(In.)
Flow top width inside pipe =   21.87(In.)
Critical Depth =   16.63(In.)
Pipe flow velocity =      6.23(Ft/s)
Travel time through pipe =    0.48 min.
Time of concentration (TC) =    10.92 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       47.000 to Point/Station       48.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   939.340(Ft.)
Downstream point/station elevation =   939.300(Ft.)
Pipe length  =     8.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.780(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    14.780(CFS)
Normal flow depth in pipe =   18.21(In.)
Flow top width inside pipe =   20.54(In.)
Critical Depth =   16.63(In.)
Pipe flow velocity =      5.78(Ft/s)
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```
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    10.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       48.000 to Point/Station       48.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    10.94 min.
Rainfall intensity =      3.609(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.880
Subarea runoff =      0.504(CFS) for    0.290(Ac.)
Total runoff =     15.284(CFS)
Effective area this stream =        4.81(Ac.)
Total Study Area (Main Stream No. 1) =        4.81(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       48.000 to Point/Station       49.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   939.300(Ft.)
Downstream point/station elevation =   938.900(Ft.)
Pipe length  =    82.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.284(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    15.284(CFS)
Normal flow depth in pipe =   18.98(In.)
Flow top width inside pipe =   19.52(In.)
Critical Depth =   16.91(In.)
Pipe flow velocity =      5.73(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =    11.18 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       49.000 to Point/Station       49.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =    11.18 min.
Rainfall intensity =      3.563(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.880
Subarea runoff =      7.795(CFS) for    2.550(Ac.)
Total runoff =     23.080(CFS)
```

```
Effective area this stream =        7.36(Ac.)
Total Study Area (Main Stream No. 1) =        7.36(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       49.000 to Point/Station       50.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   938.900(Ft.)
Downstream point/station elevation =   938.500(Ft.)
Pipe length  =    63.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    23.080(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    23.080(CFS)
Normal flow depth in pipe =   20.72(In.)
Flow top width inside pipe =   22.82(In.)
Critical Depth =   20.19(In.)
Pipe flow velocity =      7.05(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =    11.33 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      7.360(Ac.)
Runoff from this stream =     23.080(CFS)
Time of concentration =   11.33 min.
Rainfall intensity =     3.535(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       62.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   498.000(Ft.)
Top (of initial area) elevation =   953.000(Ft.)
Bottom (of initial area) elevation =   947.800(Ft.)
Difference in elevation =     5.200(Ft.)
Slope =    0.01044  s(%)=       1.04
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.078 min.
Rainfall intensity =      4.037(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff =      7.232(CFS)
Total initial stream area =       2.030(Ac.)
Pervious area fraction = 0.100
```

```
Initial area Fm value =    0.079(In/Hr)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       62.000 to Point/Station       63.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   939.500(Ft.)
Downstream point/station elevation =   938.520(Ft.)
Pipe length  =   161.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.232(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.232(CFS)
Normal flow depth in pipe =   13.13(In.)
Flow top width inside pipe =   16.00(In.)
Critical Depth =   12.50(In.)
Pipe flow velocity =      5.23(Ft/s)
Travel time through pipe =    0.51 min.
Time of concentration (TC) =     9.59 min.


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       63.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     9.59 min.
Rainfall intensity =      3.906(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      2.964(CFS) for    0.930(Ac.)
Total runoff =     10.196(CFS)
Effective area this stream =        2.96(Ac.)
Total Study Area (Main Stream No. 2) =       10.32(Ac.)
Area averaged Fm value =    0.079(In/Hr)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       50.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   938.520(Ft.)
Downstream point/station elevation =   938.500(Ft.)
Pipe length  =     7.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.196(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    10.196(CFS)
Normal flow depth in pipe =   17.34(In.)
Flow top width inside pipe =   21.49(In.)
Critical Depth =   13.71(In.)
Pipe flow velocity =      4.19(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     9.62 min.


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Process from Point/Station       50.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
```

```
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      2.960(Ac.)
Runoff from this stream =     10.196(CFS)
Time of concentration =    9.62 min.
Rainfall intensity =     3.899(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area     TC     Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)        (min)  (In/Hr)      (In/Hr)


1     23.08     7.360     11.33    0.079      3.535
2     10.20     2.960      9.62    0.079      3.899
Qmax(1) =
          1.000 *    1.000 *    23.080) +
          0.905 *    1.000 *    10.196) + =      32.304
Qmax(2) =
          1.105 *    0.849 *    23.080) +
          1.000 *    1.000 *    10.196) + =      31.862

Total of 2 main streams to confluence:
Flow rates before confluence point:
      24.080      11.196
Maximum flow rates at confluence using above data:
       32.304       31.862
Area of streams before confluence:
        7.360        2.960
Effective area values after confluence:
       10.320        9.211


Results of confluence:
Total flow rate =      32.304(CFS)
Time of concentration =    11.328 min.
Effective stream area after confluence  =     10.320(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total =      10.32(Ac.)
End of computations, Total Study Area =           10.32 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number =  32.0
```

Appendix C
100-year Unit Hydrograph

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 05/12/23

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6530

HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL
100 YEAR STORM EVENT - EXISTING UNIT HYDROGRAPH BUILDING 1
5884Q100EUHB1
BP

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
19.16	1	1.31
Rainfall data for year 100		
19.16	6	3.09
Rainfall data for year 100		
19.16	24	5.64

+++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
50.0	70.0	19.16	1.000	0.532	1.000	0.532

Area-averaged adjusted loss rate Fm (In/Hr) = 0.532

********* Area-Averaged low loss rate fraction, Yb **********

Area Area SCS CN SCS CN S Pervious

(Ac.)	Fract	(AMC2)	(AMC3)		Yield Fr
19.16	1.000	50.0	70.0	4.29	0.447

Area-averaged catchment yield fraction, Y = 0.447
Area-averaged low loss fraction, Yb = 0.553
User entry of time of concentration = 0.409 (hours)
+++
Watershed area = 19.16(Ac.)
Catchment Lag time = 0.327 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 25.4686
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.532(In/Hr)
Average low loss rate fraction (Yb) = 0.553 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.485(In)
Computed peak 30-minute rainfall = 0.993(In)
Specified peak 1-hour rainfall = 1.310(In)
Computed peak 3-hour rainfall = 2.217(In)
Specified peak 6-hour rainfall = 3.090(In)
Specified peak 24-hour rainfall = 5.640(In)

Rainfall depth area reduction factors:
Using a total area of 19.16(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.484(In)
30-minute factor = 0.999 Adjusted rainfall = 0.992(In)
1-hour factor = 0.999 Adjusted rainfall = 1.309(In)
3-hour factor = 1.000 Adjusted rainfall = 2.217(In)
6-hour factor = 1.000 Adjusted rainfall = 3.090(In)
24-hour factor = 1.000 Adjusted rainfall = 5.640(In)

U n i t H y d r o g r a p h
++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 231.72 (CFS))	
1	1.583	3.669
2	7.902	14.642
3	21.613	31.769
4	40.124	42.893
5	62.428	51.681
6	78.079	36.266
7	88.077	23.168
8	93.289	12.075
9	96.495	7.431
10	98.072	3.654
11	98.614	1.254
12	99.072	1.062
13	99.530	1.062
14	100.000	0.531

Total soil rain loss = 2.83(In)
Total effective rainfall = 2.81(In)
Peak flow rate in flood hydrograph = 32.50(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0 10.0 20.0 30.0 40.0
0+ 5	0.0001	0.01	Q
0+10	0.0006	0.07	Q
0+15	0.0019	0.19	Q
0+20	0.0043	0.35	Q
0+25	0.0081	0.55	Q
0+30	0.0129	0.69	Q
0+35	0.0183	0.78	Q
0+40	0.0240	0.83	Q
0+45	0.0299	0.86	Q
0+50	0.0360	0.88	Q
0+55	0.0421	0.88	Q
1+ 0	0.0482	0.89	Q
1+ 5	0.0544	0.90	Q
1+10	0.0606	0.90	Q
1+15	0.0669	0.91	Q
1+20	0.0731	0.91	Q
1+25	0.0794	0.91	Q
1+30	0.0857	0.91	Q
1+35	0.0920	0.92	Q
1+40	0.0983	0.92	Q
1+45	0.1047	0.92	Q
1+50	0.1111	0.93	Q
1+55	0.1175	0.93	QV
2+ 0	0.1239	0.93	QV
2+ 5	0.1304	0.94	QV
2+10	0.1368	0.94	QV
2+15	0.1433	0.94	QV
2+20	0.1498	0.94	QV
2+25	0.1563	0.95	QV
2+30	0.1629	0.95	QV
2+35	0.1695	0.95	QV
2+40	0.1761	0.96	QV
2+45	0.1827	0.96	QV
2+50	0.1893	0.96	QV
2+55	0.1960	0.97	QV
3+ 0	0.2027	0.97	QV
3+ 5	0.2094	0.97	QV
3+10	0.2161	0.98	QV
3+15	0.2229	0.98	QV
3+20	0.2297	0.99	Q V
3+25	0.2365	0.99	Q V
3+30	0.2433	0.99	Q V
3+35	0.2502	1.00	Q V
3+40	0.2570	1.00	Q V
3+45	0.2640	1.00	|QV
3+50	0.2709	1.01	|QV
3+55	0.2779	1.01	|QV
4+ 0	0.2848	1.01	|QV
4+ 5	0.2919	1.02	|QV
4+10	0.2989	1.02	|QV
4+15	0.3060	1.03	|QV
4+20	0.3131	1.03	|QV
4+25	0.3202	1.03	|QV
4+30	0.3273	1.04	|QV
4+35	0.3345	1.04	|QV

4+40	0.3417	1.05	Q V			
4+45	0.3490	1.05	Q V			
4+50	0.3562	1.06	Q V			
4+55	0.3635	1.06	Q V			
5+ 0	0.3709	1.06	Q V			
5+ 5	0.3782	1.07	Q V			
5+10	0.3856	1.07	Q V			
5+15	0.3930	1.08	Q V			
5+20	0.4005	1.08	Q V			
5+25	0.4080	1.09	Q V			
5+30	0.4155	1.09	Q V			
5+35	0.4230	1.10	Q V			
5+40	0.4306	1.10	Q V			
5+45	0.4382	1.11	Q V			
5+50	0.4459	1.11	Q V			
5+55	0.4536	1.12	Q V			
6+ 0	0.4613	1.12	Q V			
6+ 5	0.4690	1.13	Q V			
6+10	0.4768	1.13	Q V			
6+15	0.4847	1.14	Q V			
6+20	0.4925	1.14	Q V			
6+25	0.5004	1.15	Q V			
6+30	0.5084	1.15	Q V			
6+35	0.5163	1.16	Q V			
6+40	0.5243	1.16	Q V			
6+45	0.5324	1.17	Q V			
6+50	0.5405	1.17	Q V			
6+55	0.5486	1.18	Q V			
7+ 0	0.5568	1.19	Q V			
7+ 5	0.5650	1.19	Q V			
7+10	0.5733	1.20	Q V			
7+15	0.5816	1.20	Q V			
7+20	0.5899	1.21	Q V			
7+25	0.5983	1.22	Q V			
7+30	0.6067	1.22	Q V			
7+35	0.6152	1.23	Q V			
7+40	0.6237	1.24	Q V			
7+45	0.6323	1.24	Q V			
7+50	0.6409	1.25	Q V			
7+55	0.6496	1.26	Q V			
8+ 0	0.6583	1.26	Q V			
8+ 5	0.6670	1.27	Q V			
8+10	0.6758	1.28	Q V			
8+15	0.6847	1.29	Q V			
8+20	0.6936	1.29	Q V			
8+25	0.7026	1.30	Q V			
8+30	0.7116	1.31	Q V			
8+35	0.7207	1.32	Q V			
8+40	0.7298	1.33	Q V			
8+45	0.7390	1.33	Q V			
8+50	0.7482	1.34	Q V			
8+55	0.7575	1.35	Q V			
9+ 0	0.7669	1.36	Q V			
9+ 5	0.7763	1.37	Q V			
9+10	0.7857	1.38	Q V			
9+15	0.7953	1.39	Q V			
9+20	0.8049	1.39	Q V			
9+25	0.8146	1.40	Q V			
9+30	0.8243	1.41	Q V			
9+35	0.8341	1.42	Q V			
9+40	0.8440	1.43	Q V			
9+45	0.8539	1.44	Q V			
9+50	0.8639	1.45	Q V			

9+55	0.8740	1.46	Q V				
10+ 0	0.8842	1.47	Q V				
10+ 5	0.8944	1.49	Q V				
10+10	0.9047	1.50	Q V				
10+15	0.9151	1.51	Q V				
10+20	0.9256	1.52	Q V				
10+25	0.9361	1.53	Q V				
10+30	0.9467	1.54	Q V				
10+35	0.9575	1.56	Q V				
10+40	0.9683	1.57	Q V				
10+45	0.9792	1.58	Q V				
10+50	0.9902	1.60	Q V				
10+55	1.0012	1.61	Q V				
11+ 0	1.0124	1.62	Q V				
11+ 5	1.0237	1.64	Q V				
11+10	1.0351	1.65	Q V				
11+15	1.0466	1.67	Q V				
11+20	1.0582	1.68	Q V				
11+25	1.0699	1.70	Q V				
11+30	1.0817	1.72	Q V				
11+35	1.0936	1.73	Q V				
11+40	1.1056	1.75	Q V				
11+45	1.1178	1.77	Q V				
11+50	1.1301	1.78	Q	V			
11+55	1.1425	1.80	Q	V			
12+ 0	1.1551	1.82	Q	V			
12+ 5	1.1678	1.85	Q	V			
12+10	1.1807	1.88	Q	V			
12+15	1.1940	1.93	Q	V			
12+20	1.2077	1.99	Q	V			
12+25	1.2218	2.05	Q	V			
12+30	1.2363	2.11	Q	V			
12+35	1.2512	2.15	Q	V			
12+40	1.2662	2.19	Q	V			
12+45	1.2815	2.22	Q	V			
12+50	1.2970	2.25	Q	V			
12+55	1.3127	2.28	Q	V			
13+ 0	1.3286	2.31	Q	V			
13+ 5	1.3447	2.34	Q	V			
13+10	1.3611	2.37	Q	V			
13+15	1.3776	2.40	Q	V			
13+20	1.3944	2.44	Q	V			
13+25	1.4115	2.47	Q	V			
13+30	1.4288	2.51	Q	V			
13+35	1.4463	2.55	Q	V			
13+40	1.4641	2.59	Q	V			
13+45	1.4823	2.63	Q	V			
13+50	1.5007	2.68	Q	V			
13+55	1.5194	2.72	Q	V			
14+ 0	1.5385	2.77	Q	V			
14+ 5	1.5580	2.82	Q	V			
14+10	1.5778	2.88	Q	V			
14+15	1.5980	2.94	Q	V			
14+20	1.6186	3.00	Q	V			
14+25	1.6397	3.06	Q	V			
14+30	1.6613	3.13	Q	V			
14+35	1.6834	3.21	Q	V			
14+40	1.7061	3.29	Q	V			
14+45	1.7293	3.38	Q	V			
14+50	1.7532	3.47	Q	V			
14+55	1.7778	3.57	Q	V			
15+ 0	1.8031	3.68	Q	V			
15+ 5	1.8293	3.80	Q	V			

15+10	1.8564	3.93
15+15	1.8845	4.08
15+20	1.9138	4.25
15+25	1.9442	4.43
15+30	1.9758	4.58
15+35	2.0083	4.71
15+40	2.0416	4.84
15+45	2.0760	5.00
15+50	2.1126	5.31
15+55	2.1533	5.91
16+ 0	2.2023	7.12
16+ 5	2.2751	10.58
16+10	2.3936	17.20
16+15	2.5705	25.68
16+20	2.7813	30.61
16+25	3.0051	32.50
16+30	3.1744	24.59
16+35	3.2950	17.50
16+40	3.3759	11.75
16+45	3.4368	8.85
16+50	3.4824	6.62
16+55	3.5181	5.18
17+ 0	3.5505	4.71
17+ 5	3.5806	4.36
17+10	3.6072	3.87
17+15	3.6308	3.43
17+20	3.6532	3.24
17+25	3.6745	3.09
17+30	3.6949	2.96
17+35	3.7144	2.84
17+40	3.7333	2.74
17+45	3.7515	2.64
17+50	3.7691	2.56
17+55	3.7862	2.48
18+ 0	3.8028	2.41
18+ 5	3.8189	2.34
18+10	3.8346	2.27
18+15	3.8496	2.19
18+20	3.8641	2.10
18+25	3.8779	2.01
18+30	3.8912	1.93
18+35	3.9041	1.87
18+40	3.9166	1.82
18+45	3.9288	1.77
18+50	3.9408	1.74
18+55	3.9525	1.70
19+ 0	3.9640	1.67
19+ 5	3.9753	1.64
19+10	3.9864	1.61
19+15	3.9973	1.58
19+20	4.0080	1.56
19+25	4.0186	1.53
19+30	4.0290	1.51
19+35	4.0392	1.49
19+40	4.0493	1.46
19+45	4.0592	1.44
19+50	4.0690	1.42
19+55	4.0787	1.40
20+ 0	4.0882	1.39
20+ 5	4.0976	1.37
20+10	4.1069	1.35
20+15	4.1161	1.33
20+20	4.1252	1.32

```
   20+25       4.1342      1.30   |Q          |          |          |     V    |
   20+30       4.1430      1.29   |Q          |          |          |      V   |
   20+35       4.1518      1.27   |Q          |          |          |      V   |
   20+40       4.1604      1.26   |Q          |          |          |      V   |
   20+45       4.1690      1.24   |Q          |          |          |      V   |
   20+50       4.1775      1.23   |Q          |          |          |      V   |
   20+55       4.1859      1.22   |Q          |          |          |      V   |
   21+ 0       4.1942      1.20   |Q          |          |          |      V   |
   21+ 5       4.2024      1.19   |Q          |          |          |      V   |
   21+10       4.2105      1.18   |Q          |          |          |      V   |
   21+15       4.2186      1.17   |Q          |          |          |      V   |
   21+20       4.2265      1.16   |Q          |          |          |      V   |
   21+25       4.2344      1.15   |Q          |          |          |      V   |
   21+30       4.2423      1.14   |Q          |          |          |      V   |
   21+35       4.2500      1.13   |Q          |          |          |      V   |
   21+40       4.2577      1.12   |Q          |          |          |       V  |
   21+45       4.2653      1.11   |Q          |          |          |       V  |
   21+50       4.2729      1.10   |Q          |          |          |       V  |
   21+55       4.2803      1.09   |Q          |          |          |       V  |
   22+ 0       4.2878      1.08   |Q          |          |          |       V  |
   22+ 5       4.2951      1.07   |Q          |          |          |       V  |
   22+10       4.3024      1.06   |Q          |          |          |       V  |
   22+15       4.3097      1.05   |Q          |          |          |       V  |
   22+20       4.3168      1.04   |Q          |          |          |       V  |
   22+25       4.3240      1.03   |Q          |          |          |       V  |
   22+30       4.3310      1.03   |Q          |          |          |       V  |
   22+35       4.3380      1.02   |Q          |          |          |       V  |
   22+40       4.3450      1.01   |Q          |          |          |       V  |
   22+45       4.3519      1.00   |Q          |          |          |       V  |
   22+50       4.3588      1.00   Q           |          |          |       V  |
   22+55       4.3656      0.99   Q           |          |          |        V|
   23+ 0       4.3723      0.98   Q           |          |          |        V|
   23+ 5       4.3790      0.97   Q           |          |          |        V|
   23+10       4.3857      0.97   Q           |          |          |        V|
   23+15       4.3923      0.96   Q           |          |          |        V|
   23+20       4.3989      0.95   Q           |          |          |        V|
   23+25       4.4054      0.95   Q           |          |          |        V|
   23+30       4.4119      0.94   Q           |          |          |        V|
   23+35       4.4183      0.94   Q           |          |          |        V|
   23+40       4.4247      0.93   Q           |          |          |        V|
   23+45       4.4311      0.92   Q           |          |          |        V|
   23+50       4.4374      0.92   Q           |          |          |        V|
   23+55       4.4437      0.91   Q           |          |          |        V|
   24+ 0       4.4499      0.91   Q           |          |          |        V|
   24+ 5       4.4560      0.89   Q           |          |          |        V|
   24+10       4.4617      0.83   Q           |          |          |        V|
   24+15       4.4665      0.70   Q           |          |          |        V|
   24+20       4.4702      0.53   Q           |          |          |        V|
   24+25       4.4725      0.33   Q           |          |          |        V|
   24+30       4.4738      0.19   Q           |          |          |        V|
   24+35       4.4746      0.10   Q           |          |          |        V|
   24+40       4.4750      0.06   Q           |          |          |        V|
   24+45       4.4752      0.03   Q           |          |          |        V|
   24+50       4.4753      0.02   Q           |          |          |        V|
   24+55       4.4753      0.01   Q           |          |          |        V|
   25+ 0       4.4754      0.01   Q           |          |          |        V|
   25+ 5       4.4754      0.00   Q           |          |          |         V
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 05/12/23

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6530

HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL
100 YEAR STORM EVENT - EXISTING UNIT HYDROGRAPH BUILDING 2
5884Q100EUHB2
BP

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
10.33	1	1.31
Rainfall data for year 100		
10.33	6	3.09
Rainfall data for year 100		
10.33	24	5.64

+++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
50.0	70.0	10.33	1.000	0.532	1.000	0.532

Area-averaged adjusted loss rate Fm (In/Hr) = 0.532

********* Area-Averaged low loss rate fraction, Yb **********

Area   Area   SCS CN   SCS CN   S   Pervious

(Ac.)	Fract	(AMC2)	(AMC3)		Yield Fr
10.33	1.000	50.0	70.0	4.29	0.447

Area-averaged catchment yield fraction, Y = 0.447
Area-averaged low loss fraction, Yb = 0.553
User entry of time of concentration = 0.319 (hours)
++
Watershed area = 10.33(Ac.)
Catchment Lag time = 0.255 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 32.6541
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.532(In/Hr)
Average low loss rate fraction (Yb) = 0.553 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.485(In)
Computed peak 30-minute rainfall = 0.993(In)
Specified peak 1-hour rainfall = 1.310(In)
Computed peak 3-hour rainfall = 2.217(In)
Specified peak 6-hour rainfall = 3.090(In)
Specified peak 24-hour rainfall = 5.640(In)

Rainfall depth area reduction factors:
Using a total area of 10.33(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000	Adjusted rainfall = 0.485(In)
30-minute factor = 1.000	Adjusted rainfall = 0.992(In)
1-hour factor = 1.000	Adjusted rainfall = 1.309(In)
3-hour factor = 1.000	Adjusted rainfall = 2.217(In)
6-hour factor = 1.000	Adjusted rainfall = 3.090(In)
24-hour factor = 1.000	Adjusted rainfall = 5.640(In)

U n i t H y d r o g r a p h

+++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 124.93 (CFS))	
1	2.200	2.749
2	13.160	13.692
3	34.227	26.319
4	62.018	34.718
5	81.132	23.879
6	91.160	12.528
7	96.053	6.113
8	98.135	2.601
9	98.796	0.826
10	99.384	0.734
11	100.000	0.367

Total soil rain loss = 2.83(In)
Total effective rainfall = 2.81(In)
Peak flow rate in flood hydrograph = 20.81(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in   5   Minute intervals ((CFS))

```
     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        7.5      15.0      22.5      30.0
-----------------------------------------------------------------------
  0+ 5       0.0001      0.01  Q          |         |         |         |
  0+10       0.0005      0.06  Q          |         |         |         |
  0+15       0.0016      0.16  Q          |         |         |         |
  0+20       0.0037      0.30  Q          |         |         |         |
  0+25       0.0063      0.39  Q          |         |         |         |
  0+30       0.0093      0.44  Q          |         |         |         |
  0+35       0.0125      0.46  Q          |         |         |         |
  0+40       0.0157      0.47  Q          |         |         |         |
  0+45       0.0190      0.48  Q          |         |         |         |
  0+50       0.0223      0.48  Q          |         |         |         |
  0+55       0.0257      0.48  Q          |         |         |         |
  1+ 0       0.0290      0.48  Q          |         |         |         |
  1+ 5       0.0324      0.49  Q          |         |         |         |
  1+10       0.0357      0.49  Q          |         |         |         |
  1+15       0.0391      0.49  Q          |         |         |         |
  1+20       0.0425      0.49  Q          |         |         |         |
  1+25       0.0459      0.49  Q          |         |         |         |
  1+30       0.0493      0.49  Q          |         |         |         |
  1+35       0.0527      0.50  Q          |         |         |         |
  1+40       0.0561      0.50  Q          |         |         |         |
  1+45       0.0595      0.50  Q          |         |         |         |
  1+50       0.0630      0.50  QV         |         |         |         |
  1+55       0.0664      0.50  QV         |         |         |         |
  2+ 0       0.0699      0.50  QV         |         |         |         |
  2+ 5       0.0734      0.51  QV         |         |         |         |
  2+10       0.0769      0.51  QV         |         |         |         |
  2+15       0.0804      0.51  QV         |         |         |         |
  2+20       0.0839      0.51  QV         |         |         |         |
  2+25       0.0874      0.51  QV         |         |         |         |
  2+30       0.0910      0.51  QV         |         |         |         |
  2+35       0.0945      0.52  QV         |         |         |         |
  2+40       0.0981      0.52  QV         |         |         |         |
  2+45       0.1017      0.52  QV         |         |         |         |
  2+50       0.1053      0.52  QV         |         |         |         |
  2+55       0.1089      0.52  QV         |         |         |         |
  3+ 0       0.1125      0.52  QV         |         |         |         |
  3+ 5       0.1161      0.53  QV         |         |         |         |
  3+10       0.1197      0.53  QV         |         |         |         |
  3+15       0.1234      0.53  Q V        |         |         |         |
  3+20       0.1271      0.53  Q V        |         |         |         |
  3+25       0.1307      0.53  Q V        |         |         |         |
  3+30       0.1344      0.54  Q V        |         |         |         |
  3+35       0.1381      0.54  Q V        |         |         |         |
  3+40       0.1419      0.54  Q V        |         |         |         |
  3+45       0.1456      0.54  Q V        |         |         |         |
  3+50       0.1493      0.54  Q V        |         |         |         |
  3+55       0.1531      0.55  Q V        |         |         |         |
  4+ 0       0.1569      0.55  Q V        |         |         |         |
  4+ 5       0.1607      0.55  Q V        |         |         |         |
  4+10       0.1645      0.55  Q V        |         |         |         |
  4+15       0.1683      0.55  Q V        |         |         |         |
  4+20       0.1721      0.56  Q V        |         |         |         |
  4+25       0.1760      0.56  Q V        |         |         |         |
  4+30       0.1799      0.56  Q V        |         |         |         |
  4+35       0.1837      0.56  Q  V       |         |         |         |
  4+40       0.1876      0.57  Q  V       |         |         |         |
  4+45       0.1916      0.57  Q  V       |         |         |         |
  4+50       0.1955      0.57  Q  V       |         |         |         |
```

4+55	0.1994	0.57	Q V
5+ 0	0.2034	0.58	Q V
5+ 5	0.2074	0.58	Q V
5+10	0.2114	0.58	Q V
5+15	0.2154	0.58	Q V
5+20	0.2194	0.59	Q V
5+25	0.2235	0.59	Q V
5+30	0.2275	0.59	Q V
5+35	0.2316	0.59	Q V
5+40	0.2357	0.60	Q V
5+45	0.2398	0.60	Q V
5+50	0.2440	0.60	Q V
5+55	0.2481	0.60	Q V
6+ 0	0.2523	0.61	Q V
6+ 5	0.2565	0.61	Q V
6+10	0.2607	0.61	Q V
6+15	0.2649	0.61	Q V
6+20	0.2692	0.62	Q V
6+25	0.2735	0.62	Q V
6+30	0.2778	0.62	Q V
6+35	0.2821	0.63	Q V
6+40	0.2864	0.63	Q V
6+45	0.2908	0.63	Q V
6+50	0.2951	0.64	Q V
6+55	0.2995	0.64	Q V
7+ 0	0.3040	0.64	Q V
7+ 5	0.3084	0.65	Q V
7+10	0.3129	0.65	Q V
7+15	0.3174	0.65	Q V
7+20	0.3219	0.66	Q V
7+25	0.3264	0.66	Q V
7+30	0.3310	0.66	Q V
7+35	0.3356	0.67	Q V
7+40	0.3402	0.67	Q V
7+45	0.3448	0.67	Q V
7+50	0.3495	0.68	Q V
7+55	0.3542	0.68	Q V
8+ 0	0.3589	0.68	Q V
8+ 5	0.3636	0.69	Q V
8+10	0.3684	0.69	Q V
8+15	0.3732	0.70	Q V
8+20	0.3780	0.70	Q V
8+25	0.3829	0.70	Q V
8+30	0.3878	0.71	Q V
8+35	0.3927	0.71	Q V
8+40	0.3976	0.72	Q V
8+45	0.4026	0.72	Q V
8+50	0.4076	0.73	Q V
8+55	0.4126	0.73	Q V
9+ 0	0.4177	0.74	Q V
9+ 5	0.4228	0.74	Q V
9+10	0.4279	0.75	Q V
9+15	0.4331	0.75	|Q V
9+20	0.4383	0.76	|Q V
9+25	0.4436	0.76	|Q V
9+30	0.4488	0.77	|Q V
9+35	0.4542	0.77	|Q V
9+40	0.4595	0.78	|Q V
9+45	0.4649	0.78	|Q V
9+50	0.4703	0.79	|Q V
9+55	0.4758	0.79	|Q V
10+ 0	0.4813	0.80	|Q V
10+ 5	0.4868	0.81	|Q V

```
10+10       0.4924      0.81   |Q      V |         |         |         |
10+15       0.4981      0.82   |Q      V |         |         |         |
10+20       0.5037      0.82   |Q      V |         |         |         |
10+25       0.5095      0.83   |Q      V |         |         |         |
10+30       0.5152      0.84   |Q      V |         |         |         |
10+35       0.5211      0.84   |Q      V |         |         |         |
10+40       0.5269      0.85   |Q      V |         |         |         |
10+45       0.5328      0.86   |Q      V |         |         |         |
10+50       0.5388      0.87   |Q      V |         |         |         |
10+55       0.5448      0.87   |Q       V|         |         |         |
11+ 0       0.5509      0.88   |Q       V|         |         |         |
11+ 5       0.5570      0.89   |Q       V|         |         |         |
11+10       0.5632      0.90   |Q       V|         |         |         |
11+15       0.5694      0.91   |Q       V|         |         |         |
11+20       0.5757      0.91   |Q       V|         |         |         |
11+25       0.5821      0.92   |Q       V|         |         |         |
11+30       0.5885      0.93   |Q       V|         |         |         |
11+35       0.5950      0.94   |Q       V|         |         |         |
11+40       0.6015      0.95   |Q       V|         |         |         |
11+45       0.6082      0.96   |Q        V         |         |         |
11+50       0.6148      0.97   |Q        V         |         |         |
11+55       0.6216      0.98   |Q        V         |         |         |
12+ 0       0.6284      0.99   |Q        V         |         |         |
12+ 5       0.6353      1.00   |Q        V         |         |         |
12+10       0.6424      1.03   |Q        V         |         |         |
12+15       0.6497      1.06   |Q        V         |         |         |
12+20       0.6573      1.10   |Q        V         |         |         |
12+25       0.6652      1.14   |Q        |V        |         |         |
12+30       0.6732      1.16   |Q        |V        |         |         |
12+35       0.6813      1.18   |Q        |V        |         |         |
12+40       0.6895      1.20   |Q        |V        |         |         |
12+45       0.6979      1.21   |Q        |V        |         |         |
12+50       0.7063      1.23   |Q        |V        |         |         |
12+55       0.7149      1.24   |Q        |V        |         |         |
13+ 0       0.7236      1.26   |Q        | V       |         |         |
13+ 5       0.7324      1.28   |Q        | V       |         |         |
13+10       0.7413      1.29   |Q        | V       |         |         |
13+15       0.7503      1.31   |Q        | V       |         |         |
13+20       0.7594      1.33   |Q        | V       |         |         |
13+25       0.7687      1.35   |Q        | V       |         |         |
13+30       0.7782      1.37   |Q        | V       |         |         |
13+35       0.7878      1.39   |Q        |  V      |         |         |
13+40       0.7975      1.41   |Q        |  V      |         |         |
13+45       0.8074      1.44   |Q        |  V      |         |         |
13+50       0.8175      1.46   |Q        |  V      |         |         |
13+55       0.8277      1.49   |Q        |  V      |         |         |
14+ 0       0.8382      1.52   | Q       |  V      |         |         |
14+ 5       0.8488      1.55   | Q       |   V     |         |         |
14+10       0.8597      1.58   | Q       |   V     |         |         |
14+15       0.8708      1.61   | Q       |   V     |         |         |
14+20       0.8821      1.65   | Q       |   V     |         |         |
14+25       0.8937      1.68   | Q       |   V     |         |         |
14+30       0.9056      1.72   | Q       |    V    |         |         |
14+35       0.9177      1.76   | Q       |    V    |         |         |
14+40       0.9302      1.81   | Q       |    V    |         |         |
14+45       0.9430      1.86   | Q       |    V    |         |         |
14+50       0.9562      1.91   | Q       |    V    |         |         |
14+55       0.9697      1.97   | Q       |     V   |         |         |
15+ 0       0.9838      2.04   | Q       |     V   |         |         |
15+ 5       0.9983      2.11   | Q       |     V   |         |         |
15+10       1.0133      2.18   | Q       |     V   |         |         |
15+15       1.0289      2.27   |  Q      |      V  |         |         |
15+20       1.0453      2.37   |  Q      |      V  |         |         |
```

15+25	1.0623	2.47	Q V
15+30	1.0799	2.55	Q V
15+35	1.0978	2.60	Q V
15+40	1.1160	2.65	Q V
15+45	1.1351	2.78	Q V
15+50	1.1560	3.02	Q V
15+55	1.1797	3.45	Q V
16+ 0	1.2099	4.39	Q V
16+ 5	1.2585	7.05	Q V
16+10	1.3476	12.93	Q V
16+15	1.4751	18.52	Q
16+20	1.6184	20.81	VQ
16+25	1.7232	15.22	Q V
16+30	1.7887	9.50	Q V
16+35	1.8304	6.05	Q V
16+40	1.8587	4.12	Q V
16+45	1.8799	3.08	Q V
16+50	1.8989	2.75	Q V
16+55	1.9153	2.39	Q V
17+ 0	1.9297	2.08	Q V
17+ 5	1.9431	1.94	Q V
17+10	1.9557	1.84	Q V
17+15	1.9677	1.74	Q V
17+20	1.9792	1.66	Q V
17+25	1.9901	1.59	Q V
17+30	2.0006	1.53	Q V
17+35	2.0108	1.47	Q V
17+40	2.0206	1.42	Q V
17+45	2.0301	1.38	Q V
17+50	2.0393	1.34	Q V
17+55	2.0482	1.30	Q V
18+ 0	2.0569	1.26	Q V
18+ 5	2.0654	1.23	Q V
18+10	2.0736	1.19	Q V
18+15	2.0814	1.14	Q V
18+20	2.0889	1.08	Q V
18+25	2.0960	1.04	Q V
18+30	2.1029	1.00	Q V
18+35	2.1096	0.98	Q V
18+40	2.1162	0.95	Q V
18+45	2.1227	0.94	Q V
18+50	2.1290	0.92	Q V
18+55	2.1352	0.90	Q V
19+ 0	2.1413	0.88	Q V
19+ 5	2.1472	0.87	Q V
19+10	2.1531	0.85	Q V
19+15	2.1589	0.84	Q V
19+20	2.1646	0.83	Q V
19+25	2.1702	0.81	Q V
19+30	2.1757	0.80	Q V
19+35	2.1811	0.79	Q V
19+40	2.1865	0.78	Q V
19+45	2.1918	0.77	Q V
19+50	2.1970	0.76	Q V
19+55	2.2021	0.75	Q V
20+ 0	2.2072	0.74	Q V
20+ 5	2.2122	0.73	Q V
20+10	2.2172	0.72	Q V
20+15	2.2221	0.71	Q V
20+20	2.2269	0.70	Q V
20+25	2.2317	0.69	Q V
20+30	2.2364	0.69	Q V
20+35	2.2411	0.68	Q V

20+40	2.2457	0.67	Q				V
20+45	2.2503	0.66	Q				V
20+50	2.2548	0.66	Q				V
20+55	2.2593	0.65	Q				V
21+ 0	2.2637	0.64	Q				V
21+ 5	2.2681	0.64	Q				V
21+10	2.2724	0.63	Q				V
21+15	2.2767	0.62	Q				V
21+20	2.2810	0.62	Q				V
21+25	2.2852	0.61	Q				V
21+30	2.2894	0.61	Q				V
21+35	2.2935	0.60	Q				V
21+40	2.2976	0.60	Q				V
21+45	2.3017	0.59	Q				V
21+50	2.3057	0.59	Q				V
21+55	2.3097	0.58	Q				V
22+ 0	2.3137	0.58	Q				V
22+ 5	2.3176	0.57	Q				V
22+10	2.3215	0.57	Q				V
22+15	2.3254	0.56	Q				V
22+20	2.3292	0.56	Q				V
22+25	2.3330	0.55	Q				V
22+30	2.3368	0.55	Q				V
22+35	2.3406	0.54	Q				V
22+40	2.3443	0.54	Q				V
22+45	2.3480	0.54	Q				V
22+50	2.3516	0.53	Q				V
22+55	2.3553	0.53	Q				V
23+ 0	2.3589	0.53	Q				V
23+ 5	2.3625	0.52	Q				V
23+10	2.3661	0.52	Q				V
23+15	2.3696	0.51	Q				V
23+20	2.3731	0.51	Q				V
23+25	2.3766	0.51	Q				V
23+30	2.3801	0.50	Q				V
23+35	2.3835	0.50	Q				V
23+40	2.3870	0.50	Q				V
23+45	2.3904	0.49	Q				V
23+50	2.3937	0.49	Q				V
23+55	2.3971	0.49	Q				V
24+ 0	2.4005	0.49	Q				V
24+ 5	2.4037	0.47	Q				V
24+10	2.4066	0.42	Q				V
24+15	2.4087	0.31	Q				V
24+20	2.4100	0.18	Q				V
24+25	2.4106	0.09	Q				V
24+30	2.4109	0.04	Q				V
24+35	2.4110	0.02	Q				V
24+40	2.4110	0.01	Q				V
24+45	2.4111	0.00	Q				V
24+50	2.4111	0.00	Q				V

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 05/10/23

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6530

HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL
100 YEAR STORM EVENT- PROPOSED UNIT HYDROGRAPH BUILDING 1
5884Q100PUHB1
BP

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
19.17	1	1.31
Rainfall data for year 100		
19.17	6	3.09
Rainfall data for year 100		
19.17	24	5.64

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	52.0	19.17	1.000	0.785	0.100	0.079

Area-averaged adjusted loss rate Fm (In/Hr) = 0.079

********* Area-Averaged low loss rate fraction, Yb **********

Area   Area   SCS CN   SCS CN   S   Pervious

```
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     1.92   0.100         32.0      52.0       9.23     0.196
    17.25   0.900         98.0      98.0       0.20     0.958

Area-averaged catchment yield fraction, Y =  0.882
Area-averaged low loss fraction, Yb =  0.118
User entry of time of concentration  =   0.257 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      19.17(Ac.)
Catchment Lag time =   0.205 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 40.5950
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.079(In/Hr)
Average low loss rate fraction (Yb) = 0.118 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.485(In)
Computed peak 30-minute rainfall =  0.993(In)
Specified peak 1-hour rainfall =  1.310(In)
Computed peak 3-hour rainfall =  2.217(In)
Specified peak 6-hour rainfall =  3.090(In)
Specified peak 24-hour rainfall =  5.640(In)


Rainfall depth area reduction factors:
Using a total area of      19.17(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999     Adjusted rainfall =  0.484(In)
30-minute factor = 0.999    Adjusted rainfall =  0.992(In)
1-hour factor = 0.999       Adjusted rainfall =  1.309(In)
3-hour factor = 1.000       Adjusted rainfall =  2.217(In)
6-hour factor = 1.000       Adjusted rainfall =  3.090(In)
24-hour factor = 1.000      Adjusted rainfall =  5.640(In)
---------------------------------------------------------------------

                   U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph         Unit Hydrograph
Number            Mean values            ((CFS))
---------------------------------------------------------------------
             (K =       231.84 (CFS))

  1                3.115                  7.223
  2               20.135                 39.459
  3               50.921                 71.372
  4               78.933                 64.942
  5               91.701                 29.602
  6               96.970                 12.216
  7               98.550                  3.661
  8               99.280                  1.694
  9              100.000                  1.669
---------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Total soil rain loss =      0.59(In)
Total effective rainfall =      5.05(In)
Peak flow rate in flood hydrograph =     51.92(CFS)
---------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                   24 - H O U R   S T O R M
              R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))
```

```
    -----------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)   0       15.0      30.0      45.0      60.0
-----------------------------------------------------------------------
  0+ 5       0.0004      0.05  Q         |         |         |         |
  0+10       0.0028      0.35  Q         |         |         |         |
  0+15       0.0089      0.89  Q         |         |         |         |
  0+20       0.0184      1.38  Q         |         |         |         |
  0+25       0.0294      1.60  VQ        |         |         |         |
  0+30       0.0411      1.70  VQ        |         |         |         |
  0+35       0.0530      1.73  VQ        |         |         |         |
  0+40       0.0651      1.75  VQ        |         |         |         |
  0+45       0.0772      1.77  VQ        |         |         |         |
  0+50       0.0894      1.77  VQ        |         |         |         |
  0+55       0.1017      1.78  VQ        |         |         |         |
  1+ 0       0.1140      1.78  VQ        |         |         |         |
  1+ 5       0.1263      1.79  VQ        |         |         |         |
  1+10       0.1386      1.79  VQ        |         |         |         |
  1+15       0.1510      1.80  VQ        |         |         |         |
  1+20       0.1635      1.81  VQ        |         |         |         |
  1+25       0.1759      1.81  VQ        |         |         |         |
  1+30       0.1884      1.82  VQ        |         |         |         |
  1+35       0.2010      1.82  VQ        |         |         |         |
  1+40       0.2136      1.83   |Q       |         |         |         |
  1+45       0.2262      1.83   |Q       |         |         |         |
  1+50       0.2389      1.84   |Q       |         |         |         |
  1+55       0.2516      1.85   |Q       |         |         |         |
  2+ 0       0.2644      1.85   |Q       |         |         |         |
  2+ 5       0.2772      1.86   |Q       |         |         |         |
  2+10       0.2900      1.86   |Q       |         |         |         |
  2+15       0.3029      1.87   |Q       |         |         |         |
  2+20       0.3158      1.88   |Q       |         |         |         |
  2+25       0.3288      1.88   |Q       |         |         |         |
  2+30       0.3418      1.89   |Q       |         |         |         |
  2+35       0.3549      1.90   |Q       |         |         |         |
  2+40       0.3680      1.90   |Q       |         |         |         |
  2+45       0.3812      1.91   |Q       |         |         |         |
  2+50       0.3944      1.92   |Q       |         |         |         |
  2+55       0.4076      1.92   |QV      |         |         |         |
  3+ 0       0.4209      1.93   |QV      |         |         |         |
  3+ 5       0.4342      1.94   |QV      |         |         |         |
  3+10       0.4476      1.94   |QV      |         |         |         |
  3+15       0.4611      1.95   |QV      |         |         |         |
  3+20       0.4745      1.96   |QV      |         |         |         |
  3+25       0.4881      1.97   |QV      |         |         |         |
  3+30       0.5017      1.97   |QV      |         |         |         |
  3+35       0.5153      1.98   |QV      |         |         |         |
  3+40       0.5290      1.99   |QV      |         |         |         |
  3+45       0.5427      1.99   |QV      |         |         |         |
  3+50       0.5565      2.00   |QV      |         |         |         |
  3+55       0.5704      2.01   |QV      |         |         |         |
  4+ 0       0.5843      2.02   |QV      |         |         |         |
  4+ 5       0.5982      2.03   |QV      |         |         |         |
  4+10       0.6122      2.03   |Q V     |         |         |         |
  4+15       0.6263      2.04   |Q V     |         |         |         |
  4+20       0.6404      2.05   |Q V     |         |         |         |
  4+25       0.6546      2.06   |Q V     |         |         |         |
  4+30       0.6688      2.07   |Q V     |         |         |         |
  4+35       0.6831      2.07   |Q V     |         |         |         |
  4+40       0.6974      2.08   |Q V     |         |         |         |
  4+45       0.7118      2.09   |Q V     |         |         |         |
  4+50       0.7263      2.10   |Q V     |         |         |         |
  4+55       0.7408      2.11   |Q V     |         |         |         |
```

5+ 0	0.7554	2.12	Q V			
5+ 5	0.7700	2.13	Q V			
5+10	0.7847	2.13	Q V			
5+15	0.7995	2.14	Q V			
5+20	0.8143	2.15	Q V			
5+25	0.8292	2.16	Q V			
5+30	0.8442	2.17	Q V			
5+35	0.8592	2.18	Q V			
5+40	0.8743	2.19	Q V			
5+45	0.8894	2.20	Q V			
5+50	0.9047	2.21	Q V			
5+55	0.9200	2.22	Q V			
6+ 0	0.9353	2.23	Q V			
6+ 5	0.9508	2.24	Q V			
6+10	0.9663	2.25	Q V			
6+15	0.9818	2.26	Q V			
6+20	0.9975	2.27	Q V			
6+25	1.0132	2.28	Q V			
6+30	1.0290	2.29	Q V			
6+35	1.0449	2.31	Q V			
6+40	1.0609	2.32	Q V			
6+45	1.0769	2.33	Q V			
6+50	1.0930	2.34	Q V			
6+55	1.1092	2.35	Q V			
7+ 0	1.1255	2.36	Q V			
7+ 5	1.1419	2.38	Q V			
7+10	1.1583	2.39	Q V			
7+15	1.1749	2.40	Q V			
7+20	1.1915	2.41	Q V			
7+25	1.2082	2.43	Q V			
7+30	1.2250	2.44	Q V			
7+35	1.2419	2.45	Q V			
7+40	1.2589	2.47	Q V			
7+45	1.2759	2.48	Q V			
7+50	1.2931	2.49	Q V			
7+55	1.3104	2.51	Q V			
8+ 0	1.3277	2.52	Q V			
8+ 5	1.3452	2.54	Q V			
8+10	1.3628	2.55	Q V			
8+15	1.3805	2.57	Q V			
8+20	1.3982	2.58	Q V			
8+25	1.4161	2.60	Q V			
8+30	1.4341	2.61	Q V			
8+35	1.4522	2.63	Q V			
8+40	1.4704	2.64	Q V			
8+45	1.4887	2.66	Q V			
8+50	1.5072	2.68	Q V			
8+55	1.5257	2.69	Q V			
9+ 0	1.5444	2.71	Q V			
9+ 5	1.5632	2.73	Q V			
9+10	1.5821	2.75	Q V			
9+15	1.6012	2.77	Q V			
9+20	1.6204	2.78	Q V			
9+25	1.6397	2.80	Q V			
9+30	1.6591	2.82	Q V			
9+35	1.6787	2.84	Q V			
9+40	1.6984	2.86	Q V			
9+45	1.7183	2.88	Q V			
9+50	1.7383	2.91	Q V			
9+55	1.7584	2.93	Q V			
10+ 0	1.7788	2.95	Q V			
10+ 5	1.7992	2.97	Q V			
10+10	1.8198	2.99	Q V			

10+15	1.8406	3.02	Q V
10+20	1.8615	3.04	Q V
10+25	1.8827	3.07	Q V
10+30	1.9039	3.09	Q V
10+35	1.9254	3.12	Q V
10+40	1.9470	3.14	Q V
10+45	1.9689	3.17	Q V
10+50	1.9909	3.20	Q V
10+55	2.0131	3.22	Q V
11+ 0	2.0355	3.25	Q V
11+ 5	2.0581	3.28	Q V
11+10	2.0809	3.31	Q V
11+15	2.1039	3.34	Q V
11+20	2.1271	3.37	Q V
11+25	2.1506	3.41	Q V
11+30	2.1743	3.44	Q V
11+35	2.1982	3.47	Q V
11+40	2.2224	3.51	Q V
11+45	2.2468	3.55	Q V
11+50	2.2715	3.58	Q V
11+55	2.2965	3.62	Q V
12+ 0	2.3217	3.66	Q V
12+ 5	2.3473	3.72	Q V
12+10	2.3736	3.83	Q V
12+15	2.4011	3.99	Q V
12+20	2.4297	4.15	Q V
12+25	2.4589	4.24	Q V
12+30	2.4886	4.31	Q V
12+35	2.5187	4.37	Q V
12+40	2.5492	4.43	Q V
12+45	2.5800	4.48	Q V
12+50	2.6113	4.54	Q V
12+55	2.6430	4.60	Q V
13+ 0	2.6750	4.66	Q V
13+ 5	2.7075	4.72	Q V
13+10	2.7405	4.79	Q V
13+15	2.7739	4.85	Q V
13+20	2.8078	4.92	Q V
13+25	2.8423	5.00	Q V
13+30	2.8772	5.08	Q V
13+35	2.9127	5.16	Q V
13+40	2.9488	5.24	Q V
13+45	2.9856	5.33	Q V
13+50	3.0229	5.43	Q V
13+55	3.0610	5.52	Q V
14+ 0	3.0997	5.63	Q V
14+ 5	3.1393	5.74	Q V
14+10	3.1796	5.86	Q V
14+15	3.2208	5.98	Q V
14+20	3.2630	6.12	Q V
14+25	3.3061	6.26	Q V
14+30	3.3503	6.41	Q V
14+35	3.3955	6.57	Q V
14+40	3.4420	6.75	Q V
14+45	3.4898	6.94	Q V
14+50	3.5390	7.15	Q V
14+55	3.5898	7.37	Q V
15+ 0	3.6423	7.62	Q V
15+ 5	3.6966	7.89	Q V
15+10	3.7531	8.20	Q V
15+15	3.8119	8.54	Q V
15+20	3.8734	8.93	Q V
15+25	3.9376	9.32	Q V

15+30	4.0033	9.54
15+35	4.0694	9.59
15+40	4.1371	9.84
15+45	4.2098	10.55
15+50	4.2908	11.77
15+55	4.3849	13.66
16+ 0	4.5013	16.90
16+ 5	4.6691	24.36
16+10	4.9458	40.18
16+15	5.3033	51.92
16+20	5.6188	45.80
16+25	5.8131	28.21
16+30	5.9377	18.11
16+35	6.0262	12.85
16+40	6.1012	10.88
16+45	6.1690	9.85
16+50	6.2272	8.44
16+55	6.2808	7.79
17+ 0	6.3309	7.28
17+ 5	6.3782	6.86
17+10	6.4229	6.50
17+15	6.4656	6.19
17+20	6.5064	5.92
17+25	6.5455	5.68
17+30	6.5832	5.47
17+35	6.6196	5.28
17+40	6.6548	5.11
17+45	6.6889	4.96
17+50	6.7221	4.81
17+55	6.7543	4.68
18+ 0	6.7858	4.56
18+ 5	6.8163	4.44
18+10	6.8457	4.27
18+15	6.8736	4.05
18+20	6.9001	3.85
18+25	6.9257	3.71
18+30	6.9505	3.61
18+35	6.9748	3.53
18+40	6.9987	3.46
18+45	7.0220	3.39
18+50	7.0449	3.32
18+55	7.0673	3.26
19+ 0	7.0894	3.21
19+ 5	7.1111	3.15
19+10	7.1325	3.10
19+15	7.1535	3.05
19+20	7.1742	3.00
19+25	7.1945	2.96
19+30	7.2146	2.91
19+35	7.2344	2.87
19+40	7.2539	2.83
19+45	7.2731	2.79
19+50	7.2921	2.75
19+55	7.3108	2.72
20+ 0	7.3293	2.68
20+ 5	7.3475	2.65
20+10	7.3655	2.62
20+15	7.3834	2.59
20+20	7.4010	2.56
20+25	7.4184	2.53
20+30	7.4356	2.50
20+35	7.4526	2.47
20+40	7.4694	2.44

```
    20+45       7.4861       2.42  |Q         |         |         |      V  |
    20+50       7.5025       2.39  |Q         |         |         |      V  |
    20+55       7.5189       2.37  |Q         |         |         |      V  |
    21+ 0       7.5350       2.34  |Q         |         |         |      V  |
    21+ 5       7.5510       2.32  |Q         |         |         |      V  |
    21+10       7.5668       2.30  |Q         |         |         |      V  |
    21+15       7.5825       2.28  |Q         |         |         |      V  |
    21+20       7.5980       2.26  |Q         |         |         |      V  |
    21+25       7.6134       2.23  |Q         |         |         |      V  |
    21+30       7.6287       2.21  |Q         |         |         |      V  |
    21+35       7.6438       2.19  |Q         |         |         |      V  |
    21+40       7.6588       2.18  |Q         |         |         |      V  |
    21+45       7.6736       2.16  |Q         |         |         |       V |
    21+50       7.6884       2.14  |Q         |         |         |       V |
    21+55       7.7030       2.12  |Q         |         |         |       V |
    22+ 0       7.7174       2.10  |Q         |         |         |       V |
    22+ 5       7.7318       2.09  |Q         |         |         |       V |
    22+10       7.7460       2.07  |Q         |         |         |       V |
    22+15       7.7602       2.05  |Q         |         |         |       V |
    22+20       7.7742       2.04  |Q         |         |         |       V |
    22+25       7.7881       2.02  |Q         |         |         |       V |
    22+30       7.8019       2.00  |Q         |         |         |       V |
    22+35       7.8156       1.99  |Q         |         |         |       V |
    22+40       7.8292       1.98  |Q         |         |         |       V |
    22+45       7.8427       1.96  |Q         |         |         |       V |
    22+50       7.8561       1.95  |Q         |         |         |       V |
    22+55       7.8694       1.93  |Q         |         |         |        V|
    23+ 0       7.8827       1.92  |Q         |         |         |        V|
    23+ 5       7.8958       1.91  |Q         |         |         |        V|
    23+10       7.9088       1.89  |Q         |         |         |        V|
    23+15       7.9218       1.88  |Q         |         |         |        V|
    23+20       7.9346       1.87  |Q         |         |         |        V|
    23+25       7.9474       1.85  |Q         |         |         |        V|
    23+30       7.9601       1.84  |Q         |         |         |        V|
    23+35       7.9727       1.83  |Q         |         |         |        V|
    23+40       7.9852       1.82  |Q         |         |         |        V|
    23+45       7.9977       1.81  |Q         |         |         |        V|
    23+50       8.0100       1.80  |Q         |         |         |        V|
    23+55       8.0223       1.78  |Q         |         |         |        V|
    24+ 0       8.0345       1.77  |Q         |         |         |        V|
    24+ 5       8.0463       1.71  |Q         |         |         |        V|
    24+10       8.0560       1.40  Q          |         |         |        V|
    24+15       8.0619       0.86  Q          |         |         |        V|
    24+20       8.0644       0.37  Q          |         |         |        V|
    24+25       8.0654       0.15  Q          |         |         |        V|
    24+30       8.0658       0.05  Q          |         |         |        V|
    24+35       8.0660       0.03  Q          |         |         |        V|
    24+40       8.0661       0.01  Q          |         |         |         V
 -----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  05/10/23

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San Bernardino County Synthetic Unit Hydrology Method
             Manual date - August 1986


Program License Serial Number 6530

---------------------------------------------------------------------
HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL
100 YEAR STORM EVENT - PROPOSED UNIT HYDROGRAPH BUILDING 2
5884Q100PUHB2
BP
--------------------------------------------------------------------

      Storm Event Year = 100

      Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



Area averaged rainfall intensity isohyetal data:
       Sub-Area        Duration        Isohyetal
       (Ac.)            (hours)          (In)
Rainfall data for year 100
           10.32            1           1.31
--------------------------------------------------------------------
Rainfall data for year 100
           10.32            6           3.09
--------------------------------------------------------------------
Rainfall data for year 100
           10.32           24           5.64
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0       52.0         10.32     1.000     0.785    0.100    0.079

Area-averaged adjusted loss rate Fm (In/Hr) =  0.079

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
```

```
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     1.03   0.100         32.0      52.0       9.23     0.196
     9.29   0.900         98.0      98.0       0.20     0.958

Area-averaged catchment yield fraction, Y =  0.882
Area-averaged low loss fraction, Yb =  0.118
User entry of time of concentration  =   0.189 (hours)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =      10.32(Ac.)
Catchment Lag time =   0.151 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 55.1730
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.079(In/Hr)
Average low loss rate fraction (Yb) = 0.118 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.485(In)
Computed peak 30-minute rainfall =  0.993(In)
Specified peak 1-hour rainfall =  1.310(In)
Computed peak 3-hour rainfall =  2.217(In)
Specified peak 6-hour rainfall =  3.090(In)
Specified peak 24-hour rainfall =  5.640(In)


Rainfall depth area reduction factors:
Using a total area of      10.32(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.485(In)
30-minute factor = 1.000    Adjusted rainfall =  0.992(In)
1-hour factor = 1.000       Adjusted rainfall =  1.309(In)
3-hour factor = 1.000       Adjusted rainfall =  2.217(In)
6-hour factor = 1.000       Adjusted rainfall =  3.090(In)
24-hour factor = 1.000      Adjusted rainfall =  5.640(In)
---------------------------------------------------------------------

                    U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph         Unit Hydrograph
Number           Mean values            ((CFS))
---------------------------------------------------------------------
             (K =       124.81 (CFS))

  1               5.537                  6.911
  2              35.749                 37.706
  3              76.382                 50.714
  4              93.314                 21.132
  5              98.130                  6.010
  6              99.262                  1.413
  7             100.000                  0.921
---------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Total soil rain loss =      0.59(In)
Total effective rainfall =      5.05(In)
Peak flow rate in flood hydrograph =     31.78(CFS)
---------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - H O U R   S T O R M
               R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

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

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0       10.0      20.0      30.0      40.0
-----------------------------------------------------------------------
  0+ 5       0.0004      0.05  Q        |         |         |         |
  0+10       0.0027      0.33  Q        |         |         |         |
  0+15       0.0076      0.72  Q        |         |         |         |
  0+20       0.0136      0.88  Q        |         |         |         |
  0+25       0.0200      0.92  Q        |         |         |         |
  0+30       0.0265      0.94  Q        |         |         |         |
  0+35       0.0330      0.95  Q        |         |         |         |
  0+40       0.0395      0.95  Q        |         |         |         |
  0+45       0.0461      0.95  Q        |         |         |         |
  0+50       0.0527      0.96  Q        |         |         |         |
  0+55       0.0593      0.96  Q        |         |         |         |
  1+ 0       0.0659      0.96  Q        |         |         |         |
  1+ 5       0.0725      0.96  Q        |         |         |         |
  1+10       0.0792      0.97  Q        |         |         |         |
  1+15       0.0859      0.97  Q        |         |         |         |
  1+20       0.0926      0.97  Q        |         |         |         |
  1+25       0.0993      0.98  Q        |         |         |         |
  1+30       0.1061      0.98  Q        |         |         |         |
  1+35       0.1129      0.98  QV       |         |         |         |
  1+40       0.1196      0.99  QV       |         |         |         |
  1+45       0.1265      0.99  QV       |         |         |         |
  1+50       0.1333      0.99  QV       |         |         |         |
  1+55       0.1402      1.00  QV       |         |         |         |
  2+ 0       0.1470      1.00  QV       |         |         |         |
  2+ 5       0.1540      1.00  |Q       |         |         |         |
  2+10       0.1609      1.01  |Q       |         |         |         |
  2+15       0.1678      1.01  |Q       |         |         |         |
  2+20       0.1748      1.01  |Q       |         |         |         |
  2+25       0.1818      1.02  |Q       |         |         |         |
  2+30       0.1888      1.02  |Q       |         |         |         |
  2+35       0.1959      1.02  |Q       |         |         |         |
  2+40       0.2030      1.03  |Q       |         |         |         |
  2+45       0.2101      1.03  |Q       |         |         |         |
  2+50       0.2172      1.03  |QV      |         |         |         |
  2+55       0.2243      1.04  |QV      |         |         |         |
  3+ 0       0.2315      1.04  |QV      |         |         |         |
  3+ 5       0.2387      1.05  |QV      |         |         |         |
  3+10       0.2459      1.05  |QV      |         |         |         |
  3+15       0.2532      1.05  |QV      |         |         |         |
  3+20       0.2605      1.06  |QV      |         |         |         |
  3+25       0.2678      1.06  |QV      |         |         |         |
  3+30       0.2751      1.06  |QV      |         |         |         |
  3+35       0.2825      1.07  |QV      |         |         |         |
  3+40       0.2898      1.07  |QV      |         |         |         |
  3+45       0.2973      1.08  |QV      |         |         |         |
  3+50       0.3047      1.08  |QV      |         |         |         |
  3+55       0.3122      1.08  |QV      |         |         |         |
  4+ 0       0.3197      1.09  |QV      |         |         |         |
  4+ 5       0.3272      1.09  |Q V     |         |         |         |
  4+10       0.3348      1.10  |Q V     |         |         |         |
  4+15       0.3424      1.10  |Q V     |         |         |         |
  4+20       0.3500      1.11  |Q V     |         |         |         |
  4+25       0.3576      1.11  |Q V     |         |         |         |
  4+30       0.3653      1.12  |Q V     |         |         |         |
  4+35       0.3730      1.12  |Q V     |         |         |         |
  4+40       0.3808      1.12  |Q V     |         |         |         |
  4+45       0.3885      1.13  |Q V     |         |         |         |
  4+50       0.3963      1.13  |Q V     |         |         |         |
  4+55       0.4042      1.14  |Q V     |         |         |         |
  5+ 0       0.4120      1.14  |Q V     |         |         |         |
  5+ 5       0.4199      1.15  |Q V     |         |         |         |
```

5+10	0.4279	1.15	Q V
5+15	0.4359	1.16	Q V
5+20	0.4439	1.16	Q V
5+25	0.4519	1.17	Q V
5+30	0.4600	1.17	Q V
5+35	0.4681	1.18	Q V
5+40	0.4762	1.18	Q V
5+45	0.4844	1.19	Q V
5+50	0.4926	1.19	Q V
5+55	0.5009	1.20	Q V
6+ 0	0.5092	1.20	Q V
6+ 5	0.5175	1.21	Q V
6+10	0.5259	1.22	Q V
6+15	0.5343	1.22	Q V
6+20	0.5428	1.23	Q V
6+25	0.5513	1.23	Q V
6+30	0.5598	1.24	Q V
6+35	0.5684	1.25	Q V
6+40	0.5770	1.25	Q V
6+45	0.5857	1.26	Q V
6+50	0.5944	1.26	Q V
6+55	0.6031	1.27	Q V
7+ 0	0.6119	1.28	Q V
7+ 5	0.6208	1.28	Q V
7+10	0.6297	1.29	Q V
7+15	0.6386	1.30	Q V
7+20	0.6476	1.30	Q V
7+25	0.6566	1.31	Q V
7+30	0.6657	1.32	Q V
7+35	0.6748	1.33	Q V
7+40	0.6840	1.33	Q V
7+45	0.6932	1.34	Q V
7+50	0.7025	1.35	Q V
7+55	0.7118	1.36	Q V
8+ 0	0.7212	1.36	Q V
8+ 5	0.7307	1.37	Q V
8+10	0.7401	1.38	Q V
8+15	0.7497	1.39	Q V
8+20	0.7593	1.39	Q V
8+25	0.7690	1.40	Q V
8+30	0.7787	1.41	Q V
8+35	0.7885	1.42	Q V
8+40	0.7983	1.43	Q V
8+45	0.8082	1.44	Q V
8+50	0.8182	1.45	Q V
8+55	0.8282	1.46	Q V
9+ 0	0.8383	1.47	Q V
9+ 5	0.8485	1.48	Q V
9+10	0.8587	1.49	Q V
9+15	0.8690	1.50	Q V
9+20	0.8794	1.51	Q V
9+25	0.8899	1.52	Q V
9+30	0.9004	1.53	Q V
9+35	0.9110	1.54	Q V
9+40	0.9216	1.55	Q V
9+45	0.9324	1.56	Q V
9+50	0.9432	1.57	Q V
9+55	0.9541	1.58	Q V
10+ 0	0.9651	1.60	Q V
10+ 5	0.9762	1.61	Q V
10+10	0.9873	1.62	Q V
10+15	0.9986	1.63	Q V
10+20	1.0099	1.65	Q V

```
10+25       1.0213      1.66   |Q       V|         |         |         |
10+30       1.0329      1.67   |Q       V|         |         |         |
10+35       1.0445      1.69   |Q       V|         |         |         |
10+40       1.0562      1.70   |Q       V|         |         |         |
10+45       1.0680      1.72   |Q       V|         |         |         |
10+50       1.0799      1.73   |Q       V|         |         |         |
10+55       1.0919      1.75   |Q        V         |         |         |
11+ 0       1.1041      1.76   |Q        V         |         |         |
11+ 5       1.1163      1.78   |Q        V         |         |         |
11+10       1.1287      1.79   |Q        V         |         |         |
11+15       1.1411      1.81   |Q        V         |         |         |
11+20       1.1537      1.83   |Q        V         |         |         |
11+25       1.1665      1.85   |Q        V         |         |         |
11+30       1.1793      1.86   |Q        V         |         |         |
11+35       1.1923      1.88   |Q        V         |         |         |
11+40       1.2054      1.90   |Q        |V        |         |         |
11+45       1.2186      1.92   |Q        |V        |         |         |
11+50       1.2320      1.94   |Q        |V        |         |         |
11+55       1.2455      1.96   |Q        |V        |         |         |
12+ 0       1.2592      1.99   |Q        |V        |         |         |
12+ 5       1.2731      2.02   | Q       |V        |         |         |
12+10       1.2877      2.11   | Q       |V        |         |         |
12+15       1.3029      2.22   | Q       | V       |         |         |
12+20       1.3186      2.28   | Q       | V       |         |         |
12+25       1.3346      2.32   | Q       | V       |         |         |
12+30       1.3507      2.34   | Q       | V       |         |         |
12+35       1.3671      2.37   | Q       | V       |         |         |
12+40       1.3836      2.40   | Q       | V       |         |         |
12+45       1.4004      2.43   | Q       | V       |         |         |
12+50       1.4174      2.46   | Q       |  V      |         |         |
12+55       1.4346      2.50   | Q       |  V      |         |         |
13+ 0       1.4520      2.53   | Q       |  V      |         |         |
13+ 5       1.4696      2.56   | Q       |  V      |         |         |
13+10       1.4875      2.60   | Q       |  V      |         |         |
13+15       1.5057      2.64   | Q       |  V      |         |         |
13+20       1.5242      2.68   | Q       |   V     |         |         |
13+25       1.5429      2.72   | Q       |   V     |         |         |
13+30       1.5619      2.76   | Q       |   V     |         |         |
13+35       1.5812      2.81   | Q       |   V     |         |         |
13+40       1.6009      2.85   | Q       |   V     |         |         |
13+45       1.6209      2.90   | Q       |   V     |         |         |
13+50       1.6412      2.96   | Q       |    V    |         |         |
13+55       1.6620      3.01   |  Q      |    V    |         |         |
14+ 0       1.6831      3.07   |  Q      |    V    |         |         |
14+ 5       1.7047      3.13   |  Q      |    V    |         |         |
14+10       1.7267      3.20   |  Q      |    V    |         |         |
14+15       1.7492      3.27   |  Q      |     V   |         |         |
14+20       1.7722      3.34   |  Q      |     V   |         |         |
14+25       1.7958      3.42   |  Q      |     V   |         |         |
14+30       1.8199      3.51   |  Q      |     V   |         |         |
14+35       1.8447      3.60   |  Q      |     V   |         |         |
14+40       1.8702      3.70   |  Q      |      V  |         |         |
14+45       1.8964      3.81   |  Q      |      V  |         |         |
14+50       1.9234      3.92   |  Q      |      V  |         |         |
14+55       1.9513      4.05   |   Q     |      V  |         |         |
15+ 0       1.9802      4.19   |   Q     |       V |         |         |
15+ 5       2.0102      4.35   |   Q     |       V |         |         |
15+10       2.0414      4.53   |   Q     |       V |         |         |
15+15       2.0739      4.73   |   Q     |        V|         |         |
15+20       2.1080      4.95   |   Q     |        V|         |         |
15+25       2.1436      5.16   |    Q    |        V|         |         |
15+30       2.1793      5.18   |    Q    |         V         |         |
15+35       2.2148      5.16   |    Q    |         V         |         |
```

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15+40      2.2523      5.45  |    Q    |         V         |         |
15+45      2.2936      5.99  |    Q    |         |V        |         |
15+50      2.3407      6.84  |     Q   |         |V        |         |
15+55      2.3967      8.13  |       Q |         | V       |         |
16+ 0      2.4686     10.44  |         Q         | V       |         |
16+ 5      2.5808     16.30  |         |     Q   |  V      |         |
16+10      2.7802     28.95  |         |         |    V  Q |         |
16+15      2.9990     31.78  |         |         |      V  |Q        |
16+20      3.1228     17.97  |         |      Q  |       V |         |
16+25      3.1905      9.83  |        Q|         |        V|         |
16+30      3.2369      6.75  |     Q   |         |        V|         |
16+35      3.2776      5.90  |    Q    |         |         V         |
16+40      3.3124      5.05  |    Q    |         |         V         |
16+45      3.3441      4.61  |   Q     |         |         V         |
16+50      3.3734      4.26  |   Q     |         |         |V        |
16+55      3.4008      3.98  |  Q      |         |         |V        |
17+ 0      3.4266      3.74  |  Q      |         |         |V        |
17+ 5      3.4510      3.54  |  Q      |         |         |V        |
17+10      3.4742      3.37  |  Q      |         |         | V       |
17+15      3.4964      3.22  |  Q      |         |         | V       |
17+20      3.5177      3.09  |  Q      |         |         | V       |
17+25      3.5382      2.97  | Q       |         |         | V       |
17+30      3.5579      2.87  | Q       |         |         | V       |
17+35      3.5770      2.78  | Q       |         |         | V       |
17+40      3.5956      2.69  | Q       |         |         |  V      |
17+45      3.6136      2.61  | Q       |         |         |  V      |
17+50      3.6311      2.54  | Q       |         |         |  V      |
17+55      3.6481      2.47  | Q       |         |         |  V      |
18+ 0      3.6647      2.41  | Q       |         |         |  V      |
18+ 5      3.6809      2.34  | Q       |         |         |  V      |
18+10      3.6962      2.23  | Q       |         |         |   V     |
18+15      3.7106      2.09  | Q       |         |         |   V     |
18+20      3.7244      2.01  | Q       |         |         |   V     |
18+25      3.7379      1.95  |Q        |         |         |   V     |
18+30      3.7510      1.91  |Q        |         |         |   V     |
18+35      3.7639      1.87  |Q        |         |         |   V     |
18+40      3.7765      1.83  |Q        |         |         |   V     |
18+45      3.7889      1.80  |Q        |         |         |   V     |
18+50      3.8011      1.77  |Q        |         |         |    V    |
18+55      3.8130      1.73  |Q        |         |         |    V    |
19+ 0      3.8248      1.71  |Q        |         |         |    V    |
19+ 5      3.8363      1.68  |Q        |         |         |    V    |
19+10      3.8477      1.65  |Q        |         |         |    V    |
19+15      3.8589      1.62  |Q        |         |         |    V    |
19+20      3.8699      1.60  |Q        |         |         |    V    |
19+25      3.8807      1.58  |Q        |         |         |    V    |
19+30      3.8914      1.55  |Q        |         |         |    V    |
19+35      3.9019      1.53  |Q        |         |         |    V    |
19+40      3.9123      1.51  |Q        |         |         |     V   |
19+45      3.9226      1.49  |Q        |         |         |     V   |
19+50      3.9327      1.47  |Q        |         |         |     V   |
19+55      3.9427      1.45  |Q        |         |         |     V   |
20+ 0      3.9526      1.43  |Q        |         |         |     V   |
20+ 5      3.9623      1.41  |Q        |         |         |     V   |
20+10      3.9719      1.40  |Q        |         |         |     V   |
20+15      3.9814      1.38  |Q        |         |         |     V   |
20+20      3.9908      1.36  |Q        |         |         |     V   |
20+25      4.0001      1.35  |Q        |         |         |     V   |
20+30      4.0093      1.33  |Q        |         |         |     V   |
20+35      4.0184      1.32  |Q        |         |         |      V  |
20+40      4.0274      1.31  |Q        |         |         |      V  |
20+45      4.0363      1.29  |Q        |         |         |      V  |
20+50      4.0451      1.28  |Q        |         |         |      V  |
```

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   20+55       4.0538      1.27  |Q         |         |         |      V  |
   21+ 0       4.0625      1.25  |Q         |         |         |      V  |
   21+ 5       4.0710      1.24  |Q         |         |         |      V  |
   21+10       4.0795      1.23  |Q         |         |         |      V  |
   21+15       4.0879      1.22  |Q         |         |         |      V  |
   21+20       4.0962      1.21  |Q         |         |         |      V  |
   21+25       4.1044      1.20  |Q         |         |         |      V  |
   21+30       4.1126      1.18  |Q         |         |         |      V  |
   21+35       4.1206      1.17  |Q         |         |         |      V  |
   21+40       4.1287      1.16  |Q         |         |         |       V |
   21+45       4.1366      1.15  |Q         |         |         |       V |
   21+50       4.1445      1.14  |Q         |         |         |       V |
   21+55       4.1523      1.13  |Q         |         |         |       V |
   22+ 0       4.1601      1.13  |Q         |         |         |       V |
   22+ 5       4.1677      1.12  |Q         |         |         |       V |
   22+10       4.1754      1.11  |Q         |         |         |       V |
   22+15       4.1829      1.10  |Q         |         |         |       V |
   22+20       4.1904      1.09  |Q         |         |         |       V |
   22+25       4.1979      1.08  |Q         |         |         |       V |
   22+30       4.2053      1.07  |Q         |         |         |       V |
   22+35       4.2126      1.07  |Q         |         |         |       V |
   22+40       4.2199      1.06  |Q         |         |         |       V |
   22+45       4.2271      1.05  |Q         |         |         |       V |
   22+50       4.2343      1.04  |Q         |         |         |        V|
   22+55       4.2415      1.04  |Q         |         |         |        V|
   23+ 0       4.2485      1.03  |Q         |         |         |        V|
   23+ 5       4.2556      1.02  |Q         |         |         |        V|
   23+10       4.2626      1.01  |Q         |         |         |        V|
   23+15       4.2695      1.01  |Q         |         |         |        V|
   23+20       4.2764      1.00  |Q         |         |         |        V|
   23+25       4.2832      0.99  Q          |         |         |        V|
   23+30       4.2900      0.99  Q          |         |         |        V|
   23+35       4.2968      0.98  Q          |         |         |        V|
   23+40       4.3035      0.97  Q          |         |         |        V|
   23+45       4.3102      0.97  Q          |         |         |        V|
   23+50       4.3168      0.96  Q          |         |         |        V|
   23+55       4.3234      0.96  Q          |         |         |        V|
   24+ 0       4.3299      0.95  Q          |         |         |        V|
   24+ 5       4.3361      0.89  Q          |         |         |        V|
   24+10       4.3403      0.61  Q          |         |         |        V|
   24+15       4.3418      0.22  Q          |         |         |        V|
   24+20       4.3422      0.06  Q          |         |         |        V|
   24+25       4.3423      0.02  Q          |         |         |        V|
   24+30       4.3424      0.01  Q          |         |         |         V
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Appendix D

STORAGE STAGE TABLES
FOR REFERENCE ONLY

Project: HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL BUILDING 1

Detention/ Infiltration System Routing Study Summary

Stage Storage Number	Storage Depth (ft)	Elevation (ft)	Area (ft^2)	Incremental volume (ft^3)	Total Volume (ft^3)	Total Volume (acre-ft)	Outflow Q (cfs)	Notes
1	0.0	936.63	20,872	0	0	0	0	Bottom of Infiltration System Rock
2	0.75	937.38	20,872	6,262	6,262	0.144	0.65	
3	1.5	938.13	20,872	13,470	19,731	0.453	0.65	
4	2.5	939.13	20,872	17,420	37,151	0.853	0.65	
5	3.5	940.13	20,872	16,414	53,565	1.230	0.65	
6	5.08	941.71	20,872	22,251	75,816	1.741	0.65	*Meets WQMP DCV
7	6.58	943.21	20,872	7,133	82,949	1.904	0.65	36" Outlet
8	6.60	943.23	20,872	6,262	89,211	2.048	5.46	
9	6.75	943.38	20,872	1,391	90,602	2.080	14.68	Top of Infiltration/ Detention System Release Water
10	7.75	944.38	20,872	0	90,602	2.080	37.46	
11	8.0	944.63	20,872	0	90,602	2.080	41.21	
12	9.00	945.63	20,872	0	90,602	2.080	53.60	
96" CMP system with 6" rock top & bottom								

Infiltration System Bottom Area Discharge ($Q_{out,bottom}$)

Infiltration Rate per Geo Tech Report (in/hr)		=	3.7
Factor of Safety			2.75
Unit Conversion (ft/sec)	$\frac{3.7\frac{in}{hr}}{2.75} \times \frac{1\,ft}{12\,in} \times \frac{1\,hr}{60\,min} \times \frac{1\,min}{60\,sec}$	=	0.0000311
Infiltration System Footprint (ft^2)	223.83 ft x 93.25 f	=	20,872
$Q_{out,bottom}$ (cfs)		=	**0.65**

*WQMP Design Capture Volume (DCV) is 75,308 CF

Basin Routing Summary Table

	100 YR 24 HR
Existing Q (cfs) 19.16 ac	47.0
Proposed Q(cfs) 19.16 ac	49.6
Q (cfs) after Routing	52.0
WSE (ft)	945.6

Storm Drain System Net Drainage (Q_{net})

One 36-inch Outlet Pipe + Infiltration $Q_{out,bottom}$

Orifice Eqn $= C * A * \sqrt{2gh} + Q_{out,bottom}$

$= 0.6 \times A\sqrt{2 \times 32.2 \times h} + Q_{out,bottom}$

A: Outlet pipe cross sectional area

h: WSE - outlet pipe centerline elevation

Example: WSE @ 929.00 ft

Q_{net}	$= C \times A\sqrt{2 \times 32.2 \times h} + Q_{out,bottom}$
C	0.6
A (ft^2) = πr^2	7.07
WSE (ft)	945.63
Outlet Centerline (ft)	943.21
h (ft)	2.42
$Q_{out,bottom}$ (cfs)	0.65
Q_{net} =	**53.60**

HUITT-ZOLLARS

Project: HILLWOOD - 11171 CHERRY AVENUE INDUSTRIAL BUILDING 2

Detention/ Infiltration System Routing Study Summary

Stage Storage Number	Storage Depth (ft)	Elevation (ft)	Area (ft^2)	Incremental volume (ft^3)	Total Volume (ft^3)	Total Volume (acre-ft)	Outflow Q (cfs)	Notes
1	0.0	937.73	13,691	0	0	0	0	**Bottom of Infiltration System Rock**
2	0.75	938.48	13,691	4,108	4,108	0.094	0.28	
3	1.5	939.23	13,691	8,834	12,942	0.297	0.28	
4	2.5	940.23	13,691	11,195	24,137	0.554	0.28	
5	3.5	941.23	13,691	10,023	34,161	0.784	0.28	
6	4.08	941.81	13,691	4,839	39,000	0.895	0.28	***Meets WQMP DCV**
7	5.33	943.06	13,691	7,097	46,097	1.058	0.28	**30" Outlet**
8	5.42	943.15	13,691	456	46,553	1.069	7.37	
9	5.50	943.23	13,691	456	47,010	1.079	10.02	**Top of Infiltration/ Detention System Release Water**
10	6.50	944.23	13,691	0	47,010	1.079	25.84	
11	7.0	944.73	13,691	0	47,010	1.079	30.82	
12	7.50	945.23	13,691	0	47,010	1.079	35.09	
96" CMP system with 6" rock top & bottom								

Infiltration System Bottom Area Discharge ($Q_{out,bottom}$)

Infiltration Rate per Geo Tech Report (in/hr)		=	2.4
Factor of Safety			2.75
Unit Conversion (ft/sec)	$\frac{6.8\frac{in}{hr}}{3.25} \times \frac{1\,ft}{12\,in} \times \frac{1\,hr}{60\,min} \times \frac{1\,min}{60\,sec}$	=	0.0000202
Infiltration System Footprint (ft^2)	175.35 ft x 78.08 f	=	13,691
$Q_{out,bottom}$ (cfs)		=	**0.28**

*WQMP Design Capture Volume (DCV) is 38,900 CF

Storm Drain System Net Drainage (Q_{net})

One 30-inch Outlet Pipe + Infiltration $Q_{out,bottom}$

Orifice Eqn $= C * A * \sqrt{2gh} + Q_{out,bottom}$

$= 0.6 \times A\sqrt{2 \times 32.2 \times h} + Q_{out,bottom}$

A: Outlet pipe cross sectional area

h: WSE - outlet pipe centerline elevation

Example: WSE @ 929.00 ft

$Q_{net} = C \times A\sqrt{2 \times 32.2 \times h} + Q_{out,bottom}$

C	0.6
A (ft^2) = πr^2	4.91
WSE (ft)	945.23
Outlet Centerline (ft)	943.06
h (ft)	2.17
$Q_{out,bottom}$ (cfs)	0.28
Q_{net} =	**35.09**

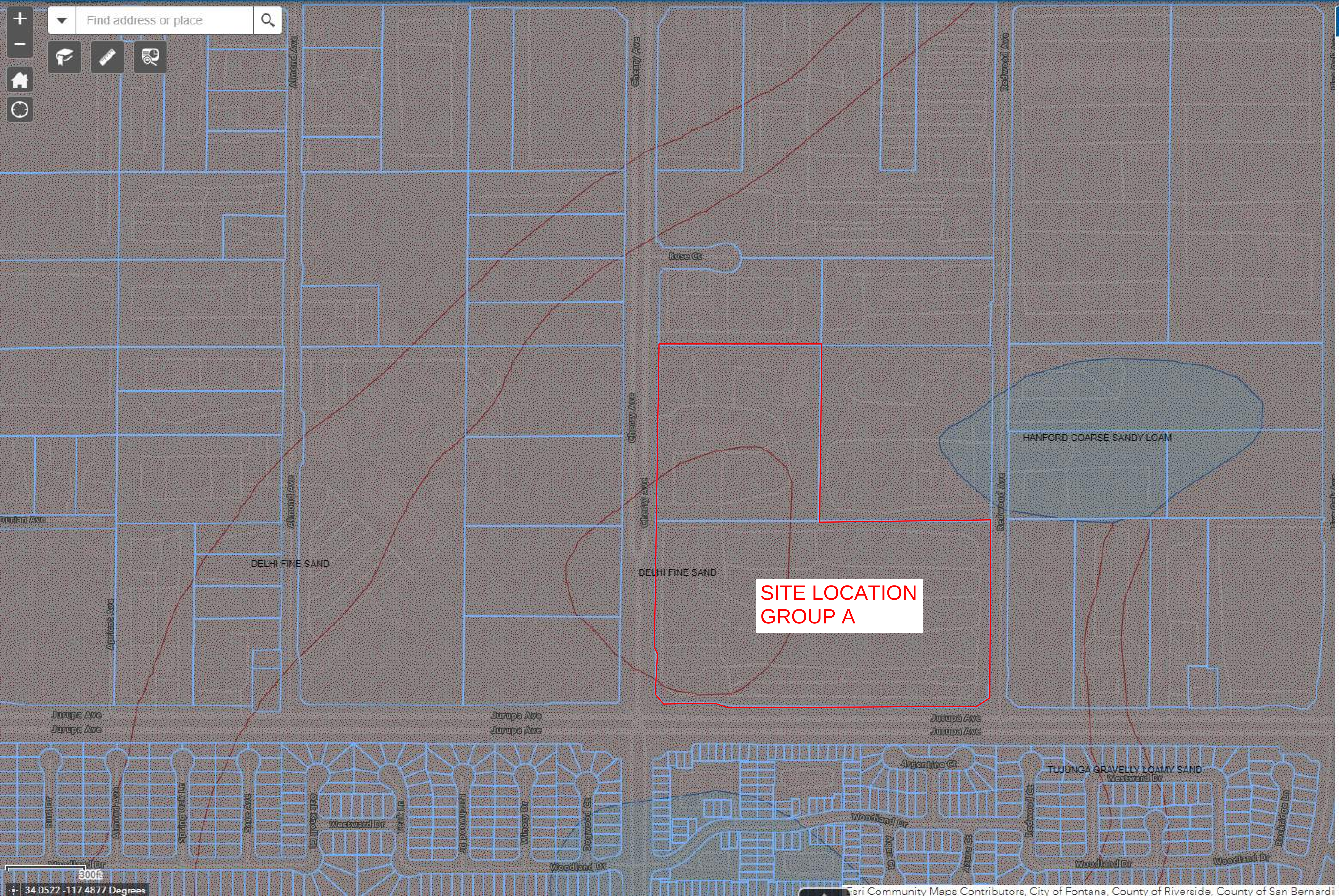
Basin Routing Summary Table

	100 YR 24 HR
Existing Q (cfs) 10.32 ac	47.0
Proposed Q(cfs) 10.32 ac	32.3
Q (cfs) after Routing	31.8
WSE (ft)	944.9

HUITT-ZOLLARS

Appendix E
Soils Group Map and NOAA Precipitation Frequency

Stormwater Facility Mapping Tool



Legend

Parcels

County Boundaries

Drainage Facilities

- EHM
- Non-EHM (Low)
- Non-EHM (Medium)
- Non-EHM (High)
- Non-EHM (default-high)

Water Storage Facility

- Interim
- Ultimate
- Other

Soils

- Soils - Hydro Group A
- Soils - Hydro Group B
- Soils - Hydro Group C
- Soils - Hydro Group D
- Soils - No Hydra Group

NOAA Atlas 14, Volume 6, Version 2
Location name: Fontana, California, USA*
Latitude: 34.05°, Longitude: -117.4869°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.103** (0.086-0.124)	**0.135** (0.112-0.164)	**0.178** (0.148-0.216)	**0.214** (0.176-0.262)	**0.263** (0.209-0.334)	**0.302** (0.235-0.392)	**0.343** (0.260-0.456)	**0.385** (0.284-0.528)	**0.445** (0.314-0.637)	**0.493** (0.336-0.731)
10-min	**0.147** (0.123-0.178)	**0.193** (0.161-0.235)	**0.255** (0.212-0.310)	**0.306** (0.252-0.376)	**0.377** (0.300-0.479)	**0.433** (0.337-0.562)	**0.491** (0.372-0.654)	**0.552** (0.407-0.757)	**0.638** (0.450-0.913)	**0.706** (0.481-1.05)
15-min	**0.178** (0.148-0.216)	**0.234** (0.195-0.284)	**0.309** (0.256-0.375)	**0.370** (0.305-0.454)	**0.456** (0.363-0.579)	**0.524** (0.407-0.680)	**0.594** (0.450-0.791)	**0.668** (0.492-0.915)	**0.771** (0.544-1.10)	**0.854** (0.582-1.27)
30-min	**0.268** (0.223-0.324)	**0.352** (0.293-0.427)	**0.464** (0.385-0.564)	**0.557** (0.458-0.683)	**0.686** (0.545-0.871)	**0.787** (0.613-1.02)	**0.893** (0.677-1.19)	**1.00** (0.740-1.38)	**1.16** (0.819-1.66)	**1.28** (0.875-1.91)
60-min	**0.394** (0.328-0.477)	**0.517** (0.431-0.627)	**0.682** (0.566-0.829)	**0.818** (0.674-1.00)	**1.01** (0.802-1.28)	**1.16** (0.901-1.50)	**1.31** (0.996-1.75)	**1.48** (1.09-2.02)	**1.71** (1.20-2.44)	**1.89** (1.29-2.80)
2-hr	**0.585** (0.488-0.709)	**0.760** (0.633-0.922)	**0.988** (0.820-1.20)	**1.17** (0.966-1.44)	**1.43** (1.13-1.81)	**1.62** (1.26-2.10)	**1.82** (1.38-2.42)	**2.03** (1.49-2.78)	**2.31** (1.63-3.30)	**2.53** (1.72-3.75)
3-hr	**0.741** (0.618-0.898)	**0.959** (0.798-1.16)	**1.24** (1.03-1.51)	**1.47** (1.21-1.80)	**1.77** (1.41-2.25)	**2.00** (1.56-2.60)	**2.24** (1.70-2.98)	**2.48** (1.83-3.40)	**2.81** (1.98-4.02)	**3.06** (2.09-4.54)
6-hr	**1.05** (0.876-1.27)	**1.36** (1.13-1.65)	**1.75** (1.45-2.13)	**2.06** (1.70-2.53)	**2.47** (1.97-3.14)	**2.78** (2.16-3.61)	**3.09** (2.34-4.11)	**3.40** (2.51-4.66)	**3.82** (2.69-5.46)	**4.13** (2.81-6.13)
12-hr	**1.38** (1.15-1.67)	**1.80** (1.50-2.19)	**2.33** (1.93-2.83)	**2.74** (2.26-3.36)	**3.28** (2.61-4.17)	**3.68** (2.86-4.78)	**4.07** (3.09-5.42)	**4.46** (3.29-6.12)	**4.97** (3.51-7.12)	**5.35** (3.65-7.94)
24-hr	**1.85** (1.64-2.13)	**2.45** (2.16-2.83)	**3.20** (2.82-3.70)	**3.78** (3.31-4.41)	**4.54** (3.84-5.47)	**5.10** (4.23-6.27)	**5.64** (4.57-7.10)	**6.18** (4.87-8.00)	**6.87** (5.20-9.27)	**7.39** (5.41-10.3)
2-day	**2.23** (1.98-2.58)	**3.02** (2.67-3.49)	**4.02** (3.55-4.65)	**4.81** (4.21-5.61)	**5.85** (4.95-7.04)	**6.62** (5.49-8.14)	**7.38** (5.98-9.29)	**8.14** (6.41-10.5)	**9.14** (6.91-12.3)	**9.89** (7.23-13.8)
3-day	**2.42** (2.15-2.80)	**3.33** (2.95-3.85)	**4.50** (3.97-5.20)	**5.43** (4.75-6.33)	**6.67** (5.64-8.03)	**7.60** (6.30-9.35)	**8.53** (6.91-10.7)	**9.47** (7.46-12.3)	**10.7** (8.11-14.5)	**11.7** (8.54-16.3)
4-day	**2.62** (2.32-3.03)	**3.64** (3.22-4.21)	**4.96** (4.38-5.74)	**6.03** (5.27-7.03)	**7.45** (6.31-8.98)	**8.53** (7.08-10.5)	**9.62** (7.79-12.1)	**10.7** (8.45-13.9)	**12.2** (9.23-16.5)	**13.3** (9.76-18.6)
7-day	**3.02** (2.68-3.48)	**4.25** (3.76-4.91)	**5.87** (5.17-6.79)	**7.18** (6.28-8.38)	**8.97** (7.60-10.8)	**10.3** (8.58-12.7)	**11.7** (9.51-14.8)	**13.2** (10.4-17.1)	**15.1** (11.4-20.4)	**16.6** (12.2-23.2)
10-day	**3.27** (2.89-3.76)	**4.63** (4.10-5.35)	**6.44** (5.68-7.45)	**7.93** (6.93-9.24)	**9.96** (8.43-12.0)	**11.5** (9.57-14.2)	**13.2** (10.7-16.6)	**14.8** (11.7-19.2)	**17.1** (13.0-23.1)	**18.9** (13.8-26.4)
20-day	**3.86** (3.42-4.45)	**5.55** (4.91-6.40)	**7.83** (6.90-9.06)	**9.74** (8.52-11.4)	**12.4** (10.5-15.0)	**14.5** (12.0-17.9)	**16.7** (13.5-21.1)	**19.0** (15.0-24.7)	**22.3** (16.9-30.0)	**24.9** (18.2-34.7)
30-day	**4.56** (4.03-5.25)	**6.55** (5.79-7.56)	**9.28** (8.19-10.7)	**11.6** (10.1-13.5)	**14.9** (12.6-17.9)	**17.5** (14.5-21.5)	**20.3** (16.4-25.5)	**23.2** (18.3-30.1)	**27.4** (20.7-36.9)	**30.7** (22.5-42.9)
45-day	**5.39** (4.77-6.21)	**7.70** (6.81-8.88)	**10.9** (9.61-12.6)	**13.6** (11.9-15.9)	**17.6** (14.9-21.2)	**20.8** (17.2-25.5)	**24.2** (19.6-30.4)	**27.8** (21.9-36.0)	**33.0** (25.0-44.6)	**37.3** (27.3-52.0)
60-day	**6.33** (5.60-7.29)	**8.92** (7.89-10.3)	**12.5** (11.1-14.5)	**15.7** (13.7-18.3)	**20.2** (17.1-24.4)	**23.9** (19.9-29.5)	**27.9** (22.6-35.2)	**32.3** (25.4-41.8)	**38.5** (29.1-51.9)	**43.6** (31.9-60.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

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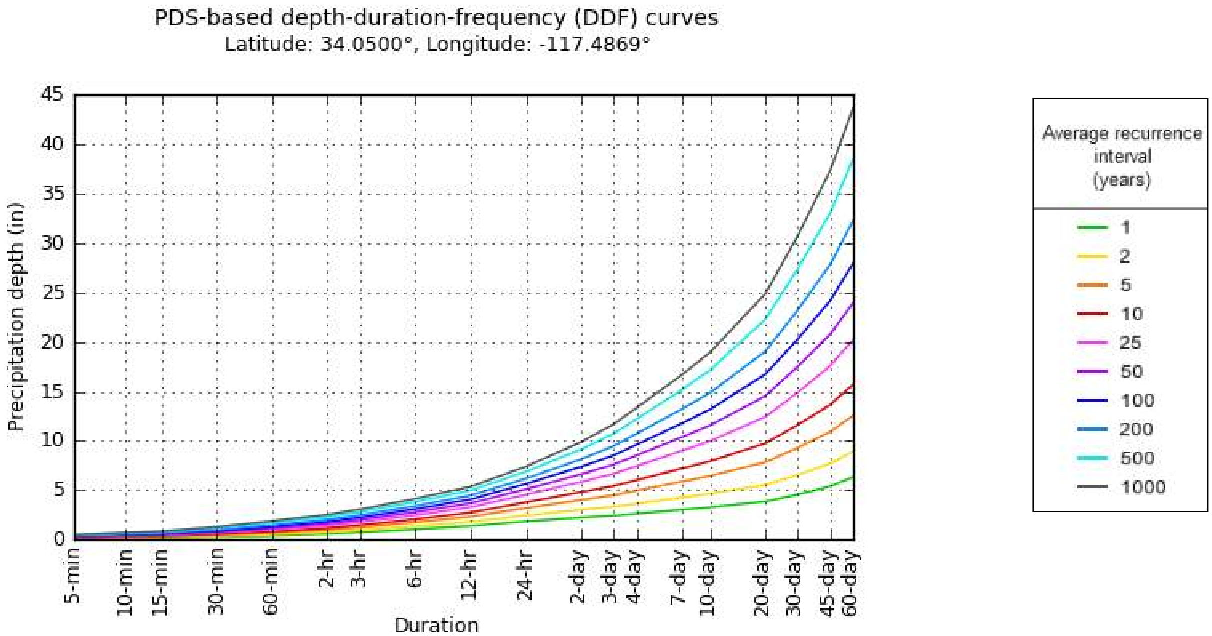
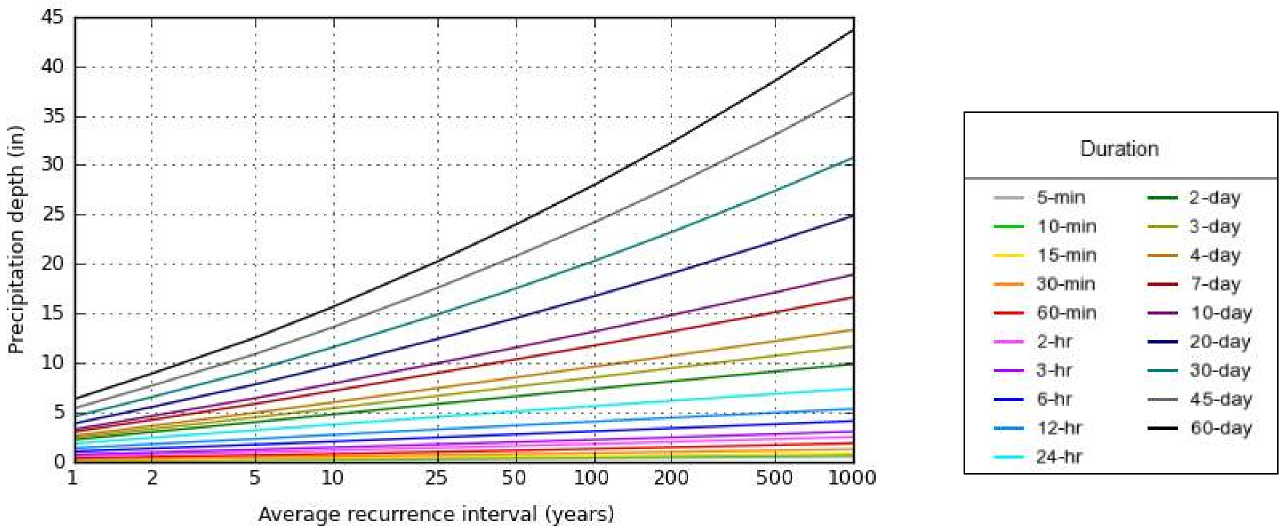
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue May 9 00:44:32 2023

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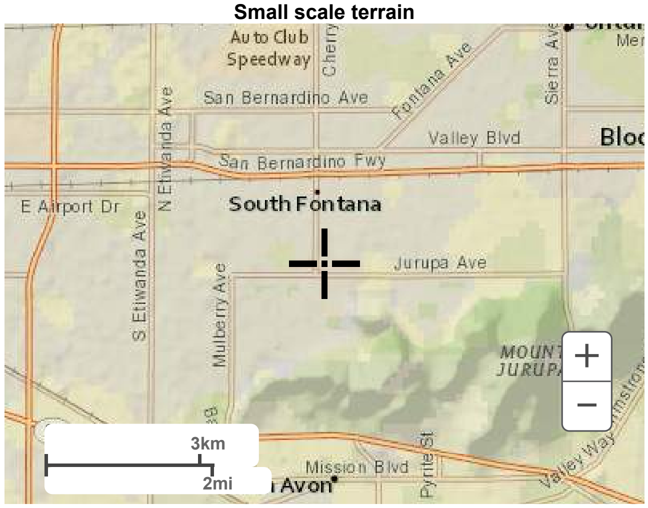
Maps & aerials

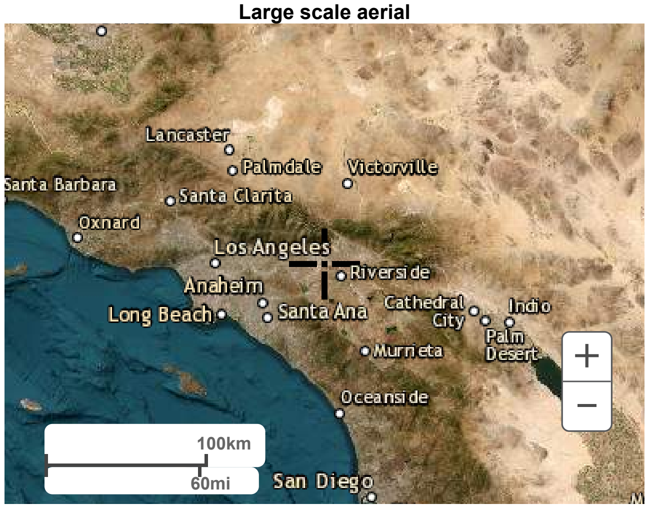
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Preliminary

Water Quality Management Plan

For:

Hillwood – Cherry Industrial

APN: 0236-191-14 & 0236-191-25
R315884.01 & .02

Prepared for:

Hillwood Enterprises

901 Via Piemonte, Suite 175

Ontario, CA 91764

909-382-0033

Prepared by:

Huitt-Zollars, Inc

3990 Concours, Suite 330

Ontario, CA 91764

909-941-7799

Prepared Date: 05/8/2022
Submittal Date: _________
Revision Date: _________

Preliminary for Entitlements Complete Date: ______________________

Construction WQMP Complete Date: ______________________

Final WQMP Approved Date: ______________________

MCN No.____________ **WQMP No.___________**

Project Owner's Certification

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

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

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	N/A	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			0236-191-14 & 0236-191-25

Owner's Signature			
Owner Name: Kathy Hoffer			
Title	Vice President, Development		
Company	Hillwood Enterprises, LP		
Address	901 Via Piemonte, Suite 175 Ontario, CA 91764		
Email	Kathy.Hoffer@hillwood.com		
Telephone #	909-382-0033		
Signature	FINAL TO BE SIGNED	Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	N/A	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			0236-191-14 & 0236-191-25

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

Engineer: Manuel (Manny) Gonzales, PE		PE Stamp Below
Title	Project Manager	
Company	Huitt-Zollars, Inc	
Address	3990 Concours, Suite 330. Ontario, CA 91764	
Email	mgonzales@huitt-zollars.com	
Telephone #	909-941-7799 ext. 11450	
Signature	FINAL TO BE SIGNED	
Date		

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Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

<table>
<tr><td colspan="2">Project Name</td><td colspan="6">Hillwood – Cherry Industrial</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="6">Kathy Hoffer</td></tr>
<tr><td>Mailing Address:</td><td colspan="2">901 Via Piemonte, Suite 175
Ontario, CA 91764</td><td>E-mail Address:</td><td>Kathy.Hoffer@hillwood.com</td><td>Telephone:</td><td colspan="2">909-382-0033</td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td colspan="2">TBD</td><td>Tract/Parcel Map Number(s):</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Additional Information/
Comments:</td><td colspan="6">N/A</td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="6">This project is a new development of two industrial warehouse facilities located to the north of Jurupa Avenue, between Cherry Avenue and Redwood Avenue in the City of Fontana, San Bernardino County. The proposed buildings' footprints are approximately 477,480 square feet and 224,315 square feet on approximately 29.5 acres. The existing site is partially developed with a majority of the site being used as a storage yard. All on-site run-off will be collected by catch basins and conveyed to one of the two underground infiltration systems. Each system is designed to collect and treat the design capture volume (DCV) of the tributary area. The runoff from building 1 will be collected to the at the south east area of the building 1 site and have a 90,603 cubic foot capacity. The runoff from building 2 will be collected in the southwest section of the site and have a 47,009 cubic foot capacity. An outflow storm drain line will be provided to discharge runoff beyond the design capture volume at a controlled rate. Each building site will have a separate outlet but will join at a public storm drain facility and will connect to the existing 78-inch public storm drain in Jurupa Avenue.</td></tr>
<tr><td colspan="2">Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.</td><td colspan="6">N/A</td></tr>
</table>

Section 2 Project Description

2.1 Project Information

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

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

Form 2.1-1 Description of Proposed Project			
1 Development Category (Select all that apply):			
☐ Significant re-development involving the addition or replacement of 5,000 ft^2 or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft^2 or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft^2 or more
☐ Hillside developments of 5,000 ft^2 or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft^2 of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☐ Parking lots of 5,000 ft^2 or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft^2 or more, or have a projected average daily traffic of 100 or more vehicles per day
☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.			

2 Project Area (ft2):	1,284,635	3 Number of Dwelling Units:	N/A	4 SIC Code:	1541
5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*					
6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*					

2.2 Property Ownership/Management

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

Form 2.2-1 Property Ownership/Management
Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:
The property is being developed by Hillwood Enterprises. Hillwood Enterprises, or subsequent owners of the property, will be the entity responsible for long term maintenance of WQMP Storm Water Facilities throughout the site. Name: Hillwood Enterprises Address: 901 Via Piemonte, Suite 175 Ontario, CA 91764 Contact Person: Kathy Hoffer, Vice President, Development Phone: 909-382-0033

2.3 Potential Stormwater Pollutants

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

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Pathogens are typically caused by the transport of animal or human fecal wastes from the watershed.
Nutrients - Phosphorous	E ☒	N ☐	Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Noxious Aquatic Plants	E ☒	N ☐	Noxious aquatic plants are typically from animals or vehicle transport that grow aggressively, multiply quickly without natural controls (native herbivores, soil chemistry, etc.), and adversely affect native habitats.
Sediment	E ☒	N ☐	Sediments are solid materials that are eroded from the land surface.
Metals	E ☒	N ☐	The primary source of metal pollution in stormwater is typically commercially available metals and metal products, as well as emissions from brake pad and tire tread wear associated with driving.
Oil and Grease	E ☒	N ☐	Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E ☒	N ☐	Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste from human or animals
Pesticides / Herbicides	E ☒	N ☐	Pesticides and herbicides can be washed off urban landscapes during storm events.
Organic Compounds	E ☒	N ☐	Sources of organic compounds may include waste handling areas and vehicle or landscape maintenance areas.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits **(N/A)**

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

Form 2.4-1 Water Quality Credits			
1 Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % 0 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	**NOT APPLICABLE**		

Section 3 Site and Watershed Description

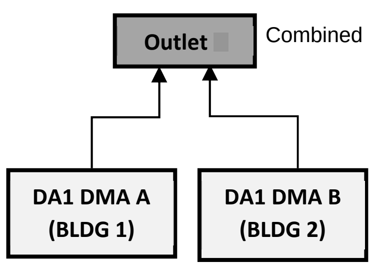
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and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

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34°02'59"N	Longitude 117°13'13"W	Thomas Bros Map page 644

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

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



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA A (BLDG 1) to Outlet 1	Runoff from the area DMA A will be directed to the proposed detention/infiltration basin along the southeastern corner of the site and excess will discharge onto Jurupa Avenue.
DA1 DMA B (BLDG 2) to Outlet 1	Runoff from the area DMA B will be directed to the proposed detention/infiltration basin along the western section of the site and excess will discharge onto Jurupa Avenue.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA 1	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	1,338,678	N/A	N/A	N/A
2 Existing site impervious area (ft^2)	0	N/A	N/A	N/A
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	N/A	N/A	N/A
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	A	N/A	N/A	N/A
5 Longest flowpath length (ft)	1,832	N/A	N/A	N/A
6 Longest flowpath slope (ft/ft)	0.009	N/A	N/A	N/A
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Undeveloped/ Barren	N/A	N/A	N/A
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Poor	N/A	N/A	N/A

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

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool -* *See 'Drainage Facilities" link at this website*	Cherry Ave Storm Drain, Declez Channel, San Sevaine Channel, Santa Ana Reach 3,2,1, Prado Control basin, and Pacific Ocean.
Applicable TMDLs *Refer to Local Implementation Plan*	Per 2010 303(d) list, Santa Ana River Reach 3: TMDL still required. Prado Flood Control Basin: TMDL still required.
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	The project expects to generate Pathogens, Nutrients and Metals (Copper & Lead) which are listed for downstream receiving waters on the latest CWA 303(d) list.
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	None
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	Santa Ana River
Hydrologic Conditions of Concern	☐ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☒ No Included the WAP report for verification
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

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

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

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Property owners shall review and become familiar with the site specific WQMP. Additional educational materials for day to day operations are contained in Attachment C. Additional materials can be obtained from the local water pollution prevention program. Education of property owners begin with the review/preparation of the site specific WQMP and continues through the review of additional educational material as it applies to their project.
N2	Activity Restrictions	☒	☐	Activity restriction shall be stated in the owners lease terms prior to occupancy: • Fuelling areas, air/water supply areas, maintenance bays, vehicle washing areas, outdoor material storage areas, outdoor work areas, outdoor processing areas, wash water from food preparation areas within the project site will not be allowed on the project site. • Storage of hazardous materials will not be allowed on the project site. • All pesticide applications shall be performed by a licensed contractor certified by the California Department of Pesticide Regulation. • All dumpster lids shall be kept closed at all times. • Blowing, Sweeping or hosing of debris (leaf, litter, grass clippings, trash or debris) into the streets, underground stormdrain facilities or other storm water conveyance areas shall be strictly prohibited
N3	Landscape Management BMPs	☒	☐	A landscape architect will provide design plans for the on-site landscaping and irrigation system. The design shall incorporate the use of native and drought tolerant trees and shrubs throughout the project site.
N4	BMP Maintenance	☒	☐	Property owners shall maintain the designated on-site BMP areas, see Section 5 for self inspection and maintenance form
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Industrial purposed warehouse does not apply to Title 22 CCR.
N6	Local Water Quality Ordinances	☒	☐	Local Water Quality Ordinances will be addressed by implementation of this WQMP

Form 4.1-1 Non-Structural Source Control BMPs				
N7	Spill Contingency Plan	☒	☐	Industrial Warehouse buildings and truck dock areas have potential for spills and therefore each tenant shall be required to prepare a spill contingency plan and it shall be implemented in accordance with section 6.95 of the California Health and Safety Code. The spill contingency plan shall identify responsible persons in the event of a spill, an action item list identifying how the spill should be contained, cleaned up and who should be contacted in the event of a spill. Documentation of any spill event and cleanup process shall be kept on site in perpetuity.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks are proposed for this site.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials are planned to be stored on this site.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	Underground fire protection service and fire sprinklers will be provided per the uniform fire code and the requirements of the County of San Bernardino Fire Department.
N11	Litter/Debris Control Program	☒	☐	Trash storage areas will be designed to have adjacent areas drain away from the trash storage areas. The trash storage areas shall be inspected and maintained on a monthly basis. Collection of trash from the trash storage areas shall occur on a regular basis to ensure that the trash receptacles are not overflowing. Documentation of such inspection/maintenance and trash collection shall be kept by the owner in perpetuity. See the WQMP site map in Attachment A for anticipated location of trash storage areas.
N12	Employee Training	☒	☐	The following requirements shall be stated in the owners lease terms; an Employee Training/Education program shall be provided annually to help educate employees about storm water quality management and practices that help prevent storm water pollution. Documentation of such training/education program implementation shall be kept by the owner for a minimum of ten years. Sample education materials have been provided in Attachment C. Additional educational materials can be obtained from the City of Fontana or the County of San Bernardino storm water program.
N13	Housekeeping of Loading Docks	☒	☐	The project site will have truck docks. The truck docks shall be inspected on a weekly basis to help ensure that any trash and debris are collected prior to being washed into the underground storm drain system. All storm water runoff from the loading dock areas will be discharged into infiltration basins and/or underground infiltration system prior to conveyance to the public storm drain system. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
N14	Catch Basin Inspection Program	☒	☐	The onsite catch basins shall be inspected on a quarterly basis. Inspection of the on-site catch basins shall consist of visual inspection of any sediment, trash or debris collected in the bottom of each catch basin. Any sediment, trash or debris found shall be removed from the catch basins and disposed of in a legal manner. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.

N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	The on-site parking lots, drive aisles, and loading dock areas shall be swept on a monthly basis. Documentation of such sweeping shall be kept by the owner in perpetuity. Frequency of sweeping shall be adjusted as needed to maintain a clean site.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not Applicable
N17	Comply with all other applicable NPDES permits	☒	☐	General construction permit "SWRCB Orders No. 2009-009-DWQ as amended by Order 2010-0014-DWQ"

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	The on-site storm drain catch basins shall be stenciled with the phrase "Drains to River" or other approved language. The signage shall be inspected on an annual basis. Missing or faded signage shall be replaced. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage areas are proposed for this site.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash storage areas will be designed to have adjacent areas drain away from the trash storage areas as well as have a permanent roof over them. The trash storage areas shall be inspected and maintained on a monthly basis. Collection of trash from the trash storage areas shall occur on a regular basis to ensure that the trash receptacles are not overflowing. Documentation of such inspection/maintenance and trash collection shall be kept by the owner in perpetuity. See the WQMP site map in Attachment A for anticipated location of trash storage areas.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	The landscape architect will provide design plans for the on-site irrigation system. The irrigation system shall be inspected on a monthly basis to ensure proper operation. Any broken sprinkler heads shall be repaired immediately to ensure that the system continues to operate efficiently. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	The landscape architect will provide design plans for the on-site landscaping and irrigation system. The design shall incorporate a finish grade of landscaping areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement throughout the project site.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	No designed slope and channel are planned for this site.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Docks are not covered.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No maintenance bays are planned for this site.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash areas are planned for this site.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas are planned for this site.
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No equipment wash areas are planned for this site.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas are planned for this site.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside landscaping are planned in this area.
S14	Wash water control for food preparation areas	☐	☒	Food preparation areas are not planned for this site.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community car wash racks are planned for this site.

4.1.2 Preventative LID Site Design Practices

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

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

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

Form 4.1-3 Preventative LID Site Design Practices Checklist
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☐ No ☒ Explanation: Industrial developments maximize the building and parking footprint. However, an underground infiltration system is sized accordingly.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: The entire site's runoff drains to the underground infiltration system, thereby maximizing the natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: All of the site's runoff will drain to an on-site underground Infiltration System. The underground Infiltration system will meet 48-hour drawdown requirements which will lengthen the time of concentration. Thus, mimicking the existing time of concentration condition.
Disconnect impervious areas: Yes ☐ No ☒ Explanation: No, however the underground infiltration system is sized to detain and infiltrate runoff generated from the DCV by all impervious areas.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The site has no existing vegetation or sensitive areas to protect. New vegetation will be placed throughout the site.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: All landscape areas will be vegetated for stabilization.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The soils in the proposed infiltration system's footprint will be uncompacted.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Some landscaped swales will be provided but we are not taking LID credit. Releasing roof runoff directly into these swales will cause them to erode. Instead, roof drains will be piped into the proposed onsite storm drain system.

4.2 Project Performance Criteria

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

Methods applied in the following forms include:

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

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

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DMA A – BLDG 1)		
1 Project area DMA A (ft^2): 834,715	2 Imperviousness after applying preventative site design practices (Imp%): 89.3%	3 Runoff Coefficient (Rc): 0.72 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.517		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.766 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 75,308 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DMA B – BLDG 2)

1 Project area DMA B (ft^2): 449,920	2 Imperviousness after applying preventative site design practices (Imp%): 87.2%	3 Runoff Coefficient (Rc): 0.69 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.517		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.766 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*	24-hrs ☐ 48-hrs ☒	
7 Compute design capture volume, DCV (ft^3): 38,900 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

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

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

Go to: *http://permitrack.sbcounty.gov/wap/*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

13 Pre-developed time of concentration (min): N/A *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): N/A *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet HCOC requirement (min): N/A *T_{C-HCOC} = (Item 13 * 0.95) – Item 14*

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

Compute peak runoff for pre- and post-developed conditions

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

8 Pre-developed Q_p at T_c for DMA A: N/A

*Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*

9 Pre-developed Q_p at T_c for DMA B: N/A

*Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*

10 Pre-developed Q_p at T_c for DMA C: N/A

*Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*

10 Peak runoff from pre-developed condition confluence analysis (cfs): N/A *Maximum of Item 8, 9, and 10 (including additional forms as needed)*

11 Post-developed Q_p at T_c for DMA A: N/A
Same as Item 8 for post-developed values

12 Post-developed Q_p at T_c for DMA B: N/A
Same as Item 9 for post-developed values

13 Post-developed Q_p at T_c for DMA C: N/A
Same as Item 10 for post-developed values

14 Peak runoff from post-developed condition confluence analysis (cfs): N/A *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

15 Peak runoff reduction needed to meet HCOC Requirement (cfs): N/A *Q_{p-HCOC} = (Item 14 * 0.95) – Item 10*

4.3 Project Conformance Analysis

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

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

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

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

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

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

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

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

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

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP.
If no, then proceed to Item 9, below.

[9] All answers to Item 1 through Item 6 are "No":
Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.
Proceed to Form 4.3-2, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP (N/A)

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

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1) (N/A)			
1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): $V_{retention}$ *=Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): $V_{retention}$ *=Sum of Item 12 for all BMPs*			

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1) (N/A)			
14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) $V_{retention}$ *= Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3):	$V_{retention}$ *=Sum of Item 19 for all BMPs*		
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3):	$V_{retention}$ *= Sum of Item 24 for all BMPs*		
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) $V_{retention}$ *= Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3):	$V_{retention}$ *=Sum of Item 28 for all BMPs*		
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs:	*Sum of Items 5, 13, 20, 25 and 29*		

4.3.2 Infiltration BMPs

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

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

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

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

[1] Remaining LID DCV not met by site design HSC BMP (ft³): 75,308 & 38,900 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A (BLDG 1) BMP Type UG	DA 1 DMA B (BLDG 2) BMP Type UG	DA DMA BMP Type *(Use additional forms for more BMPs)*
[2] Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods SOILS REPORT*	3.7	2.4	N/A
[3] Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.75	2.75	N/A
[4] Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.35	0.87	N/A
[5] Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	N/A
[6] Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	5	3.5	N/A
[7] Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	5	3.5	N/A
[8] Infiltrating surface area, SA_{BMP} (ft²) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	21,390	14,457	N/A
[9] Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
[10] Amended soil porosity	N/A	N/A	N/A
[11] Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A	N/A	N/A
[12] Gravel porosity	N/A	N/A	N/A
[13] Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	N/A	N/A	N/A
[14] Above Ground Retention Volume (ft³) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0	0	N/A
[15] Underground Retention Volume (ft³) *Volume determined using manufacturer's specifications and calculations*	90,603 (See Attachment B For Manufacturer's Specs)	47,009 (See Attachment B For Manufacturer's Specs)	N/A

[16] Total Retention Volume from LID Infiltration BMPs: 137,612 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

[17] Fraction of DCV achieved with infiltration BMP: 120% *Retention% = Item 16 / Form 4.2-1 Item 7*

[18] Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.3 Harvest and Use BMP (N/A)

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

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

Form 4.3-4 Harvest and Use BMPs (DA 1) N/A			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*			
BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff detention facility	N/A	N/A	N/A
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*	N/A	N/A	N/A
4 Landscaped area planned for use of harvested stormwater (ft^2)	N/A	N/A	N/A
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day	N/A	N/A	N/A
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*	N/A	N/A	N/A
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*	N/A	N/A	N/A
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*	N/A	N/A	N/A
9 Total Retention Volume (ft^3) from Harvest and Use BMP = 0 *Sum of Item 8 for all harvest and use BMP included in plan*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*			

4.3.4 Biotreatment BMP (N/A)

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

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

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

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

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

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A	N/A	N/A
2 Amended soil infiltration rate *Typical ~ 5.0*	N/A	N/A	N/A
3 Amended soil infiltration safety factor *Typical ~ 2.0*	N/A	N/A	N/A
4 Amended soil design percolation rate (in/hr) P_{design} *= Item 2 / Item 3*	N/A	N/A	N/A
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*	N/A	N/A	N/A
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
7 Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*	N/A	N/A	N/A
8 Amended soil surface area (ft^2)	N/A	N/A	N/A
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
10 Amended soil porosity, *n*	N/A	N/A	N/A
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
12 Gravel porosity, *n*	N/A	N/A	N/A
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	N/A	N/A	N/A
14 Biotreated Volume (ft^3) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	N/A	N/A	N/A
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: 0 *Sum of Item 14 for all volume-based BMPs included in this form*			

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

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

13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : 0
(Sum of Item 12 for all BMP included in plan)

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

4.3.5 Conformance Summary

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

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)
1 Total LID DCV for the Project DA-1 (ft^3): 75,308 & 38,900 *Copy Item 7 in Form 4.2-1*
2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*
3 On-site retention with LID infiltration BMP (ft^3): 90,603 & 47,009 *Copy Item 16 in Form 4.3-3*
4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*
5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*
6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-5*
7 LID BMP performance criteria are achieved if answer to any of the following is “Yes”: • Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐ *If yes, sum of Items 2, 3, and 4 is greater than Item 1* • Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐ N/A See Above *If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized* ▪ On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐ N/A See Above *If yes, Form 4.3-1 Items 7 and 8 were both checked yes*
8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance: • Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐ *Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance,* V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%* • An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐ *Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed*

4.3.6 Hydromodification Control BMP (N/A)

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

Form 4.3-10 Hydromodification Control BMPs (DA 1)	
1 Volume reduction needed for HCOC performance criteria (ft^3): 0 *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): 0 *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): 0 *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*
5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*	
6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ N/A *If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐ *BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)* • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐ • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐	
7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐ N/A *If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐ *BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)* • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐	

4.4 Alternative Compliance Plan (if applicable) (N/A)

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

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

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

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

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

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

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
UG Infilt. System (N4)	Owner	- Inspect/Maintain UG-Infiltration Basin Systems - Isolator Row or clarifier (TBD) for collected trash, sediments and/or debris. Remove trash, sediments and debris by jet-vac and pump and dispose of trash, sediments and debris in a legal manner. - Inspect system for standing water. If system has standing water, perform re-inspection within 48 hours. If system still has standing water then the system shall be jet-vacuumed and pumped and removed debris shall be disposed of in a legal manner.	Bi-monthly and Prior to storm event and 48 hours after storm has passed
Loading Dock and Parking Lot Sweeping (N15)	Owner	Sweep loading dock and parking lot and truck courts.	Monthly / As needed.
Catch Basin Filter (N14)	Owner	- Inspect and maintain catch basin filters as required. - Inspect catch basin bottom for debris / remove debris and dispose as required.	Quarterly

Truck Dock (N13)	Owner	- Inspect loading dock for trash debris and sediments. - Inspect loading dock for evidence of spills and broken containers. - Clean up spills and dispose of collected material in a legal manner.	Weekly
Planting (N3)	Owner	- Inspect health of planting and erosion of landscape area. - Trimming trees and bushes when needed.	Monthly
Efficient Irrigation (S4)	Owner	- Inspect irrigation system general operation and durations. - Repair damaged sprinkler and drip irrigation lines as needed. - Reduce durations during the winter season to prevent over irrigation.	Monthly
Trash Storage Areas and Litter Control (SD-32)(N2,N11)	Owner	Inspect trash container, lids, screens and clean trash storage areas.	Weekly
Employee Training / Education Program	Owner	Building tenants to provide BMP training and hand out educational materials.	Annually or upon hire
Roof Runoff Controls (SD-11)	Owner	Inspect / repair roof drains	Quarterly
Storm drain system signage	Owner	Inspect Catch basin signage for faded or lost signs / repair or replace as needed.	Annually

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

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

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

6.2 Electronic Data Submittal

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

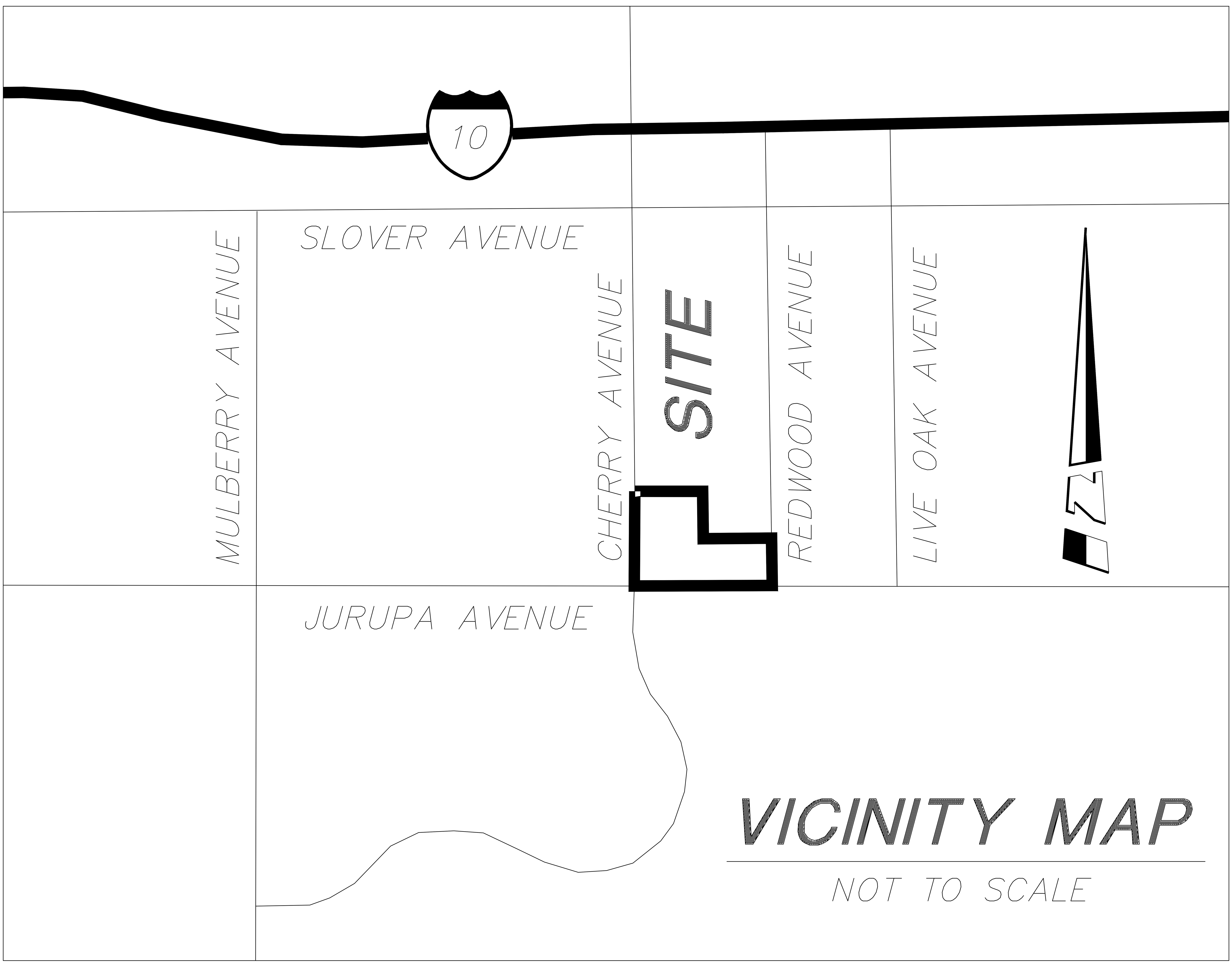
6.3 Post Construction

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

6.4 Other Supporting Documentation

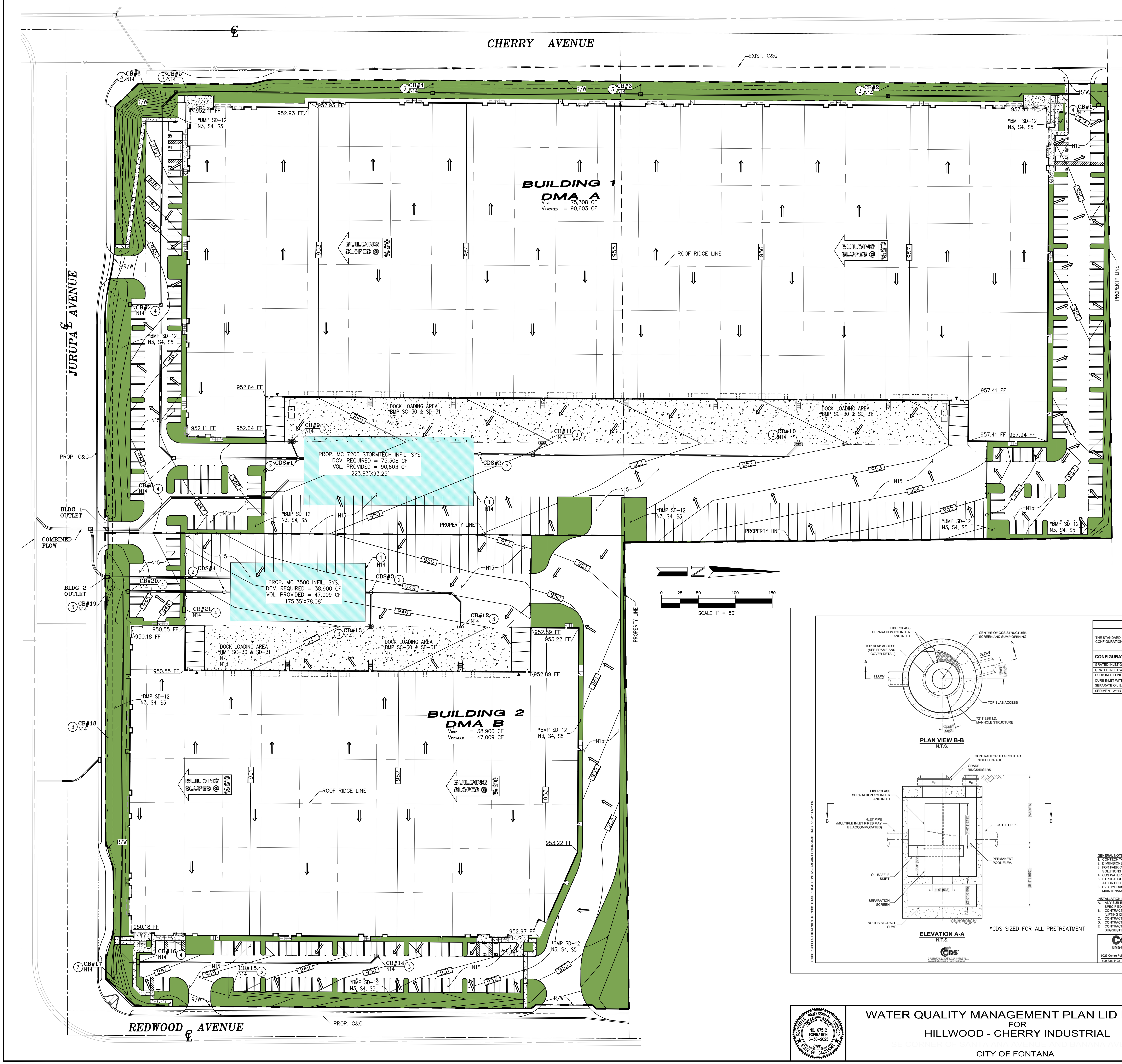
- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

Attachment A
WQMP Site Plan



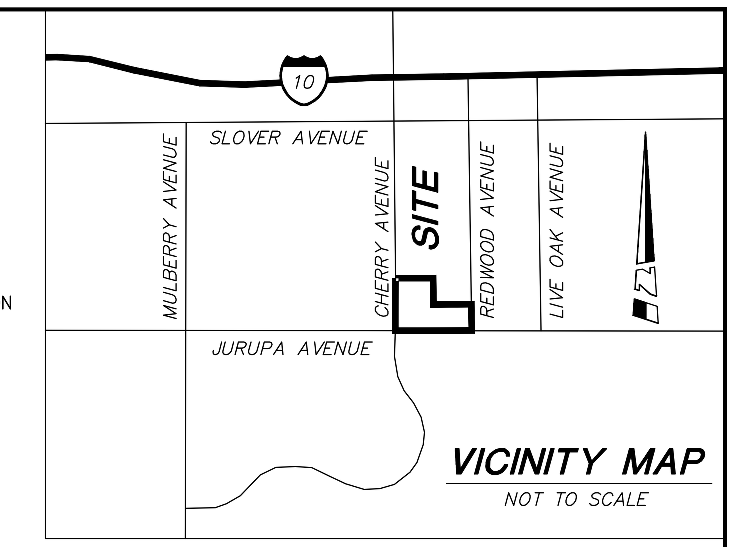
VICINITY MAP

NOT TO SCALE



LEGEND

- PROPOSED STORM DRAIN
- DRAINAGE AREA BOUNDARY
- PROPOSED CATCH BASIN INLET
- PROPOSED LANDSCAPING AREA – *BMP SD-10 & SD-12
- PROPOSED UNDERGROUND INFILTRATION BASIN – *BMP SD-10 & SD-12
- CB CATCH BASIN
- FLOW DIRECTION



VICINITY MAP

NOT TO SCALE

WQMP BMP NOTES

1. INSTALL ADS STORMTECH INFILTRATION/DETENTION SYSTEM OR APPROVED EQUAL
2. INSTALL CDS UNIT (MODEL TO BE SPECIFIED IN FINAL WQMP)
3. OPTIONAL BIOCLEAN GRATE INLET FILTER OR APPROVED EQUAL
4. OPTIONAL BIOCLEAN CURB INLET FILTER OR APPROVED EQUAL

WQMP MANAGEMENT

NAME	AREA (SF)	i	C	V_{BMP} (CF)	BMP	$V_{PROVIDE}$ (CF)
DMA A	834,715	0.893	0.72	75,308	INFILTRATION SYSTEM	90,603
DMA B	449,920	0.872	0.69	38,900	INFILTRATION SYSTEM	47,009

SOURCE CONTROL BMPs INCLUDED ONSITE		
IDENTIFIER	DESCRIPTION OF BMP	RESPONSIBLE PARTY
N2	INSPECT/MAINTAIN TRASH CONTAINER	OWNER
N3	LANDSCAPE MAINTENANCE BMP'S	OWNER
N4	INSPECT/MAINTAIN UG-INFILTRATION BASIN	OWNER
N7	PROVIDE SPILL PLAN	OWNER
N11	LITTER/DEBRIS CONTROL PROGRAM	OWNER
N13	HOUSEKEEPING OF LOADING DOCKS	OWNER
N14	CATCH BASIN INSPECTION PROGRAM	OWNER
N15	VACUUM SWEEPING OF PARKING LOTS	OWNER
N17	NPDES COMPLIANCE	OWNER
S3	REDUCED WASTE STORAGE POLLUTION	OWNER
S4	EFFICIENT IRRIGATION SYSTEM	OWNER
S5	LANDSCAPING MIN. 1-2" BELOW CURB	OWNER

*SEE WQMP REPORT ATTACHMENT C FOR BMP FACT SHEET

DEVELOPER
HILLWOOD
36 DISCOVERY, SUITE 130
IRVINE, CA 92688
901 VIA PIEMONTE
ONTARIO, CA 91764
PHONE: D: (909) 380-7157
M: (949) 310-0083
CONTACT: KATHY HOFFER

ENGINEER
HUITT-ZOLLARS
3990 CONCOURS, SUITE 330
ONTARIO, CALIFORNIA 91764
PHONE: (909) 941-7799
CONTACT: MANUEL GONZALES

CDS3020-6-C DESIGN NOTES
PLAN VIEW B-B
ELEVATION A-A
FRAME AND COVER
SITE SPECIFIC DATA REQUIREMENTS
CONTECH ENGINEERED SOLUTIONS LLC
CDS3020-6-C
INLINE CDS
STANDARD DETAIL

*CDS SIZED FOR ALL PRETREATMENT

WATER QUALITY MANAGEMENT PLAN LID EXHIBIT
FOR
HILLWOOD - CHERRY INDUSTRIAL

CITY OF FONTANA

REGISTERED PROFESSIONAL ENGINEER JOHNNY MURAD NO. 67512 EXPIRATION 6-30-2025 CIVIL STATE OF CALIFORNIA

HUITT ZOLLARS
3990 CONCOURS, SUITE 330, ONTARIO, CALIFORNIA 91764
Phone (909) 941-7799, www.huitt-zollars.com

DESIGNED BY	MG
DRAWN BY	HZ STAFF
CHECKED BY	J.M.
FIELD BOOK	

SHEET 1 OF 2 SHEETS
JOB NO. R315884.01

Trash Capture Products

100% Full trash capture

Grate Inlet Filter

The Bio Clean Grate Inlet Filter for catch basins keeps property owners in compliance. Preferred by public agencies and backed by an 8 year warranty, this easy to install filter is continuously chosen for its durability and simple maintenance.

Constructed of 100% high grade stainless steel, it is built to last longer than any other filter brand. The non-clogging screens provide higher levels of filtration and water flow. The filter is equipped with unimpeded high flow bypass for even the largest storm events.

The filter is also equipped with a floating hydrocarbon boom mounted to rails allowing it to flow up and down with the water level over a range of flow conditions.

The filter is designed for grated inlets of any size and depth. Each filter can be custom built to meet specific project needs. Screen size and media type can be modified to remove specific pollutants.

Advantages and Performance

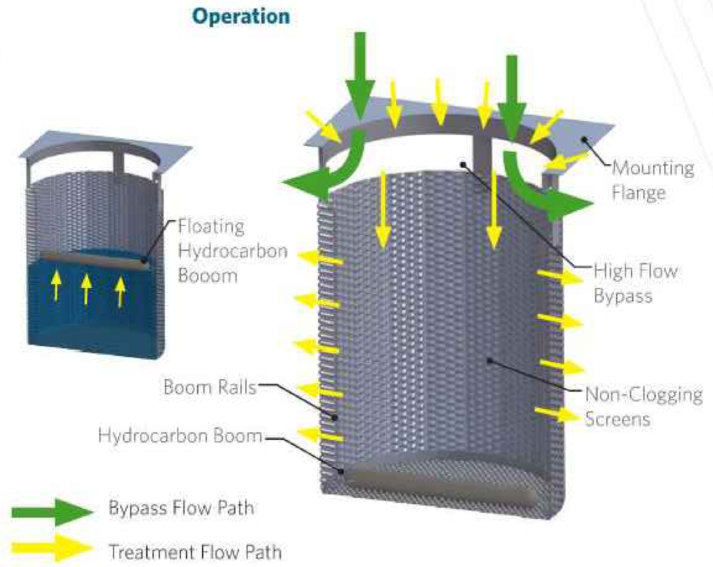
- 8 Year warranty
- Custom sizes available
- No nets or geofabrics
- 15+years user life
- No replacement costs as found with fabric filters
- Meets LEED requirements
- Fits in shallow catch basins
- 100% removal of trash and debris
- Meets full capture requirements

Specifications

Model #	Treatment Flow (CFS)	Bypass Flow (CFS)
BC-GRATE-12-12-12	1.55	1.55
BC-GRATE-18-18-18	4.32	3.68
BC-GRATE-24-24-24	7.67	4.83
BC-GRATE-30-30-24	12.97	6.21
BC-GRATE-25-38-24	13.53	6.59
BC-GRATE-36-36-24	19.64	7.60
BC-GRATE-48-48-18	25.59	10.13

NOTE: Treatment and bypass flow rates include a safety factor of 2.

Operation



(3) OPTIONAL GRATE INLET FILTER

NOT TO SCALE

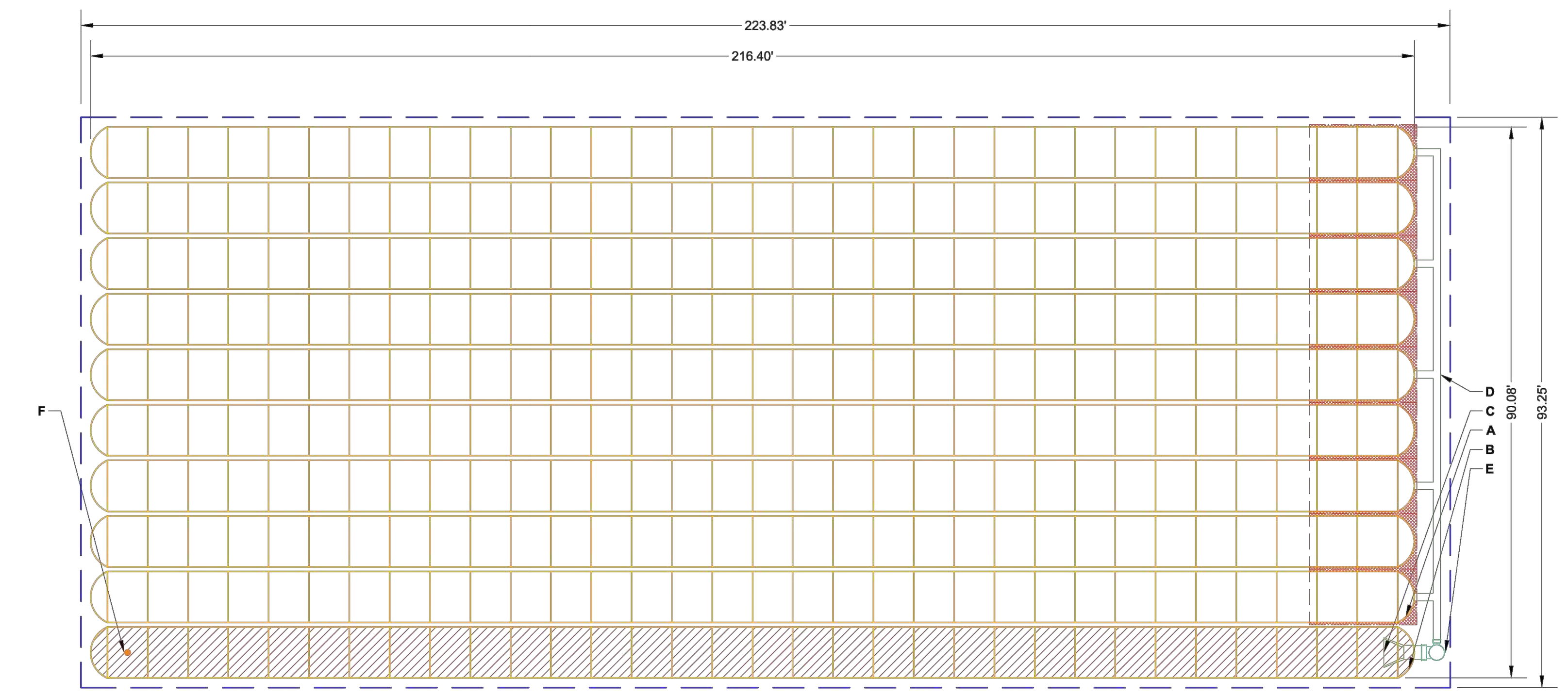
MC-7200 StormTech layout

PROPOSED LAYOUT	
320	STORMTECH MC-7200 CHAMBERS
20	STORMTECH MC-7200 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	STONE VOID
90603	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
20872	SYSTEM AREA (SF)
634.2	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS:	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	12.75
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	8.25
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	7.75
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	7.75
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	7.75
TOP OF STONE:	6.75
TOP OF MC-7200 CHAMBER:	5.75
12" x 12" TOP MANIFOLD INVERT:	3.72
24" ISOLATOR ROW PLUS INVERT:	0.94
BOTTOM OF MC-7200 CHAMBER:	0.75
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	12" TOP PARTIAL CUT END CAP, PART#: MC7200IEPP12T / TYP OF ALL 12" TOP CONNECTIONS	35.69"	
PREFABRICATED END CAP	B	24" BOTTOM PARTIAL CUT END CAP, PART#: MC7200IEPP24B / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.26"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MCFLAMP		
MANIFOLD	D	12" x 12" TOP MANIFOLD, ADS N-12	35.69"	
NYLOPLAST (INLET W/ ISO PLUS ROW)	E	30" DIAMETER (24.00" SUMP MIN)		7.5 CFS IN
INSPECTION PORT	F	4" SEE DETAIL		



ISOLATOR ROW PLUS SEE DETAIL()

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

CHERRY (MC-7200)
FONTANA, CA, USA

DRAWN: TZ
CHECKED: N/A
DATE:
PROJECT #:

DATE | DRW | CHK | DESCRIPTION

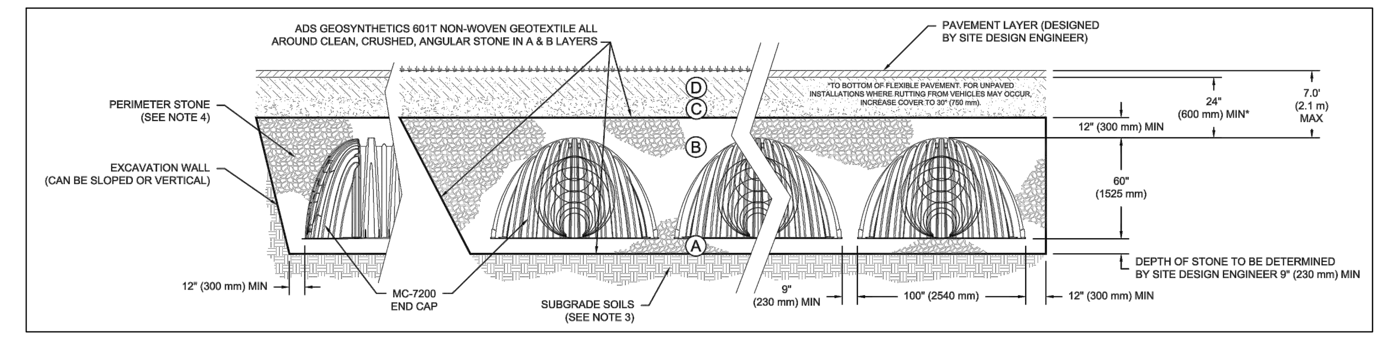
StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SHEET 2 OF 6

(1) MC-7200 STORMTECH INFILTRATION SYSTEM

NOT TO SCALE



BIO CLEAN FULL CAPTURE FILTER WITH TROUGH SYSTEM

FOR USE IN CURB INLETS

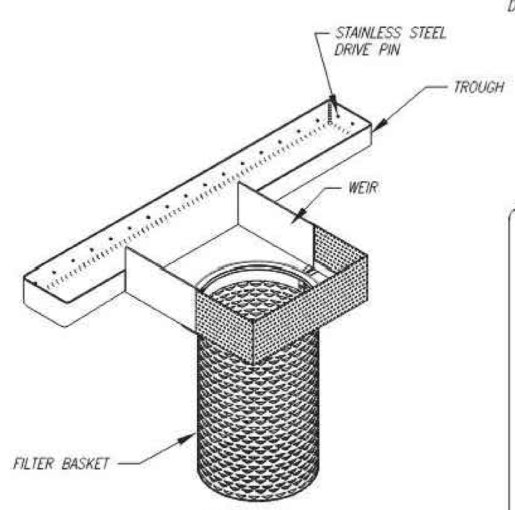


FIGURE 1:
DETAIL OF PARTS

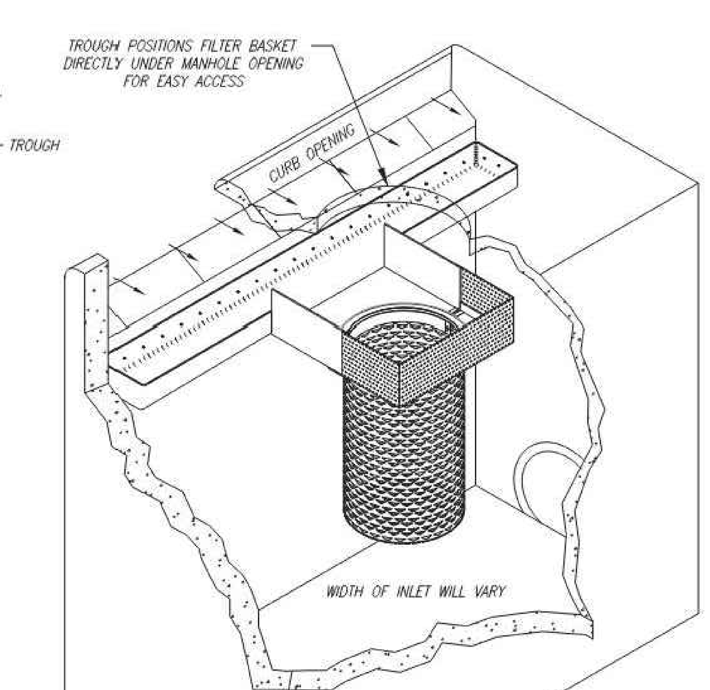


FIGURE 2:
DETAIL OF CONFIGURATION

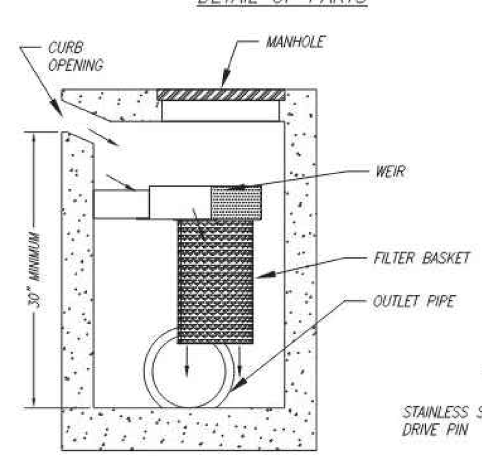


FIGURE 4:
DETAIL OF PROFILE

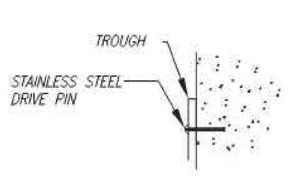


FIGURE 3:
DETAIL OF MOUNTING

NOTES:

1. TROUGH SYSTEM PROVIDES FOR ENTIRE COVERAGE OF INLET OPENING SO TO DIVERT ALL FLOW TO FILTER.
2. TROUGH SYSTEM MANUFACTURED FROM MARINE GRADE FIBERGLASS, GEL COATED FOR UV PROTECTION.
3. SYSTEM ATTACHED TO THE CATCH BASIN WITH NON-CORROSIVE HARDWARE.
4. FILTER MANUFACTURED OF 100% STAINLESS STEEL.
5. FILTER MADE OF NON-CLOGGIN SCREEN WITH 4.7 MM OPENINGS AND MEETS FULL CAPTURE REQUIREMENTS.
6. FILTER CAN BE FITTED WITH HYDROCARBON ABSORBENT BOOM
7. FILTER IS LOCATED DIRECTLY UNDER THE MANHOLE FOR EASY REMOVAL AND MAINTENANCE.
8. LENGTH OF TROUGH CAN VARY FROM 2' TO 30'
9. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE - CONTACT BIO CLEAN FOR MORE INFORMATION.
10. CONSIDERS A SAFETY FACTOR OF 2.0
11. BYPASS IS FACILITATED VIA OVERFLOW OF THE TROUGH SYSTEM AND IS EQUAL TO THE CAPACITY OF THE CURB OPENING
12. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.
13. ADDITIONAL TREATMENT AND STORAGE CAPACITY CAN BE ACHIEVED BY UTILIZING MULTIPLE FILTER BASKETS.

MODEL NUMBER	TREATMENT FLOW (cfs)*	SOLIDS STORAGE CAPACITY (cu ft)
BC-CURB-FC-30	2.85	2.21
BC-CURB-FC-24	2.85	1.77
BC-CURB-FC-18	2.85	1.33
BC-CURB-FC-12	2.85	0.88

*SEE PAGE 2 FOR EXPLANATION OF FLOW RATES

DRAWING: BIO CLEAN CURB INLET FILTER DETAILS		MEETS FULL CAPTURE REQUIREMENTS	
TREATMENT FLOW RATE: 2.85 cfs		MODEL #: BC-CURB-FC	
WARRANTY: 5 YEAR MANUFACTURERS		PROJECT:	
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE:760-433-7640 FAX:760-433-3176		REVISIONS:	DATE:
		REVISIONS:	DATE:
DATE: 10/12/2017	SCALE: NTS	REVISIONS:	DATE:
DRAFTER: M.C.P.	UNITS = INCHES	REVISIONS:	DATE:

Bio Clean
A Forterra Company

PAGE 1

(4) OPTIONAL CURB INLET FILTER

NOT TO SCALE

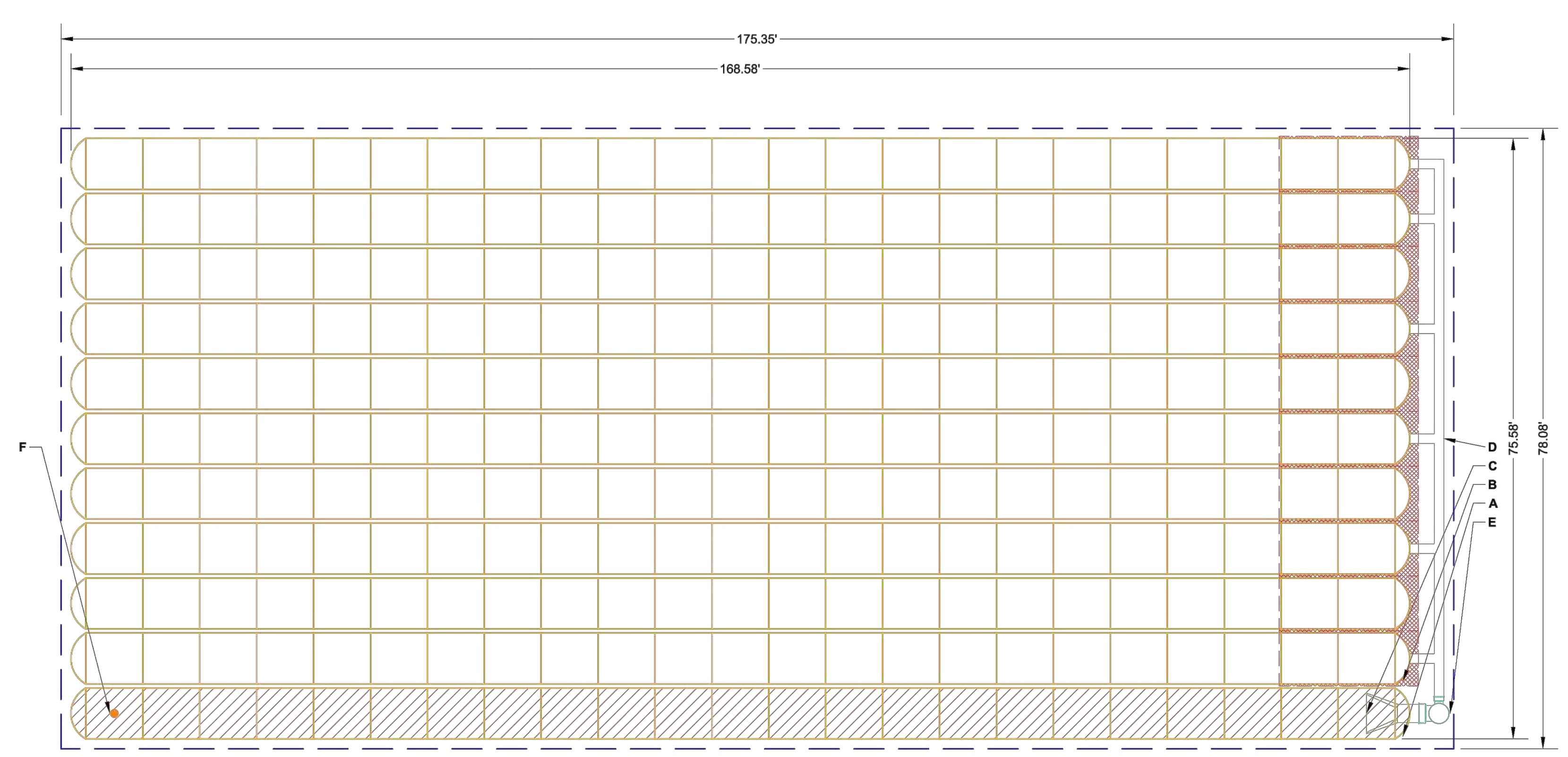
MC-3500 StormTech layout

PROPOSED LAYOUT	
253	STORMTECH MC-3500 CHAMBERS
22	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	STONE VOID
47009	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
13692	SYSTEM AREA (SF)
506.9	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS:	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	12.50
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	6.50
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	6.00
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	6.00
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	6.00
TOP OF STONE:	5.50
TOP OF MC-3500 CHAMBER:	4.50
12" x 12" TOP MANIFOLD INVERT:	2.95
24" ISOLATOR ROW PLUS INVERT:	0.92
BOTTOM OF MC-3500 CHAMBER:	0.75
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	24" BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.06"	
PREFABRICATED END CAP	B	12" TOP CORED END CAP, PART#: MC3500IEPP12T / TYP OF ALL 12" TOP CONNECTIONS	26.36"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MCFLAMP		
MANIFOLD	D	12" x 12" TOP MANIFOLD, ADS N-12	26.36"	
NYLOPLAST (INLET W/ ISO PLUS ROW)	E	30" DIAMETER (24.00" SUMP MIN)		6.7 CFS IN
INSPECTION PORT	F	4" SEE DETAIL		



ISOLATOR ROW PLUS SEE DETAIL()

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

CHERRY (MC-3500)
FONTANA, CA, USA

DRAWN: TZ
CHECKED: N/A
DATE:
PROJECT #:

DATE | DRW | CHK | DESCRIPTION

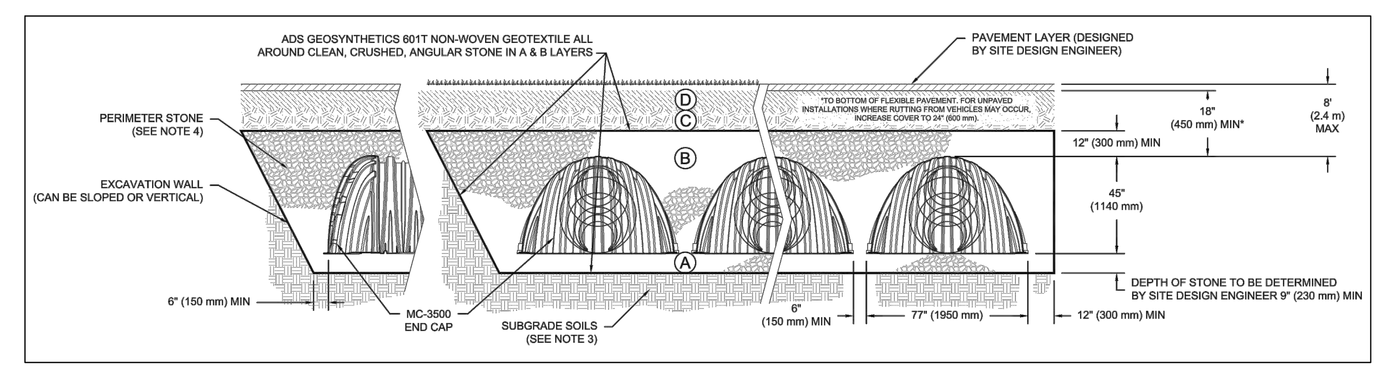
StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SHEET 2 OF 6

(1) MC-3500 STORMTECH INFILTRATION SYSTEM

NOT TO SCALE



REGISTERED PROFESSIONAL ENGINEER
JOHNNY MURAD
NO. 67512
EXPIRATION 6-30-2025
CIVIL
STATE OF CALIFORNIA

WATER QUALITY MANAGEMENT PLAN LID EXHIBIT
FOR
HILLWOOD - CHERRY INDUSTRIAL
SE CORNER OF SANTA ANA AVENUE AND BANANA AVEUNE
CITY OF FONTANA

HZ HUITT ZOLLARS
3990 CONCOURS, SUITE 330, ONTARIO, CALIFORNIA 91764
Phone (909) 941-7799, www.huitt-zollars.com

DESIGNED BY	MG
DRAWN BY	HZ STAFF
CHECKED BY	J.M.
FIELD BOOK	

SHEET 1 OF 2 SHEETS

JOB NO. R315884.01

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Attachment B
BMP Details, Support Calc's, and Fact Sheets

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

ADS SiteAssist™
FOR STORMTECH INSTALLATION INSTRUCTIONS VISIT OUR APP

CHERRY (MC-7200)

FONTANA, CA, USA

MC-7200 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-7200.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-7200 CHAMBER SYSTEM

1. STORMTECH MC-7200 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-7200 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE SHALL BE BROUGHT UP EVENLY AROUND CHAMBERS SO AS NOT TO DISTORT THE CHAMBER SHAPE. STONE DEPTHS SHOULD NEVER DIFFER BY MORE THAN 12" (300 mm) BETWEEN ADJACENT CHAMBER ROWS.
10. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
11. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIAL BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
12. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-7200 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-7200 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-7200 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

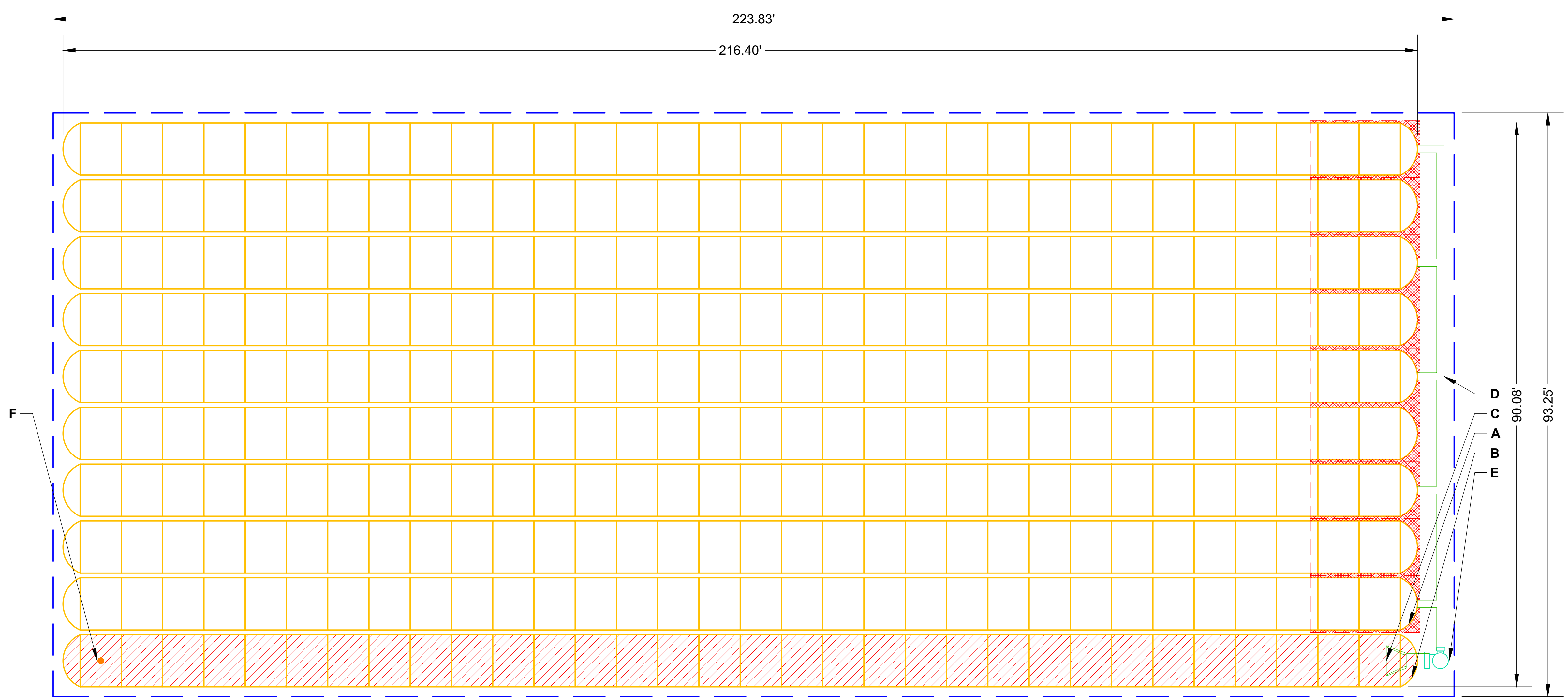
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT	
320	STORMTECH MC-7200 CHAMBERS
20	STORMTECH MC-7200 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	STONE VOID
90603	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
20872	SYSTEM AREA (SF)
634.2	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS:	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	12.75
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	8.25
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	7.75
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	7.75
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	7.75
TOP OF STONE:	6.75
TOP OF MC-7200 CHAMBER:	5.75
12" x 12" TOP MANIFOLD INVERT:	3.72
24" ISOLATOR ROW PLUS INVERT:	0.94
BOTTOM OF MC-7200 CHAMBER:	0.75
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	12" TOP PARTIAL CUT END CAP, PART#: MC7200IEPP12T / TYP OF ALL 12" TOP CONNECTIONS	35.69"	
PREFABRICATED END CAP	B	24" BOTTOM PARTIAL CUT END CAP, PART#: MC7200IEPP24B / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.26"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MCFLAMP		
MANIFOLD	D	12" x 12" TOP MANIFOLD, ADS N-12	35.69"	
NYLOPLAST (INLET W/ ISO PLUS ROW)	E	30" DIAMETER (24.00" SUMP MIN)		7.5 CFS IN
INSPECTION PORT	F	4" SEE DETAIL		



ISOLATOR ROW PLUS
SEE DETAIL()

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

CHERRY (MC-7200)
FONTANA, CA, USA

DATE:
DRAWN: TZ
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

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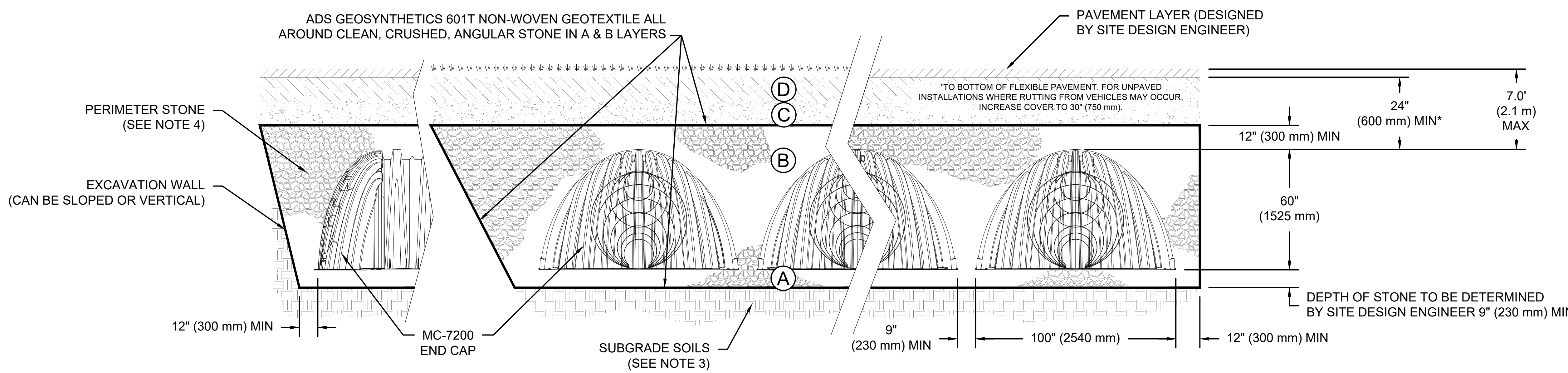
ACCEPTABLE FILL MATERIALS: STORMTECH MC-7200 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101
2. MC-7200 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

CHERRY (MC-7200)
FONTANA, CA, USA
DRAWN: TZ
CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
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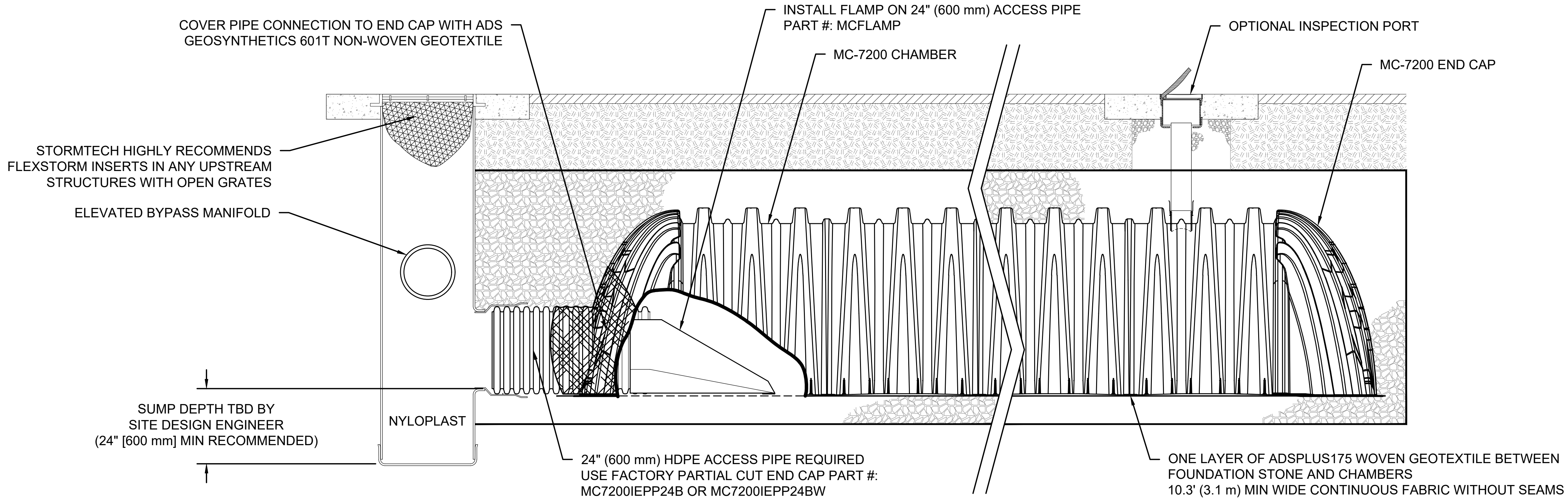

MC-7200 ISOLATOR ROW PLUS DETAIL

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INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT

- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS

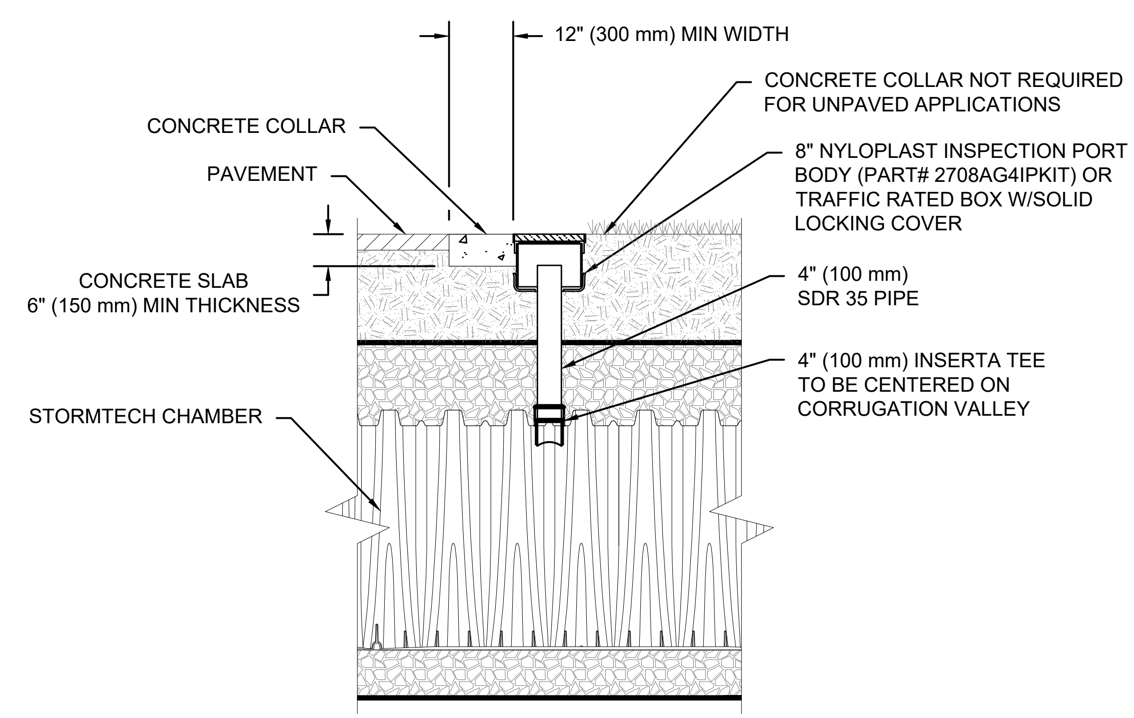
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION VALLEY.

4" PVC INSPECTION PORT DETAIL (MC SERIES CHAMBER)

NTS

CHERRY (MC-7200)
FONTANA, CA, USA

DATE:
DRAWN: TZ
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

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Chamber System
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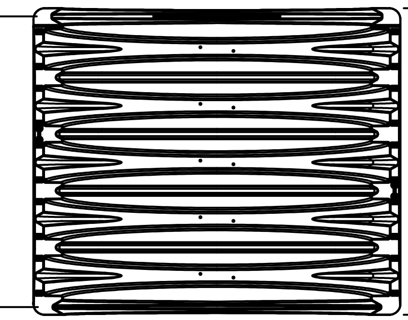
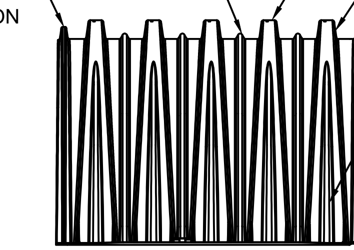
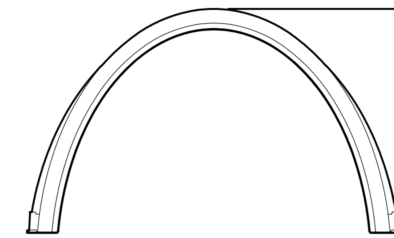
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

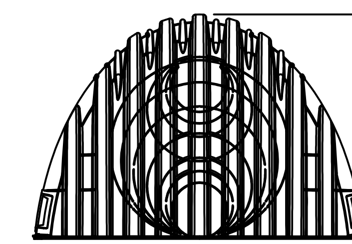
MC-7200 TECHNICAL SPECIFICATION

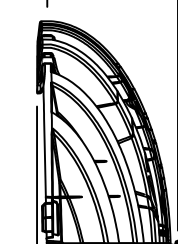
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	100.0" X 60.0" X 79.1"	(2540 mm X 1524 mm X 2010 mm)
CHAMBER STORAGE	175.9 CUBIC FEET	(4.98 m³)
MINIMUM INSTALLED STORAGE*	267.3 CUBIC FEET	(7.56 m³)
WEIGHT (NOMINAL)	205 lbs.	(92.9 kg)

NOMINAL END CAP SPECIFICATIONS

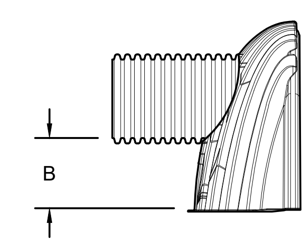
SIZE (W X H X INSTALLED LENGTH)	90.0" X 61.0" X 32.8"	(2286 mm X 1549 mm X 833 mm)
END CAP STORAGE	39.5 CUBIC FEET	(1.12 m³)
MINIMUM INSTALLED STORAGE*	115.3 CUBIC FEET	(3.26 m³)
WEIGHT (NOMINAL)	90 lbs.	(40.8 kg)

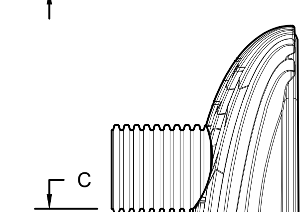
*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC7200IEPP06T	6" (150 mm)	42.54" (1081 mm)	---
MC7200IEPP06B		---	0.86" (22 mm)
MC7200IEPP08T	8" (200 mm)	40.50" (1029 mm)	---
MC7200IEPP08B		---	1.01" (26 mm)
MC7200IEPP10T	10" (250 mm)	38.37" (975 mm)	---
MC7200IEPP10B		---	1.33" (34 mm)
MC7200IEPP12T	12" (300 mm)	35.69" (907 mm)	---
MC7200IEPP12B		---	1.55" (39 mm)
MC7200IEPP15T	15" (375 mm)	32.72" (831 mm)	---
MC7200IEPP15B		---	1.70" (43 mm)
MC7200IEPP18T	18" (450 mm)	29.36" (746 mm)	---
MC7200IEPP18TW			
MC7200IEPP18B		---	1.97" (50 mm)
MC7200IEPP18BW			
MC7200IEPP24T	24" (600 mm)	23.05" (585 mm)	---
MC7200IEPP24TW			
MC7200IEPP24B		---	2.26" (57 mm)
MC7200IEPP24BW			
MC7200IEPP30BW	30" (750 mm)	---	2.95" (75 mm)
MC7200IEPP36BW	36" (900 mm)	---	3.25" (83 mm)
MC7200IEPP42BW	42" (1050 mm)	---	3.55" (90 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL

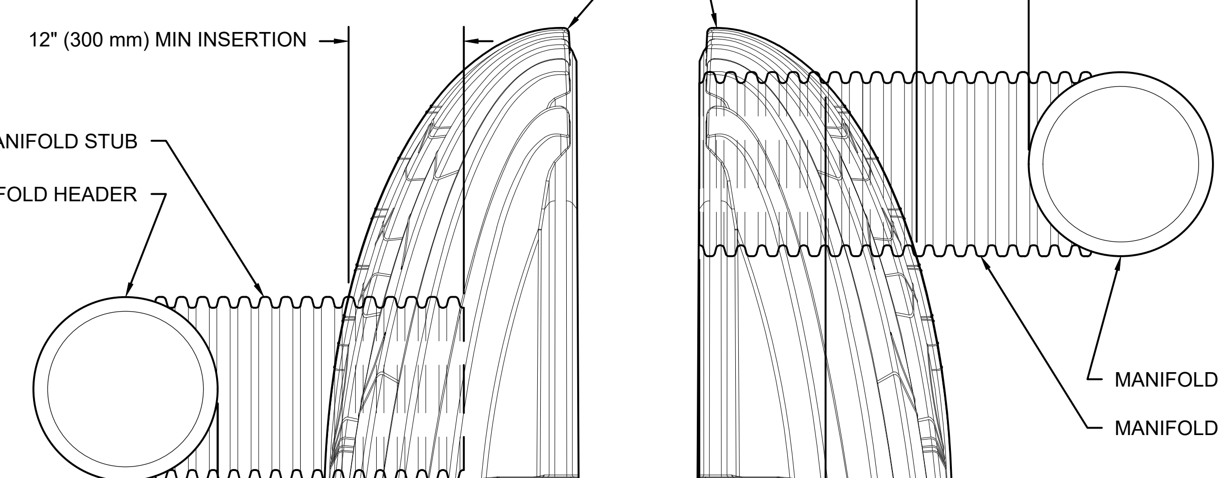




CUSTOM PREFABRICATED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-7200 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

CHERRY (MC-7200)
FONTANA, CA, USA

DATE:
DRAWN: TZ
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD
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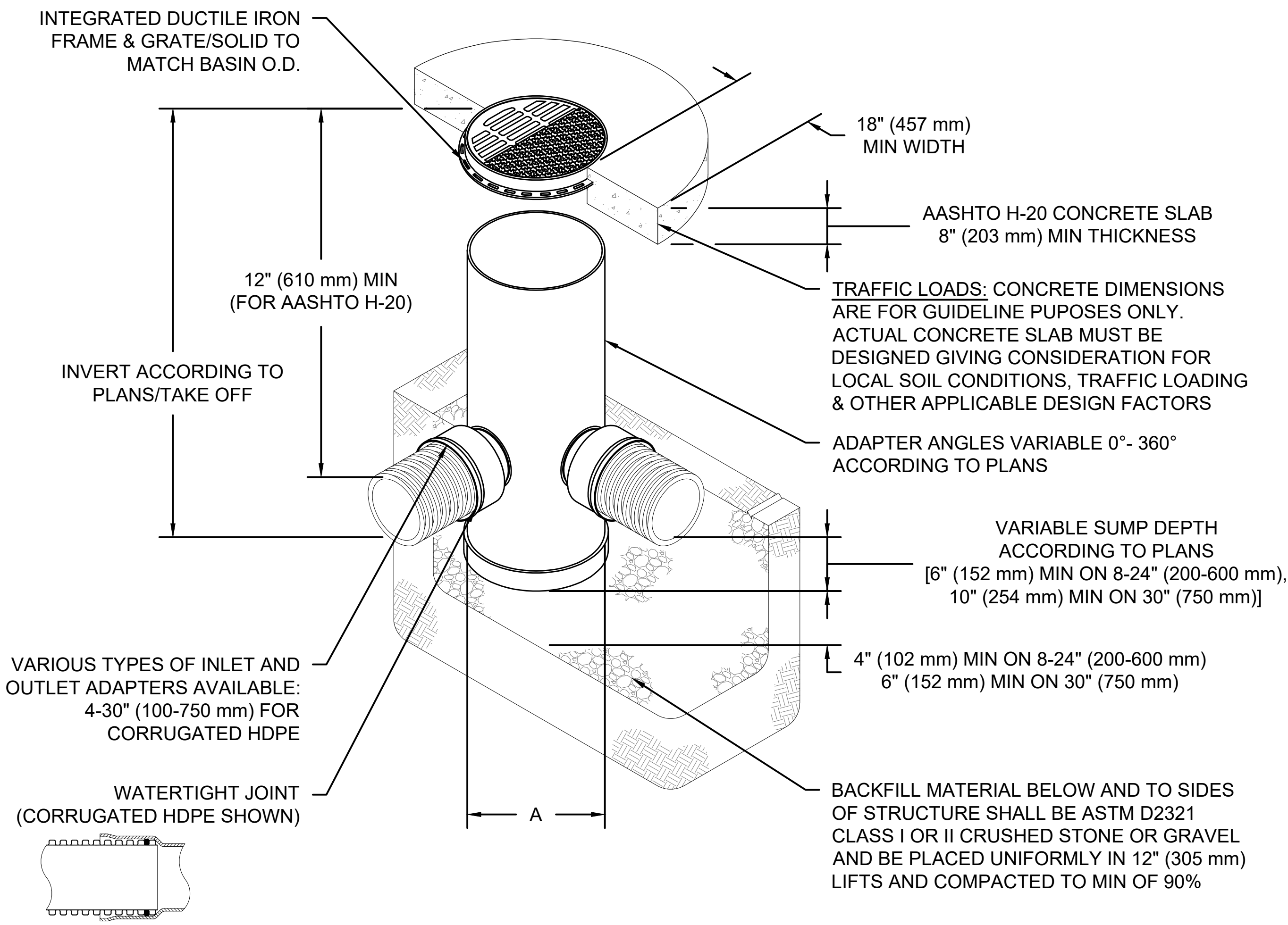
1-800-733-7473

NYLOPLAST DRAIN BASIN

NTS



NOTES

1. 8-30" (200-750 mm) GRATES/SOLID COVERS SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
2. 12-30" (300-750 mm) FRAMES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
3. DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS
4. DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC
5. FOR COMPLETE DESIGN AND PRODUCT INFORMATION: **WWW.NYLOPLAST-US.COM**
6. TO ORDER CALL: **800-821-6710**

A	PART #	GRATE/SOLID COVER OPTIONS		
8" (200 mm)	2808AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
10" (250 mm)	2810AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
12" (300 mm)	2812AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
15" (375 mm)	2815AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
18" (450 mm)	2818AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
24" (600 mm)	2824AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2830AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

CHERRY (MC-7200)

FONTANA, CA, USA

DATE:

DRAWN: TZ

PROJECT #:

CHECKED: N/A

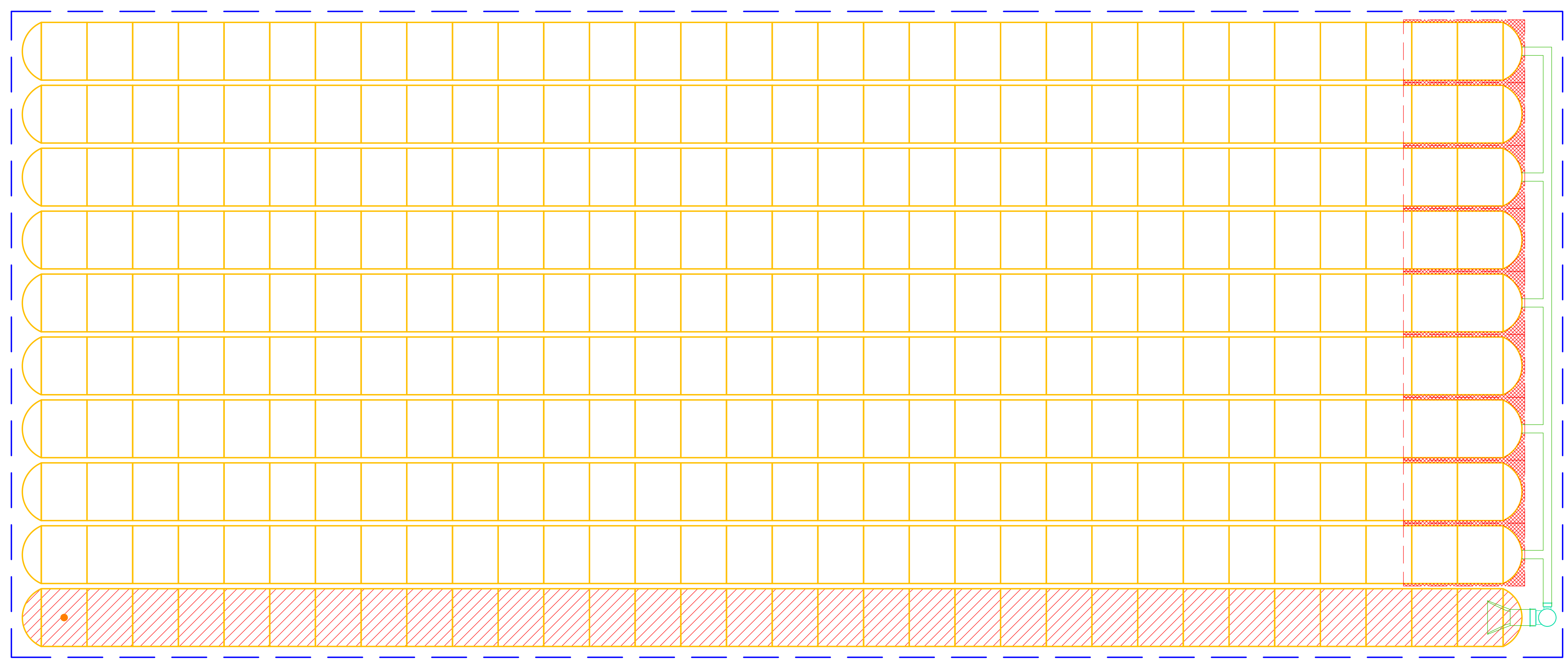
DATE	DRW	CHK	DESCRIPTION

ADS

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

Nyloplast®

770-932-2443 | WWW.NYLOPLAST-US.COM



Project: **Cherry (MC-7200)**

Chamber Model -	MC-7200	
Units -	Imperial	
Number of Chambers -	320	
Number of End Caps -	20	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in

Area of system - 20872 sf Min. Area - 19838 sf min. area

StormTech MC-7200 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch, EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
81	0.00	0.00	0.00	0.00	695.73	695.73	90602.11	6.75
80	0.00	0.00	0.00	0.00	695.73	695.73	89906.38	6.67
79	0.00	0.00	0.00	0.00	695.73	695.73	89210.65	6.58
78	0.00	0.00	0.00	0.00	695.73	695.73	88514.91	6.50
77	0.00	0.00	0.00	0.00	695.73	695.73	87819.18	6.42
76	0.00	0.00	0.00	0.00	695.73	695.73	87123.45	6.33
75	0.00	0.00	0.00	0.00	695.73	695.73	86427.71	6.25
74	0.00	0.00	0.00	0.00	695.73	695.73	85731.98	6.17
73	0.00	0.00	0.00	0.00	695.73	695.73	85036.25	6.08
72	0.00	0.00	0.00	0.00	695.73	695.73	84340.51	6.00
71	0.00	0.00	0.00	0.00	695.73	695.73	83644.78	5.92
70	0.00	0.00	0.00	0.00	695.73	695.73	82949.05	5.83
69	0.06	0.01	19.00	0.26	688.03	707.29	82253.31	5.75
68	0.19	0.03	60.86	0.68	671.12	732.65	81546.02	5.67
67	0.28	0.05	88.06	1.04	660.10	749.19	80813.37	5.58
66	0.36	0.07	114.32	1.32	649.48	765.12	80064.18	5.50
65	0.46	0.08	146.69	1.66	636.39	784.74	79299.06	5.42
64	0.74	0.11	237.32	2.11	599.96	839.39	78514.32	5.33
63	1.10	0.13	350.84	2.65	554.34	907.83	77674.93	5.25
62	1.32	0.16	421.91	3.22	525.68	950.81	76767.10	5.17
61	1.50	0.19	479.43	3.77	502.45	985.66	75816.29	5.08
60	1.65	0.22	529.44	4.37	482.21	1016.02	74830.63	5.00
59	1.79	0.25	574.07	4.94	464.13	1043.14	73814.61	4.92
58	1.92	0.28	614.29	5.51	447.82	1067.61	72771.48	4.83
57	2.04	0.30	651.98	6.04	432.53	1090.54	71703.86	4.75
56	2.15	0.33	686.50	6.55	418.51	1111.57	70613.32	4.67
55	2.25	0.35	719.26	7.09	405.19	1131.55	69501.76	4.58
54	2.34	0.38	749.81	7.67	392.74	1150.22	68370.21	4.50
53	2.43	0.41	778.70	8.18	380.98	1167.87	67219.99	4.42
52	2.52	0.44	806.10	8.82	369.77	1184.68	66052.12	4.33
51	2.60	0.47	832.18	9.38	359.11	1200.67	64867.44	4.25
50	2.68	0.50	857.09	9.90	348.93	1215.93	63666.77	4.17
49	2.75	0.52	880.82	10.41	339.24	1230.47	62450.84	4.08
48	2.82	0.54	903.50	10.89	329.98	1244.37	61220.36	4.00
47	2.89	0.57	925.25	11.34	321.10	1257.69	59976.00	3.92
46	2.96	0.59	946.03	11.77	312.61	1270.42	58718.31	3.83
45	3.02	0.61	966.01	12.20	304.45	1282.66	57447.90	3.75
44	3.08	0.63	985.16	12.64	296.61	1294.42	56165.24	3.67
43	3.14	0.64	1003.61	12.86	289.14	1305.62	54870.82	3.58
42	3.19	0.68	1021.37	13.55	281.77	1316.68	53565.20	3.50
41	3.25	0.70	1038.41	14.00	274.77	1327.17	52248.52	3.42
40	3.30	0.72	1054.82	14.45	268.03	1337.30	50921.35	3.33
39	3.35	0.74	1070.60	14.87	261.54	1347.02	49584.05	3.25
38	3.39	0.76	1085.80	15.29	255.30	1356.38	48237.04	3.17
37	3.44	0.79	1100.43	15.71	249.28	1365.42	46880.65	3.08
36	3.48	0.80	1114.52	16.05	243.50	1374.08	45515.23	3.00
35	3.53	0.82	1128.11	16.40	237.93	1382.44	44141.16	2.92
34	3.57	0.84	1141.18	16.77	232.56	1390.50	42758.71	2.83
33	3.61	0.85	1153.79	17.03	227.41	1398.22	41368.21	2.75
32	3.64	0.86	1165.91	17.19	222.49	1405.60	39969.99	2.67
31	3.68	0.89	1177.58	17.79	217.58	1412.96	38564.40	2.58
30	3.71	0.90	1188.80	18.08	212.98	1419.86	37151.44	2.50
29	3.75	0.92	1199.58	18.35	208.56	1426.49	35731.58	2.42
28	3.78	0.92	1209.92	18.40	204.41	1432.72	34305.09	2.33
27	3.81	0.94	1219.85	18.87	200.24	1438.97	32872.37	2.25
26	3.84	0.96	1229.34	19.13	196.35	1444.81	31433.40	2.17
25	3.87	0.97	1238.45	19.37	192.60	1450.43	29988.59	2.08
24	3.90	0.98	1247.17	19.63	189.01	1455.81	28538.16	2.00
23	3.92	0.97	1255.50	19.42	185.76	1460.69	27082.35	1.92
22	3.95	1.00	1263.45	20.06	182.33	1465.84	25621.66	1.83
21	3.97	1.01	1271.02	20.22	179.23	1470.48	24155.82	1.75
20	3.99	1.02	1278.25	20.41	176.27	1474.93	22685.33	1.67
19	4.02	1.03	1285.10	20.61	173.45	1479.16	21210.41	1.58
18	4.04	1.04	1291.59	20.77	170.79	1483.15	19731.25	1.50
17	4.06	1.05	1297.74	20.93	168.27	1486.93	18248.10	1.42
16	4.07	1.05	1303.54	21.08	165.89	1490.50	16761.17	1.33
15	4.09	1.05	1308.96	21.01	163.74	1493.72	15270.67	1.25
14	4.11	1.06	1314.14	21.13	161.62	1496.90	13776.95	1.17
13	4.12	1.08	1319.07	21.51	159.50	1500.08	12280.05	1.08
12	4.14	1.08	1323.69	21.66	157.59	1502.94	10779.97	1.00
11	4.15	1.09	1327.99	21.76	155.83	1505.59	9277.03	0.92
10	4.17	1.11	1334.72	22.13	152.99	1509.84	7771.44	0.83
9	0.00	0.00	0.00	0.00	695.73	695.73	6261.60	0.75
8	0.00	0.00	0.00	0.00	695.73	695.73	5565.87	0.67
7	0.00	0.00	0.00	0.00	695.73	695.73	4870.13	0.58
6	0.00	0.00	0.00	0.00	695.73	695.73	4174.40	0.50
5	0.00	0.00	0.00	0.00	695.73	695.73	3478.67	0.42
4	0.00	0.00	0.00	0.00	695.73	695.73	2782.93	0.33
3	0.00	0.00	0.00	0.00	695.73	695.73	2087.20	0.25
2	0.00	0.00	0.00	0.00	695.73	695.73	1391.47	0.17
1	0.00	0.00	0.00	0.00	695.73	695.73	695.73	0.08

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteAssist™
FOR STORMTECH INSTALLATION INSTRUCTIONS VISIT OUR APP

CHERRY (MC-3500)

FONTANA, CA, USA

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

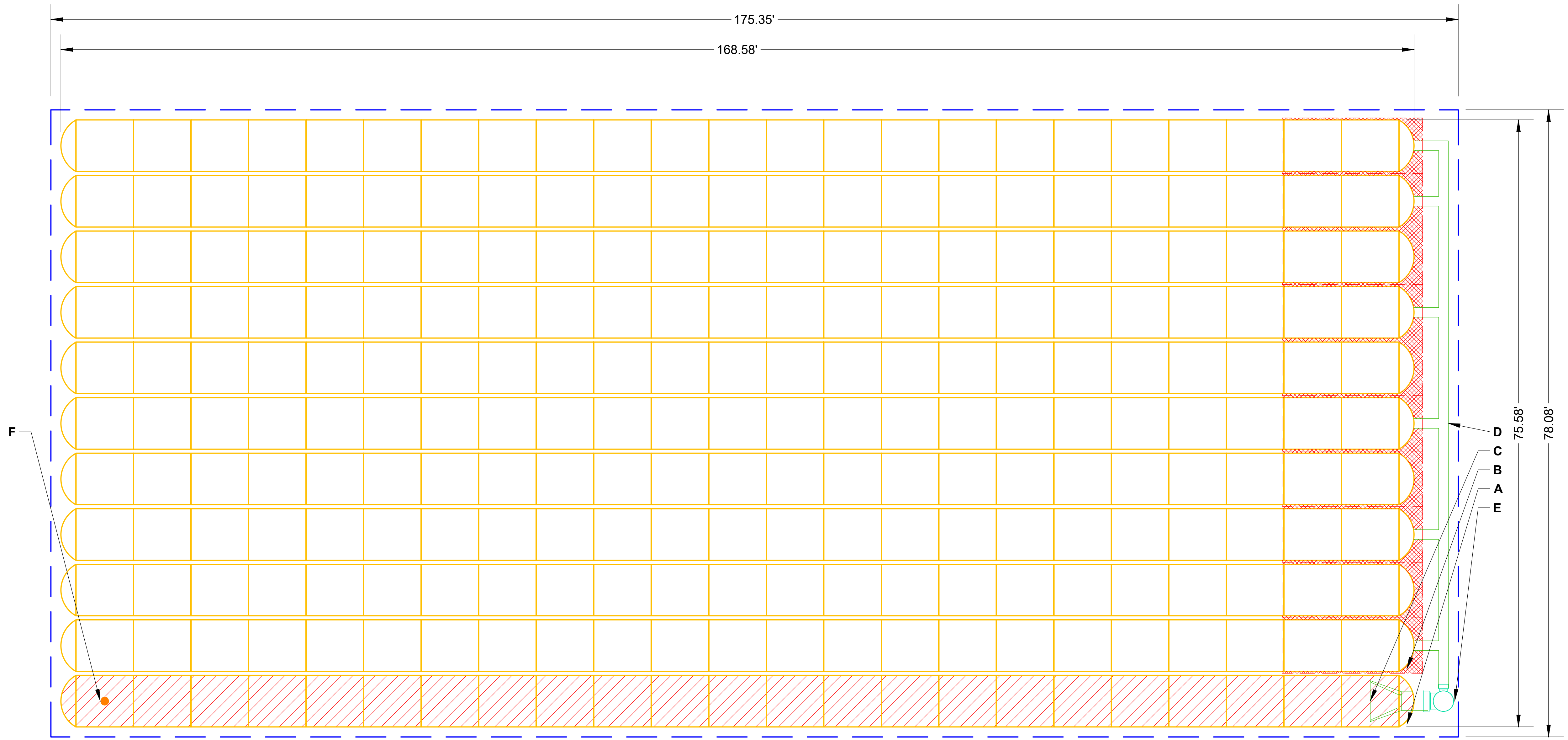
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT	
253	STORMTECH MC-3500 CHAMBERS
22	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	STONE VOID
47009	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
13692	SYSTEM AREA (SF)
506.9	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS:	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	12.50
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	6.50
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	6.00
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	6.00
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	6.00
TOP OF STONE:	5.50
TOP OF MC-3500 CHAMBER:	4.50
12" x 12" TOP MANIFOLD INVERT:	2.95
24" ISOLATOR ROW PLUS INVERT:	0.92
BOTTOM OF MC-3500 CHAMBER:	0.75
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	24" BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.06"	
PREFABRICATED END CAP	B	12" TOP CORED END CAP, PART#: MC3500IEPP12T / TYP OF ALL 12" TOP CONNECTIONS	26.36"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MCFLAMP		
MANIFOLD	D	12" x 12" TOP MANIFOLD, ADS N-12	26.36"	
NYLOPLAST (INLET W/ ISO PLUS ROW)	E	30" DIAMETER (24.00" SUMP MIN)		6.7 CFS IN
INSPECTION PORT	F	4" SEE DETAIL		



ISOLATOR ROW PLUS
SEE DETAIL()

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

CHERRY (MC-3500)
FONTANA, CA, USA

DRAWN: TZ
CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

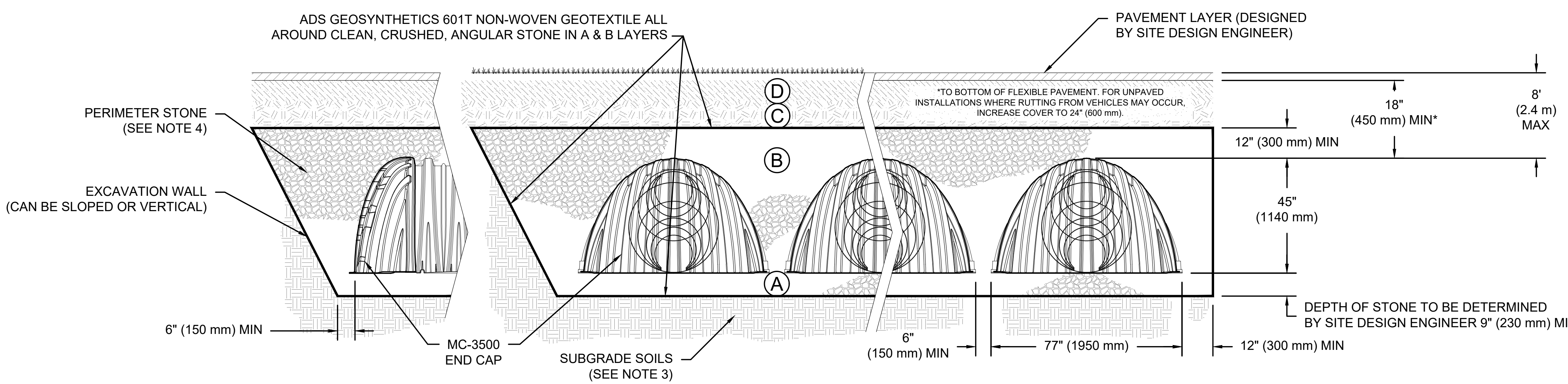
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

0 15 30

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

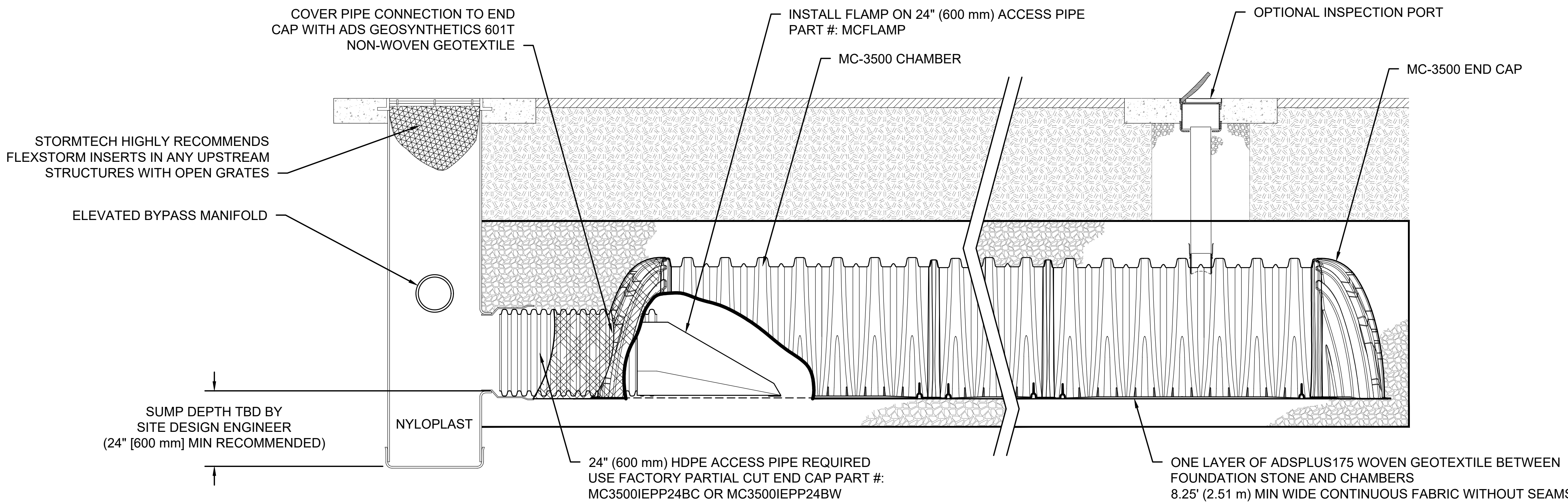
CHERRY (MC-3500)
FONTANA, CA, USA

DATE:
DRAWN: TZ
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473



MC-3500 ISOLATOR ROW PLUS DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

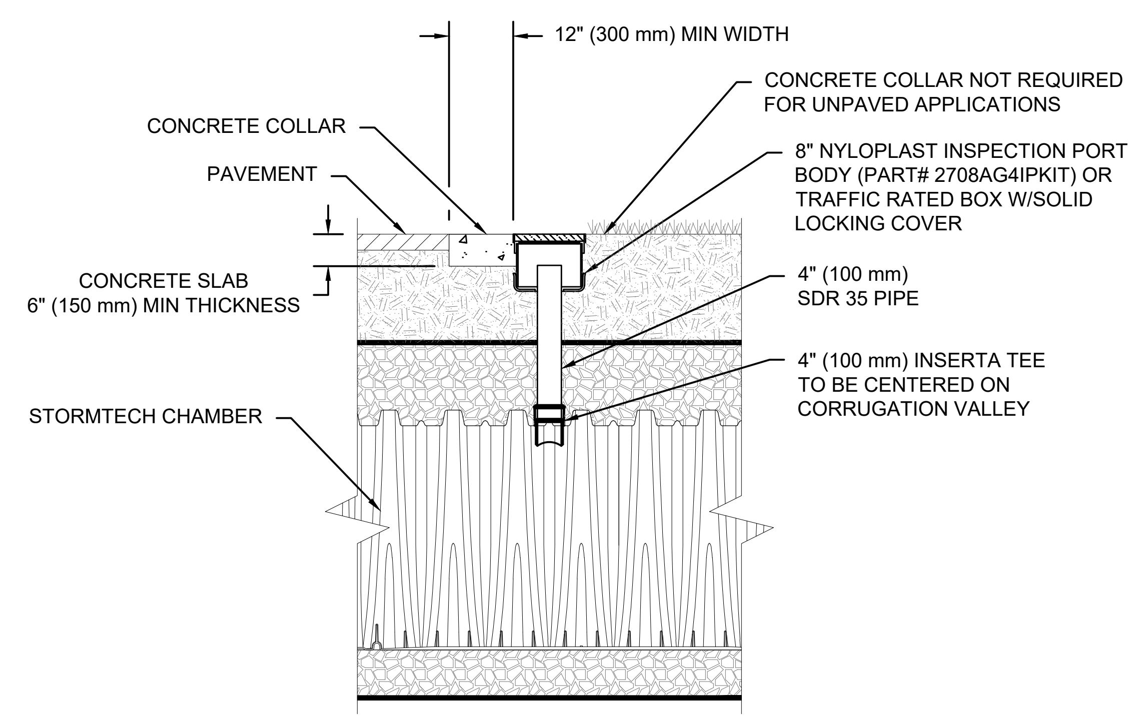
STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION VALLEY.

4" PVC INSPECTION PORT DETAIL (MC SERIES CHAMBER)

NTS

CHERRY (MC-3500)
FONTANA, CA, USA

DATE: | DRAWN: TZ | PROJECT #: | CHECKED: N/A

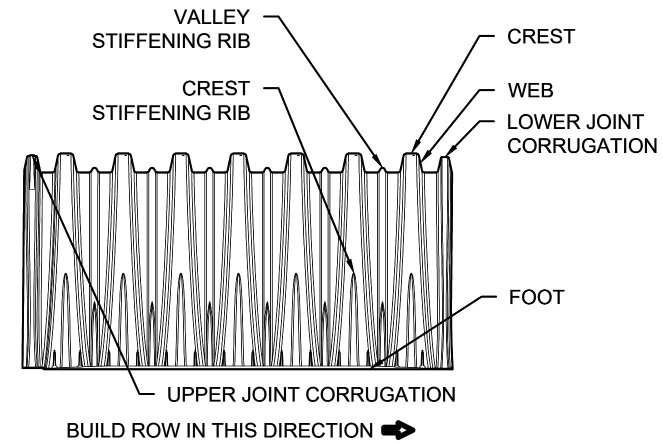
DATE	DRW	CHK	DESCRIPTION

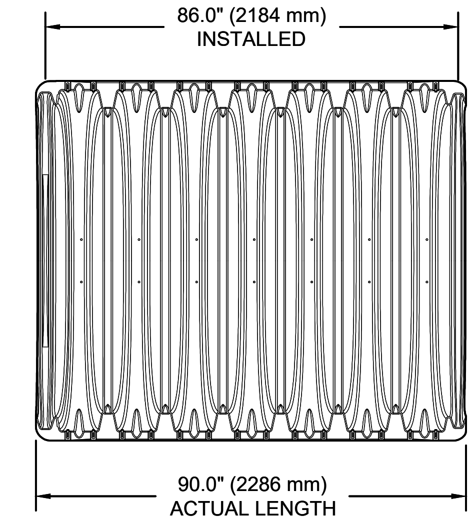
StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

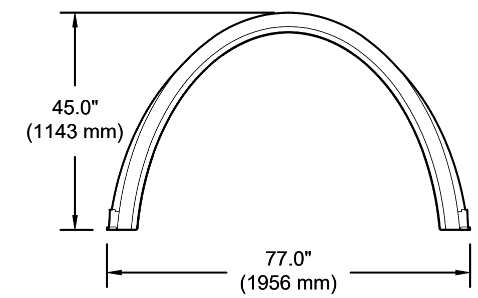
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

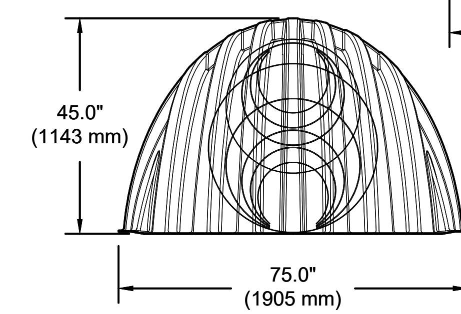
MC-3500 TECHNICAL SPECIFICATION

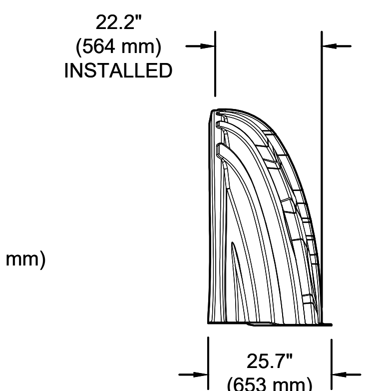
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

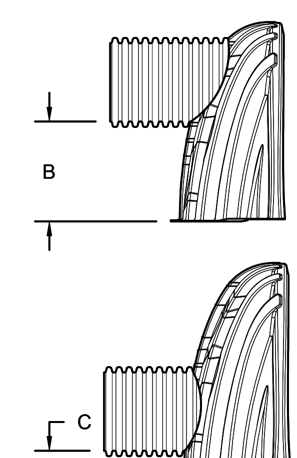
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

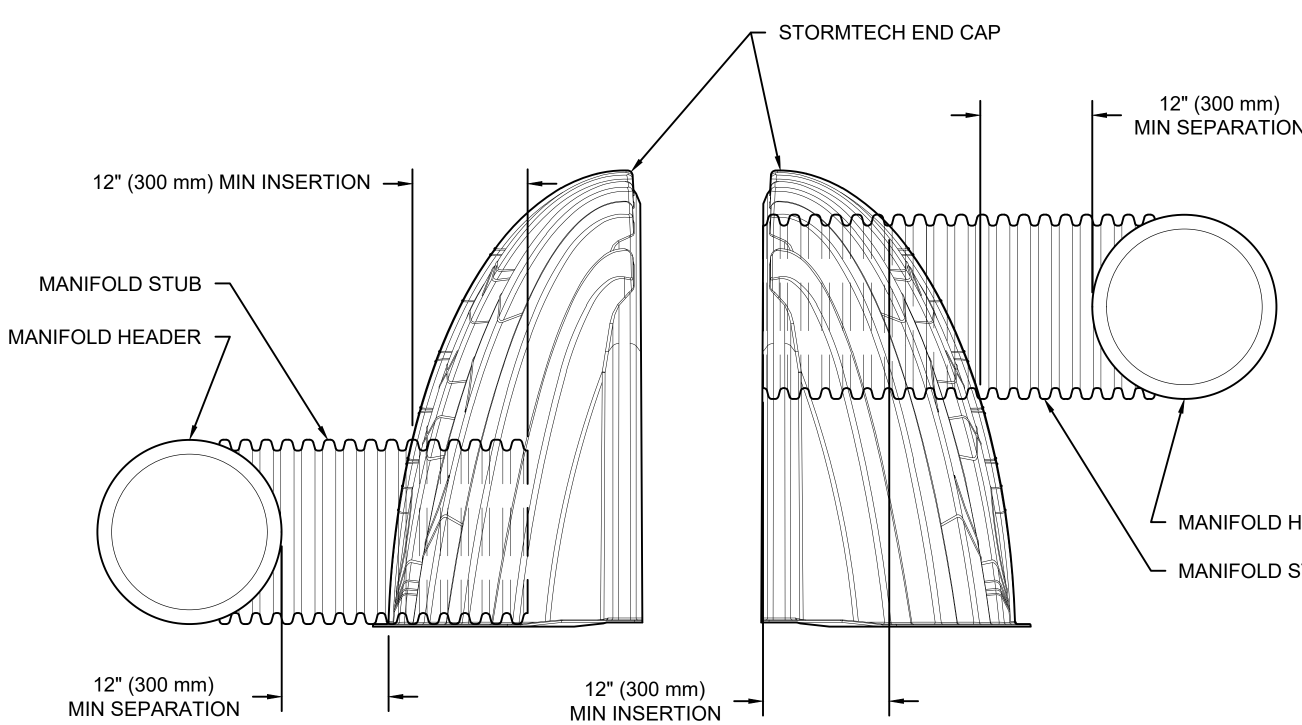
NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

CHERRY (MC-3500)
FONTANA, CA, USA

DRAWN: TZ
CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

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Chamber System
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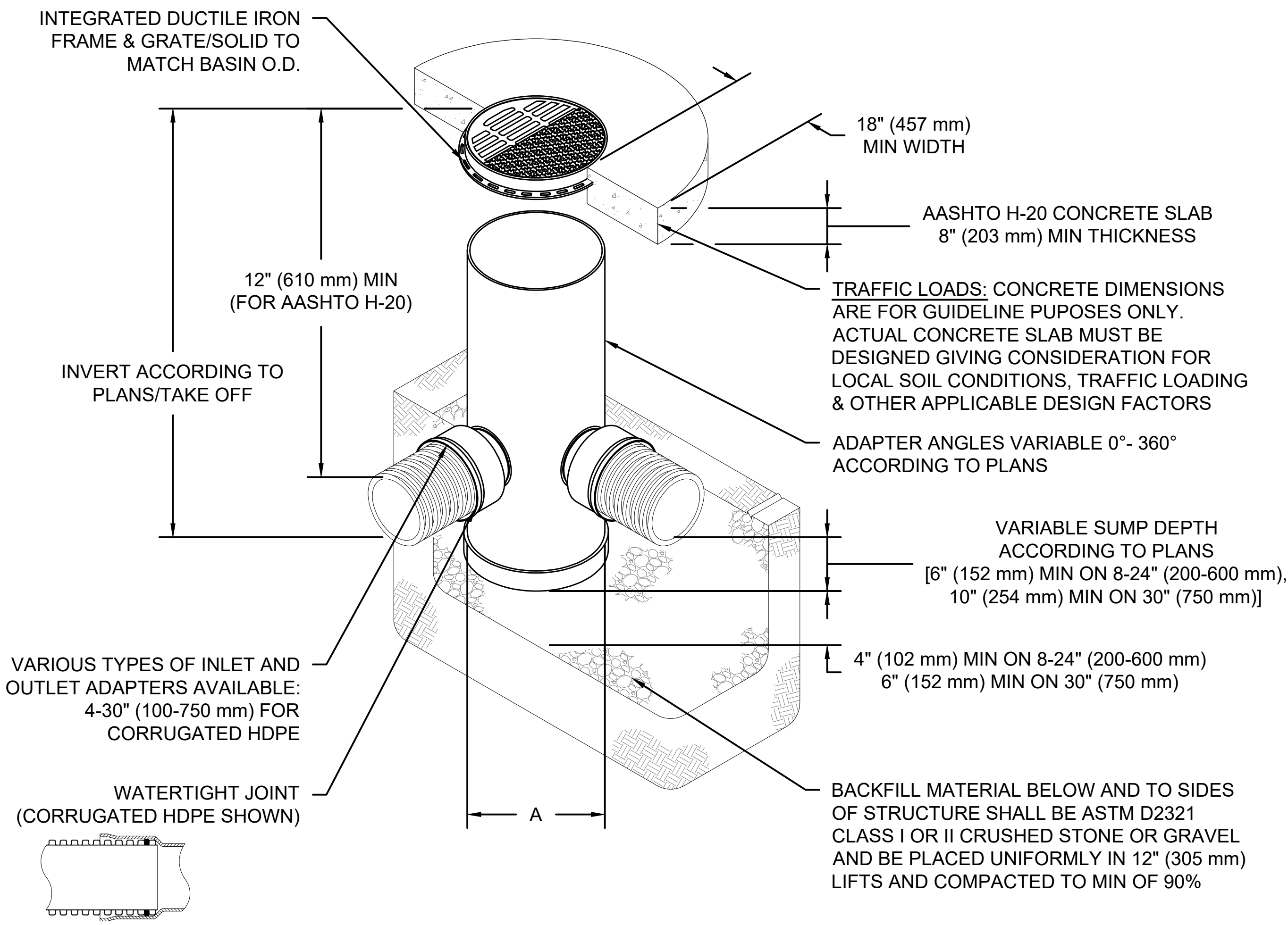
NYLOPLAST DRAIN BASIN

NTS



NOTES

1. 8-30" (200-750 mm) GRATES/SOLID COVERS SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
2. 12-30" (300-750 mm) FRAMES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
3. DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS
4. DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC
5. FOR COMPLETE DESIGN AND PRODUCT INFORMATION: **WWW.NYLOPLAST-US.COM**
6. TO ORDER CALL: **800-821-6710**

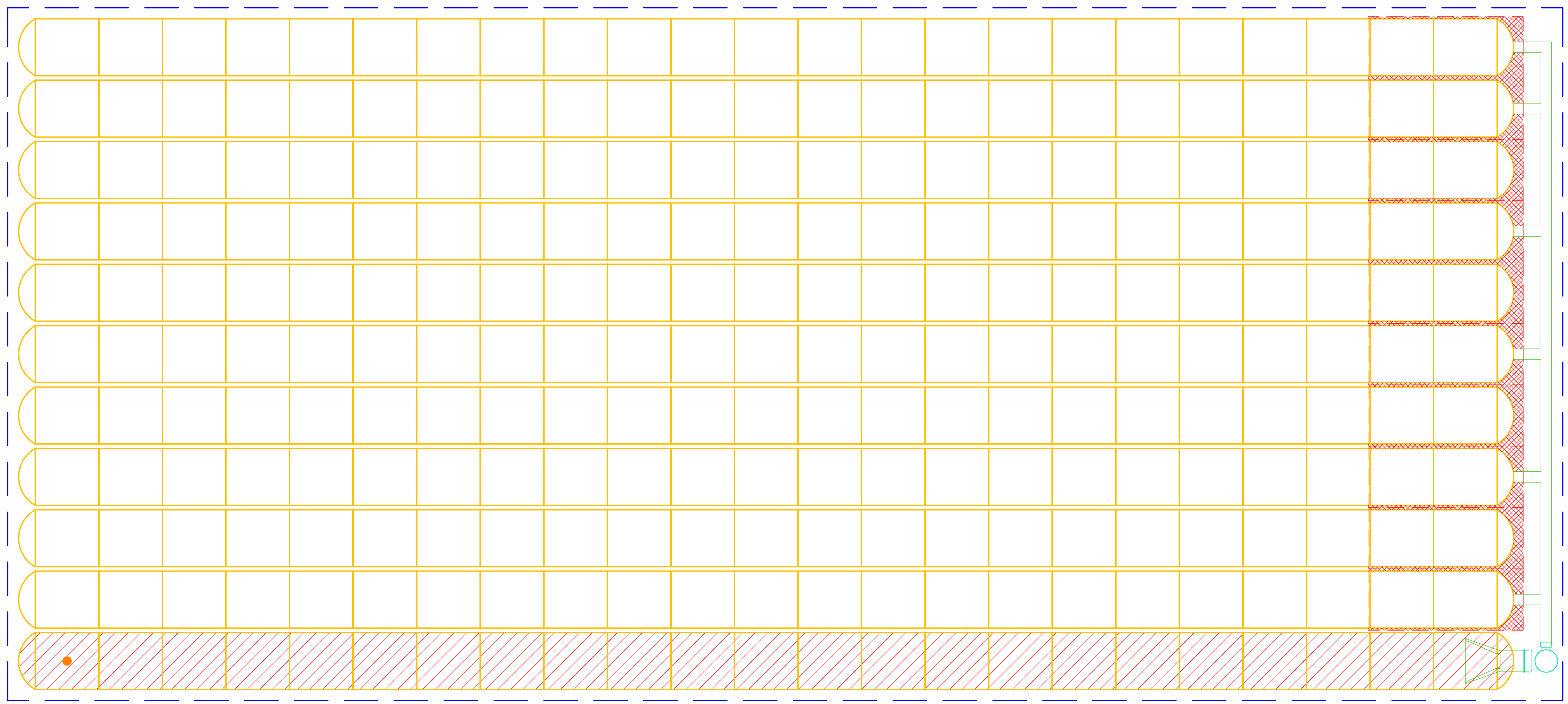
A	PART #	GRATE/SOLID COVER OPTIONS		
8" (200 mm)	2808AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
10" (250 mm)	2810AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
12" (300 mm)	2812AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
15" (375 mm)	2815AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
18" (450 mm)	2818AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
24" (600 mm)	2824AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2830AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

CHERRY (MC-3500)
FONTANA, CA, USA

DATE:
DRAWN: TZ
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

Nyloplast®
770-932-2443 | WWW.NYLOPLAST-US.COM
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473



Project: **Cherry (MC-3500)**

Chamber Model -	MC-3500	
Units -	Imperial	
Number of Chambers -	253	
Number of End Caps -	22	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in
Amount of Stone Between Chambers -	6	in
Area of system -	13692	sf Min. Area - 12899 sf min. area

StormTech MC-3500 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch, EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
66	0.00	0.00	0.00	0.00	456.40	456.40	47009.80	5.50
65	0.00	0.00	0.00	0.00	456.40	456.40	46553.40	5.42
64	0.00	0.00	0.00	0.00	456.40	456.40	46097.00	5.33
63	0.00	0.00	0.00	0.00	456.40	456.40	45640.60	5.25
62	0.00	0.00	0.00	0.00	456.40	456.40	45184.20	5.17
61	0.00	0.00	0.00	0.00	456.40	456.40	44727.80	5.08
60	0.00	0.00	0.00	0.00	456.40	456.40	44271.40	5.00
59	0.00	0.00	0.00	0.00	456.40	456.40	43815.00	4.92
58	0.00	0.00	0.00	0.00	456.40	456.40	43358.60	4.83
57	0.00	0.00	0.00	0.00	456.40	456.40	42902.20	4.75
56	0.00	0.00	0.00	0.00	456.40	456.40	42445.80	4.67
55	0.00	0.00	0.00	0.00	456.40	456.40	41989.40	4.58
54	0.06	0.00	14.70	0.00	450.52	465.22	41533.00	4.50
53	0.19	0.02	49.11	0.53	436.55	486.18	41067.78	4.42
52	0.29	0.04	74.37	0.83	426.32	501.52	40581.60	4.33
51	0.40	0.05	102.12	1.13	415.10	518.35	40080.08	4.25
50	0.69	0.07	173.86	1.49	386.26	561.61	39561.73	4.17
49	1.03	0.09	260.16	1.94	351.56	613.66	39000.12	4.08
48	1.25	0.11	316.13	2.36	329.00	647.49	38386.46	4.00
47	1.42	0.13	359.82	2.78	311.36	673.96	37738.97	3.92
46	1.57	0.14	398.00	3.18	295.93	697.11	37065.01	3.83
45	1.71	0.16	431.91	3.58	282.20	717.70	36367.90	3.75
44	1.83	0.18	462.61	4.00	269.76	736.36	35650.21	3.67
43	1.94	0.20	490.26	4.41	258.53	753.20	34913.84	3.58
42	2.04	0.22	516.33	4.80	247.95	769.08	34160.64	3.50
41	2.13	0.23	540.08	5.17	238.30	783.55	33391.56	3.42
40	2.22	0.25	562.73	5.51	229.10	797.34	32608.02	3.33
39	2.31	0.27	583.62	5.84	220.62	810.08	31810.67	3.25
38	2.38	0.28	603.35	6.16	212.60	822.10	31000.60	3.17
37	2.46	0.29	622.15	6.47	204.95	833.57	30178.49	3.08
36	2.53	0.31	639.63	6.77	197.84	844.24	29344.92	3.00
35	2.59	0.32	656.22	7.07	191.09	854.37	28500.68	2.92
34	2.66	0.33	671.98	7.36	184.66	864.00	27646.31	2.83
33	2.72	0.35	686.92	7.63	178.58	873.13	26782.31	2.75
32	2.77	0.36	701.14	7.92	172.78	881.83	25909.17	2.67
31	2.82	0.37	714.64	8.19	167.27	890.10	25027.34	2.58
30	2.88	0.38	727.49	8.45	162.02	897.97	24137.24	2.50
29	2.92	0.40	739.81	8.71	156.99	905.51	23239.28	2.42
28	2.97	0.41	751.38	8.97	152.26	912.61	22333.76	2.33
27	3.01	0.42	762.15	9.21	147.86	919.22	21421.16	2.25
26	3.05	0.43	772.47	9.45	143.63	925.56	20501.94	2.17
25	3.09	0.44	782.85	9.69	139.38	931.92	19576.38	2.08
24	3.13	0.45	792.03	9.92	135.62	937.57	18644.46	2.00
23	3.17	0.46	800.91	10.14	131.98	943.03	17706.89	1.92
22	3.20	0.47	809.46	10.35	128.47	948.29	16763.86	1.83
21	3.23	0.48	817.47	10.56	125.19	953.22	15815.57	1.75
20	3.26	0.49	825.14	10.76	122.04	957.94	14862.35	1.67
19	3.29	0.50	832.44	10.96	119.04	962.43	13904.41	1.58
18	3.32	0.51	839.44	11.14	116.17	966.75	12941.97	1.50
17	3.34	0.51	846.06	11.32	113.45	970.83	11975.22	1.42
16	3.37	0.52	852.26	11.49	110.90	974.65	11004.39	1.33
15	3.39	0.53	858.30	11.65	108.42	978.37	10029.74	1.25
14	3.41	0.54	863.88	11.80	106.13	981.81	9051.37	1.17
13	3.44	0.54	869.57	11.95	103.79	985.31	8069.56	1.08
12	3.46	0.55	874.80	12.09	101.64	988.53	7084.25	1.00
11	3.48	0.56	880.11	12.21	99.47	991.79	6095.72	0.92
10	3.51	0.59	886.79	13.09	96.45	996.33	5103.93	0.83
9	0.00	0.00	0.00	0.00	456.40	456.40	4107.60	0.75
8	0.00	0.00	0.00	0.00	456.40	456.40	3651.20	0.67
7	0.00	0.00	0.00	0.00	456.40	456.40	3194.80	0.58
6	0.00	0.00	0.00	0.00	456.40	456.40	2738.40	0.50
5	0.00	0.00	0.00	0.00	456.40	456.40	2282.00	0.42
4	0.00	0.00	0.00	0.00	456.40	456.40	1825.60	0.33
3	0.00	0.00	0.00	0.00	456.40	456.40	1369.20	0.25
2	0.00	0.00	0.00	0.00	456.40	456.40	912.80	0.17
1	0.00	0.00	0.00	0.00	456.40	456.40	456.40	0.08

BIO CLEAN FULL CAPTURE FILTER WITH TROUGH SYSTEM

FOR USE IN CURB INLETS

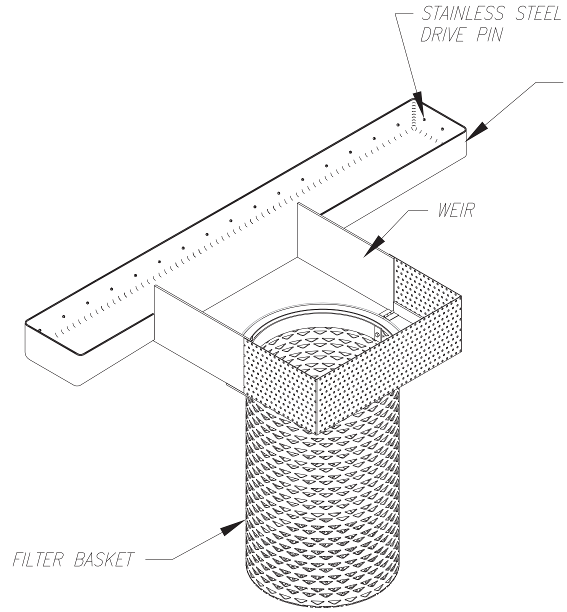


FIGURE 1:
DETAIL OF PARTS

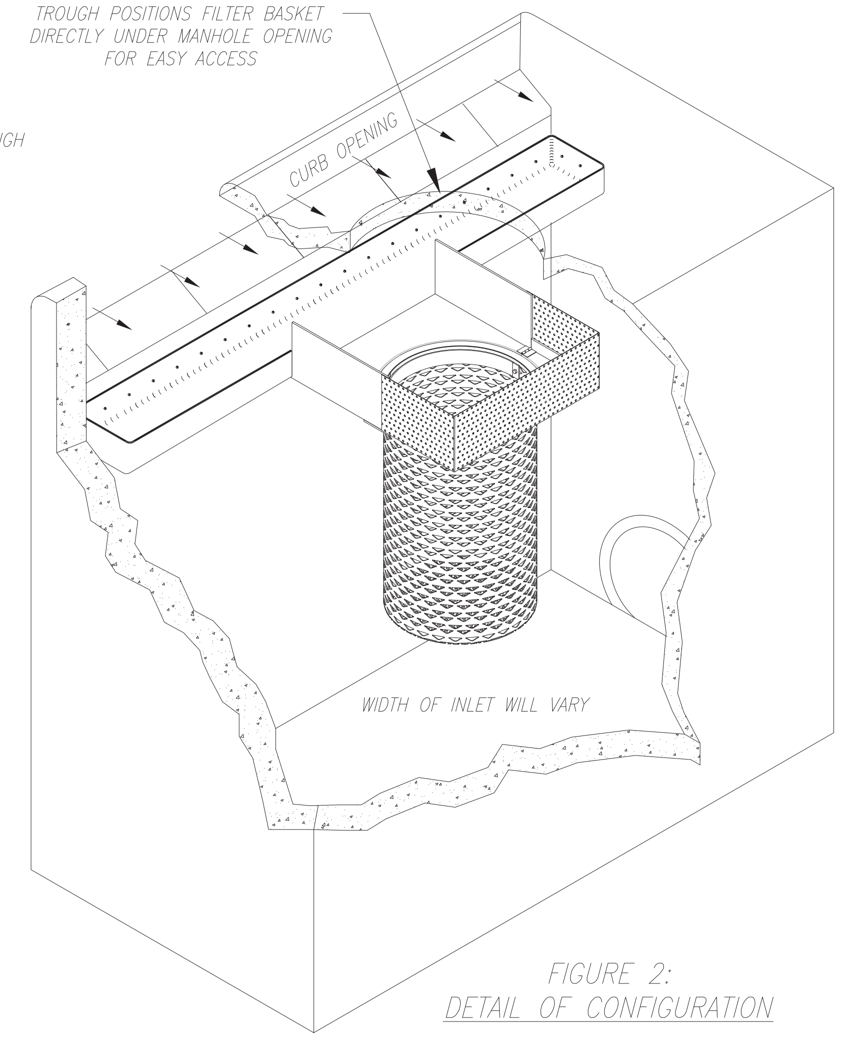


FIGURE 2:
DETAIL OF CONFIGURATION

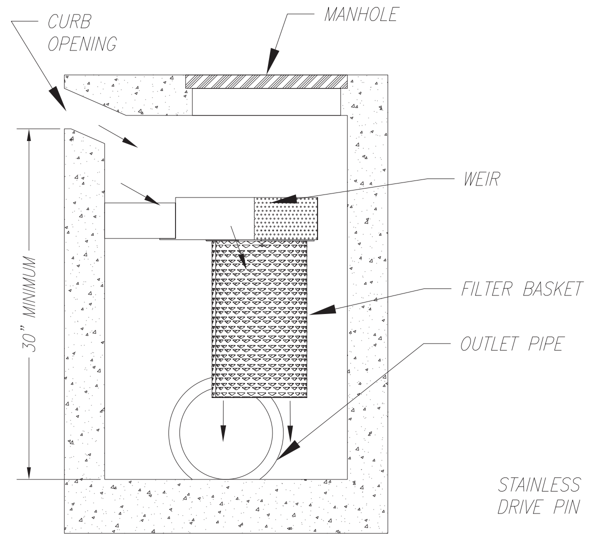


FIGURE 4:
DETAIL OF PROFILE

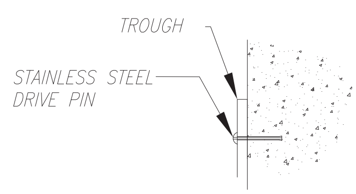


FIGURE 3:
DETAIL OF MOUNTING

NOTES:

1. TROUGH SYSTEM PROVIDES FOR ENTIRE COVERAGE OF INLET OPENING SO TO DIVERT ALL FLOW TO FILTER.
2. TROUGH SYSTEM MANUFACTURED FROM MARINE GRADE FIBERGLASS, GEL COATED FOR UV PROTECTION.
3. SYSTEM ATTACHED TO THE CATCH BASIN WITH NON-CORROSIVE HARDWARE.
4. FILTER MANUFACTURED OF 100% STAINLESS STEEL.
5. FILTER MADE OF NON-CLOGGIN SCREEN WITH 4.7 MM OPENINGS AND MEETS FULL CAPTURE REQUIREMENTS.
6. FILTER CAN BE FITTED WITH HYDROCARBON ABSORBENT BOOM
7. FILTER IS LOCATED DIRECTLY UNDER THE MANHOLE FOR EASY REMOVAL AND MAINTENANCE.
8. LENGTH OF TROUGH CAN VARY FROM 2' TO 30'
9. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
10. CONSIDERS A SAFETY FACTOR OF 2.0
11. BYPASS IS FACILITATED VIA OVERFLOW OF THE TROUGH SYSTEM AND IS EQUAL TO THE CAPACITY OF THE CURB OPENING
12. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.
13. ADDITIONAL TREATMENT AND STORAGE CAPACITY CAN BE ACHIEVED BY UTILIZING MULTIPLE FILTER BASKETS.

MODEL NUMBER	TREATMENT FLOW (cfs)*	SOLIDS STORAGE CAPACITY (cu ft)
BC-CURB-FC-30	2.85	2.21
BC-CURB-FC-24	2.85	1.77
BC-CURB-FC-18	2.85	1.33
BC-CURB-FC-12	2.85	0.88

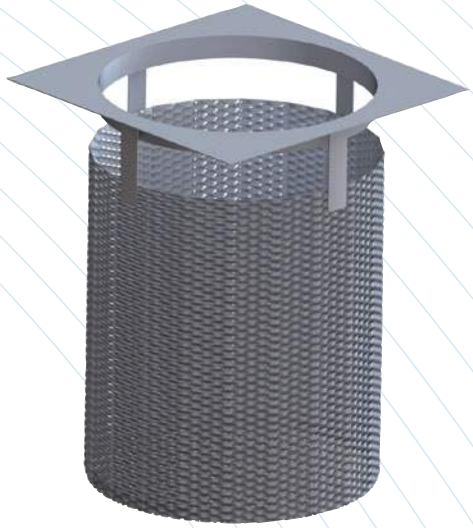
*SEE PAGE 2 FOR EXPLANATION OF FLOW RATES

DRAWING: BIO CLEAN CURB INLET FILTER DETAILS		MEETS FULL CAPTURE REQUIREMENTS	
TREATMENT FLOW RATE: 2.85 cfs		MODEL #: BC-CURB-FC	
WARRANTY: 5 YEAR MANUFACTURERS		PROJECT:	
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE:760-433-7640 FAX:760-433-3176		REVISIONS:	DATE:
		REVISIONS:	DATE:
DATE: 10/12/2017	SCALE: NTS	REVISIONS:	DATE:
DRAFTER: M.C.P.	UNITS = INCHES	REVISIONS:	DATE:

Bio Clean
A Forterra Company

Grate Inlet Filter

100% Full trash capture



The Bio Clean Grate Inlet Filter for catch basins keeps property owners in compliance. Preferred by public agencies and backed by an 8 year warranty, this easy to install filter is continuously chosen for its durability and simple maintenance.

Constructed of 100% high grade stainless steel, it is built to last longer than any other filter brand. The non-clogging screens provide higher levels of filtration and water flow. The filter is equipped with unimpeded high flow bypass for even the largest storm events.

The filter is also equipped with a floating hydrocarbon boom mounted to rails allowing it to flow up and down with the water level over a range of flow conditions.

The filter is designed for grated inlets of any size and depth. Each filter can be custom built to meet specific project needs. Screen size and media type can be modified to remove specific pollutants.

Advantages and Performance

- 8 Year warranty
- Custom sizes available
- No nets or geofabrics
- 15+years user life
- No replacement costs as found with fabric filters
- Meets LEED requirements
- Fits in shallow catch basins
- 100% removal of trash and debris
- Meets full capture requirements

Specifications

Model #	Treatment Flow (CFS)	Bypass Flow (CFS)
BC-GRATE-12-12-12	1.55	1.55
BC-GRATE-18-18-18	4.32	3.68
BC-GRATE-24-24-24	7.67	4.83
BC-GRATE-30-30-24	12.97	6.21
BC-GRATE-25-38-24	13.53	6.59
BC-GRATE-36-36-24	19.64	7.60
BC-GRATE-48-48-18	25.59	10.13

NOTE: Treatment and bypass flow rates include a safety factor of 2.

Operation

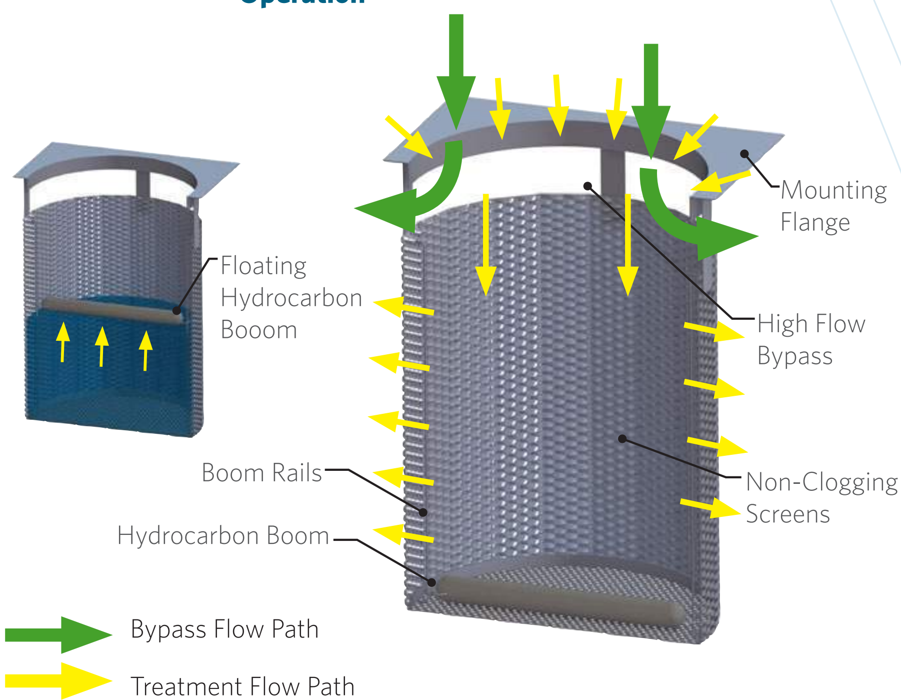
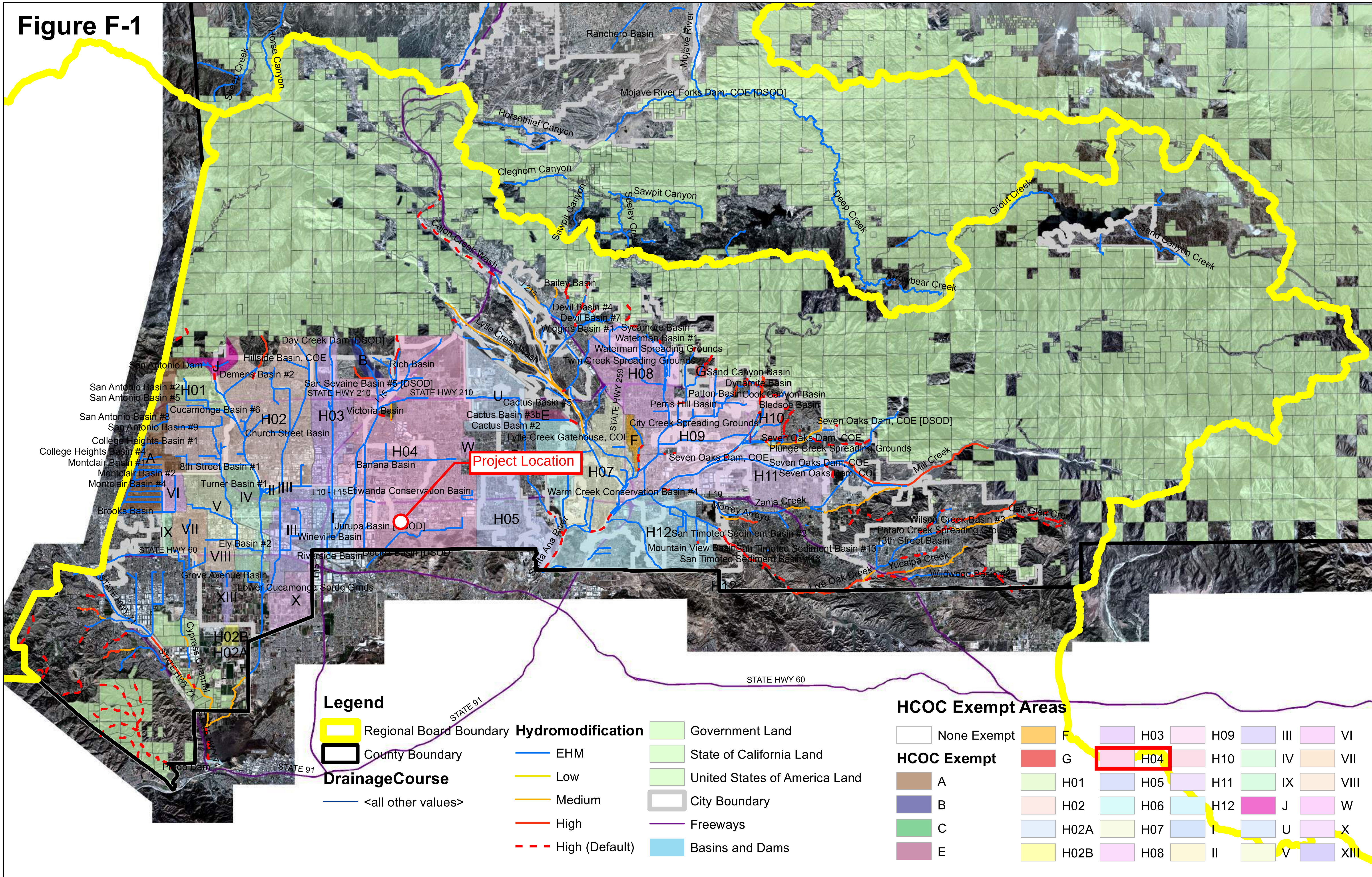


Figure F-1



Ranchero Basin
Mojave River
Horse Canyon
Sheep Creek
Mojave River Forks Dam, COE [DSOD]
Horsethief Canyon
Cleghorn Canyon
Sawpit Canyon
Seeley Creek
Deep Creek
Grout Creek
Sand Canyon Creek
Holcomb Creek
Cajon Creek Wash
Bailey Basin
Devil Basin #4
Devil Basin #7
Wiggins Basin #1
Sycamore Basin
Waterman Basin #1
Waterman Spreading Grounds
Twin Creek Spreading Grounds
Lytle Creek Wash
Day Creek Dam [DSOD]
Hillside Basin, COE
Rich Basin
San Antonio Dam
Demens Basin #2
San Sevaine Basin #5 [DSOD]
STATE HWY 210
San Antonio Basin #2
San Antonio Basin #5
Cucamonga Basin #6
San Antonio Basin #8
San Antonio Basin #9
College Heights Basin #1
College Heights Basin #4
Montclair Basin #1
Montclair Basin #2
Montclair Basin #4
Church Street Basin
Victoria Basin
Cactus Basin #5
Cactus Basin #3b
Cactus Basin #2
Lytle Creek Gatehouse, COE
Sand Canyon Basin
Dynamite Basin
Patton Basin
Cook Canyon Basin
Perris Hill Basin
Bledsoe Basin
City Creek Spreading Grounds
Seven Oaks Dam, COE [DSOD]
Seven Oaks Dam, COE
Plunge Creek Spreading Grounds
Mill Creek
Banana Basin
8th Street Basin #1
Turner Basin #1
Etiwanda Conservation Basin
Warm Creek Conservation Basin #4
Zanja Creek
Morrey Arroyo
Oak Glen Creek
Wilson Creek Basin #3
Potato Creek Spreading Grounds
13th Street Basin
Brooks Basin
Jurupa Basin
Wineville Basin
Ely Basin #2
STATE HWY 60
Riverside Basin
Grove Avenue Basin
Lower Cucamonga Sprdg Grnds
San Timoteo Sediment Basin #3
Mountain View Basin
San Timoteo Sediment Basin #18
Yucaipa Creek
Wildwood Basin #2
Live Oak Creek
Santa Ana River
Cypress Channel
Prado Dam
STATE 91
STATE HWY 71
STATE HWY 259
Project Location
H01 H02 H02A H02B H03 H04 H05 H07 H08 H09 H10 H11 H12
A B E F G J U W I II III IIII IV V VI VII VIII IX X XIII
Legend
Regional Board Boundary
County Boundary
DrainageCourse
<all other values>
Hydromodification
EHM
Low
Medium
High
High (Default)
Government Land
State of California Land
United States of America Land
City Boundary
Freeways
Basins and Dams
HCOC Exempt Areas
None Exempt
HCOC Exempt
A
B
C
E
F
G
H01
H02
H02A
H02B
H03
H04
H05
H06
H07
H08
H09
H10
H11
H12
I
II
III
IV
IX
J
U
V
VI
VII
VIII
W
X
XIII

Hydromodification

A.1 Hydrologic Conditions of Concern (HCOC) Analysis

HCOC Exemption:

1. **Sump Condition:** All downstream conveyance channel to an adequate sump (for example, Prado Dam, 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.

2. **Pre = Post**: The runoff flow rate, volume and velocity for the post-development condition of the Priority Development Project do not exceed the pre-development (i.e, naturally occurring condition for the 2-year, 24-hour rainfall event utilizing latest San Bernardino County Hydrology Manual.

   a. Submit a substantiated hydrologic analysis to justify your request.

3. **Diversion to Storage Area**: The drainage areas that divert to water storage areas which are considered as control/release point and utilized for water conservation.

   a. See Appendix F for the HCOC Exemption Map and the on-line Watershed Geodatabase (http://sbcounty.permitrack.com/wap) for reference.

4. **Less than One Acre**: The Priority Development Project disturbs less than one acre. The Co-permittee 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 project disturbs less than one acre and is not part of a common plan of development.

5. **Built Out Area**: The contributing watershed area to which the project discharges has a developed area percentage greater than 90 percent.

   a. See Appendix F for the HCOC Exemption Map and the on-line Watershed Geodatabase (http://sbcounty.permitrack.com/wap) for reference.

Summary of HCOC Exempted Area

	HCOC Exemption reasoning				
	1	2	3	4	5
Area					
A			X		X
B			X		
C					X
E			X		
F					X
G			X		X
H01	X		X		
H02	X		X		
H02A	X		X		
H02B			X		
H03			X		
H04	X		X		
H05	X				
H06			X		
H07	X				
H08	X		X		
H09	X				
H10	X		X		
H11	X		X		
H12	X				
J			X		
U			X		
W			X		
I			X		
II			X		
III					X
IV			X		X
V			X*		
VI					X
VII					X
VIII			X		
IX					X
X			X		
XIII			X		

*Detention/Conservation Basin

Attachment C
Educational Materials

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

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Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:

  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.

  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.

- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.

- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- Irrigate slowly to prevent runoff and then only as much as is needed.

- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, polyphosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

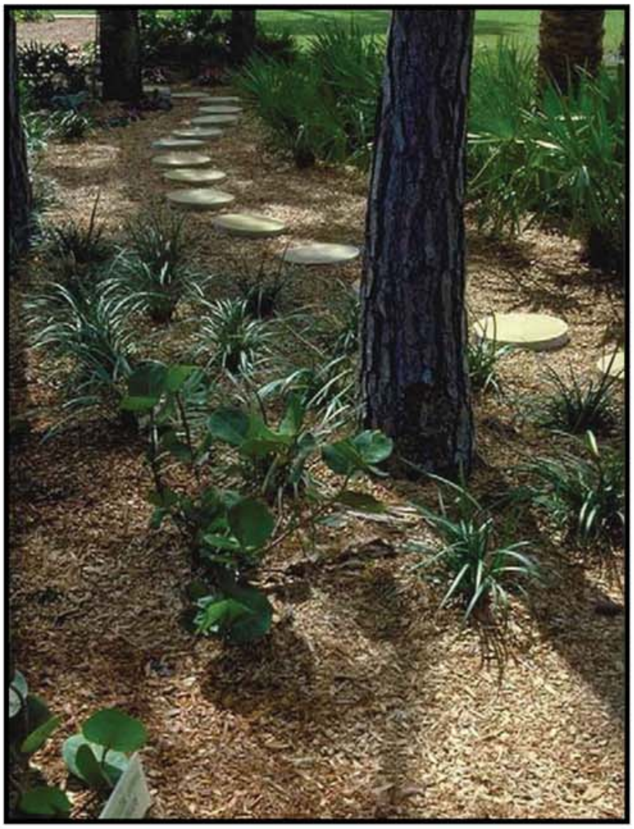
King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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Designing New Installations

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

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

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

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

Conserve Natural Areas during Landscape Planning

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

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

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

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

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

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

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

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

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

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

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

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

Rain Garden

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

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

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

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

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

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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

Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

Contain Pollutants

Collect and Convey

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

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

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

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

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

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.

- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:

  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff

  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect

  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible

  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth

- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Design Objectives

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

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

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

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.

- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.

- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.

- Other features may be comparable and equally effective.

Redeveloping Existing Installations

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

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

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

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

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

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

Trash Storage Areas SD-32

Design Objectives

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

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

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

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

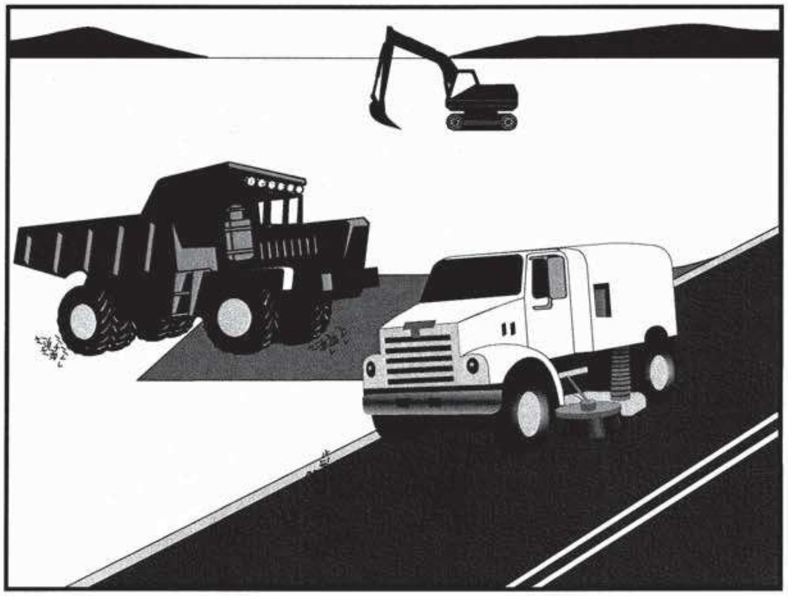
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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

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

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

Street Sweeping and Vacuuming SE-7



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

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.

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.

- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

- ● Low
- ■ High
- ▲ Medium

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

References and Sources of Additional Information

Caltrans, 2002, BMP Retrofit Pilot Program Proposed Final Report, Rpt. CTSW-RT-01-050, California Dept. of Transportation, Sacramento, CA.

Galli, J. 1992. *Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland*. Metropolitan Washington Council of Governments, Washington, DC.

Hilding, K. 1996. Longevity of infiltration basins assessed in Puget Sound. *Watershed Protection Techniques* 1(3):124–125.

Maryland Department of the Environment (MDE). 2000. *Maryland Stormwater Design Manual*. http://www.mde.state.md.us/environment/wma/stormwatermanual. Accessed May 22, 2002.

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The Dark Side Of Stormwater Runoff Management: Disease Vectors Associated With Structural BMPs. Stormwater 3(2): 24-39.

Nightingale, H.I., 1975, "Lead, Zinc, and Copper in Soils of Urban Storm-Runoff Retention Basins," American Water Works Assoc. Journal. Vol. 67, p. 443-446.

Nightingale, H.I., 1987a, "Water Quality beneath Urban Runoff Water Management Basins," Water Resources Bulletin, Vol. 23, p. 197-205.

Nightingale, H.I., 1987b, "Accumulation of As, Ni, Cu, and Pb in Retention and Recharge Basin Soils from Urban Runoff," Water Resources Bulletin, Vol. 23, p. 663-672.

Nightingale, H.I., 1987c, "Organic Pollutants in Soils of Retention/Recharge Basins Receiving Urban Runoff Water," Soil Science Vol. 148, pp. 39-45.

Nightingale, H.I., Harrison, D., and Salo, J.E., 1985, "An Evaluation Technique for Ground-water Quality Beneath Urban Runoff Retention and Percolation Basins," Ground Water Monitoring Review, Vol. 5, No. 1, pp. 43-50.

Oberts, G. 1994. Performance of Stormwater Ponds and Wetlands in Winter. *Watershed Protection Techniques* 1(2): 64–68.

Pitt, R., et al. 1994, *Potential Groundwater Contamination from Intentional and Nonintentional Stormwater Infiltration*, EPA/600/R-94/051, Risk Reduction Engineering Laboratory, U.S. EPA, Cincinnati, OH.

Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments, Washington, DC.

Schroeder, R.A., 1995, *Potential For Chemical Transport Beneath a Storm-Runoff Recharge (Retention) Basin for an Industrial Catchment in Fresno, CA*, USGS Water-Resource Investigations Report 93-4140.

Southeastern Wisconsin Regional Planning Commission (SWRPC). 1991. *Costs of Urban Nonpoint Source Water Pollution Control Measures*. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI.

U.S. EPA, 1983, *Results of the Nationwide Urban Runoff Program: Volume 1 – Final Report*, WH-554, Water Planning Division, Washington, DC.

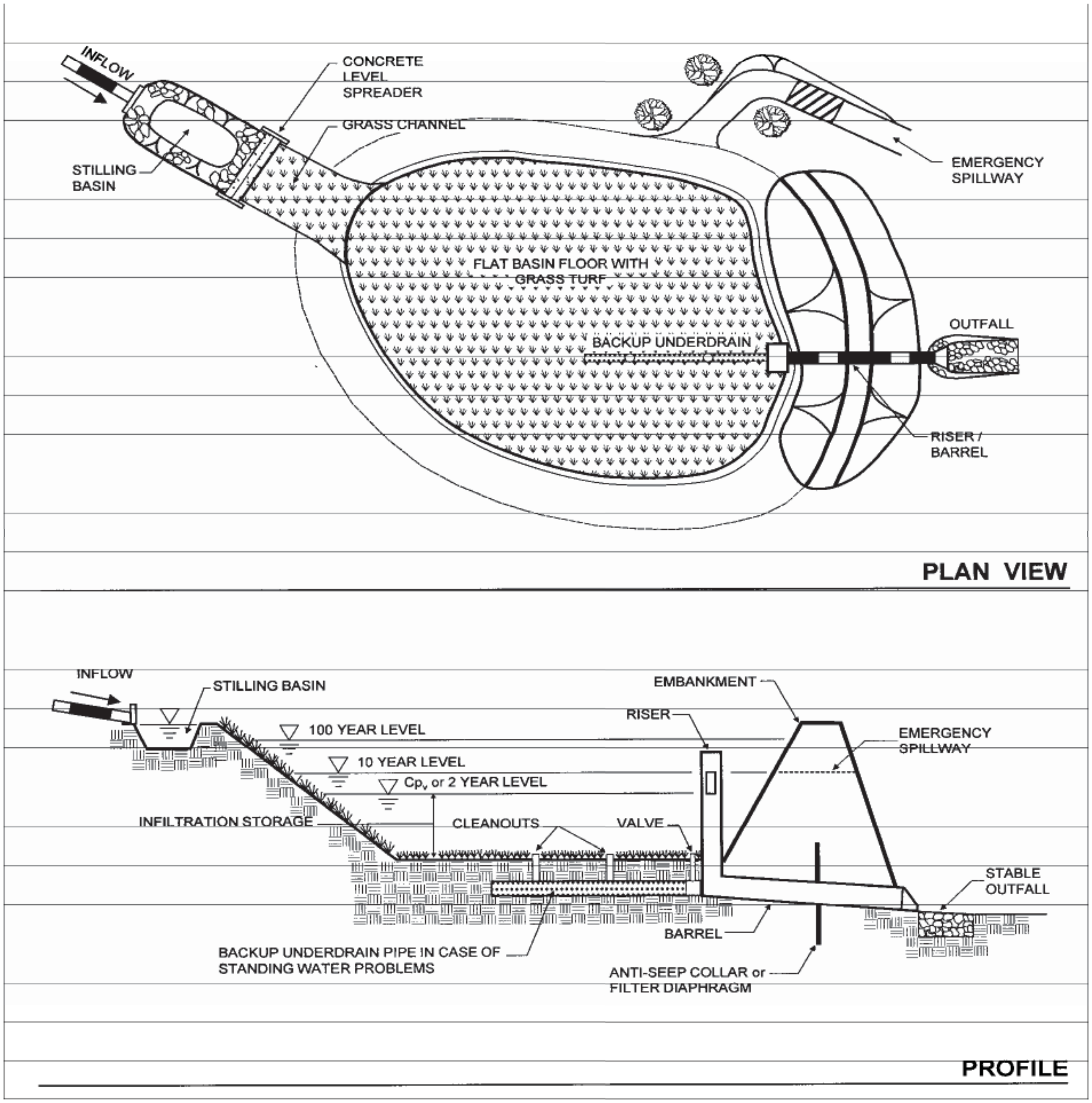
Watershed Management Institute (WMI). 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. Prepared for U.S. Environmental Protection Agency Office of Water, Washington, DC.

Information Resources

Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for U.S. Environmental Protection Agency Office of Wetlands, Oceans and Watersheds. Washington, DC.

Ferguson, B.K., 1994. *Stormwater Infiltration*. CRC Press, Ann Arbor, MI.

USEPA. 1993. *Guidance to Specify Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.



INFLOW
CONCRETE LEVEL SPREADER
GRASS CHANNEL
STILLING BASIN
EMERGENCY SPILLWAY
FLAT BASIN FLOOR WITH GRASS TURF
OUTFALL
BACKUP UNDERDRAIN
RISER / BARREL
PLAN VIEW
INFLOW
STILLING BASIN
EMBANKMENT
RISER
100 YEAR LEVEL
EMERGENCY SPILLWAY
10 YEAR LEVEL
Cp_v or 2 YEAR LEVEL
INFILTRATION STORAGE
CLEANOUTS
VALVE
STABLE OUTFALL
BARREL
BACKUP UNDERDRAIN PIPE IN CASE OF STANDING WATER PROBLEMS
ANTI-SEEP COLLAR or FILTER DIAPHRAGM
PROFILE

XIV.1. Hydrologic Source Control Fact Sheets (HSC)

HSC-1: Localized On-Lot Infiltration

'Localized on-lot infiltration' refers to the practice of collecting on-site runoff from small distributed areas within a catchment and diverting it to a dedicated on-site infiltration area. This technique can include disconnecting downspouts and draining sidewalks and patios into french drains, trenches, small rain gardens, or other surface depressions. For downspout disconnections and other impervious area disconnection involving dispersion over pervious surfaces, but without intentional ponding, see HSC-2: Impervious Area Dispersion.

Also known as:

- *Downspout infiltration*
- *Retention grading*
- *French drains*
- *On-lot rain gardens*

On-lot rain garden
Source: lowimpactdevelopment.org

Feasibility Screening Considerations

- 'Localized on-lot infiltration' shall meet infiltration infeasibility screening criteria to be considered for use.

Opportunity Criteria

- Runoff can be directed to and temporarily pond in pervious area depressions, rock trenches, or similar.
- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Shallow utilities are not present below infiltration areas.

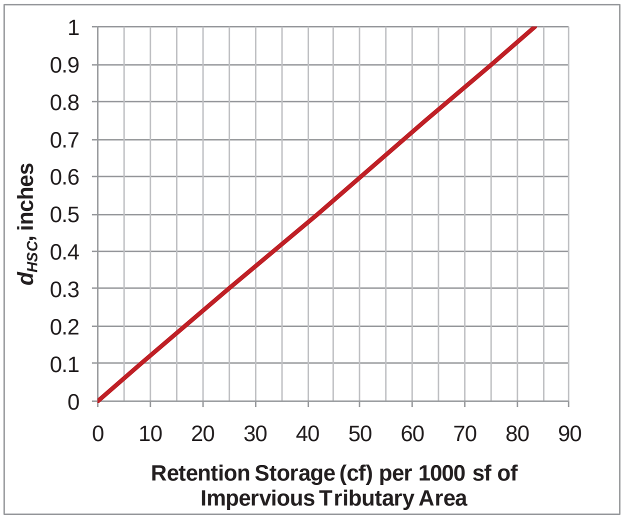
OC-Specific Design Criteria and Considerations

- ☐ A single on-lot infiltration area should not be sized to retain runoff from impervious areas greater than 4,000 sq. ft.; if the drainage area exceeds this criteria, sizing should be based on calculations for bioretention areas or infiltration trenches.
- ☐ Soils should be sufficiently permeable to eliminate ponded water within 24 hours following a 85^{th} percentile, 24-hour storm event.
- ☐ Maximum ponding depth should be should be less than 3 inches and trench depth should be less than 1.5 feet.
- ☐ Infiltration should not be used when the depth to the mounded seasonally high table is within 5 feet of the bottom of infiltrating surface.
- ☐ Infiltration via depression storage, french drains, or rain gardens should be located greater than 8 feet from building foundations.
- ☐ Site slope should be less than 10%.
- ☐ Infiltration unit should not be located within 50 feet of slopes greater than 15 percent.
- ☐ Side slopes of rain garden or depression storage should not exceed 3H:1V.
- ☐ Effective energy dissipation and uniform flow spreading methods should be employed to prevent erosion resulting fromwater entering infiltration areas.

☐ Overflow should be located such that it does not cause erosion orand is conveyed away from structures toward the downstream conveyance and treatment system. .

Calculating HSC Retention Volume

- The retention volume provided by localized on-lot infiltration can be computed as the storage volume provided by surface ponding and the pore space within an amended soil layer or gravel trench.
- Estimate the average retention volume per 1000 square feet impervious tributary area provided by on-lot infiltration.
- Look up the storm retention depth, d_{HSC} from the chart to the right.
- The max d_{HSC} is equal to the design capture storm depth for the project site.



Configuration for Use in a Treatment Train

- Localized on-lot infiltration would typically serve as the first in a treatment train and should only be used where tributary areas do not generate significant sediment that would require pretreatment to mitigate clogging.
- The use of impervious area disconnection reduces the sizing requirement for downstream LID and/or conventional treatment control BMPs.

Additional References for Design Guidance

- LID Center – Rain Garden Design Template. http://www.lowimpactdevelopment.org/raingarden_design/
- University of Wisconsin Extension. Rain Gardens: A How-To Manual for Homeowners. http://learningstore.uwex.edu/assets/pdfs/GWQ037.pdf

HSC-2: Impervious Area Dispersion

Also known as:

- *Downspout disconnection*
- *Impervious area disconnection*
- *Sheet flow dispersion*

Simple Downspout Dispersion
Source: toronto.ca/environment/water.htm

Impervious area dispersion refers to the practice of routing runoff from impervious areas, such as rooftops, walkways, and patios onto the surface of adjacent pervious areas. Runoff is dispersed uniformly via splash block or dispersion trench and soaks into the ground as it move slowly across the surface of pervious areas. Minor ponding may occur, but it is not the intent of this practice to actively promote localized on-lot storage (See HSC-1: Localized On-Lot Infiltration).

Feasibility Screening Considerations

- Impervious area dispersion can be used where infiltration would otherwise be infeasible, however dispersion depth over landscaped areas should be limited by site-specific conditions to prevent standing water or geotechnical issues.

Opportunity Criteria

- Rooftops and other low traffic impervious surface present in drainage area.
- Soils are adequate for infiltration. If not, soils can be amended to improve capacity to absorb dispersed water (see MISC-2: Amended Soils).
- Significant pervious area present in drainage area with shallow slope
- Overflow from pervious area can be safely managed.

OC-Specific Design Criteria and Considerations

☐ Soils should be preserved from their natural condition or restored via soil amendments to meet minimum criteria described in Section .

☐ A minimum of 1 part pervious area capable of receiving flow should be provided for every 2 parts of impervious area disconnected.

☐ The pervious area receiving flow should have a slope ≤ 2 percent and path lengths of ≥ 20 feet per 1000 sf of impervious area.

☐ Dispersion areas should be maintained to remove trash and debris, loose vegetation, and protect any areas of bare soil from erosion.

☐ Velocity of dispersed flow should not be greater than 0.5 ft per second to avoid scour.

Calculating HSC Retention Volume

- The retention volume provided by downspout dispersion is a function of the ratio of impervious to pervious area and the condition of soils in the pervious area.
- Determine flow patterns in pervious area and estimate footprint of pervious area receiving dispersed flow. Calculate the ratio of pervious to impervious area.
- Check soil conditions using the soil condition design criteria below; amend if necessary.
- Look up the storm retention depth, d_{HSC} from the chart below.

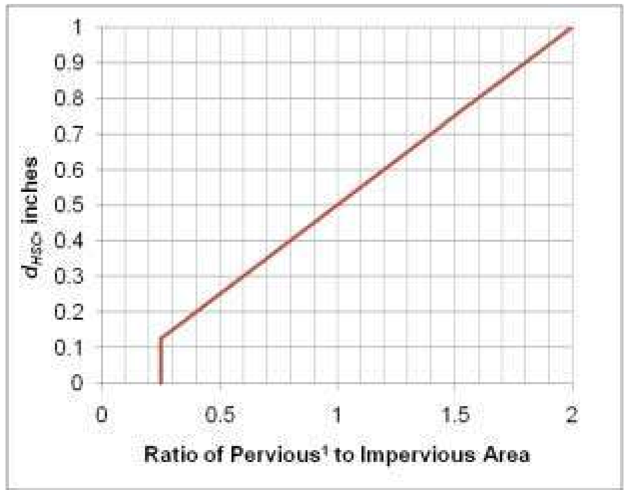
- The max d_{HSC} is equal to the design storm depth for the project site.

Soil Condition Design Criteria

- ☐ Maximum slope of 2 percent
- ☐ Well-established lawn or landscaping
- ☐ Minimum soil amendments per criteria in MISC-2: Amended Soils.

Configuration for Use in a Treatment Train

- Impervious area disconnection is an HSC that may be used as the first element in any treatment train
- The use of impervious area disconnection reduces the sizing requirement for downstream LID and/or treatment control BMPs



[1] Pervious area used in calculation should only include the pervious area receiving flow, not pervious area receiving only direct rainfall or upslope pervious drainage.

Additional References for Design Guidance

- SMC LID Manual (pp 131) http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- City of Portland Bureau of Environmental Services. 2010. How to manage stormwater – Disconnect Downspouts. http://www.portlandonline.com/bes/index.cfm?c=43081&a=177702
- Seattle Public Utility: http://www.cityofseattle.org/util/stellent/groups/public/@spu/@usm/documents/webcontent/spu01_006395.pdf
- Thurston County, Washington State (pp 10): http://www.co.thurston.wa.us/stormwater/manual/docs-faqs/DG-5-Roof-Runoff-Control_Rev11Jan24.pdf

HSC-3: Street Trees

By intercepting rainfall, trees can provide several aesthetic and stormwater benefits including peak flow control, increased infiltration and ET, and runoff temperature reduction. The volume of precipitation intercepted by the canopy reduces the treatment volume required for downstream treatment BMPs. Shading reduces the heat island effect as well as the temperature of adjacent impervious surfaces, over which stormwater flows, and thus reduces the heat transferred to downstream receiving waters. Tree roots also strengthen the soil structure and provide infiltrative pathways, simultaneously reducing erosion potential and enhancing infiltration.

Also known as:
- *Canopy interception*

Street trees
Source: Geosyntec Consultants

Feasibility Screening Considerations

- Not applicable

Opportunity Criteria

- Street trees can be incorporated in green streets designs along sidewalks, streets, parking lots, or driveways.
- Street trees can be used in combination with bioretention systems along medians or in traffic calming bays.
- There must be sufficient space available to accommodate both the tree canopy and root system.

OC-Specific Design Criteria and Considerations

- ☐ Mature tree canopy, height, and root system should not interfere with subsurface utilities, suspended powerlines, buildings and foundations, or other existing or planned structures. Required setbacks should be adhered to.
- ☐ Depending on space constarints, a 20 to 30 foot diameter canopy (at maturity) is recommended for stormwater mitigation.
- ☐ Native, drought-tolerant species should be selected in order to minimize irrigation requirements and improve the long-term viability of trees.
- ☐ Trees should not impede pedstrian or vehicle sight lines.
- ☐ Planting locations should receive adequate sunlight and wind protection; other environmental factors should be considered prior to planting.
- ☐ Frequency and degree of vegetation management and maintenance should be considered with respect to owner capabilities (e.g., staffing, funding, etc.).
- ☐ Soils should be preserved in their natural condition (if appropriate for planting) or restored via soil amendments to meet minimum criteria described in MISC-2: Amended Soils. If necessary, a landscape architect or plant biologist should be consulted.
- ☐ A street tree selection guide, such as that specific to the City of Los Angeles, may need to be consulted to select species appropriate for the site design constraints (e.g., parkway size, tree height, canopy spread, etc.)
- ☐ Infiltration should not cause geotechnical hazards related to adjacent structures (buildings,

roadways, sidewalks, utilities, etc.)

Calculating HSC Retention Volume

- The retention volume provided by streets trees via canopy interception is dependent on the tree species, time of the year, and maturity.
- To compute the retention depth, the expected impervious area covered by the full tree canopy after 4 years of growth must be computed (IA_{HSC}). The maximum retention depth credit for canopy interception (d_{HSC}) is 0.05 inches over the area covered by the canopy at 4 years of growth.

Configuration for Use in a Treatment Train

- As a HSC, street trees would serve as the first step in a treatment train by reducing the treatment volume and flow rate of a downstream treatment BMP.

Additional References for Design Guidance

- California Stormwater BMP Handbook. http://www.cabmphandbooks.com/Documents/Development/Section_3.pdf
- City of Los Angeles, Street Tree Division - Street Tree Selection Guide. http://bss.lacity.org/UrbanForestryDivision/StreetTreeSelectionGuide.htm
- Portland Stormwater Management Manual. http://www.portlandonline.com/bes/index.cfm?c=35122&a=55791
- San Diego County – Low Impact Development Fact Sheets. http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

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 stormwater 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 away 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 of wash water into 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 with being toxic free. Soapy water entering the storm drain system can 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 inlets 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.

Helpful telephone numbers and links:

Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

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

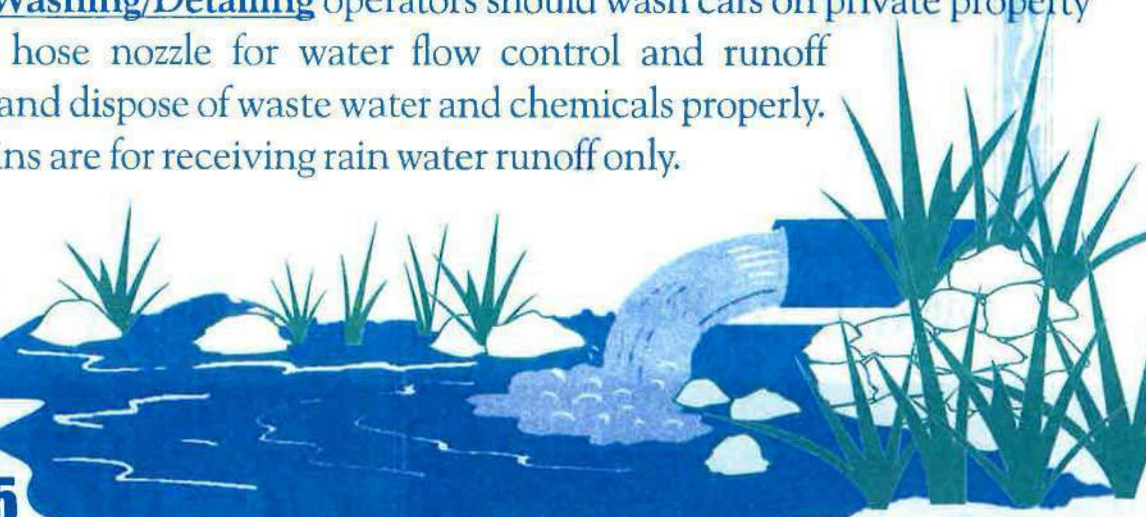
Do you know where street flows actually go?

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



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

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.

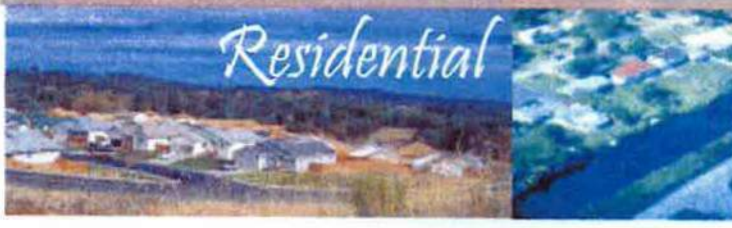
- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic 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

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



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.

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.

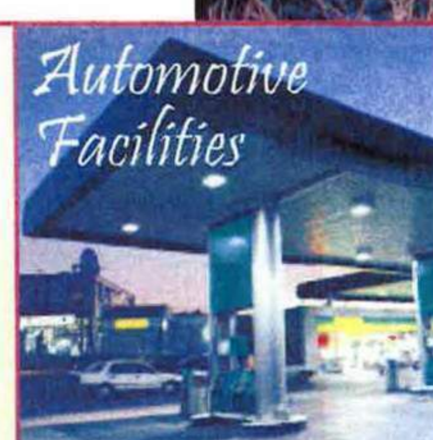
- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas 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.

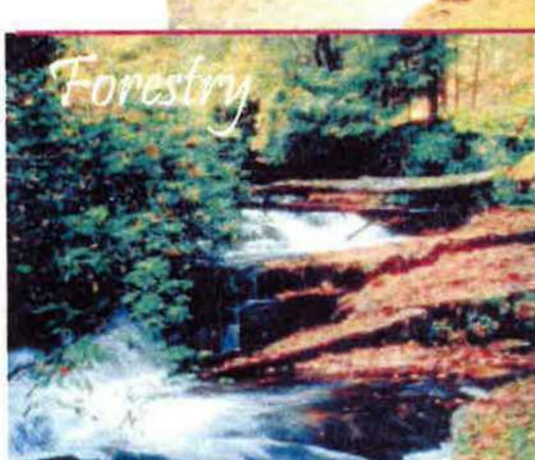
Automotive Facilities



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



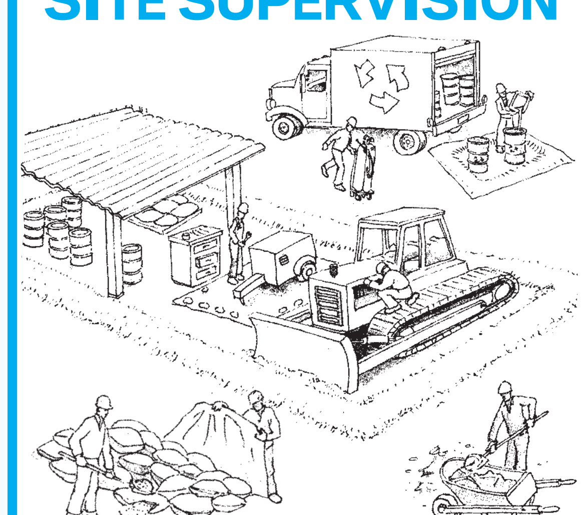
Improperly managed logging operations can result in erosion and sedimentation.

- 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.

StormWater Pollution

What you should know for...

GENERAL CONSTRUCTION & SITE SUPERVISION



Best Management Practices (BMPs) for:

- Developers
- General Contractors
- Home Builders
- Construction Inspectors
- Anyone in the construction business

Resources

State Water Resources Control Board
Division of Water Quality
1001 I Street
Sacramento CA 95814
(916) 341-5455
www.swrcb.ca.gov/stormwtr/

Colorado River Basin Regional Water Quality Control Board - Region 7
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260
(760) 346-7491
www.swrcb.ca.gov/~rwqcb7/

Santa Ana Regional Water Quality Control Board - Region 8
3737 Main Street, Suite 500
Riverside, CA 92501-3348
(909) 782-4130
www.swrcb.ca.gov/~rwqcb8/

San Diego Regional Water Quality Control Board - Region 9
9771 Clairemont Mesa Blvd., Suite A
San Diego, CA 92124
(858) 467-2952
www.swrcb.ca.gov/~rwqcb9/

To report a hazardous materials spill, call:

Riverside County Hazardous Materials Emergency Response Team
(909) 358-5055 8:00 a.m. – 5:00 p.m.
(909) 358-5245 after 5:00 p.m.

In an emergency call: **911**

For recycling and hazardous waste disposal, call:

(909) 358-5055

To report an illegal dumping or a clogged storm drain, call:

1-800-506-2555

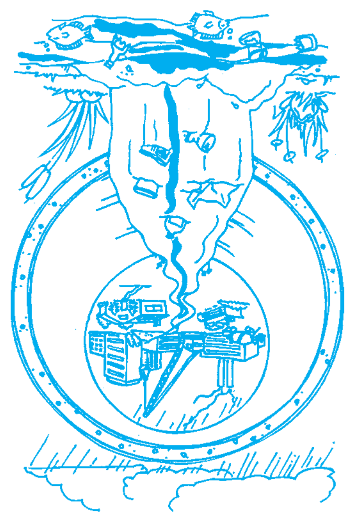
To order additional brochures or to obtain information on other pollution prevention activities, please call (909) 955-1200 or visit the StormWater/CleanWater Protection Program website at: www.co.riverside.ca.us/depts/flood/waterquality npdes.asp

StormWater CleanWater PROTECTION PROGRAM

The StormWater/CleanWater Protection Program gratefully acknowledges the Santa Clara Valley Nonpoint Pollution Control Program, Alameda Countywide CleanWater Program and the City of Los Angeles Stormwater Management Division for information provided in this brochure.

StormWater Pollution . . . What You Should Know

Riverside County has two drainage systems - sewers and storm drains. The storm drain system was designed to reduce flooding by carrying excess rainwater away from streets and developed areas. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our local waterways.



Unlike sanitary sewers, storm drains are not connected to a wastewater treatment plant – they flow directly to our local streams, rivers and lakes.

Stormwater runoff is a part of the natural hydrologic process. However, land development and construction activities can significantly alter natural drainage processes and introduce pollutants into stormwater runoff. Polluted stormwater runoff from construction sites has been identified as a major source of water pollution in California. It jeopardizes the quality of our local waterways and can pose a serious threat to the health of our aquatic ecosystems.

The Cities and County of Riverside StormWater/CleanWater Protection Program

Because 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 on pollution prevention activities. This pamphlet describes various Best Management Practices (BMPs) that construction site operators can use to prevent stormwater pollution.

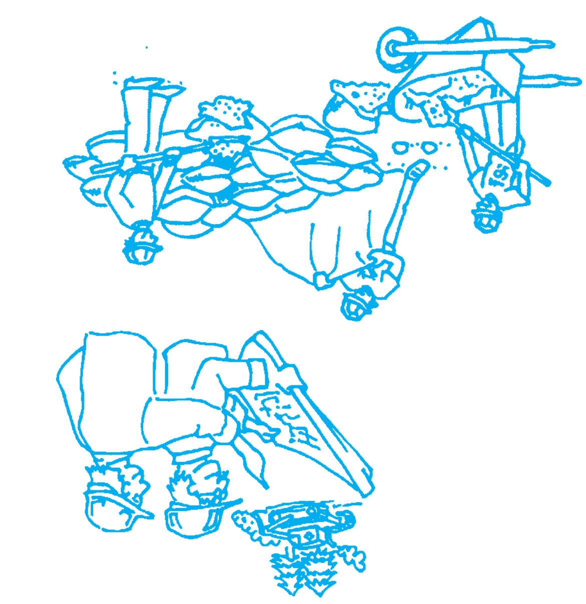
In accordance with applicable federal and state law, the Cities and County of Riverside have adopted ordinances for stormwater management and discharge control that **prohibit** the discharge of pollutants into the storm drain system or local surface water. This includes discharges from construction sites containing sediment, concrete, mortar, paint, solvents, lubricants, vehicle fluids, fuel, pesticides, and construction debris.

PLEASE NOTE: The Federal, State and local regulations strictly prohibit the discharge of sediment and pollutants into the streets, the storm drain system or waterways. As an owner, operator or supervisor of a construction site, you may be held financially responsible for any environmental damage caused by your subcontractors or employees.

Stormwater Pollution from Construction Activities

The two most common sources of stormwater pollution problems associated with construction activities are ***erosion*** and ***sedimentation***. Failure to maintain adequate erosion and sediment controls at construction sites often results in sediment discharges into the storm drain system, creating multiple problems once it enters local waterways.

Construction vehicles and heavy equipment can also track significant amounts of mud and sediment onto adjacent streets. Additionally, wind may transport construction materials and wastes into streets storm drains, or directly into our local waterways.



What Should You Do?

Advance Planning to Prevent Pollution

- ❑ Remove existing vegetation only as needed.
- ❑ Schedule excavation, grading, and paving operations for dry weather periods, if possible.
- ❑ Designate a specific area of the construction site, well away from storm drain inlets or watercourses, for material storage and equipment maintenance.
- ❑ Develop and implement an effective combination of erosion and sediment controls for the construction site.
- ❑ Practice source reduction by ordering only the amount of materials that are needed to finish the project.
- ❑ Educate your employees and subcontractors about stormwater management requirements and their pollution prevention responsibilities.
- ❑ Control the amount of surface runoff at the construction site by impeding internally generated flows and using berms or drainage ditches to direct incoming offsite flows to go around the site. ***Note:*** *Consult local drainage policies for more information.*

Best Management Practices

The following Best Management Practices (BMPs) can significantly reduce pollutant discharges from your construction site. Compliance with stormwater regulations can be as simple as minimizing stormwater contact with potential pollutants by providing covers and secondary containment for construction materials, designating areas away from storm drain systems for storing equipment and materials and implementing good housekeeping practices at the construction site.

- ❑ Protect all storm drain inlets and streams located near the construction site to prevent sediment-laden water from entering the storm drain system.
- ❑ Limit access to and from the site. Stabilize construction entrances/exits to minimize the track out of dirt and mud onto adjacent streets. Conduct frequent street sweeping.
- ❑ Protect stockpiles and construction materials from winds and rain by storing them under a roof, secured impermeable tarp or plastic sheeting.
- ❑ Avoid storing or stockpiling materials near storm drain inlets, gullies or streams.
- ❑ Phase grading operations to limit disturbed areas and duration of exposure.
- ❑ Perform major maintenance and repairs of vehicles and equipment offsite.
- ❑ Wash out concrete mixers only in designated washout areas at the construction site.
- ❑ Set-up and operate small concrete mixers on tarps or heavy plastic drop cloths.
- ❑ Keep construction sites clean by removing trash, debris, wastes, etc. on a regular basis.
- ❑ Clean-up spills immediately using dry clean-up methods (e.g., absorbent materials such as cat litter, sand or rags for liquid spills; sweeping for dry spills such as cement, mortar or fertilizer) and by removing the contaminated soil from spills on dirt areas. .
- ❑ Prevent erosion by implementing any or a combination of soil stabilization practices such as mulching, surface roughening, permanent or temporary seeding.
- ❑ Maintain all vehicles and equipment in good working condition. Inspect frequently for leaks, and repair promptly.
- ❑ Practice proper waste disposal. Many construction materials and wastes, including solvents, water-based paint, vehicle fluids, broken asphalt and concrete, wood, and cleared vegetation can be recycled. Materials that cannot be recycled must be taken to an appropriate landfill or disposed of as hazardous waste.
- ❑ Cover open dumpsters with secured tarps or plastic sheeting. Never clean out a dumpster by washing it down on the construction site.
- ❑ Arrange for an adequate debris disposal schedule to insure that dumpsters do not overflow.

General Construction Activities Stormwater Permit

(Construction Activities General Permit)

The State Water Resources Control Board (SWRCB) adopted a new Construction Activities General Permit (WQ Order No. 99-08DWQ) on August 19, 1999, superseding the now expired SWRCB statewide General Permit (WQ Order No. 92-08DWQ). This permit is administered and enforced by the SWRCB and the local Regional Water Quality Control Boards (RWQCB). The updated Construction Activities General Permit establishes a number of new stormwater management requirements for construction site operator.

NOTE: *Some construction activies stormwater permits are issued on a regional basis. Consult your local RWQCB to find out if your project requires coverage under any of these permits.*

Frequently Asked Questions:

Does my construction site require coverage under the Construction Activities General Permit?

Yes, if construction activity results in the disturbance of five or more acres of total land area or is part of a common plan of development that results in the disturbance of five or more acres.

How do I obtain coverage under the Construction Activities General Permit?

Obtain the permit package and submit the completed Notice of Intent (NOI) form to the SWRCB prior to grading or disturbing soil at the construction site. For ongoing construction activity involving a change of ownership, the new owner must submit a new NOI within 30 days of the date of change of ownership. The completed NOI along with the required fee should be mailed to the SWRCB.

What must I do to comply with the requirements of the Construction Activities General Permit?

- Implement BMPs for non-stormwater discharges year-round.
- Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) prior to commencing construction activities.
- Keep a copy of the SWPPP at the construction site for the entire duration of the project.
- Calculate the anticipated stormwater run-off.
- Implement an effective combination of erosion and sediment control on all soil disturbed areas.
- Conduct site inspections prior to anticipated storm events, every 24-hours during extended storm events, and after actual storm event.
- Perform repair and maintenance of BMPs as soon as possible after storm events depending upon worker safety.
- Update the SWPPP as needed, to manage pollutants or reflect changes in site conditions.
- Include description of post construction BMPs at the construction site, including parties responsible for long-term maintenance.

NOTE: *Please refer to the Construction Activities General Permit for detailed information. You may contact the SWRCB, your local RWQCB, or visit the SWRCB website at www.swrcb.ca.gov/stormwtr/ to obtain a State Construction Activities Stormwater General Permit packet.*

How long is this Construction Activities General Permit in effect?

The Permit coverage stays in effect untilyou submit a Notice of Termination (NOT) to the SWRCB. For the purpose of submitting a NOT, all soil disturbing activities have to be completed and one of the three following criteria has to be met:

1. Change of ownership;
2. A uniform vegetative cover with 70 percent coverage has been established; or,
3. Equivalent stabilization measures such as the use of reinforced channel liners, soil cement, fiber matrices, geotextiles, etc., have been employed.

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.*

Attachment D
Infiltration Report

April 12, 2023

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Hillwood
36 Discovery, Suite 130
Irvine, California 92618

Attention: Ms. Kathy Hoffer
Vice President, Development

Project No.: **23G117-2**

Subject: **Results of Infiltration Testing**
Proposed Industrial Development
11171 Cherry Avenue
Fontana, California

Reference: Geotechnical Investigation, Proposed Industrial Development, 11171 Cherry Avenue, Fontana, California, prepared by Southern California Geotechnical, Inc. (SCG) for Hillwood, SCG Project No. 23G117-1, dated April 7, 2023.

Ms. Hoffer:

In accordance with your request, we have conducted infiltration testing at the subject site. We are pleased to present this report summarizing the results of the infiltration testing and our design recommendations.

Scope of Services

The scope of services performed for this project was in general accordance with our Proposal No. 23P177, dated March 6, 2023. The scope of services included site reconnaissance, subsurface exploration, field testing, and engineering analysis to determine the infiltration rates of the on-site soils. The infiltration testing was performed in general accordance with the guidelines published in the Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A, prepared for the Riverside County Department of Environmental Health (RCDEH), dated December, 2013. The San Bernardino County standards defer to the guidelines published by the RCDEH.

Site and Project Description

The subject site is located at the northeast corner of Cherry Avenue and Jurupa Avenue in Fontana, California. The site is also referenced by the street address 11171 Cherry Avenue. The site is bound to the north by existing commercial/industrial developments, to the west by Cherry Avenue, to the south by Jurupa Avenue, and to the east by Redwood Avenue and an existing commercial/industrial development. The general location of the site is illustrated on the Site Location Map, included as Plate 1 of this report.

The subject site is an L-shaped property and consists of two (2) rectangular-shaped parcels which total 29.6± acres in size. The northern parcel is developed with two (2) industrial buildings, 16,500 ft² and 20,000± ft² in size, and is mainly used for equipment and trailer storage. The

22885 Savi Ranch Parkway ▾ Suite E ▾ Yorba Linda ▾ California ▾ 92887
voice: (714) 685-1115 ▾ fax: (714) 685-1118 ▾ www.socalgeo.com

buildings are single-story structures of metal frame and metal siding construction, and are presumed to be supported on conventional shallow foundations with concrete slab-on-grade floors. Ground surface cover immediately surrounding the existing structures consist of Portland cement concrete (PCC) and asphaltic concrete (AC) pavements. The existing pavements are in poor condition with severe cracking throughout. Ground surface cover for the remainder of the northern parcel consists of open-graded gravel areas, and exposed soil. The southern parcel is developed with a few steel-framed canopies with ground surface cover consisting of open-graded gravel areas, and exposed soil. This parcel is mainly used for equipment and material storage. A tree line is present in most areas between the two parcels.

Detailed topographic information was not available at the time of this report. Based on elevations obtained from Google Earth, and visual observations made at the time of the subsurface investigation, the overall site topography slopes downward to the south at a gradient of 2± percent.

3.2 Proposed Development

A conceptual site plan (Scheme 1), prepared by HPA, Inc., has been provided to our office by the client. Based on this plan, the subject site will be developed with two new buildings:

Building No.	Warehouse (ft^2)	Office (ft^2)	Location on site
1	473,980	3,500	West
2	229,000	3,500	East

Dock-high doors will be constructed along portions of at least one building wall for both buildings. The proposed buildings are expected to be surrounded by AC pavements in the parking and drive areas, PCC pavements in the loading dock areas, and concrete flatwork and landscaped planters throughout the site.

Detailed structural information has not been provided. We assume that the new buildings will be single-story structures of tilt-up concrete construction, typically supported on conventional shallow foundations with concrete slab-on-grade floors. Based on the assumed construction, maximum column and wall loads are expected to be on the order of 100 kips and 4 to 7 kips per linear foot, respectively.

Based on discussions with representatives of Huitt-Zollars, Inc. (HZI), the project civil engineer, the site will utilize on-site stormwater disposal. Prior to infiltration testing, HZI provided an infiltration location plan. Based on this plan, the infiltration system will consist of the following:

Infiltration System	Infiltration Location	Depth to Bottom of System (feet)
"A"	East of Building 1	12
"B"	South of Building 1	12
"C"	West of Building 2	12

However, we understand that Infiltration System "B" will not be used in the design of the on-site stormwater disposal. SCG has included the infiltration test results and design recommendations for Infiltration System "B" should this system be used in the design of the stormwater disposal system in the future.

Concurrent Study

SCG concurrently conducted a geotechnical investigation at the subject site, referenced above. As a part of this study, eleven (11) borings (identified as Boring Nos. B-1 through B-11) were advanced to depths of 15 to 25± feet below the existing site grades. Each boring was logged during drilling by a member of our staff.

Artificial fill soils were encountered at the ground surface at all of the boring locations, extending to depths of 1½ to 5½± feet below the existing site grades. The fill soils generally consist of medium dense to very dense silty sands and sandy silts with varying fine to coarse gravel content. Boring Nos. B-1 encountered a stratum consisting of dense sandy silts with little fine gravel content at depths of 4½ to 5½± feet. The fill soils possess a disturbed and mottled appearance, with a sample possessing debris such as brick fragments, resulting in their classification as artificial fill. Native alluvial soils were encountered beneath the fill soils at all of the boring locations, extending to at least the maximum depth explored of 25± feet below the existing site grades. The near-surface alluvium generally consists of loose to dense gravelly sands, sandy silts, and silty sands, extending to depths of 4½ to 8± feet. At greater depths, the alluvium becomes denser with occasional medium dense sands.

Groundwater

Free water was not encountered during the drilling of any of the borings. Based on the lack of any water within the borings, and the moisture contents of the recovered soil samples, the static groundwater table is considered to have existed at a depth in excess of 25± feet at the time of the subsurface exploration.

Subsurface Exploration

Scope of Exploration

The subsurface exploration conducted for the infiltration testing consisted of six (6) infiltration test borings, advanced to a depth of 12± feet below the existing site grades. The infiltration borings were advanced using a truck-mounted drilling rig, equipped with 8-inch-diameter hollow-stem augers and were logged during drilling by a member of our staff. The approximate locations of the infiltration test borings (identified as I-1 through I-6) are indicated on the Infiltration Test Location Plan, enclosed as Plate 2 of this report.

Upon the completion of the infiltration borings, the bottom of each test boring was covered with 2± inches of clean ¾-inch gravel. A sufficient length of 3-inch-diameter perforated PVC casing was then placed into each test hole so that the PVC casing extended from the bottom of the test hole to the ground surface. Clean ¾-inch gravel was then installed in the annulus surrounding the PVC casing.

Geotechnical Conditions

Native alluvial soils were encountered beneath the ground surface at all infiltration test locations, extending to at least the maximum depth explored of 12± feet. The alluvium generally consists of loose to medium dense fine to medium sandy silts, silty fine to medium sands, and fine to medium sands extending to the maximum explored depth of 12± feet. The Boring Logs, which illustrate the conditions encountered at the boring locations, are included with this report.

Free water was not encountered during the drilling of any of the geotechnical or infiltration borings. Based on the lack of any water within the geotechnical and infiltration borings, and the moisture contents of the recovered soil samples, the static groundwater table is considered to have existed at a depth in excess of 25± feet at the time of the subsurface exploration.

As part of our research, we reviewed readily available groundwater data in order to determine regional groundwater depths. Recent water level data was obtained from the California Department of Water Resources, Water Data Library Station Map, website, https://wdl.water.ca.gov/waterdatalibrary/. One monitoring well on record (identified as Local Well: CHINO-1207068) is located as close as 700± feet west of the site. Water level readings within this monitoring well indicate a high groundwater level of 225± feet below the ground surface in January 2000.

Infiltration Testing

The infiltration testing was performed in general accordance with the guidelines published in Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A, which apply to San Bernardino County.

Pre-soaking

In accordance with the county infiltration standards for sandy soils, the infiltration test borings were pre-soaked 2 hours prior to the infiltration testing or until all of the water had percolated through the test holes. The pre-soaking process consisted of filling test borings by inverting a full 5-gallon bottle of clear water supported over each hole so that the water flow into the hole holds constant at a level at least 5 times the hole's radius above the gravel at the bottom of each hole. Pre-soaking was completed after all of the water had percolated through the test holes.

Infiltration Testing

Following the pre-soaking process of the infiltration test borings, SCG performed the infiltration testing. Each test hole was filled with water to a depth of at least 5 times the hole's radius above the gravel at the bottom of the test holes. In accordance with the San Bernardino County guidelines, since "sandy soils" (where 6 inches of water infiltrated into the surrounding soils in less than 25 minutes for two consecutive readings) were encountered at the bottom of the infiltration test borings, readings were taken at 10-minute intervals for a total of 1 hour, except for I-3 in which readings were taken at 30-minute intervals for a total of 3 hours. After each reading, water was added to the borings so that the depth of the water was at least 5 times the radius of the hole. The water level readings are presented on the spreadsheets enclosed with this report. The infiltration rates for each of the timed intervals are also tabulated on the spreadsheets.

The infiltration rates from the tests are tabulated in inches per hour. In accordance with the typically accepted practice, it is recommended that the most conservative reading from the latter part of the infiltration tests be used as the design infiltration rate. The rates are summarized below:

Infiltration Test No.	**Depth (feet)**	**Soil Description**	**Measured Infiltration Rate (inches/hour)**
I-1	12	Brown Silty fine to medium Sand, trace coarse Sand	6.0
I-2	12	Gray fine Sandy Silt, trace medium Sand	1.3
I-3	12	Brown Silty fine to medium Sand, trace coarse Sand, trace fine Gravel	0.8
I-4	12	Brown Silty fine Sand to fine Sandy Silt, little medium Sand	0.7
I-5	12	Gray fine to medium Sandy Silt	2.7
I-6	12	Brown Silty fine Sand, trace medium Sand	2.1

Laboratory Testing

Moisture Content

The moisture contents for the recovered soil samples within the borings were determined in accordance with ASTM D-2216 and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Grain Size Analysis

The grain size distribution of selected soils collected from the base of each infiltration test boring have been determined using a range of wire mesh screens. These tests were performed in general accordance with ASTM D-422 and/or ASTM D-1140. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these tests are presented on Plates C-1 through C-6 of this report.

Design Recommendations

Six (6) infiltration tests were performed at the subject site. As noted above, the infiltration rates at these locations vary from 0.7 to 6.0 inches per hour. The major factor affecting the difference in infiltration rates at the infiltration test locations is the presence of silt in the soils at the tested depths.

Based on the results of the infiltration testing, we recommend the following infiltration rates for the proposed infiltration systems:

Infiltration System	Location	Bottom of Infiltration System (feet)	Design Infiltration Rate (Inches per Hour)
"A"	East of Building 1	12	3.7*
"B"	South of Building 1	12	0.8*
"C"	West of Building 2	12	2.4*

*Please note that an average infiltration rate was used for the recommended design infiltration rates.

The design of the storm water infiltration systems should be performed by the project civil engineer, in accordance with the County of San Bernardino guidelines. It is recommended that the systems be constructed so as to facilitate removal of silt and clay, or other deleterious materials from any water that may enter the systems. The presence of such materials would decrease the effective infiltration rates. **It is recommended that the project civil engineer apply an appropriate factor of safety. The infiltration rates recommended above are based on the assumption that only clean water will be introduced to the subsurface profile. Any fines, debris, or organic materials could significantly impact the infiltration rate.** It should be noted that the recommended infiltration rates are based on infiltration testing at six (6) discrete locations and that the overall infiltration rates of the proposed infiltration systems could vary considerably.

<u>Infiltration Rate Considerations</u>

The infiltration rates presented herein were determined in accordance with the San Bernardino County guidelines and is considered valid only for the time and place of the actual test. Varying subsurface conditions will exist in other areas of the site, which could alter the recommended infiltration rate presented above. The infiltration rate will decline over time between maintenance cycles as silt or clay particles accumulate on the BMP surface. The infiltration rate is highly dependent upon a number of factors, including density, silt and clay content, grainsize distribution throughout the range of particle sizes, and particle shape. Small changes in these factors can cause large changes in the infiltration rate.

Infiltration rates are based on unsaturated flow. As water is introduced into soils by infiltration, the soils become saturated and the wetting front advances from the unsaturated zone to the saturated zone. Once the soils become saturated, infiltration rates become zero, and water can only move through soils by hydraulic conductivity at a rate determined by pressure head and soil permeability. Changes in soil moisture content will affect the infiltration rate. Infiltration rates should be expected to decrease until the soils become saturated. Soil permeability values will then govern groundwater movement. Permeability values may be on the order of 10 to 20 times less than infiltration rates. The system designer should incorporate adequate factors of safety and allow for overflow design into appropriate traditional storm drain systems, which would transport storm water off-site.

Construction Considerations

The infiltration rates presented in this report are specific to the tested locations and tested depths. Infiltration rates can be significantly reduced if the soils are exposed to excessive disturbance or compaction during construction. Compaction of the soils at the bottom of the infiltration system can significantly reduce the infiltration ability of the basins. Therefore, the subgrade soils within proposed infiltration system areas should not be over-excavated, undercut or compacted in any significant manner. **It is recommended that a note to this effect be added to the project plans and/or specifications.**

We recommend that a representative from the geotechnical engineer be on-site during the construction of the proposed infiltration system to identify the soil classification at the base of the system. It should be confirmed that the soils at the base of the proposed infiltration systems correspond with those presented in this report to ensure that the performance of the systems will be consistent with the rate reported herein.

We recommend that scrapers and other rubber-tired heavy equipment not be operated on the basin bottom, or at levels lower than 2 feet above the bottom of the system, particularly within basins. As such, the bottom 24 inches of the infiltration system should be excavated with non-rubber-tired equipment, such as excavators.

Chamber Maintenance

The proposed project will include infiltration chambers. Water flowing into these chambers will carry some level of sediment. This layer has the potential to significantly reduce the infiltration rate of the chamber subgrade soils. Therefore, a formal chamber maintenance program should be established to ensure that these silt and clay deposits are removed from the chamber on a regular basis.

Location of Infiltration Systems

The use of on-site storm water infiltration systems carries a risk of creating adverse geotechnical conditions. Increasing the moisture content of the soil can cause the soil to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Overlying structures and pavements in the infiltration area could potentially be damaged due to saturation of the subgrade soils. **The proposed infiltration system for this site should be located at least 25 feet away from any structures, including retaining walls.** Even with this provision of locating the infiltration system at least 25 feet from the building(s), it is possible that infiltrating water into the subsurface soils could have an adverse effect on the proposed or existing structures. It should also be noted that utility trenches which happen to collect storm water can also serve as conduits to transmit storm water toward the structure, depending on the slope of the utility trench. Therefore, consideration should also be given to the proposed locations of underground utilities which may pass near the proposed infiltration system.

The infiltration system designer should also give special consideration to the effect that the proposed infiltration system may have on nearby subterranean structures, open excavations, or descending slopes. In particular, infiltration systems should not be located near the crest of descending slopes, particularly where the slopes are comprised of granular soils. Such systems will require specialized design and analysis to evaluate the potential for slope instability, piping failures and other phenomena that typically apply to earthen dam design. This type of analysis is beyond the scope of this infiltration test report, but these factors should be considered by the infiltration system designer when locating the infiltration systems.

General Comments

This report has been prepared as an instrument of service for use by the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, structural engineer, and/or civil engineer. The design of the proposed storm water infiltration system is the responsibility of the civil engineer. The role of the geotechnical engineer is limited to determination of infiltration rate only. By using the design infiltration rate contained herein, the civil engineer agrees to indemnify, defend, and hold harmless the geotechnical engineer for all aspects of the design and performance of the proposed storm water infiltration system. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and testing depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted. The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

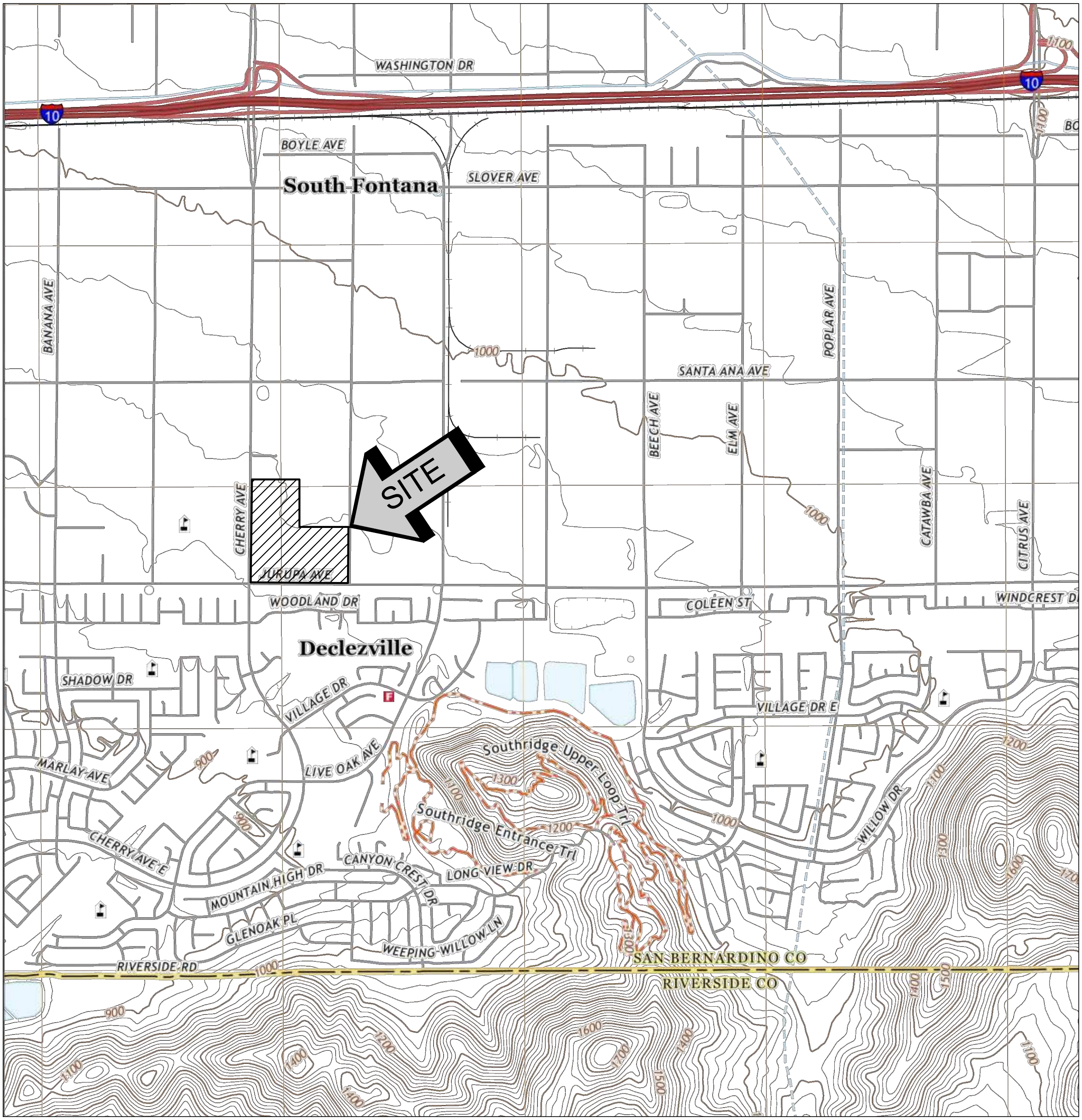
Michelle Krizek
Staff Geologist

REGISTERED PROFESSIONAL ENGINEER
ROBERT TRAZO
No. 2655
GEOTECHNICAL
STATE OF CALIFORNIA

Robert G. Trazo, GE 2364
Principal Engineer

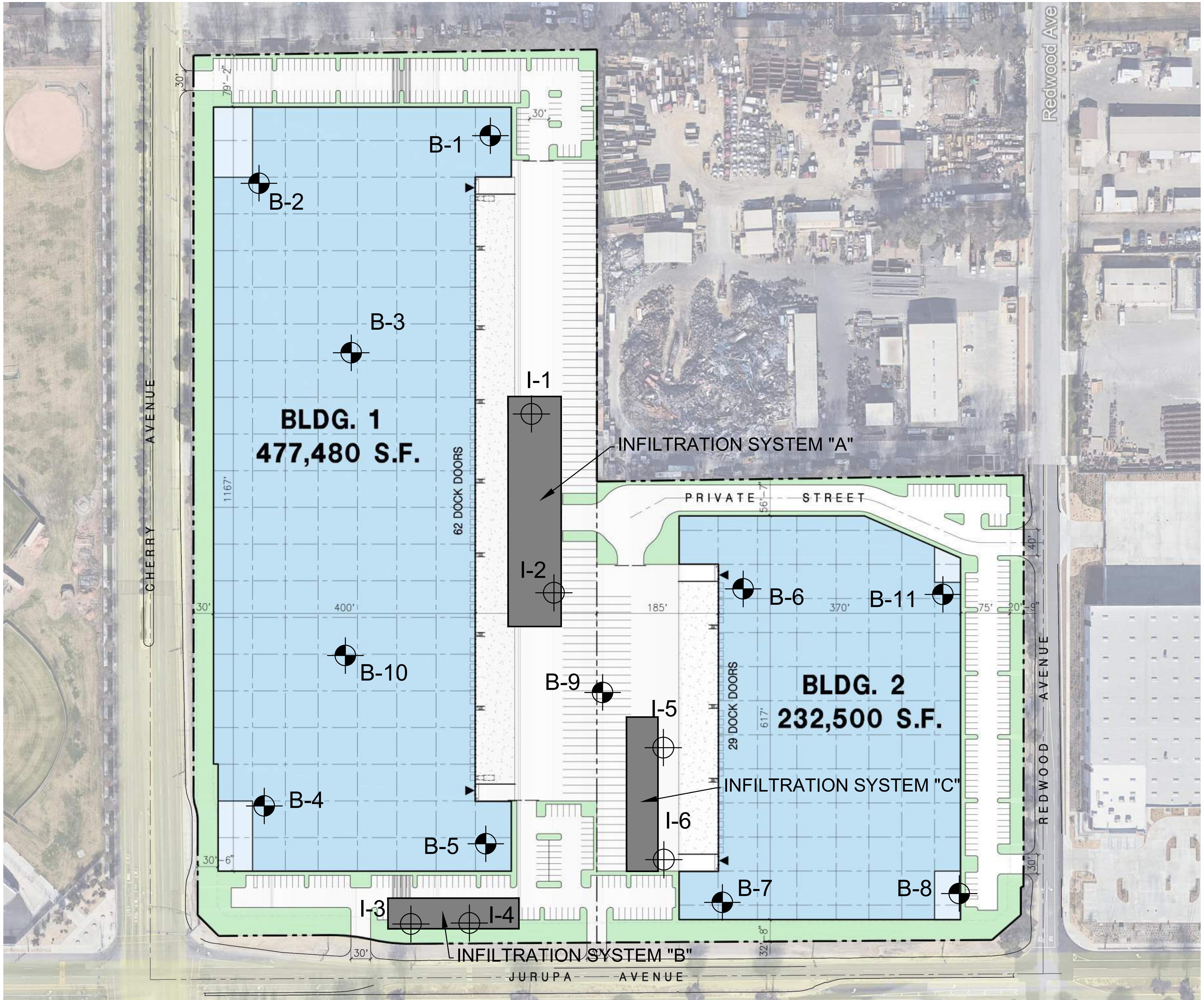
Distribution: (1) Addressee

Enclosures:
- Plate 1 - Site Location Map
- Plate 2 - Infiltration Test Location Plan
- Boring Log Legend and Logs (8 pages)
- Infiltration Test Results Spreadsheets (6 pages)
- Grain Size Distribution Graphs (6 pages)



SOURCE: USGS TOPOGRAPHIC MAP OF THE FONTANA QUADRANGLE, SAN BERNARDINO COUNTY, CALIFORNIA, 2021.

SITE LOCATION MAP	
PROPOSED INDUSTRIAL DEVELOPMENT	
FONTANA, CALIFORNIA	
SCALE: 1" = 2000'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JLL CHKD: RGT	
SCG PROJECT 23G117-2	
PLATE 1	



GEOTECHNICAL LEGEND

- APPROXIMATE INFILTRATION LOCATION
- APPROXIMATE BORING LOCATION (SCG PROJECT NO. 23G117-1)
- PROPOSED INFILTRATION CHAMBERS

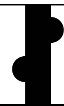
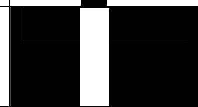
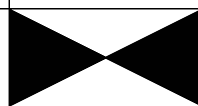
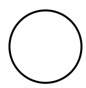
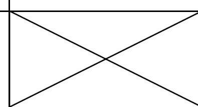
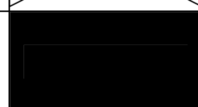
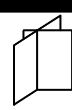
NOTE: CONCEPTUAL SITE PLAN PROVIDED BY HPA, INC.
AERIAL PHOTO OBTAINED FROM GOOGLE EARTH.

INFILTRATION TEST LOCATION PLAN
PROPOSED INDUSTRIAL DEVELOPMENT
FONTANA, CALIFORNIA

SCALE: 1" = 150'
DRAWN: JLL
CHKD: RGT
SCG PROJECT 23G117-2
PLATE 2

SOUTHERN CALIFORNIA GEOTECHNICAL

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3” indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-1

JOB NO.: 23G117-2
PROJECT: Proposed Industrial Development
LOCATION: Fontana, California

DRILLING DATE: 3/27/23
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
0					ALLUVIUM: Brown fine Sandy Silt, trace medium Sand, medium dense-damp							
	X	15					3					
5												
					Brown Silty fine Sand to fine Sandy Silt, trace medium Sand, medium dense-damp							
	X	16					3					
10					Brown Silty fine to medium Sand, trace coarse Sand, medium dense-dry							
	X	14					2			30		

Boring Terminated at 12'

TBL 23G117-2.GPJ SOCALGEO.GDT 4/12/23

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-2

JOB NO.: 23G117-2
PROJECT: Proposed Industrial Development
LOCATION: Fontana, California

DRILLING DATE: 3/27/23
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					ALLUVIUM: Brown Silty fine Sand to fine Sandy Silt, loose-damp to moist							
	X	6					9					
5												
					Gray fine Sandy Silt, trace medium Sand, little Calcareous veining, medium dense to dense-dampt to moist							
	X	38					12					
10												
	X	11					9			57		

Boring Terminated at 12'

TBL 23G117-2.GPJ SOCALGEO.GDT 4/12/23

TEST BORING LOG

BORING NO. I-3

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

JOB NO.: 23G117-2	DRILLING DATE: 3/27/23	WATER DEPTH: Dry
PROJECT: Proposed Industrial Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: ---
LOCATION: Fontana, California	LOGGED BY: Ryan Bremer	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					ALLUVIUM: Brown Silty fine Sand to fine Sandy Silt, trace medium Sand, medium dense-damp							
	X	10					9					
5												
					Brown fine Sandy Silt, trace medium Sand, trace Iron Oxide veining, some Calcareous deposits, medium dense-very moist							
	X	18					28					
10												
	X	9			Brown Silty fine to medium Sand, trace coarse Sand, trace fine Gravel, trace Calcareous veining, loose-damp to moist		11			43		

Boring Terminated at 12'

TBL 23G117-2.GPJ SOCALGEO.GDT 4/12/23

TEST BORING LOG **PLATE B-3**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-4

JOB NO.: 23G117-2
PROJECT: Proposed Industrial Development
LOCATION: Fontana, California

DRILLING DATE: 3/27/23
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					ALLUVIUM: Brown Silty fine Sand, trace medium to coarse Sand, loose-damp							
	X	7					5					
5												
					Brown Silty fine Sand to fine Sandy Silt, little medium Sand, trace Iron Oxide staining, medium dense-moist							
	X	16					14					
10												
	X	16					12			49		
					Boring Terminated at 12'							

TBL 23G117-2.GPJ SOCALGEO.GDT 4/12/23

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-5

JOB NO.: 23G117-2	DRILLING DATE: 3/27/23	WATER DEPTH: Dry
PROJECT: Proposed Industrial Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: ---
LOCATION: Fontana, California	LOGGED BY: Ryan Bremer	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					ALLUVIUM: Brown fine to medium Sand, trace Silt, medium dense-damp							
	X	13					3					
5												
					Gray Brown Silty fine Sand, trace medium Sand, trace Iron Oxide staining, medium dense-damp							
	X	22					4					
10												
	X	29			Gray fine to medium Sandy Silt, little Iron Oxide veining, some Calcareous deposits, medium dense-very moist		26			82		
					Boring Terminated at 12'							

TBL 23G117-2.GPJ SOCALGEO.GDT 4/12/23

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. I-6

JOB NO.: 23G117-2
PROJECT: Proposed Industrial Development
LOCATION: Fontana, California

DRILLING DATE: 3/27/23
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: ---
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					ALLUVIUM: Brown Silty fine Sand to fine Sandy Silt, trace medium Sand, loose-damp							
	X	7					10					
5												
					Brown Silty fine Sand, trace medium Sand, medium dense-damp to moist							
	X	17					14					
10												
	X	15					9			43		
					Boring Terminated at 12'							

TBL 23G117-2.GPJ SOCALGEO.GDT 4/12/23

INFILTRATION CALCULATIONS

Project Name	Proposed Industrial Development
Project Location	Fontana, California
Project Number	23G117-2
Engineer	Michelle Krizek

Test Hole Radius	4	(in)
Test Depth	12.05	(ft)

Infiltration Test Hole	I-1

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	11:01 AM	25.00	10.00	23.28	YES	SANDY SOILS
	Final	11:26 AM		11.94			
2	Initial	11:33 AM	25.00	10.00	23.16	YES	SANDY SOILS
	Final	11:58 AM		11.93			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	12:05 PM	10.00	10.00	1.54	1.28	12.77
	Final	12:15 PM		11.54			
2	Initial	12:17 PM	10.00	10.00	1.32	1.39	10.18
	Final	12:27 PM		11.32			
3	Initial	12:30 PM	10.00	10.00	1.19	1.46	8.81
	Final	12:40 PM		11.19			
4	Initial	12:41 PM	10.00	10.00	1.05	1.53	7.45
	Final	12:51 PM		11.05			
5	Initial	12:54 PM	10.00	10.00	0.90	1.60	6.11
	Final	1:04 PM		10.90			
6	Initial	1:06 PM	10.00	10.00	0.89	1.61	6.03
	Final	1:16 PM		10.89			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Industrial Development
Project Location	Fontana, California
Project Number	23G117-2
Engineer	Michelle Krizek

Test Hole Radius	4	(in)
Test Depth	11.90	(ft)

Infiltration Test Hole	I-2

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	10:51 AM	25.00	9.50	12.60	YES	SANDY SOILS
	Final	11:16 AM		10.55			
2	Initial	11:21 AM	25.00	9.50	10.08	YES	SANDY SOILS
	Final	11:46 AM		10.34			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	11:48 AM	10.00	9.50	0.71	2.05	3.85
	Final	11:58 AM		10.21			
2	Initial	12:01 PM	10.00	9.50	0.48	2.16	2.48
	Final	12:11 PM		9.98			
3	Initial	12:13 PM	10.00	9.50	0.41	2.20	2.08
	Final	12:23 PM		9.91			
4	Initial	12:26 PM	10.00	9.50	0.37	2.22	1.86
	Final	12:36 PM		9.87			
5	Initial	12:37 PM	10.00	9.50	0.28	2.26	1.38
	Final	12:47 PM		9.78			
6	Initial	12:49 PM	10.00	9.50	0.27	2.27	1.33
	Final	12:59 PM		9.77			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Industrial Development
Project Location	Fontana, California
Project Number	23G117-2
Engineer	Michelle Krizek

Test Hole Radius	4	(in)
Test Depth	12.92	(ft)

Infiltration Test Hole	I-3

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	10:19 AM	25.00	11.00	9.60	YES	SANDY SOILS
	Final	10:44 AM		11.80			
2	Initial	10:51 AM	25.00	11.00	5.16	NO	NON-SANDY SOILS
	Final	11:16 AM		11.43			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	11:24 AM	30.00	11.00	0.42	1.71	0.90
	Final	11:54 AM		11.42			
2	Initial	11:56 AM	30.00	11.00	0.41	1.72	0.87
	Final	12:26 PM		11.41			
3	Initial	12:30 PM	30.00	11.00	0.40	1.72	0.85
	Final	1:00 PM		11.40			
4	Initial	1:02 PM	30.00	11.00	0.39	1.73	0.82
	Final	1:32 PM		11.39			
5	Initial	1:35 PM	30.00	11.00	0.38	1.73	0.80
	Final	2:05 PM		11.38			
6	Initial	2:08 PM	30.00	11.00	0.38	1.73	0.80
	Final	2:38 PM		11.38			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Industrial Development
Project Location	Fontana, California
Project Number	23G117-2
Engineer	Michelle Krizek

Test Hole Radius	4	(in)
Test Depth	12.86	(ft)

Infiltration Test Hole	I-4

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	10:31 AM	25.00	10.85	9.60	YES	SANDY SOILS
	Final	10:56 AM		11.65			
2	Initial	11:03 AM	25.00	10.85	8.40	YES	SANDY SOILS
	Final	11:28 AM		11.55			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	11:31 AM	10.00	10.85	0.26	1.88	1.52
	Final	11:41 AM		11.11			
2	Initial	11:42 AM	10.00	10.85	0.21	1.91	1.22
	Final	11:52 AM		11.06			
3	Initial	11:53 AM	10.00	10.85	0.17	1.93	0.98
	Final	12:03 PM		11.02			
4	Initial	12:04 PM	10.00	10.85	0.15	1.94	0.86
	Final	12:14 PM		11.00			
5	Initial	12:15 PM	10.00	10.85	0.15	1.94	0.86
	Final	12:25 PM		11.00			
6	Initial	12:27 PM	10.00	10.85	0.13	1.95	0.74
	Final	12:37 PM		10.98			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)
ΔH = Change in Height (Water Level) over the time interval
r = Test Hole (Borehole) Radius
Δt = Time Interval
H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Industrial Development
Project Location	Fontana, California
Project Number	23G117-2
Engineer	Michelle Krizek

Test Hole Radius	4	(in)
Test Depth	11.65	(ft)

Infiltration Test Hole	I-5

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	9:51 AM	25.00	9.65	18.72	YES	SANDY SOILS
	Final	10:16 AM		11.21			
2	Initial	10:22 AM	25.00	9.65	14.28	YES	SANDY SOILS
	Final	10:47 AM		10.84			

Test Data

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	10:50 AM	10.00	9.65	1.00	1.50	7.20
	Final	11:00 AM		10.65			
2	Initial	11:02 AM	10.00	9.65	0.64	1.68	4.16
	Final	11:12 AM		10.29			
3	Initial	11:13 AM	10.00	9.65	0.56	1.72	3.56
	Final	11:23 AM		10.21			
4	Initial	11:25 AM	10.00	9.65	0.49	1.76	3.06
	Final	11:35 AM		10.14			
5	Initial	11:38 AM	10.00	9.65	0.44	1.78	2.71
	Final	11:48 AM		10.09			
6	Initial	11:52 AM	10.00	9.65	0.44	1.78	2.71
	Final	12:02 PM		10.09			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Industrial Development
Project Location	Fontana, California
Project Number	23G117-2
Engineer	Michelle Krizek

Test Hole Radius	4	(in)
Test Depth	11.48	(ft)

Infiltration Test Hole	I-6

Soil Criteria Test

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (in)	Did 6 inches of water seep away in less than 25 minutes?	Sandy Soils or Non-Sandy Soils?
1	Initial	8:34 AM	25.00	9.00	28.32	YES	SANDY SOILS
	Final	8:59 AM		11.36			
2	Initial	9:06 AM	25.00	9.00	16.20	YES	SANDY SOILS
	Final	9:31 AM		10.35			

Test Data

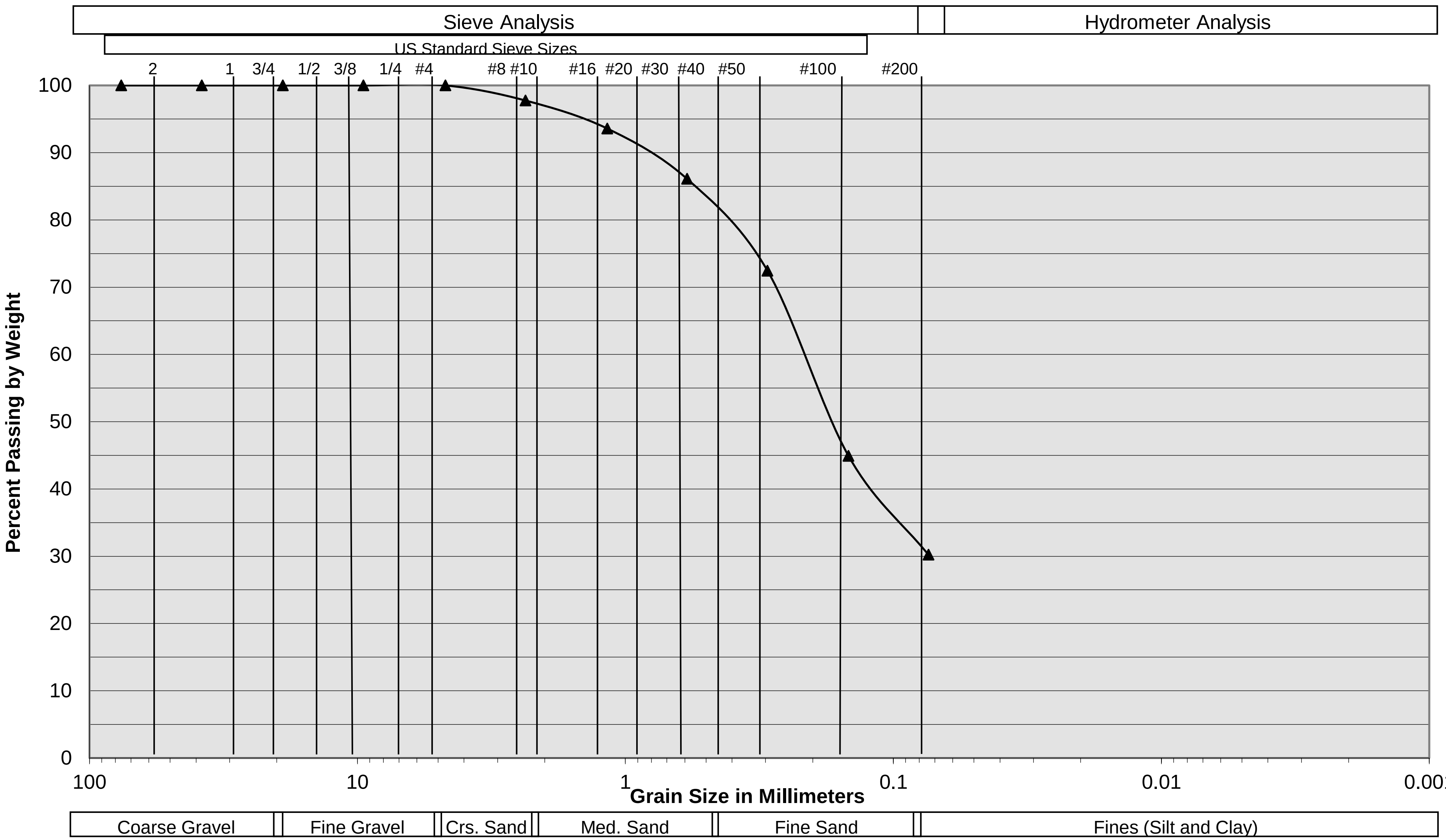
Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	9:33 AM	10.00	9.00	1.17	1.90	6.81
	Final	9:43 AM		10.17			
2	Initial	9:46 AM	10.00	9.00	0.74	2.11	3.90
	Final	9:56 AM		9.74			
3	Initial	9:58 AM	10.00	9.00	0.53	2.22	2.67
	Final	10:08 AM		9.53			
4	Initial	10:10 AM	10.00	9.00	0.49	2.24	2.45
	Final	10:20 AM		9.49			
5	Initial	10:24 AM	10.00	9.00	0.43	2.27	2.12
	Final	10:34 AM		9.43			
6	Initial	10:35 AM	10.00	9.00	0.43	2.27	2.12
	Final	10:45 AM		9.43			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)
ΔH = Change in Height (Water Level) over the time interval
r = Test Hole (Borehole) Radius
Δt = Time Interval
H_{avg} = Average Head Height over the time interval

Grain Size Distribution

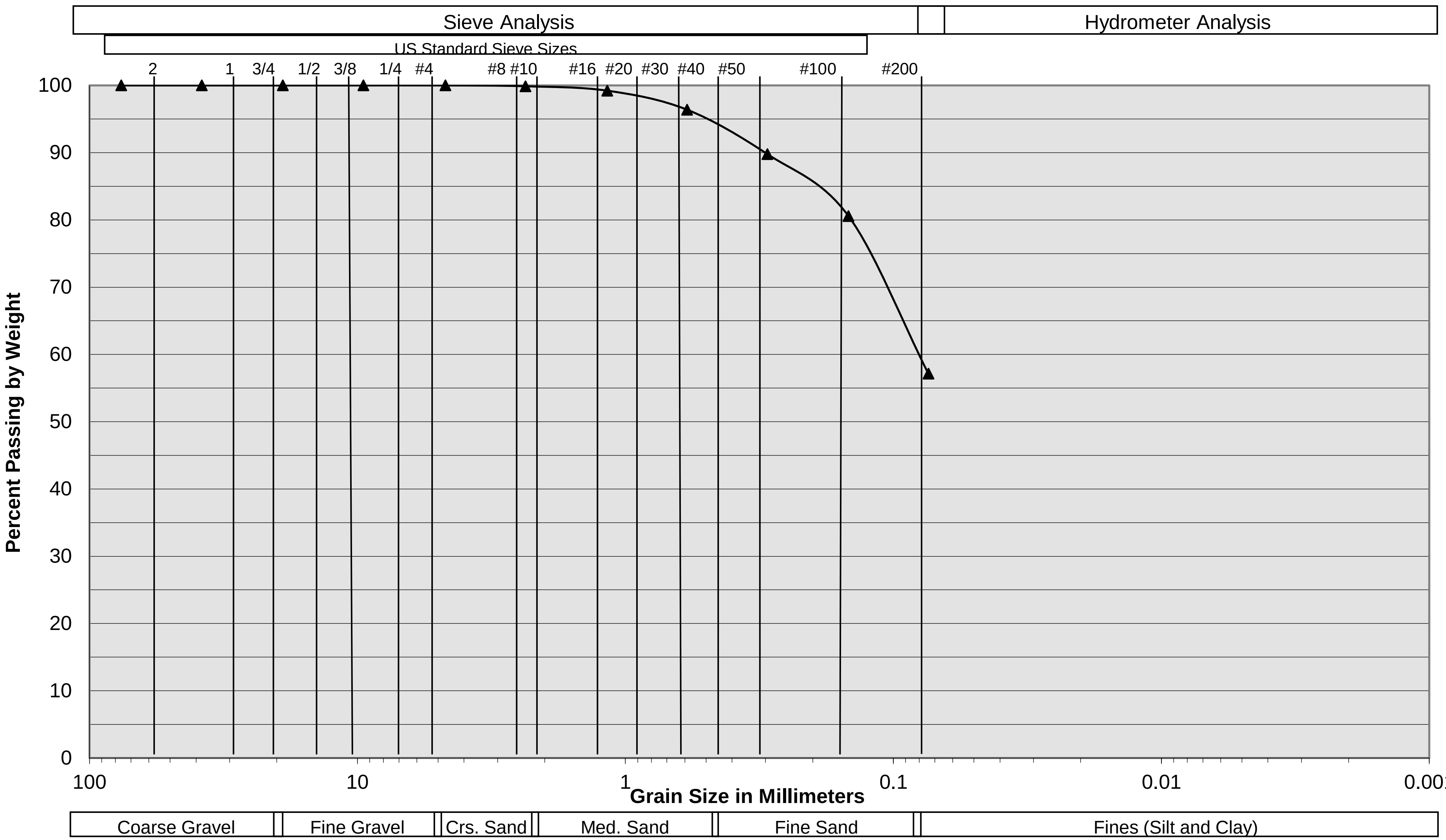


Sample Description	I-1 @ 10½ to 12 feet
Soil Classification	Brown Silty fine to medium Sand, trace coarse Sand

Proposed Industrial Development
Fontana, California
Project No. 23G117-2
PLATE C- 1

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Grain Size Distribution

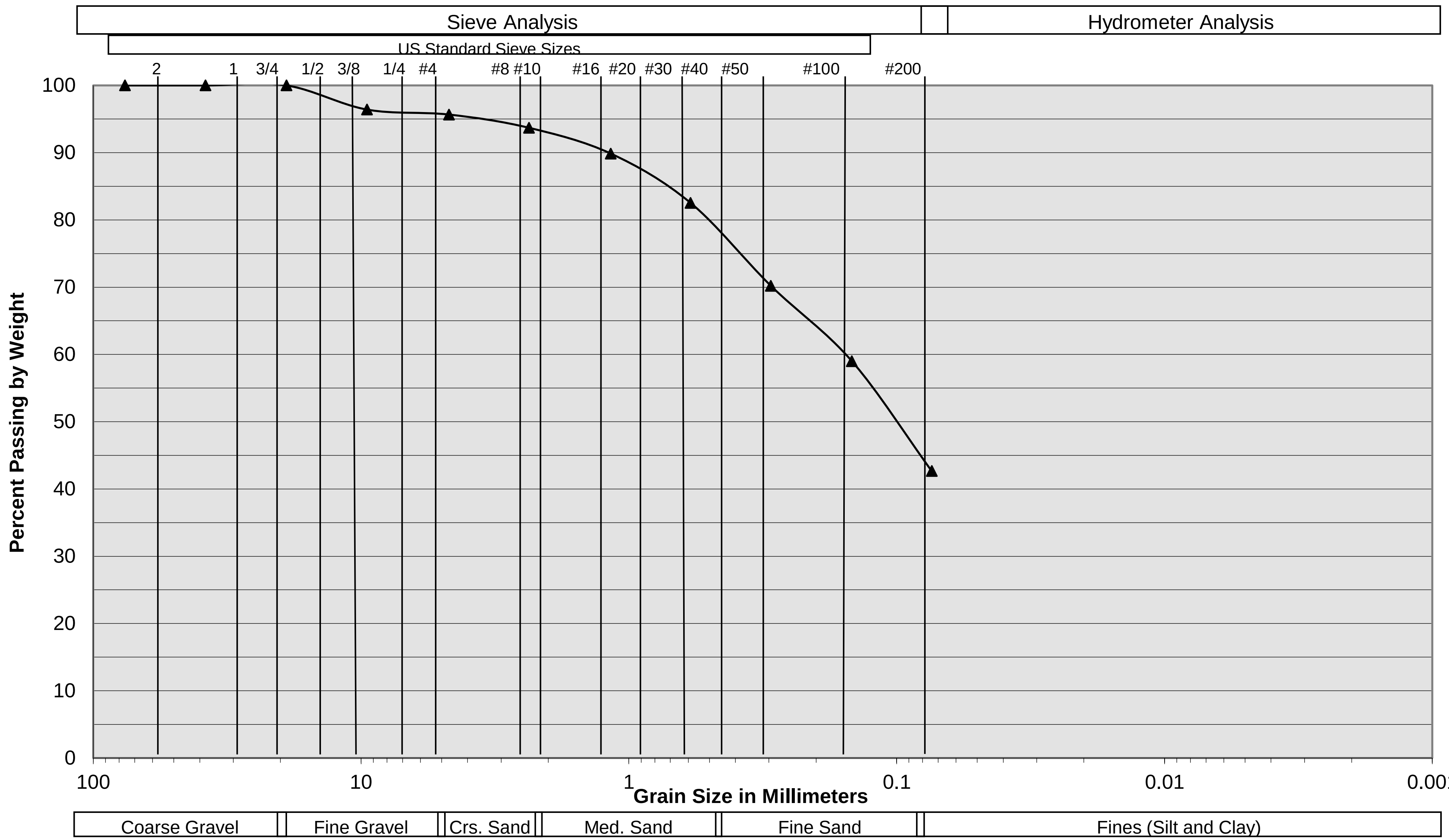


Sample Description	I-2 @ 10½ to 12 feet
Soil Classification	Gray fine Sandy Silt, trace medium Sand

Proposed Industrial Development
Fontana, California
Project No. 23G117-2
PLATE C- 2

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL *A California Corporation*

Grain Size Distribution

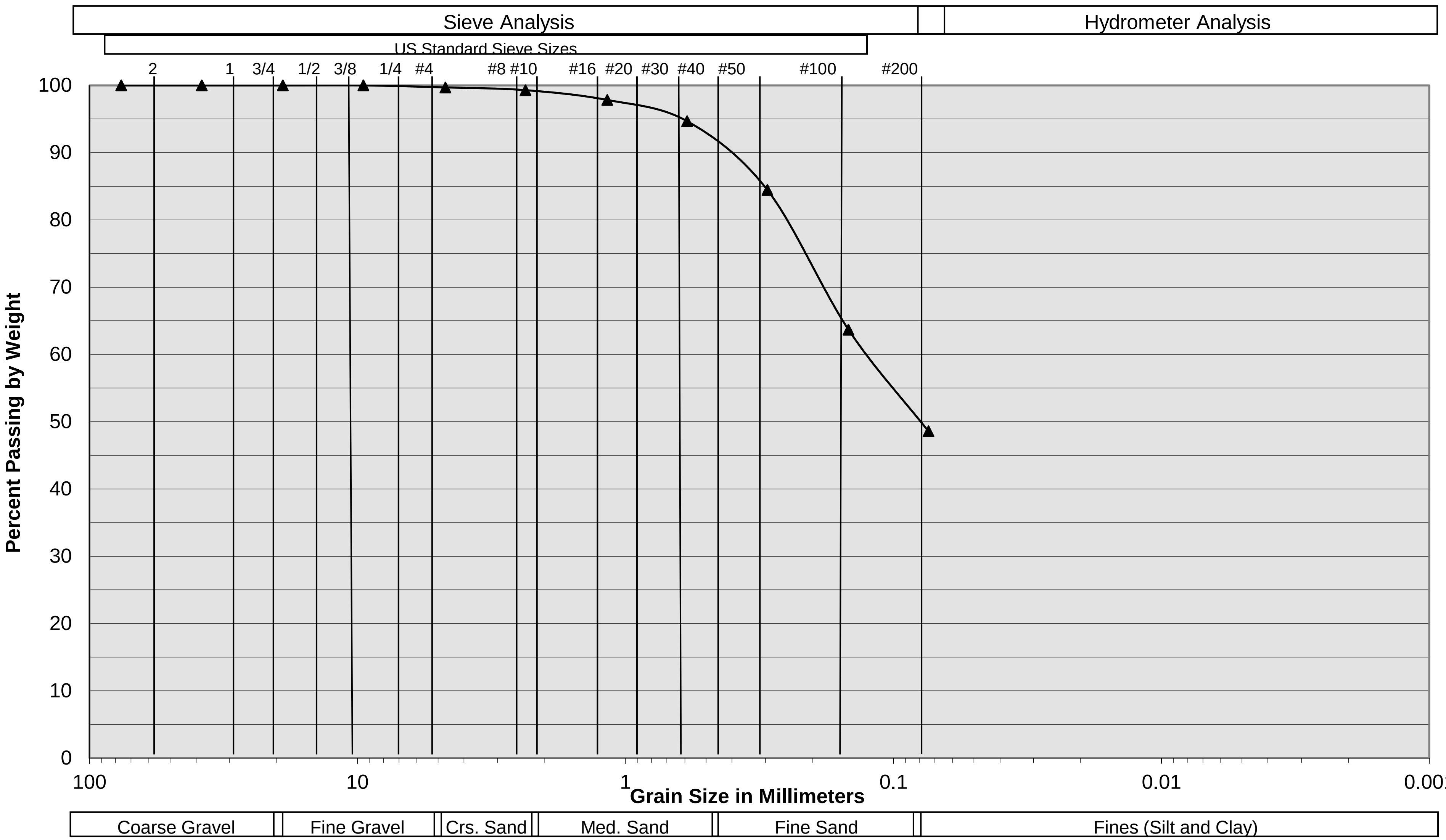


Sample Description	I-3 @ 10½ to 12 feet
Soil Classification	Brown Silty fine to medium Sand, trace coarse Sand, trace fine Gravel

Proposed Industrial Development
Fontana, California
Project No. 23G117-2
PLATE C- 3

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

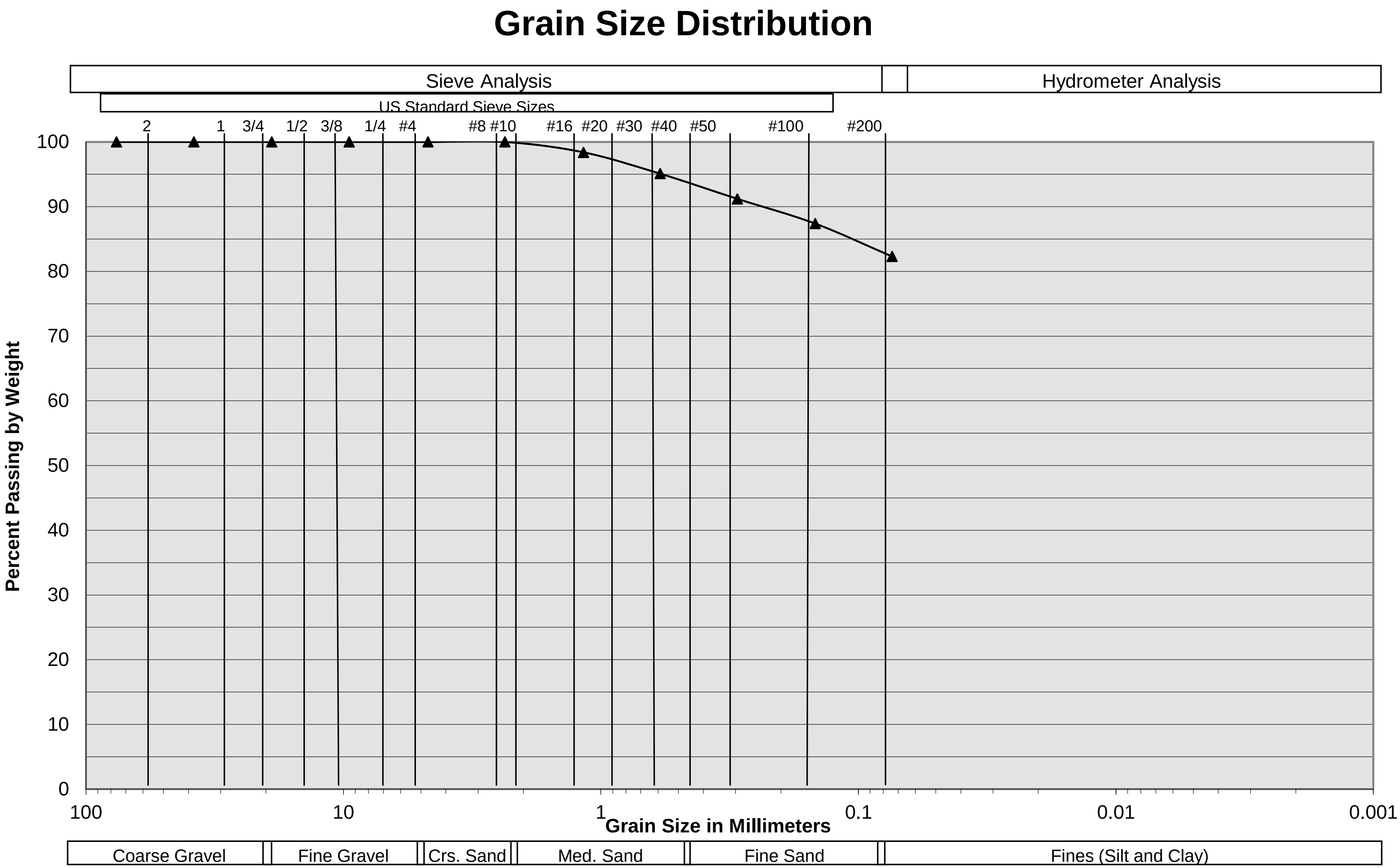
Grain Size Distribution



Sample Description	I-4 @ 10½ to 12 feet
Soil Classification	Brown Silty fine Sand to fine Sandy Silt, little medium Sand

Proposed Industrial Development
Fontana, California
Project No. 23G117-2
PLATE C- 4

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

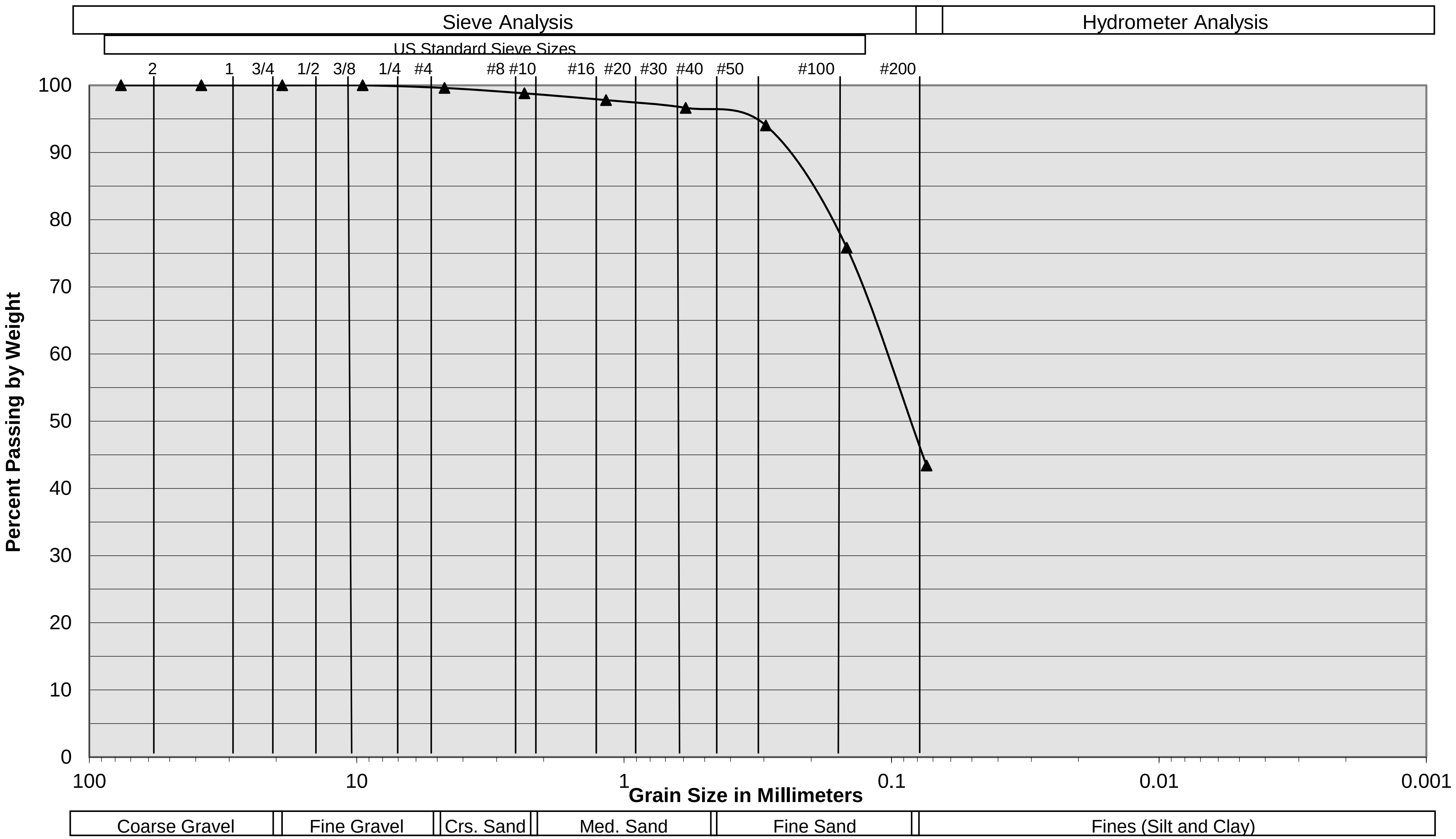


Sample Description	I-5 @ 10½ to 12 feet
Soil Classification	Gray fine to medium Sandy Silt

Proposed Industrial Development
Fontana, California
Project No. 23G117-2
PLATE C- 5

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL A California Corporation

Grain Size Distribution



Sample Description	I-6 @ 10½ to 12 feet
Soil Classification	Brown Silty fine Sand, trace medium Sand

Proposed Industrial Development
Fontana, California
Project No. 23G117-2
PLATE C- 6

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL A California Corporation

Attachment E
Rainfall Data (NOAA Atlas 14)
& Worksheet H

NOAA Atlas 14, Volume 6, Version 2
Location name: Fontana, California, USA*
Latitude: 34.05°, Longitude: -117.4869°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.103** (0.086-0.124)	**0.135** (0.112-0.164)	**0.178** (0.148-0.216)	**0.214** (0.176-0.262)	**0.263** (0.209-0.334)	**0.302** (0.235-0.392)	**0.343** (0.260-0.456)	**0.385** (0.284-0.528)	**0.445** (0.314-0.637)	**0.493** (0.336-0.731)
10-min	**0.147** (0.123-0.178)	**0.193** (0.161-0.235)	**0.255** (0.212-0.310)	**0.306** (0.252-0.376)	**0.377** (0.300-0.479)	**0.433** (0.337-0.562)	**0.491** (0.372-0.654)	**0.552** (0.407-0.757)	**0.638** (0.450-0.913)	**0.706** (0.481-1.05)
15-min	**0.178** (0.148-0.216)	**0.234** (0.195-0.284)	**0.309** (0.256-0.375)	**0.370** (0.305-0.454)	**0.456** (0.363-0.579)	**0.524** (0.407-0.680)	**0.594** (0.450-0.791)	**0.668** (0.492-0.915)	**0.771** (0.544-1.10)	**0.854** (0.582-1.27)
30-min	**0.268** (0.223-0.324)	**0.352** (0.293-0.427)	**0.464** (0.385-0.564)	**0.557** (0.458-0.683)	**0.686** (0.545-0.871)	**0.787** (0.613-1.02)	**0.893** (0.677-1.19)	**1.00** (0.740-1.38)	**1.16** (0.819-1.66)	**1.28** (0.875-1.91)
60-min	**0.394** (0.328-0.477)	**0.517** (0.431-0.627)	**0.682** (0.566-0.829)	**0.818** (0.674-1.00)	**1.01** (0.802-1.28)	**1.16** (0.901-1.50)	**1.31** (0.996-1.75)	**1.48** (1.09-2.02)	**1.71** (1.20-2.44)	**1.89** (1.29-2.80)
2-hr	**0.585** (0.488-0.709)	**0.760** (0.633-0.922)	**0.988** (0.820-1.20)	**1.17** (0.966-1.44)	**1.43** (1.13-1.81)	**1.62** (1.26-2.10)	**1.82** (1.38-2.42)	**2.03** (1.49-2.78)	**2.31** (1.63-3.30)	**2.53** (1.72-3.75)
3-hr	**0.741** (0.618-0.898)	**0.959** (0.798-1.16)	**1.24** (1.03-1.51)	**1.47** (1.21-1.80)	**1.77** (1.41-2.25)	**2.00** (1.56-2.60)	**2.24** (1.70-2.98)	**2.48** (1.83-3.40)	**2.81** (1.98-4.02)	**3.06** (2.09-4.54)
6-hr	**1.05** (0.876-1.27)	**1.36** (1.13-1.65)	**1.75** (1.45-2.13)	**2.06** (1.70-2.53)	**2.47** (1.97-3.14)	**2.78** (2.16-3.61)	**3.09** (2.34-4.11)	**3.40** (2.51-4.66)	**3.82** (2.69-5.46)	**4.13** (2.81-6.13)
12-hr	**1.38** (1.15-1.67)	**1.80** (1.50-2.19)	**2.33** (1.93-2.83)	**2.74** (2.26-3.36)	**3.28** (2.61-4.17)	**3.68** (2.86-4.78)	**4.07** (3.09-5.42)	**4.46** (3.29-6.12)	**4.97** (3.51-7.12)	**5.35** (3.65-7.94)
24-hr	**1.85** (1.64-2.13)	**2.45** (2.16-2.83)	**3.20** (2.82-3.70)	**3.78** (3.31-4.41)	**4.54** (3.84-5.47)	**5.10** (4.23-6.27)	**5.64** (4.57-7.10)	**6.18** (4.87-8.00)	**6.87** (5.20-9.27)	**7.39** (5.41-10.3)
2-day	**2.23** (1.98-2.58)	**3.02** (2.67-3.49)	**4.02** (3.55-4.65)	**4.81** (4.21-5.61)	**5.85** (4.95-7.04)	**6.62** (5.49-8.14)	**7.38** (5.98-9.29)	**8.14** (6.41-10.5)	**9.14** (6.91-12.3)	**9.89** (7.23-13.8)
3-day	**2.42** (2.15-2.80)	**3.33** (2.95-3.85)	**4.50** (3.97-5.20)	**5.43** (4.75-6.33)	**6.67** (5.64-8.03)	**7.60** (6.30-9.35)	**8.53** (6.91-10.7)	**9.47** (7.46-12.3)	**10.7** (8.11-14.5)	**11.7** (8.54-16.3)
4-day	**2.62** (2.32-3.03)	**3.64** (3.22-4.21)	**4.96** (4.38-5.74)	**6.03** (5.27-7.03)	**7.45** (6.31-8.98)	**8.53** (7.08-10.5)	**9.62** (7.79-12.1)	**10.7** (8.45-13.9)	**12.2** (9.23-16.5)	**13.3** (9.76-18.6)
7-day	**3.02** (2.68-3.48)	**4.25** (3.76-4.91)	**5.87** (5.17-6.79)	**7.18** (6.28-8.38)	**8.97** (7.60-10.8)	**10.3** (8.58-12.7)	**11.7** (9.51-14.8)	**13.2** (10.4-17.1)	**15.1** (11.4-20.4)	**16.6** (12.2-23.2)
10-day	**3.27** (2.89-3.76)	**4.63** (4.10-5.35)	**6.44** (5.68-7.45)	**7.93** (6.93-9.24)	**9.96** (8.43-12.0)	**11.5** (9.57-14.2)	**13.2** (10.7-16.6)	**14.8** (11.7-19.2)	**17.1** (13.0-23.1)	**18.9** (13.8-26.4)
20-day	**3.86** (3.42-4.45)	**5.55** (4.91-6.40)	**7.83** (6.90-9.06)	**9.74** (8.52-11.4)	**12.4** (10.5-15.0)	**14.5** (12.0-17.9)	**16.7** (13.5-21.1)	**19.0** (15.0-24.7)	**22.3** (16.9-30.0)	**24.9** (18.2-34.7)
30-day	**4.56** (4.03-5.25)	**6.55** (5.79-7.56)	**9.28** (8.19-10.7)	**11.6** (10.1-13.5)	**14.9** (12.6-17.9)	**17.5** (14.5-21.5)	**20.3** (16.4-25.5)	**23.2** (18.3-30.1)	**27.4** (20.7-36.9)	**30.7** (22.5-42.9)
45-day	**5.39** (4.77-6.21)	**7.70** (6.81-8.88)	**10.9** (9.61-12.6)	**13.6** (11.9-15.9)	**17.6** (14.9-21.2)	**20.8** (17.2-25.5)	**24.2** (19.6-30.4)	**27.8** (21.9-36.0)	**33.0** (25.0-44.6)	**37.3** (27.3-52.0)
60-day	**6.33** (5.60-7.29)	**8.92** (7.89-10.3)	**12.5** (11.1-14.5)	**15.7** (13.7-18.3)	**20.2** (17.1-24.4)	**23.9** (19.9-29.5)	**27.9** (22.6-35.2)	**32.3** (25.4-41.8)	**38.5** (29.1-51.9)	**43.6** (31.9-60.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

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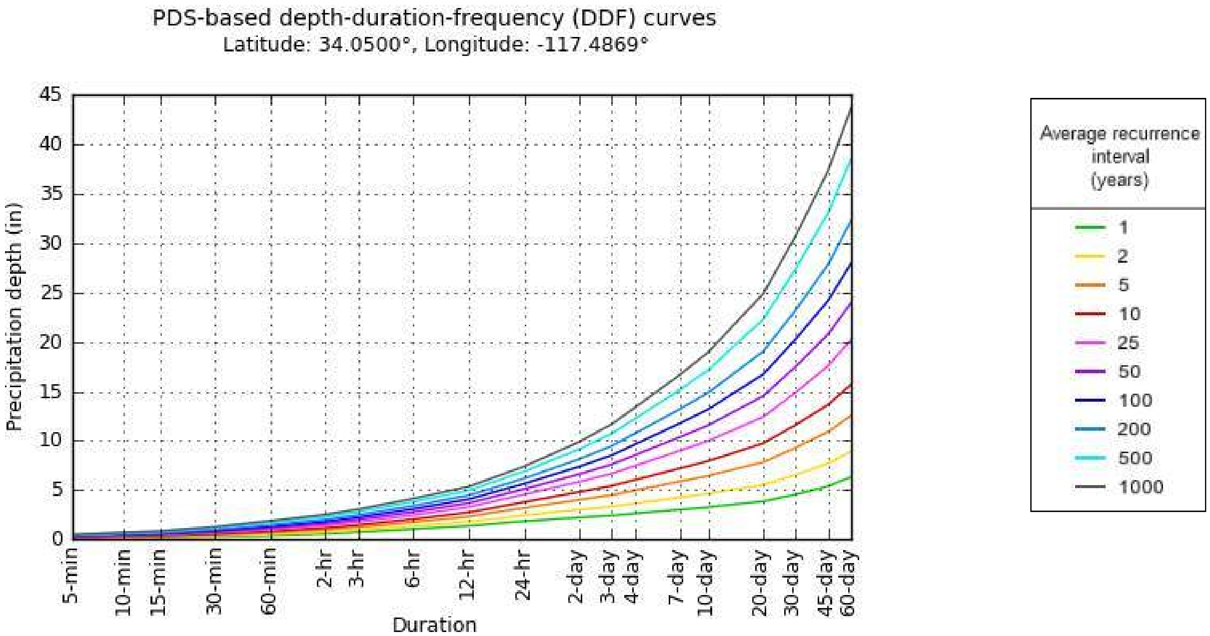
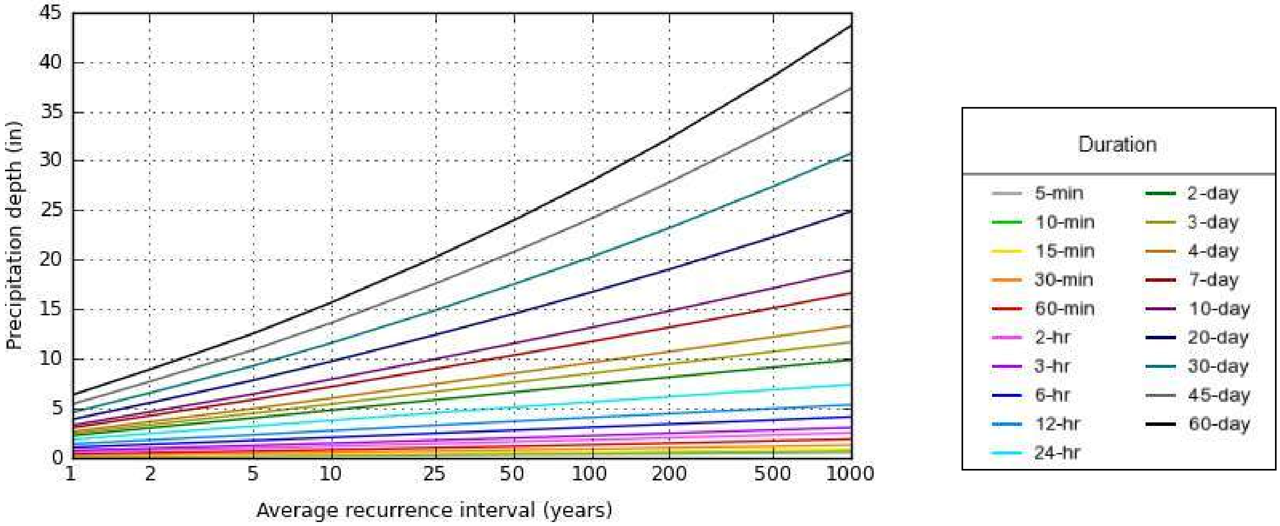
PF graphical





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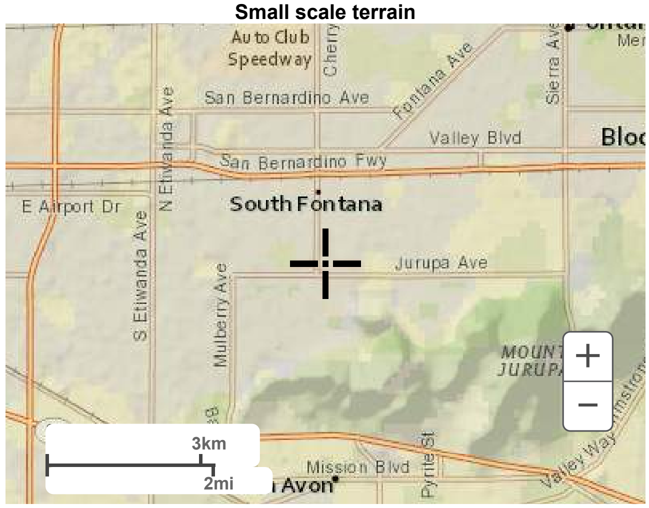
Maps & aerials

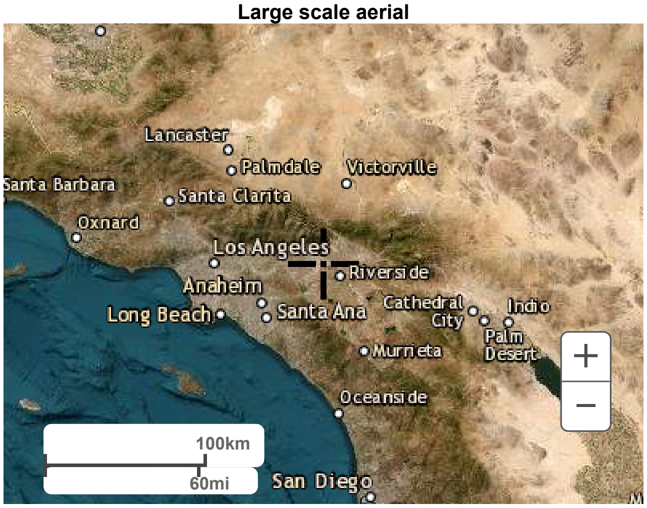
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

VII.4.1. Site Suitability Considerations

Suitability assessment related considerations include (**Table VII.3**):

- Soil assessment methods – the site assessment extent (e.g., number of borings, test pits, etc.) and the measurement method used to estimate the short-term infiltration rate.
- Predominant soil texture/percent fines – soil texture and the percent of fines can greatly influence the potential for clogging.
- Site soil variability – site with spatially heterogeneous soils (vertically or horizontally) as determined from site investigations are more difficult to estimate average properties for resulting in a higher level of uncertainty associated with initial estimates.
- Depth to seasonal high groundwater/impervious layer – groundwater mounding may become an issue during excessively wet conditions where shallow aquifers or shallow clay lenses are present.

Table VII.3: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern	
Assessment methods (see explanation below)	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates	Direct measurement of ≥ 20 percent of infiltration area with localized infiltration measurement methods (e.g., infiltrometer)	Direct measurement of ≥ 50 percent of infiltration area with localized infiltration measurement methods or Use of extensive test pit infiltration measurement methods	Per infiltration report in Attachment D
Texture Class	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils	Per infiltration report in Attachment D
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils	Per infiltration report in Attachment D
Depth to groundwater/ impervious layer	<5 ft below facility bottom	5-10 ft below facility bottom	>10 below facility bottom	Per infiltration report in Attachment D

Localized infiltration testing refers to methods such as the double ring infiltrometer test (ASTM D3385-88) which measure infiltration rates over an area less than 10 sq-ft, may include lateral flow, and do not attempt to account for heterogeneity of soil. The amount of area each test represents should be estimated depending on the observed heterogeneity of the soil.

Extensive infiltration testing refers to methods that include excavating a significant portion of the proposed infiltration area, filling the excavation with water, and monitoring drawdown. The excavation should be to the depth of the proposed infiltration surface and ideally be at least 50 to 100 square feet.

In all cases, testing should be conducted in the area of the proposed BMP where, based on review of available geotechnical data, soils appear least likely to support infiltration.

VII.4.2. Design Related Considerations

Design related considerations include (**Table VII.4**):

- Size of area tributary to facility – all things being equal, risk factors related to infiltration facilities increase with an increase in the tributary area served. Therefore facilities serving larger tributary areas should use more restrictive adjustment factors.
- Level of pretreatment/expected influent sediment loads – credit should be given for good pretreatment by allowing less restrictive factors to account for the reduced probability of clogging from high sediment loading. Also, facilities designed to capture runoff from relatively clean surfaces such as rooftops are likely to see low sediment loads and therefore should be allowed to apply less restrictive safety factors.
- Redundancy – facilities that consist of multiple subsystems operating in parallel such that parts of the system remains functional when other parts fail and/or bypass should be rewarded for the built-in redundancy with less restrictive correction and safety factors. For example, if bypass flows would be at least partially treated in another BMP, the risk of discharging untreated runoff in the event of clogging the primary facility is reduced. A bioretention facility that overflows to a landscaped area is another example.
- Compaction during construction – proper construction oversight is needed during construction to ensure that the bottoms of infiltration facility are not overly compacted. Facilities that do not commit to proper construction practices and oversight should have to use more restrictive correction and safety factors.

Table VII.4: Design Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pretreatment/ expected influent sediment loads	Pretreatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pretreatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pretreatment with BMPs that mitigate fine sediments such as bioretention or media filtration OR sedimentation or facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train.	Medium redundancy, other BMPs available in treatment train to maintain at least 50% of function of facility in event of failure.	High redundancy, multiple components capable of operating independently and in parallel, maintaining at least 90% of facility functionality in event of failure.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.

Catch basin filters (Bio-Clean or approved equal) will be provided in all on-site catch basins as a pre-treatment control BMP prior to allowing runoff to be conveyed to the primary treatment BMP. The catch basin filters will help remove large debris, trash, sediment and oil/grease from the runoff before outleting into the the on-site infiltration systems. See Attachment B for catch basin filter specification.

The soil in the proposed infiltration system footprints will be uncompacted in-place native material.

Specific project site pollutants that will be treated by these Bio-Clean Filter Systems are as follows: Heavy Metals (79% of Zinc), Sediments (93% of Turbidity), Trash & Debris, and Oil and Grease before the pollutants go to the on-site infiltration system. See Attachment B for catch basin filter specification.

VII.4.3. Determining Factor of Safety

A factor of safety shall be used. To assist in selecting the appropriate design infiltration rate, the measured short term infiltration rate should be adjusted using a weighted average of several safety factors using the worksheet shown in **Worksheet H** below. The design infiltration rate would be determined as follows:

1. For each consideration shown in **Table VII.3** and **Table VII.4** above, determine whether the consideration is a high, medium, or low concern.
2. For all high concerns, assign a factor value of 3, for medium concerns, assign a factor value of 2, and for low concerns assign a factor value of 1.
3. Multiply each of the factors by the corresponding weight to get a product.
4. Sum the products within each factor category to obtain a safety factor for each.
5. Multiply the two safety factors together to get the final combined safety factor. If the combined safety factor is less than 2, then 2 shall be used as the safety factor.
6. Divide the measured short term infiltration rate by the combined safety factor to obtain the adjusted design infiltration rate for use in sizing the infiltration facility.

The design infiltration rate shall be used to size BMPs and to evaluate their expected long term performance. This rate shall not be less than 2, but may be higher at the discretion of the design engineer.

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	2	0.5
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.25
B	Design	Tributary area size	0.25	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	1	0.25
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.50
Combined Safety Factor, ~~$S_{TOT} = S_A \times S_B$~~ $S_{TOT} = S_A + S_B$					2.75
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					3.7
Design Infiltration Rate, in/hr, K_{DESIGN} = ~~$S_{TOT} \times K_M$~~ $K_M \div S_{TOT}$					1.35

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

See Attachment D for Infiltration Report.
Safety Factor of 2.75 will be used for BMP Calculations.

Design infiltration rate is 1.35 in/hr.

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

VII.5. References

ASTM D 3385-94, 2003. “Standard Test Method for Infiltration Rate of Soils Field Using Double-Ring Infiltrometer.” American Society for Testing Materials, Conshohocken, PA. 10 Jun, 2003.

Caltrans, 2003. “Infiltration Basin Site Selection”. Study Volume I. California Department of Transportation. Report No. CTSW-RT-03-025.

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Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.

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Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

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		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.25
B	Design	Tributary area size	0.25	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	1	0.25
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.50
Combined Safety Factor, ~~$S_{TOT} = S_A \times S_B$~~ $S_{TOT} = S_A + S_B$					2.75
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					2.4
Design Infiltration Rate, in/hr, K_{DESIGN} = ~~$S_{TOT} \times K_M$~~ $K_M \div S_{TOT}$					0.87

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

See Attachment D for Infiltration Report.
Safety Factor of 2.75 will be used for BMP Calculations.

Design infiltration rate is 0.87 in/hr.

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

VII.5. References

ASTM D 3385-94, 2003. "Standard Test Method for Infiltration Rate of Soils Field Using Double-Ring Infiltrometer." American Society for Testing Materials, Conshohocken, PA. 10 Jun, 2003.

Caltrans, 2003. "Infiltration Basin Site Selection". Study Volume I. California Department of Transportation. Report No. CTSW-RT-03-025.

City of Portland, 2010. *Appendix F.2: Infiltration Testing.* Portland Stormwater Management Manual, Revised February 1, 2010.

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