

Appendix E

Hydrology Study

**Grand Terrace Assembly and
Light Manufacturing Building
INITIAL STUDY/MITIGATED
NEGATIVE DECLARATION**



KIER+WRIGHT

PRELIMINARY HYDROLOGY STUDY

FOR

Barton Road Industrial Development

BARTON RD NEAR INTERSTATE 215

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PURPOSE

This study will estimate the pre-development peak flow rate for a 25-year storm event and compare it with the post-development peak flow rate for a 100-year storm event at the project site. A unit hydrograph and stage storage analysis will be performed to size an underground detention system to mitigate the increased post-development peak flow rate,

PROJECT DESCRIPTION

The project site is in the City of Grand Terrace, off Barton Road, east of South La Cadena Drive and west of Interstate 215. The site is generally trapezoidal in shape with a 12' strip of land extending approximately 657' from the southwest corner of the main site to the right-of-way line at De Berry Street.

The proposed development will demolish the existing buildings and other site improvements and replace it with an industrial warehouse building along with other site improvements. The main project site is approximately 9.02 acres. Typical site improvements for the warehouse building include loading docks, trailer parking, vehicular parking. A landscaping strip is proposed along the west, north, and east perimeter of the site and adjacent to the north and east sides of the building. The warehouse building has an area of approximately 170,152 sf which will encompass 50,326 square feet of assembly, 115,026 square feet of assembly storage, 4,800 square feet of office space, 18 dock doors, and 241 auto parking spaces.

A storm drain line is proposed within the 12' strip of land to convey the main site drainage to outlet onto a public catch basin on De Berry Street.



Location Map

METHODOLOGY

CivilDesign Hydrology software, based on the San Bernardino Hydrology Manual Rational Method, was used to estimate the pre- and post-development peak flow rate.

For the pre-development condition, the 100-year peak flow rate was calculated using the 25-year rainfall and AMC 2. For Post-Development condition, the 100-year peak flow was calculated using the 100-year rainfall and AMC 3.

A Unit Hydrograph analysis of the 100-year 24-hour storm event was also performed using the CivilDesign software.

HydroCad software, using the output data from the CivilDesign Unit Hydrograph analysis, was used to size the detention and outlet system.

Rainfall depths are based on NOAA Atlas 14 Point Precipitation Frequency Estimates.

The site hydrologic soil type is 60% "A" and 40% "C".



PROJECT SITE DRAINAGE

Existing Site Drainage Condition:

The project site generally slopes from northeast to southwest and ranges in elevation from approximately 973 feet to 953 feet above sea level at the main site area. Within the 12' strip to the southwest, the site slopes southwesterly from approximately 954 feet to 949 feet above sea level toward De Berry Street.

In addition, there are 2 offsite drainage areas that drain onto the project site. The first offsite drainage area is the existing southerly half of Barton Road at the property frontage and extending easterly to just before the existing roundabout on Barton Road. The second drainage area is from a portion of the adjacent lots to the east of the project site. See Existing Hydrology Map in Appendix 2. Subareas A1 and A2 as shown on the said map includes the main project site area as well as the 2 drainage offsite areas.

Subarea B is the narrow 12' strip of land near the southwest corner of the main project site and extending southwesterly to DeBerry Street.

Proposed Site Drainage Condition:

Subareas A and B as shown on the Proposed Hydrology Map in Appendix 3 includes the main project site areas. Gutters will direct stormwater from these areas into catch basins located throughout the site. Storm drain (SD Line "A") will convey stormwater from these catch basins to an underground detention basin near the southwest corner of the project site.

The detention system will be sized to mitigate the 100-year post-development peak flow rate to less than or equal that of the 100-year pre-development peak flow rate and using a 25-year rainfall and AMC 2. Storm water that exceeds the capacity of the detention system will be conveyed via a proposed 21"-24" storm drain pipe to a public catch basin on De Berry Street.

Stormwater that is below the detention system outflow pipe elevation will be conveyed via a pump system to a Modular Wetlands System (MWS) biofiltration unit for water quality treatment before discharging to the storm drain system. The volume of stormwater detained shall be at least the required Design Capture Volume (DCV) to meet the requirements of the Water Quality Management Plan (WQMP). The MWS biofiltration unit and pump system shall be designed such that the stormwater volume in the detention system is pumped and treated by the MWS unit within 48 hours.

After passing through the detention basin, the mitigated drainage from Storm Drain Line "A" and Storm Drain Line "B" will confluence at node 15, and then directed to Storm Drain Line "C".

Storm Drain Line "B" takes drainage from Subarea D which is comprised of the adjacent lots to the east of the project.

Subarea C is comprised of the 12" strip of land at the southwest corner of the project site and extending to DeBerry Street. Other than installing a new Storm Drain Line "C", no other improvement or surface improvement is proposed within this strip of land. Therefore, the post-development peak flow rate is expected to remain the same as in the pre-development condition for this subarea. Storm Drain Line "C" connects to a public catch basin on De Berry Street.



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Subarea E is within the public right-of-way on Barton Road. Barton Road is proposed to be improved as part of the City of Colton "Bridge Removal and Road Construction Project" Plan No. 1337-1. Once Barton Road is improved, drainage from this subarea will no longer be directed through the project site. Therefore, drainage from this area will be excluded in the proposed condition hydrology study.



SUMMARY

The following table shows the pre-development peak flow rate for the project site at the following nodes:

Existing Condition Peak Flow Rate		
Node	Q ₁₀₀ (cfs)	Description
12	21.27	Flows to southwesterly corner of project site
21	0.37	Flows southwesterly towards DeBerry Street. This is only for Subarea B pre-development condition.

See Existing Condition Hydrology Map (Appendix 2) for node location.

The following table shows the total post-development peak flow rate leaving the project site:
See Proposed Condition Hydrology Map (Appendix 3) for node location.

Post-Development Condition Peak Flow Rate		
Node	Q ₁₀₀ (cfs)	Description
18	18.80	Drainage from on-site Subareas A & B, and off-site Subarea D.

The peak flow rate of 18.80 cfs in the post-development condition is less than the 21.27 cfs after mitigation through the on-site detention system.

Pre-development Subarea B is the same as post-development Subarea C. As previously mentioned, Other than installing a new Storm Drain Line "C", no other improvement or surface improvement is proposed within this strip of land. Therefore, the post-development peak flow rate is expected to remain the same as in the pre-development condition for this subarea.



APPENDIX 1

Preliminary Grading Plan

LEGEND

▲	AREA DRAIN
■	STORM DRAIN CATCH BASIN
◆	STORM DRAIN JUNCTION BOX
○	STORM DRAIN MANHOLE
—	FLOW LINE
—	FINISHED FLOOR
—	PAVEMENT
—	RIM ELEVATION
—	SPOT ELEVATION
—	TOP OF CURB
—	HYDRO DYNAMIC SEPARATOR
—	TOP OF WALL

MATCHLINE SEE RIGHT

W-H GT OWNER IX, L.P.
(DOC 2022-0115931)

BARTON ROAD

C3.0


C2.1



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APPENDIX 2

Existing Condition Hydrology Map






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APPENDIX 3

Proposed Condition Hydrology Map





APPENDIX 4

Hydrology Calculations

PRE-DEVELOPMENT
100-YR HYDROLOGY
USING 25-YR RAINFALL

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: 06/28/23

A22158 - EXISTING 100 YEAR
CALCULATED USING 25-YR STORM EVENT
BARTON ROAD SITE

Program License Serial Number 6509

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

Rational hydrology study storm event year is 100.0

10 Year storm 1 hour rainfall = 0.698(In.)

100 Year storm 1 hour rainfall = 1.080(In.)

Computed rainfall intensity:

Storm year = 25.00 1 hour rainfall = 0.850 (In.)

Slope used for rainfall intensity curve b = 0.6000

Soil antecedent moisture condition (AMC) = 2

+++++
Process from Point/Station 10.000 to Point/Station 11.000

**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type

Decimal fraction soil group A = 0.600

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.400

Decimal fraction soil group D = 0.000

SCS curve number for soil(AMC 2) = 46.80

Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.085(In/Hr)

Initial subarea data:

Initial area flow distance = 990.000(Ft.)

Top (of initial area) elevation = 977.000(Ft.)

Bottom (of initial area) elevation = 959.500(Ft.)

Difference in elevation = 17.500(Ft.)

Slope = 0.01768 s(%)= 1.77
TC = $k(0.304)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 10.756 min.
Rainfall intensity = 2.384(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.868
Subarea runoff = 18.439(CFS)
Total initial stream area = 8.910(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.085(In/Hr)

+++++
Process from Point/Station 11.000 to Point/Station 12.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 959.500(Ft.)
End of street segment elevation = 952.500(Ft.)
Length of street segment = 370.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 40.000(Ft.)
Distance from crown to crossfall grade break = 10.000(Ft.)
Slope from gutter to grade break (v/hz) = -0.010
Slope from grade break to crown (v/hz) = -0.010
Street flow is on [2] side(s) of the street
Distance from curb to property line = 10.000(Ft.)
Slope from curb to property line (v/hz) = 1.000
Gutter width = 1.500(Ft.)
Gutter hike from flowline = 1.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150
Estimated mean flow rate at midpoint of street = 19.925(CFS)
Depth of flow = 0.244(Ft.), Average velocity = 3.350(Ft/s)
Note: depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 40.000(Ft.)
Flow velocity = 3.35(Ft/s)
Travel time = 1.84 min. TC = 12.60 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.085(In/Hr)
Rainfall intensity = 2.169(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area,(total area with modified

rational method)(Q=KCIA) is C = 0.865
Subarea runoff = 2.829(CFS) for 2.430(Ac.)
Total runoff = 21.268(CFS)
Effective area this stream = 11.34(Ac.)
Total Study Area (Main Stream No. 1) = 11.34(Ac.)
Area averaged Fm value = 0.085(In/Hr)
Street flow at end of street = 21.268(CFS)
Half street flow at end of street = 10.634(CFS)
Depth of flow = 0.250(Ft.), Average velocity = 3.406(Ft/s)
Note: depth of flow exceeds top of street crown.
Flow width (from curb towards crown)= 40.000(Ft.)

++++++
Process from Point/Station 20.000 to Point/Station 21.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.500
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 50.50
Pervious ratio(A_p) = 0.1000 Max loss rate(F_m)= 0.080(In/Hr)
Initial subarea data:
Initial area flow distance = 657.000(Ft.)
Top (of initial area) elevation = 954.400(Ft.)
Bottom (of initial area) elevation = 949.600(Ft.)
Difference in elevation = 4.800(Ft.)
Slope = 0.00731 s(%)= 0.73
 $TC = k(0.304)*[(length^3)/(elevation change)]^{0.2}$
Initial area time of concentration = 10.893 min.
Rainfall intensity = 2.366(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.869
Subarea runoff = 0.370(CFS)
Total initial stream area = 0.180(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.080(In/Hr)
End of computations, Total Study Area = 11.52 (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(A_p) = 0.100
Area averaged SCS curve number = 46.9

**POST-DEVELOPMENT
100-YR HYDROLOGY
CALCULATION TO DETENTION SYSTEM NODE 14**

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: 07/06/23

A22158 BARTON
PROPOSED Q100

Program License Serial Number 6509

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

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 0.698(In.)
100 Year storm 1 hour rainfall = 1.080(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.080 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

+++++
Process from Point/Station 10.000 to Point/Station 11.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.058(In/Hr)
Initial subarea data:
Initial area flow distance = 230.000(Ft.)
Top (of initial area) elevation = 965.800(Ft.)
Bottom (of initial area) elevation = 963.400(Ft.)
Difference in elevation = 2.400(Ft.)
Slope = 0.01043 s(%)= 1.04
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.666 min.
Rainfall intensity = 4.036(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.887
Subarea runoff = 5.657(CFS)
Total initial stream area = 1.580(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.058(In/Hr)

+++++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 960.000(Ft.)
Downstream point/station elevation = 954.750(Ft.)
Pipe length = 480.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.657(CFS)
Given pipe size = 12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
8.056(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 12.098(Ft.)
Minor friction loss = 1.208(Ft.) K-factor = 1.50
Pipe flow velocity = 7.20(Ft/s)
Travel time through pipe = 1.11 min.
Time of concentration (TC) = 7.78 min.

++++++
Process from Point/Station 12.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(A_p) = 0.1000 Max loss rate(F_m)= 0.058(In/Hr)
Time of concentration = 7.78 min.
Rainfall intensity = 3.680(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)($Q=KCIA$) is $C = 0.886$
Subarea runoff = 1.155(CFS) for 0.510(Ac.)
Total runoff = 6.813(CFS)
Effective area this stream = 2.09(Ac.)
Total Study Area (Main Stream No. 1) = 2.09(Ac.)
Area averaged F_m value = 0.058(In/Hr)

++++++
Process from Point/Station 12.000 to Point/Station 13.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 954.750(Ft.)
Downstream point/station elevation = 951.000(Ft.)
Pipe length = 370.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.813(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 6.813(CFS)
Normal flow depth in pipe = 10.51(In.)
Flow top width inside pipe = 17.74(In.)
Critical Depth = 12.12(In.)
Pipe flow velocity = 6.36(Ft/s)
Travel time through pipe = 0.97 min.
Time of concentration (TC) = 8.75 min.

++++++
Process from Point/Station 13.000 to Point/Station 13.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.058(In/Hr)
Time of concentration = 8.75 min.
Rainfall intensity = 3.429(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.885
Subarea runoff = 8.328(CFS) for 2.900(Ac.)
Total runoff = 15.140(CFS)
Effective area this stream = 4.99(Ac.)
Total Study Area (Main Stream No. 1) = 4.99(Ac.)
Area averaged Fm value = 0.058(In/Hr)

++++++
Process from Point/Station 13.000 to Point/Station 14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 951.000(Ft.)
Downstream point/station elevation = 949.000(Ft.)
Pipe length = 185.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 15.140(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.140(CFS)
Normal flow depth in pipe = 14.00(In.)
Flow top width inside pipe = 23.66(In.)
Critical Depth = 16.82(In.)
Pipe flow velocity = 7.95(Ft/s)
Travel time through pipe = 0.39 min.
Time of concentration (TC) = 9.13 min.

++++++
Process from Point/Station 14.000 to Point/Station 14.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.058(In/Hr)
Time of concentration = 9.13 min.
Rainfall intensity = 3.341(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.884
Subarea runoff = 6.637(CFS) for 2.380(Ac.)
Total runoff = 21.777(CFS)
Effective area this stream = 7.37(Ac.)
Total Study Area (Main Stream No. 1) = 7.37(Ac.)
Area averaged Fm value = 0.058(In/Hr)

++++++

Process from Point/Station 14.000 to Point/Station 14.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.370(Ac.)
Runoff from this stream = 21.777(CFS)
Time of concentration = 9.13 min.
Rainfall intensity = 3.341(In/Hr)
Area averaged loss rate (Fm) = 0.0581(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000

+++++
Process from Point/Station 30.000 to Point/Station 31.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.058(In/Hr)
Initial subarea data:
Initial area flow distance = 310.000(Ft.)
Top (of initial area) elevation = 964.000(Ft.)
Bottom (of initial area) elevation = 961.200(Ft.)
Difference in elevation = 2.800(Ft.)
Slope = 0.00903 s(%)= 0.90
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.731 min.
Rainfall intensity = 3.693(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.886
Subarea runoff = 3.729(CFS)
Total initial stream area = 1.140(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.058(In/Hr)

+++++
Process from Point/Station 31.000 to Point/Station 14.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 961.200(Ft.)
End of street segment elevation = 953.850(Ft.)
Length of street segment = 530.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 23.000(Ft.)
Distance from crown to crossfall grade break = 1.500(Ft.)
Slope from gutter to grade break (v/hz) = -0.020
Slope from grade break to crown (v/hz) = -0.056
Street flow is on [2] side(s) of the street
Distance from curb to property line = 0.000(Ft.)
Slope from curb to property line (v/hz) = 0.000
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150
Estimated mean flow rate at midpoint of street = 4.288(CFS)

Depth of flow = 0.237(Ft.), Average velocity = 2.444(Ft/s)
 Note: depth of flow exceeds top of street crown.
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 23.000(Ft.)
 Flow velocity = 2.44(Ft/s)
 Travel time = 3.61 min. TC = 11.35 min.
 Adding area flow to street
 COMMERCIAL subarea type
 Decimal fraction soil group A = 0.600
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.400
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 46.80
 Adjusted SCS curve number for AMC 3 = 66.80
 Pervious ratio(A_p) = 0.1000 Max loss rate(F_m)= 0.058(In/Hr)
 Rainfall intensity = 2.934(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area,(total area with modified rational method)($Q=K_{CIA}$) is $C = 0.882$
 Subarea runoff = 0.955(CFS) for 0.670(Ac.)
 Total runoff = 4.684(CFS)
 Effective area this stream = 1.81(Ac.)
 Total Study Area (Main Stream No. 1) = 9.18(Ac.)
 Area averaged F_m value = 0.058(In/Hr)
 Street flow at end of street = 4.684(CFS)
 Half street flow at end of street = 2.342(CFS)
 Depth of flow = 0.243(Ft.), Average velocity = 2.496(Ft/s)
 Note: depth of flow exceeds top of street crown.
 Flow width (from curb towards crown)= 23.000(Ft.)

+++++
 Process from Point/Station 14.000 to Point/Station 14.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 1.810(Ac.)
 Runoff from this stream = 4.684(CFS)
 Time of concentration = 11.35 min.
 Rainfall intensity = 2.934(In/Hr)
 Area averaged loss rate (F_m) = 0.0581(In/Hr)
 Area averaged Pervious ratio (A_p) = 0.1000
 Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	F_m (In/Hr)	Rainfall Intensity (In/Hr)
1	21.78	7.370	9.13	0.058	3.341
2	4.68	1.810	11.35	0.058	2.934
Qmax(1) =				1.000 * 1.000 * 21.777) + 1.142 * 0.805 * 4.684) + =	26.083
Qmax(2) =				0.876 * 1.000 * 21.777) + 1.000 * 1.000 * 4.684) + =	23.757

Total of 2 streams to confluence:
 Flow rates before confluence point:
 21.777 4.684
 Maximum flow rates at confluence using above data:
 26.083 23.757

Area of streams before confluence:
 7.370 1.810
Effective area values after confluence:
 8.827 9.180
Results of confluence:
Total flow rate = 26.083(CFS)
Time of concentration = 9.134 min.
Effective stream area after confluence = 8.827(Ac.)
Study area average Pervious fraction(A_p) = 0.100
Study area average soil loss rate(F_m) = 0.058(In/Hr)
Study area total (this main stream) = 9.18(Ac.)
End of computations, Total Study Area = 9.18 (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(A_p) = 0.100
Area averaged SCS curve number = 46.8

**POST-DEVELOPMENT
100-YR HYDROLOGY
CALCULATION AFTER MITIGATION THROUGH DETENTION
SYSTEM AT NODE 14**

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: 07/06/23

A22158
PROPOSED 100YR STORM
MITIGATED

Program License Serial Number 6509

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

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 0.698(In.)
100 Year storm 1 hour rainfall = 1.080(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.080 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

+++++
Process from Point/Station 14.000 to Point/Station 14.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(A_p) = 0.1000 Max loss rate(F_m)= 0.058(In/Hr)
Rainfall intensity = 3.342(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 9.13 min. Rain intensity = 3.34(In/Hr)
Total area this stream = 9.18(Ac.)
Total Study Area (Main Stream No. 1) = 9.18(Ac.)
Total runoff = 15.65(CFS)

Mitigated Q from Hydrocad results at Node 14M
after passing through the detention basin

+++++
Process from Point/Station 14.000 to Point/Station 15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 952.500(Ft.)
Downstream point/station elevation = 951.000(Ft.)
Pipe length = 23.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 15.650(CFS)
Given pipe size = 21.00(In.)
Calculated individual pipe flow = 15.650(CFS)
Normal flow depth in pipe = 9.06(In.)

Flow top width inside pipe = 20.80(In.)
Critical Depth = 17.54(In.)
Pipe flow velocity = 15.75(Ft/s)
Travel time through pipe = 0.02 min.
Time of concentration (TC) = 9.15 min.

++++++
Process from Point/Station 15.000 to Point/Station 15.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 9.180(Ac.)
Runoff from this stream = 15.650(CFS)
Time of concentration = 9.15 min.
Rainfall intensity = 3.337(In/Hr)
Area averaged loss rate (Fm) = 0.0581(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000

++++++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 46.80
Adjusted SCS curve number for AMC 3 = 66.80
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.058(In/Hr)
Initial subarea data:
Initial area flow distance = 572.000(Ft.)
Top (of initial area) elevation = 975.000(Ft.)
Bottom (of initial area) elevation = 967.500(Ft.)
Difference in elevation = 7.500(Ft.)
Slope = 0.01311 s(%)= 1.31
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.169 min.
Rainfall intensity = 3.334(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
Subarea runoff = 3.420(CFS)
Total initial stream area = 1.160(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.058(In/Hr)

++++++
Process from Point/Station 41.000 to Point/Station 15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 961.300(Ft.)
Downstream point/station elevation = 951.000(Ft.)
Pipe length = 760.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.420(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 3.420(CFS)
Normal flow depth in pipe = 6.51(In.)
Flow top width inside pipe = 17.30(In.)
Critical Depth = 8.45(In.)

Pipe flow velocity = 5.93(Ft/s)
 Travel time through pipe = 2.13 min.
 Time of concentration (TC) = 11.30 min.

+++++
 Process from Point/Station 41.000 to Point/Station 15.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 1.160(Ac.)
 Runoff from this stream = 3.420(CFS)
 Time of concentration = 11.30 min.
 Rainfall intensity = 2.940(In/Hr)
 Area averaged loss rate (Fm) = 0.0581(In/Hr)
 Area averaged Pervious ratio (Ap) = 0.1000
 Summary of stream data:

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

1 15.65 9.180 9.15 0.058 3.337

2 3.42 1.160 11.30 0.058 2.940

$$Q_{max}(1) = \frac{1.000 * 1.000 * 15.650}{1.138 * 0.810 * 3.420} + = 18.801$$

$$Q_{max}(2) = \frac{0.879 * 1.000 * 15.650}{1.000 * 1.000 * 3.420} + = 17.177$$

Total of 2 streams to confluence:

Flow rates before confluence point:

15.650 3.420

Maximum flow rates at confluence using above data:

18.801 17.177

Area of streams before confluence:

9.180 1.160

Effective area values after confluence:

10.119 10.340

Results of confluence:

Total flow rate = 18.801(CFS)

Time of concentration = 9.154 min.

Effective stream area after confluence = 10.119(Ac.)

Study area average Pervious fraction(Ap) = 0.100

Study area average soil loss rate(Fm) = 0.058(In/Hr)

Study area total (this main stream) = 10.34(Ac.)

Q leaving the main project
after mitigation through the
detention basin

+++++
 Process from Point/Station 15.000 to Point/Station 16.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 951.000(Ft.)
 Downstream point/station elevation = 949.200(Ft.)
 Pipe length = 105.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 18.801(CFS)
 Given pipe size = 24.00(In.)
 Calculated individual pipe flow = 18.801(CFS)
 Normal flow depth in pipe = 13.88(In.)
 Flow top width inside pipe = 23.71(In.)

Critical Depth = 18.73(In.)
Pipe flow velocity = 9.98(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 9.33 min.

++++++
Process from Point/Station 16.000 to Point/Station 17.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 948.000(Ft.)
Downstream point/station elevation = 943.000(Ft.)
Pipe length = 690.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 18.801(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 18.801(CFS)
Normal flow depth in pipe = 19.17(In.)
Flow top width inside pipe = 19.24(In.)
Critical Depth = 18.73(In.)
Pipe flow velocity = 6.99(Ft/s)
Travel time through pipe = 1.65 min.
Time of concentration (TC) = 10.98 min.

++++++
Process from Point/Station 17.000 to Point/Station 18.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 943.000(Ft.)
Downstream point/station elevation = 939.650(Ft.)
Pipe length = 50.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 18.801(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 18.801(CFS)
Normal flow depth in pipe = 9.35(In.)
Flow top width inside pipe = 23.41(In.)
Critical Depth = 18.73(In.)
Pipe flow velocity = 16.60(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 11.03 min.
End of computations, Total Study Area = 10.34 (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(A_p) = 0.100
Area averaged SCS curve number = 46.8

**POST-DEVELOPMENT
100-YR HYDROLOGY
UNIT HYDROGRAPH CALCULATION AT NODE 14**
Unit Hydrograph Analysis

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018, Version 9.0

Study date 07/06/23

+++++-----

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

Program License Serial Number 6509

A22158 Barton Road
PROP Q100UH

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 10		
9.18	1	0.70

Rainfall data for year 2
9.18 6 1.12

Rainfall data for year 2
9.18 24 1.99

Rainfall data for year 100
9.18 1 1.08

Rainfall data for year 100
9.18 6 2.61

Rainfall data for year 100
9.18 24 4.61

***** 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)
46.8	66.8	9.18	1.000	0.581	0.100	0.058

Area-averaged adjusted loss rate Fm (In/Hr) = 0.058

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

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
0.92	0.100	46.8	66.8	4.97	0.330
8.26	0.900	98.0	98.0	0.20	0.949

Area-averaged catchment yield fraction, Y = 0.887

Area-averaged low loss fraction, Yb = 0.113

User entry of time of concentration = 0.152 (hours)

+++++ Watershed area = 9.18(Ac.)

Catchment Lag time = 0.122 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 68.5307

Hydrograph baseflow = 0.00(CFS)

Average maximum watershed loss rate(Fm) = 0.058(In/Hr)

Average low loss rate fraction (Yb) = 0.113 (decimal)

VALLEY DEVELOPED S-Graph Selected

Computed peak 5-minute rainfall = 0.400(In)

Computed peak 30-minute rainfall = 0.818(In)

Specified peak 1-hour rainfall = 1.080(In)

Computed peak 3-hour rainfall = 1.855(In)

Specified peak 6-hour rainfall = 2.610(In)

Specified peak 24-hour rainfall = 4.610(In)

Rainfall depth area reduction factors:

Using a total area of 9.18(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000	Adjusted rainfall = 0.400(In)
30-minute factor = 1.000	Adjusted rainfall = 0.818(In)
1-hour factor = 1.000	Adjusted rainfall = 1.080(In)
3-hour factor = 1.000	Adjusted rainfall = 1.855(In)
6-hour factor = 1.000	Adjusted rainfall = 2.610(In)
24-hour factor = 1.000	Adjusted rainfall = 4.610(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 = 111.02 (CFS))

1	8.427	9.356
2	51.842	48.200
3	88.385	40.570
4	97.697	10.338
5	99.350	1.835
6	100.000	0.722

Total soil rain loss = 0.46(In)
 Total effective rainfall = 4.15(In)
 Peak flow rate in flood hydrograph = 25.73(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	7.5	15.0	22.5	30.0
0+ 5	0.0004	0.05	Q				
0+10	0.0027	0.34	Q				
0+15	0.0066	0.57	Q				
0+20	0.0110	0.64	Q				
0+25	0.0155	0.65	Q				
0+30	0.0200	0.65	Q				
0+35	0.0245	0.66	Q				
0+40	0.0290	0.66	Q				
0+45	0.0336	0.66	Q				
0+50	0.0381	0.66	Q				
0+55	0.0427	0.66	Q				
1+ 0	0.0473	0.67	Q				
1+ 5	0.0519	0.67	Q				
1+10	0.0565	0.67	Q				
1+15	0.0612	0.67	Q				
1+20	0.0658	0.68	Q				
1+25	0.0705	0.68	Q				
1+30	0.0752	0.68	Q				
1+35	0.0799	0.68	QV				
1+40	0.0846	0.68	QV				
1+45	0.0893	0.69	QV				
1+50	0.0941	0.69	QV				
1+55	0.0988	0.69	QV				
2+ 0	0.1036	0.69	QV				
2+ 5	0.1084	0.70	QV				
2+10	0.1132	0.70	QV				
2+15	0.1181	0.70	QV				
2+20	0.1229	0.70	QV				
2+25	0.1278	0.71	QV				
2+30	0.1326	0.71	QV				
2+35	0.1375	0.71	QV				
2+40	0.1425	0.71	QV				
2+45	0.1474	0.72	QV				
2+50	0.1524	0.72	QV				
2+55	0.1573	0.72	QV				
3+ 0	0.1623	0.72	Q V				
3+ 5	0.1673	0.73	Q V				
3+10	0.1723	0.73	Q V				
3+15	0.1774	0.73	Q V				
3+20	0.1825	0.74	Q V				
3+25	0.1875	0.74	Q V				
3+30	0.1927	0.74	Q V				
3+35	0.1978	0.74	Q V				
3+40	0.2029	0.75	Q V				
3+45	0.2081	0.75	Q V				
3+50	0.2133	0.75	QV				
3+55	0.2185	0.76	QV				

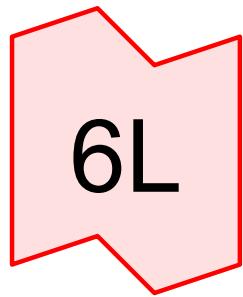
4+ 0	0.2237	0.76	Q V			
4+ 5	0.2290	0.76	Q V			
4+10	0.2342	0.77	Q V			
4+15	0.2395	0.77	Q V			
4+20	0.2448	0.77	Q V			
4+25	0.2502	0.77	Q V			
4+30	0.2555	0.78	Q V			
4+35	0.2609	0.78	Q V			
4+40	0.2663	0.78	Q V			
4+45	0.2717	0.79	Q V			
4+50	0.2772	0.79	Q V			
4+55	0.2827	0.79	Q V			
5+ 0	0.2882	0.80	Q V			
5+ 5	0.2937	0.80	Q V			
5+10	0.2992	0.81	Q V			
5+15	0.3048	0.81	Q V			
5+20	0.3104	0.81	Q V			
5+25	0.3160	0.82	Q V			
5+30	0.3217	0.82	Q V			
5+35	0.3273	0.82	Q V			
5+40	0.3330	0.83	Q V			
5+45	0.3388	0.83	Q V			
5+50	0.3445	0.84	Q V			
5+55	0.3503	0.84	Q V			
6+ 0	0.3561	0.84	Q V			
6+ 5	0.3619	0.85	Q V			
6+10	0.3678	0.85	Q V			
6+15	0.3737	0.86	Q V			
6+20	0.3796	0.86	Q V			
6+25	0.3856	0.86	Q V			
6+30	0.3916	0.87	Q V			
6+35	0.3976	0.87	Q V			
6+40	0.4036	0.88	Q V			
6+45	0.4097	0.88	Q V			
6+50	0.4158	0.89	Q V			
6+55	0.4220	0.89	Q V			
7+ 0	0.4281	0.90	Q V			
7+ 5	0.4343	0.90	Q V			
7+10	0.4406	0.91	Q V			
7+15	0.4469	0.91	Q V			
7+20	0.4532	0.92	Q V			
7+25	0.4595	0.92	Q V			
7+30	0.4659	0.93	Q V			
7+35	0.4723	0.93	Q V			
7+40	0.4788	0.94	Q V			
7+45	0.4853	0.94	Q V			
7+50	0.4918	0.95	Q V			
7+55	0.4984	0.95	Q V			
8+ 0	0.5050	0.96	Q V			
8+ 5	0.5116	0.97	Q V			
8+10	0.5183	0.97	Q V			
8+15	0.5250	0.98	Q V			
8+20	0.5318	0.98	Q V			
8+25	0.5386	0.99	Q V			
8+30	0.5455	1.00	Q V			
8+35	0.5524	1.00	Q V			
8+40	0.5593	1.01	Q V			
8+45	0.5663	1.02	Q V			
8+50	0.5734	1.02	Q V			
8+55	0.5804	1.03	Q V			
9+ 0	0.5876	1.04	Q V			

9+ 5	0.5948	1.04	Q	V			
9+10	0.6020	1.05	Q	V			
9+15	0.6093	1.06	Q	V			
9+20	0.6166	1.07	Q	V			
9+25	0.6240	1.07	Q	V			
9+30	0.6315	1.08	Q	V			
9+35	0.6390	1.09	Q	V			
9+40	0.6465	1.10	Q	V			
9+45	0.6541	1.11	Q	V			
9+50	0.6618	1.11	Q	V			
9+55	0.6695	1.12	Q	V			
10+ 0	0.6773	1.13	Q	V			
10+ 5	0.6852	1.14	Q	V			
10+10	0.6931	1.15	Q	V			
10+15	0.7011	1.16	Q	V			
10+20	0.7091	1.17	Q	V			
10+25	0.7172	1.18	Q	V			
10+30	0.7254	1.19	Q	V			
10+35	0.7337	1.20	Q	V			
10+40	0.7420	1.21	Q	V			
10+45	0.7504	1.22	Q	V			
10+50	0.7589	1.23	Q	V			
10+55	0.7675	1.24	Q	V			
11+ 0	0.7761	1.26	Q	V			
11+ 5	0.7849	1.27	Q	V			
11+10	0.7937	1.28	Q	V			
11+15	0.8026	1.29	Q	V			
11+20	0.8116	1.31	Q	V			
11+25	0.8206	1.32	Q	V			
11+30	0.8298	1.33	Q	V			
11+35	0.8391	1.35	Q	V			
11+40	0.8485	1.36	Q	V			
11+45	0.8579	1.38	Q	V			
11+50	0.8675	1.39	Q	V			
11+55	0.8772	1.41	Q	V			
12+ 0	0.8870	1.42	Q	V			
12+ 5	0.8971	1.47	Q	V			
12+10	0.9082	1.61	Q	V			
12+15	0.9202	1.74	Q	V			
12+20	0.9324	1.78	Q	V			
12+25	0.9449	1.81	Q	V			
12+30	0.9575	1.83	Q	V			
12+35	0.9702	1.85	Q	V			
12+40	0.9831	1.87	Q	V			
12+45	0.9962	1.90	Q	V			
12+50	1.0094	1.92	Q	V			
12+55	1.0228	1.94	Q	V			
13+ 0	1.0364	1.97	Q	V			
13+ 5	1.0501	2.00	Q	V			
13+10	1.0641	2.02	Q	V			
13+15	1.0782	2.05	Q	V			
13+20	1.0925	2.08	Q	V			
13+25	1.1071	2.11	Q	V			
13+30	1.1219	2.15	Q	V			
13+35	1.1369	2.18	Q	V			
13+40	1.1522	2.22	Q	V			
13+45	1.1677	2.26	Q	V			
13+50	1.1835	2.30	Q	V			
13+55	1.1997	2.34	Q	V			
14+ 0	1.2161	2.38	Q	V			
14+ 5	1.2328	2.43	Q	V			

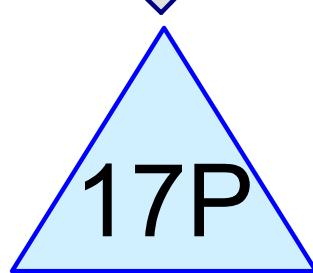
14+10	1.2499	2.48	Q	V			
14+15	1.2674	2.53	Q	V			
14+20	1.2852	2.59	Q	V			
14+25	1.3035	2.65	Q	V			
14+30	1.3222	2.72	Q	V			
14+35	1.3414	2.79	Q	V			
14+40	1.3612	2.87	Q	V			
14+45	1.3815	2.95	Q	V			
14+50	1.4024	3.04	Q	V			
14+55	1.4240	3.14	Q	V			
15+ 0	1.4464	3.25	Q	V			
15+ 5	1.4696	3.37	Q	V			
15+10	1.4937	3.51	Q	V			
15+15	1.5189	3.66	Q	V			
15+20	1.5454	3.84	Q	V			
15+25	1.5727	3.97	Q	V			
15+30	1.5993	3.86	Q	V			
15+35	1.6257	3.84	Q	V			
15+40	1.6542	4.14	Q	V			
15+45	1.6859	4.61	Q	V			
15+50	1.7227	5.34	Q	V			
15+55	1.7668	6.40	Q	V			
16+ 0	1.8252	8.48	Q	V			
16+ 5	1.9211	13.93	Q	V			
16+10	2.0983	25.73	Q	V			
16+15	2.2453	21.34	Q	V			
16+20	2.3132	9.86	Q	V			
16+25	2.3517	5.59	Q	V			
16+30	2.3832	4.58	Q	V			
16+35	2.4110	4.04	Q	V			
16+40	2.4365	3.70	Q	V			
16+45	2.4599	3.40	Q	V			
16+50	2.4817	3.17	Q	V			
16+55	2.5022	2.97	Q	V			
17+ 0	2.5215	2.81	Q	V			
17+ 5	2.5399	2.67	Q	V			
17+10	2.5574	2.55	Q	V			
17+15	2.5742	2.44	Q	V			
17+20	2.5904	2.35	Q	V			
17+25	2.6060	2.26	Q	V			
17+30	2.6211	2.19	Q	V			
17+35	2.6357	2.12	Q	V			
17+40	2.6498	2.06	Q	V			
17+45	2.6636	2.00	Q	V			
17+50	2.6770	1.95	Q	V			
17+55	2.6901	1.90	Q	V			
18+ 0	2.7029	1.85	Q	V			
18+ 5	2.7152	1.79	Q	V			
18+10	2.7264	1.62	Q	V			
18+15	2.7366	1.48	Q	V			
18+20	2.7463	1.42	Q	V			
18+25	2.7558	1.38	Q	V			
18+30	2.7651	1.35	Q	V			
18+35	2.7742	1.32	Q	V			
18+40	2.7831	1.29	Q	V			
18+45	2.7919	1.27	Q	V			
18+50	2.8004	1.25	Q	V			
18+55	2.8089	1.22	Q	V			
19+ 0	2.8171	1.20	Q	V			
19+ 5	2.8253	1.18	Q	V			
19+10	2.8333	1.16	Q	V			

19+15	2.8411	1.14	Q			V	
19+20	2.8489	1.12	Q			V	
19+25	2.8565	1.11	Q			V	
19+30	2.8640	1.09	Q			V	
19+35	2.8714	1.07	Q			V	
19+40	2.8787	1.06	Q			V	
19+45	2.8859	1.04	Q			V	
19+50	2.8930	1.03	Q			V	
19+55	2.9000	1.02	Q			V	
20+ 0	2.9069	1.00	Q			V	
20+ 5	2.9137	0.99	Q			V	
20+10	2.9204	0.98	Q			V	
20+15	2.9271	0.97	Q			V	
20+20	2.9337	0.95	Q			V	
20+25	2.9402	0.94	Q			V	
20+30	2.9466	0.93	Q			V	
20+35	2.9529	0.92	Q			V	
20+40	2.9592	0.91	Q			V	
20+45	2.9654	0.90	Q			V	
20+50	2.9716	0.89	Q			V	
20+55	2.9776	0.88	Q			V	
21+ 0	2.9837	0.87	Q			V	
21+ 5	2.9896	0.87	Q			V	
21+10	2.9955	0.86	Q			V	
21+15	3.0014	0.85	Q			V	
21+20	3.0072	0.84	Q			V	
21+25	3.0129	0.83	Q			V	
21+30	3.0186	0.82	Q			V	
21+35	3.0242	0.82	Q			V	
21+40	3.0298	0.81	Q			V	
21+45	3.0353	0.80	Q			V	
21+50	3.0408	0.80	Q			V	
21+55	3.0462	0.79	Q			V	
22+ 0	3.0516	0.78	Q			V	
22+ 5	3.0569	0.78	Q			V	
22+10	3.0622	0.77	Q			V	
22+15	3.0675	0.76	Q			V	
22+20	3.0727	0.76	Q			V	
22+25	3.0778	0.75	Q			V	
22+30	3.0830	0.74	Q			V	
22+35	3.0881	0.74	Q			V	
22+40	3.0931	0.73	Q			V	
22+45	3.0981	0.73	Q			V	
22+50	3.1031	0.72	Q			V	
22+55	3.1080	0.72	Q			V	
23+ 0	3.1129	0.71	Q			V	
23+ 5	3.1178	0.71	Q			V	
23+10	3.1226	0.70	Q			V	
23+15	3.1274	0.70	Q			V	
23+20	3.1322	0.69	Q			V	
23+25	3.1369	0.69	Q			V	
23+30	3.1416	0.68	Q			V	
23+35	3.1463	0.68	Q			V	
23+40	3.1509	0.67	Q			V	
23+45	3.1555	0.67	Q			V	
23+50	3.1601	0.66	Q			V	
23+55	3.1647	0.66	Q			V	
24+ 0	3.1692	0.66	Q			V	
24+ 5	3.1733	0.60	Q			V	
24+10	3.1755	0.31	Q			V	
24+15	3.1760	0.08	Q			V	

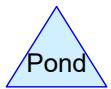
24+20	3.1761	0.02	Q				v
24+25	3.1761	0.00	Q				v



Inflow 100-yr
Hydrograph



ADS Stormtech



Routing Diagram for A22158-1 - BARTON-STUDY
Prepared by Kier + Wright, Printed 7/6/2023
HydroCAD® 10.10-5a s/n 02379 © 2020 HydroCAD Software Solutions LLC

Summary for Pond 17P: ADS Stormtech

Inflow = 25.38 cfs @ 16.18 hrs, Volume= 3.177 af
 Outflow = 15.65 cfs @ 16.29 hrs, Volume= 2.299 af, Atten= 38%, Lag= 6.6 min
 Primary = 15.65 cfs @ 16.29 hrs, Volume= 2.299 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.08 hrs
 Peak Elev= 955.20' @ 16.29 hrs Surf.Area= 18,418 sf Storage= 44,038 cf

Plug-Flow detention time= 280.4 min calculated for 2.295 af (72% of inflow)
 Center-of-Mass det. time= 163.6 min (995.1 - 831.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	945.50'	14,091 cf	64.83'W x 136.27'L x 6.75'H Field A 59,634 cf Overall - 24,407 cf Embedded = 35,227 cf x 40.0% Voids
#2A	946.25'	24,407 cf	ADS_StormTech MC-4500 b +Cap x 224 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 224 Chambers in 7 Rows Cap Storage= +39.5 cf x 2 x 7 rows = 553.0 cf
#3	953.60'	8,906 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		47,403 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
953.60	0	0	0
954.00	780	156	156
954.50	3,313	1,023	1,179
955.00	7,330	2,661	3,840
955.50	12,933	5,066	8,906

Device	Routing	Invert	Outlet Devices
#1	Primary	952.50'	21.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=15.53 cfs @ 16.29 hrs HW=955.17' (Free Discharge)
 ↑1=Orifice/Grate (Orifice Controls 15.53 cfs @ 6.46 fps)

MITIGATED FLOWRATE AT
DETENTION SYSTEM.
NODE 14M IN RATIONAL
METHOD HYDROLOGY

Pond 17P: ADS Stormtech - Chamber Wizard Field A**Chamber Model = ADS_StormTech MC-4500 b +Cap (ADS StormTech® MC-4500 with cap volume)**

Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf

Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap

Cap Storage= +39.5 cf x 2 x 7 rows = 553.0 cf

100.0" Wide + 9.0" Spacing = 109.0" C-C Row Spacing

32 Chambers/Row x 4.02' Long +2.73' Cap Length x 2 = 134.27' Row Length +12.0" End Stone x 2 = 136.27' Base Length

7 Rows x 100.0" Wide + 9.0" Spacing x 6 + 12.0" Side Stone x 2 = 64.83' Base Width

9.0" Stone Base + 60.0" Chamber Height + 12.0" Stone Cover = 6.75' Field Height

224 Chambers x 106.5 cf + 39.5 cf Cap Volume x 2 x 7 Rows = 24,406.9 cf Chamber Storage

59,633.7 cf Field - 24,406.9 cf Chambers = 35,226.8 cf Stone x 40.0% Voids = 14,090.7 cf Stone Storage

Chamber Storage + Stone Storage = 38,497.6 cf = 0.884 af

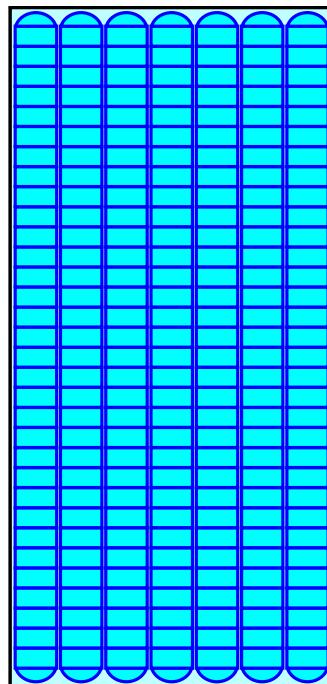
Overall Storage Efficiency = 64.6%

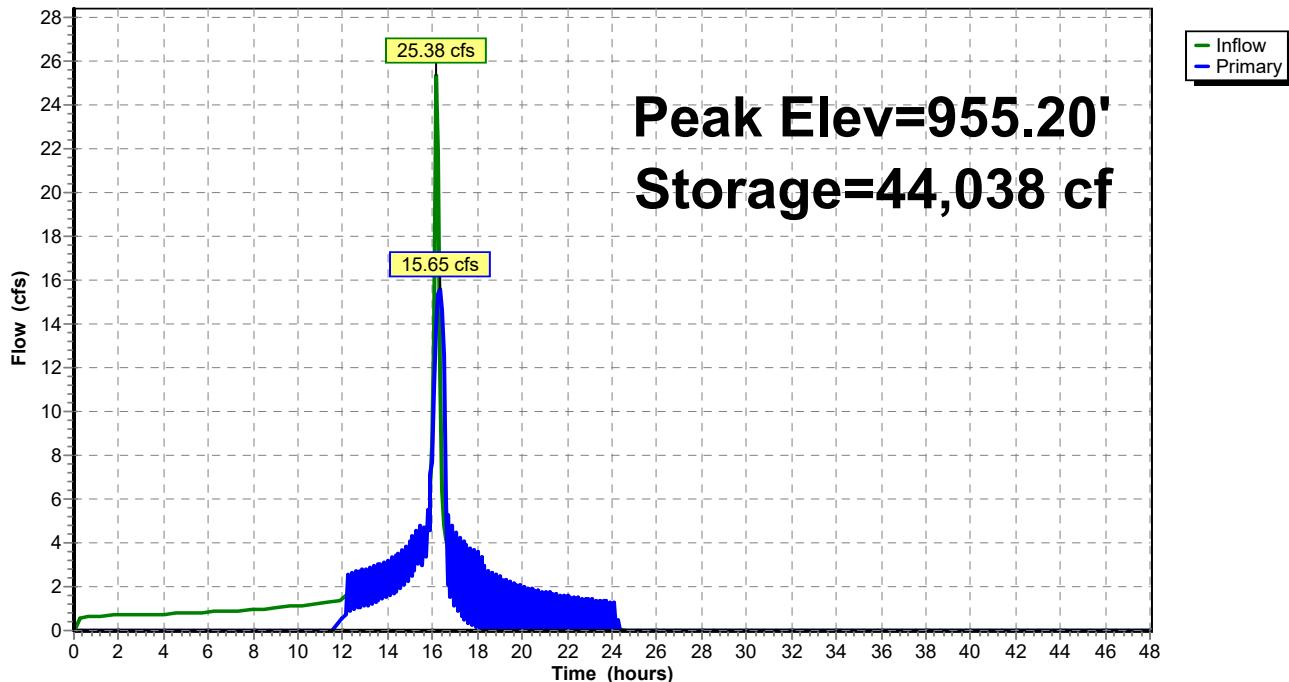
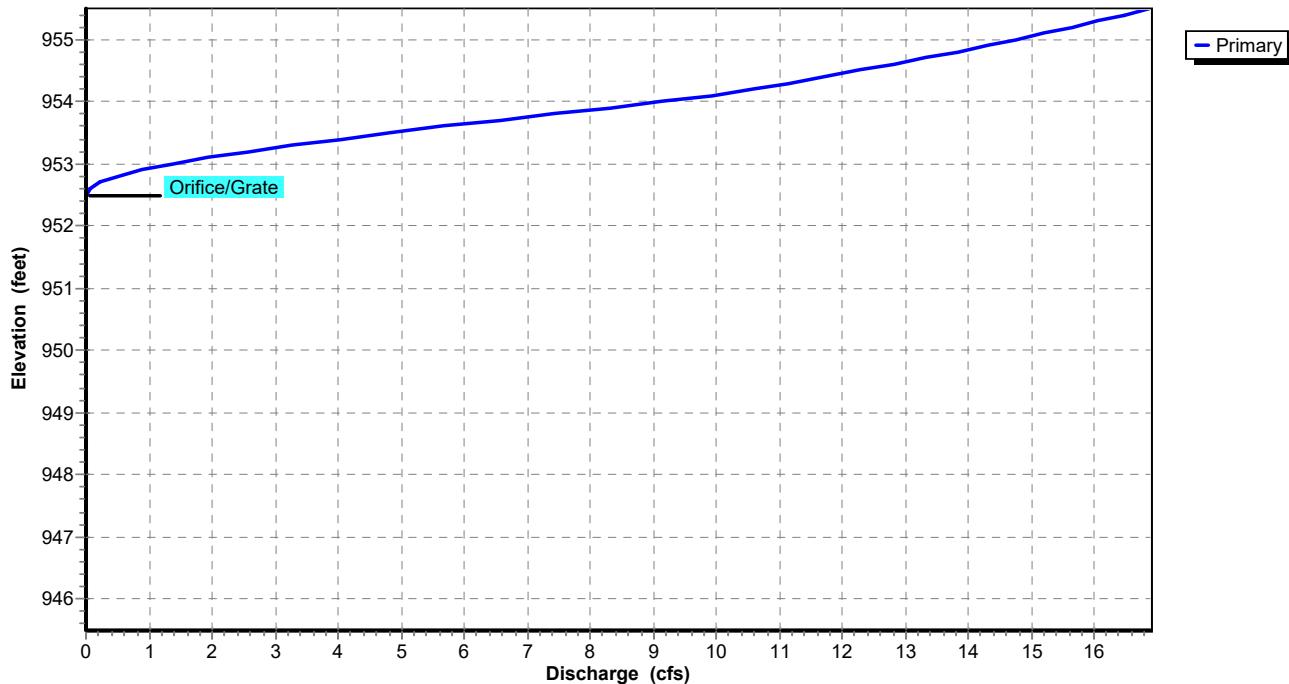
Overall System Size = 136.27' x 64.83' x 6.75'

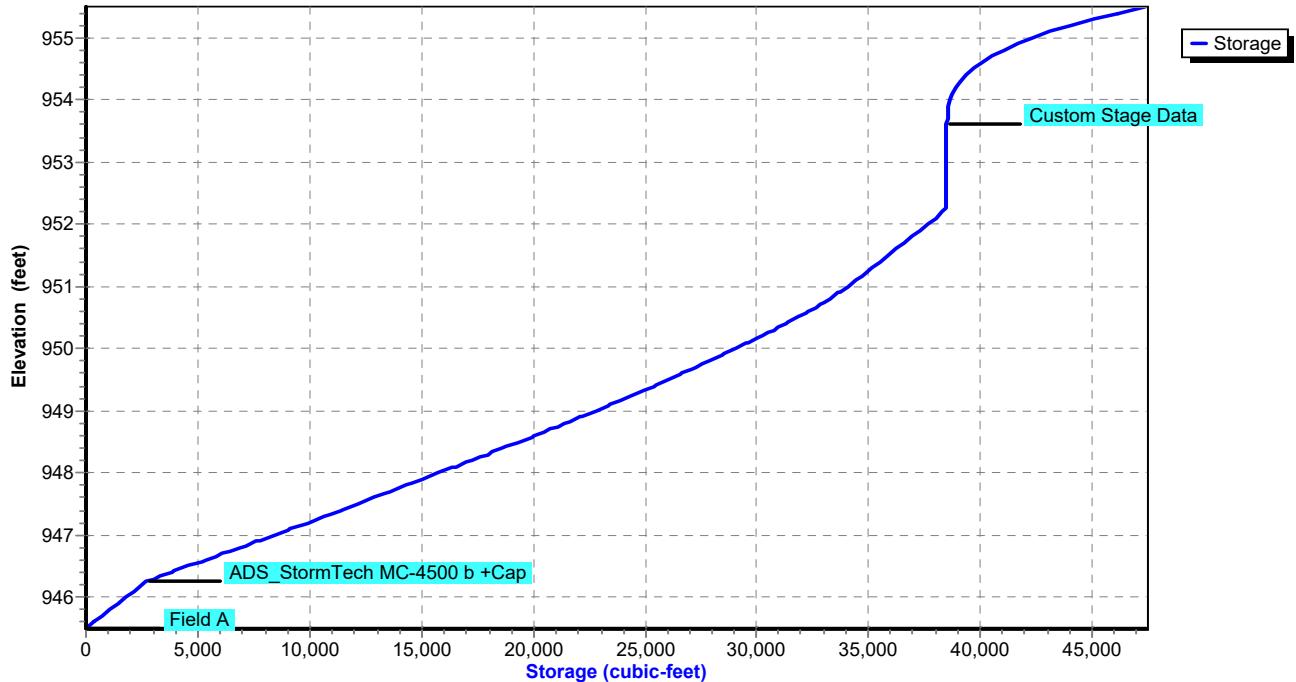
224 Chambers

2,208.7 cy Field

1,304.7 cy Stone



Pond 17P: ADS Stormtech**Hydrograph****Pond 17P: ADS Stormtech****Stage-Discharge**

Pond 17P: ADS Stormtech**Stage-Area-Storage**

Hydrograph for Pond 17P: ADS Stormtech

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	945.50	0.00
1.60	0.68	3,402	946.35	0.00
3.20	0.73	7,467	946.88	0.00
4.80	0.79	11,842	947.46	0.00
6.40	0.86	16,596	948.11	0.00
8.00	0.96	21,835	948.86	0.00
9.60	1.09	27,722	949.77	0.00
11.20	1.28	34,523	951.13	0.00
12.80	1.91	38,498	952.93	1.06
14.40	2.64	38,498	953.07	1.78
16.00	8.48	38,549	953.83	7.67
17.60	2.11	38,498	952.75	0.36
19.20	1.15	38,498	952.50	0.00
20.80	0.89	38,498	952.50	0.00
22.40	0.75	38,498	952.50	0.00
24.00	0.66	38,498	952.50	0.00
25.60	0.00	38,498	952.50	0.00
27.20	0.00	38,498	952.50	0.00
28.80	0.00	38,498	952.50	0.00
30.40	0.00	38,498	952.50	0.00
32.00	0.00	38,498	952.50	0.00
33.60	0.00	38,498	952.50	0.00
35.20	0.00	38,498	952.50	0.00
36.80	0.00	38,498	952.50	0.00
38.40	0.00	38,498	952.50	0.00
40.00	0.00	38,498	952.50	0.00
41.60	0.00	38,498	952.50	0.00
43.20	0.00	38,498	952.50	0.00
44.80	0.00	38,498	952.50	0.00
46.40	0.00	38,498	952.50	0.00
48.00	0.00	38,498	952.50	0.00

Stage-Discharge for Pond 17P: ADS Stormtech

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
945.50	0.00	948.15	0.00	950.80	0.00	953.45	4.43
945.55	0.00	948.20	0.00	950.85	0.00	953.50	4.84
945.60	0.00	948.25	0.00	950.90	0.00	953.55	5.26
945.65	0.00	948.30	0.00	950.95	0.00	953.60	5.68
945.70	0.00	948.35	0.00	951.00	0.00	953.65	6.12
945.75	0.00	948.40	0.00	951.05	0.00	953.70	6.56
945.80	0.00	948.45	0.00	951.10	0.00	953.75	7.00
945.85	0.00	948.50	0.00	951.15	0.00	953.80	7.44
945.90	0.00	948.55	0.00	951.20	0.00	953.85	7.88
945.95	0.00	948.60	0.00	951.25	0.00	953.90	8.31
946.00	0.00	948.65	0.00	951.30	0.00	953.95	8.74
946.05	0.00	948.70	0.00	951.35	0.00	954.00	9.15
946.10	0.00	948.75	0.00	951.40	0.00	954.05	9.55
946.15	0.00	948.80	0.00	951.45	0.00	954.10	9.93
946.20	0.00	948.85	0.00	951.50	0.00	954.15	10.28
946.25	0.00	948.90	0.00	951.55	0.00	954.20	10.59
946.30	0.00	948.95	0.00	951.60	0.00	954.25	10.83
946.35	0.00	949.00	0.00	951.65	0.00	954.30	11.14
946.40	0.00	949.05	0.00	951.70	0.00	954.35	11.44
946.45	0.00	949.10	0.00	951.75	0.00	954.40	11.73
946.50	0.00	949.15	0.00	951.80	0.00	954.45	12.01
946.55	0.00	949.20	0.00	951.85	0.00	954.50	12.28
946.60	0.00	949.25	0.00	951.90	0.00	954.55	12.55
946.65	0.00	949.30	0.00	951.95	0.00	954.60	12.82
946.70	0.00	949.35	0.00	952.00	0.00	954.65	13.08
946.75	0.00	949.40	0.00	952.05	0.00	954.70	13.33
946.80	0.00	949.45	0.00	952.10	0.00	954.75	13.58
946.85	0.00	949.50	0.00	952.15	0.00	954.80	13.83
946.90	0.00	949.55	0.00	952.20	0.00	954.85	14.07
946.95	0.00	949.60	0.00	952.25	0.00	954.90	14.30
947.00	0.00	949.65	0.00	952.30	0.00	954.95	14.53
947.05	0.00	949.70	0.00	952.35	0.00	955.00	14.76
947.10	0.00	949.75	0.00	952.40	0.00	955.05	14.99
947.15	0.00	949.80	0.00	952.45	0.00	955.10	15.21
947.20	0.00	949.85	0.00	952.50	0.00	955.15	15.43
947.25	0.00	949.90	0.00	952.55	0.01	955.20	15.65
947.30	0.00	949.95	0.00	952.60	0.06	955.25	15.86
947.35	0.00	950.00	0.00	952.65	0.13	955.30	16.07
947.40	0.00	950.05	0.00	952.70	0.23	955.35	16.28
947.45	0.00	950.10	0.00	952.75	0.36	955.40	16.48
947.50	0.00	950.15	0.00	952.80	0.51	955.45	16.68
947.55	0.00	950.20	0.00	952.85	0.69	955.50	16.88
947.60	0.00	950.25	0.00	952.90	0.89		
947.65	0.00	950.30	0.00	952.95	1.12		
947.70	0.00	950.35	0.00	953.00	1.37		
947.75	0.00	950.40	0.00	953.05	1.63		
947.80	0.00	950.45	0.00	953.10	1.92		
947.85	0.00	950.50	0.00	953.15	2.23		
947.90	0.00	950.55	0.00	953.20	2.56		
947.95	0.00	950.60	0.00	953.25	2.90		
948.00	0.00	950.65	0.00	953.30	3.26		
948.05	0.00	950.70	0.00	953.35	3.64		
948.10	0.00	950.75	0.00	953.40	4.03		

Stage-Area-Storage for Pond 17P: ADS Stormtech

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
945.50	0	950.80	33,238
945.60	353	950.90	33,647
945.70	707	951.00	34,037
945.80	1,060	951.10	34,417
945.90	1,414	951.20	34,785
946.00	1,767	951.30	35,140
946.10	2,120	951.40	35,494
946.20	2,474	951.50	35,847
946.30	3,035	951.60	36,201
946.40	3,805	951.70	36,554
946.50	4,572	951.80	36,907
946.60	5,337	951.90	37,261
946.70	6,101	952.00	37,614
946.80	6,862	952.10	37,968
946.90	7,622	952.20	38,321
947.00	8,378	952.30	38,498
947.10	9,133	952.40	38,498
947.20	9,885	952.50	38,498
947.30	10,634	952.60	38,498
947.40	11,380	952.70	38,498
947.50	12,123	952.80	38,498
947.60	12,863	952.90	38,498
947.70	13,599	953.00	38,498
947.80	14,331	953.10	38,498
947.90	15,060	953.20	38,498
948.00	15,785	953.30	38,498
948.10	16,506	953.40	38,498
948.20	17,222	953.50	38,498
948.30	17,933	953.60	38,498
948.40	18,640	953.70	38,507
948.50	19,341	953.80	38,537
948.60	20,038	953.90	38,585
948.70	20,729	954.00	38,654
948.80	21,414	954.10	38,757
948.90	22,093	954.20	38,911
949.00	22,765	954.30	39,116
949.10	23,432	954.40	39,371
949.20	24,091	954.50	39,677
949.30	24,743	954.60	40,048
949.40	25,387	954.70	40,500
949.50	26,023	954.80	41,032
949.60	26,651	954.90	41,645
949.70	27,269	955.00	42,338
949.80	27,878	955.10	43,127
949.90	28,477	955.20	44,028
950.00	29,065	955.30	45,041
950.10	29,642	955.40	46,166
950.20	30,207	955.50	47,403
950.30	30,758		
950.40	31,294		
950.50	31,814		
950.60	32,315		
950.70	32,793		

VOLUME BELOW OUTLET PIPE
ELEVATION - TO BE PUMPED TO
MODULAR WETLANDS SYSTEM FOR
WQMP WATER QUALITY TREATMENT
MIN. DESIGN CAPTURE VOLUME PER
WQMP = 32,700 CF

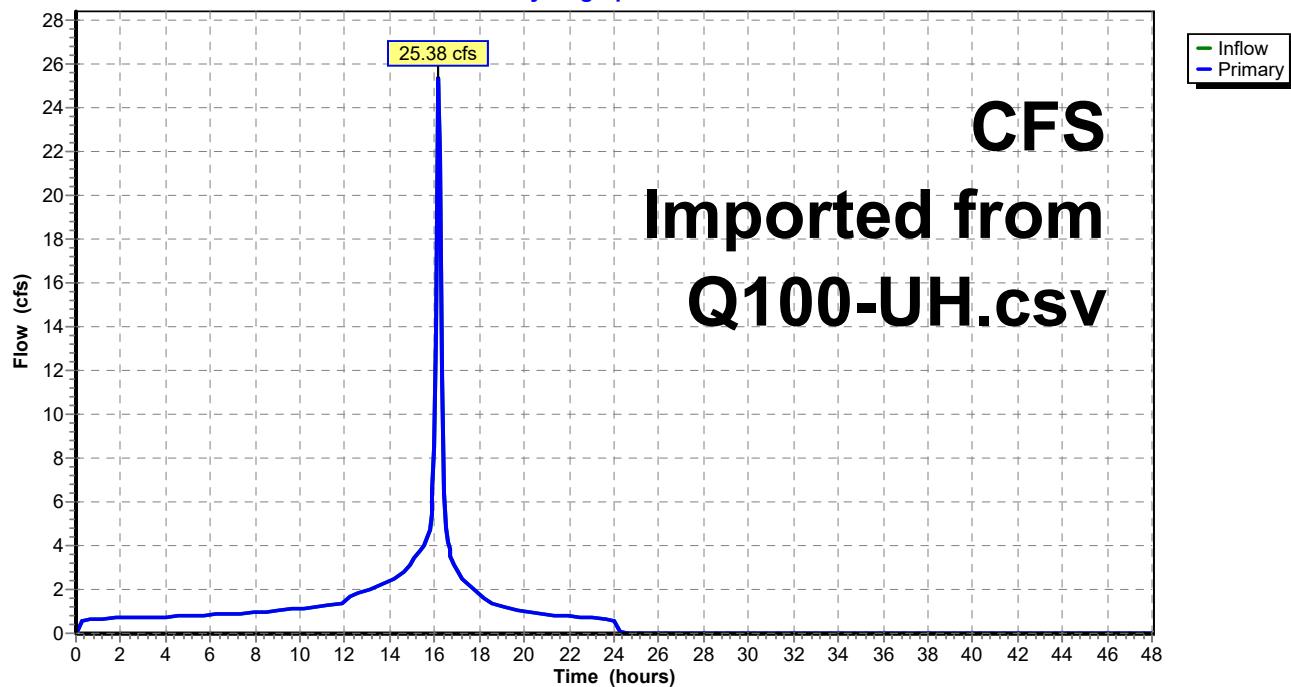
952.50 INV ELEVATION -
21" OUTLET PIPE

Summary for Link 6L: Inflow 100-yr Hydrograph

Inflow = 25.38 cfs @ 16.18 hrs, Volume= 3.177 af
Primary = 25.38 cfs @ 16.18 hrs, Volume= 3.177 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.08 hrs

CFS Imported from Q100-UH.csv

Link 6L: Inflow 100-yr Hydrograph**Hydrograph**

Hydrograph for Link 6L: Inflow 100-yr Hydrograph

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	42.40	0.00	0.00	0.00
0.80	0.66	0.00	0.66	43.20	0.00	0.00	0.00
1.60	0.68	0.00	0.68	44.00	0.00	0.00	0.00
2.40	0.71	0.00	0.71	44.80	0.00	0.00	0.00
3.20	0.73	0.00	0.73	45.60	0.00	0.00	0.00
4.00	0.76	0.00	0.76	46.40	0.00	0.00	0.00
4.80	0.79	0.00	0.79	47.20	0.00	0.00	0.00
5.60	0.82	0.00	0.82	48.00	0.00	0.00	0.00
6.40	0.86	0.00	0.86				
7.20	0.91	0.00	0.91				
8.00	0.96	0.00	0.96				
8.80	1.02	0.00	1.02				
9.60	1.09	0.00	1.09				
10.40	1.18	0.00	1.18				
11.20	1.28	0.00	1.28				
12.00	1.42	0.00	1.42				
12.80	1.91	0.00	1.91				
13.60	2.19	0.00	2.19				
14.40	2.64	0.00	2.64				
15.20	3.57	0.00	3.57				
16.00	8.48	0.00	8.48				
16.80	3.26	0.00	3.26				
17.60	2.11	0.00	2.11				
18.40	1.39	0.00	1.39				
19.20	1.15	0.00	1.15				
20.00	1.00	0.00	1.00				
20.80	0.89	0.00	0.89				
21.60	0.82	0.00	0.82				
22.40	0.75	0.00	0.75				
23.20	0.70	0.00	0.70				
24.00	0.66	0.00	0.66				
24.80	0.00	0.00	0.00				
25.60	0.00	0.00	0.00				
26.40	0.00	0.00	0.00				
27.20	0.00	0.00	0.00				
28.00	0.00	0.00	0.00				
28.80	0.00	0.00	0.00				
29.60	0.00	0.00	0.00				
30.40	0.00	0.00	0.00				
31.20	0.00	0.00	0.00				
32.00	0.00	0.00	0.00				
32.80	0.00	0.00	0.00				
33.60	0.00	0.00	0.00				
34.40	0.00	0.00	0.00				
35.20	0.00	0.00	0.00				
36.00	0.00	0.00	0.00				
36.80	0.00	0.00	0.00				
37.60	0.00	0.00	0.00				
38.40	0.00	0.00	0.00				
39.20	0.00	0.00	0.00				
40.00	0.00	0.00	0.00				
40.80	0.00	0.00	0.00				
41.60	0.00	0.00	0.00				



APPENDIX 5

Supporting Documents

**NOAA Atlas 14, Volume 6, Version 2****Location name:** Grand Terrace, California, USA***Latitude:** 34.0331°, **Longitude:** -117.3282°**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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.092 (0.077-0.112)	0.118 (0.098-0.143)	0.152 (0.126-0.185)	0.180 (0.148-0.221)	0.218 (0.173-0.277)	0.248 (0.193-0.322)	0.279 (0.211-0.371)	0.311 (0.229-0.426)	0.355 (0.250-0.508)	0.390 (0.265-0.578)
10-min	0.133 (0.110-0.161)	0.169 (0.141-0.205)	0.218 (0.181-0.265)	0.258 (0.212-0.316)	0.313 (0.249-0.397)	0.355 (0.277-0.461)	0.399 (0.303-0.532)	0.445 (0.328-0.611)	0.509 (0.359-0.728)	0.558 (0.380-0.828)
15-min	0.160 (0.134-0.194)	0.204 (0.170-0.248)	0.263 (0.218-0.320)	0.311 (0.256-0.382)	0.378 (0.301-0.480)	0.430 (0.334-0.558)	0.483 (0.366-0.643)	0.539 (0.397-0.738)	0.615 (0.434-0.880)	0.675 (0.460-1.00)
30-min	0.245 (0.204-0.297)	0.312 (0.260-0.379)	0.402 (0.333-0.489)	0.475 (0.391-0.584)	0.577 (0.459-0.733)	0.656 (0.511-0.852)	0.737 (0.559-0.982)	0.822 (0.606-1.13)	0.939 (0.663-1.34)	1.03 (0.702-1.53)
60-min	0.359 (0.299-0.435)	0.458 (0.381-0.556)	0.590 (0.489-0.718)	0.698 (0.574-0.857)	0.847 (0.673-1.08)	0.963 (0.749-1.25)	1.08 (0.821-1.44)	1.21 (0.889-1.65)	1.38 (0.973-1.97)	1.51 (1.03-2.24)
2-hr	0.509 (0.424-0.617)	0.649 (0.540-0.788)	0.834 (0.692-1.01)	0.987 (0.812-1.21)	1.20 (0.951-1.52)	1.36 (1.06-1.77)	1.53 (1.16-2.03)	1.70 (1.25-2.33)	1.94 (1.37-2.78)	2.13 (1.45-3.16)
3-hr	0.625 (0.521-0.757)	0.797 (0.663-0.967)	1.02 (0.850-1.25)	1.21 (0.997-1.49)	1.47 (1.17-1.87)	1.67 (1.30-2.17)	1.87 (1.42-2.49)	2.09 (1.54-2.86)	2.38 (1.68-3.40)	2.61 (1.78-3.87)
6-hr	0.875 (0.729-1.06)	1.12 (0.930-1.36)	1.44 (1.19-1.75)	1.70 (1.40-2.08)	2.05 (1.63-2.61)	2.33 (1.81-3.03)	2.61 (1.98-3.48)	2.91 (2.14-3.99)	3.31 (2.34-4.74)	3.63 (2.47-5.37)
12-hr	1.16 (0.967-1.41)	1.48 (1.24-1.80)	1.91 (1.58-2.32)	2.25 (1.85-2.77)	2.72 (2.16-3.46)	3.08 (2.40-4.00)	3.45 (2.62-4.60)	3.83 (2.82-5.25)	4.35 (3.07-6.22)	4.75 (3.24-7.04)
24-hr	1.55 (1.37-1.78)	1.99 (1.76-2.29)	2.56 (2.26-2.96)	3.02 (2.64-3.52)	3.65 (3.09-4.40)	4.13 (3.43-5.08)	4.61 (3.74-5.81)	5.11 (4.03-6.62)	5.79 (4.38-7.80)	6.31 (4.62-8.80)
2-day	1.89 (1.67-2.17)	2.45 (2.17-2.83)	3.20 (2.82-3.70)	3.81 (3.33-4.44)	4.63 (3.92-5.58)	5.27 (4.37-6.48)	5.92 (4.79-7.45)	6.58 (5.19-8.52)	7.49 (5.67-10.1)	8.20 (6.00-11.4)
3-day	2.01 (1.78-2.32)	2.66 (2.35-3.07)	3.52 (3.11-4.08)	4.23 (3.70-4.94)	5.21 (4.41-6.27)	5.97 (4.95-7.34)	6.74 (5.46-8.49)	7.55 (5.95-9.78)	8.66 (6.56-11.7)	9.54 (6.98-13.3)
4-day	2.15 (1.91-2.48)	2.88 (2.55-3.32)	3.84 (3.39-4.45)	4.64 (4.06-5.41)	5.74 (4.86-6.92)	6.61 (5.48-8.13)	7.50 (6.07-9.44)	8.43 (6.64-10.9)	9.71 (7.35-13.1)	10.7 (7.85-15.0)
7-day	2.49 (2.20-2.87)	3.34 (2.95-3.85)	4.47 (3.94-5.17)	5.41 (4.73-6.31)	6.70 (5.68-8.08)	7.72 (6.41-9.50)	8.77 (7.11-11.1)	9.88 (7.78-12.8)	11.4 (8.63-15.4)	12.6 (9.22-17.6)
10-day	2.71 (2.40-3.12)	3.64 (3.22-4.20)	4.89 (4.31-5.66)	5.93 (5.18-6.91)	7.36 (6.24-8.87)	8.49 (7.05-10.4)	9.66 (7.83-12.2)	10.9 (8.58-14.1)	12.6 (9.52-17.0)	13.9 (10.2-19.4)
20-day	3.29 (2.92-3.80)	4.46 (3.94-5.15)	6.02 (5.31-6.97)	7.33 (6.41-8.54)	9.14 (7.74-11.0)	10.6 (8.78-13.0)	12.1 (9.78-15.2)	13.6 (10.8-17.7)	15.8 (12.0-21.4)	17.6 (12.9-24.5)
30-day	3.90 (3.45-4.50)	5.30 (4.69-6.12)	7.19 (6.34-8.32)	8.77 (7.67-10.2)	11.0 (9.30-13.2)	12.7 (10.6-15.7)	14.6 (11.8-18.3)	16.5 (13.0-21.3)	19.2 (14.5-25.9)	21.3 (15.6-29.8)
45-day	4.66 (4.13-5.38)	6.35 (5.62-7.33)	8.63 (7.61-9.99)	10.5 (9.23-12.3)	13.2 (11.2-15.9)	15.4 (12.7-18.9)	17.6 (14.2-22.2)	20.0 (15.7-25.8)	23.3 (17.6-31.4)	25.9 (19.0-36.2)
60-day	5.42 (4.80-6.25)	7.39 (6.53-8.53)	10.0 (8.85-11.6)	12.3 (10.7-14.3)	15.4 (13.0-18.5)	17.9 (14.8-22.0)	20.5 (16.6-25.8)	23.2 (18.3-30.0)	27.1 (20.5-36.5)	30.2 (22.1-42.1)

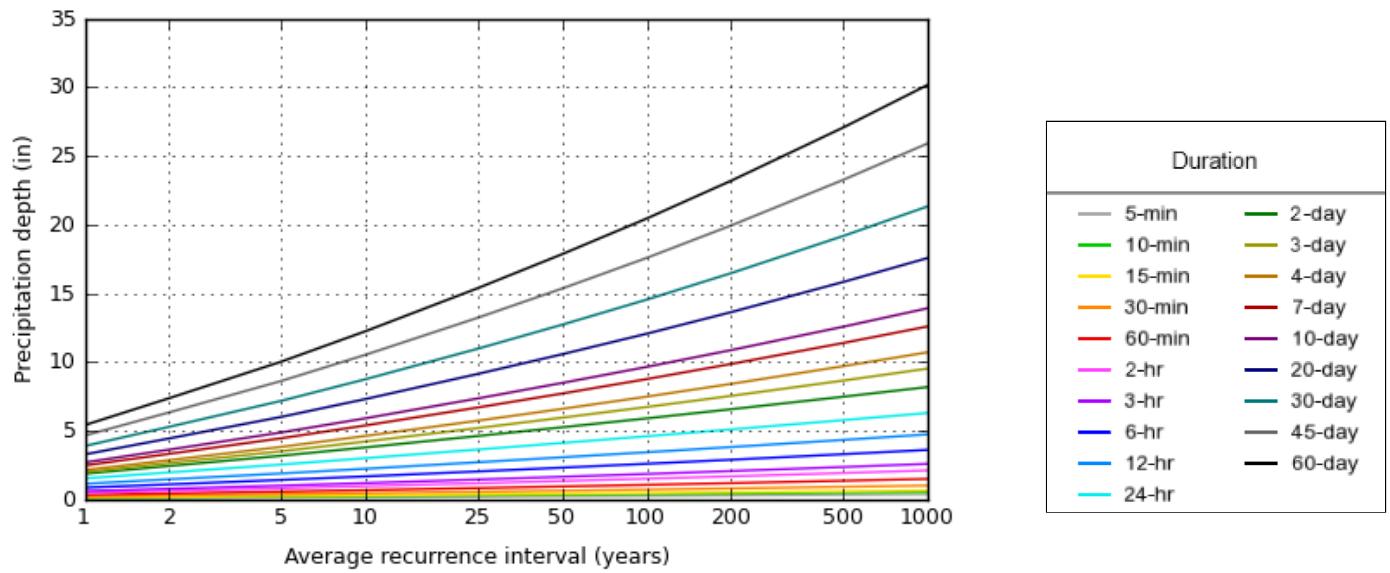
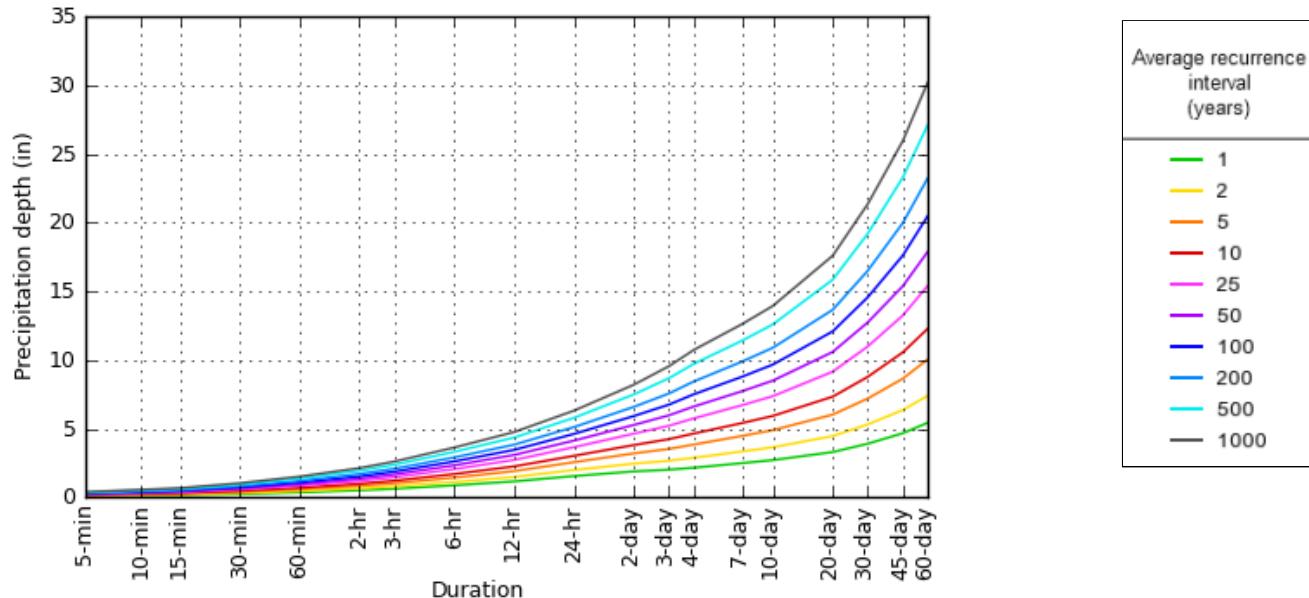
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

[Back to Top](#)**PF graphical**

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.0331°, Longitude: -117.3282°



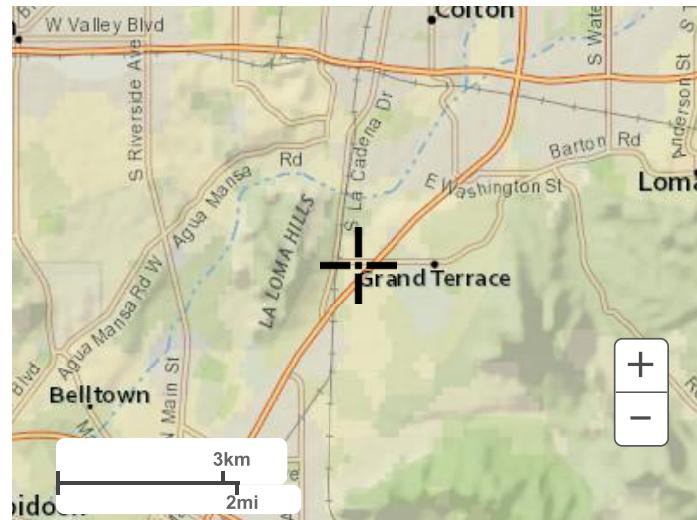
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Mar 16 22:10:49 2023

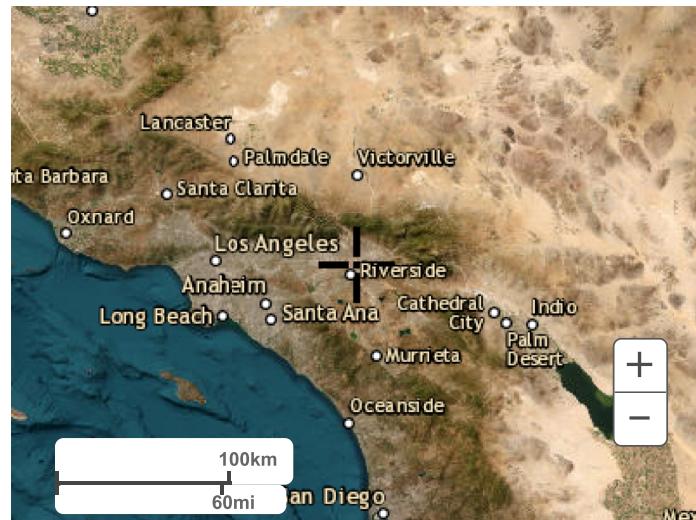
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[Small scale terrain](#)



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 Questions?: HDSC.Questions@noaa.gov

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Hydrologic Soil Group—San Bernardino County Southwestern Part, California



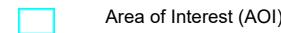
Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

3/24/2023
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MAP LEGEND

Area of Interest (AOI)



Soils

Soil Rating Polygons

	A
	A/D
	B
	B/D
	C
	C/D
	D
	Not rated or not available

Soil Rating Lines

	A
	A/D
	B
	B/D
	C
	C/D
	D
	Not rated or not available

Soil Rating Points

	A
	A/D
	B
	B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California

Survey Area Data: Version 14, Sep 6, 2022

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

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GtC	Greenfield sandy loam, 2 to 9 percent slopes	A	6.0	57.2%
MoC	Monserate sandy loam, 2 to 9 percent slopes	C	4.5	42.8%
Totals for Area of Interest			10.6	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

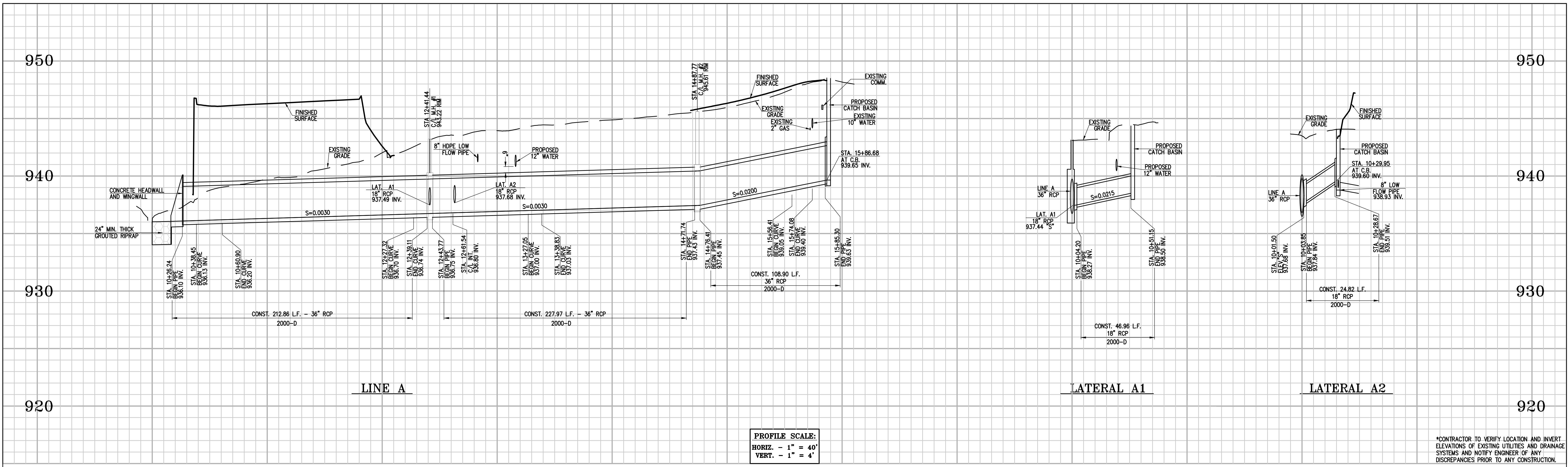
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

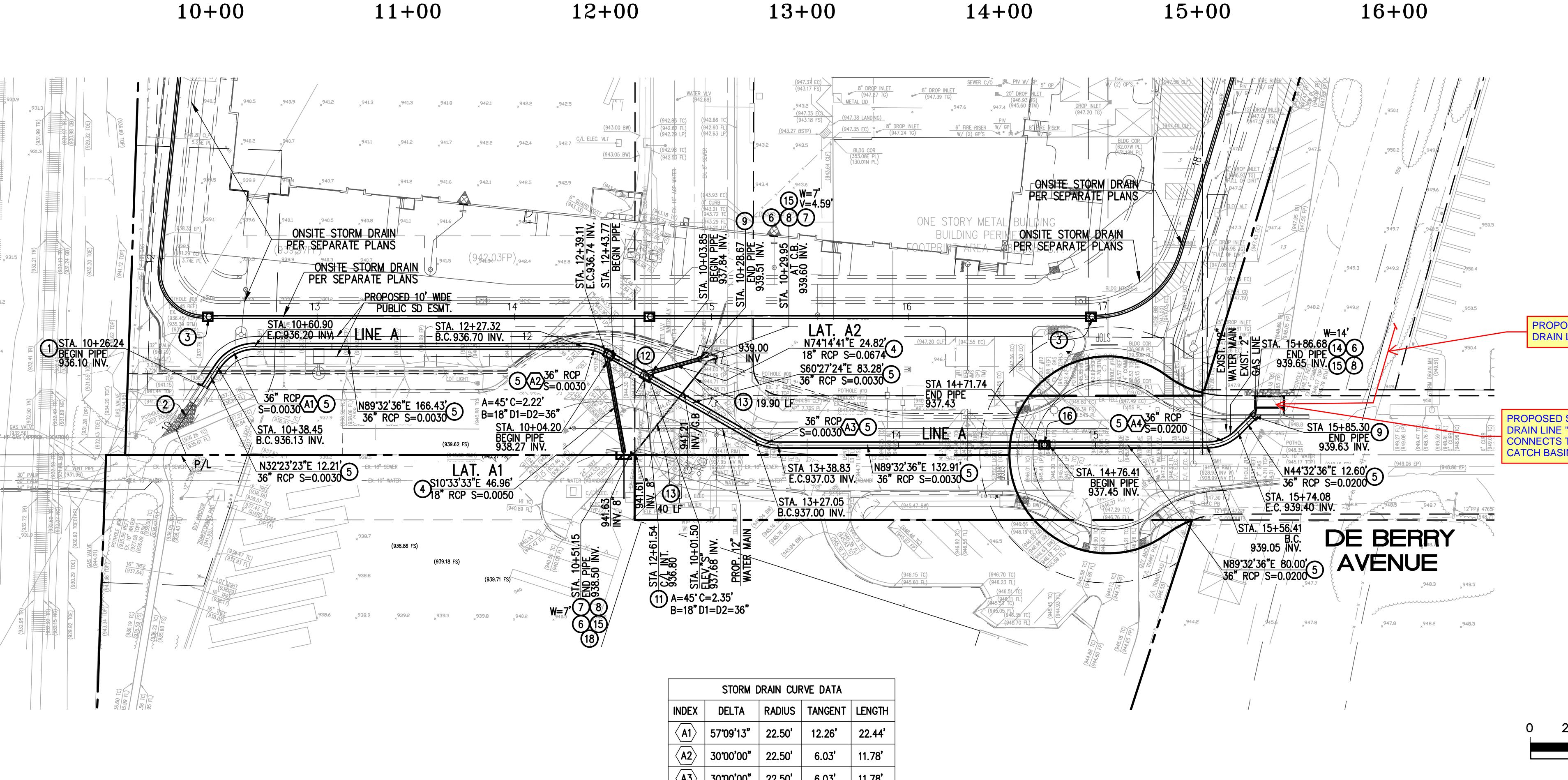
Rating Options

Aggregation Method: Dominant Condition





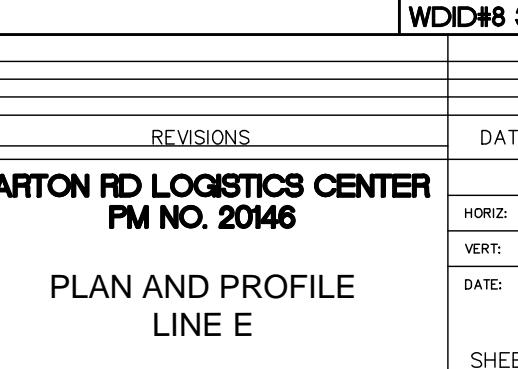
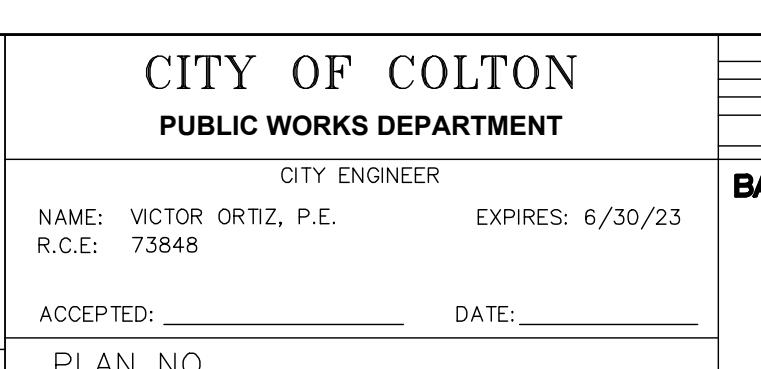
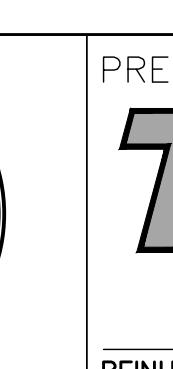
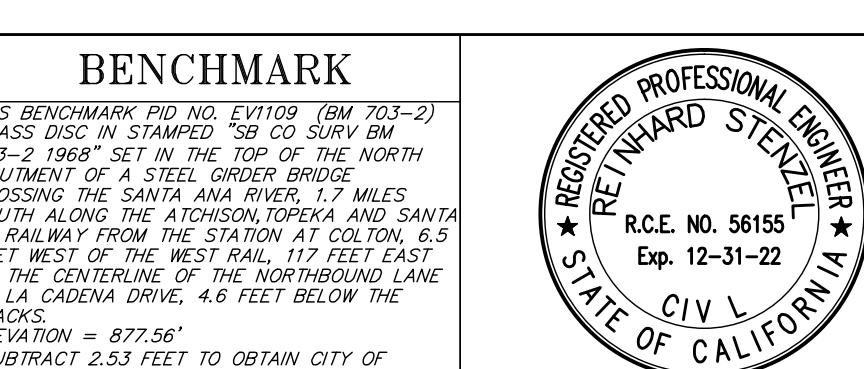
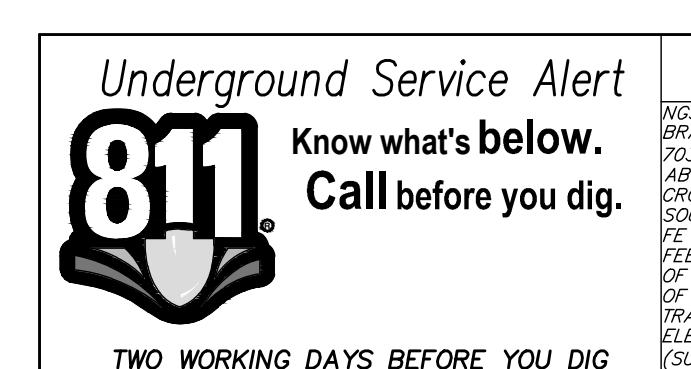
*CONTRACTOR TO VERIFY LOCATION AND INVERT ELEVATIONS OF EXISTING UTILITIES AND DRAINAGE SYSTEMS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO ANY CONSTRUCTION.

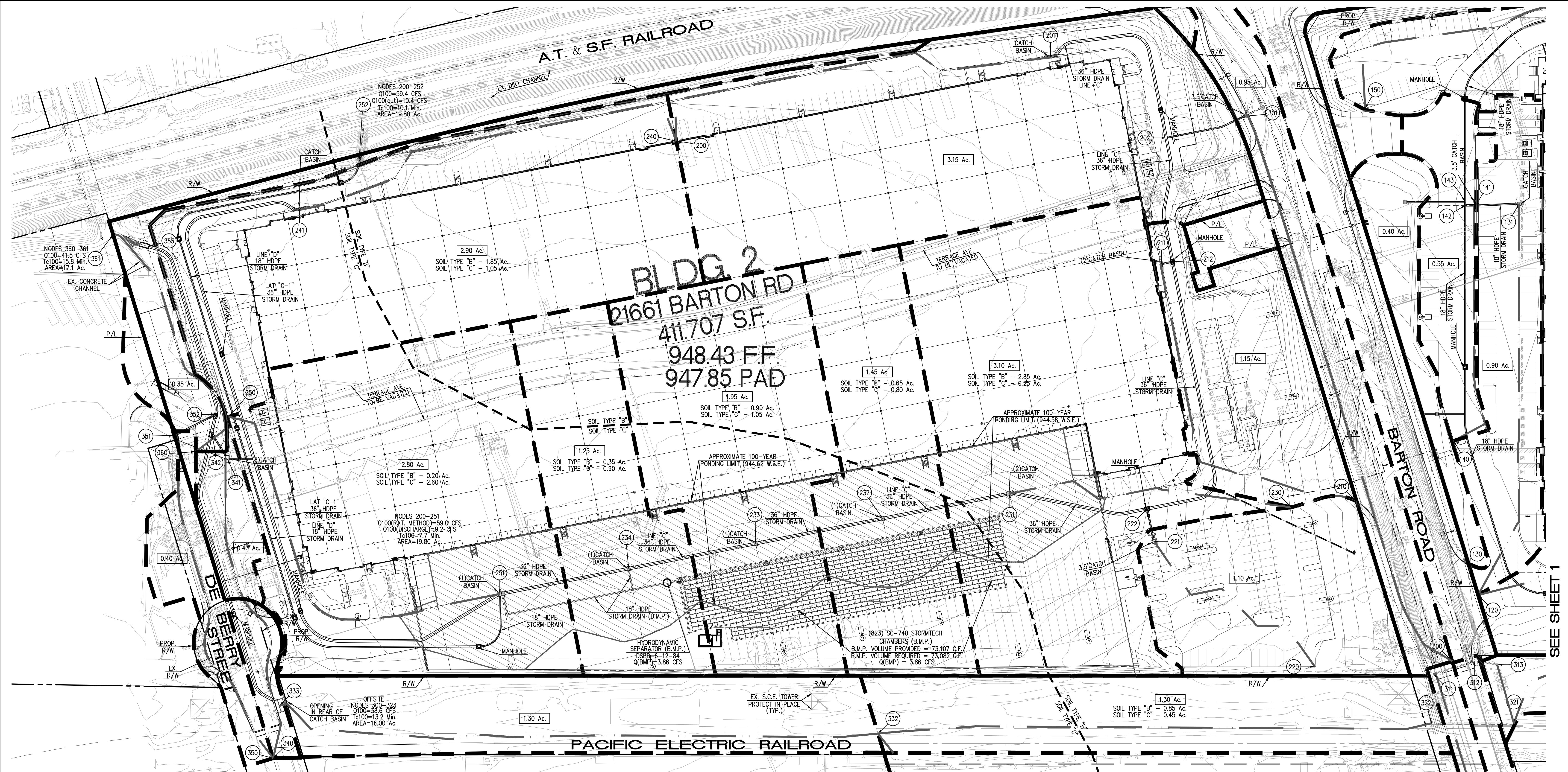


STORM DRAIN CONSTRUCTION NOTES

- ① CONSTRUCT CONCRETE HEADWALL AND WINGWALL, DETAILS ON SHEET 3.
- ② CONSTRUCT 24" MIN. THICK GROUTED RIPRAP, DETAILS ON SHEET 3.
- ③ CONSTRUCT MANHOLE PIPE TO PIPE PER S.P.P.W.C. STD PLAN NO. 321-2, DETAILS ON SHEET 3.
- ④ CONSTRUCT 18" R.C.P. D-2000 WITH WATER TIGHT JOINTS, BACKFILL PER CITY OF COLTON SPECIFICATIONS.
- ⑤ CONSTRUCT 36" R.C.P. D-2000 WITH WATER TIGHT JOINTS, BACKFILL PER CITY OF COLTON SPECIFICATIONS.
- ⑥ CONSTRUCT CATCH BASIN STENCIL, DETAIL ON SHEET 6.
- ⑦ CONSTRUCT CURB OPENING CATCH BASIN PER SPPWC 300-3, "V" AND "W" PER PLAN PER DETAIL ON SHEET 4.
- ⑧ CONSTRUCT LOCAL DEPRESSION AT CATCH BASIN PER S.P.P.W.C. STD PLAN NO. 313-3 CASE E, DETAILS ON SHEET 4.
- ⑨ CONSTRUCT MONOLITHIC CATCH BASIN CONNECTION PER SPPWC 308-2, DETAILS ON SHEET 4.
- ⑩ CONSTRUCT CONCRETE COLLAR PER SPPWC 380-4, DETAILS ON SHEET 4.
- ⑪ CONSTRUCT JUNCTION STRUCTURE PER SPPWC STD. 331-3, SEE DETAILS ON SHEET 5.
- ⑫ CONSTRUCT STORM DRAIN MANHOLE PER SPPWC STD. 322-2, DETAILS ON SHEET 5.
- ⑬ CONSTRUCT 8" HDPE N-12 PIPE.
- ⑭ CONSTRUCT MODIFIED CURB OPENING CATCH BASIN PER SPPWC 300-3, "V" AND "W" PER PLAN PER DETAIL ON SHEET 5.
- ⑮ CONSTRUCT CONNECTOR PIPE SCREEN, DETAILS ON SHEETS 6 AND 7.
- ⑯ CONSTRUCT MANHOLE PIPE TO PIPE PER S.P.P.W.C. STD PLAN NO. 320-2, DETAILS ON SHEET 6.
- ⑰ CONNECT NEW PIPE TO ON SITE 2-CATCH BASIN.
- ⑱ CONSTRUCT BIO CLEAN DVERT SYSTEM, DETAIL ON SHEET 6

REFERENCE PLAN FROM CITY OF COLTON APPROVED HYDROLOGY REPORT DATED 07/28/2022





HYDROLOGIC SUMMARY TABLE				
NODE NUMBER	AREA	Tc	Q100 (R.M.)	Q100 (OUT)
155	19.50 AC.	11.6 MIN.	64.3 CFS	18.2 CFS
172	5.80 AC.	8.3 MIN.	20.7 CFS	6.8 CFS
252	19.80 AC.	10.1 MIN.	59.4 CFS	10.4 CFS
361	17.10 AC.	15.8 MIN.	41.5 CFS	41.5 CFS

PREPARED FOR:

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FAX: (949) 253-7921



Designed by	Approved by
Date	Date
Checked by	
Date	
Designed by	
Date	
Checked by	
Date	

Public Works Director R.C.E. XXXXX

Sheet 2 of 2 Sheets

