FIR Wilson
TPM XXXXX, DPR PXX-XXXXX
City of Perris, Riverside County, California

Preliminary Drainage Study

Prepared for:
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Original Date Prepared: April 2019
Revision Date(s):

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Senior Engineer

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SECTION 1 - SUMMARY

PURPOSE

The purpose of this report is to document the hydrologic and hydraulic analyses performed in support of the First Industrial Realty Trust (FIR) Wilson project located in the City of Perris, County of Riverside, California. The project site is located south of Rider Street, north of Placentia Avenue and situated between Wilson Avenue and the Perris Valley Storm Drain Channel. The project proposes to build a commercial/industrial building on approximately 13.7 net acres. This report will summarize the hydrologic and hydraulic analyses that were conducted in order to determine the necessary drainage improvements required to provide flood protection for the proposed building and safely convey the runoff through the site.

The scope of this report will include the following:

- Determine the peak 100-year and 10-year flow rates for the developed condition using the Riverside County Flood Control and Water Conservation District (RCFC&WCD) Rational Method.
- Determine the required storm drain facilities, alignment, and sizes required to flood protect the project site.
- Determine the necessary basin area and media depth required for water quality treatment
- Preparation of a preliminary report summarizing the hydrology and hydraulic results.

DESCRIPTION OF WATERSHED

As previously described, the project is proposing a commercial/industrial building (approximately 297,020 square feet) on approximately 13.7 net acres of vacant land. Existing elevations across the site vary from 1441 at the northwest corner to 1438 at the southeast corner (NAVD 88). The site currently slopes down at an approximate 0.2% grade to the southeast. The existing drainage pattern for the site and the general area is characterized by sheet flows that follow the slope to the southeast. The runoff in discharges into the Perris Valley Storm Drain Channel which drains into the San Jacinto River before finally reaching Canyon Lake and Lake Elsinore.

The project is located within the Perris Valley Commerce Center (PVCC) specific plan and is also within the Perris Valley Master Drainage Plan (PVMDP) adopted July 1987 and revised June 1991. This project is tabled to discharge into MDP Line A-C, which does not currently exist. However, WEBB believes that construction of this MDP facility is not the burden of this development. The alignment of Line A-C crosses Wilson Avenue at an existing low point via a cross gutter roughly 200’ south of the project’s southerly property line, not through the project site. In addition, the proposed RCTC Mid County Parkway (MCP) – currently in the early stages of design - runs directly through the Line A-C alignment and surrounding surface draining tributary areas (see Appendix C). The MCP will change these areas and drainage paths, so the mitigation of these impacts – including Line A-C dissolution - is the burden of the MCP project. Accordingly, WEBB proposes to connect this development directly to the Perris Valley Storm Drain Channel from the southeasterly basin.

PROPOSED CONDITIONS

The proposed project will only generate on-site flows. This runoff will surface flow through the site utilizing curb and gutter and will require minimal subsurface storm drain. All on-site flow will discharge into a proposed bio-retention basin which will treat the water quality volume and bypass higher degree volumes. Mitigation for HCOC is not required; the project will connect directly to the adjacent Perris Valley Storm Drain Channel.

Since the project is HCOC exempt, a comparison analysis between existing and proposed drainage conditions will not be required. Only analyses demonstrating how proposed designs will flood protect the proposed site are necessary.

The project proposes two main on-site drainage paths. The southern and western portions of the site will surface flow only to the eastern screen wall in the truck court, and runoff will outfall into the proposed bio-retention basin via a wall cut and U-channel. The northern and eastern portions will surface flow into inlets, and a proposed subsurface storm drain will convey the runoff into the proposed bio-retention basin. See the Rational Method Map in Appendix A.

The project proposes two main on-site drainage paths. The southern and western portions of the site will surface flow only to the eastern screen wall in the truck court, and runoff will outfall into the proposed bio-retention basin via a wall cut and U-channel. The northern and eastern portions will surface flow into inlets, and a proposed subsurface storm drain will convey the runoff into the proposed bio-retention basin. See the Rational Method Map in Appendix A.

This project will not be subject to off-site run-on. All adjacent vacant properties currently and will continue to sheet flow into the Perris Valley Storm Drain Channel. In addition, Wilson Avenue already safely conveys road runoff via existing curb and gutter. Street improvements will not be considered since Wilson Avenue is already constructed to its ultimate width. Therefore, no analyses need to be done for off-site flows.

METHODOLOGY

HYDROLOGY

Hydrologic calculations were performed in accordance with the RCFC&WCD Hydrology Manual, dated April 1978. The Rational Method was utilized in determining peak flow rates.

The hydrological parameters, including rainfall values and soil types were derived from the RCFC&WCD Hydrology Manual. The isohyetal maps and soil map have been included in Section 2.

Rational Method calculations were performed using a computer program developed by CivilDesign Corporation and Joseph E. Bonadiman and Associates Inc. The computer program is commonly referred to as CivilD which incorporates the hydrological parameters outlined in the RCFC&WCD Hydrology Manual.

The Rational Method was used to determine the peak flow rates to size and design the drainage facilities need to convey onsite flows through the site to the proposed basin. The flow rates were computed by generating a hydrologic "link-node" model in which the overall area is divided into separate drainage sub-areas, each tributary to a concentration point (node) determined by the proposed layout and grading.

The Unit Hydrograph Method will not be utilized since there is no need to compare existing and proposed conditions due to the HCOC exemption for this project.

HYDRAULICS

Water quality basin calculations were performed using spreadsheets that were created by RCFC&WCD. Preliminary calculations and additional details can be found in the Preliminary-WQMP.

Basin routing will not be utilized since there is no need to show flow mitigation and volume containment due to the HCOC exemption for this project.

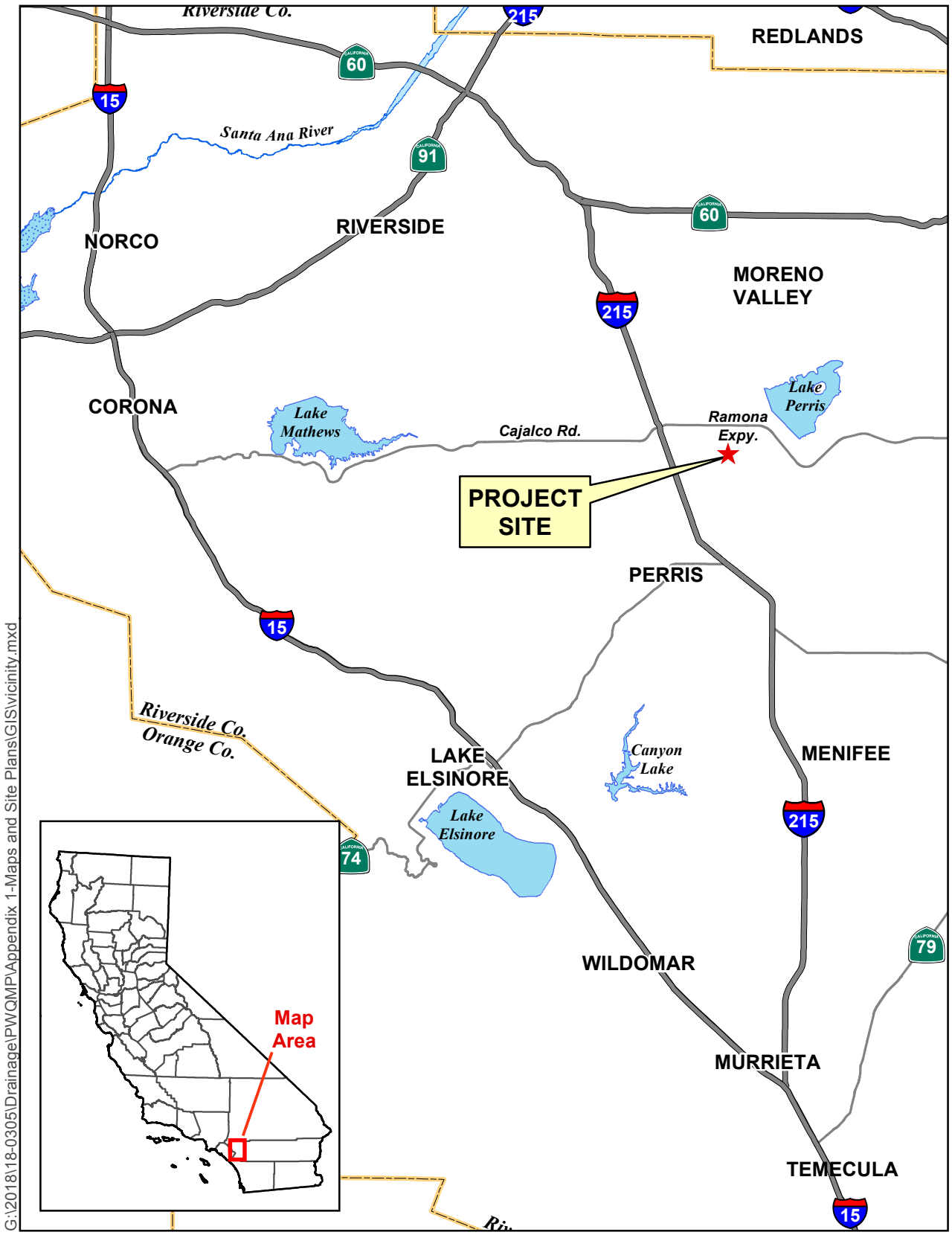
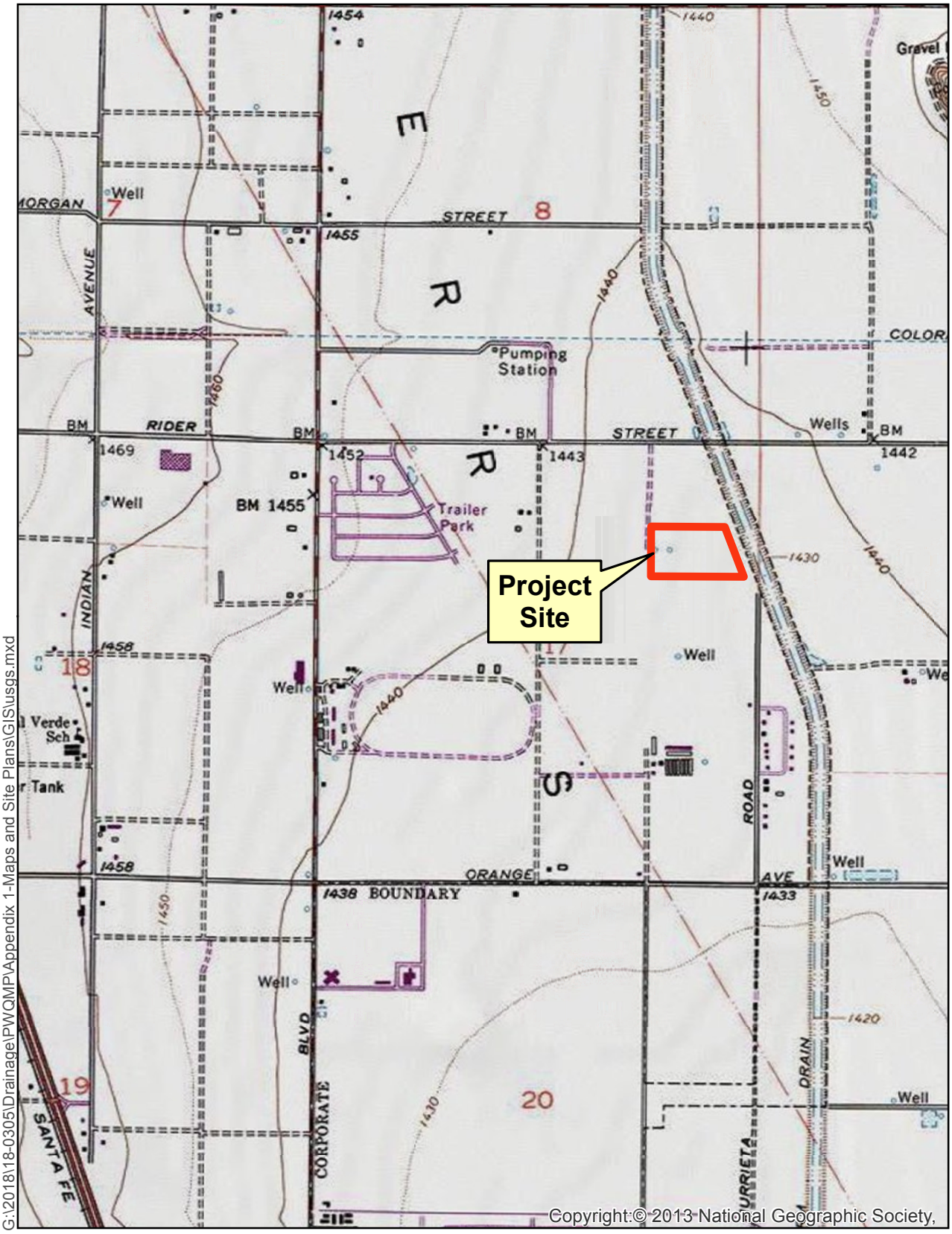


Figure 1. Vicinity Map

0 2.5 5 Miles



G:\2018\18-0305\Drainage\PWQMP\Appendix 1-Maps and Site Plans\GIS\usgs.mxd

Sources: ESRI / USGS 7.5min Quad
DRGs: PERRIS

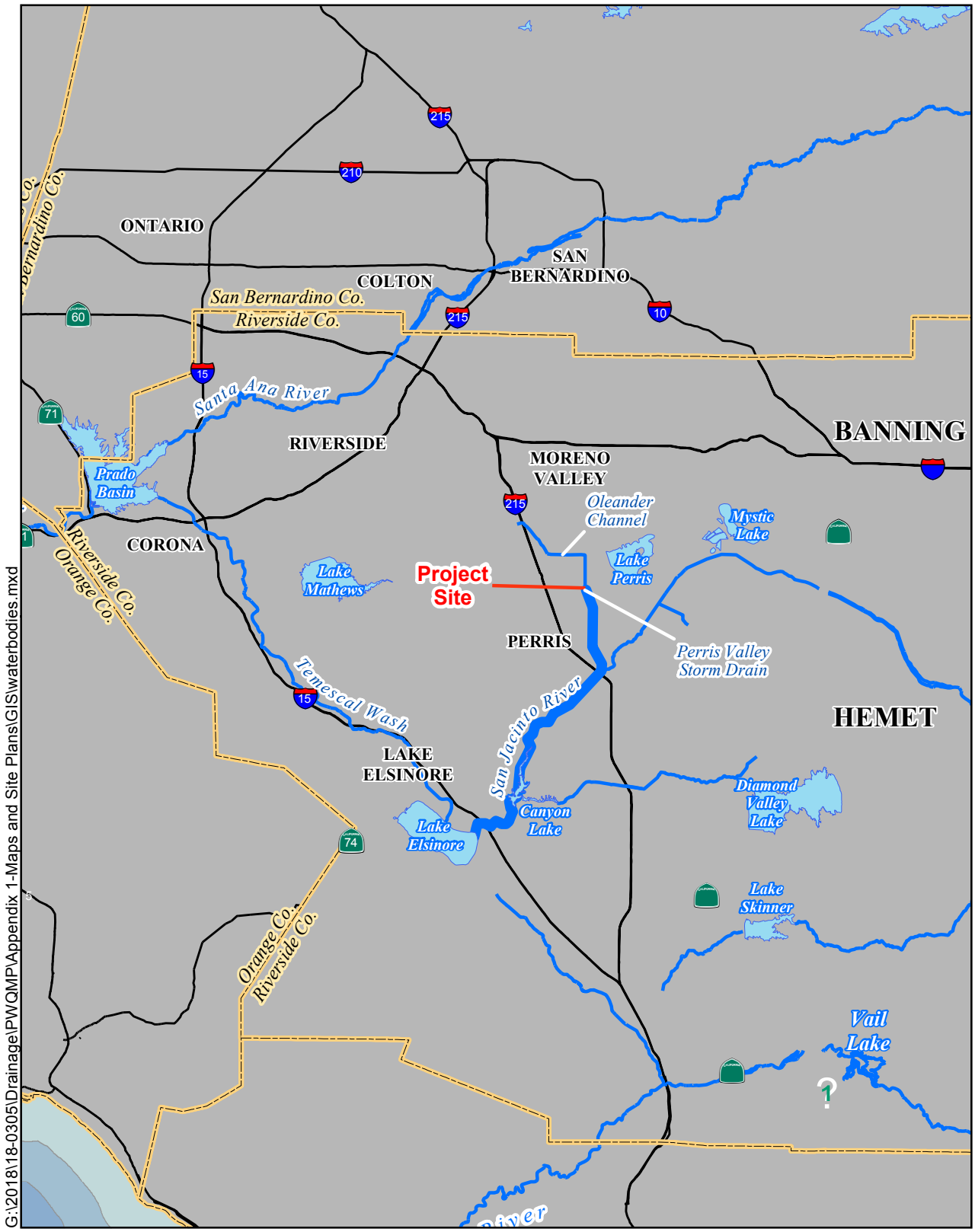
Figure 2. USGS Topography Map

0 1,000 2,000 Feet

Sources: County of Riverside GIS, 2013; Eagle Aerial, April 2012.

Figure 3. Aerial Photograph

0 400 800 Feet



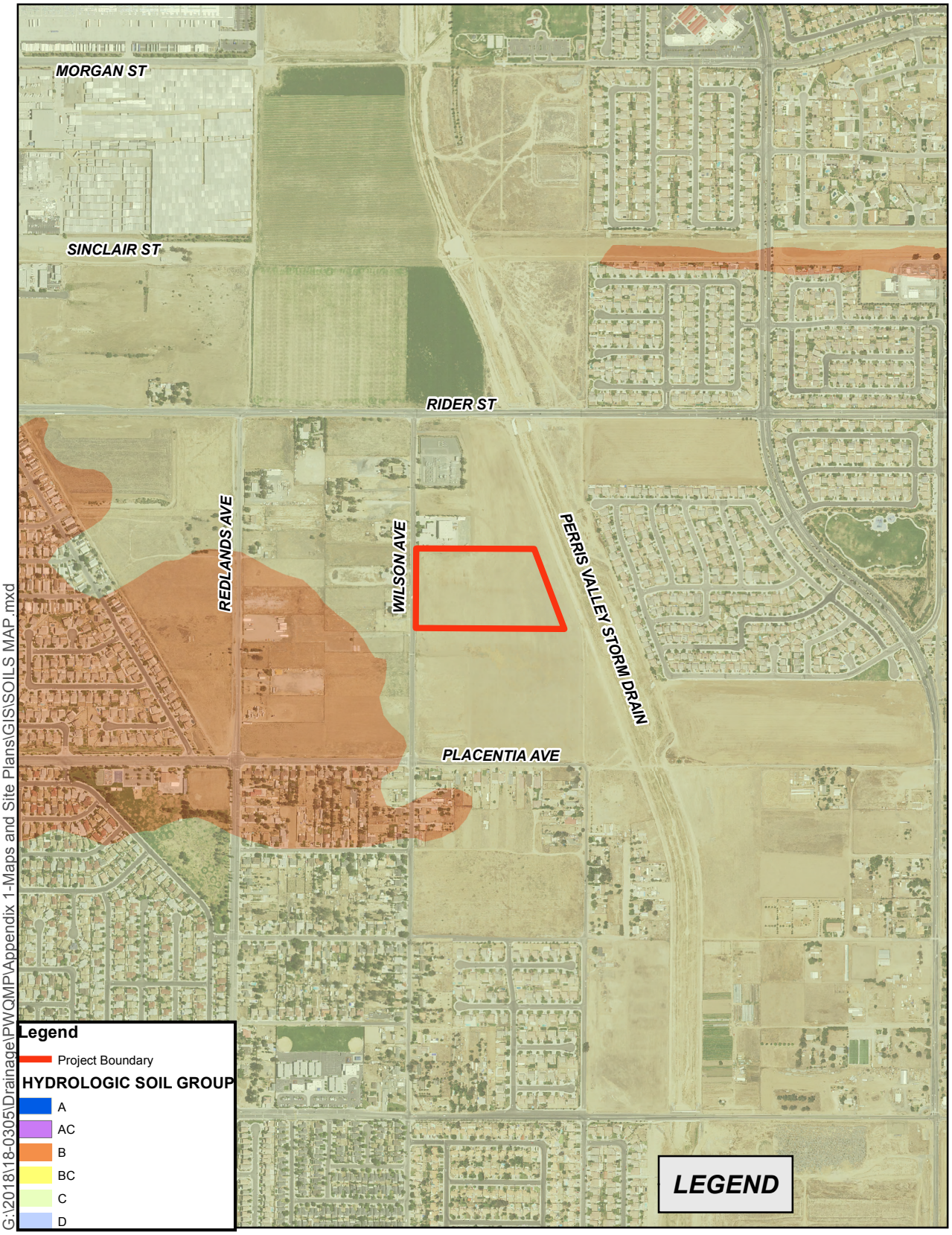
G:\2018\18-0305\Drainage\PWQMP\Appendix 1-Maps and Site Plans\GIS\waterbodies.mxd

Sources: USGS 30 Meter DEM;
USGS Digital Line Graph

Figure 4. Receiving Waterbodies

0 2 4 6
Miles

Flowpath



Eagle Aerial, April 2010;
Riverside County GIS, 2012
RCFC&WCD Hydology Manual Plate C-1.30

N
W E
S

0 500 1,000
Feet

Figure 5. Soils Map

SECTION 2 - HYDROLOGY ANALYSIS

HYDROLOGY PARAMETERS

The RCFC&WCD Hydrology Manual was used to determine several of the hydrological parameters. The following rainfall depths were utilized in the hydrology analyses, which were obtained from the isohyetal maps provided in the RCFC&WCD Hydrology Manual:

Table 1 – Precipitation Values

	Duration
Storm Event	1-Hour (inches)
2-Year	0.45
100-Year	1.21

The value for slope of intensity was determined to be 0.49. The isohyetal maps have been included in Appendix A.

Based on the Plate C-1.30 (Perris) in the RCFC&WCD Hydrology Manual, the project site is classified as soil type C. The soils map is included in Appendix A.

The cover type was determined based on the existing land cover and proposed land use of the site. Hydrological computations for the existing condition were done using 'Undeveloped – Poor Cover'. The commercial landscaping cover type was used to represent the developed condition. Table 2 below summarizes the runoff index values and the recommended values for percentage of impervious cover for each category:

Table 2 – Cover Type

Cover Type	Soil Group A	Soil Group B	Soil Group C	Soil Group D	Percentage of Impervious Cover
Undeveloped Poor Cover	67	78	86	89	0%
Commercial Landscaping	32	56	69	75	90%

ON-SITE RATIONAL METHOD HYDROLOGY

The rational method was used to determine peak flow rates in order to adequately size the proposed subsurface storm drains and associated inlets used to convey on-site flows to the proposed basin. The project site was separated into five sub areas.

Areas A-1 and A-2 account for the southern and western portions of the site. They produce a 100-year peak flowrate of 18.1 cfs. This runoff will surface flow only and discharge into the proposed bio-retention basin via a wall opening and U-channel.

Areas A-3 and A-4 account for the northern and eastern portions of the site. They produce a 100-year peak flowrate of 10.2 cfs. This runoff will surface flow into inlets and be conveyed to the proposed basin via subsurface storm pipe.

Area A-5 is the area including the proposed basin. This area is self-draining.

The following table summarizes the rational method results at key points:

Table 3 – Rational Method Results

Point of Interest	10-Year Peak Flow Rate (cfs)	100-Year Peak Flow Rate (cfs)
Node 103 – Flow from A-1 and A-2	11.3	18.1
Node 203 – Flow from A-3 and A-4	6.4	10.2
Node 104 – Total Flow	18.1	29.1

The rational method output files and hydrology map have been included in Appendix A.

SECTION 3 - HYDRAULIC ANALYSIS

ON-SITE STORM DRAIN FACILITIES

The project proposes one subsurface storm drain (Line-A) and will utilize curb and gutter, curb cuts, and u-channels to convey on-site flows to the proposed bio-retention basin. From the basin, the runoff will discharge into Outlet Structure A. The runoff from Outlet Structure A discharges into the Perris Valley Storm Drain Channel via proposed Line-B

A brief summary of each system has been provided and the results of the hydraulic analyses are included in Appendix B. The peak flow rates determined from the 100-year rational method on-site hydrology analysis were utilized to evaluate the proposed storm drain systems.

Outlet Structure A

The outlet structure was sized using the peak 100-year flow rate of 29.1 cfs. A weir calculation was employed to size the Basin-A outlet. A grated inlet with 4 grates is proposed to handle the 100-year overflow. Based on a peak flow rate of 29.1 cfs, a total of 0.6-feet of head is required to bypass the 100-year flow rate resulting in a water surface elevation of 1434.0 feet. The calculation has been included in Appendix B.

Line-A (On-site)

The northern and eastern portion of the project site will surface flow to one low point within each portion and be collected by Line-A. Line-A proposes to convey the 100-year peak flow rate from Rational Method areas A-3 and A-4 (10.2 cfs) to Basin-A. A normal depth calculation was used to determine the appropriate size for Line-A with a flowrate of 10.2 cfs; this diameter was determined to be 24-inches. A hydraulic model for Line-A will be provided during final engineering to further assess the storm drain design.

Line-B (Channel Connection)

Line-B will convey the entire runoff generated from the site into the Perris Valley Storm Drain Channel. A normal depth calculation was used with the 100-year peak flow rate (29.1 cfs) produced from the entire site to determine the appropriate size for Line-B. It was determined that a 36-inch RCP will safely convey runoff to the Channel. A hydraulic model for Line-B will be provided during final engineering to further assess the storm drain design.

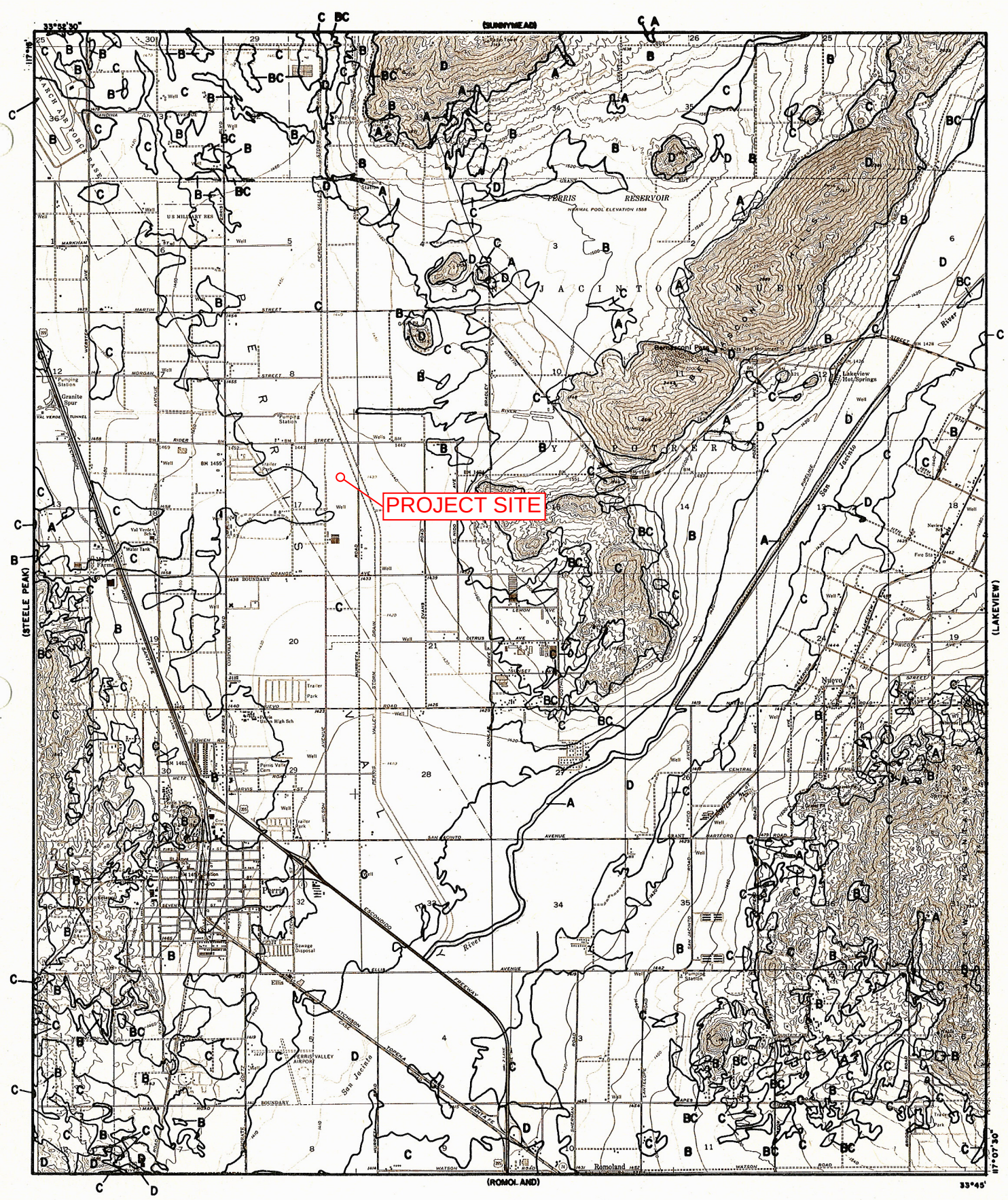
SECTION 4 - CONCLUSION

Based on the analyses and results of this report, the following conclusions were derived from the hydrology and hydraulic results:

- The proposed drainage improvements will adequately convey flows to the basin and provide flood protection for the 100-year storm event.
- The proposed basin will provide adequate water quality treatment.
- The proposed project will not impact flooding condition to upstream or downstream properties.

APPENDIX A – HYDROLOGY

HYDROLOGIC SOILS GROUP MAP (PLATE C-1.30)



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC&WCD

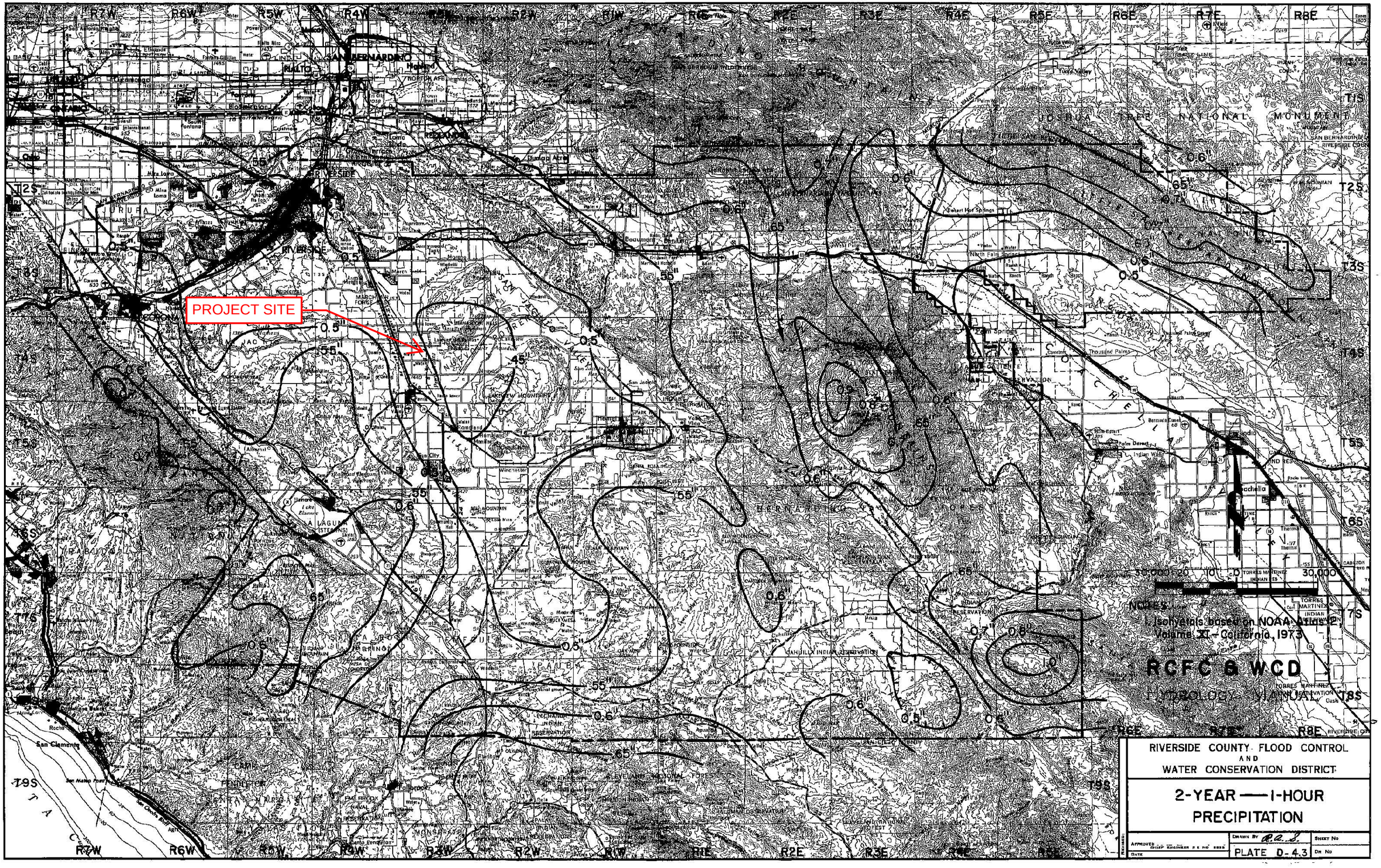
HYDROLOGY MANUAL

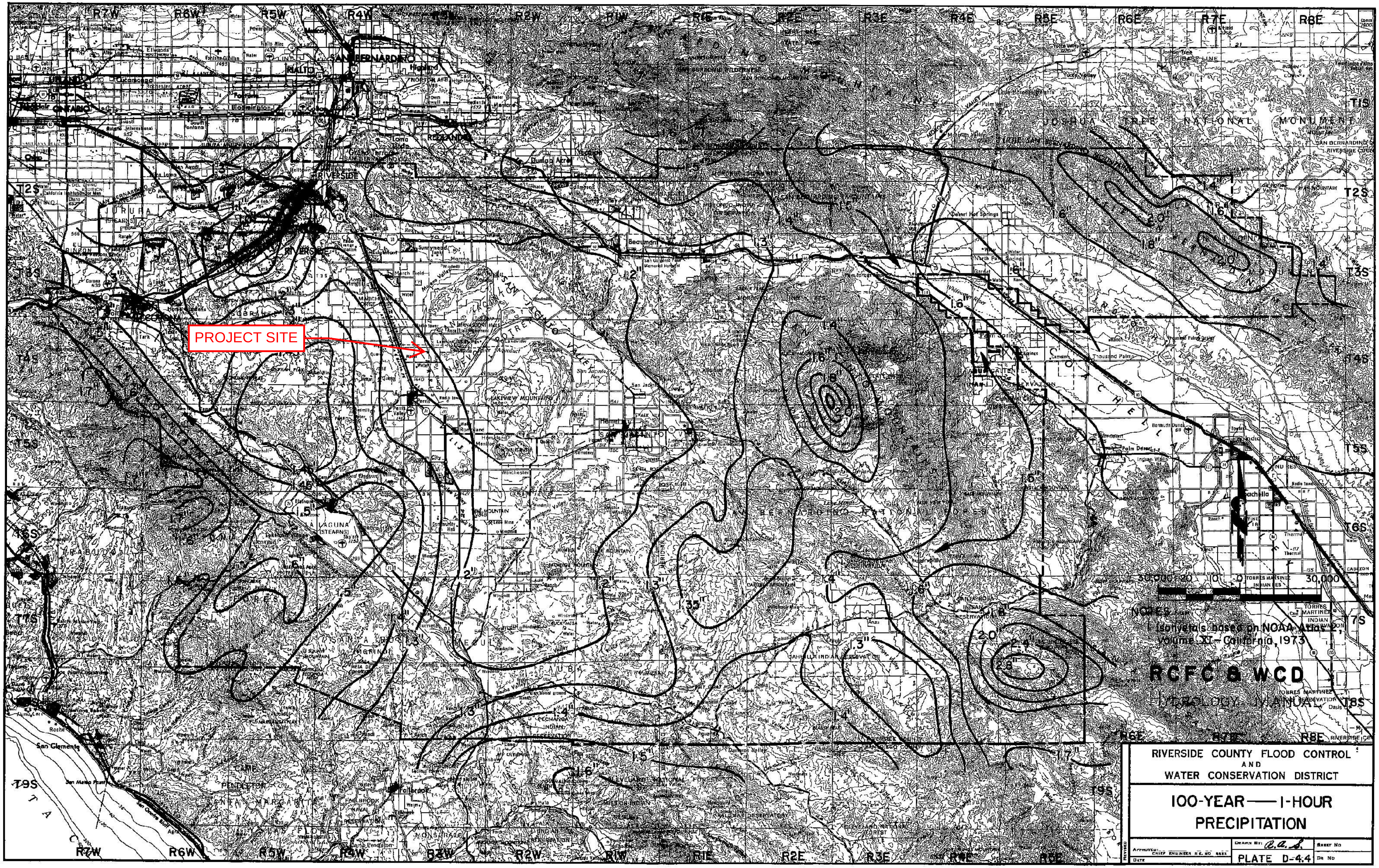
0 FEET 5000

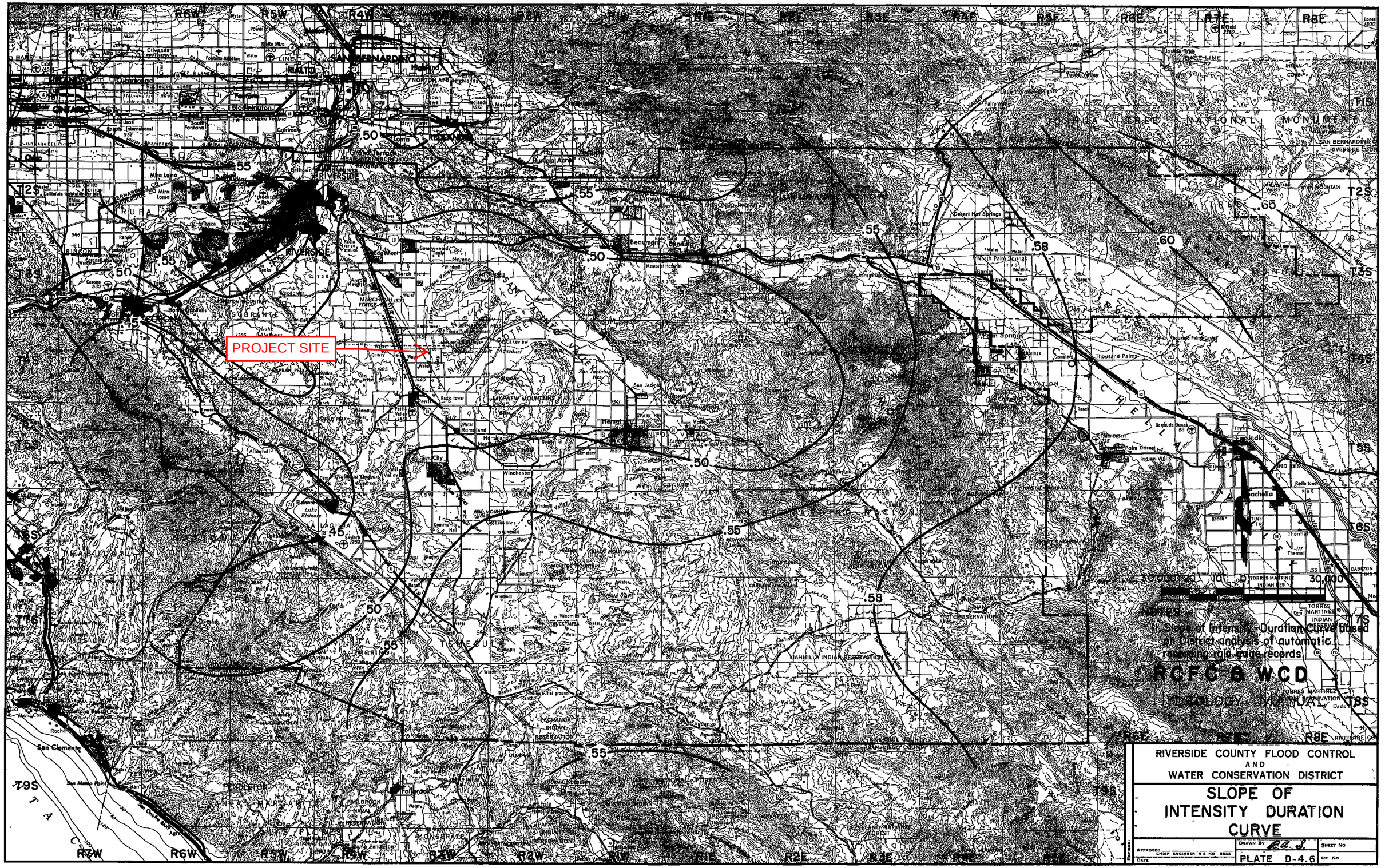
HYDROLOGIC SOILS GROUP MAP FOR PERRIS

PLATE C-1.30

ISOHYETAL MAPS


PROJECT SITE
NOTES
1. Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
2-YEAR — 1-HOUR PRECIPITATION
DRAWN BY R.A.S.
PLATE D-4.3
SHEET NO
DR NO


PROJECT SITE
RIVERSIDE
SAN BERNARDINO
JOSHUA TREE NATIONAL MONUMENT
NOTES:
Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
100-YEAR —— 1-HOUR
PRECIPITATION
PLATE D-4.4



1. Slope of Intensity-Duration Curve based on District analysis of automatic recording rain gage records

RCFC & WCD

1982 DCM MANUAL

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

SLOPE OF INTENSITY DURATION CURVE

APPROVED CHIEF ENGINEER R.E. NO. 8824	DRAWN BY R.A.S.	SHEET NO
DATE	PLATE D-4.6	DR NO

10-YEAR ONSITE HYDROLOGY (RATIONAL METHOD)

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 04/16/19 File:PROP10.out

18-0305 - FIR WILSON
ONSITE RATIONAL METHOD HYDROLOGY
10 YEAR STORM EVENT
FN: PROP10.OUT TSW

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

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation = 0.450(In.)
100 year, 1 hour precipitation = 1.210(In.)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.763(In/Hr)
Slope of intensity duration curve = 0.4900

++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 1440.700(Ft.)
Bottom (of initial area) elevation = 1435.000(Ft.)
Difference in elevation = 5.700(Ft.)
Slope = 0.00570 s(percent)= 0.57
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 13.364 min.
Rainfall intensity = 1.592(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 6.828(CFS)
Total initial stream area = 4.900(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 102.000 to Point/Station 103.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1435.000(Ft.)
Downstream point elevation = 1433.900(Ft.)
Channel length thru subarea = 313.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 40.000
Slope or 'Z' of right channel bank = 100.000
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 6.828(CFS)
Depth of flow = 0.256(Ft.), Average velocity = 1.491(Ft/s)
Channel flow top width = 35.813(Ft.)

```
Flow Velocity =    1.49(Ft/s)
Travel time  =    3.50 min.
Time of concentration =   16.86 min.

Sub-Channel No. 1 Critical depth =      0.227(Ft.)
  '     '       '     Critical flow top width =     31.719(Ft.)
  '     '       '     Critical flow velocity=    1.900(Ft/s)
  '     '       '     Critical flow area =      3.593(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    16.86 min.
Rainfall intensity =      1.420(In/Hr) for a    10.0 year storm
Subarea runoff =      4.466(CFS) for      3.600(Ac.)
Total runoff =     11.294(CFS)  Total area =       8.500(Ac.)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Process from Point/Station      103.000 to Point/Station      104.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =  1433.900(Ft.)
Downstream point elevation =  1432.900(Ft.)
Channel length thru subarea  =    21.000(Ft.)
Channel base width      =    8.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.670(Ft.)
Flow(q) thru subarea =     11.294(CFS)
Depth of flow =   0.198(Ft.), Average velocity =   7.118(Ft/s)
Channel flow top width =    8.000(Ft.)
Flow Velocity =    7.12(Ft/s)
Travel time  =    0.05 min.
Time of concentration =   16.91 min.

Sub-Channel No. 1 Critical depth =      0.395(Ft.)
  '     '       '     Critical flow top width =      8.000(Ft.)
  '     '       '     Critical flow velocity=    3.578(Ft/s)
  '     '       '     Critical flow area =      3.156(Sq.Ft)



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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      8.500(Ac.)
Runoff from this stream =     11.294(CFS)
Time of concentration =   16.91 min.
Rainfall intensity =     1.418(In/Hr)


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Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   830.000(Ft.)
Top (of initial area) elevation =  1442.000(Ft.)
Bottom (of initial area) elevation =  1437.900(Ft.)
Difference in elevation =     4.100(Ft.)
Slope =    0.00494  s(percent)=       0.49
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.765 min.
Rainfall intensity =      1.628(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
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Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      5.561(CFS)
Total initial stream area =        3.900(Ac.)
Pervious area fraction = 0.100


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Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1434.900(Ft.)
Downstream point/station elevation =  1433.200(Ft.)
Pipe length  =   426.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     5.561(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     5.561(CFS)
Normal flow depth in pipe =   11.88(In.)
Flow top width inside pipe =   17.05(In.)
Critical Depth =   10.91(In.)
Pipe flow velocity =      4.49(Ft/s)
Travel time through pipe =    1.58 min.
Time of concentration (TC) =    14.35 min.


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Process from Point/Station      203.000 to Point/Station      203.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    14.35 min.
Rainfall intensity =      1.538(In/Hr) for a    10.0 year storm
Subarea runoff =      0.807(CFS) for      0.600(Ac.)
Total runoff =      6.368(CFS)  Total area =       4.500(Ac.)


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Process from Point/Station      203.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1433.200(Ft.)
Downstream point/station elevation =  1432.900(Ft.)
Pipe length  =    89.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     6.368(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.368(CFS)
Normal flow depth in pipe =   14.20(In.)
Flow top width inside pipe =   14.69(In.)
Critical Depth =   11.71(In.)
Pipe flow velocity =      4.26(Ft/s)
Travel time through pipe =    0.35 min.
Time of concentration (TC) =    14.69 min.


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.500(Ac.)
Runoff from this stream =      6.368(CFS)
Time of concentration =   14.69 min.
Rainfall intensity =     1.520(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)
```

```
1       11.294     16.91                 1.418
2        6.368     14.69                 1.520
Largest stream flow has longer time of concentration
Qp =     11.294 + sum of
          Qb         Ia/Ib
           6.368 *    0.933 =      5.944
Qp =     17.238

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.294        6.368
Area of streams before confluence:
       8.500        4.500
Results of confluence:
Total flow rate =     17.238(CFS)
Time of concentration =    16.913 min.
Effective stream area after confluence =     13.000(Ac.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    16.91 min.
Rainfall intensity =      1.418(In/Hr) for a    10.0 year storm
Subarea runoff =      0.867(CFS) for      0.700(Ac.)
Total runoff =     18.105(CFS)  Total area =      13.700(Ac.)
End of computations, total study area =           13.70 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  69.0
```

100-YEAR ONSITE HYDROLOGY (RATIONAL METHOD)

Riverside County Rational Hydrology Program

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CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 04/16/19  File:PROP100.out
------------------------------------------------------------------------
18-0305 - FIR WILSON
ONSITE RATIONAL METHOD HYDROLOGY
100 YEAR STORM EVENT
FN: PROP100.OUT TSW
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

------------------------------------------------------------------------


Program License Serial Number 4010

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.450(In.)
100 year, 1 hour precipitation =  1.210(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.210(In/Hr)
Slope of intensity duration curve = 0.4900




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  1440.700(Ft.)
Bottom (of initial area) elevation =  1435.000(Ft.)
Difference in elevation =     5.700(Ft.)
Slope =    0.00570  s(percent)=       0.57
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.364 min.
Rainfall intensity =      2.526(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =     10.924(CFS)
Total initial stream area =        4.900(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =  1435.000(Ft.)
Downstream point elevation =  1433.900(Ft.)
Channel length thru subarea  =   313.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  40.000
Slope or 'Z' of right channel bank = 100.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     10.924(CFS)
Depth of flow =   0.305(Ft.), Average velocity =   1.677(Ft/s)
Channel flow top width =   42.714(Ft.)
```

```
Flow Velocity =    1.68(Ft/s)
Travel time  =    3.11 min.
Time of concentration =   16.48 min.

Sub-Channel No. 1 Critical depth =      0.273(Ft.)
  '     '       '     Critical flow top width =     38.281(Ft.)
  '     '       '     Critical flow velocity=    2.087(Ft/s)
  '     '       '     Critical flow area =      5.234(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
COMMERCIAL subarea type
Runoff Coefficient = 0.881
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    16.48 min.
Rainfall intensity =      2.279(In/Hr) for a   100.0 year storm
Subarea runoff =      7.232(CFS) for      3.600(Ac.)
Total runoff =     18.156(CFS)  Total area =       8.500(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =  1433.900(Ft.)
Downstream point elevation =  1432.900(Ft.)
Channel length thru subarea  =    21.000(Ft.)
Channel base width      =    8.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.670(Ft.)
Flow(q) thru subarea =     18.156(CFS)
Depth of flow =   0.265(Ft.), Average velocity =   8.553(Ft/s)
Channel flow top width =    8.000(Ft.)
Flow Velocity =    8.55(Ft/s)
Travel time  =    0.04 min.
Time of concentration =   16.52 min.

Sub-Channel No. 1 Critical depth =      0.543(Ft.)
  '     '       '     Critical flow top width =      8.000(Ft.)
  '     '       '     Critical flow velocity=    4.180(Ft/s)
  '     '       '     Critical flow area =      4.344(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      8.500(Ac.)
Runoff from this stream =     18.156(CFS)
Time of concentration =   16.52 min.
Rainfall intensity =     2.277(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   830.000(Ft.)
Top (of initial area) elevation =  1442.000(Ft.)
Bottom (of initial area) elevation =  1437.900(Ft.)
Difference in elevation =     4.100(Ft.)
Slope =    0.00494  s(percent)=       0.49
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.765 min.
Rainfall intensity =      2.583(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
```

```
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      8.896(CFS)
Total initial stream area =        3.900(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1434.900(Ft.)
Downstream point/station elevation =  1433.200(Ft.)
Pipe length  =   426.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     8.896(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     8.896(CFS)
Normal flow depth in pipe =   14.48(In.)
Flow top width inside pipe =   19.43(In.)
Critical Depth =   13.31(In.)
Pipe flow velocity =      5.03(Ft/s)
Travel time through pipe =    1.41 min.
Time of concentration (TC) =    14.18 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    14.18 min.
Rainfall intensity =      2.454(In/Hr) for a   100.0 year storm
Subarea runoff =      1.299(CFS) for      0.600(Ac.)
Total runoff =     10.195(CFS)  Total area =       4.500(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1433.200(Ft.)
Downstream point/station elevation =  1432.900(Ft.)
Pipe length  =    89.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =    10.195(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    10.195(CFS)
Normal flow depth in pipe =   17.67(In.)
Flow top width inside pipe =   15.34(In.)
Critical Depth =   14.27(In.)
Pipe flow velocity =      4.72(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =    14.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.500(Ac.)
Runoff from this stream =     10.195(CFS)
Time of concentration =   14.49 min.
Rainfall intensity =     2.427(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)
```

```
1       18.156     16.52                 2.277
2       10.195     14.49                 2.427
Largest stream flow has longer time of concentration
Qp =     18.156 + sum of
          Qb          Ia/Ib
          10.195 *    0.938 =      9.561
Qp =     27.717

Total of 2 streams to confluence:
Flow rates before confluence point:
      18.156      10.195
Area of streams before confluence:
       8.500       4.500
Results of confluence:
Total flow rate =     27.717(CFS)
Time of concentration =    16.517 min.
Effective stream area after confluence =     13.000(Ac.)

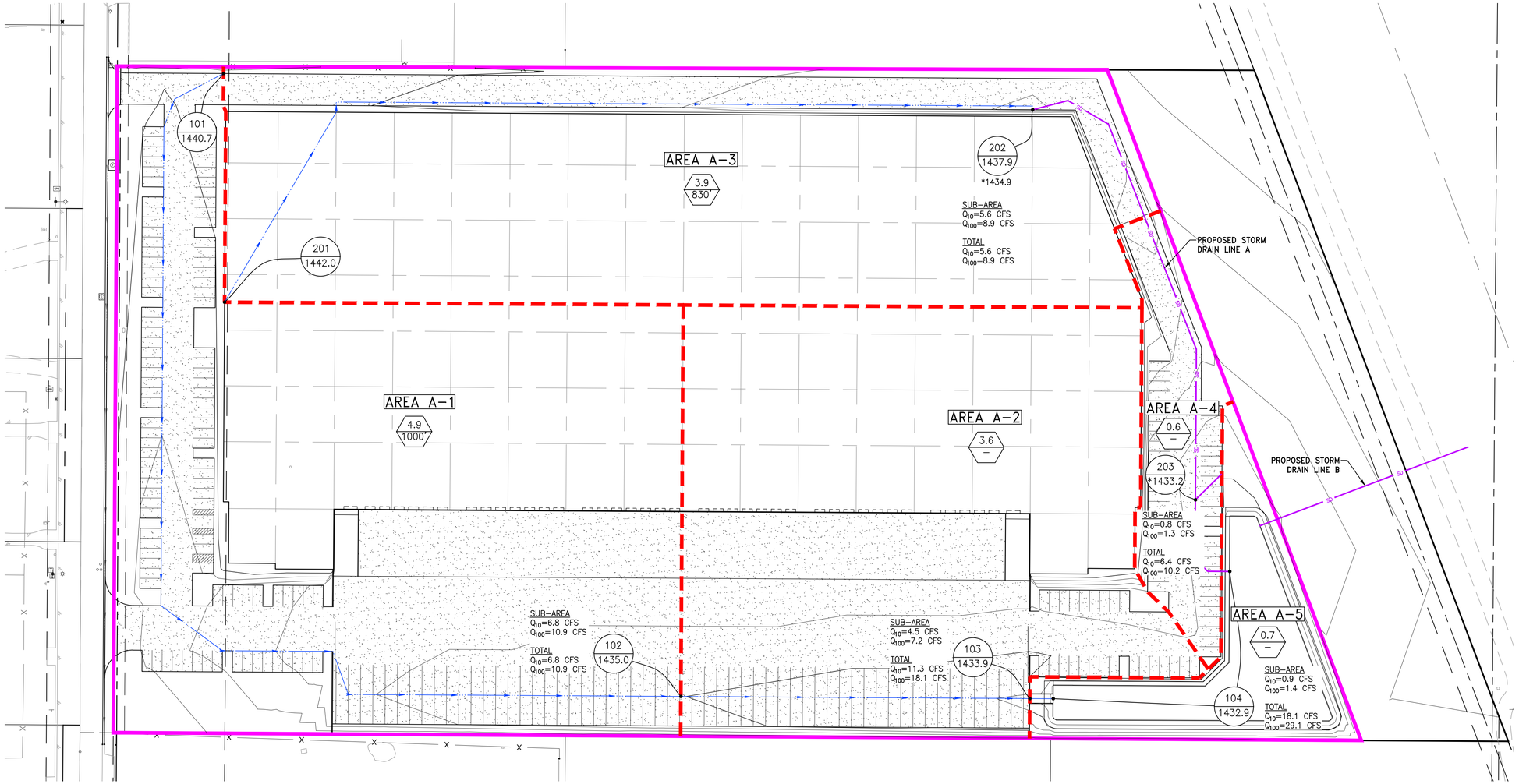

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Runoff Coefficient = 0.881
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    16.52 min.
Rainfall intensity =      2.277(In/Hr) for a   100.0 year storm
Subarea runoff =      1.404(CFS) for      0.700(Ac.)
Total runoff =     29.122(CFS)  Total area =      13.700(Ac.)
End of computations, total study area =           13.70 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

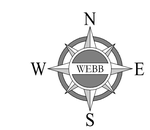
Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  69.0
```

RATIONAL METHOD HYDROLOGY MAP

LEGEND

- DRAINAGE MANAGEMENT BOUNDARY
- SUB-AREA
- FLOW DIRECTION
- 101 / 14xx — NODE DESIGNATION / NODE ELEVATION
- *14XX — *INVERT ELEVATION
- 5.0 / 1000' — WATERSHED AREA (ACRES) / LONGEST WATER PATH (FT)





1" = 50'

25 0 50 100 150

CITY OF PERRIS

RATIONAL METHOD HYDROLOGY MAP

FIR WILSON

PXX-XXXXX

SCALE:	1"=50'	ALBERT A. WEBB ASSOCIATES — ENGINEERING CONSULTANTS, 3788 McCRAY STREET, RIVERSIDE CA. 92506, PH. (951) 686-1070, FAX (951) 788-1256	W.O. 18-0305
DATE:	4/16/19		SHEET |
DESIGNED:	TSW		OF 1 SHEETS
CHECKED:	DJA		DWG. NO.
PLN CK REF:			
F.B.			

G:\2018\18-0305\DRAINAGE\PHYD\DWG FOLDER\18-0305-PHYD-RATIONAL.DWG 4/16/2019 5:25:30 PM

PLOT DATE

APPENDIX B – HYDRAULICS

INLET AND CATCH BASIN CALCULATIONS

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Tuesday, April 16, 2019

Project Units: U.S. Customary Units

Notes:

Curb and Gutter Analysis: Node 202

Notes:

Gutter Input Parameters

Longitudinal Slope of Road: 0.0040 ft/ft

Cross-Slope of Pavement: 0.0100 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 2.0000 ft

Width of Spread: 29.2482 ft

Gutter Result Parameters

Design Flow: 8.9000 cfs

Gutter Depression: 0.0000 in

Area of Flow: 4.2773 ft^2

Eo (Gutter Flow to Total Flow): 0.1723

Gutter Depth at Curb: 3.5098 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 10.0000 ft

Curb opening height: 6.0000 in

Local Depression: 1.0000 in

Inlet Result Parameters

Perimeter: 13.6000 ft

Effective Perimeter: 13.6000 ft

Area: 5.8333 ft^2

Effective Area: 5.8333 ft^2

Depth at curb face (upstream of local depression): 0.4326 ft

Computed Width of Spread at Sag: 43.2596 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: Node 203

Notes:

Gutter Input Parameters

Longitudinal Slope of Road: 0.0030 ft/ft

Cross-Slope of Pavement: 0.0230 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 2.0000 ft

Width of Spread: 8.9156 ft

Gutter Result Parameters

Design Flow: 1.3000 cfs

Gutter Depression: 0.0000 in

Area of Flow: 0.9141 ft^2

Eo (Gutter Flow to Total Flow): 0.4925

Gutter Depth at Curb: 2.4607 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 4.0000 ft

Curb opening height: 6.0000 in

Local Depression: 1.0000 in

Inlet Result Parameters

Perimeter: 7.6000 ft

Effective Perimeter: 7.6000 ft

Area: 2.3333 ft^2

Effective Area: 2.3333 ft^2

Depth at curb face (upstream of local depression): 0.1768 ft

Computed Width of Spread at Sag: 7.6891 ft

Flow type: Weir Flow

Efficiency: 1.0000

SUBSURFACE STORM DRAIN CALCULATIONS

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Tuesday, April 16, 2019

Project Units: U.S. Customary Units

Notes:

Channel Analysis: LineA

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0039 ft/ft

Manning's n: 0.0120

Flow: 10.2000 cfs

Result Parameters

Depth: 1.1937 ft

Area of Flow: 1.9557 ft^2

Wetted Perimeter: 3.5314 ft

Hydraulic Radius: 0.5538 ft

Average Velocity: 5.2155 ft/s

Top Width: 1.9621 ft

Froude Number: 0.9206

Critical Depth: 1.1436 ft

Critical Velocity: 5.4930 ft/s

Critical Slope: 0.0045 ft/ft

Critical Top Width: 1.98 ft

Calculated Max Shear Stress: 0.2905 lb/ft^2

Calculated Avg Shear Stress: 0.1348 lb/ft^2

Channel Analysis: LineB

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.0130

Flow: 29.1000 cfs

Result Parameters

Depth: 1.8316 ft

Area of Flow: 4.5210 ft^2

Wetted Perimeter: 5.3812 ft

Hydraulic Radius: 0.8402 ft

Average Velocity: 6.4366 ft/s

Top Width: 2.9258 ft

Froude Number: 0.9125

Critical Depth: 1.7461 ft

Critical Velocity: 6.8162 ft/s

Critical Slope: 0.0046 ft/ft

Critical Top Width: 2.96 ft

Calculated Max Shear Stress: 0.4572 lb/ft^2

Calculated Avg Shear Stress: 0.2097 lb/ft^2

OUTLET STRUCTURE A CALCULATION

Weir Inlet
Ponding Depth Calculation

ALBERT A WEBB ASSOCIATES
ENGINEERING CONSULTANTS

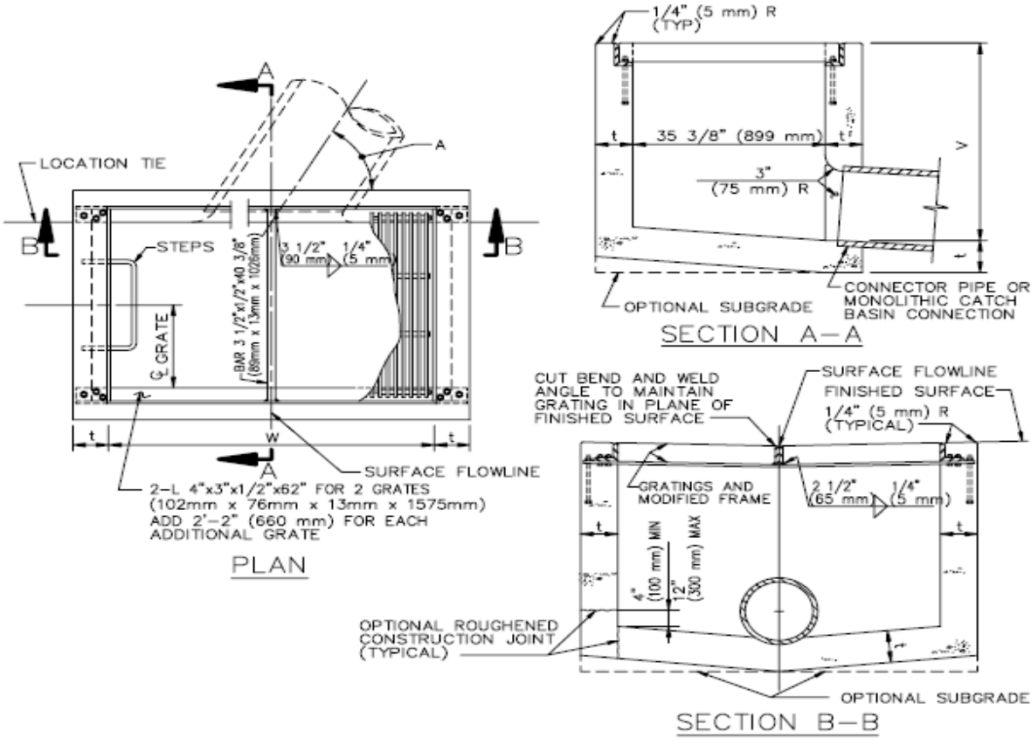
Designer:	TSW
Date:	4/16/2019
Project:	FIR Wilson
Location:	Outlet Structure for WQ Basin A

OUTLET STRUCTURE PONDING DEPTH SPPWC 305-3

DISCHARGE (cfs)		29.1	
NUMBER OF GRATES		4	
LENGTH (ft)		23.146	
WEIR COEFFICIENT	C	3	
WEIR LENGTH	L	23.146	ft^2
HEAD	h	0.56	ft
Flow	Q	29.10	cfs

$$Q = C L (h)^{3/2}$$

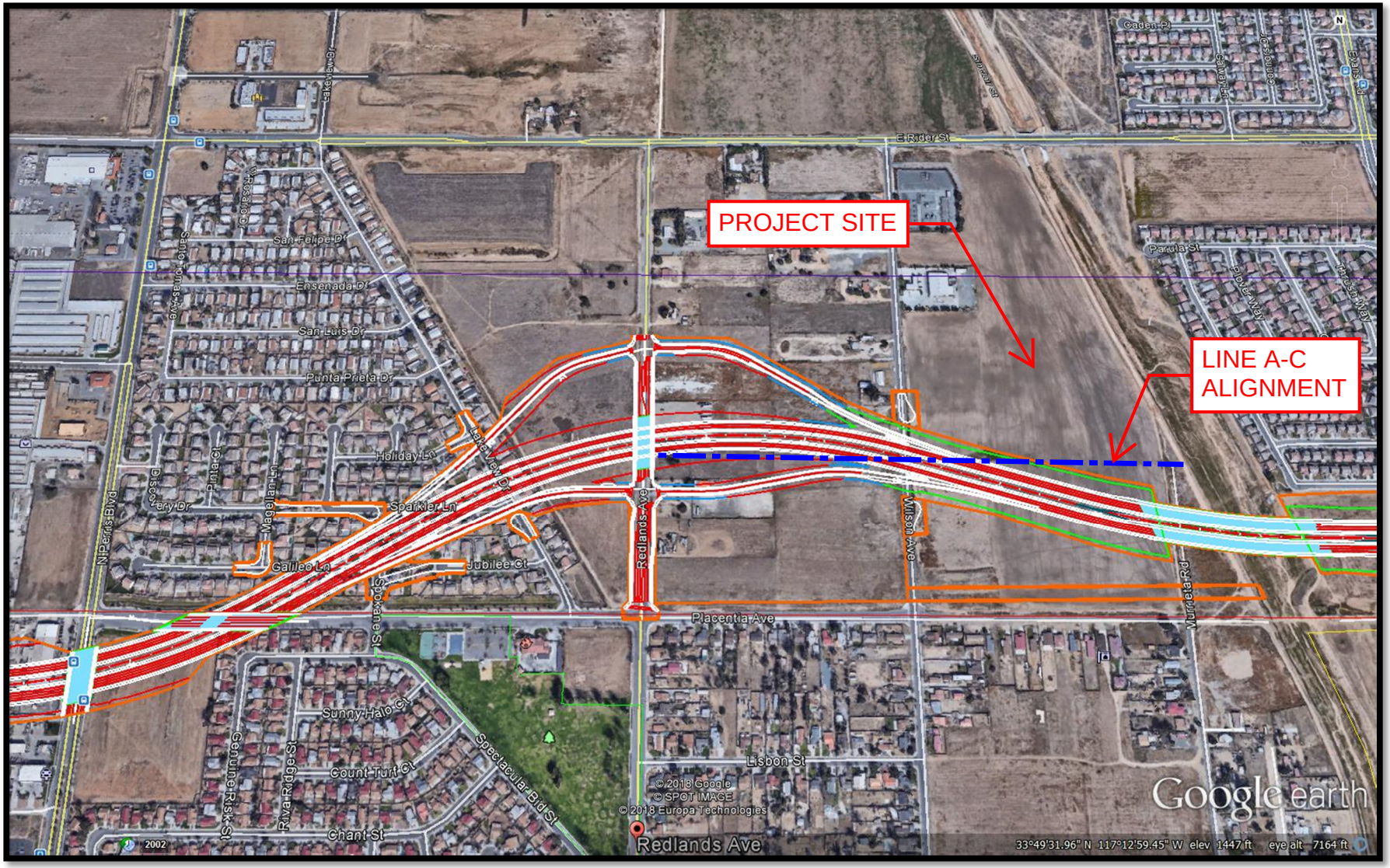
Top of Weir Elevation: 1433.4
Water Surface Elevation: 1433.96



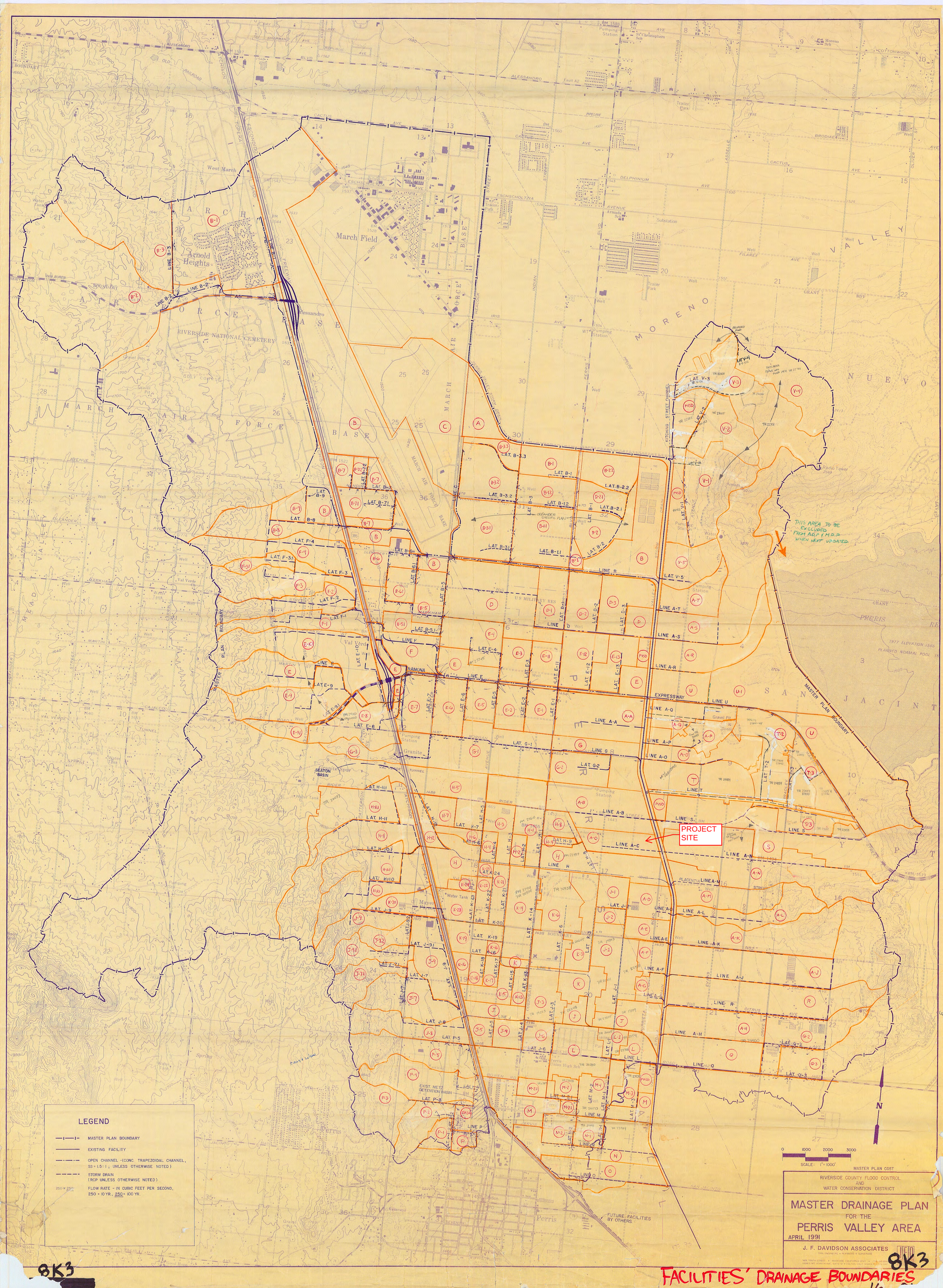
APPENDIX C – REFERENCES

RCTC MID COUNTY PARKWAY ALIGNMENT

RCTC MID COUNTY PARKWAY ALIGNMENT



MDP LINE A-C


LEGEND
MASTER PLAN BOUNDARY
EXISTING FACILITY
OPEN CHANNEL -(CONC. TRAPEZOIDAL CHANNEL, SS = 1.5:1 ; UNLESS OTHERWISE NOTED)
STORM DRAIN (RCP UNLESS OTHERWISE NOTED)
250 or 250 FLOW RATE - IN CUBIC FEET PER SECOND, 250 = 10 YR., 250 = 100 YR.
PROJECT SITE
THIS AREA TO BE EXCLUDED FROM A.D.P. & M.D.P. WHEN NEXT UPDATED.
FUTURE FACILITIES BY OTHERS.
SCALE: 1"= 1000'
MASTER PLAN COST
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
MASTER DRAINAGE PLAN FOR THE PERRIS VALLEY AREA
APRIL 1991
J. F. DAVIDSON ASSOCIATES
8K3
FACILITIES' DRAINAGE BOUNDARIES
1/2
8K3