HYDROLOGY STUDY

Jersey Blvd. Warehouse

APN: 0229-011-60-0-000
NW c/o Jersey Blvd. and Milliken Ave.
Rancho Cucamonga, CA 91730

Prepared for:
-

Prepared by:
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Date: April 6, 2020

Prepared under the supervision of:

_____
Kevin J. Richer
RCE 43714, Exp. 3/31/21

Table of Contents

Discussion

The project proposes to develop a 7.39-acre site located at the northwesterly corner of the intersection of Milliken Ave. and Jersey Blvd. in the city of Rancho Cucamonga. The site is bounded to the north and west by industrial developments, to the south by the right-of-way of Jersey Blvd. and to the east by the right-of-way of Milliken Ave. Site soils have been identified as Hydrologic Soil Group "A."

The project site is currently undeveloped graded land with poor natural grass coverage during the rainy season. There are no impervious surfaces. Storm water sheets in a southeasterly direction across the project site and flows are intercepted by an existing detention basin located in the southeasterly corner of the project site. Flows pond in the basin and an existing CMP riser intercepts flows and discharges them into an existing public catch basin in the right-of-way of Jersey Blvd. The project site does not accept run-on from the adjacent properties, as existing swales along the westerly and northerly boundaries of the project site direct storm water away from the project site. See the Pre-Developed Hydrology Map in Appendix B.

The project proposes to develop the site for commercial use. The development proposes to construct a warehousing building with office facilities, AC pavement, concrete sidewalk, concrete curb, concrete gutter, trash facilities, landscaping, fencing, catch basins with inlet filters, an on-site storm drain system, and an underground storage infiltration system. The proposed development will be 89% impervious. Proposed drainage patterns will mimic the existing drainage pattern of the project site, directing storm water runoff to the southeasterly corner of the property. There are two drainage areas. Drainage Area A consists of the northerly half of the project site. Storm water sheets across AC pavement, concrete pavement, and landscaping in a southeasterly direction to be intercepted by a total of six inlets located along the loading docks of the proposed building. The inlets intercept flows and discharge into the proposed on-site storm drain system, which then conveys flows to the proposed underground storage infiltration system located at the southeasterly corner of the site. Drainage Area B consists of the southerly half of the project site. Storm water sheets across AC pavement, concrete pavement, and landscaping in a southeasterly direction to be intercepted by concrete gutters. Gutters convey flows easterly to a total of three inlets located along the southerly boundary of the site. The inlets intercept flows and discharge into the proposed on-site storm drain system, which then conveys flows to the same proposed underground storage infiltration system as DA A. The proposed infiltration system infiltrates storm water into native soils. Overflows of the system are intercepted by the existing outlet pipe discharging into the existing public catch basin in the right-of-way of Jersey Blvd. See the Post-Developed Hydrology Map in Appendix C.

The proposed underground storage infiltration system has been designed to store the Design Capture Volume (DCV) for the project site, and to infiltrate it into the soil within 48 hours. The design is in accordance with the 2013 Technical Guidance Document for Water Quality Management Plans of San Bernardino County. The system also provides retention of storm water runoff so as to mitigate the increase runoff produced by the proposed development.

A Rational Study has been prepared for both the pre-developed and post-developed conditions of the project site for a 10-year and 100-year storm. See Appendix B and C. The results are as follows:

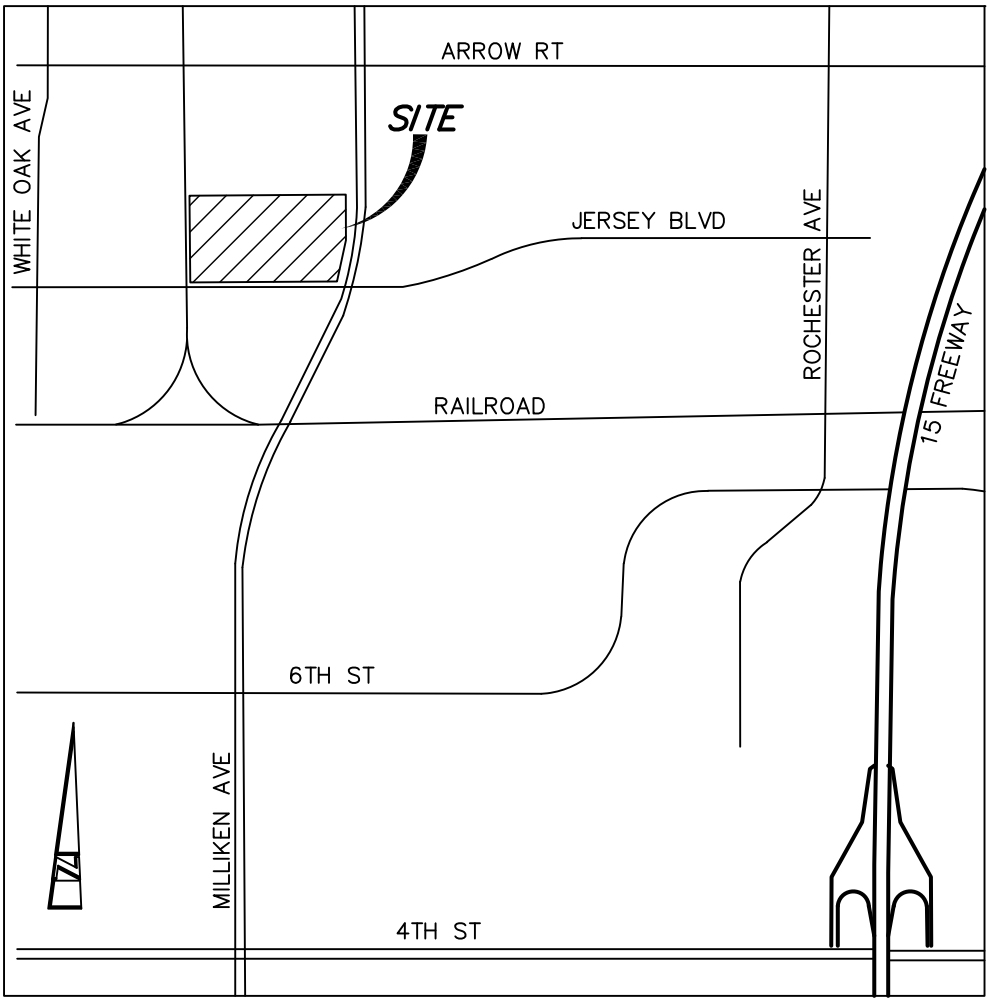
	Q_{PRE} (CFS)	$T_{C,PRE}$ (MIN)	Q_{POST} (CFS)	$T_{C,POST}$ (MIN)	ΔV (CF)	$V_{STORAGE}$ (CF)
10-YR	9.44	18.0	13.36	9.6	3,387	31,668
100-YR	17.24	18.0	26.04	9.5	7,524	31,668

The change in run-off volume due to the proposed development has been calculated as follows:

$$\Delta V = 1.5\ (\Delta Q)\ (TC,POST*60)$$

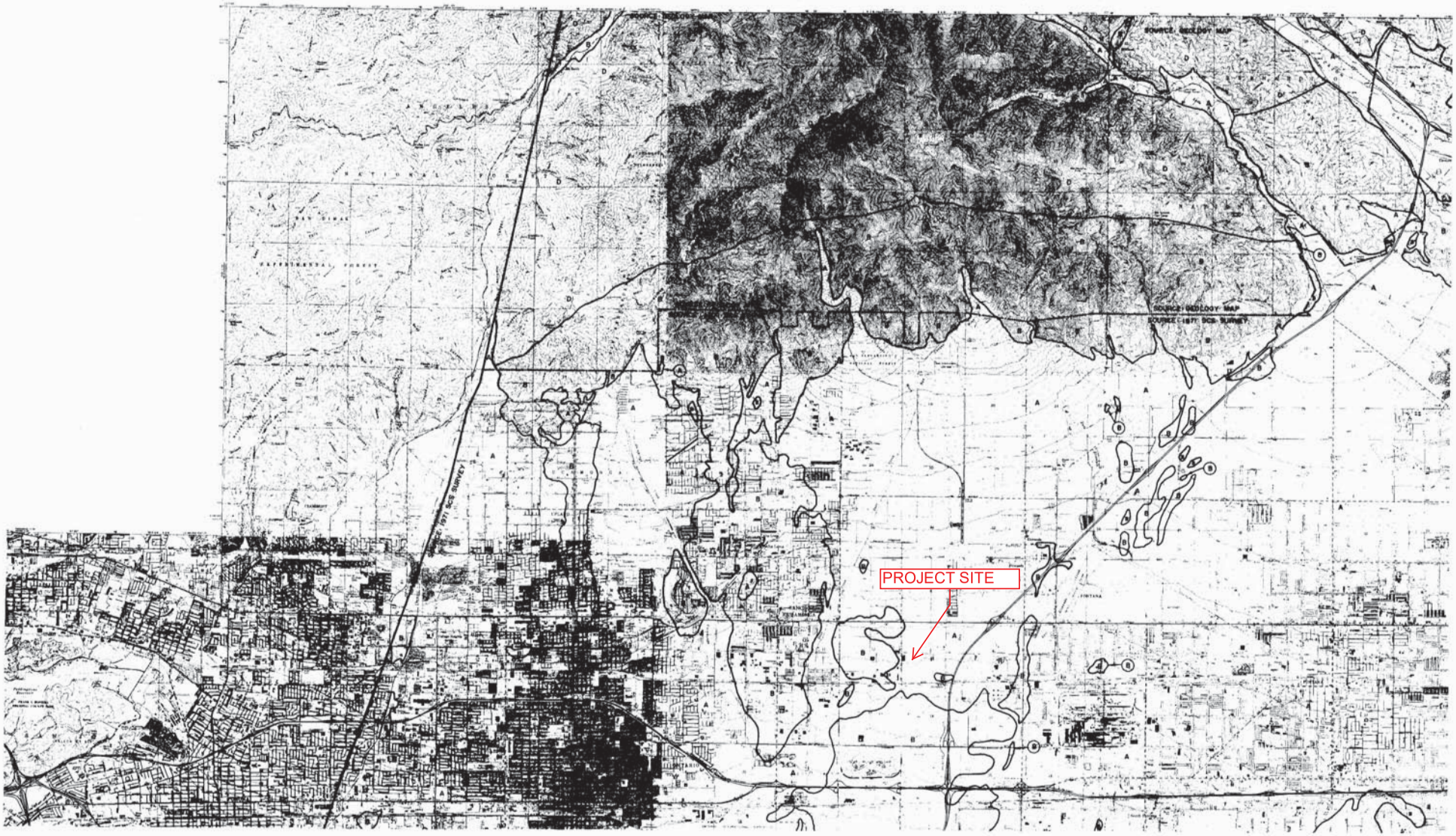
Due to the proposed development, the volume of storm water runoff generated by the proposed development increases from the volume generated by the pre-developed site. The volume of retention ($V_{STORAGE}$) provided by the proposed underground storage infiltration system is greater than the increase in said runoff (ΔV). Therefore, the project will not increase the discharge of stormwater runoff from the project site.

Appendix A



VICINITY MAP

NTS



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP
FOR
SOUTHWEST-A AREA

FIGURE C-13

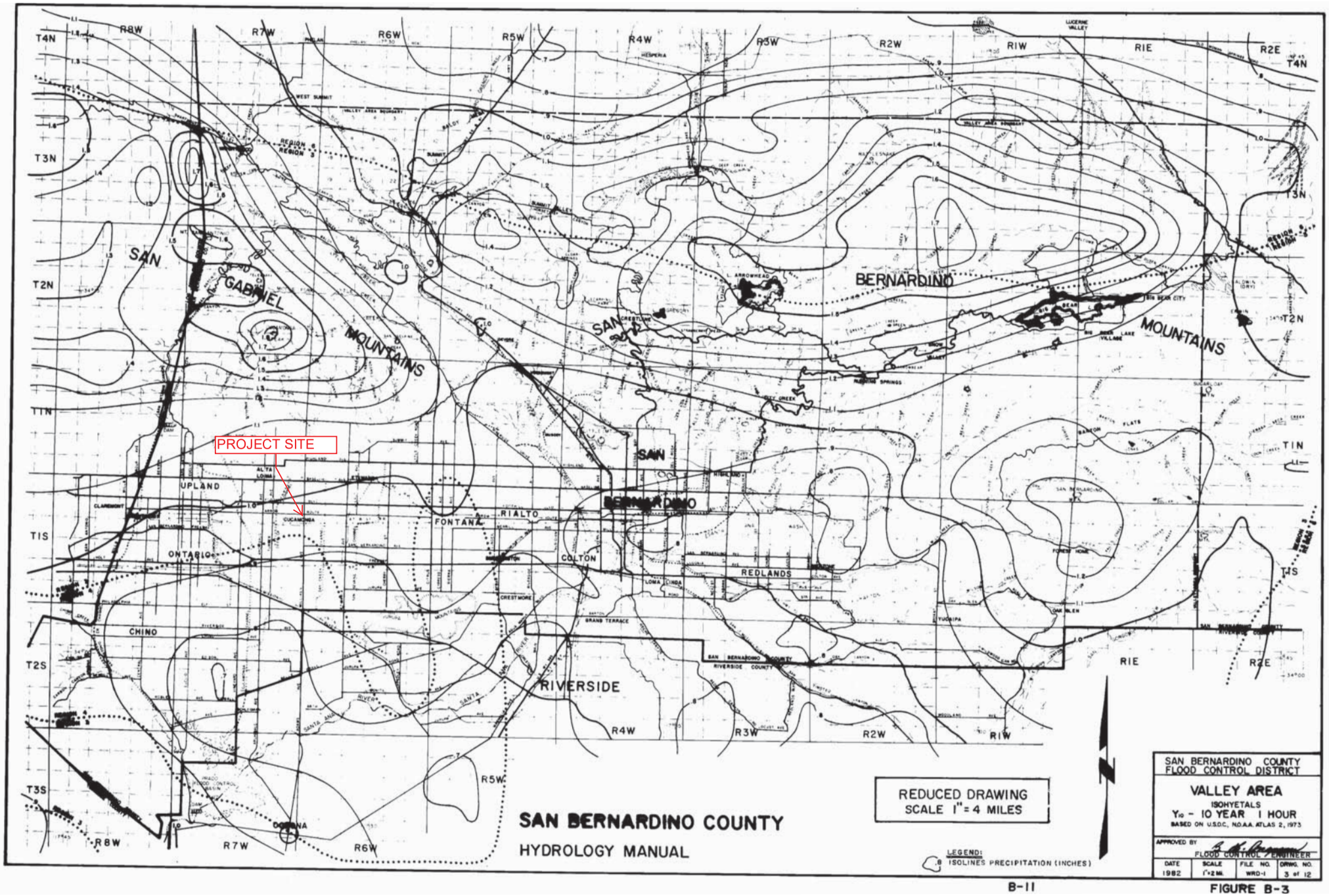

PROJECT SITE
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL
REDUCED DRAWING
SCALE 1" = 4 MILES
LEGEND:
ISOLINES PRECIPITATION (INCHES)
SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT
VALLEY AREA
ISOHYETALS
Y6 - 10 YEAR 1 HOUR
BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973
APPROVED BY
FLOOD CONTROL ENGINEER
DATE 1982
SCALE 1"=2 MI.
FILE NO. WRD-1
DRWG. NO. 3 of 12
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
UPLAND
ONTARIO
CHINO
CLAREMONT
ALTA LOMA
CUCAMONGA
FONTANA
RIALTO
SAN BERNARDINO
COLTON
REDLANDS
LOMA LINDA
GRAND TERRACE
CREST MORE
RIVERSIDE
DEVORE
YUCAIPA
OAK GLEN
FOREST HOME
BIG BEAR CITY
BIG BEAR LAKE
LAKE ARROWHEAD
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
T4N
T3N
T2N
T1N
T1S
T2S
T3S
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E

FIGURE B-3

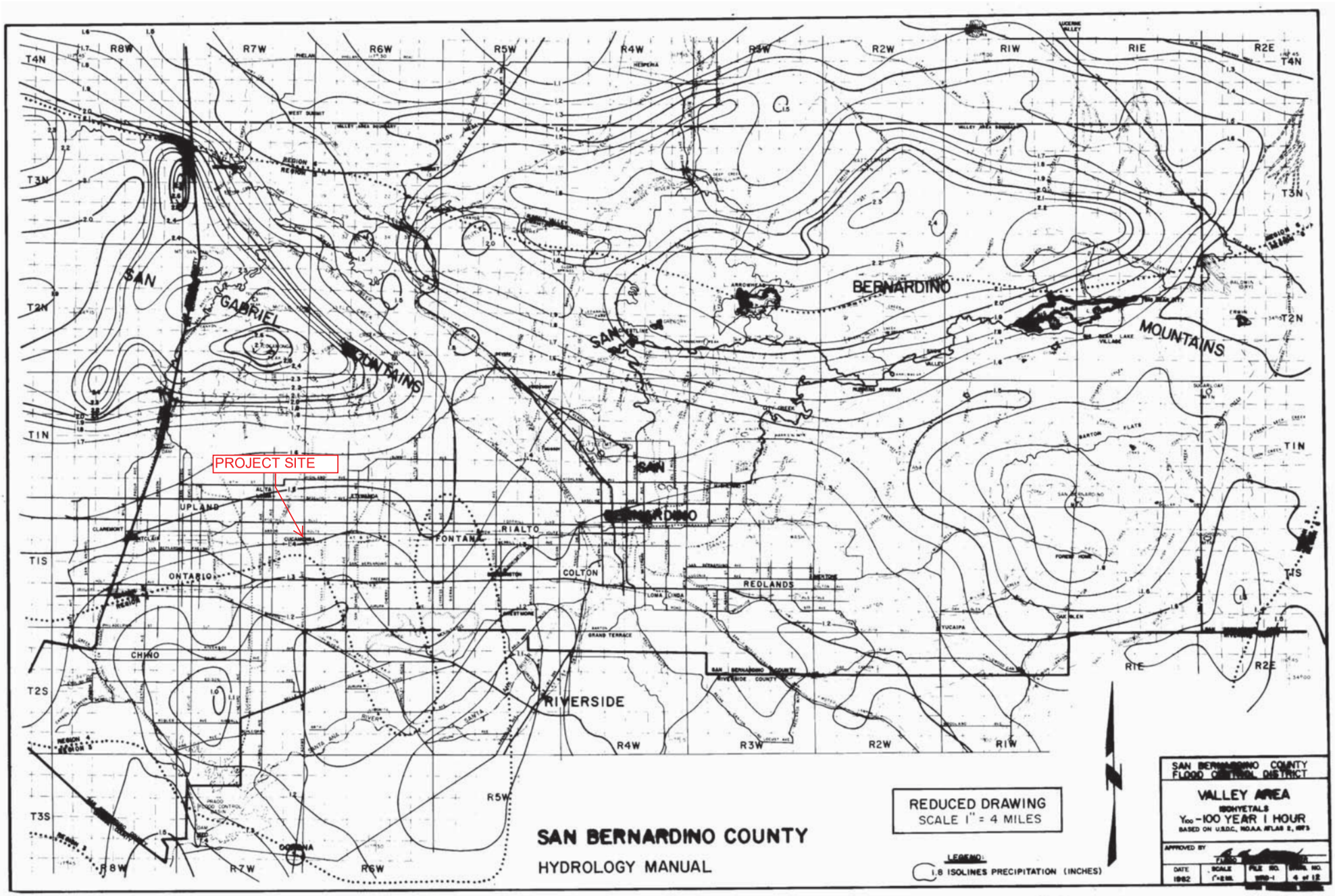
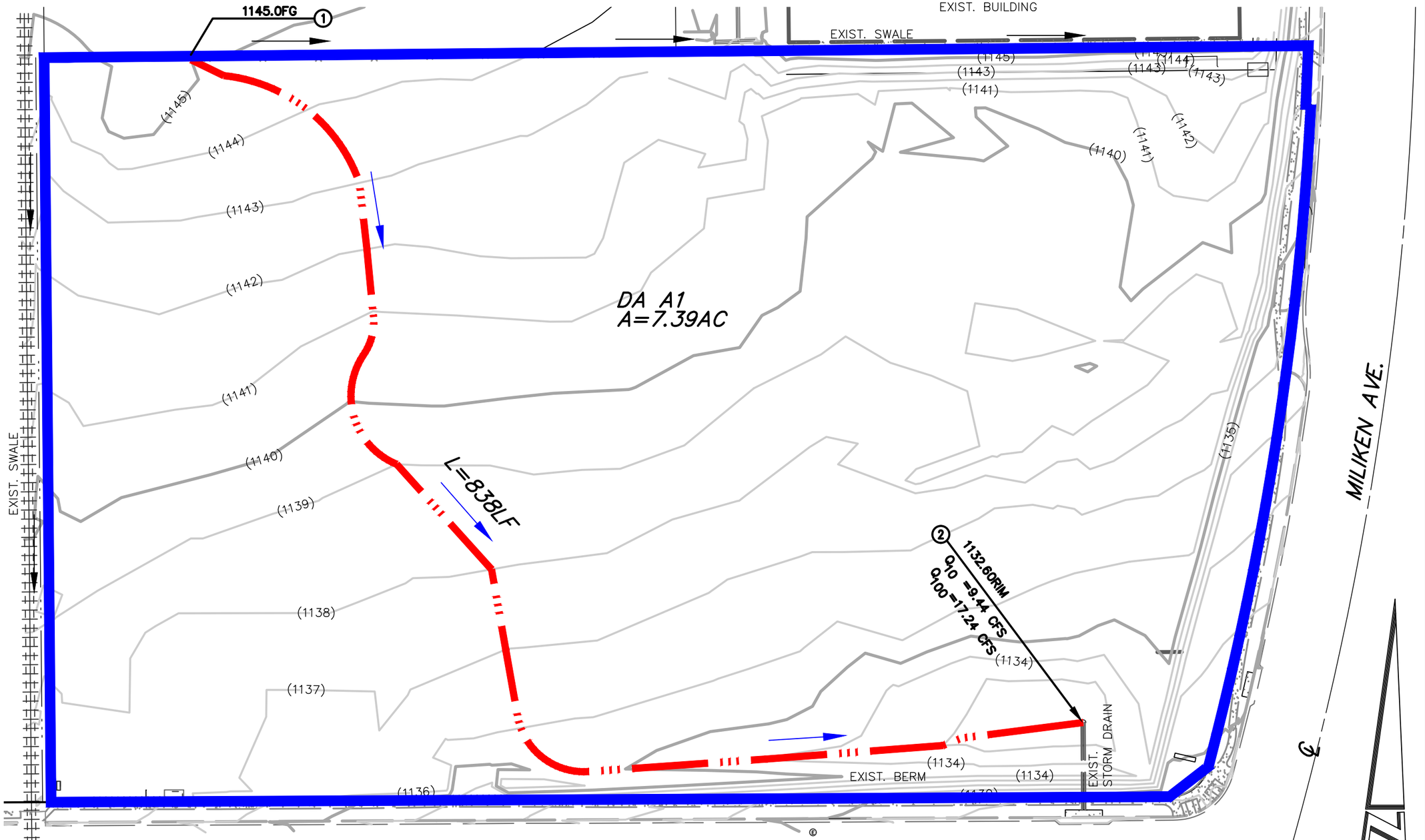

PROJECT SITE
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL
REDUCED DRAWING
SCALE 1" = 4 MILES
LEGEND:
1.8 ISOLINES PRECIPITATION (INCHES)
SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT
VALLEY AREA
ISOHYETALS
Y100 - 100 YEAR 1 HOUR
BASED ON U.S.D.C., NOAA ATLAS 2, VOL 9
DATE 1982
SCALE 1"=2 MI.
FILE NO. 1982-1
SHEET NO. 4 of 12
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
UPLAND
ONTARIO
CHINO
CLAREMONT
FONTANA
RIALTO
COLTON
REDLANDS
LOMA LINDA
GRAND TERRACE
YUCAIPA
RIVERSIDE
CORONA
T4N
T3N
T2N
T1N
T1S
T2S
T3S
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E

FIGURE B-4

Appendix B



PRE-DEVELOPED HYDROLOGY MAP

PROJECT SITE

JERSEY BOULEVARD WAREHOUSE
RANCHO CUCAMONGA, CA
91730

PREPARED FOR

PETROSSI AND ASSOCIATES, INC.
1300 BRISTOL ST., STE. 270
NEWPORT BEACH, CA 92660

LEGEND

- WATER SHED BOUNDARY
- WATER COURSE
- DIRECTION OF FLOW
- (#) NODE NUMBER

60 0 60 120 180

SCALE: 1"=60'

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 04/04/20

JN6064 RATIONAL STUDY
PRE-DEVELOPED CONDITION
10YR STORM

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.970 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Initial subarea data:
Initial area flow distance = 838.000(Ft.)
Top (of initial area) elevation = 1145.000(Ft.)
Bottom (of initial area) elevation = 1132.600(Ft.)
Difference in elevation = 12.400(Ft.)
Slope = 0.01480 s(%)= 1.48
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 18.006 min.
Rainfall intensity = 1.997(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.639
Subarea runoff = 9.437(CFS)
Total initial stream area = 7.390(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.578(In/Hr)
End of computations, Total Study Area = 7.39 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 67.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 04/04/20

JN6064 RATIONAL STUDY
PRE-DEVELOPED CONDITION
100YR STORM

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.400 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Adjusted SCS curve number for AMC 3 = 84.60
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.290(In/Hr)
Initial subarea data:
Initial area flow distance = 838.000(Ft.)
Top (of initial area) elevation = 1145.000(Ft.)
Bottom (of initial area) elevation = 1132.600(Ft.)
Difference in elevation = 12.400(Ft.)
Slope = 0.01480 s(%)= 1.48
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 18.006 min.
Rainfall intensity = 2.882(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.809
Subarea runoff = 17.243(CFS)
Total initial stream area = 7.390(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.290(In/Hr)
End of computations, Total Study Area = 7.39 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 67.0

Appendix C

POST-DEVELOPED HYDROLOGY MAP

PROJECT SITE

JERSEY BOULEVARD WAREHOUSE
RANCHO CUCAMONGA, CA
91730

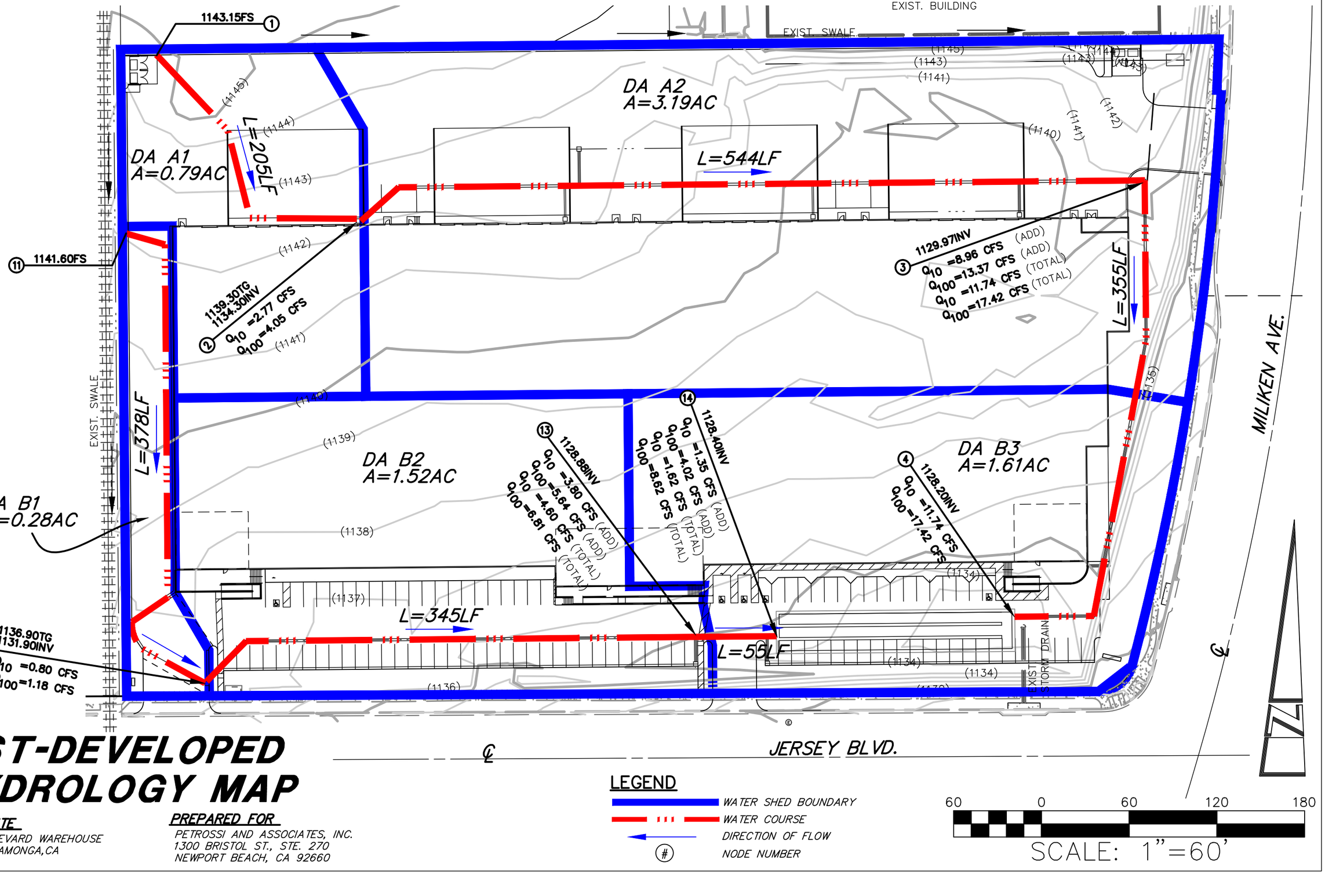
PREPARED FOR

PETROSSI AND ASSOCIATES, INC.
1300 BRISTOL ST., STE. 270
NEWPORT BEACH, CA 92660

LEGEND

- WATER SHED BOUNDARY
- WATER COURSE
- DIRECTION OF FLOW
- (#) NODE NUMBER

SCALE: 1"=60'



San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 04/04/20

JN6064 RATIONAL STUDY
POST-DEVELOPED CONDITION
10YR STORM - DA A

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.970 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
Initial subarea data:
Initial area flow distance = 205.000(Ft.)
Top (of initial area) elevation = 1143.150(Ft.)
Bottom (of initial area) elevation = 1139.300(Ft.)
Difference in elevation = 3.850(Ft.)
Slope = 0.01878 s(%)= 1.88
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 5.660 min.
Rainfall intensity = 3.999(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.878
Subarea runoff = 2.774(CFS)
Total initial stream area = 0.790(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.098(In/Hr)

++
Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1134.300(Ft.)
Downstream point/station elevation = 1129.970(Ft.)
Pipe length = 544.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 2.774(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 2.774(CFS)
Normal flow depth in pipe = 6.43(In.)
Flow top width inside pipe = 17.25(In.)
Critical Depth = 7.58(In.)

```
Pipe flow velocity =      4.89(Ft/s)
Travel time through pipe =    1.85 min.
Time of concentration (TC) =     7.51 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =     7.51 min.
Rainfall intensity =      3.374(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.874
Subarea runoff =      8.963(CFS) for    3.190(Ac.)
Total runoff =     11.736(CFS)
Effective area this stream =        3.98(Ac.)
Total Study Area (Main Stream No. 1) =        3.98(Ac.)
Area averaged Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =  1129.970(Ft.)
Downstream point/station elevation =  1128.200(Ft.)
Pipe length  =   355.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =    11.736(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    11.736(CFS)
Normal flow depth in pipe =   14.48(In.)
Flow top width inside pipe =   23.48(In.)
Critical Depth =   14.76(In.)
Pipe flow velocity =      5.92(Ft/s)
Travel time through pipe =    1.00 min.
Time of concentration (TC) =     8.51 min.
End of computations, Total Study Area =            3.98 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

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

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 04/04/20

JN6064 RATIONAL STUDY
POST-DEVELOPED CONDITION
10YR STORM - DA B

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.970 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
Initial subarea data:
Initial area flow distance = 378.000(Ft.)
Top (of initial area) elevation = 1141.600(Ft.)
Bottom (of initial area) elevation = 1136.900(Ft.)
Difference in elevation = 4.700(Ft.)
Slope = 0.01243 s(%)= 1.24
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.851 min.
Rainfall intensity = 3.286(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.873
Subarea runoff = 0.803(CFS)
Total initial stream area = 0.280(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.098(In/Hr)

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

Upstream point/station elevation = 1131.900(Ft.)
Downstream point/station elevation = 1128.880(Ft.)
Pipe length = 345.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 0.803(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 0.803(CFS)
Normal flow depth in pipe = 3.35(In.)
Flow top width inside pipe = 14.00(In.)
Critical Depth = 3.99(In.)

```
Pipe flow velocity =      3.55(Ft/s)
Travel time through pipe =    1.62 min.
Time of concentration (TC) =     9.47 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =     9.47 min.
Rainfall intensity =      2.936(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.870
Subarea runoff =      3.795(CFS) for    1.520(Ac.)
Total runoff =      4.598(CFS)
Effective area this stream =        1.80(Ac.)
Total Study Area (Main Stream No. 1) =        1.80(Ac.)
Area averaged Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =  1128.880(Ft.)
Downstream point/station elevation =  1128.400(Ft.)
Pipe length  =    55.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     4.598(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     4.598(CFS)
Normal flow depth in pipe =    8.27(In.)
Flow top width inside pipe =   17.94(In.)
Critical Depth =    9.89(In.)
Pipe flow velocity =      5.80(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =     9.63 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =     9.63 min.
Rainfall intensity =      2.907(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.870
Subarea runoff =      4.024(CFS) for    1.610(Ac.)
Total runoff =      8.622(CFS)
Effective area this stream =        3.41(Ac.)
```

Total Study Area (Main Stream No. 1) = 3.41(Ac.)
Area averaged Fm value = 0.098(In/Hr)
End of computations, Total Study Area = 3.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

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

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 04/04/20

JN6064 RATIONAL STUDY
POST-DEVELOPED CONDITION
100YR STORM - DA A

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.400 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 205.000(Ft.)
Top (of initial area) elevation = 1143.150(Ft.)
Bottom (of initial area) elevation = 1139.300(Ft.)
Difference in elevation = 3.850(Ft.)
Slope = 0.01878 s(%)= 1.88
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 5.660 min.
Rainfall intensity = 5.772(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
Subarea runoff = 4.048(CFS)
Total initial stream area = 0.790(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++

Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1134.300(Ft.)
Downstream point/station elevation = 1129.970(Ft.)
Pipe length = 544.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 4.048(CFS)

```
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     4.048(CFS)
Normal flow depth in pipe =    7.90(In.)
Flow top width inside pipe =   17.87(In.)
Critical Depth =    9.24(In.)
Pipe flow velocity =      5.42(Ft/s)
Travel time through pipe =    1.67 min.
Time of concentration (TC) =     7.33 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     7.33 min.
Rainfall intensity =      4.942(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 =     13.371(CFS) for    3.190(Ac.)
Total runoff =     17.419(CFS)
Effective area this stream =        3.98(Ac.)
Total Study Area (Main Stream No. 1) =        3.98(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =  1129.970(Ft.)
Downstream point/station elevation =  1128.200(Ft.)
Pipe length  =   355.00(Ft.)   Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =    17.419(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.691(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.793(Ft.)
 Minor friction loss =      0.668(Ft.)    K-factor =   1.40
Pipe flow velocity =      5.54(Ft/s)
Travel time through pipe =    1.07 min.
Time of concentration (TC) =     8.40 min.
End of computations, Total Study Area =            3.98 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

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

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 04/04/20

JN6064 RATIONAL STUDY
POST-DEVELOPED CONDITION
100YR STORM - DA B

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.400 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 378.000(Ft.)
Top (of initial area) elevation = 1141.600(Ft.)
Bottom (of initial area) elevation = 1136.900(Ft.)
Difference in elevation = 4.700(Ft.)
Slope = 0.01243 s(%)= 1.24
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.851 min.
Rainfall intensity = 4.743(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.885
Subarea runoff = 1.175(CFS)
Total initial stream area = 0.280(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

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

Upstream point/station elevation = 1131.900(Ft.)
Downstream point/station elevation = 1128.880(Ft.)
Pipe length = 345.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 1.175(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 1.175(CFS)
Normal flow depth in pipe = 4.04(In.)
Flow top width inside pipe = 15.02(In.)

```
Critical Depth =    4.85(In.)
Pipe flow velocity =      3.96(Ft/s)
Travel time through pipe =    1.45 min.
Time of concentration (TC) =     9.30 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** SUBAREA FLOW ADDITION ****
_______________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     9.30 min.
Rainfall intensity =      4.284(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 =      5.638(CFS) for    1.520(Ac.)
Total runoff =      6.813(CFS)
Effective area this stream =        1.80(Ac.)
Total Study Area (Main Stream No. 1) =        1.80(Ac.)
Area averaged Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_______________________________________________________________________________
Upstream point/station elevation =  1128.880(Ft.)
Downstream point/station elevation =  1128.400(Ft.)
Pipe length  =    55.00(Ft.)   Manning's N = 0.012
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 =   10.48(In.)
Flow top width inside pipe =   17.76(In.)
Critical Depth =   12.12(In.)
Pipe flow velocity =      6.38(Ft/s)
Travel time through pipe =    0.14 min.
Time of concentration (TC) =     9.45 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** SUBAREA FLOW ADDITION ****
_______________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Time of concentration =     9.45 min.
Rainfall intensity =      4.245(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.883
```

Subarea runoff =   5.974(CFS) for   1.610(Ac.)
Total runoff =   12.787(CFS)
Effective area this stream =   3.41(Ac.)
Total Study Area (Main Stream No. 1) =   3.41(Ac.)
Area averaged Fm value =   0.079(In/Hr)
End of computations, Total Study Area =   3.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

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

Appendix D

CATCH BASIN INLETS

KING'S MANUAL $\frac{Q}{P} = 3.0\,H^{3/2}$ * ASSUME 25% CLOGGING

NODE (2)

$Q_{100} = 4.05$ CFS $H = 0.3$ LF

$P = \frac{4.05}{(75\%)(3.0)(0.3)^{3/2}} = 10.9$ LF $S = \frac{10.9}{4} = 2.7$ LF 36"x36" MIN. GRATE

NODE (3)

SEA INLETS $Q_{100} = \frac{13.37\ CFS}{5} = 2.67$ CFS $H = 0.3$ LF

$P = \frac{2.67}{(75\%)(3.0)(0.3)^{3/2}} = 7.2$ LF $S = \frac{7.2}{4} = 1.8$ LF 24"x24" MIN. GRATE

NODE (12)

$Q_{100} = 1.18$ CFS $H = 0.2$ LF

$P = \frac{1.18}{(75\%)(3.0)(0.2)^{3/2}} = 5.9$ LF $S = \frac{5.9}{4} = 1.5$ LF 18"x18" MIN. GRATE

NODE (13)

$Q_{100} = 5.64$ CFS $H = 0.4$ LF

$P = \frac{5.64}{(75\%)(3.0)(0.4)^{3/2}} = 9.9$ LF $S = \frac{9.9}{4} = 2.5$ LF 36"x36" MIN. GRATE

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NODE (14)

Q_{100} = 4.02 CFS H = 0.4 LF

$$P = \frac{4.02}{(75\%)(3.0)(0.4)^{3/2}} = 7.1 \text{ LF} \qquad S = \frac{7.1}{4} = 1.8 \text{ LF}$$

24"x24" MIN. GRATE

STORM DRAIN PIPES

KING'S MANUAL TABLE 6-2

NODE (2) TO (3)

HDPE PIPE $n = 0.012$ $S = 0.008$

$$Q_{100} = 17.42 - \frac{13.37}{5} = 14.7 \text{ CFS}$$

24"ϕ PIPE MIN.

NODE (3) TO (4)

HDPE PIPE $n = 0.012$ $S = 0.005$

Q_{100} = 17.42 CFS 24" ϕ PIPE MIN.

NODE (12) TO (14)

HDPE PIPE $n = 0.012$ $S = 0.0085$

Q_{100} = 8.62 CFS 18" ϕ PIPE MIN.

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