Drainage Study for:

Nicholas Im

PM: 19401

APN: 3068-171-07

Purpose:

The owner of APN 3068-171-07 (Tentative Parcel Map 19401) is proposing to divide this 36 acre site into 4 – 5 Acre Parcels and a 16 Acre Remainder Parcel. The purpose of this study is to determine whether this site is impacted by off-site drainage flows, and if so; how much flow, and what measures may be necessary to protect a future structure from these flows. This study is also to determine whether a drainage easement should be dedicated for any of these flows, and what size it should be.

Background:

This parcel lies on the Northerly side of Highway 138, between Soledad Road and Crystal Aire Road in the unincorporated area of Phelan, CA. This site is ¼ mile Easterly of the San Bernardino-Los Angeles County line. State Highway 138 abuts the Southwesterly side of this property. Soledad Road and Solano Road abut the Westerly and Northerly side respectively, and are existing dirt roads. Crystal Aire Road and Rancho Road are proposed to be extended along the Easterly and Southerly side of this site.

The topographical data was obtained for this land division and is shown on Tentative Parcel Map 19401. This topographical data shows that the natural slope of this site is to the Northeast at 2%. The topographic data also shows three drainage courses crossing this site.

Research Data:

A review of the Mescal Creek Quad Map, portion attached, finds that the only visible flow path through this site is a "blue-line" stream that runs near to and along the Easterly property line. The Quad Map also shows that ¼ mile North of the site, the run off from this area is directed into a constructed earthen channel that runs through Tract 8045. This "blue-line" stream also continues Southerly for approximately ½ mile and has a dedicated Right of Way of 90 and 100 feet.

A review of the San Bernardino County Hazard Map shows that the majority of this site is in a Flood Hazard Area and as such, the elevating of building pads will be required upon future development of the proposed parcels.

Field Review:

A Field Review was performed to determine the extent of the drainage area that impacts this site. The quality and size of any pipes crossing under Highway 138 was also to be determined by this Field Review.

Four drainage culverts, each being a 36" metal pipe, to provide for drainage flows were located under the Highway roadbed and into the three flow paths that cross this site. A 2 foot by 4 foot deep graded dirt channel exists on the Southwesterly side of the Highway that connects the inlets of these four pipes. This channel is constructed so that small flows are directed under the Highway while larger flows are distributed to all four pipes. The two Westerly flow paths carry direct flows from one culvert each, while the "blue-line" flow path along the Easterly boundary carries direct flows from two pipe crossings.

Run Off Volumes/Calculations:

Calculations using the "rational method" and support data from the San Bernardino County Drainage Manual were performed using CivilCadd/Civil Design Engineering Software, Version 7.0. These calculations, attached as Calc "A", determined an anticipated 100 year run off of 440 cfs from a 238 drainage area. The existing pipes under Highway 128 are laid on an average grade of 4%. Using a 4% grade, these 36" pipes are anticipated to carry from 69 cfs to 85 cfs, depending on the available head, see attached Calc "B". Flows in excess of the capacity of the four pipes will generally flow along the graded channel area and adjoining part of the roadway, with a portion overflowing the roadway onto this site. The majority of flows through this site, therefore, are limited by these pipe capacities. The two Westerly flow paths can be anticipated to receive 85 cfs each and the third flow path, the most Easterly, will received 170 cfs from two pipe crossings.

Existing Flow Paths:

The three existing flow paths through this site vary from 2' to 3' deep and from 30' to 50' wide. As such they will carry the flows that come under the roadway through the 36" pipes.

Conclusions and Recommendations:

The proposed parcels of this land division are 5 acres or larger in area size, and have sufficient room to construct a residence clear of the existing flow paths. Because of the possibility of sheet flow over the Highway and this parcel also being within a FP3 Flood Plain, it is the recommendation of this study that all building pads be elevated a minimum of 1' above the natural ground.

As stated above, there are 90 foot and 100 foot Rights of Way Southerly of this site along the alignment of the "blue-line" stream. A 100 foot Drainage Easement is therefore proposed to continue through this site along the existing "blue-line" flow path.

PLAT MAP _Moscal Creek Quad_

PROJECT _Parcel Map 19401_
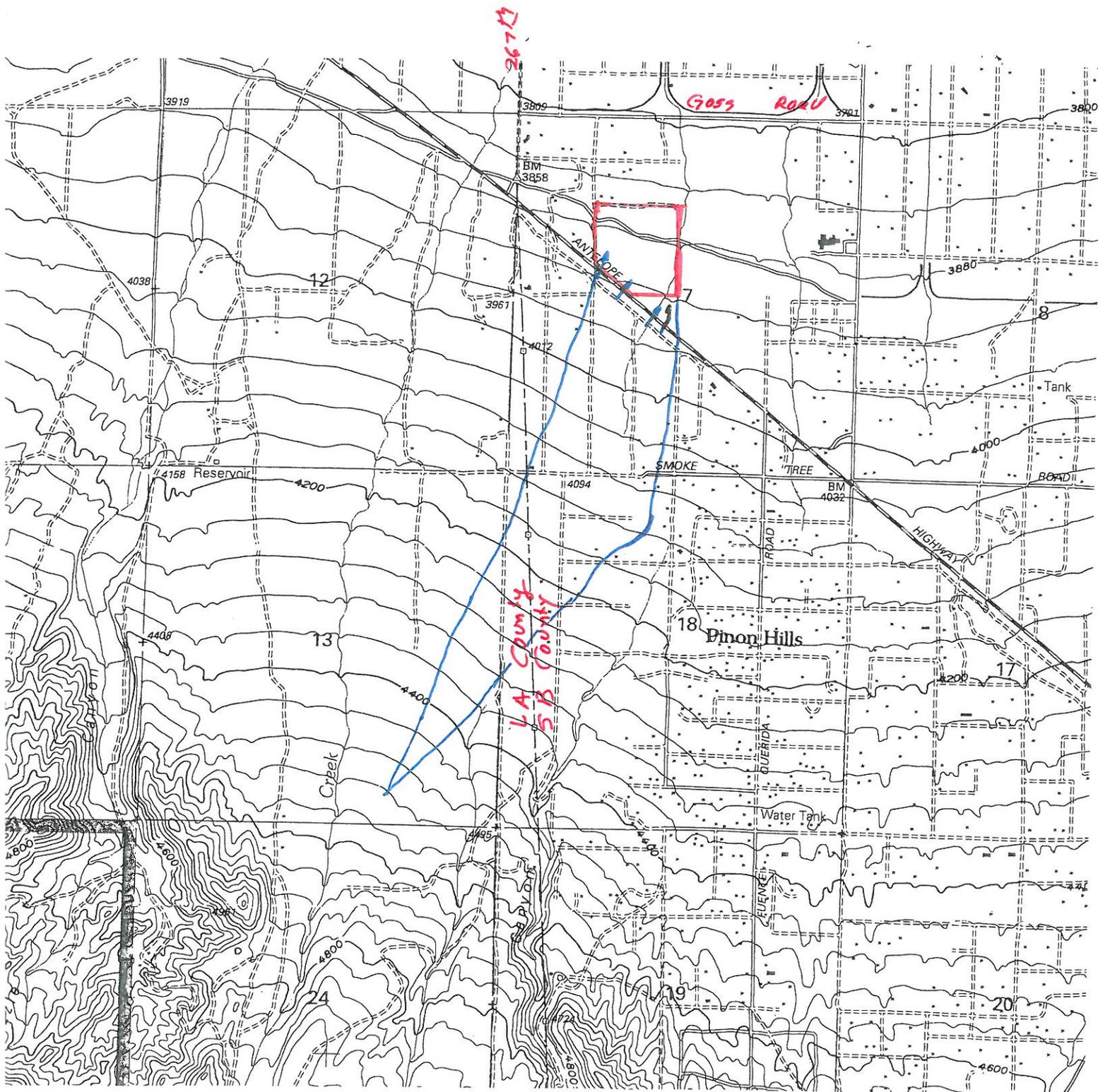
OWNER _Nicholas Im_

PLAT MAP _Moscal Creek Quad_

PROJECT _Parcel Map 19401_

OWNER _Nicholas Im_

Drainage Node Map

Desert Area
100yr – 1 hour

Fig B-10
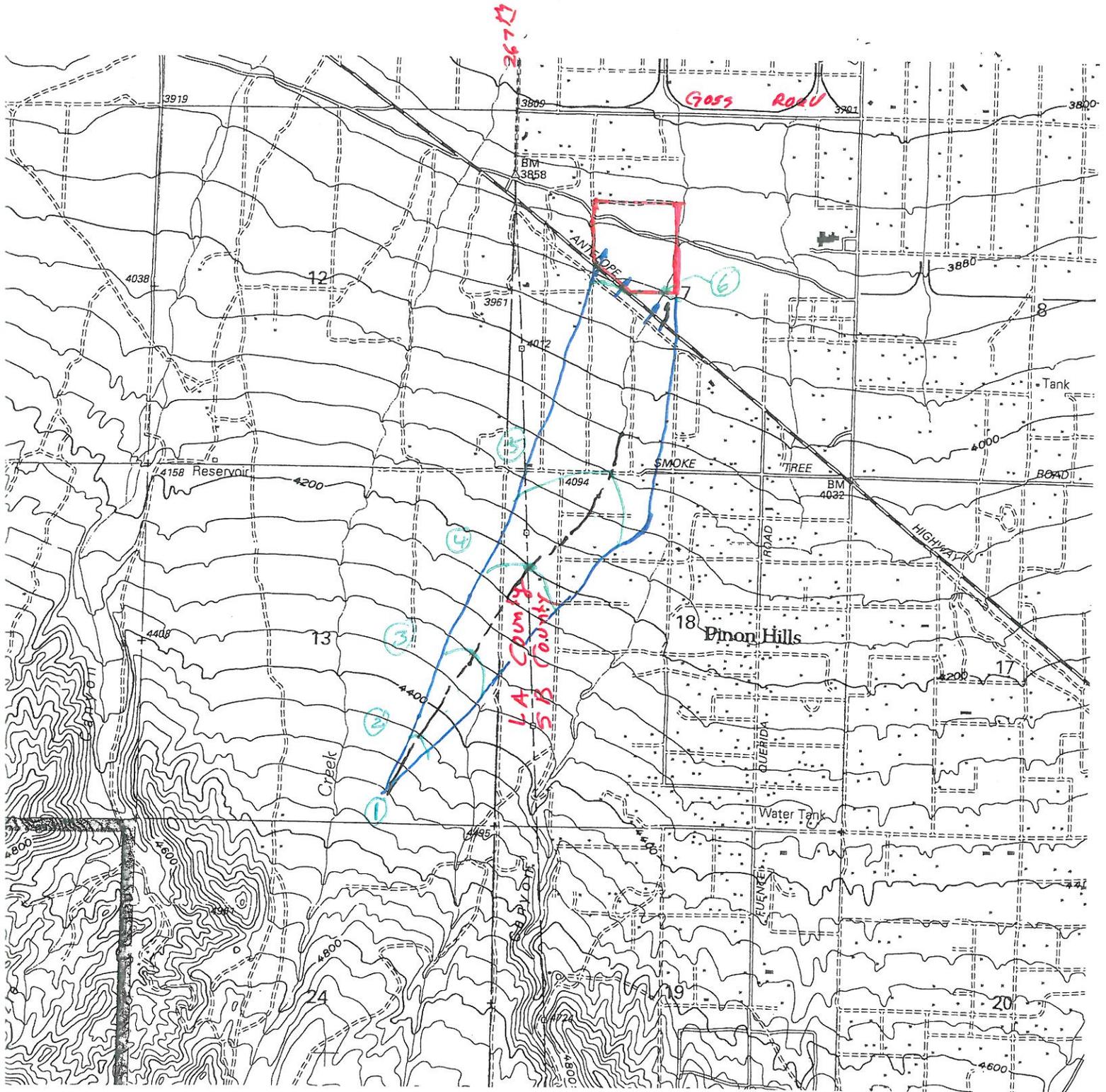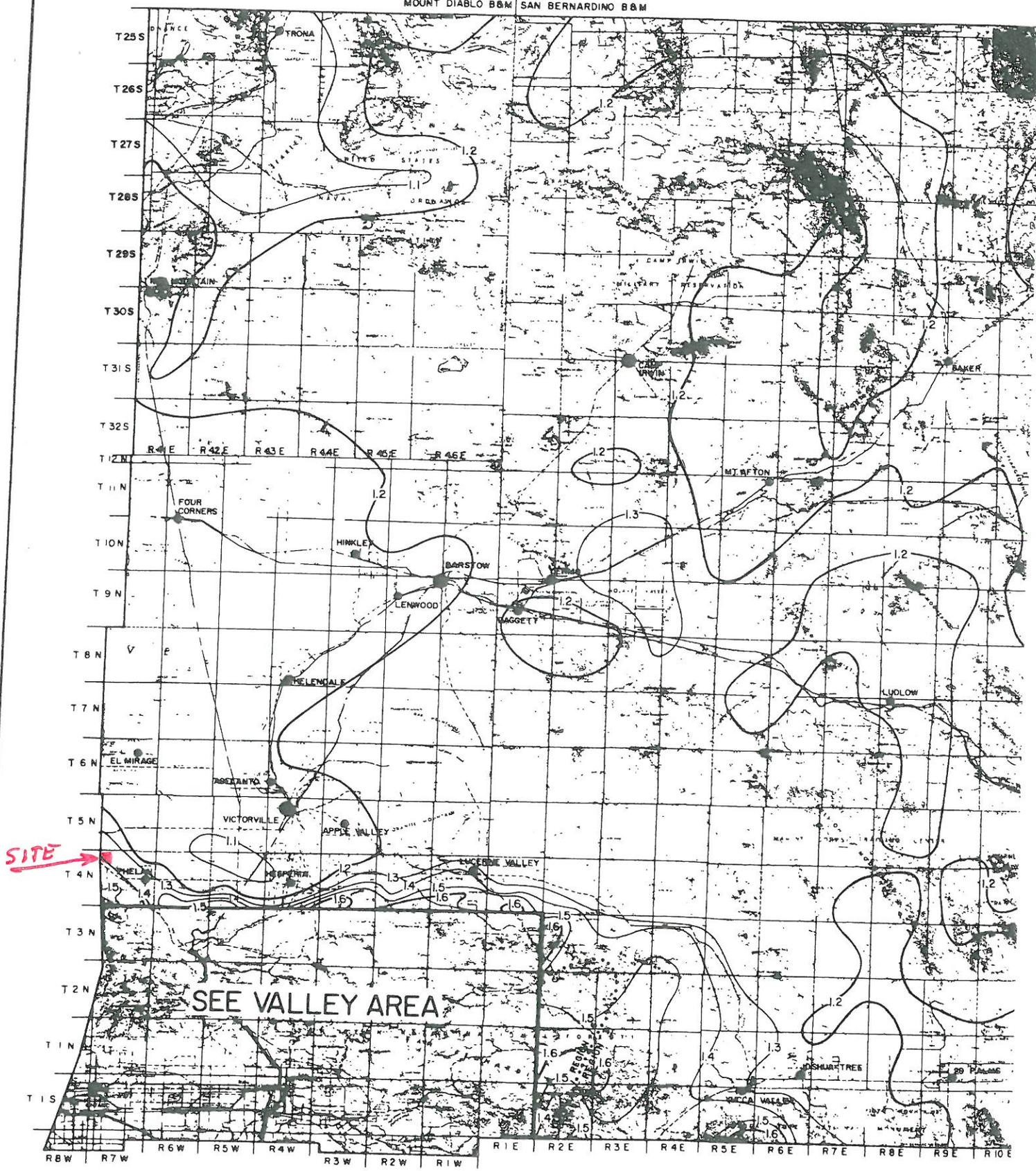
SAN BERNARDINO COUNTY

HYDROLOGY MANUAL
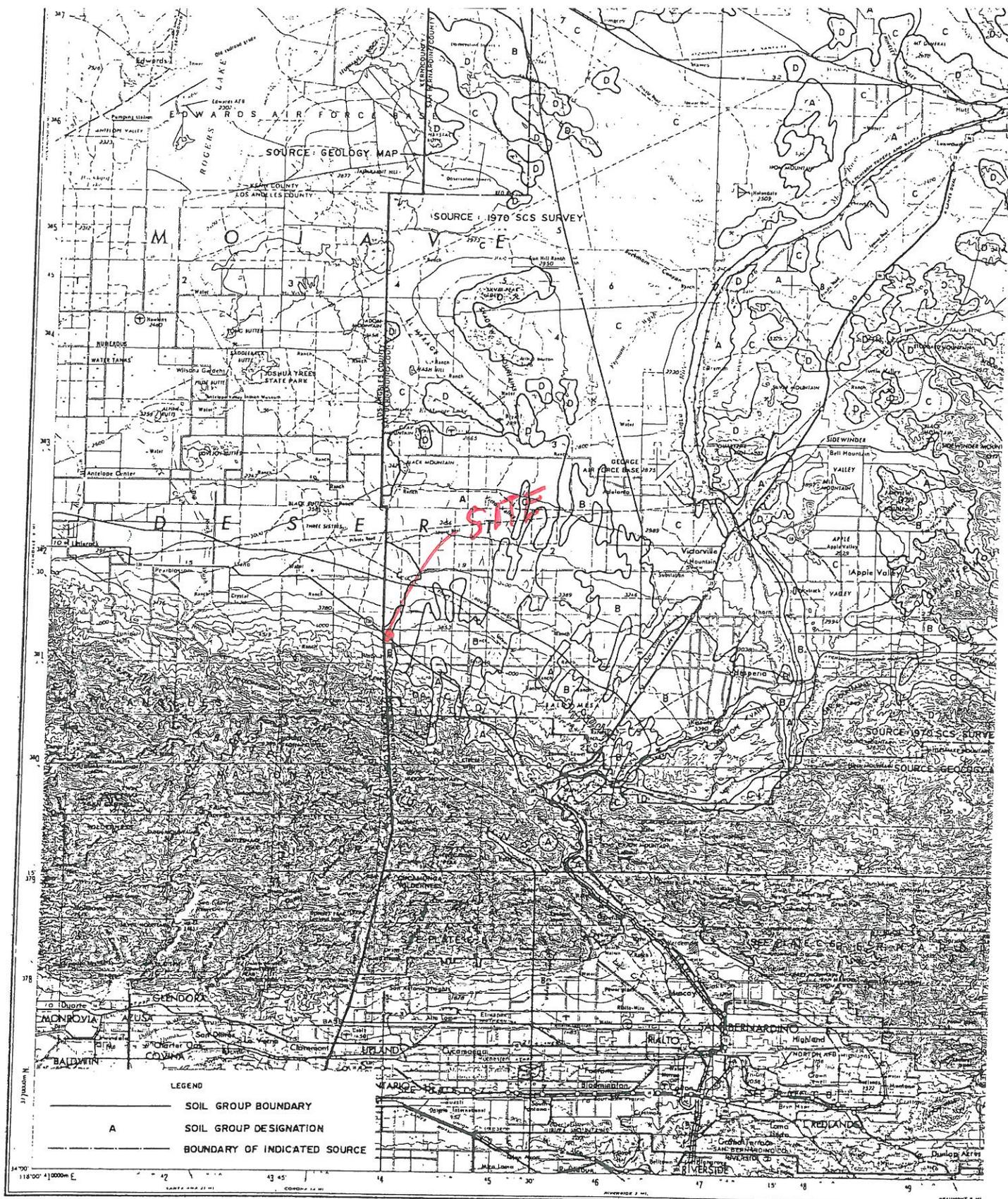
LEGEND

————————	SOIL GROUP BOUNDARY
A	SOIL GROUP DESIGNATION
————————	BOUNDARY OF INDICATED SOURCE
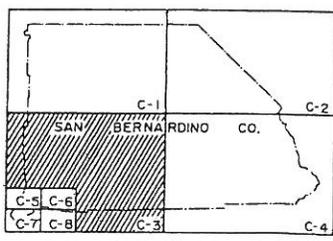
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DROLOGY MANUAL

Soils Group
Map
FIG C-11
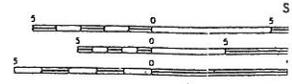
SCALE REI

INDEX MAP

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2004 Version 7.0
      Rational Hydrology Study   Date: 08/30/12

Parcel Map 19401
Natural Runoff
APN 3068-171-07
00700612n

Program License Serial Number 4057

 ********* 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 = 0.7000
Soil antecedent moisture condition (AMC) = 3

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Process from Point/Station   1.000 to Point/Station   2.000
**** INITIAL AREA EVALUATION ****
_____
RESIDENTIAL(2.5 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.9000   Max loss rate(Fm) =   0.396(In/Hr)
Initial subarea data:
Initial area flow distance =   900.000(Ft.)
Top (of initial area) elevation = 4520.000(Ft.)
Bottom (of initial area) elevation = 4440.000(Ft.)
Difference in elevation =   80.000(Ft.)
Slope =   0.08889 s(%)=   8.89
TC = k(0.487)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.008 min.
Rainfall intensity =   4.317(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.817
Subarea runoff =   19.411(CFS)
Total initial stream area =   5.500(Ac.)
Pervious area fraction = 0.900
Initial area Fm value =   0.396(In/Hr)

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Process from Point/Station   2.000 to Point/Station   3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
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Estimated mean flow rate at midpoint of channel =   0.000(CFS)

Calc "A"   1

Depth of flow =   0.667(Ft.), Average velocity =   6.125(Ft/s)
       ****** Irregular Channel Data **********

Information entered for subchannel number 1 :
Point number   'X' coordinate   'Y' coordinate
     1   0.00   5.00
     2   50.00   0.00
     3   55.00   0.00
     4   105.00   5.00
Manning's 'N' friction factor =   0.040

Sub-Channel flow   =   47.625(CFS)
  '   '   flow top width =   18.330(Ft.)
  '   '   velocity=   6.125(Ft/s)
  '   '   area =   7.775(Sq.Ft)
  '   '   Froude number =   1.657

Upstream point elevation =   4440.000(Ft.)
Downstream point elevation =   4320.000(Ft.)
Flow length =   1400.000(Ft.)
Travel time   =   3.81 min.
Time of concentration =   15.82 min.
Depth of flow =   0.667(Ft.)
Average velocity =   6.125(Ft/s)
Total irregular channel flow =   47.625(CFS)
Irregular channel normal depth above invert elev. =   0.667(Ft.)
Average velocity of channel(s) =   6.125(Ft/s)
 Adding area flow to channel
RESIDENTIAL(2.5 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.9000   Max loss rate(Fm)=   0.396(In/Hr)
Rainfall intensity =   3.560(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.800
Subarea runoff =   56.336(CFS) for   21.100(Ac.)
Total runoff =   75.747(CFS)
Effective area this stream =   26.60(Ac.)
Total Study Area (Main Stream No. 1) =   26.60(Ac.)
Area averaged Fm value =   0.396(In/Hr)
Depth of flow =   0.826(Ft.), Average velocity =   6.916(Ft/s)

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Process from Point/Station   3.000 to Point/Station   4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel =   0.000(CFS)
Depth of flow =   1.014(Ft.), Average velocity =   7.515(Ft/s)
       ****** Irregular Channel Data **********

Information entered for subchannel number 1 :
Point number   'X' coordinate   'Y' coordinate
     1   0.00   5.00
     2   50.00   0.00
     3   55.00   0.00
     4   105.00   5.00

Calc "A"   2

Manning's 'N' friction factor =   0.040

Sub-Channel flow   =   115.347(CFS)
   '   '   flow top width =   25.278(Ft.)
   '   '   velocity=   7.515(Ft/s)
   '   '   area =   15.349(Sq.Ft)
   '   '   Froude number =   1.699

Upstream point elevation = 4320.000(Ft.)
Downstream point elevation = 4200.000(Ft.)
Flow length = 1500.000(Ft.)
Travel time   =   3.33 min.
Time of concentration =   19.14 min.
Depth of flow =   1.014(Ft.)
Average velocity =   7.515(Ft/s)
Total irregular channel flow =   115.347(CFS)
Irregular channel normal depth above invert elev. =   1.014(Ft.)
Average velocity of channel(s) =   7.515(Ft/s)
 Adding area flow to channel
RESIDENTIAL(2.5 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.9000   Max loss rate(Fm)=   0.396(In/Hr)
Rainfall intensity =   3.115(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.786
Subarea runoff =   79.140(CFS) for   36.700(Ac.)
Total runoff =   154.888(CFS)
Effective area this stream =   63.30(Ac.)
Total Study Area (Main Stream No. 1) =   63.30(Ac.)
Area averaged Fm value =   0.396(In/Hr)
Depth of flow =   1.155(Ft.), Average velocity =   8.105(Ft/s)

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Process from Point/Station   4.000 to Point/Station   5.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel =   0.000(CFS)
Depth of flow =   1.357(Ft.), Average velocity =   8.134(Ft/s)
       ******* Irregular Channel Data ***********

Information entered for subchannel number 1 :
Point number   'X' coordinate   'Y' coordinate
     1   0.00   5.00
     2   50.00   0.00
     3   55.00   0.00
     4   105.00   5.00
Manning's 'N' friction factor =   0.040

Sub-Channel flow   =   204.998(CFS)
   '   '   flow top width =   32.143(Ft.)
   '   '   velocity=   8.134(Ft/s)
   '   '   area =   25.204(Sq.Ft)
   '   '   Froude number =   1.619

Upstream point elevation = 4200.000(Ft.)

Calc "A"   3

Downstream point elevation = 4080.000(Ft.)
Flow length = 1800.000(Ft.)
Travel time = 3.69 min.
Time of concentration = 22.83 min.
Depth of flow = 1.357(Ft.)
Average velocity = 8.134(Ft/s)
Total irregular channel flow = 204.998(CFS)
Irregular channel normal depth above invert elev. = 1.357(Ft.)
Average velocity of channel(s) = 8.134(Ft/s)
 Adding area flow to channel
RESIDENTIAL(2.5 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.9000   Max loss rate(Fm)= 0.396(In/Hr)
Rainfall intensity = 2.753(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.771
Subarea runoff = 100.131(CFS) for 56.900(Ac.)
Total runoff = 255.018(CFS)
Effective area this stream = 120.20(Ac.)
Total Study Area (Main Stream No. 1) = 120.20(Ac.)
Area averaged Fm value = 0.396(In/Hr)
Depth of flow = 1.490(Ft.), Average velocity = 8.598(Ft/s)

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Process from Point/Station   5.000 to Point/Station   6.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 0.000(CFS)
Depth of flow = 2.448(Ft.), Average velocity = 11.510(Ft/s)
       ******* Irregular Channel Data **********

Information entered for subchannel number 1 :
Point number   'X' coordinate   'Y' coordinate
     1   0.00   5.00
     2   15.00   0.00
     3   20.00   0.00
     4   35.00   5.00
Manning's 'N' friction factor = 0.040

Sub-Channel flow =   347.858(CFS)
  '   '   flow top width =   19.690(Ft.)
  '   '   velocity= 11.510(Ft/s)
  '   '   area =   30.224(Sq.Ft)
  '   '   Froude number =   1.637

Upstream point elevation = 4080.000(Ft.)
Downstream point elevation = 3920.000(Ft.)
Flow length = 2800.000(Ft.)
Travel time = 4.05 min.
Time of concentration = 26.89 min.
Depth of flow = 2.448(Ft.)
Average velocity = 11.510(Ft/s)
Total irregular channel flow = 347.858(CFS)
Irregular channel normal depth above invert elev. = 2.448(Ft.)
Average velocity of channel(s) = 11.510(Ft/s)

Calc "A" 4

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  Adding area flow to channel
RESIDENTIAL(2.5 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.9000      Max loss rate(Fm)=     0.396(In/Hr)
Rainfall intensity =    2.456(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.755
Subarea runoff =    185.605(CFS) for  117.500(Ac.)
Total runoff =    440.623(CFS)
Effective area this stream =       237.70(Ac.)
Total Study Area (Main Stream No. 1) =       237.70(Ac.)
Area averaged Fm value =    0.396(In/Hr)
Depth of flow =   2.730(Ft.), Average velocity =  12.236(Ft/s)
End of computations, Total Study Area =       237.70 (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) = 0.900
Area averaged SCS curve number =  56.0
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Calc "A" 5

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CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
------------------------------------------------------------------
Parcel Map 19401
Pipe Capacity
APN 3068-171-07
00700612pipe
------------------------------------------------------------------


Program License Serial Number 4057

------------------------------------------------------------------
           *** Improved Channel Analysis ***

      Upstream (headworks) Elevation =     100.000(Ft.)
      Downstream (outlet) Elevation =      96.000(Ft.)
      Runoff/Flow Distance =     100.000(Ft.)
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*** CALCULATED OUTFLOW DATA AT INLET DEPTH =     3.00(Ft.) ***


Channel Type: PRESSURE/NON-PRESSURE PIPE
Height of channel inlet  =    100.000(Ft.)
Water surface elevation at inlet =   103.000(Ft.)
Height of channel outlet  =     96.000(Ft.)
Water surface elevation at outlet =    99.000(Ft.)
Difference in depth at inlet =        3.00(Ft.)
Pipe length  =   100.00(Ft.)
Manning's N = 0.025   No. of pipes = 1
Pipe size =       36.00(In.)

Following is data if FLOW RATE of     69.366(CFS) is
used so the total head loss =  difference in head:
     The total friction loss through the pipe is       4.000(Ft.)
     Pipe friction loss =        4.000(Ft.)
     Minor friction loss =        0.000(Ft.)   K-factor =   0.00
Calculated flow rate through pipe(s) =      69.366(CFS)
Pipe flow velocity =        9.81(Ft/s)


TOTAL OUTFLOW at this depth =     69.37(CFS)

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*** CALCULATED OUTFLOW DATA AT INLET DEPTH =     3.50(Ft.) ***


Channel Type: PRESSURE/NON-PRESSURE PIPE
Height of channel inlet  =    100.000(Ft.)
Water surface elevation at inlet =    103.500(Ft.)
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Calc "B"   1

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Height of channel outlet   =     96.000(Ft.)
Water surface elevation at outlet =     99.000(Ft.)
Difference in depth at inlet =       3.50(Ft.)
Pipe length  =    100.00(Ft.)
Manning's N = 0.025   No. of pipes = 1
Pipe size  =       36.00(In.)


Following is data if FLOW RATE of      73.574(CFS) is
used so the total head loss =  difference in head:
     The total friction loss through the pipe is       4.500(Ft.)
     Pipe friction loss =      4.500(Ft.)
     Minor friction loss =       0.000(Ft.)   K-factor =   0.00
Note: Pressure flow at pipe inlet
Calculated flow rate through pipe(s) =      73.574(CFS)
Pipe flow velocity =      10.41(Ft/s)


TOTAL OUTFLOW at this depth =       73.57(CFS)


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*** CALCULATED OUTFLOW DATA AT INLET DEPTH =      4.00(Ft.) ***


Channel Type: PRESSURE/NON-PRESSURE PIPE
Height of channel inlet   =    100.000(Ft.)
Water surface elevation at inlet =     104.000(Ft.)
Height of channel outlet   =     96.000(Ft.)
Water surface elevation at outlet =     99.000(Ft.)
Difference in depth at inlet =       4.00(Ft.)
Pipe length  =    100.00(Ft.)
Manning's N = 0.025   No. of pipes = 1
Pipe size  =       36.00(In.)


Following is data if FLOW RATE of      77.554(CFS) is
used so the total head loss =  difference in head:
     The total friction loss through the pipe is       5.000(Ft.)
     Pipe friction loss =      5.000(Ft.)
     Minor friction loss =       0.000(Ft.)   K-factor =   0.00
Note: Pressure flow at pipe inlet
Calculated flow rate through pipe(s) =      77.554(CFS)
Pipe flow velocity =      10.97(Ft/s)


TOTAL OUTFLOW at this depth =       77.55(CFS)


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*** CALCULATED OUTFLOW DATA AT INLET DEPTH =      5.00(Ft.) ***


Channel Type: PRESSURE/NON-PRESSURE PIPE
Height of channel inlet   =    100.000(Ft.)
Water surface elevation at inlet =     105.000(Ft.)
Height of channel outlet   =     96.000(Ft.)
Water surface elevation at outlet =     99.000(Ft.)
Difference in depth at inlet =       5.00(Ft.)
Pipe length  =    100.00(Ft.)
Manning's N = 0.025   No. of pipes = 1
Pipe size  =       36.00(In.)
```

Calc "B"   2

Following is data if FLOW RATE of   84.956(CFS) is
used so the total head loss = difference in head:
     The total friction loss through the pipe is   6.000(Ft.)
     Pipe friction loss =   6.000(Ft.)
     Minor friction loss =   0.000(Ft.)   K-factor =   0.00
Note: Pressure flow at pipe inlet
Calculated flow rate through pipe(s) =   84.956(CFS)
Pipe flow velocity =   12.02(Ft/s)

TOTAL OUTFLOW at this depth =   84.96(CFS)

FLOWRATE (CFS)   vs. INLET DEPTH (Ft.) & OUTLET DEPTH (Ft.) Summary:
          69.366   103.000   99.000
          73.574   103.500   99.000
          77.554   104.000   99.000
          84.956   105.000   99.000

Calc "B"   3