Appendix B: 100-Year Pre-Project Condition Hydrologic Output

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              San Diego County Rational Hydrology Program

 CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2009 Version 7.8

 Rational method hydrology  program based on
 San Diego County Flood Control Division 2003 hydrology manual
       Rational Hydrology Study        Date: 01/24/17
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 Shady Oak
 Existing Conditions
 Major Drainage Basin 100
 100-Year Flow Rate
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  *********   Hydrology Study Control Information **********

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 Program License Serial Number 6289

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 Rational hydrology study storm event year is   100.0
 English (in-lb) input data Units used

 Map data precipitation entered:
 6 hour,  precipitation(inches) =  3.750
 24 hour precipitation(inches) =  8.200
 P6/P24 =    45.7%
 San Diego hydrology manual 'C' values used


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 Process from Point/Station      100.000 to Point/Station      101.000
 **** INITIAL AREA EVALUATION ****
 ______________________________________________________________________
 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
 [LOW DENSITY RESIDENTIAL                     ]
 (1.0 DU/A or Less       )
 Impervious value, Ai = 0.100
 Sub-Area C Value = 0.360
 Initial subarea total flow distance  =   75.000(Ft.)
 Highest elevation = 1508.000(Ft.)
 Lowest elevation = 1502.000(Ft.)
 Elevation difference =    6.000(Ft.) Slope =  8.000 %
 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 The maximum overland flow distance is 100.00 (Ft)
 for the top area slope value of   8.00 %, in a development type of
  1.0 DU/A or Less
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In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.66 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3600)*( 100.000^.5)/(   8.000^(1/3)]=   6.66
Rainfall intensity (I) =      8.212(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff =      0.296(CFS)
Total initial stream area =       0.100(Ac.)


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Process from Point/Station      101.000 to Point/Station      102.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1502.000(Ft.)
Downstream point elevation =  1330.000(Ft.)
Channel length thru subarea  =   845.000(Ft.)
Channel base width      =   25.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =     13.964(CFS)
Manning's 'N'    = 0.035
Maximum depth of channel  =    4.000(Ft.)
Flow(q) thru subarea =     13.964(CFS)
Depth of flow =   0.119(Ft.), Average velocity =   4.570(Ft/s)
Channel flow top width =   26.194(Ft.)
Flow Velocity =    4.57(Ft/s)
Travel time  =    3.08 min.
Time of concentration =    9.74 min.
Critical depth =      0.211(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      6.426(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.997
Decimal fraction soil group D = 0.003
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity =      6.426(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360  CA =      4.286
Subarea runoff =     27.245(CFS) for     11.800(Ac.)
Total runoff =     27.540(CFS)      Total area =      11.900(Ac.)
Depth of flow =   0.179(Ft.), Average velocity =   5.942(Ft/s)
Critical depth =      0.328(Ft.)


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Process from Point/Station      102.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1330.000(Ft.)
Downstream point elevation =  1295.000(Ft.)
Channel length thru subarea  =   800.000(Ft.)
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Channel base width      =   37.000(Ft.)
Slope or 'Z' of left channel bank =  58.000
Slope or 'Z' of right channel bank =  58.000
Estimated mean flow rate at midpoint of channel =     34.236(CFS)
Manning's 'N'    = 0.035
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     34.236(CFS)
Depth of flow =   0.235(Ft.), Average velocity =   2.883(Ft/s)
Channel flow top width =   64.222(Ft.)
Flow Velocity =    2.88(Ft/s)
Travel time  =    4.63 min.
Time of concentration =   14.37 min.
Critical depth =      0.258(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.001(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.115
Decimal fraction soil group D = 0.885
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.404
Rainfall intensity =      5.001(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.380  CA =      8.167
Subarea runoff =     13.305(CFS) for      9.600(Ac.)
Total runoff =     40.845(CFS)      Total area =      21.500(Ac.)
Depth of flow =   0.258(Ft.), Average velocity =   3.042(Ft/s)
Critical depth =      0.287(Ft.)


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Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     21.500(Ac.)
Runoff from this stream =     40.845(CFS)
Time of concentration =   14.37 min.
Rainfall intensity =     5.001(In/Hr)


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Process from Point/Station      110.000 to Point/Station      111.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  162.000(Ft.)
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Highest elevation = 1486.000(Ft.)
Lowest elevation = 1445.000(Ft.)
Elevation difference =   41.000(Ft.) Slope = 25.309 %
Top of Initial Area Slope adjusted by User to 25.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  25.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.92 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  25.000^(1/3)]=   4.92
Calculated TC of    4.925 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.296(CFS)
Total initial stream area =        0.100(Ac.)


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Process from Point/Station      111.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1445.000(Ft.)
Downstream point elevation =  1295.000(Ft.)
Channel length thru subarea  =  1405.000(Ft.)
Channel base width      =   19.000(Ft.)
Slope or 'Z' of left channel bank =  30.000
Slope or 'Z' of right channel bank =  30.000
Estimated mean flow rate at midpoint of channel =      8.108(CFS)
Manning's 'N'    = 0.035
Maximum depth of channel  =    0.200(Ft.)
Flow(q) thru subarea =      8.108(CFS)
Depth of flow =   0.118(Ft.), Average velocity =   3.035(Ft/s)
Channel flow top width =   26.108(Ft.)
Flow Velocity =    3.03(Ft/s)
Travel time  =    7.72 min.
Time of concentration =   12.64 min.
Critical depth =      0.162(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.432(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.300
Decimal fraction soil group D = 0.700
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.395
Rainfall intensity =      5.432(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.394  CA =      2.913
Subarea runoff =     15.530(CFS) for      7.300(Ac.)
Total runoff =     15.826(CFS)      Total area =       7.400(Ac.)
Depth of flow =   0.173(Ft.), Average velocity =   3.783(Ft/s)
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Critical depth =      0.238(Ft.)


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Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      7.400(Ac.)
Runoff from this stream =     15.826(CFS)
Time of concentration =   12.64 min.
Rainfall intensity =     5.432(In/Hr)
Summary of stream data:

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


1       40.845     14.37              5.001
2       15.826     12.64              5.432
Qmax(1) =
         1.000 *    1.000 *    40.845) +
         0.921 *    1.000 *    15.826) + =      55.417
Qmax(2) =
         1.000 *    0.880 *    40.845) +
         1.000 *    1.000 *    15.826) + =      51.763

Total of 2 streams to confluence:
Flow rates before confluence point:
      40.845      15.826
Maximum flow rates at confluence using above data:
       55.417       51.763
Area of streams before confluence:
       21.500        7.400
Results of confluence:
Total flow rate =     55.417(CFS)
Time of concentration =    14.367 min.
Effective stream area after confluence =     28.900(Ac.)


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Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1295.000(Ft.)
Downstream point/station elevation =  1294.500(Ft.)
Pipe length  =    12.00(Ft.) Slope =   0.0417  Manning's N = 0.024
No. of pipes = 1  Required pipe flow  =    55.417(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    55.417(CFS)
Normal flow depth in pipe =   25.59(In.)
Flow top width inside pipe =   27.54(In.)
Critical Depth =   29.06(In.)
Pipe flow velocity =     11.20(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    14.39 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 1
Stream flow area =     28.900(Ac.)
Runoff from this stream =     55.417(CFS)
Time of concentration =   14.39 min.
Rainfall intensity =     4.997(In/Hr)


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Process from Point/Station      120.000 to Point/Station      121.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation = 1340.000(Ft.)
Lowest elevation = 1325.000(Ft.)
Elevation difference =   15.000(Ft.) Slope = 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  15.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.84 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  15.000^(1/3)]=   5.84
Rainfall intensity (I) =      8.940(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.268(CFS)
Total initial stream area =       0.100(Ac.)


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Process from Point/Station      121.000 to Point/Station      122.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1325.000(Ft.)
End of street segment elevation =  1298.000(Ft.)
Length of street segment  =  1117.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  31.999(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
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Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.000
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  6.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      4.397(CFS)
Depth of flow =   0.575(Ft.), Average velocity =   2.456(Ft/s)
Warning: depth of flow exceeds top of curb
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   3.766(Ft.)
Flow velocity =   2.46(Ft/s)
Travel time =    7.58 min.     TC =   13.42  min.
 Adding area flow to street
Rainfall intensity (I) =      5.227(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.610
Decimal fraction soil group D = 0.390
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.582
Rainfall intensity =      5.227(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.572  CA =      1.659
Subarea runoff =      8.402(CFS) for      2.800(Ac.)
Total runoff =      8.670(CFS)      Total area =       2.900(Ac.)
Street flow at end of street =      8.670(CFS)
Half street flow at end of street =      4.335(CFS)
Depth of flow =   0.610(Ft.), Average velocity =   3.103(Ft/s)
Warning: depth of flow exceeds top of curb
Flow width (from curb towards crown)=   5.482(Ft.)


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Process from Point/Station      122.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1295.200(Ft.)
Downstream point/station elevation =  1294.500(Ft.)
Pipe length  =   160.00(Ft.) Slope =   0.0044  Manning's N = 0.024
No. of pipes = 1  Required pipe flow  =     8.670(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     3.574(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      3.714(Ft.)
 Minor friction loss =      0.561(Ft.)    K-factor =   1.50
Pipe flow velocity =      4.91(Ft/s)
Travel time through pipe =    0.54 min.
Time of concentration (TC) =    13.96 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 =      2.900(Ac.)
Runoff from this stream =      8.670(CFS)
Time of concentration =   13.96 min.
Rainfall intensity =     5.095(In/Hr)
Summary of stream data:

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


1       55.417     14.39              4.997
2        8.670     13.96              5.095
Qmax(1) =
         1.000 *    1.000 *    55.417) +
         0.981 *    1.000 *     8.670) + =      63.922
Qmax(2) =
         1.000 *    0.971 *    55.417) +
         1.000 *    1.000 *     8.670) + =      62.459

Total of 2 streams to confluence:
Flow rates before confluence point:
      55.417       8.670
Maximum flow rates at confluence using above data:
       63.922       62.459
Area of streams before confluence:
       28.900        2.900
Results of confluence:
Total flow rate =     63.922(CFS)
Time of concentration =    14.385 min.
Effective stream area after confluence =     31.800(Ac.)


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Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1294.500(Ft.)
Downstream point/station elevation =  1288.700(Ft.)
Pipe length  =    96.00(Ft.) Slope =   0.0604  Manning's N = 0.024
No. of pipes = 1  Required pipe flow  =    63.922(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    63.922(CFS)
Normal flow depth in pipe =   24.66(In.)
Flow top width inside pipe =   28.69(In.)
Critical Depth =   30.40(In.)
Pipe flow velocity =     13.43(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =    14.50 min.
End of computations, total study area =          31.800 (Ac.)
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Appendix C: 100-Year Post-Project Condition Hydrologic Output

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            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2009 Version 7.8

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 01/24/17
-----------------------------------------------------------------------
-
Shady Oak
Proposed Conditions
Major Drainage Basin 100
100-Year Flow Rate
-----------------------------------------------------------------------
-
 *********   Hydrology Study Control Information **********

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



Program License Serial Number 6289

-----------------------------------------------------------------------
-
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.750
24 hour precipitation(inches) =  8.200
P6/P24 =    45.7%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation = 1508.000(Ft.)
Lowest elevation = 1502.000(Ft.)
Elevation difference =    6.000(Ft.) Slope =  8.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   8.00 %, in a development type of
 1.0 DU/A or Less
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```
In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.66 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3600)*( 100.000^.5)/(   8.000^(1/3)]=   6.66
Rainfall intensity (I) =      8.212(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff =      0.296(CFS)
Total initial stream area =        0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1502.000(Ft.)
Downstream point elevation =  1330.000(Ft.)
Channel length thru subarea  =   845.000(Ft.)
Channel base width      =   25.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =     13.964(CFS)
Manning's 'N'    = 0.035
Maximum depth of channel  =    4.000(Ft.)
Flow(q) thru subarea =     13.964(CFS)
Depth of flow =   0.119(Ft.), Average velocity =   4.570(Ft/s)
Channel flow top width =   26.194(Ft.)
Flow Velocity =    4.57(Ft/s)
Travel time  =    3.08 min.
Time of concentration =    9.74 min.
Critical depth =      0.211(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      6.426(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.997
Decimal fraction soil group D = 0.003
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity =      6.426(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360  CA =      4.286
Subarea runoff =     27.245(CFS) for     11.800(Ac.)
Total runoff =     27.540(CFS)      Total area =      11.900(Ac.)
Depth of flow =   0.179(Ft.), Average velocity =   5.942(Ft/s)
Critical depth =      0.328(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1330.000(Ft.)
Downstream point elevation =  1295.000(Ft.)
Channel length thru subarea  =   800.000(Ft.)
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```
Channel base width      =   37.000(Ft.)
Slope or 'Z' of left channel bank =  58.000
Slope or 'Z' of right channel bank =  58.000
Estimated mean flow rate at midpoint of channel =     34.236(CFS)
Manning's 'N'    = 0.035
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     34.236(CFS)
Depth of flow =   0.235(Ft.), Average velocity =   2.883(Ft/s)
Channel flow top width =   64.222(Ft.)
Flow Velocity =    2.88(Ft/s)
Travel time  =    4.63 min.
Time of concentration =   14.37 min.
Critical depth =      0.258(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.001(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.115
Decimal fraction soil group D = 0.885
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.404
Rainfall intensity =      5.001(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.380  CA =      8.167
Subarea runoff =     13.305(CFS) for      9.600(Ac.)
Total runoff =     40.845(CFS)      Total area =      21.500(Ac.)
Depth of flow =   0.258(Ft.), Average velocity =   3.042(Ft/s)
Critical depth =      0.287(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     21.500(Ac.)
Runoff from this stream =     40.845(CFS)
Time of concentration =   14.37 min.
Rainfall intensity =     5.001(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      111.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  162.000(Ft.)
```

```
Highest elevation = 1486.000(Ft.)
Lowest elevation = 1445.000(Ft.)
Elevation difference =   41.000(Ft.) Slope = 25.309 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  25.30 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.91 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  25.300^(1/3)]=   4.91
Calculated TC of    4.905 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.296(CFS)
Total initial stream area =        0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1445.000(Ft.)
Downstream point elevation =  1295.000(Ft.)
Channel length thru subarea  =  1537.000(Ft.)
Channel base width      =   19.000(Ft.)
Slope or 'Z' of left channel bank =  30.000
Slope or 'Z' of right channel bank =  30.000
Estimated mean flow rate at midpoint of channel =      2.456(CFS)
Manning's 'N'    = 0.035
Maximum depth of channel  =    0.200(Ft.)
Flow(q) thru subarea =      2.456(CFS)
Depth of flow =   0.061(Ft.), Average velocity =   1.939(Ft/s)
Channel flow top width =   22.649(Ft.)
Flow Velocity =    1.94(Ft/s)
Travel time  =   13.21 min.
Time of concentration =   18.11 min.
Critical depth =      0.077(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.307(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.593
Decimal fraction soil group D = 0.407
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.380
Rainfall intensity =      4.307(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.377  CA =      1.057
Subarea runoff =      4.256(CFS) for      2.700(Ac.)
Total runoff =      4.552(CFS)      Total area =       2.800(Ac.)
Depth of flow =   0.087(Ft.), Average velocity =   2.416(Ft/s)
Critical depth =      0.113(Ft.)
```

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Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.800(Ac.)
Runoff from this stream =      4.552(CFS)
Time of concentration =   18.11 min.
Rainfall intensity =     4.307(In/Hr)
Summary of stream data:

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


1       40.845     14.37               5.001
2        4.552     18.11               4.307
Qmax(1) =
         1.000 *    1.000 *    40.845) +
         1.000 *    0.793 *     4.552) + =      44.456
Qmax(2) =
         0.861 *    1.000 *    40.845) +
         1.000 *    1.000 *     4.552) + =      39.727

Total of 2 streams to confluence:
Flow rates before confluence point:
      40.845       4.552
Maximum flow rates at confluence using above data:
       44.456       39.727
Area of streams before confluence:
       21.500        2.800
Results of confluence:
Total flow rate =     44.456(CFS)
Time of concentration =    14.367 min.
Effective stream area after confluence =     24.300(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1295.000(Ft.)
Downstream point/station elevation =  1294.500(Ft.)
Pipe length  =    12.00(Ft.) Slope =   0.0417  Manning's N = 0.024
No. of pipes = 1  Required pipe flow  =    44.456(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    44.456(CFS)
Normal flow depth in pipe =   24.09(In.)
Flow top width inside pipe =   23.86(In.)
Critical Depth =   26.60(In.)
Pipe flow velocity =     10.53(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    14.39 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 1
Stream flow area =     24.300(Ac.)
Runoff from this stream =     44.456(CFS)
Time of concentration =   14.39 min.
Rainfall intensity =     4.997(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      150.000 to Point/Station      151.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.600
Initial subarea total flow distance  =   72.000(Ft.)
Highest elevation = 1299.000(Ft.)
Lowest elevation = 1298.000(Ft.)
Elevation difference =    1.000(Ft.) Slope =  1.389 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of   1.38 %, in a development type of
 10.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.52 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6000)*(  65.000^.5)/(   1.380^(1/3)]=   6.52
Rainfall intensity (I) =      8.328(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.600
Subarea runoff =      0.500(CFS)
Total initial stream area =        0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      151.000 to Point/Station      152.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1298.000(Ft.)
End of street segment elevation =  1297.700(Ft.)
Length of street segment  =    36.500(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  41.000(Ft.)
Distance from crown to crossfall grade break  =  40.990(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
```

```
Slope from curb to property line (v/hz) =   0.020
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  6.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      2.215(CFS)
Depth of flow =   0.661(Ft.), Average velocity =   1.711(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    8.05(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   8.045(Ft.)
Flow velocity =   1.71(Ft/s)
Travel time =    0.36 min.     TC =    6.87  min.
 Adding area flow to street
Rainfall intensity (I) =      8.047(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.600
Rainfall intensity =      8.047(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.600  CA =      0.480
Subarea runoff =      3.363(CFS) for      0.700(Ac.)
Total runoff =      3.863(CFS)      Total area =       0.800(Ac.)
Street flow at end of street =      3.863(CFS)
Half street flow at end of street =      3.863(CFS)
Depth of flow =   0.698(Ft.), Average velocity =   1.978(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    9.88(Ft.)
Flow width (from curb towards crown)=   9.881(Ft.)


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Process from Point/Station      152.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1295.200(Ft.)
Downstream point/station elevation =  1294.500(Ft.)
Pipe length  =   160.00(Ft.) Slope =   0.0044  Manning's N = 0.024
No. of pipes = 1  Required pipe flow  =     3.863(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.148(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.737(Ft.)
 Minor friction loss =      0.111(Ft.)    K-factor =   1.50
Pipe flow velocity =      2.19(Ft/s)
Travel time through pipe =    1.22 min.
Time of concentration (TC) =     8.09 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 =      0.800(Ac.)
Runoff from this stream =      3.863(CFS)
Time of concentration =    8.09 min.
Rainfall intensity =     7.242(In/Hr)
Summary of stream data:

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


1       44.456     14.39              4.997
2        3.863      8.09              7.242
Qmax(1) =
         1.000 *    1.000 *    44.456) +
         0.690 *    1.000 *     3.863) + =      47.121
Qmax(2) =
         1.000 *    0.563 *    44.456) +
         1.000 *    1.000 *     3.863) + =      28.871

Total of 2 streams to confluence:
Flow rates before confluence point:
      44.456       3.863
Maximum flow rates at confluence using above data:
       47.121       28.871
Area of streams before confluence:
       24.300        0.800
Results of confluence:
Total flow rate =     47.121(CFS)
Time of concentration =    14.386 min.
Effective stream area after confluence =     25.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1294.500(Ft.)
Downstream point/station elevation =  1288.700(Ft.)
Pipe length  =    96.00(Ft.) Slope =   0.0604  Manning's N = 0.024
No. of pipes = 1  Required pipe flow  =    47.121(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    47.121(CFS)
Normal flow depth in pipe =   21.49(In.)
Flow top width inside pipe =   27.04(In.)
Critical Depth =   27.12(In.)
Pipe flow velocity =     12.52(Ft/s)
Travel time through pipe =    0.13 min.
Time of concentration (TC) =    14.51 min.


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Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     25.100(Ac.)
Runoff from this stream =     47.121(CFS)
Time of concentration =   14.51 min.
Rainfall intensity =     4.969(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      130.000 to Point/Station      131.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.570
Initial subarea total flow distance  =   60.000(Ft.)
Highest elevation = 1317.800(Ft.)
Lowest elevation = 1314.000(Ft.)
Elevation difference =    3.800(Ft.) Slope =  6.333 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   6.33 %, in a development type of
 10.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.16 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5700)*( 100.000^.5)/(   6.330^(1/3)]=   5.16
Rainfall intensity (I) =      9.685(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.570
Subarea runoff =      0.552(CFS)
Total initial stream area =        0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      131.000 to Point/Station      132.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1314.000(Ft.)
End of street segment elevation =  1297.000(Ft.)
Length of street segment  =   770.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  13.000(Ft.)
Distance from crown to crossfall grade break  =  11.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  11.500(Ft.)
```

```
Slope from curb to property line (v/hz) =   0.015
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.270(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      9.295(CFS)
Depth of flow =   0.198(Ft.), Average velocity =   3.558(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.000(Ft.)
Flow velocity =   3.56(Ft/s)
Travel time =    3.61 min.     TC =    8.76  min.
 Adding area flow to street
Rainfall intensity (I) =      6.880(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.756
Decimal fraction soil group D = 0.244
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.577
Rainfall intensity =      6.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.577  CA =      2.597
Subarea runoff =     17.316(CFS) for      4.400(Ac.)
Total runoff =     17.868(CFS)      Total area =       4.500(Ac.)
Street flow at end of street =     17.868(CFS)
Half street flow at end of street =      8.934(CFS)
Depth of flow =   0.246(Ft.), Average velocity =   4.613(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  13.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      132.000 to Point/Station      132.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      4.500(Ac.)
Runoff from this stream =     17.868(CFS)
Time of concentration =    8.76 min.
Rainfall intensity =     6.880(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      140.000 to Point/Station      141.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
```

```
Impervious value, Ai = 0.450
Sub-Area C Value = 0.600
Initial subarea total flow distance  =  127.000(Ft.)
Highest elevation = 1311.300(Ft.)
Lowest elevation = 1307.560(Ft.)
Elevation difference =    3.740(Ft.) Slope =  2.945 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   2.94 %, in a development type of
 10.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.96 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6000)*(  90.000^.5)/(   2.940^(1/3)]=   5.96
Rainfall intensity (I) =      8.822(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.600
Subarea runoff =      0.529(CFS)
Total initial stream area =        0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      141.000 to Point/Station      132.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1307.560(Ft.)
End of street segment elevation =  1297.000(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  14.000(Ft.)
Distance from crown to crossfall grade break  =  12.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.004
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.015
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  4.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      1.059(CFS)
Depth of flow =   0.244(Ft.), Average velocity =   3.948(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   1.500(Ft.)
Flow velocity =   3.95(Ft/s)
Travel time =    1.27 min.     TC =    7.23  min.
 Adding area flow to street
Rainfall intensity (I) =      7.791(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.600
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```
Rainfall intensity =      7.791(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.600  CA =      0.180
Subarea runoff =      0.873(CFS) for      0.200(Ac.)
Total runoff =      1.402(CFS)      Total area =       0.300(Ac.)
Street flow at end of street =      1.402(CFS)
Half street flow at end of street =      0.701(CFS)
Depth of flow =   0.271(Ft.), Average velocity =   4.236(Ft/s)
Flow width (from curb towards crown)=   1.500(Ft.)


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Process from Point/Station      132.000 to Point/Station      132.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.300(Ac.)
Runoff from this stream =      1.402(CFS)
Time of concentration =    7.23 min.
Rainfall intensity =     7.791(In/Hr)
Summary of stream data:

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


1       17.868      8.76               6.880
2        1.402      7.23               7.791
Qmax(1) =
         1.000 *    1.000 *    17.868) +
         0.883 *    1.000 *     1.402) + =      19.106
Qmax(2) =
         1.000 *    0.825 *    17.868) +
         1.000 *    1.000 *     1.402) + =      16.136

Total of 2 streams to confluence:
Flow rates before confluence point:
      17.868       1.402
Maximum flow rates at confluence using above data:
       19.106       16.136
Area of streams before confluence:
        4.500        0.300
Results of confluence:
Total flow rate =     19.106(CFS)
Time of concentration =     8.764 min.
Effective stream area after confluence =      4.800(Ac.)


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Process from Point/Station      132.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1292.700(Ft.)
Downstream point/station elevation =  1259.600(Ft.)
Pipe length  =    12.66(Ft.) Slope =   2.6145  Manning's N = 0.015
No. of pipes = 1  Required pipe flow  =    19.106(CFS)
```

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Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =    19.106(CFS)
Normal flow depth in pipe =    6.22(In.)
Flow top width inside pipe =    8.31(In.)
Critical depth could not be calculated.
Pipe flow velocity =     58.60(Ft/s)
Travel time through pipe =    0.00 min.
Time of concentration (TC) =     8.77 min.


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Process from Point/Station      122.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      4.800(Ac.)
Runoff from this stream =     19.106(CFS)
Time of concentration =    8.77 min.
Rainfall intensity =     6.878(In/Hr)


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Process from Point/Station      120.000 to Point/Station      121.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation = 1340.000(Ft.)
Lowest elevation = 1325.000(Ft.)
Elevation difference =   15.000(Ft.) Slope = 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  15.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.84 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  15.000^(1/3)]=   5.84
Rainfall intensity (I) =      8.940(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.268(CFS)
Total initial stream area =        0.100(Ac.)


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Process from Point/Station      121.000 to Point/Station      122.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1325.000(Ft.)
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End of street segment elevation =  1298.100(Ft.)
Length of street segment  =  1008.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  30.100(Ft.)
Distance from crown to crossfall grade break  =  28.600(Ft.)
Slope from gutter to grade break (v/hz) =   0.055
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.500(Ft.)
Slope from curb to property line (v/hz) =   0.500
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  5.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      3.350(CFS)
Depth of flow =   0.466(Ft.), Average velocity =   3.744(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   3.967(Ft.)
Flow velocity =   3.74(Ft/s)
Travel time =    4.49 min.     TC =   10.33  min.
 Adding area flow to street
Rainfall intensity (I) =      6.189(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.930
Decimal fraction soil group D = 0.070
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.572
Rainfall intensity =      6.189(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.558  CA =      1.060
Subarea runoff =      6.290(CFS) for      1.800(Ac.)
Total runoff =      6.559(CFS)      Total area =       1.900(Ac.)
Street flow at end of street =      6.559(CFS)
Half street flow at end of street =      3.279(CFS)
Depth of flow =   0.533(Ft.), Average velocity =   3.959(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    0.07(Ft.)
Flow width (from curb towards crown)=   7.330(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.900(Ac.)
Runoff from this stream =      6.559(CFS)
Time of concentration =   10.33 min.
Rainfall intensity =     6.189(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
```

```
 No.       (CFS)       (min)                 (In/Hr)


1       19.106      8.77               6.878
2        6.559     10.33               6.189
Qmax(1) =
         1.000 *    1.000 *    19.106) +
         1.000 *    0.849 *     6.559) + =      24.675
Qmax(2) =
         0.900 *    1.000 *    19.106) +
         1.000 *    1.000 *     6.559) + =      23.751

Total of 2 streams to confluence:
Flow rates before confluence point:
      19.106       6.559
Maximum flow rates at confluence using above data:
       24.675       23.751
Area of streams before confluence:
        4.800        1.900
Results of confluence:
Total flow rate =     24.675(CFS)
Time of concentration =     8.767 min.
Effective stream area after confluence =      6.700(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =    1292.500(Ft.)
Downstream point/station elevation =  1291.000(Ft.)
Pipe length  =   317.66(Ft.) Slope =   0.0047  Manning's N = 0.015
No. of pipes = 1  Required pipe flow  =    24.675(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    24.675(CFS)
Normal flow depth in pipe =   21.98(In.)
Flow top width inside pipe =   31.12(In.)
Critical Depth =   19.72(In.)
Pipe flow velocity =      5.87(Ft/s)
Travel time through pipe =    0.90 min.
Time of concentration (TC) =     9.67 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      6.700(Ac.)
Runoff from this stream =     24.675(CFS)
Time of concentration =    9.67 min.
Rainfall intensity =     6.457(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
```

```
 No.       (CFS)       (min)                 (In/Hr)


1       47.121     14.51               4.969
2       24.675      9.67               6.457
Qmax(1) =
         1.000 *    1.000 *    47.121) +
         0.770 *    1.000 *    24.675) + =      66.109
Qmax(2) =
         1.000 *    0.666 *    47.121) +
         1.000 *    1.000 *    24.675) + =      56.068

Total of 2 main streams to confluence:
Flow rates before confluence point:
      47.121      24.675
Maximum flow rates at confluence using above data:
       66.109       56.068
Area of streams before confluence:
       25.100        6.700


Results of confluence:
Total flow rate =     66.109(CFS)
Time of concentration =    14.514 min.
Effective stream area after confluence  =     31.800(Ac.)
End of computations, total study area =          31.800 (Ac.)
```

Appendix D: HEC-1 Detention Calculations

```
1*******************************************                           *******************************************
 *                                         *                           *                                         *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *                           *   U.S. ARMY CORPS OF ENGINEERS          *
 *              JUN  1998                  *                           *   HYDROLOGIC ENGINEERING CENTER         *
 *            VERSION 4.1                  *                           *          609 SECOND STREET              *
 *                                         *                           *       DAVIS, CALIFORNIA 95616           *
 *  RUN DATE   18APR17  TIME  17:17:04     *                           *           (916) 756-1104                *
 *                                         *                           *                                         *
 *******************************************                           *******************************************




                                   X     X  XXXXXXX   XXXXX           X
                                   X     X  X        X     X         XX
                                   X     X  X        X                X
                                   XXXXXXX  XXXX     X       XXXXX    X
                                   X     X  X        X                X
                                   X     X  X        X     X          X
                                   X     X  XXXXXXX   XXXXX          XXX




          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL    LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                            HEC-1 INPUT                                                     PAGE  1

         LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                     *DIAGRAM
 *** FREE ***
            1        ID   SHADY OAK
            2        ID   PRELIMINARY 100-YEAR DETENTION ANALYSIS
            3        IT       2 01JAN90    1200     200

            4        KK   BASIN
            5        KM   RATIONAL METHOD HYDROGRAPH PROGRAM
            6        KM   100-YEAR, 6-HOUR RAINFALL IS 3.75 INCHES
            7        KM   RATIONAL METHOD RUNOFF COEFFICIENT IS 0.418
            8        KM   RATIONAL METHOD TIME OF CONCENTRATION IS 14.514 MINUTES
            9        KM   DRAINAGE AREA IS 31.8 ACRES
           10        BA  0.0497
           11        IN      15 01JAN90    1153
           12        QI       0       3     3.1     3.3     3.4     3.6     3.8     4.1     4.3     4.8
           13        QI       5     5.8     6.3     7.7     8.7    12.8    16.6    66.1    10.3     6.9
           14        QI     5.4     4.5     3.9     3.5     3.2       0       0       0       0       0
           15        QI       0       0       0       0       0       0

           16        KK  DETAIN
           17        RS       1    STOR      -1
           18        SV       0    0.06
           19        SQ       0    63.9
           20        SE     100     101
           21        ZZ
1
            SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   4       BASIN
               V
               V
  16       DETAIN

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*******************************************                           *******************************************
 *                                         *                           *                                         *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *                           *   U.S. ARMY CORPS OF ENGINEERS          *
 *              JUN  1998                  *                           *   HYDROLOGIC ENGINEERING CENTER         *
 *            VERSION 4.1                  *                           *          609 SECOND STREET              *
 *                                         *                           *       DAVIS, CALIFORNIA 95616           *
 *  RUN DATE   18APR17  TIME  17:17:04     *                           *           (916) 756-1104                *
 *                                         *                           *                                         *
 *******************************************                           *******************************************




                          SHADY OAK
                          PRELIMINARY 100-YEAR DETENTION ANALYSIS

    IT          HYDROGRAPH TIME DATA
                        NMIN          2  MINUTES IN COMPUTATION INTERVAL
                       IDATE     1JAN90  STARTING DATE
                       ITIME       1200  STARTING TIME
                          NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     1JAN90  ENDING DATE
                      NDTIME       1838  ENDING TIME
                       ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL     .03 HOURS
                      TOTAL TIME BASE    6.63 HOURS

       ENGLISH UNITS
            DRAINAGE AREA         SQUARE MILES
            PRECIPITATION DEPTH   INCHES
            LENGTH, ELEVATION     FEET
            FLOW                  CUBIC FEET PER SECOND
            STORAGE VOLUME        ACRE-FEET
            SURFACE AREA          ACRES
```

```
              TEMPERATURE             DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   4 KK       *   BASIN    *
              *            *
              **************

                              RATIONAL METHOD HYDROGRAPH PROGRAM
                              100-YEAR, 6-HOUR RAINFALL IS 3.75 INCHES
                              RATIONAL METHOD RUNOFF COEFFICIENT IS 0.418
                              RATIONAL METHOD TIME OF CONCENTRATION IS 14.514 MINUTES
                              DRAINAGE AREA IS 31.8 ACRES

  11 IN             TIME DATA FOR INPUT TIME SERIES
                          JXMIN          15  TIME INTERVAL IN MINUTES
                         JXDATE      1JAN90  STARTING DATE
                         JXTIME        1153  STARTING TIME

              SUBBASIN RUNOFF DATA

  10 BA             SUBBASIN CHARACTERISTICS
                          TAREA         .05  SUBBASIN AREA

                                                       ***

*************************************************************************************************************************************

                                                    HYDROGRAPH AT STATION    BASIN

*************************************************************************************************************************************
                                  *                                  *                                  *
   DA MON HRMN  ORD        FLOW   *    DA MON HRMN  ORD       FLOW   *    DA MON HRMN  ORD       FLOW   *    DA MON HRMN  ORD         FLOW
                                  *                                  *                                  *
    1 JAN 1200    1          1.   *    1 JAN 1340   51          4.   *    1 JAN 1520  101          9.   *    1 JAN 1700  151            5.
    1 JAN 1202    2          2.   *    1 JAN 1342   52          4.   *    1 JAN 1522  102          9.   *    1 JAN 1702  152            5.
    1 JAN 1204    3          2.   *    1 JAN 1344   53          4.   *    1 JAN 1524  103          9.   *    1 JAN 1704  153            5.
    1 JAN 1206    4          3.   *    1 JAN 1346   54          4.   *    1 JAN 1526  104         10.   *    1 JAN 1706  154            5.
    1 JAN 1208    5          3.   *    1 JAN 1348   55          4.   *    1 JAN 1528  105         10.   *    1 JAN 1708  155            5.
    1 JAN 1210    6          3.   *    1 JAN 1350   56          4.   *    1 JAN 1530  106         11.   *    1 JAN 1710  156            4.
    1 JAN 1212    7          3.   *    1 JAN 1352   57          4.   *    1 JAN 1532  107         11.   *    1 JAN 1712  157            4.
    1 JAN 1214    8          3.   *    1 JAN 1354   58          4.   *    1 JAN 1534  108         12.   *    1 JAN 1714  158            4.
    1 JAN 1216    9          3.   *    1 JAN 1356   59          4.   *    1 JAN 1536  109         12.   *    1 JAN 1716  159            4.
    1 JAN 1218   10          3.   *    1 JAN 1358   60          4.   *    1 JAN 1538  110         13.   *    1 JAN 1718  160            4.
    1 JAN 1220   11          3.   *    1 JAN 1400   61          5.   *    1 JAN 1540  111         13.   *    1 JAN 1720  161            4.
    1 JAN 1222   12          3.   *    1 JAN 1402   62          5.   *    1 JAN 1542  112         14.   *    1 JAN 1722  162            4.
    1 JAN 1224   13          3.   *    1 JAN 1404   63          5.   *    1 JAN 1544  113         14.   *    1 JAN 1724  163            4.
    1 JAN 1226   14          3.   *    1 JAN 1406   64          5.   *    1 JAN 1546  114         15.   *    1 JAN 1726  164            4.
    1 JAN 1228   15          3.   *    1 JAN 1408   65          5.   *    1 JAN 1548  115         15.   *    1 JAN 1728  165            4.
    1 JAN 1230   16          3.   *    1 JAN 1410   66          5.   *    1 JAN 1550  116         16.   *    1 JAN 1730  166            4.
    1 JAN 1232   17          3.   *    1 JAN 1412   67          5.   *    1 JAN 1552  117         16.   *    1 JAN 1732  167            4.
    1 JAN 1234   18          3.   *    1 JAN 1414   68          5.   *    1 JAN 1554  118         20.   *    1 JAN 1734  168            4.
    1 JAN 1236   19          3.   *    1 JAN 1416   69          5.   *    1 JAN 1556  119         27.   *    1 JAN 1736  169            4.
    1 JAN 1238   20          3.   *    1 JAN 1418   70          5.   *    1 JAN 1558  120         33.   *    1 JAN 1738  170            4.
    1 JAN 1240   21          3.   *    1 JAN 1420   71          5.   *    1 JAN 1600  121         40.   *    1 JAN 1740  171            3.
    1 JAN 1242   22          3.   *    1 JAN 1422   72          5.   *    1 JAN 1602  122         46.   *    1 JAN 1742  172            3.
    1 JAN 1244   23          3.   *    1 JAN 1424   73          5.   *    1 JAN 1604  123         53.   *    1 JAN 1744  173            3.
    1 JAN 1246   24          3.   *    1 JAN 1426   74          5.   *    1 JAN 1606  124         60.   *    1 JAN 1746  174            3.
    1 JAN 1248   25          3.   *    1 JAN 1428   75          5.   *    1 JAN 1608  125         66.   *    1 JAN 1748  175            3.
    1 JAN 1250   26          3.   *    1 JAN 1430   76          5.   *    1 JAN 1610  126         59.   *    1 JAN 1750  176            3.
    1 JAN 1252   27          3.   *    1 JAN 1432   77          5.   *    1 JAN 1612  127         51.   *    1 JAN 1752  177            3.
    1 JAN 1254   28          3.   *    1 JAN 1434   78          6.   *    1 JAN 1614  128         44.   *    1 JAN 1754  178            3.
    1 JAN 1256   29          3.   *    1 JAN 1436   79          6.   *    1 JAN 1616  129         36.   *    1 JAN 1756  179            3.
    1 JAN 1258   30          3.   *    1 JAN 1438   80          6.   *    1 JAN 1618  130         29.   *    1 JAN 1758  180            2.
    1 JAN 1300   31          3.   *    1 JAN 1440   81          6.   *    1 JAN 1620  131         21.   *    1 JAN 1800  181            2.
    1 JAN 1302   32          4.   *    1 JAN 1442   82          6.   *    1 JAN 1622  132         14.   *    1 JAN 1802  182            1.
    1 JAN 1304   33          4.   *    1 JAN 1444   83          6.   *    1 JAN 1624  133         10.   *    1 JAN 1804  183            1.
    1 JAN 1306   34          4.   *    1 JAN 1446   84          6.   *    1 JAN 1626  134         10.   *    1 JAN 1806  184            0.
    1 JAN 1308   35          4.   *    1 JAN 1448   85          6.   *    1 JAN 1628  135          9.   *    1 JAN 1808  185            0.
    1 JAN 1310   36          4.   *    1 JAN 1450   86          6.   *    1 JAN 1630  136          9.   *    1 JAN 1810  186            0.
    1 JAN 1312   37          4.   *    1 JAN 1452   87          6.   *    1 JAN 1632  137          8.   *    1 JAN 1812  187            0.
    1 JAN 1314   38          4.   *    1 JAN 1454   88          6.   *    1 JAN 1634  138          8.   *    1 JAN 1814  188            0.
    1 JAN 1316   39          4.   *    1 JAN 1456   89          7.   *    1 JAN 1636  139          7.   *    1 JAN 1816  189            0.
    1 JAN 1318   40          4.   *    1 JAN 1458   90          7.   *    1 JAN 1638  140          7.   *    1 JAN 1818  190            0.
    1 JAN 1320   41          4.   *    1 JAN 1500   91          7.   *    1 JAN 1640  141          7.   *    1 JAN 1820  191            0.
    1 JAN 1322   42          4.   *    1 JAN 1502   92          7.   *    1 JAN 1642  142          7.   *    1 JAN 1822  192            0.
    1 JAN 1324   43          4.   *    1 JAN 1504   93          7.   *    1 JAN 1644  143          6.   *    1 JAN 1824  193            0.
    1 JAN 1326   44          4.   *    1 JAN 1506   94          8.   *    1 JAN 1646  144          6.   *    1 JAN 1826  194            0.
    1 JAN 1328   45          4.   *    1 JAN 1508   95          8.   *    1 JAN 1648  145          6.   *    1 JAN 1828  195            0.
    1 JAN 1330   46          4.   *    1 JAN 1510   96          8.   *    1 JAN 1650  146          6.   *    1 JAN 1830  196            0.
    1 JAN 1332   47          4.   *    1 JAN 1512   97          8.   *    1 JAN 1652  147          6.   *    1 JAN 1832  197            0.
    1 JAN 1334   48          4.   *    1 JAN 1514   98          8.   *    1 JAN 1654  148          5.   *    1 JAN 1834  198            0.
    1 JAN 1336   49          4.   *    1 JAN 1516   99          8.   *    1 JAN 1656  149          5.   *    1 JAN 1836  199            0.
    1 JAN 1338   50          4.   *    1 JAN 1518  100          8.   *    1 JAN 1658  150          5.   *    1 JAN 1838  200            0.
                                  *                                  *                                  *
*************************************************************************************************************************************

   PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                         6-HR         24-HR        72-HR        6.63-HR
+   (CFS)         (HR)
                              (CFS)
+      66.        4.13                      8.           8.           8.            8.
                             (INCHES)    1.555        1.559        1.559         1.559
                              (AC-FT)       4.           4.           4.            4.

                           CUMULATIVE AREA =      .05 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
  16 KK       *   DETAIN   *
              *            *
              **************
```

```
                HYDROGRAPH ROUTING DATA

 17 RS            STORAGE ROUTING
                       NSTPS         1  NUMBER OF SUBREACHES
                        ITYP      STOR  TYPE OF INITIAL CONDITION
                      RSVRIC     -1.00  INITIAL CONDITION
                           X       .00 WORKING R AND D COEFFICIENT

 18 SV             STORAGE          .0        .1

 19 SQ           DISCHARGE          0.        64.

 20 SE           ELEVATION      100.00    101.00

                                         ***

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN        0. TO        64.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*******************************************************************************************************************************************

                                                    HYDROGRAPH AT STATION    DETAIN

*******************************************************************************************************************************************
                                               *                                                *
  DA MON HRMN ORD   OUTFLOW  STORAGE     STAGE *  DA MON HRMN ORD   OUTFLOW  STORAGE     STAGE *  DA MON HRMN ORD   OUTFLOW  STORAGE     STAGE
                                               *                                                *
   1 JAN 1200   1        1.       .0     100.0 *   1 JAN 1414  68        5.       .0     100.1 *   1 JAN 1628 135        9.       .0     100.1
   1 JAN 1202   2        2.       .0     100.0 *   1 JAN 1416  69        5.       .0     100.1 *   1 JAN 1630 136        9.       .0     100.1
   1 JAN 1204   3        2.       .0     100.0 *   1 JAN 1418  70        5.       .0     100.1 *   1 JAN 1632 137        8.       .0     100.1
   1 JAN 1206   4        2.       .0     100.0 *   1 JAN 1420  71        5.       .0     100.1 *   1 JAN 1634 138        8.       .0     100.1
   1 JAN 1208   5        3.       .0     100.0 *   1 JAN 1422  72        5.       .0     100.1 *   1 JAN 1636 139        8.       .0     100.1
   1 JAN 1210   6        3.       .0     100.0 *   1 JAN 1424  73        5.       .0     100.1 *   1 JAN 1638 140        7.       .0     100.1
   1 JAN 1212   7        3.       .0     100.0 *   1 JAN 1426  74        5.       .0     100.1 *   1 JAN 1640 141        7.       .0     100.1
   1 JAN 1214   8        3.       .0     100.0 *   1 JAN 1428  75        5.       .0     100.1 *   1 JAN 1642 142        7.       .0     100.1
   1 JAN 1216   9        3.       .0     100.0 *   1 JAN 1430  76        5.       .0     100.1 *   1 JAN 1644 143        6.       .0     100.1
   1 JAN 1218  10        3.       .0     100.0 *   1 JAN 1432  77        5.       .0     100.1 *   1 JAN 1646 144        6.       .0     100.1
   1 JAN 1220  11        3.       .0     100.0 *   1 JAN 1434  78        6.       .0     100.1 *   1 JAN 1648 145        6.       .0     100.1
   1 JAN 1222  12        3.       .0     100.0 *   1 JAN 1436  79        6.       .0     100.1 *   1 JAN 1650 146        6.       .0     100.1
   1 JAN 1224  13        3.       .0     100.0 *   1 JAN 1438  80        6.       .0     100.1 *   1 JAN 1652 147        6.       .0     100.1
   1 JAN 1226  14        3.       .0     100.0 *   1 JAN 1440  81        6.       .0     100.1 *   1 JAN 1654 148        5.       .0     100.1
   1 JAN 1228  15        3.       .0     100.0 *   1 JAN 1442  82        6.       .0     100.1 *   1 JAN 1656 149        5.       .0     100.1
   1 JAN 1230  16        3.       .0     100.0 *   1 JAN 1444  83        6.       .0     100.1 *   1 JAN 1658 150        5.       .0     100.1
   1 JAN 1232  17        3.       .0     100.1 *   1 JAN 1446  84        6.       .0     100.1 *   1 JAN 1700 151        5.       .0     100.1
   1 JAN 1234  18        3.       .0     100.1 *   1 JAN 1448  85        6.       .0     100.1 *   1 JAN 1702 152        5.       .0     100.1
   1 JAN 1236  19        3.       .0     100.1 *   1 JAN 1450  86        6.       .0     100.1 *   1 JAN 1704 153        5.       .0     100.1
   1 JAN 1238  20        3.       .0     100.1 *   1 JAN 1452  87        6.       .0     100.1 *   1 JAN 1706 154        5.       .0     100.1
   1 JAN 1240  21        3.       .0     100.1 *   1 JAN 1454  88        6.       .0     100.1 *   1 JAN 1708 155        5.       .0     100.1
   1 JAN 1242  22        3.       .0     100.1 *   1 JAN 1456  89        7.       .0     100.1 *   1 JAN 1710 156        4.       .0     100.1
   1 JAN 1244  23        3.       .0     100.1 *   1 JAN 1458  90        7.       .0     100.1 *   1 JAN 1712 157        4.       .0     100.1
   1 JAN 1246  24        3.       .0     100.1 *   1 JAN 1500  91        7.       .0     100.1 *   1 JAN 1714 158        4.       .0     100.1
   1 JAN 1248  25        3.       .0     100.1 *   1 JAN 1502  92        7.       .0     100.1 *   1 JAN 1716 159        4.       .0     100.1
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   1 JAN 1252  27        3.       .0     100.1 *   1 JAN 1506  94        7.       .0     100.1 *   1 JAN 1720 161        4.       .0     100.1
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   1 JAN 1256  29        3.       .0     100.1 *   1 JAN 1510  96        8.       .0     100.1 *   1 JAN 1724 163        4.       .0     100.1
   1 JAN 1258  30        3.       .0     100.1 *   1 JAN 1512  97        8.       .0     100.1 *   1 JAN 1726 164        4.       .0     100.1
   1 JAN 1300  31        3.       .0     100.1 *   1 JAN 1514  98        8.       .0     100.1 *   1 JAN 1728 165        4.       .0     100.1
   1 JAN 1302  32        4.       .0     100.1 *   1 JAN 1516  99        8.       .0     100.1 *   1 JAN 1730 166        4.       .0     100.1
   1 JAN 1304  33        4.       .0     100.1 *   1 JAN 1518 100        8.       .0     100.1 *   1 JAN 1732 167        4.       .0     100.1
   1 JAN 1306  34        4.       .0     100.1 *   1 JAN 1520 101        8.       .0     100.1 *   1 JAN 1734 168        4.       .0     100.1
   1 JAN 1308  35        4.       .0     100.1 *   1 JAN 1522 102        9.       .0     100.1 *   1 JAN 1736 169        4.       .0     100.1
   1 JAN 1310  36        4.       .0     100.1 *   1 JAN 1524 103        9.       .0     100.1 *   1 JAN 1738 170        4.       .0     100.1
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   1 JAN 1344  53        4.       .0     100.1 *   1 JAN 1558 120       31.       .0     100.5 *   1 JAN 1812 187        0.       .0     100.0
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   1 JAN 1410  66        5.       .0     100.1 *   1 JAN 1624 133       11.       .0     100.2 *   1 JAN 1838 200        0.       .0     100.0
   1 JAN 1412  67        5.       .0     100.1 *   1 JAN 1626 134       10.       .0     100.2 *
                                               *                                                *
*******************************************************************************************************************************************

   PEAK FLOW       TIME                                 MAXIMUM AVERAGE FLOW
                                             6-HR         24-HR         72-HR       6.63-HR
 +   (CFS)         (HR)
                                  (CFS)
 +      64.        4.13                        8.            8.            8.            8.
                                (INCHES)    1.555         1.559         1.559         1.559
                                 (AC-FT)       4.            4.            4.            4.

  PEAK STORAGE     TIME                                 MAXIMUM AVERAGE STORAGE
                                             6-HR         24-HR         72-HR       6.63-HR
 +   (AC-FT)       (HR)
          0.       4.13                        0.            0.            0.            0.
```

```
                                                                            DET.OUT
   PEAK STAGE      TIME                                      MAXIMUM AVERAGE STAGE
                                                    6-HR        24-HR        72-HR       6.63-HR
+    (FEET)        (HR)
    101.00         4.13                           100.13       100.12       100.12       100.12

                                  CUMULATIVE AREA =       .05 SQ MI

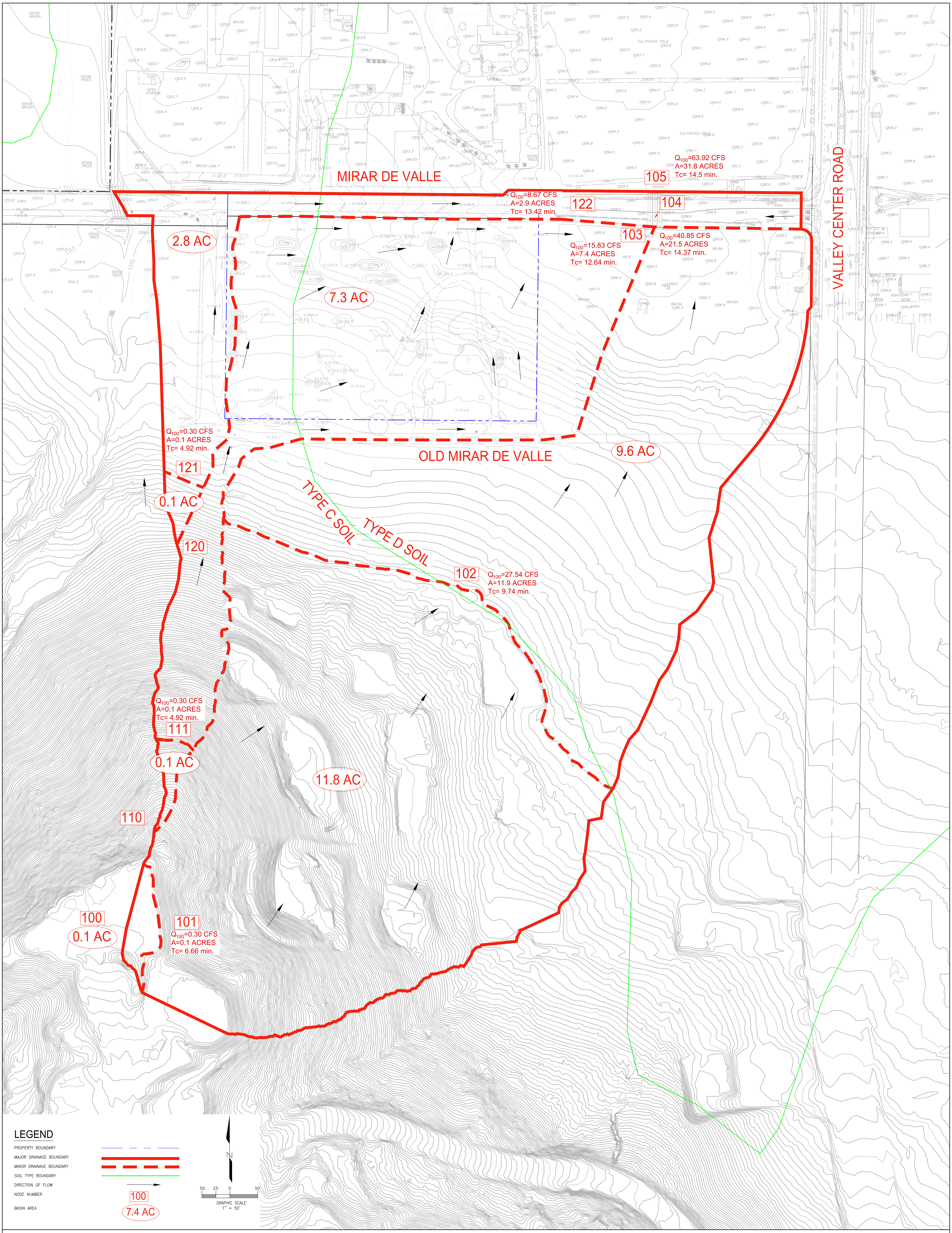
1
                                                                        RUNOFF SUMMARY
                                                                 FLOW IN CUBIC FEET PER SECOND
                                                               TIME IN HOURS,  AREA IN SQUARE MILES

                                                      PEAK     TIME OF      AVERAGE FLOW FOR MAXIMUM PERIOD            BASIN      MAXIMUM      TIME OF
              OPERATION         STATION               FLOW       PEAK                                                   AREA        STAGE     MAX STAGE
+                                                                             6-HOUR       24-HOUR      72-HOUR

              HYDROGRAPH AT
+                                 BASIN                66.     4.13              8.           8.           8.           .05

              ROUTED TO
+                                 DETAIN               64.     4.13              8.           8.           8.           .05
+                                                                                                                                 101.00        4.13


 *** NORMAL END OF HEC-1 ***
```



PREPARED BY:

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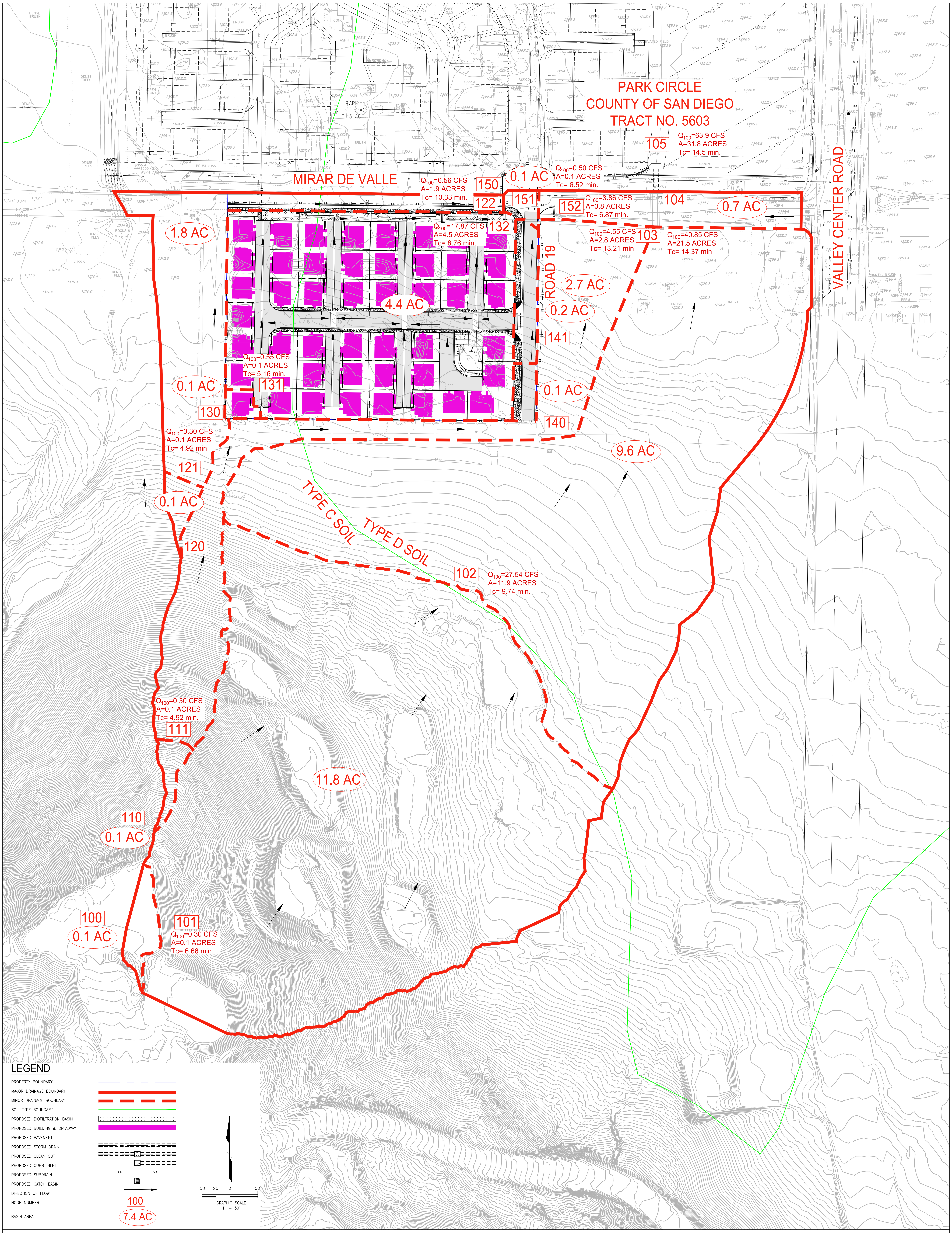
16885 Via Del Campo Ct, Suite 304, SD, CA 92127
PHONE: 858.762.9611 FAX: 858.762.9612

PRE-PROJECT DRAINAGE MAP FOR SHADY OAK



LEGEND

PROPERTY BOUNDARY	— — —
MAJOR DRAINAGE BOUNDARY	━━━
MINOR DRAINAGE BOUNDARY	━ ━ ━
SOIL TYPE BOUNDARY	───
PROPOSED BIOFILTRATION BASIN	▨
PROPOSED BUILDING & DRIVEWAY	■
PROPOSED PAVEMENT	
PROPOSED STORM DRAIN	═══
PROPOSED CLEAN OUT	═◎═
PROPOSED CURB INLET	□═
PROPOSED SUBDRAIN	— SD — SD —
PROPOSED CATCH BASIN	▤
DIRECTION OF FLOW	→
NODE NUMBER	100
BASIN AREA	7.4 AC

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POST-PROJECT DRAINAGE MAP FOR SHADY OAK

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ATTACHMENT 7

Copy of Project's Geotechnical and Groundwater Investigation Report

This is the cover sheet for Attachment 7.

If hardcopy or CD is not attached, the following information should be provided:

Title:
Prepared By:
Date:

CHRISTIAN WHEELER
ENGINEERING

GEOTECHNICAL INVESTIGATION

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

PREPARED FOR

TOUCHSTONE COMMUNITIES
9909 MIRA MESA BOULEVARD, SUITE #150
SAN DIEGO, CALIFORNIA 92131

PREPARED BY

CHRISTIAN WHEELER ENGINEERING
3980 HOME AVENUE
SAN DIEGO, CALIFORNIA 92105

CHRISTIAN WHEELER
ENGINEERING

August 5, 2016

Touchstone Communities
9909 Mira Mesa Boulevard, Suite #150
San Diego, California 92131
Attention: Brian Nestoroff

CWE 2150438.01

Subject: Geotechnical Investigation, Shady Oak
27522 Valley Center Road, Valley Center, California

In accordance with your request and our proposal dated July 24, 2015, we have completed a preliminary geotechnical investigation for the subject project. We are presenting herein our findings and recommendations.

In general, we found the subject property suitable for the proposed construction, provided the recommendations provided herein are followed. Compressible surficial soils, including residual soils and previous fills, will need to be removed and replaced as properly compacted fill during the site grading. Specific remedial grading recommendations and geotechnical design criteria are presented in the attached report.

If you have any questions after reviewing this report, please do not hesitate to contact our office. This opportunity to be of professional service is sincerely appreciated.

Respectfully submitted,
CHRISTIAN WHEELER ENGINEERING

Shawn Caya, R.G.E. #2748

Troy S. Wilson, C.E.G. #2551

SCC:scc;tsw

Distribution: brian@touchstonecommunities.com

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EXP. 6-30-18
GEOTECHNICAL
STATE OF CALIFORNIA

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TROY S. WILSON
No. 2551
CERTIFIED ENGINEERING GEOLOGIST
Expires 7-31-17
STATE OF CALIFORNIA

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CHRISTIAN WHEELER
ENGINEERING

GEOTECHNICAL INVESTIGATION

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

INTRODUCTION AND PROJECT DESCRIPTION

This report presents the results of a geotechnical investigation performed for a 47-Lot subdivision to be constructed within a mostly vacant lot at 27522 Valley Center Road, in the Valley Center area of the County of San Diego, California. The following Figure Number 1 presents a vicinity map showing the location of the project.

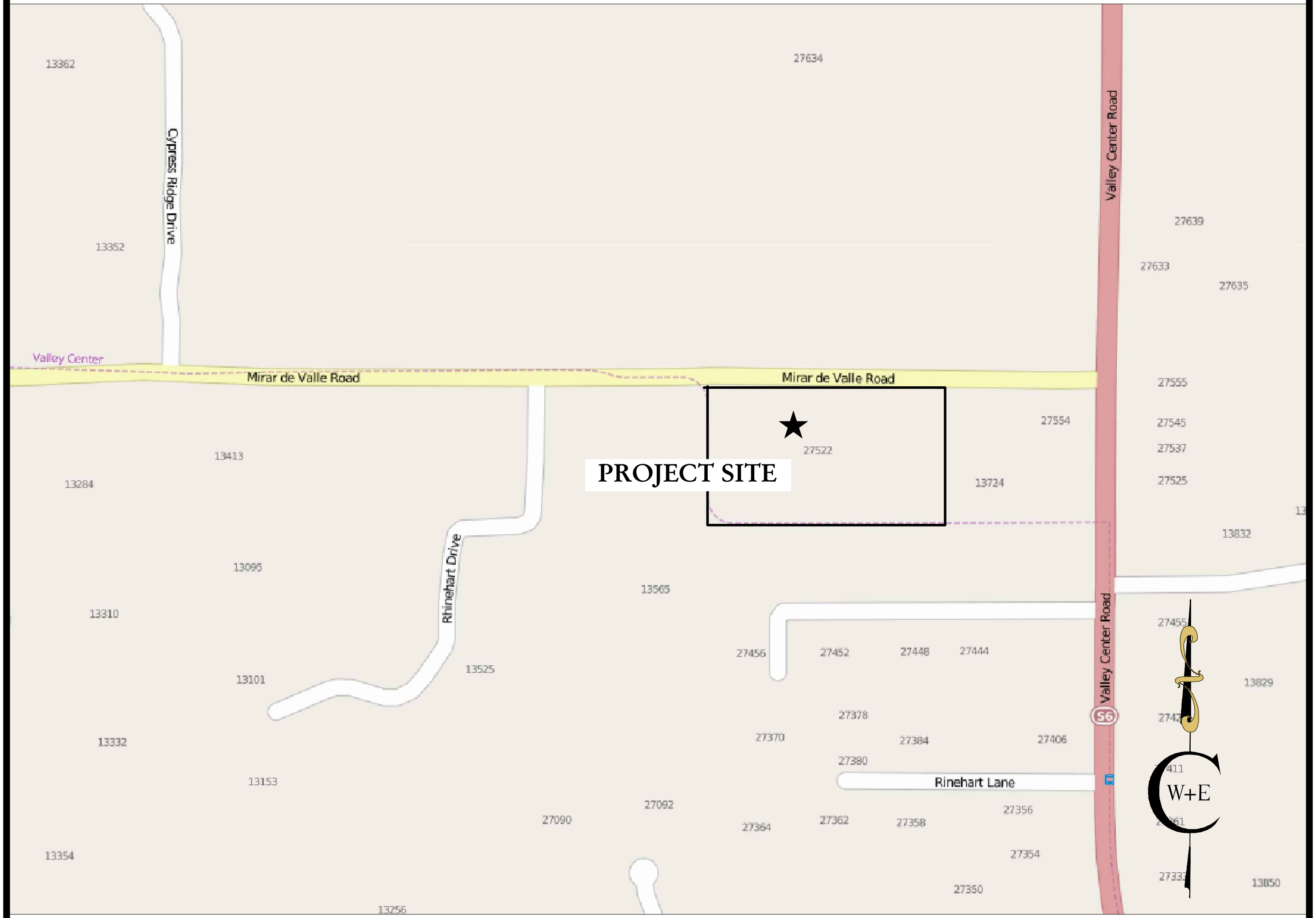
We understand that it is proposed to construct a residential subdivision on the property. The subdivision will include 47 single-family homes and associated streets and utility improvements. We expect that the homes will be one- and/or two-story, wood-frame structures with concrete on-grade floor slabs. Grading will consist of cuts and fills of less than about five feet from the existing site grades with site retaining walls of similar heights. Biofiltration basins are planned along the northern boundary of the site.

To assist in the preparation of this report, our firm has been given a Grading Plan prepared by TSAC Engineering (undated). This plan has been used as the base for our Site Plan and Geotechnical Map, which is included herewith as Plate Number 1.

This report has been prepared for the exclusive use of Touchstone Communities and its consultants for specific application to the project described herein. Should the project be modified, the new plans should be submitted to Christian Wheeler Engineering for review to determine whether the findings and recommendations presented herein remain applicable and if any additional subsurface investigation, laboratory testing and/or recommendations are necessary. Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, expressed or implied.

SITE VICINITY

© OpenStreetMap contributors



SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	1

CHRISTIAN WHEELER
ENGINEERING

INVESTIGATION SCOPE

Our preliminary geotechnical investigation consisted of surface reconnaissance, subsurface exploration, obtaining representative soil samples, laboratory testing, analysis of the field and laboratory data and review of relevant geologic literature. Our scope of service did not include assessment of hazardous substance contamination, recommendations to prevent floor slab moisture intrusion or the formation of mold within the structure, or any other services not specifically described in the scope of services presented below. More specifically, our intent was to provide the services listed below.

- Excavate nine backhoe trenches on the site to explore the existing soil conditions.
- Backfill the trenches with the removed soil. It should be noted that the soil was not compacted and will have to be removed and replaced as compacted fill during site grading.
- Evaluate, by laboratory tests and our past experience with similar soil types, the engineering properties of the various soil strata that may influence the proposed construction, including bearing capacities, expansive characteristics and settlement potential.
- Describe the general geology at the site, including possible geologic hazards that could have an effect on the proposed construction, and provide the seismic design parameters as required by the 2013 edition of the California Building Code.
- Address potential construction difficulties that may be encountered due to soil conditions, groundwater or geologic hazards, and provide geotechnical recommendations to deal with these difficulties.
- Provide site preparation and grading recommendations for the anticipated work.
- Provide foundation recommendations for the type of construction anticipated and develop soil engineering design criteria for the recommended foundation designs.
- Provide design parameters for unrestrained retaining walls.
- Provide preliminary pavement section recommendations.
- Prepare this report, which includes, in addition to our conclusions and recommendations, a plot plan showing the areal extent of the geological units and the locations of our exploratory borings, exploration logs, and a summary of the laboratory test results.

Although a test for the presence of soluble sulfates within the soils that may be in contact with reinforced concrete was performed as part of the scope of our services, it should be understood Christian Wheeler Engineering does not practice corrosion engineering. If such an analysis is considered necessary, we recommend that the client retain an engineering firm that specializes in this field to consult with them on this matter. The results of these tests should only be used as a guideline to determine if additional testing and analysis is necessary.

FINDINGS

SITE DESCRIPTION

The subject site is a 4.56 acre, rectangular-shaped lot identified as Assessor's Parcel Number 186-270-01.The lot is located just west of the intersection of Valley Center Road and Mirar de Valle and is bordered by Mirar de Valle to the north and by vacant land on the remaining sides. The property supports an existing residence and associated improvements in the southeastern portion and is undeveloped in the remaining portions. It appears that portions of the property have been used as a dump site as there are several small stockpiles of dirt, concrete, and other debris. Topographically, the site slopes gently to the north-northeast with elevations ranging from about 1296 feet (datum unknown) in the northeast corner to 1315 feet in the southwest corner.

GENERAL GEOLOGY AND SUBSURFACE CONDITIONS

GEOLOGIC SETTING AND SOIL DESCRIPTION: The subject site is located in the Foothills Physiographic Province of San Diego County. Based upon the results of our subsurface exploration and analysis of readily available, pertinent geologic literature, it was determined that the project area is underlain by Cretaceous-age granitic bedrock, residual soil, and artificial fill. These materials are described below.

> **ARTIFICIAL FILL (Qaf):** Artificial fill was encountered in areas that support the existing development in the southeast portion of the property. As encountered in trenches T-5 and T-7, the fill soils extended to a depth of about 2 to 2½ feet below existing site grade and generally consisted of brown to grayish-brown, dry to damp, loose to medium dense, silty sand (SM) with some gravel. The fill materials were judged to have a very low expansion index (EI<20).
>
> **RESIDUAL SOIL:** A layer of residual soil consisting of natural topsoil and/or subsoil was encountered in each of our exploratory trenches. The topsoil layer, which was encountered in all the trenches, extended to depths ranging from about 1 foot to 4 feet below existing grade. The topsoil consists of brown, dry to damp, loose, porous, silty sand (SM) that is judged to have a very low expansion index (EI<20). A layer of subsoil was encountered underlying the topsoil in 6 of our 9 exploratory trenches. Where encountered, the subsoil layer ranged from about 1 foot to 1½ feet in thickness and extended to approximately 2 to 4 feet below the existing grade. The subsoil consists

of reddish-brown, damp to moist, medium dense, clayey sand (SC) that was found to have a low expansion index (EI=35).

WEATHERED GRANITICS (Kgr): Weathered granitic bedrock underlies the surficial soils. Within our trenches, the weathered granitics were encountered at depths ranging from about 2 to 4 feet below the existing grades. This material consists of reddish-brown and light gray, damp, dense to very dense, silty sand (SM) and well-graded sand with silt (SW-SM). These deposits were judged to have a very low expansion index (EI<20).

GROUNDWATER: No groundwater or wet soil was encountered in any of our subsurface explorations. It should be recognized that minor groundwater seepage problems might occur after development of a site even where none were present before development. These are usually minor phenomena and are often the result of an alteration in drainage patterns and/or an increase in irrigation water. Based on the permeability characteristics of the soil and the anticipated usage and development, it is our opinion that any seepage problems which may occur will be minor in extent. It is further our opinion that these problems can be most effectively corrected on an individual basis if and when they occur.

TECTONIC SETTING: No active or potentially active faults are known to traverse the subject site. However, it should be noted that much of Southern California, including the San Diego County area, is characterized by a series of Quaternary-age fault zones that consist of several individual, en echelon faults that generally strike in a northerly to northwesterly direction. Some of these fault zones (and the individual faults within the zone) are classified as "active" according to the criteria of the California Division of Mines and Geology. Active fault zones are those that have shown conclusive evidence of faulting during the Holocene Epoch (the most recent 11,000 years). The Division of Mines and Geology used the term "potentially active" on Earthquake Fault Zone maps until 1988 to refer to all Quaternary-age (last 1.6 million years) faults for the purpose of evaluation for possible zonation in accordance with the Alquist-Priolo Earthquake Fault Zoning Act and identified all Quaternary-age faults as "potentially active" except for certain faults that were presumed to be inactive based on direct geologic evidence of inactivity during all of Holocene time or longer. Some faults considered to be "potentially active" would be considered to be "active" but lack specific criteria used by the State Geologist, such as *sufficiently active* and *well-defined*. Faults older than Quaternary-age are not specifically defined in Special Publication 42, Fault Rupture Hazard Zones in California, published by the California Division of Mines and Geology. However, it is generally accepted that faults showing no movement during the Quaternary period may be considered to be "inactive".

A review of available geologic maps indicates that the nearest active fault zone is the Elsinore Fault Zone (Julian portion), located approximately 15 kilometers northeast of the site. Other active fault zones in the region that could possibly affect the site include the Rose Canyon, Newport-Inglewood and Coronado Bank Fault Zone to the west; Palos Verdes Fault Zones to the northwest; and the Earthquake Valley and San Andreas Fault Zones to the east.

TABLE I: PROXIMAL FAULT ZONES

Fault Zone	Distance
Elsinore (Julian)	15 km
Rose Canyon	35 km
Newport-Inglewood	37 km
Earthquake Valley	42 km
Coronado Bank	58 km
Palos Verdes	84 km

GEOLOGIC HAZARDS

LANDSLIDE POTENTIAL AND SLOPE STABILITY: As part of this investigation we reviewed the publication, "Landslide Hazards in the Northern Part of the San Diego Metropolitan Area" by Tan, 1995. This reference is a comprehensive study that classifies San Diego County into areas of relative landslide susceptibility. According to this publication, the site is located in Relative Landslide Susceptibility Area 2. Area 2 is considered to be "marginally susceptible" to landsliding. Based on our findings, it is our professional opinion that the potential for slope failures within the site is very low.

SEISMIC HAZARD: A likely geologic hazard to affect the site is ground shaking as a result of movement along one of the major active fault zones mentioned in the "Tectonic Setting" section of this report. Per Chapter 16 of the 2013 California Building Code (CBC), the Risk-Targeted Maximum Considered Earthquake (MCE_R) ground acceleration is that which results in the largest maximum response to horizontal ground motions with adjustments for a targeted risk of structural collapse equal to one percent in 50 years. Figures 1613.3.1(1) and 1613.3.1(2) of the CBC present MCE_R accelerations for short (0.2 sec.) and long (1.0 sec.) periods, respectively, based on a soil Site Class B (CBC 1613.3.2) and a structural damping of five percent. For the subject site, correlation with the known properties of the underlying bedrock indicates that the upper 100 feet of geologic subgrade can be characterized as Site Class C. In this case, the mapped MCE_R accelerations are modified using the Site Coefficients presented in Tables 1613.3.3(1) and (2). The modified MCE spectral accelerations are then multiplied by two-thirds in order to obtain the design spectral accelerations. These seismic design parameters for the subject site (33.2105°, -117.0364°), based on Chapter 16 of the CBC, are presented in Table II below.

TABLE II: CBC 2013 EDITION – SEISMIC DESIGN PARAMETERS

CBC – Chapter 16 Section	Seismic Design Parameter	Recommended Value
Section 1613.3.2	Soil Site Class	C
Figure 1613.3.1 (1)	MCE_R Acceleration for Short Periods (0.2 sec), S_s	1.205 g
Figure 1613.3.1 (2)	MCE_R Acceleration for 1.0 Sec Periods (1.0 sec), S_1	0.460 g
Table 1613.3.3 (1)	Site Coefficient, F_a	1.000
Table 1613.3.3 (2)	Site Coefficient, F_v	1.340
Section 1613.3.3	S_{MS} = MCE_R Spectral Response at 0.2 sec. = $(S_s)(F_a)$	1.204 g
Section 1613.3.3	S_{M1} = MCE_R Spectral Response at 1.0 sec. = $(S_1)(F_v)$	0.617 g
Section 1613.3.4	S_{DS} = Design Spectral Response at 0.2 sec. = $2/3(S_{MS})$	0.804 g
Section 1613.3.4	S_{D1} = Design Spectral Response at 1.0 sec. = $2/3(S_{M1})$	0.411 g
Section 1803.2.12	PGA_M per Section 11.8.3 of ASCE 7	0.46 g

LIQUEFACTION: The near-surface soils encountered at the site are not considered susceptible to liquefaction due to such factors as depth to the groundwater table, soil density and grain-size distribution.

FLOODING: The site is not located flood hazard area according to the maps prepared by the Federal Emergency Management Agency.

TSUNAMIS: Tsunamis are great sea waves produced by submarine earthquakes or volcanic eruptions. According to the San Diego County Multi-Jurisdictional Hazard Mitigation Plan, the project site is located outside the limits of the maximum projected tsunami runup.

SEICHES: Seiches are periodic oscillations in large bodies of water such as lakes, harbors, bays or reservoirs. Due to the site's location, it should not be affected by seiches.

CONCLUSIONS

Based on our investigation, it is our opinion that the subject property is suitable for the proposed subdivision provided the geotechnical recommendations presented in this report are followed. The main geotechnical condition affecting the proposed development is the presence of potentially compressible, near-surface soils comprised of artificial fill and residual soil. These materials will need to be overexcavated and recompacted in order to support the proposed improvements. Additionally, stockpiled debris will need to be removed from the site prior to grading.

The site is located in an area that is relatively free of geologic hazards that will have a significant effect on the proposed development. The most likely geologic hazard that could affect the site is ground shaking due to seismic activity along one of the regional active faults. However, construction in accordance with the requirements of the most recent edition of the California Building Code and the local governmental agencies should provide a level of life-safety suitable for the type of development proposed.

RECOMMENDATIONS

GRADING AND EARTHWORK

GENERAL: All grading should conform to the guidelines presented in Appendix J of the California Building Code, the minimum requirements of the County of San Diego, and the recommended Grading Specifications and Special Provisions attached hereto, except where specifically superseded in the text of this report. Prior to grading, a representative of Christian Wheeler Engineering should be present at the pre-construction meeting to provide additional grading guidelines, if necessary, and to review the earthwork schedule.

OBSERVATION OF GRADING: Continuous observation by the Geotechnical Consultant is essential during the grading operation to confirm conditions anticipated by our investigation, to allow adjustments in design criteria to reflect actual field conditions exposed, and to determine that the grading proceeds in general accordance with the recommendations contained herein.

CLEARING AND GRUBBING: Site preparation should begin with demolition and removal of the existing improvements and the stripping and removal of vegetation, construction debris and other deleterious materials from the site. This should include all significant root material and any debris from the on-site stockpiles. The resulting materials should be disposed of off-site in a legal dumpsite.

SITE PREPARATION: Where it is not removed by the planned grading, the upper 4 feet of existing soil should be removed. We anticipate that such removals will expose competent weathered granitics at the base of the excavation. Deeper removals may be necessary in areas of the site not investigated or in areas where loose, dry, or otherwise unacceptable soils are exposed. The removals can be limited to 3 feet below the existing grade where granitic rock is exposed at the base of the removal. Laterally, the removals should extend to the property line or 5 feet outside areas to support fill and/or settlement-sensitive improvements, whichever is less. No removals are recommended beyond property lines except along the eastern boundary where permission for off-site grading has been granted. All excavated areas should be approved by the geotechnical engineer or his representative prior to replacing any of the excavated soils. The excavated material can be replaced as properly compacted fill provided that it is free of deleterious debris. Fill soils should be compacted in accordance with the recommendations presented in the "Compaction and Method of Filling" section of this report.

TEST TRENCH BACKFILL: Backfill associated with our subsurface explorations underlying settlement-sensitive improvements not removed as part of site preparation operations should be removed and replaced as compacted fill.

PROCESSING OF REMOVAL BOTTOM: Prior to placing any new fill soils or constructing any new improvements in areas that have been overexcavated as recommended in the "Site Preparation" section of this report, the exposed soils should be scarified to a depth of 12 inches, moisture conditioned, and compacted to at least 90 percent relative compaction. In areas to support fill slopes, keys should be cut into the competent supporting materials such as the weathered granitics. The keys should be at least twelve feet wide and be sloped back at least two percent. The keys should extend at least one foot into the competent supporting materials. Where the existing ground has a slope of 5:1 (horizontal to vertical) or steeper, it should be benched into as the fill extends upward from the keyways. The benching should remove all loose surficial soils and should create level areas on which to place the fill material.

COMPACTION AND METHOD OF FILLING: All structural fill and backfill material placed at the site, except as noted below, should be compacted to a relative compaction of at least 90 percent of maximum dry density as determined by ASTM Laboratory Test D1557. Fills should be placed at or slightly above optimum moisture content, in lifts six to eight inches thick, with each lift compacted by mechanical means. Fills should consist of approved earth material, free of trash or debris, roots, vegetation, or other materials determined to be unsuitable by our soil technicians or project geologist. Fill material should be free of rocks or lumps of soil in excess of twelve inches in maximum dimension; however, this should be reduced to six inches within four feet of finish grade.

All utility trench backfill should be compacted to a minimum of 90 percent of its maximum dry density. The upper twelve inches of subgrade beneath paved areas should be compacted to 95 percent of the materials maximum dry density. This compaction should be obtained by the paving contractor just prior to placing the aggregate base material and should not be part of the mass grading requirements or operation.

FILL SLOPE CONSTRUCTION: Fill slopes may be constructed at an inclination of 2:1 or flatter (horizontal to vertical). Compaction of slopes should be performed by back-rolling with a sheepsfoot compactor at vertical intervals of four feet or less as the fill is being placed, and track-walking the face of the slope when the slope is completed. As an alternative, the fill slopes may be overfilled by at least three feet and then cut back to the compacted core at the design line and grade. Keys should be made at the toe of fill slopes in accordance with the recommendations presented above under "Processing of Removal Bottom."

IMPORTED FILL MATERIAL: Soils to be imported to the site should be evaluated and approved by the Geotechnical Consultant prior to being imported. At least five working days-notice of a potential import source should be given to the Geotechnical Consultant so that appropriate testing can be accomplished. The type of material considered most desirable for import is granular material containing some silt or clay binder, which has an Expansion Index of less than 50. Less than 25 percent of the material should be larger than the Standard #4 sieve, and less than 25 percent finer than the Standard # 200 sieve. Soils not meeting there criteria should not be used for structural fill or backfill.

TEMPORARY CUT SLOPES: The contractor is solely responsible for designing and constructing stable, temporary excavations and will need to shore, slope, or bench the sides of trench excavations as required to maintain the stability of the excavation sides. The contractor's "competent person", as defined in the OSHA Construction Standards for Excavations, 29 CFR, Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety process. We anticipate that the existing on-site soils will consist of Type C material. Our firm should be contacted to observe all temporary cut slopes during grading to ascertain that no unforeseen adverse conditions exist. No surcharge loads such as foundation loads, or soil or equipment stockpiles, vehicles, etc. should be allowed within a distance from the top of temporary slopes equal to half the slope height.

SURFACE DRAINAGE: The ground around the proposed structures should be graded so that surface water flows rapidly away from the structures without ponding. In general, we recommend that the ground adjacent to structure slope away at a gradient of at least two percent. Densely vegetated areas where runoff can be impaired should have a minimum gradient of five percent within the first five feet from the structure. It is our opinion that the project site is not suitable for storm water infiltration/percolation BMPs. We recommend that the biofiltration basins be lined in such a manner as to prevent the storm water from infiltrating into the underlying soils and should be connected via pipes to the storm drain system.

GRADING PLAN REVIEW: The final grading plans should be submitted to this office for review in order to ascertain that the recommendations of this report have been implemented, and that no additional recommendations are needed due to changes in the anticipated development plans.

CONVENTIONAL SHALLOW FOUNDATIONS

GENERAL: It is our opinion that the proposed buildings may be supported by conventional continuous and isolated spread footings. The following recommendations are considered the minimum based on the anticipated soil conditions anticipated after the recommendations contained in this report are implemented and are not intended to be in lieu of structural considerations. All foundations should be designed by a qualified structural engineer.

MINIMUM DIMENSIONS: New spread footings supporting the planned structures should be embedded at least 18 inches below the finish pad grade. Continuous and isolated footings should have minimum widths of 12 and 24 inches, respectively.

BEARING CAPACITY: Footings with the above minimum dimensions may be designed for an allowable soil bearing pressure of 2,500 pounds per square foot (psf). This value can be increased by 500 psf for each additional foot of depth and width up to a maximum capacity of 4,000 psf. The allowable bearing capacity may be increased by one-third for combinations of temporary loads, such as those due to wind or seismic loads.

FOOTING REINFORCING: Reinforcement requirements for foundations should be provided by a structural engineer. However, based on the anticipated soil conditions, we recommend that the minimum reinforcing for continuous footings consist of at least one No. 4 bar positioned near the bottom of the footing and at least one No. 4 bar positioned near the top of the footing.

LATERAL LOAD RESISTANCE: Lateral loads against foundations may be resisted by friction between the bottom of the footing and the supporting soil, and by the passive pressure against the footing. The coefficient of friction between concrete and soil may be considered to be 0.35. The passive resistance may be considered to be equal to an equivalent fluid weight of 350 pounds per cubic foot. This assumes the footings are poured tight against undisturbed soil. If a combination of the passive pressure and friction is used, the friction value should be reduced by one-third.

SETTLEMENT CHARACTERISTICS: Provided the recommendations presented in this report are followed, the anticipated total and differential foundation settlement is expected to be less than about 1 inch and 1 inch over 40 feet, respectively. It should be recognized that minor cracks normally occur in concrete slabs and foundations due to shrinkage during curing or redistribution of stresses, therefore some cracks should be anticipated. Such cracks are not necessarily an indication of excessive vertical movements.

EXPANSIVE CHARACTERISTICS: The anticipated foundation soils are expected to have a low expansion potential (EI<50). The recommendations presented in this report reflect this condition.

POST-TENSIONED FOUNDATIONS

As an alternative to conventional shallow foundations, post-tensioned foundations could be used to support the proposed buildings. Post-tensioned foundations should be designed in accordance with the design procedures of the Post-Tension Institute, using the design criteria presented below in Table III and the applicable information from the "Conventional Shallow Foundations" section above.

TABLE III: POST-TENSION DESIGN CRITERIA

Post-Tensioning Institute (PTI) – 3rd Edition	**Design Value**
Edge Moisture Variation, e_m	
Center Lift (ft)	9.0
Edge Lift (ft)	5.4
Differential Soil Movement, y_m	
Center Lift (in)	0.37
Edge Lift (in)	0.85

FOUNDATION PLAN REVIEW

The final foundation plan and accompanying details and notes should be submitted to this office for review. The intent of our review will be to verify that the plans used for construction reflect the minimum dimensioning and reinforcing criteria presented in this section and that no additional criteria are required due to changes in the foundation type or layout. It is not our intent to review structural plans, notes, details, or calculations to verify that the design engineer has correctly applied the geotechnical design values. It is the responsibility of the design engineer to properly design/specify the foundations and other structural elements based on the requirements of the structure and considering the information presented in this report.

FOUNDATION EXCAVATION OBSERVATION

All foundation excavations should be observed by the Geotechnical Consultant prior to placing reinforcing steel or formwork in order to determine if the foundation recommendations presented herein are followed. All footing excavations should be excavated neat, level, and square. All loose or unsuitable material should be removed prior to the placement of concrete.

SOLUBLE SUFATES

The water soluble sulfate content was determined in accordance with California Test Method 417 for a representative soil sample from the site. The result of this test indicates that the representative soil sample had a soluble sulfate content of 0.016, which is considered negligible.

ON-GRADE SLABS

GENERAL: It is our understanding that the building floors will consist of concrete slabs-on-grade. The following recommendations are considered the minimum slab requirements based on the soil conditions and are not intended to be in lieu of structural considerations. Post-tensioned slabs should be specified by the design engineer.

INTERIOR SLAB: We recommend that the interior slab-on-grade floors be at least 4 inches thick and be reinforced with at least No. 3 bars spaced at 18 inches on center each way. The reinforcing bars should extend at least six inches into the foundations and should be supported by chairs and be positioned in the center of the slab. The owner and the project structural engineer should determine if the on-grade slabs need to be designed for special loading conditions. For such cases, a subgrade modulus of 100 pounds per cubic inch can be assumed for the subgrade provided it is prepared as recommended in this report. The allowable bearing load for the slab is 1,500 pounds per square foot.

UNDER-SLAB VAPOR RETARDERS: Steps should be taken to minimize the transmission of moisture vapor from the subsoil through the interior slabs where it can potentially damage the interior floor coverings. We recommend that the owner/contractor follow national standards for the installation of vapor retarders below interior slabs as presented in currently published standards including ACI 302, “Guide to Concrete Floor and Slab Construction” and ASTM E1643, “Standard Practice for Installation of Water Vapor Retarder Used in Contact with Earth or Granular Fill Under Concrete Slabs”. If sand is placed below the vapor retarding material, it should have a sand equivalent of at least 30 and contain less than 20% passing the Number 100 sieve and less than 10% passing the Number 200 sieve.

We recommend that the flooring installer perform standard moisture vapor emission tests prior to the installation of all moisture-sensitive floor coverings in accordance with ASTM F1869 “Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride”.

EXTERIOR CONCRETE FLATWORK: Exterior concrete on-grade slabs should have a minimum thickness of four inches. Exterior slabs abutting perimeter foundations should be doweled into the footings. All slabs should be provided with weakened plane joints in accordance with the American Concrete Institute (ACI) guidelines. Alternative patterns consistent with ACI guidelines can also be used. A concrete mix with a 1-inch maximum aggregate size and a water/cement ratio of less than 0.6 is recommended for exterior slabs. Lower water content will decrease the potential for shrinkage cracks. Both coarse and fine aggregate should conform to the latest edition of the "Standard Specifications for Public Works Construction" ('Greenbook"). Special attention should be paid to the method of concrete curing to reduce the potential for excessive shrinkage and resultant random cracking. It should be recognized that minor cracks occur normally in concrete slabs due to shrinkage. Some shrinkage cracks should be expected and are not necessarily an indication of excessive movement or structural distress.

EARTH RETAINING WALLS

FOUNDATIONS: Foundations for retaining walls can be designed in accordance with the foundation recommendations previously presented.

ACTIVE PRESSURES: The active soil pressure for the design of unrestrained earth retaining structures with level backfill surface may be assumed to be equivalent to the pressure of a fluid weighing 30 pounds per cubic foot. An additional 15 pounds per cubic foot can be added to the above values for 2:1 (H:V) sloping backfill. Thirty percent of any area surcharge placed adjacent to the retaining wall may be assumed to act as a uniform horizontal pressure against the wall. Where vehicles will be allowed within ten feet of the retaining wall, a uniform horizontal pressure of 100 pounds per square foot should be added to the upper 10 feet of the retaining wall to account for the effects of adjacent traffic. Special cases such as a combination of shored and sloping temporary slopes, or other surcharge loads not described above, may require an increase in the design values recommended above. These conditions should be evaluated by the project geotechnical engineer on a case-by-case basis. If any other loads are anticipated, the Geotechnical Consultant should be contacted for the necessary increase in soil pressure. All values are based on a drained backfill condition.

If it is necessary to consider seismic pressure, it may be assumed to be equivalent to the pressure of a fluid weighing 8 pounds per cubic foot, but the pressure distribution should be inverted so that the highest value is at the top of the wall. This corresponds to an approximate pseudo-static acceleration (Kh) of 0.10 g.

PASSIVE PRESSURE: The passive pressure for the anticipated foundation soils may be considered to be 350 pounds per square foot per foot of depth. The upper foot of embedment should be neglected when calculating passive pressures, unless the foundation abuts a hard surface such as a concrete slab. The passive pressure may be increased by one-third for seismic loading. The coefficient of friction for concrete to soil may be assumed to be 0.35 for the resistance to lateral movement. When combining frictional and passive resistance, the friction should be reduced by one-third.

WATERPROOFING AND SUBDRAINS: The project architect should provide (or coordinate) waterproofing details for the retaining walls. The design values presented above are based on a drained backfill condition and do not consider hydrostatic pressures. Unless hydrostatic pressures are incorporated into the design, the retaining wall designer should provide a subdrain detail. A typical retaining wall subdrain detail is presented as Plate No. 2 of this report. Additionally, outlets points for the retaining wall subdrains should be coordinated by the project civil engineer.

BACKFILL: All retaining wall backfill should be compacted to at least 90 percent relative compaction. It is anticipated that the on-site soils are suitable for use as backfill material provided the design parameters given herein are used in the wall design. Wall backfill material should be free of rocks or lumps of soil in excess of three inches in maximum dimension. Retaining walls should not be backfilled until the masonry/concrete has reached an adequate strength.

PRELIMINARY PAVEMENT SECTIONS

GENERAL: We expect that new pavement will be installed as part of the project. The following presents preliminary sections for asphalt concrete (AC) or Portland Cement Concrete (PCC) construction. The pavement sections provided in Table IV and Table VI should be considered preliminary and should be used for planning purposes only. Final pavement designs should be determined after R-value tests have been performed in the actual subgrade material in place after grading. Presuming the grading recommendations presented previously are followed, we estimate that the subgrade soils will have an R-Value of at least 25. The Traffic Index and Traffic Categories shown below are assumed. The project client and/or civil engineer should determine whether these assumed values are appropriate for the traffic conditions.

ASPHALT CONCRETE: We expect that the streets and drive aisles will primarily support passenger vehicles with heavily loaded vehicles such as garbage trucks and large moving vans on a daily basis. Parking stalls are expected to support primarily passenger vehicles and occasional moving vans. The asphalt concrete pavement section was calculated using the Caltrans design method using an assumed Traffic Index of 5.5 for interior streets and drive aisles and 4.5 for parking stalls.

TABLE IV: ASPHALT CONCRETE SECTIONS

Pavement Type	Traffic Index	Pavement Thickness	Base Thickness	Base Material	Subgrade Compaction
Asphalt Concrete					
Interior Streets	5.5	3.0 in.	8.5 in.	CAB or Class II	95% in upper 12”
Parking Stalls	4.5	3.0 in.	5.0 in.	CAB or Class II	95% in upper 12”

Prior to placing the base material beneath asphalt concrete pavements, the subgrade soil should be scarified to a depth of 12 inches and compacted to at least 95 percent of its maximum dry density at a moisture content one to three percent above optimum.

The base material could consist of Crushed Aggregate Base (CAB) or Class II Aggregate Base. The Crushed Aggregate Base should conform to the requirements set forth in Section 200-2.2 of the Standard Specifications for Public Works Construction. The Class II Aggregate Base should conform to requirements set forth in Section 26-1.02A of the Standard Specifications for California Department of Transportation. Asphalt concrete should be placed in accordance with ‘Standard Specifications for Public Works Construction (Greenbook), Section 302-5. Asphalt concrete pavement should be compacted to at least 95% of Hveem density.

CONCRETE PAVEMENTS: Portland cement concrete (PCC) pavement thickness can be determined from Table VI. The PCC pavement section was determined in general accordance with the procedure recommended within the American Concrete Institute report ACI-330R-08 Guide for Design and Construction of Concrete Parking Lots using the parameters listed in Table V. We recommend that the referenced ACI-330R Guide be used to determine the appropriate requirements for control joint configuration, reinforcing, and dowelling of the construction joints. Portland Cement Concrete pavement placed in front of trash enclosures should be reinforced with at least No. 4 bars placed at 12 inches on center each way.

TABLE V: CONCRETE PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of Subgrade Reaction, k	50 pci
Modulus of Rupture for Concrete, M_R	500 psi
Traffic Category (Main Driveways)	A (ADTT = 10)

ADTT = Average Daily Truck Traffic. Trucks defined as vehicles with at least six wheels.

Based on the design parameters summarized in Table V, the PCC pavements should have the minimum thicknesses shown in Table VI.

TABLE VI: MINIMUM CONCRETE PAVEMENT THICKNESS

Pavement Use	Thickness
Interior Streets/Aisles/Trash Enclosures	6.5 in
Parking Stalls	6.0 in

Prior to placing concrete pavement, the subgrade soils should be scarified to a depth of 12 inches and compacted to at least 95 percent of their maximum dry density at a moisture content one to three percent above optimum. Concrete pavement construction should comply with the requirements set forth in Sections 201-1.1.2 and 302-6 of the Standard Specifications for Public Works Construction (concrete Class 560-C-3250).

The outside edge of concrete slabs that will support wheel loads should have a thickened edge or integral curb. The thickened edge should be at least 2 inches thicker than the slab and should taper back to the recommended slab thickness 3 feet from the edge of the slab.

LIMITATIONS

REVIEW, OBSERVATION AND TESTING

The recommendations presented in this report are contingent upon our review of final plans and specifications. Such plans and specifications should be made available to the geotechnical engineer and engineering geologist so that they may review and verify their compliance with this report and with the California Building Code.

It is recommended that Christian Wheeler Engineering be retained to provide continuous soil engineering services during the earthwork operations. This is to verify compliance with the design concepts, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

UNIFORMITY OF CONDITIONS

The recommendations and opinions expressed in this report reflect our best estimate of the project requirements based on an evaluation of the subsurface soil conditions encountered at the subsurface exploration locations and on the assumption that the soil conditions do not deviate appreciably from those encountered. It should be recognized that the performance of the foundations and/or cut and fill slopes may be influenced by undisclosed or unforeseen variations in the soil conditions that may occur in the intermediate and unexplored areas. Any unusual conditions not covered in this report that may be encountered during site development should be brought to the attention of the geotechnical engineer so that he may make modifications if necessary.

CHANGE IN SCOPE

This office should be advised of any changes in the project scope or proposed site grading so that we may determine if the recommendations contained herein are appropriate. This should be verified in writing or modified by a written addendum.

TIME LIMITATIONS

The findings of this report are valid as of this date. Changes in the condition of a property can, however, occur with the passage of time, whether they be due to natural processes or the work of man on this or adjacent properties. In addition, changes in the Standards-of-Practice and/or Government Codes may occur. Due to such changes, the findings of this report may be invalidated wholly or in part by changes beyond our control. Therefore, this report should not be relied upon after a period of two years without a review by us verifying the suitability of the conclusions and recommendations.

PROFESSIONAL STANDARD

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the locations where our test pits, surveys, and explorations are made, and that our data, interpretations, and recommendations be based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but shall not be responsible for the interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of any kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

CLIENT'S RESPONSIBILITY

It is the client’s responsibility, or its representatives, to ensure that the information and recommendations contained herein are brought to the attention of the structural engineer and architect for the project and incorporated into the project's plans and specifications. It is further their responsibility to take the necessary measures to insure that the contractor and his subcontractors carry out such recommendations during construction.

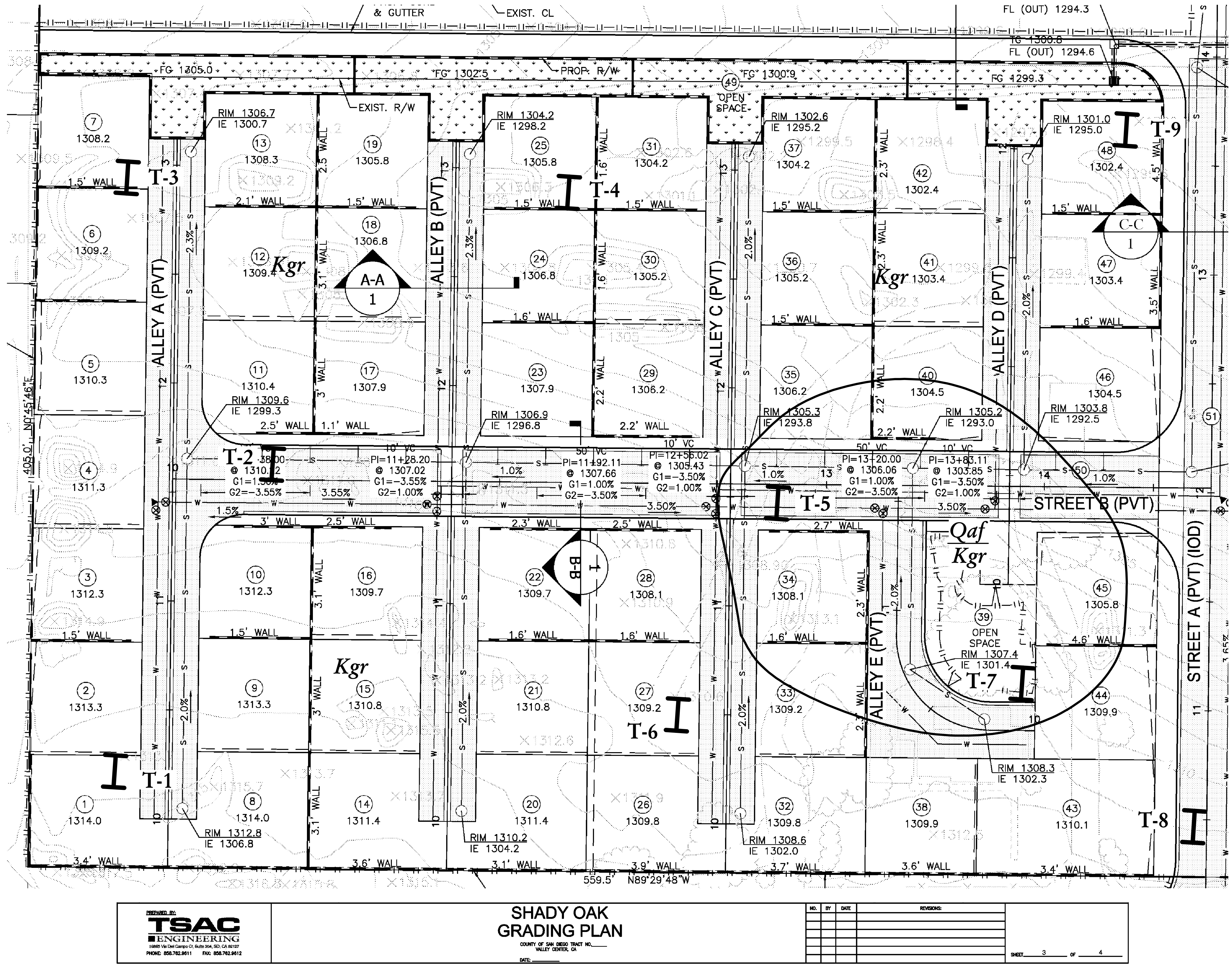
FIELD EXPLORATIONS

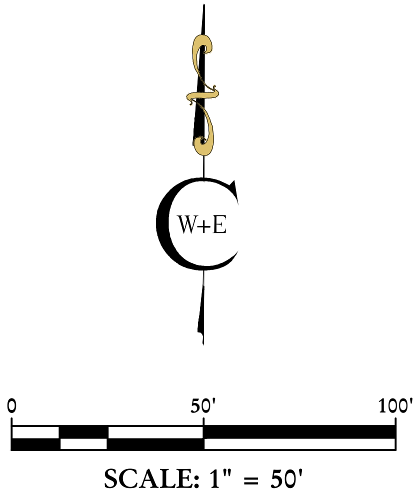
Nine subsurface explorations were made at the locations indicated on the site plans included herewith as Plate No. 1. These explorations consisted of test trenches excavated with a backhoe on August 5, 2015. The fieldwork was conducted by or under the observation of our engineering geology personnel.

The trenches were carefully logged when made. The trench logs are presented in the attached Appendix A. The soils are described in accordance with the Unified Soils Classification. In addition, a verbal textural description, the wet color, the apparent moisture and the density or consistency are provided. The density of granular soils is given as either very loose, loose, medium dense, dense or very dense. The consistency of silts or clays is given as either very soft, soft, medium stiff, stiff, very stiff, or hard. Undisturbed chunk samples and bulk samples of disturbed soil were collected and transported to the laboratory for testing.

LABORATORY TESTING

Laboratory tests were performed in accordance with the generally accepted American Society for Testing and Materials (ASTM) test methods or suggested procedures. A brief description of the tests performed and the subsequent results are presented in Appendix B.





SCALE: 1" = 50'

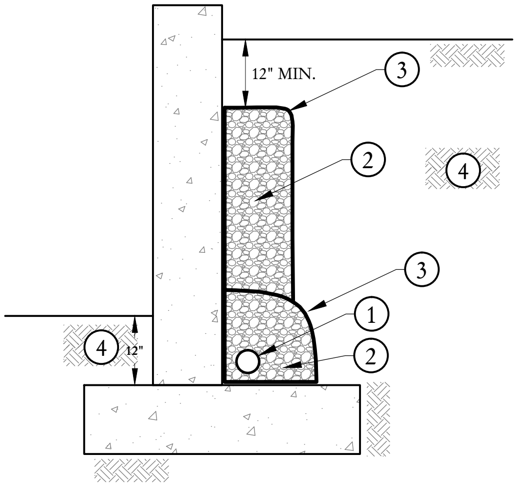
CWE LEGEND	
T-9	APPROXIMATE TRENCH LOCATION
∼	APPROXIMATE GEOLOGIC CONTACT
Qaf / Kgr	ARTIFICIAL FILL OVER WEATHERED GRANITICS
Kgr	WEATHERED GRANITICS

SITE PLAN AND GEOTECHNICAL MAP

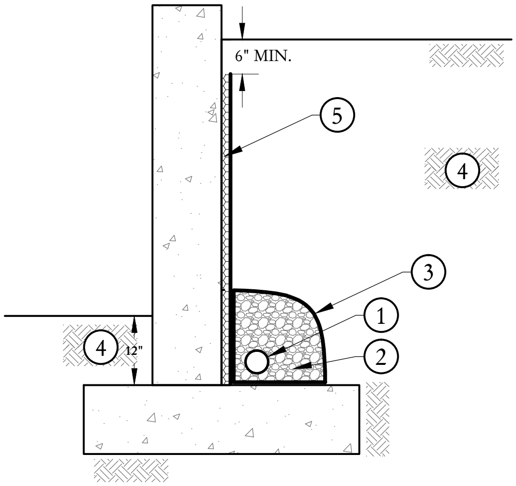
SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438.01
BY:	SRD	PLATE NO.:	1

CHRISTIAN WHEELER
ENGINEERING



1 DETAIL



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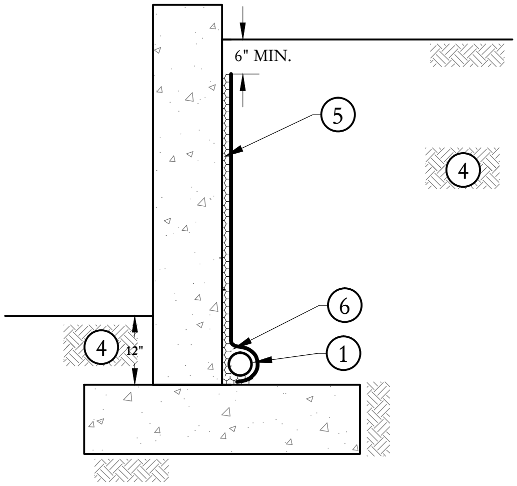
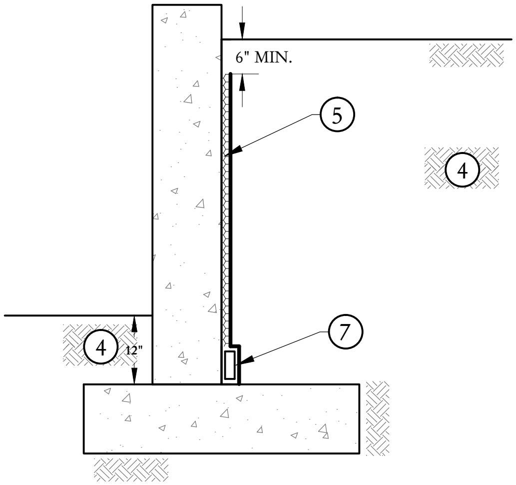


3 DETAIL



4 DETAIL

NOTES AND DETAILS

GENERAL NOTES:

1) THE NEED FOR WATERPROOFING SHOULD BE EVALUATED BY OTHERS.
2) WATERPROOFING TO BE DESIGNED BY OTHERS (CWE CAN PROVIDE A DESIGN IF REQUESTED).
3) EXTEND DRAIN TO SUITABLE DISCHARGE POINT PER CIVIL ENGINEER.
4) DO NOT CONNECT SURFACE DRAINS TO SUBDRAIN SYSTEM.

DETAILS:

① 4-INCH PERFORATED PVC PIPE ON TOP OF FOOTING, HOLES POSITIONED DOWNWARD (SDR 35, SCHEDULE 40, OR EQUIVALENT).
② ¾ INCH OPEN-GRADED CRUSHED AGGREGATE.
③ GEOFARBRIC WRAPPED COMPLETELY AROUND ROCK.
④ PROPERLY COMPACTED BACKFILL SOIL.
⑤ WALL DRAINAGE PANELS (MIRADRAIN OR EQUIVALENT) PLACED PER MANUFACTURER'S REC'S.
⑥ UNDERLAY SUBDRAIN WITH AND CUT FABRIC BACK FROM DRAINAGE PANELS AND WRAP FABRIC AROUND PIPE.
⑦ COLLECTION DRAIN (TOTAL DRAIN OR EQUIVALENT) LOCATED AT BASE OF WALL DRAINAGE PANEL PER MANUFACTURER'S RECOMMENDATIONS.

CANTILEVER RETAINING WALL
DRAINAGE SYSTEMS

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE: AUGUST 2016
JOB NO.: 2150438.01
BY: SRD
PLATE NO.: 2

CHRISTIAN WHEELER
ENGINEERING

Appendix A

Trench Logs

LOG OF TEST TRENCH T-1

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1314 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1314 feet	Depth to Water:	N/A

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0 1			SM	**Topsoil:** Brown, dry, loose, fine- to medium-grained, SILTY SAND; porous with rootlets.		CK		5.4	107.5		
2			SM	**Subsoil:** Brown to reddish-brown, moist, medium dense, SILTY SAND with trace CLAY; slightly porous.		CK		5.6	122.4		
3 4			SW-SM	**Weathered Granitic (Kgr):** Reddish-brown to light grayish-brown, damp, very dense, fine- to coarse-grained, WELL-GRADED SAND with SILT.		CK		2.4	136.9		
5 6 7 8 9 10 11 12 13 14 15				Test trench terminated at 5 feet. No groundwater or seepage encountered.							

Notes:

Symbol Legend

∇ Groundwater Level During Drilling
▼ Groundwater Level After Drilling
❜❜ Apparent Seepage
* No Sample Recovery
** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-1

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