Appendix D
Drainage Report

CEQA-LEVEL
HYDROLOGY REPORT
FOR THE
OTAY HILLS QUARRY

(Log No. 93-19-006J, P04-004, RP04-001)

February 19, 2015

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FOR REVIEW ONLY

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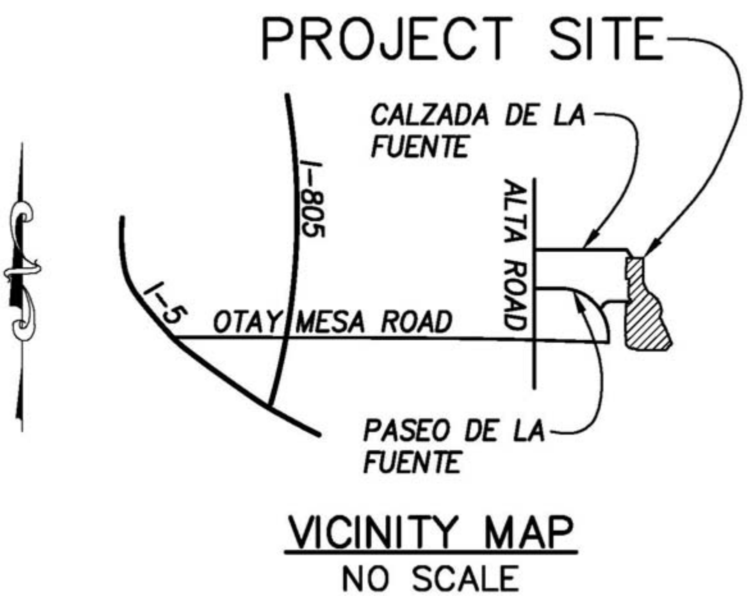
INTRODUCTION

The Otay Hills Quarry is a proposed mineral resource recovery project located beyond the westerly terminus of Otay Mesa Road in southern San Diego County (see Vicinity Map). A plot plan and reclamation plan have been prepared for the proposed recovery activities by Chang Consultants. This CEQA-level drainage report analyzes the existing and proposed (ultimate) condition hydrology at the site. The existing condition reflects the site prior to the proposed project initiation. Recent grading and improvements have been performed and constructed immediately west of the site. These grading and improvements are included on the existing and proposed condition work maps in this report. During the extraction phases of the project, borrow areas will be created that act as retention basins. There will not be an increase in off-site runoff or associated impacts during extraction and backfill due to the retention. Therefore, the interim extraction and backfill phases are not analyzed. The proposed condition reflects the ultimate, post-reclamation condition.



HYDROLOGIC ANALYSES

Hydrologic analyses were performed to determine the 100-year existing and ultimate condition flow rates associated with the footprint of the resource recovery area. The existing and ultimate conditions are shown on the work maps at the back of this report. The County of San Diego's 2003 *Hydrology Manual* rational method procedure was used for the analyses. The rational method input parameters are summarized as follows:

- Precipitation: The 100-year, 6- and 24-hour precipitation values from the *Hydrology Manual* are 3.4 and 8.0 inches, respectively.

- Drainage areas: Surface runoff patterns from the site are generally towards the west and south. There are several locations where surface runoff exits the site. The overall drainage area has been grouped into three major drainage basins, or outflow areas, for the existing and ultimate conditions (Basins 100, 200, and 300 for the existing conditions and Basins 10, 20, and 30 for the ultimate conditions). Existing Basin 100 generally corresponds to ultimate Basin 10, etc. The reclamation and plot plan were developed such that the project would generally maintain the existing off-site runoff directions.

The existing condition drainage basins were delineated using 5-foot contour topographic mapping prepared for the project as well as USGS data for off-site areas. The ultimate condition drainage basins were based on the project plans and the existing topographic mapping. A field visit was performed to verify the drainage basin delineations. The Rational Method Work Maps (see map pocket) contain the drainage basin boundaries as well as flow paths and rational method node numbers.

- Hydrologic soil groups: The hydrologic soil groups were determined from the Soil Conservation Service's *Soil Survey* for San Diego County. The soil group in the study area is entirely "D".

- Runoff coefficients: The runoff coefficients were selected based on the land use and Soil Group "D". The existing condition study area consists of relatively steep, entirely undeveloped hillsides. Since the project involves mineral recovery, the proposed condition land use will also be essentially undeveloped. According to Table 3 from the *Hydrology Manual*, undeveloped land under Soil Group "D" has a runoff coefficient of 0.35.

- Flow lengths and elevations: The flow lengths and elevations were obtained from the Rational Method Work Maps.

The 100-year rational method results are included in Appendix A. The analyses were performed for the existing and ultimate conditions using the CivilDesign Rational Method Hydrology Program, which is based on the County of San Diego criteria. There are five primary discharge locations from the site under existing conditions. These are labeled A through E on the Existing Condition Rational Method Work Map. Two are near the northwest corner, the third is approximately midway along the westerly boundary, and the final two are along the southerly boundary. Under existing conditions, the northwest-most discharge location, A, enters a natural watercourse that flows away from the site in a southwest direction. The additional two westerly discharge locations, B and C, enter a storm drain system constructed by the adjacent project. The storm drain ultimately conveys the runoff in a southwesterly direction away from the site. The southerly two overland discharge locations, D and E, enter natural drainage courses that confluence a short distance south of the site.

Under proposed conditions, the project runoff will continue to exit the site at discharge locations A, C, D, and E. Flow will not exit the site at discharge location B. The 100-year existing and proposed condition 100-year flow rate at each of the discharge locations from the site are summarized in Table 1.

Table 1 shows that the project will not increase the 100-year flow rate from discharge locations B through E. On the other hand, the flow rate from discharge location A will increase slightly. A detention analysis was performed to determine the required detention volume to attenuate the 100-year flow rate from 574 to 559 cfs. The County of San Diego's rational method to hydrograph routine was used to convert the 100-year peak flow rate results to a hydrograph. The results are included in Appendix B and show that a storage volume of at least 0.6 acre-feet is required. A basin is shown on the work map with this volume.

Discharge Location	**Existing Condition**			**Proposed Condition**		
	Tributary Area, ac	**100-Year Flow, cfs**	**100-Year Velocity, fps**	**Tributary Area, ac**	**100-Year Flow, cfs**	**100-Year Velocity, fps**
A	368.65	559	14.2	375.08	574	12.3
B	13.79	28	2.4	---	---	---
C	46.98	94	3.4	50.46	87	4.8
D	25.60	58	2.2	29.07	57	4.3
E	38.27	80	3.5	38.68	65	9.4

Table 1. Summary 100-Year Rational Method Results

HYDRAULIC ANALYSES

The flow velocities are provided in Table 1 from the rational method results. Under existing conditions, the flow velocities at each discharge location were determined using one of two methods. First, where the rational method routine tributary to the discharge location models an initial area (discharge locations B through E), the flow velocity was approximated by dividing the initial subarea flow distance by the total travel time. Second, where the rational method routine tributary to the discharge location models improved channel travel (discharge location A), the flow velocity was obtained from the improved channel results from the rational method output.

Under proposed conditions, normal depth analyses were performed to more accurately approximate the flow velocity at each of the four site discharge locations. The normal depth analyses were based on the proposed condition 100-year flow rates and the drainage conveyance at each discharge location. The analyses were performed using the FlowMaster program and the results are included after this report text. The results show that the flow velocities at discharge locations C and D are below the erosive threshold of 5 to 6 feet per second. Therefore, energy dissipation is not required at these locations. On the other hand, the flow velocities at discharge locations A and E are erosive. Discharge location A will consist of three 54-inch HDPE pipes. Riprap shall be installed at the pipe outlets in accordance with the County of San Diego's September 2014, *Hydraulic Design Manual* and *San Diego Regional Standard Drawing* D-40. For the outlet velocity of 12.3 feet per second, the rock size is required to be ½-ton with a 2.7 foot thickness over 1-inch gravel with a 1 foot thickness. Discharge Location E will consist of a drainage ditch per D-75. For the outlet velocity of 9.4 feet per second, the rock size is required to be No. 2 backing with a 1 foot thickness over ¼-inch gravel with a 1-foot thickness.

CONCLUSION

The CEQA-level hydrologic analyses show that the project will decrease the 100-year surface runoff at four of the five outflow locations (discharge locations B through E). At discharge location A, a detention basin can be installed near the outflow to mitigate for the 100-year flow increase. Based on this, the project will not adversely impact the off-site drainage conditions. Additional drainage design details will be included in the final drainage report for the project.

The northerly-most proposed pad has a tributary area exceeding 200 acres. The pad will convey the storm runoff through the site in accordance with the State Mining and Reclamation Act requirements. The mine operator shall ensure that the pad will not be adversely impacted by runoff from the watershed. Since the runoff will flow through the site within the pad and the project will not increase the runoff exiting the site, the pad will not adversely impact flow from the watershed.

DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the civil engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current design.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

FOR REVIEW ONLY

Wayne W. Chang   Date
RCE 46548
Exp. June 30, 2015

Worksheet for Discharge Location A - 191.3 cfs per pipe (3 pipes total)

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Diameter

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	4.45	ft
Diameter	4.45	ft
Discharge	191.30	ft³/s

Results

Diameter	4.45	ft
Normal Depth	4.45	ft
Flow Area	15.58	ft²
Wetted Perimeter	13.99	ft
Hydraulic Radius	1.11	ft
Top Width	0.00	ft
Critical Depth	3.97	ft
Percent Full	100.0	%
Critical Slope	0.00888	ft/ft
Velocity	12.28	ft/s
Velocity Head	2.34	ft
Specific Energy	6.80	ft
Froude Number	0.00	
Maximum Discharge	205.76	ft³/s
Discharge Full	191.28	ft³/s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Discharge Location C

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01000	ft/ft
Left Side Slope	5.00	ft/ft (H:V)
Right Side Slope	5.00	ft/ft (H:V)
Discharge	87.00	ft³/s

Results

Normal Depth	1.91	ft
Flow Area	18.32	ft²
Wetted Perimeter	19.52	ft
Hydraulic Radius	0.94	ft
Top Width	19.14	ft
Critical Depth	1.80	ft
Critical Slope	0.01395	ft/ft
Velocity	4.75	ft/s
Velocity Head	0.35	ft
Specific Energy	2.26	ft
Froude Number	0.86	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.91	ft
Critical Depth	1.80	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01395	ft/ft

Worksheet for Discharge Location D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01000	ft/ft
Left Side Slope	5.00	ft/ft (H:V)
Right Side Slope	5.00	ft/ft (H:V)
Discharge	57.00	ft^3/s

Results

Normal Depth	1.63	ft
Flow Area	13.34	ft^2
Wetted Perimeter	16.66	ft
Hydraulic Radius	0.80	ft
Top Width	16.33	ft
Critical Depth	1.52	ft
Critical Slope	0.01476	ft/ft
Velocity	4.27	ft/s
Velocity Head	0.28	ft
Specific Energy	1.92	ft
Froude Number	0.83	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.63	ft
Critical Depth	1.52	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01476	ft/ft

Worksheet for Discharge Location E - D-75 Ditch

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.016	
Channel Slope	0.01000	ft/ft
Constructed Depth	3.00	ft
Constructed Top Width	5.00	ft
Discharge	65.00	ft^3/s

Results

Normal Depth	2.34	ft
Flow Area	6.89	ft^2
Wetted Perimeter	6.73	ft
Hydraulic Radius	1.02	ft
Top Width	4.42	ft
Critical Depth	2.70	ft
Critical Slope	0.00564	ft/ft
Velocity	9.43	ft/s
Velocity Head	1.38	ft
Specific Energy	3.72	ft
Froude Number	1.33	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.34	ft
Critical Depth	2.70	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00564	ft/ft

APPENDIX A

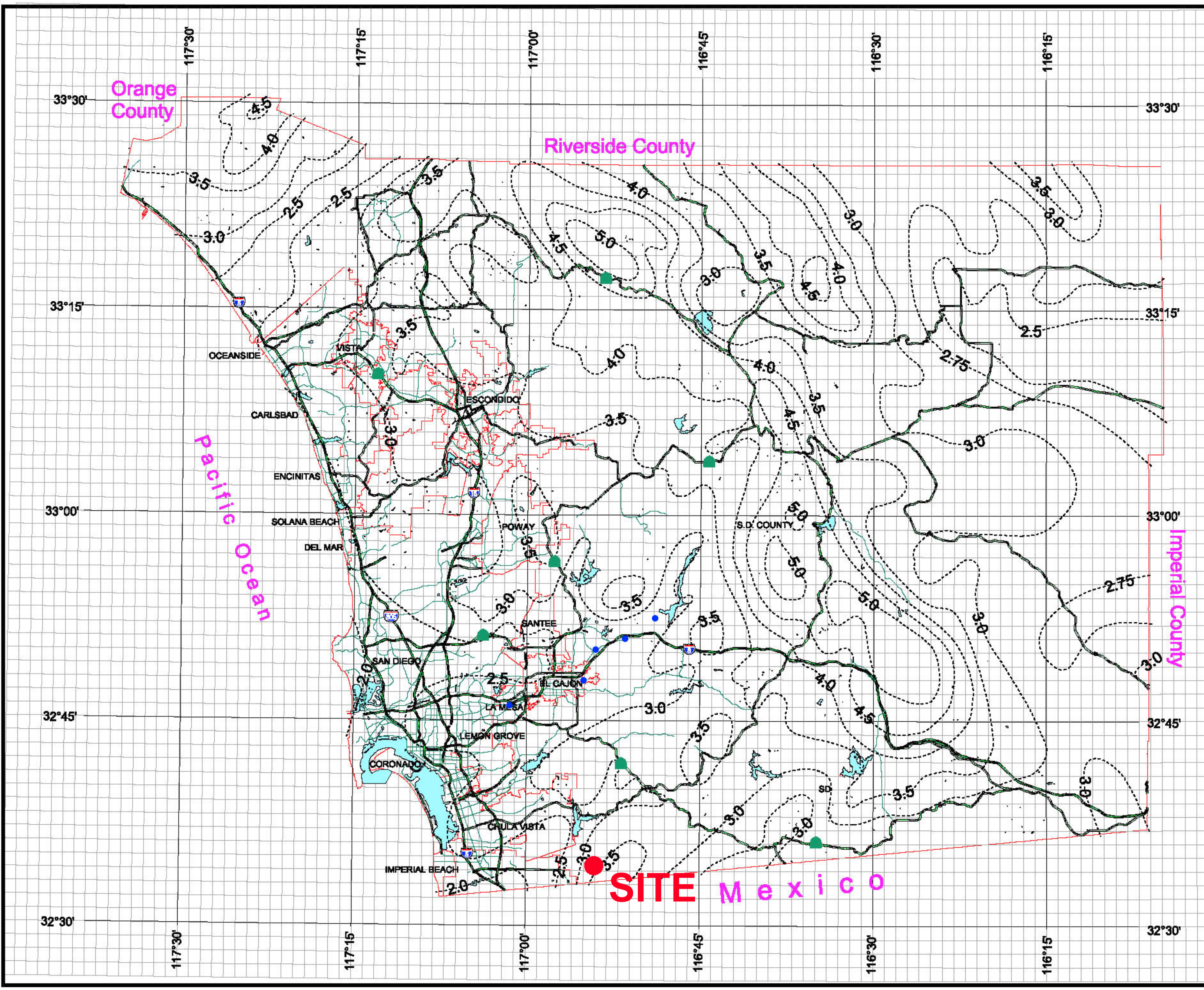
100-YEAR RATIONAL METHOD ANALYSES

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



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3 0 3 Miles

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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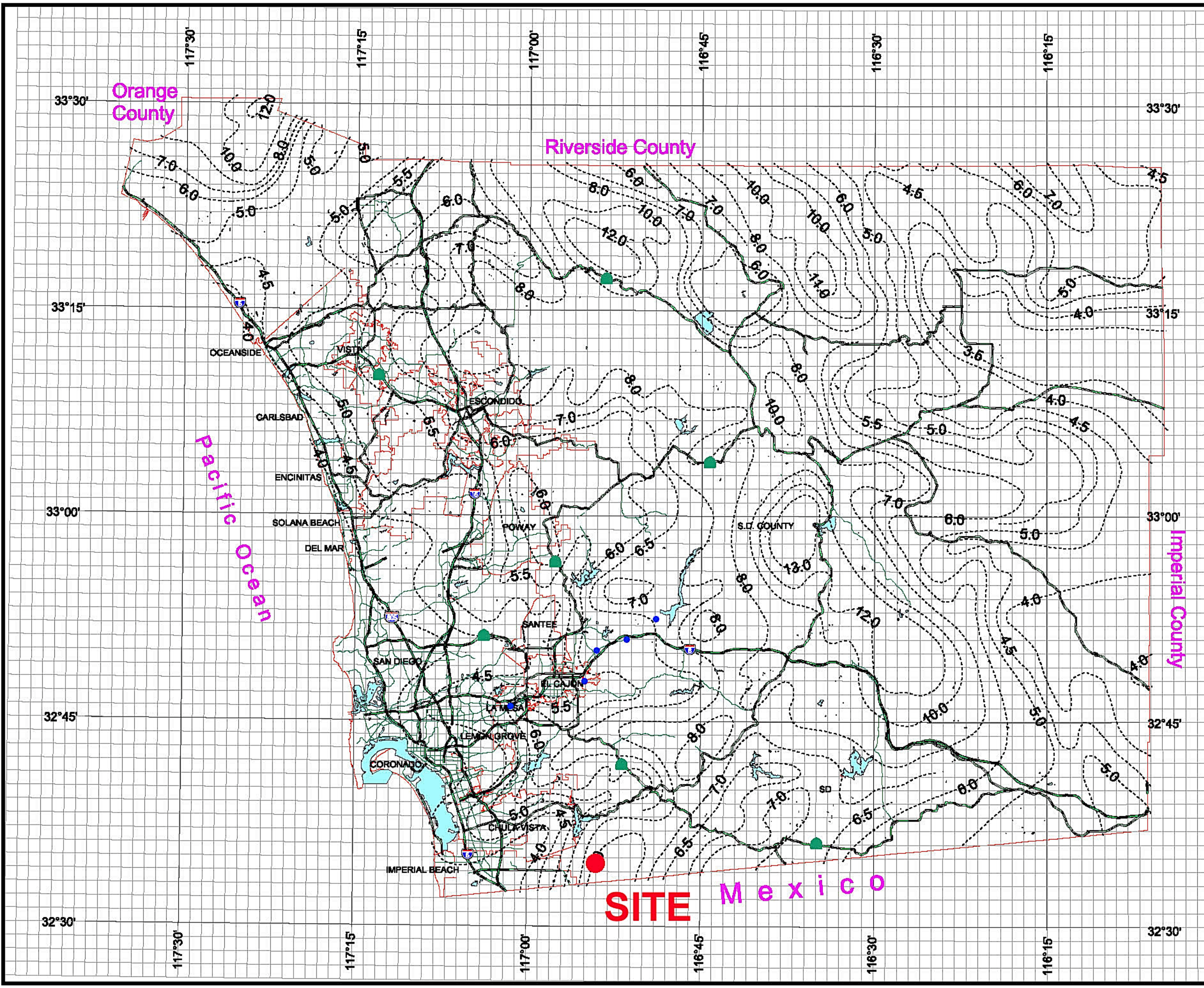

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

-------- Isopluvial (inches)

DPW GIS
Department of Public Works Geographic Information Services

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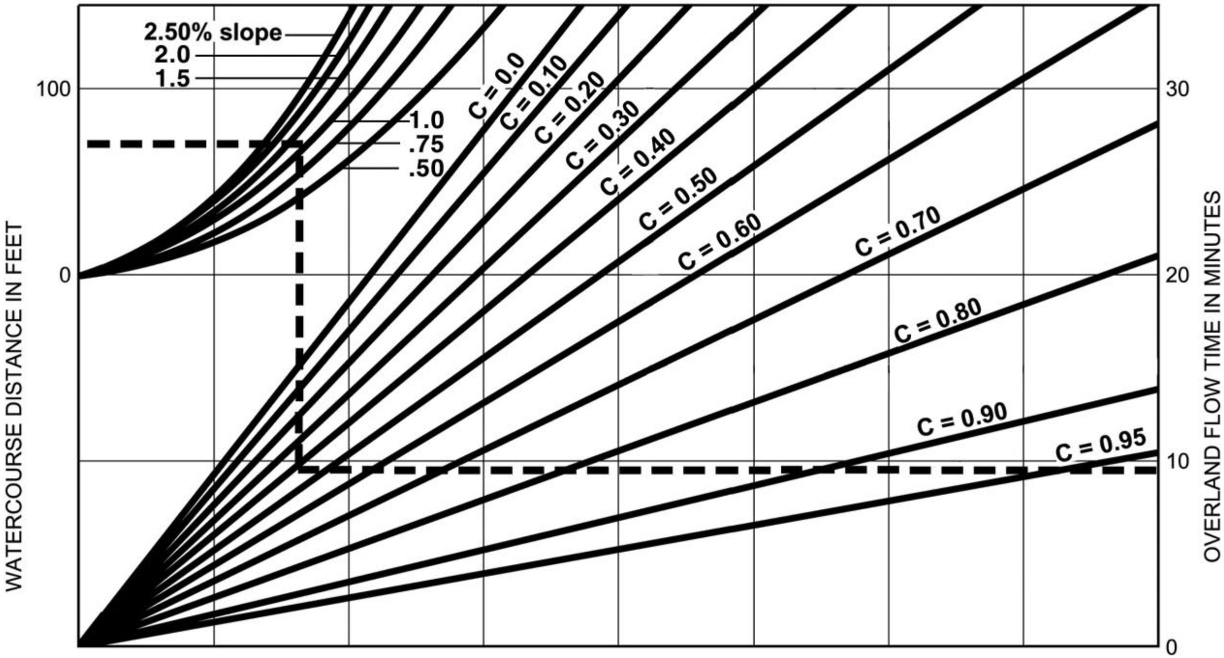
W E
S

3 0 3 Miles



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1\text{-}C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

3-3

Rational Formula - Overland Time of Flow Nomograph

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

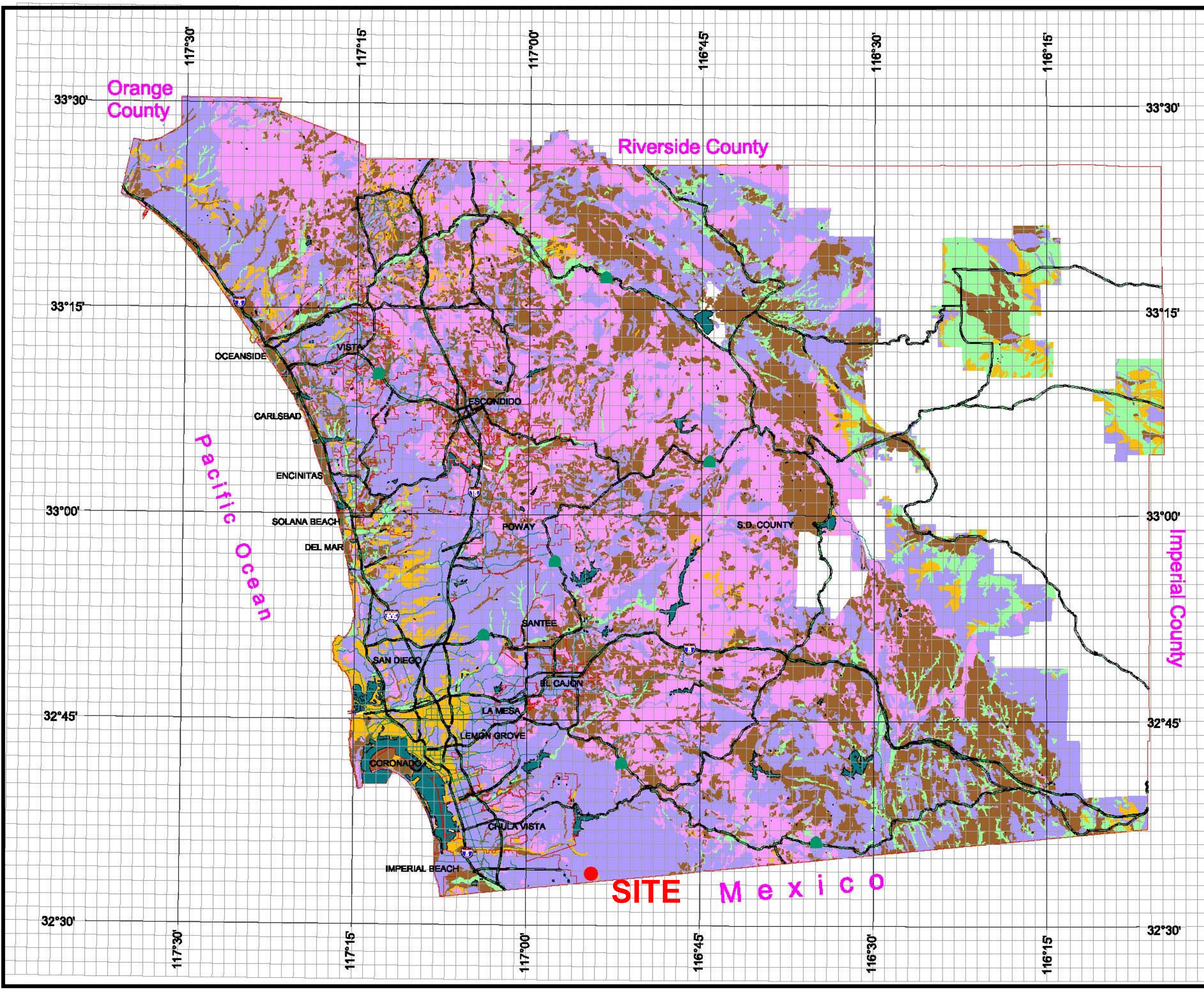
*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups
Group A
Group B
Group C
Group D
Undetermined
Data Unavailable

DPW GIS
Department of Public Works
Geographic Information Services

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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: 02/16/15
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Otay Hills Quarry
Existing Conditions
100-Year Storm Event

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

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Program License Serial Number 4028

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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) =  3.400
24 hour precipitation(inches) =  8.000
P6/P24 =    42.5%
Adjusted 6 hour precipitation (inches) =  3.600
Adjusted P6/P24 =    45.0%
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 = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 2615.000(Ft.)
Highest elevation = 1585.000(Ft.)
Lowest elevation =  895.000(Ft.)
Elevation difference =  690.000(Ft.) Slope = 26.386 %
Top of Initial Area Slope adjusted by User to 13.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  13.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.74 minutes
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```
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  13.000^(1/3)]=   5.74
The initial area total distance of 2615.00 (Ft.) entered leaves a
remaining distance of 2515.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   5.42 minutes
for a distance of 2515.00 (Ft.) and a slope of 26.39 %
with an elevation difference of 663.61(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    5.417 Minutes
Tt=[(11.9*0.4763^3)/(663.61)]^.385=  5.42
Total initial area Ti =   5.74 minutes from Figure 3-3 formula plus
  5.42 minutes from the Figure 3-4 formula =  11.16 minutes
Rainfall intensity (I) =      5.652(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     81.574(CFS)
Total initial stream area =       41.240(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   895.000(Ft.)
Downstream point elevation =   651.000(Ft.)
Channel length thru subarea  =  4193.000(Ft.)
Channel base width      =    3.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =    320.556(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =    320.556(CFS)
Depth of flow =   2.933(Ft.), Average velocity =  12.328(Ft/s)
Channel flow top width =   14.732(Ft.)
Flow Velocity =   12.33(Ft/s)
Travel time  =    5.67 min.
Time of concentration =   16.83 min.
Critical depth =      3.688(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.336(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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      4.336(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =    129.028
Subarea runoff =    477.896(CFS) for    327.410(Ac.)
Total runoff =    559.470(CFS)      Total area =     368.650(Ac.)
Depth of flow =   3.753(Ft.), Average velocity =  14.192(Ft/s)
Critical depth =      4.781(Ft.)
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Process from Point/Station      101.000 to Point/Station      102.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =    368.650(Ac.)
Runoff from this stream =    559.470(CFS)
Time of concentration =   16.83 min.
Rainfall intensity =     4.336(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** 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
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 1559.000(Ft.)
Highest elevation =  828.000(Ft.)
Lowest elevation =  652.000(Ft.)
Elevation difference =  176.000(Ft.) Slope = 11.289 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  11.29 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.02 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  11.289^(1/3)]=   6.02
The initial area total distance of 1559.00 (Ft.) entered leaves a
remaining distance of 1459.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   4.94 minutes
for a distance of 1459.00 (Ft.) and a slope of 11.29 %
with an elevation difference of 164.71(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    4.939 Minutes
Tt=[(11.9*0.2763^3)/(164.71)]^.385=  4.94
Total initial area Ti =   6.02 minutes from Figure 3-3 formula plus
  4.94 minutes from the Figure 3-4 formula =  10.96 minutes
Rainfall intensity (I) =      5.718(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     27.600(CFS)
Total initial stream area =       13.790(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
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```
Along Main Stream number: 2 in normal stream number 1
Stream flow area =     13.790(Ac.)
Runoff from this stream =     27.600(CFS)
Time of concentration =   10.96 min.
Rainfall intensity =     5.718(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      211.000
**** 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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 2258.000(Ft.)
Highest elevation =  997.000(Ft.)
Lowest elevation =  622.000(Ft.)
Elevation difference =  375.000(Ft.) Slope = 16.608 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  16.61 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.29 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  16.608^(1/3)]=   5.29
The initial area total distance of 2258.00 (Ft.) entered leaves a
remaining distance of 2158.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   5.75 minutes
for a distance of 2158.00 (Ft.) and a slope of 16.61 %
with an elevation difference of 358.40(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    5.754 Minutes
Tt=[(11.9*0.4087^3)/(358.40)]^.385=  5.75
Total initial area Ti =   5.29 minutes from Figure 3-3 formula plus
  5.75 minutes from the Figure 3-4 formula =  11.05 minutes
Rainfall intensity (I) =      5.689(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     93.541(CFS)
Total initial stream area =       46.980(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      211.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =     46.980(Ac.)
Runoff from this stream =     93.541(CFS)
Time of concentration =   11.05 min.
Rainfall intensity =     5.689(In/Hr)
Summary of stream data:
```

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


1       27.600     10.96               5.718
2       93.541     11.05               5.689
Qmax(1) =
         1.000 *    1.000 *    27.600) +
         1.000 *    0.992 *    93.541) + =     120.390
Qmax(2) =
         0.995 *    1.000 *    27.600) +
         1.000 *    1.000 *    93.541) + =     120.997
```

Total of 2 streams to confluence:
Flow rates before confluence point:
      27.600   93.541
Maximum flow rates at confluence using above data:
      120.390   120.997
Area of streams before confluence:
       13.790   46.980
Results of confluence:
Total flow rate =   120.997(CFS)
Time of concentration =   11.046 min.
Effective stream area after confluence =   60.770(Ac.)

++
Process from Point/Station   201.000 to Point/Station   211.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =   60.770(Ac.)
Runoff from this stream =   120.997(CFS)
Time of concentration =   11.05 min.
Rainfall intensity =   5.689(In/Hr)
Program is now starting with Main Stream No. 3

++
Process from Point/Station   300.000 to Point/Station   301.000
**** 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
[UNDISTURBED NATURAL TERRAIN   ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance = 2127.000(Ft.)
Highest elevation = 1015.000(Ft.)
Lowest elevation = 605.000(Ft.)
Elevation difference = 410.000(Ft.) Slope = 19.276 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:

```
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  19.28 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.03 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  19.276^(1/3)]=   5.03
The initial area total distance of 2127.00 (Ft.) entered leaves a
remaining distance of 2027.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   5.18 minutes
for a distance of 2027.00 (Ft.) and a slope of 19.28 %
with an elevation difference of 390.72(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    5.178 Minutes
Tt=[(11.9*0.3839^3)/(390.72)]^.385=  5.18
Total initial area Ti =   5.03 minutes from Figure 3-3 formula plus
  5.18 minutes from the Figure 3-4 formula =  10.21 minutes
Rainfall intensity (I) =      5.984(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     80.151(CFS)
Total initial stream area =       38.270(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 1
Stream flow area =     38.270(Ac.)
Runoff from this stream =     80.151(CFS)
Time of concentration =   10.21 min.
Rainfall intensity =     5.984(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      310.000 to Point/Station      311.000
**** 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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 1196.000(Ft.)
Highest elevation =  758.000(Ft.)
Lowest elevation =  576.000(Ft.)
Elevation difference =  182.000(Ft.) Slope = 15.217 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  15.22 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.45 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
```

```
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  15.220^(1/3)]=   5.45
The initial area total distance of 1196.00 (Ft.) entered leaves a
remaining distance of 1096.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   3.53 minutes
for a distance of 1096.00 (Ft.) and a slope of 15.22 %
with an elevation difference of 166.81(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    3.532 Minutes
Tt=[(11.9*0.2076^3)/(166.81)]^.385=  3.53
Total initial area Ti =   5.45 minutes from Figure 3-3 formula plus
  3.53 minutes from the Figure 3-4 formula =   8.98 minutes
Rainfall intensity (I) =      6.502(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     58.255(CFS)
Total initial stream area =       25.600(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      310.000 to Point/Station      311.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 2
Stream flow area =     25.600(Ac.)
Runoff from this stream =     58.255(CFS)
Time of concentration =    8.98 min.
Rainfall intensity =     6.502(In/Hr)
Summary of stream data:

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


1       80.151     10.21               5.984
2       58.255      8.98               6.502
Qmax(1) =
         1.000 *    1.000 *    80.151) +
         0.920 *    1.000 *    58.255) + =     133.766
Qmax(2) =
         1.000 *    0.879 *    80.151) +
         1.000 *    1.000 *    58.255) + =     128.728

Total of 2 streams to confluence:
Flow rates before confluence point:
      80.151      58.255
Maximum flow rates at confluence using above data:
      133.766      128.728
Area of streams before confluence:
       38.270       25.600
Results of confluence:
Total flow rate =    133.766(CFS)
Time of concentration =    10.213 min.
Effective stream area after confluence =     63.870(Ac.)


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Process from Point/Station      301.000 to Point/Station      311.000
**** CONFLUENCE OF MAIN STREAMS ****
```

```
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =     63.870(Ac.)
Runoff from this stream =    133.766(CFS)
Time of concentration =   10.21 min.
Rainfall intensity =     5.984(In/Hr)
Summary of stream data:

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


1      559.470     16.83               4.336
2      120.997     11.05               5.689
3      133.766     10.21               5.984
Qmax(1) =
         1.000 *    1.000 *   559.470) +
         0.762 *    1.000 *   120.997) +
         0.725 *    1.000 *   133.766) + =     748.626
Qmax(2) =
         1.000 *    0.656 *   559.470) +
         1.000 *    1.000 *   120.997) +
         0.951 *    1.000 *   133.766) + =     615.406
Qmax(3) =
         1.000 *    0.607 *   559.470) +
         1.000 *    0.925 *   120.997) +
         1.000 *    1.000 *   133.766) + =     585.187

Total of 3 main streams to confluence:
Flow rates before confluence point:
     559.470     120.997     133.766
Maximum flow rates at confluence using above data:
      748.626      615.406      585.187
Area of streams before confluence:
      368.650       60.770       63.870


Results of confluence:
Total flow rate =    748.626(CFS)
Time of concentration =    16.827 min.
Effective stream area after confluence  =    493.290(Ac.)
End of computations, total study area =         493.290 (Ac.)
```

```
            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: 02/19/15
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Otay Hills Quarry
Proposed Conditions
100-Year Storm Event

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

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Program License Serial Number 4028

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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) =  3.400
24 hour precipitation(inches) =  8.000
P6/P24 =    42.5%
Adjusted 6 hour precipitation (inches) =  3.600
Adjusted P6/P24 =    45.0%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** 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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 2998.000(Ft.)
Highest elevation = 1350.000(Ft.)
Lowest elevation =  683.000(Ft.)
Elevation difference =  667.000(Ft.) Slope = 22.248 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  22.25 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.80 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  22.248^(1/3)]=   4.80
```

```
The initial area total distance of 2998.00 (Ft.) entered leaves a
remaining distance of 2898.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   6.45 minutes
for a distance of 2898.00 (Ft.) and a slope of 22.25 %
with an elevation difference of 644.75(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    6.452 Minutes
Tt=[(11.9*0.5489^3)/(644.75)]^.385=  6.45
Total initial area Ti =   4.80 minutes from Figure 3-3 formula plus
  6.45 minutes from the Figure 3-4 formula =  11.25 minutes
Rainfall intensity (I) =      5.621(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =    111.199(CFS)
Total initial stream area =       56.520(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   683.000(Ft.)
Downstream point elevation =   680.300(Ft.)
Channel length thru subarea  =   234.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =    111.199(CFS)
Depth of flow =   1.209(Ft.), Average velocity =   3.802(Ft/s)
Channel flow top width =   48.374(Ft.)
Flow Velocity =    3.80(Ft/s)
Travel time  =    1.03 min.
Time of concentration =   12.28 min.
Critical depth =      1.141(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     56.520(Ac.)
Runoff from this stream =    111.199(CFS)
Time of concentration =   12.28 min.
Rainfall intensity =     5.314(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** 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
[UNDISTURBED NATURAL TERRAIN                 ]
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(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 2615.000(Ft.)
Highest elevation = 1585.000(Ft.)
Lowest elevation =  895.000(Ft.)
Elevation difference =  690.000(Ft.) Slope = 26.386 %
Top of Initial Area Slope adjusted by User to 13.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  13.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.74 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  13.000^(1/3)]=   5.74
The initial area total distance of 2615.00 (Ft.) entered leaves a
remaining distance of 2515.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   5.42 minutes
for a distance of 2515.00 (Ft.) and a slope of 26.39 %
with an elevation difference of 663.61(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    5.417 Minutes
Tt=[(11.9*0.4763^3)/(663.61)]^.385=  5.42
Total initial area Ti =   5.74 minutes from Figure 3-3 formula plus
  5.42 minutes from the Figure 3-4 formula =  11.16 minutes
Rainfall intensity (I) =      5.652(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     81.574(CFS)
Total initial stream area =       41.240(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      14.000 to Point/Station      15.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   895.000(Ft.)
Downstream point elevation =   683.000(Ft.)
Channel length thru subarea  =  3369.000(Ft.)
Channel base width      =    3.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =    250.990(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =    250.990(CFS)
Depth of flow =   2.579(Ft.), Average velocity =  11.927(Ft/s)
Channel flow top width =   13.317(Ft.)
Flow Velocity =   11.93(Ft/s)
Travel time  =    4.71 min.
Time of concentration =   15.87 min.
Critical depth =      3.313(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.504(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
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Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      4.504(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =     93.331
Subarea runoff =    338.754(CFS) for    225.420(Ac.)
Total runoff =    420.328(CFS)      Total area =     266.660(Ac.)
Depth of flow =   3.253(Ft.), Average velocity =  13.595(Ft/s)
Critical depth =      4.188(Ft.)


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Process from Point/Station       15.000 to Point/Station       12.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   683.000(Ft.)
Downstream point elevation =   680.300(Ft.)
Channel length thru subarea  =   238.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =    420.328(CFS)
Depth of flow =   1.998(Ft.), Average velocity =   5.267(Ft/s)
Channel flow top width =   79.901(Ft.)
Flow Velocity =    5.27(Ft/s)
Travel time  =    0.75 min.
Time of concentration =   16.62 min.
Critical depth =      1.938(Ft.)


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Process from Point/Station       15.000 to Point/Station       12.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    266.660(Ac.)
Runoff from this stream =    420.328(CFS)
Time of concentration =   16.62 min.
Rainfall intensity =     4.371(In/Hr)
Summary of stream data:

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


1      111.199     12.28              5.314
2      420.328     16.62              4.371
Qmax(1) =
         1.000 *    1.000 *   111.199) +
         1.000 *    0.739 *   420.328) + =     421.721
Qmax(2) =
         0.823 *    1.000 *   111.199) +
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         1.000 *    1.000 *   420.328) + =     511.800

Total of 2 streams to confluence:
Flow rates before confluence point:
     111.199     420.328
Maximum flow rates at confluence using above data:
      421.721      511.800
Area of streams before confluence:
       56.520      266.660
Results of confluence:
Total flow rate =    511.800(CFS)
Time of concentration =    16.620 min.
Effective stream area after confluence =    323.180(Ac.)


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Process from Point/Station       12.000 to Point/Station       16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   680.300(Ft.)
Downstream point elevation =   675.500(Ft.)
Channel length thru subarea  =   497.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =    511.847(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =    511.847(CFS)
Depth of flow =   2.217(Ft.), Average velocity =   5.209(Ft/s)
Channel flow top width =   88.663(Ft.)
Flow Velocity =    5.21(Ft/s)
Travel time  =    1.59 min.
Time of concentration =   18.21 min.
Critical depth =      2.094(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.121(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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
The area added to the existing stream causes a
a lower flow rate of Q =    488.191(CFS)
therefore the upstream flow rate of Q =    511.800(CFS) is being used
Rainfall intensity =      4.121(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =    118.471
Subarea runoff =      0.000(CFS) for     15.310(Ac.)
Total runoff =    511.800(CFS)      Total area =     338.490(Ac.)
Depth of flow =   2.216(Ft.), Average velocity =   5.209(Ft/s)
Critical depth =      2.094(Ft.)
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Process from Point/Station      12.000 to Point/Station      16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    338.490(Ac.)
Runoff from this stream =    511.800(CFS)
Time of concentration =   18.21 min.
Rainfall intensity =     4.121(In/Hr)


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Process from Point/Station      17.000 to Point/Station      18.000
**** 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
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 2362.000(Ft.)
Highest elevation = 1020.300(Ft.)
Lowest elevation =  684.000(Ft.)
Elevation difference =  336.300(Ft.) Slope = 14.238 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  14.24 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.57 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  14.238^(1/3)]=   5.57
The initial area total distance of 2362.00 (Ft.) entered leaves a
remaining distance of 2262.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   6.33 minutes
for a distance of 2262.00 (Ft.) and a slope of 14.24 %
with an elevation difference of 322.06(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    6.331 Minutes
Tt=[(11.9*0.4284^3)/(322.06)]^.385=  6.33
Total initial area Ti =   5.57 minutes from Figure 3-3 formula plus
  6.33 minutes from the Figure 3-4 formula =  11.90 minutes
Rainfall intensity (I) =      5.422(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     69.431(CFS)
Total initial stream area =       36.590(Ac.)


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Process from Point/Station      18.000 to Point/Station      16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   684.000(Ft.)
Downstream point elevation =   675.500(Ft.)
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Channel length thru subarea  =   694.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =     69.431(CFS)
Depth of flow =   1.002(Ft.), Average velocity =   3.456(Ft/s)
Channel flow top width =   40.091(Ft.)
Flow Velocity =    3.46(Ft/s)
Travel time  =    3.35 min.
Time of concentration =   15.25 min.
Critical depth =      0.945(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     36.590(Ac.)
Runoff from this stream =     69.431(CFS)
Time of concentration =   15.25 min.
Rainfall intensity =     4.621(In/Hr)
Summary of stream data:

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


1      511.800     18.21               4.121
2       69.431     15.25               4.621
Qmax(1) =
         1.000 *    1.000 *   511.800) +
         0.892 *    1.000 *    69.431) + =     573.720
Qmax(2) =
         1.000 *    0.837 *   511.800) +
         1.000 *    1.000 *    69.431) + =     497.986

Total of 2 streams to confluence:
Flow rates before confluence point:
     511.800      69.431
Maximum flow rates at confluence using above data:
      573.720      497.986
Area of streams before confluence:
      338.490       36.590
Results of confluence:
Total flow rate =    573.720(CFS)
Time of concentration =    18.210 min.
Effective stream area after confluence =    375.080(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
```

```
In Main Stream number: 1
Stream flow area =    375.080(Ac.)
Runoff from this stream =    573.720(CFS)
Time of concentration =   18.21 min.
Rainfall intensity =     4.121(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** 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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 1411.000(Ft.)
Highest elevation = 1020.300(Ft.)
Lowest elevation =  787.000(Ft.)
Elevation difference =  233.300(Ft.) Slope = 16.534 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  16.53 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.30 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  16.534^(1/3)]=   5.30
The initial area total distance of 1411.00 (Ft.) entered leaves a
remaining distance of 1311.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   3.93 minutes
for a distance of 1311.00 (Ft.) and a slope of 16.53 %
with an elevation difference of 216.76(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    3.927 Minutes
Tt=[(11.9*0.2483^3)/(216.76)]^.385=  3.93
Total initial area Ti =   5.30 minutes from Figure 3-3 formula plus
  3.93 minutes from the Figure 3-4 formula =   9.23 minutes
Rainfall intensity (I) =      6.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     13.730(CFS)
Total initial stream area =       6.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       22.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   787.000(Ft.)
Downstream point elevation =   650.500(Ft.)
Channel length thru subarea  =   166.000(Ft.)
Channel base width      =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
```

```
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.016
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     13.730(CFS)
Depth of flow =   0.369(Ft.), Average velocity =  30.004(Ft/s)
Channel flow top width =    1.978(Ft.)
Flow Velocity =   30.00(Ft/s)
Travel time  =    0.09 min.
Time of concentration =    9.32 min.
Critical depth =      1.109(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       23.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   650.500(Ft.)
Downstream point elevation =   624.000(Ft.)
Channel length thru subarea  =  1116.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =     50.273(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     50.273(CFS)
Depth of flow =   0.784(Ft.), Average velocity =   4.086(Ft/s)
Channel flow top width =   31.373(Ft.)
Flow Velocity =    4.09(Ft/s)
Travel time  =    4.55 min.
Time of concentration =   13.87 min.
Critical depth =      0.828(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.912(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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      4.912(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =     17.661
Subarea runoff =     73.014(CFS) for     44.320(Ac.)
Total runoff =     86.744(CFS)      Total area =      50.460(Ac.)
Depth of flow =   0.962(Ft.), Average velocity =   4.683(Ft/s)
Critical depth =      1.023(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       23.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
```

```
Stream flow area =     50.460(Ac.)
Runoff from this stream =     86.744(CFS)
Time of concentration =   13.87 min.
Rainfall intensity =     4.912(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       31.000
**** 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
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 1131.000(Ft.)
Highest elevation = 1015.000(Ft.)
Lowest elevation =  700.000(Ft.)
Elevation difference =  315.000(Ft.) Slope = 27.851 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  27.85 %, in a development type of
 Permanent Open Space
In Accordance With Table 3-2
Initial Area Time of Concentration =   6.90 minutes
 (for slope value of  10.00 %)
The initial area total distance of 1131.00 (Ft.) entered leaves a
remaining distance of 1031.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.67 minutes
for a distance of 1031.00 (Ft.) and a slope of 27.85 %
with an elevation difference of 287.14(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.670 Minutes
Tt=[(11.9*0.1953^3)/(287.14)]^.385=  2.67
Total initial area Ti =   6.90 minutes from Table 3-2 plus
  2.67 minutes from the Figure 3-4 formula =   9.57 minutes
Rainfall intensity (I) =      6.240(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     56.915(CFS)
Total initial stream area =       26.060(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       31.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   700.000(Ft.)
Downstream point elevation =   605.000(Ft.)
Channel length thru subarea  =  1399.000(Ft.)
Channel base width      =    3.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     56.940(CFS)
```

```
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     56.940(CFS)
Depth of flow =   1.076(Ft.), Average velocity =  10.270(Ft/s)
Channel flow top width =    7.305(Ft.)
Flow Velocity =   10.27(Ft/s)
Travel time  =    2.27 min.
Time of concentration =   11.84 min.
Critical depth =      1.594(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.439(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
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
The area added to the existing stream causes a
a lower flow rate of Q =     55.343(CFS)
therefore the upstream flow rate of Q =     56.915(CFS) is being used
Rainfall intensity =      5.439(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =     10.174
Subarea runoff =      0.000(CFS) for      3.010(Ac.)
Total runoff =     56.915(CFS)      Total area =      29.070(Ac.)
Depth of flow =   1.076(Ft.), Average velocity =  10.269(Ft/s)
Critical depth =      1.594(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       31.000 to Point/Station       32.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 1
Stream flow area =     29.070(Ac.)
Runoff from this stream =     56.915(CFS)
Time of concentration =   11.84 min.
Rainfall intensity =     5.439(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       34.000
**** 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
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  = 1383.000(Ft.)
Highest elevation =  653.000(Ft.)
Lowest elevation =  572.000(Ft.)
```

```
Elevation difference =   81.000(Ft.) Slope =  5.857 %
Top of Initial Area Slope adjusted by User to 26.570 %
Bottom of Initial Area Slope adjusted by User to  1.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  26.57 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.52 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  26.570^(1/3)]=   4.52
The initial area total distance of 1383.00 (Ft.) entered leaves a
remaining distance of 1283.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   9.99 minutes
for a distance of 1283.00 (Ft.) and a slope of  1.40 %
with an elevation difference of  17.96(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    9.992 Minutes
Tt=[(11.9*0.2430^3)/( 17.96)]^.385=  9.99
Total initial area Ti =   4.52 minutes from Figure 3-3 formula plus
  9.99 minutes from the Figure 3-4 formula =  14.52 minutes
Rainfall intensity (I) =      4.770(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =     64.570(CFS)
Total initial stream area =       38.680(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       34.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 2
Stream flow area =     38.680(Ac.)
Runoff from this stream =     64.570(CFS)
Time of concentration =   14.52 min.
Rainfall intensity =     4.770(In/Hr)
Summary of stream data:

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


1       56.915     11.84               5.439
2       64.570     14.52               4.770
Qmax(1) =
         1.000 *    1.000 *    56.915) +
         1.000 *    0.816 *    64.570) + =     109.582
Qmax(2) =
         0.877 *    1.000 *    56.915) +
         1.000 *    1.000 *    64.570) + =     114.475

Total of 2 streams to confluence:
Flow rates before confluence point:
      56.915      64.570
Maximum flow rates at confluence using above data:
      109.582      114.475
Area of streams before confluence:
```

```
       29.070       38.680
Results of confluence:
Total flow rate =    114.475(CFS)
Time of concentration =    14.517 min.
Effective stream area after confluence =     67.750(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       34.000 to Point/Station       34.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =     67.750(Ac.)
Runoff from this stream =    114.475(CFS)
Time of concentration =   14.52 min.
Rainfall intensity =     4.770(In/Hr)
Summary of stream data:

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


1      573.720     18.21               4.121
2       86.744     13.87               4.912
3      114.475     14.52               4.770
Qmax(1) =
         1.000 *    1.000 *   573.720) +
         0.839 *    1.000 *    86.744) +
         0.864 *    1.000 *   114.475) + =     745.400
Qmax(2) =
         1.000 *    0.762 *   573.720) +
         1.000 *    1.000 *    86.744) +
         1.000 *    0.955 *   114.475) + =     633.128
Qmax(3) =
         1.000 *    0.797 *   573.720) +
         0.971 *    1.000 *    86.744) +
         1.000 *    1.000 *   114.475) + =     656.065

Total of 3 main streams to confluence:
Flow rates before confluence point:
     573.720      86.744     114.475
Maximum flow rates at confluence using above data:
      745.400      633.128      656.065
Area of streams before confluence:
      375.080       50.460       67.750


Results of confluence:
Total flow rate =    745.400(CFS)
Time of concentration =    18.210 min.
Effective stream area after confluence  =    493.290(Ac.)
End of computations, total study area =         493.290 (Ac.)
```

APPENDIX B

100-YEAR DETENTION ANALYSIS

```
****************************************                              **************************************
*                                      *                              *                                    *
*   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   20JAN12  TIME  15:19:54   *                              *         (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

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

                      *DIAGRAM
*** FREE ***
           1          ID   OTAY HILLS QUARRY
           2          ID   100-YEAR DETENTION ANALYSIS
           3          ID   NORTHWEST OUTFLOW LOCATION
           4          IT       1 01JAN90    1200     400

           5          KK   BASIN
           6          KM   RATIONAL METHOD HYDROGRAPH PROGRAM
           7          KM   6-HOUR RAINFALL IS 3.4 INCHES
           8          KM   RATIONAL METHOD RUNOFF COEFFICIENT IS 0.35
           9          KM   RATIONAL METHOD TIME OF CONCENTRATION IS 18.21 MINUTES
          10          BA  0.5861
          11          IN      18 01JAN90    1157
          12          QI       0    26.9    28.8      30    32.6    34.1    37.8    40.1      46    49.9
          13          QI    60.9    69.4   101.9    84.7   573.7    81.7    54.7    42.8    35.8    31.2
          14          QI    27.8       0       0       0       0       0       0       0       0       0
          15          QI       0       0

          16          KK  DETAIN
          17          RS       1    STOR      -1
          18          SV       0     0.6
          19          SQ       0     559
          20          SE     100     101
          21          ZZ
```

```
              SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

   5        BASIN
                V
                V
  16       DETAIN

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************                                               ***************************************
*                                       *                                               *                                     *
*   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  20JAN12  TIME  15:19:54    *                                               *          (916) 756-1104             *
*                                       *                                               *                                     *
*****************************************                                               ***************************************



                           OTAY HILLS QUARRY
                           100-YEAR DETENTION ANALYSIS
                           NORTHWEST OUTFLOW LOCATION

    IT          HYDROGRAPH TIME DATA
                      NMIN           1  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1JAN90  STARTING DATE
                     ITIME        1200  STARTING TIME
                        NQ         400  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1JAN90  ENDING DATE
                    NDTIME        1839  ENDING TIME
                    ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL     .02 HOURS
                     TOTAL TIME BASE    6.65 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


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

            **************
            *            *
   5 KK     *    BASIN   *
            *            *
            **************
                           RATIONAL METHOD HYDROGRAPH PROGRAM
                           6-HOUR RAINFALL IS 3.4 INCHES
                           RATIONAL METHOD RUNOFF COEFFICIENT IS 0.35
                           RATIONAL METHOD TIME OF CONCENTRATION IS 18.21 MINUTES

  11 IN         TIME DATA FOR INPUT TIME SERIES
                     JXMIN          18  TIME INTERVAL IN MINUTES
                    JXDATE      1JAN90  STARTING DATE
                    JXTIME        1157  STARTING TIME

               SUBBASIN RUNOFF DATA

  10 BA         SUBBASIN CHARACTERISTICS
                     TAREA         .59  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	4.	*	1 JAN 1340	101	37.	*	1 JAN 1520	201	78.	*	1 JAN 1700	301	45.
1 JAN 1201	2	6.	*	1 JAN 1341	102	37.	*	1 JAN 1521	202	80.	*	1 JAN 1701	302	44.
1 JAN 1202	3	7.	*	1 JAN 1342	103	37.	*	1 JAN 1522	203	82.	*	1 JAN 1702	303	43.
1 JAN 1203	4	9.	*	1 JAN 1343	104	37.	*	1 JAN 1523	204	84.	*	1 JAN 1703	304	43.
1 JAN 1204	5	10.	*	1 JAN 1344	105	38.	*	1 JAN 1524	205	86.	*	1 JAN 1704	305	42.
1 JAN 1205	6	12.	*	1 JAN 1345	106	38.	*	1 JAN 1525	206	87.	*	1 JAN 1705	306	42.
1 JAN 1206	7	13.	*	1 JAN 1346	107	38.	*	1 JAN 1526	207	89.	*	1 JAN 1706	307	42.
1 JAN 1207	8	15.	*	1 JAN 1347	108	38.	*	1 JAN 1527	208	91.	*	1 JAN 1707	308	41.
1 JAN 1208	9	16.	*	1 JAN 1348	109	38.	*	1 JAN 1528	209	93.	*	1 JAN 1708	309	41.
1 JAN 1209	10	18.	*	1 JAN 1349	110	38.	*	1 JAN 1529	210	95.	*	1 JAN 1709	310	40.
1 JAN 1210	11	19.	*	1 JAN 1350	111	38.	*	1 JAN 1530	211	96.	*	1 JAN 1710	311	40.
1 JAN 1211	12	21.	*	1 JAN 1351	112	39.	*	1 JAN 1531	212	98.	*	1 JAN 1711	312	40.
1 JAN 1212	13	22.	*	1 JAN 1352	113	39.	*	1 JAN 1532	213	100.	*	1 JAN 1712	313	39.
1 JAN 1213	14	24.	*	1 JAN 1353	114	39.	*	1 JAN 1533	214	102.	*	1 JAN 1713	314	39.
1 JAN 1214	15	25.	*	1 JAN 1354	115	39.	*	1 JAN 1534	215	101.	*	1 JAN 1714	315	39.
1 JAN 1215	16	27.	*	1 JAN 1355	116	39.	*	1 JAN 1535	216	100.	*	1 JAN 1715	316	38.
1 JAN 1216	17	27.	*	1 JAN 1356	117	39.	*	1 JAN 1536	217	99.	*	1 JAN 1716	317	38.
1 JAN 1217	18	27.	*	1 JAN 1357	118	39.	*	1 JAN 1537	218	98.	*	1 JAN 1717	318	37.
1 JAN 1218	19	27.	*	1 JAN 1358	119	39.	*	1 JAN 1538	219	97.	*	1 JAN 1718	319	37.
1 JAN 1219	20	27.	*	1 JAN 1359	120	40.	*	1 JAN 1539	220	96.	*	1 JAN 1719	320	37.
1 JAN 1220	21	27.	*	1 JAN 1400	121	40.	*	1 JAN 1540	221	95.	*	1 JAN 1720	321	36.
1 JAN 1221	22	28.	*	1 JAN 1401	122	40.	*	1 JAN 1541	222	94.	*	1 JAN 1721	322	36.
1 JAN 1222	23	28.	*	1 JAN 1402	123	40.	*	1 JAN 1542	223	93.	*	1 JAN 1722	323	36.
1 JAN 1223	24	28.	*	1 JAN 1403	124	40.	*	1 JAN 1543	224	92.	*	1 JAN 1723	324	35.
1 JAN 1224	25	28.	*	1 JAN 1404	125	40.	*	1 JAN 1544	225	91.	*	1 JAN 1724	325	35.
1 JAN 1225	26	28.	*	1 JAN 1405	126	41.	*	1 JAN 1545	226	90.	*	1 JAN 1725	326	35.
1 JAN 1226	27	28.	*	1 JAN 1406	127	41.	*	1 JAN 1546	227	89.	*	1 JAN 1726	327	35.
1 JAN 1227	28	28.	*	1 JAN 1407	128	41.	*	1 JAN 1547	228	89.	*	1 JAN 1727	328	34.
1 JAN 1228	29	28.	*	1 JAN 1408	129	42.	*	1 JAN 1548	229	88.	*	1 JAN 1728	329	34.
1 JAN 1229	30	28.	*	1 JAN 1409	130	42.	*	1 JAN 1549	230	87.	*	1 JAN 1729	330	34.
1 JAN 1230	31	28.	*	1 JAN 1410	131	42.	*	1 JAN 1550	231	86.	*	1 JAN 1730	331	34.
1 JAN 1231	32	29.	*	1 JAN 1411	132	43.	*	1 JAN 1551	232	85.	*	1 JAN 1731	332	33.
1 JAN 1232	33	29.	*	1 JAN 1412	133	43.	*	1 JAN 1552	233	112.	*	1 JAN 1732	333	33.
1 JAN 1233	34	29.	*	1 JAN 1413	134	43.	*	1 JAN 1553	234	139.	*	1 JAN 1733	334	33.
1 JAN 1234	35	29.	*	1 JAN 1414	135	44.	*	1 JAN 1554	235	166.	*	1 JAN 1734	335	32.
1 JAN 1235	36	29.	*	1 JAN 1415	136	44.	*	1 JAN 1555	236	193.	*	1 JAN 1735	336	32.
1 JAN 1236	37	29.	*	1 JAN 1416	137	44.	*	1 JAN 1556	237	221.	*	1 JAN 1736	337	32.
1 JAN 1237	38	29.	*	1 JAN 1417	138	45.	*	1 JAN 1557	238	248.	*	1 JAN 1737	338	32.
1 JAN 1238	39	29.	*	1 JAN 1418	139	45.	*	1 JAN 1558	239	275.	*	1 JAN 1738	339	31.
1 JAN 1239	40	29.	*	1 JAN 1419	140	45.	*	1 JAN 1559	240	302.	*	1 JAN 1739	340	31.
1 JAN 1240	41	29.	*	1 JAN 1420	141	46.	*	1 JAN 1600	241	329.	*	1 JAN 1740	341	31.
1 JAN 1241	42	29.	*	1 JAN 1421	142	46.	*	1 JAN 1601	242	356.	*	1 JAN 1741	342	31.
1 JAN 1242	43	29.	*	1 JAN 1422	143	46.	*	1 JAN 1602	243	384.	*	1 JAN 1742	343	31.
1 JAN 1243	44	29.	*	1 JAN 1423	144	46.	*	1 JAN 1603	244	411.	*	1 JAN 1743	344	30.
1 JAN 1244	45	30.	*	1 JAN 1424	145	47.	*	1 JAN 1604	245	438.	*	1 JAN 1744	345	30.
1 JAN 1245	46	30.	*	1 JAN 1425	146	47.	*	1 JAN 1605	246	465.	*	1 JAN 1745	346	30.
1 JAN 1246	47	30.	*	1 JAN 1426	147	47.	*	1 JAN 1606	247	492.	*	1 JAN 1746	347	30.
1 JAN 1247	48	30.	*	1 JAN 1427	148	47.	*	1 JAN 1607	248	519.	*	1 JAN 1747	348	30.
1 JAN 1248	49	30.	*	1 JAN 1428	149	48.	*	1 JAN 1608	249	547.	*	1 JAN 1748	349	30.
1 JAN 1249	50	30.	*	1 JAN 1429	150	48.	*	1 JAN 1609	250	574.	*	1 JAN 1749	350	29.
1 JAN 1250	51	30.	*	1 JAN 1430	151	48.	*	1 JAN 1610	251	546.	*	1 JAN 1750	351	29.
1 JAN 1251	52	30.	*	1 JAN 1431	152	48.	*	1 JAN 1611	252	519.	*	1 JAN 1751	352	29.
1 JAN 1252	53	30.	*	1 JAN 1432	153	48.	*	1 JAN 1612	253	492.	*	1 JAN 1752	353	29.
1 JAN 1253	54	30.	*	1 JAN 1433	154	49.	*	1 JAN 1613	254	464.	*	1 JAN 1753	354	29.
1 JAN 1254	55	30.	*	1 JAN 1434	155	49.	*	1 JAN 1614	255	437.	*	1 JAN 1754	355	28.
1 JAN 1255	56	31.	*	1 JAN 1435	156	49.	*	1 JAN 1615	256	410.	*	1 JAN 1755	356	28.
1 JAN 1256	57	31.	*	1 JAN 1436	157	49.	*	1 JAN 1616	257	382.	*	1 JAN 1756	357	28.
1 JAN 1257	58	31.	*	1 JAN 1437	158	49.	*	1 JAN 1617	258	355.	*	1 JAN 1757	358	28.
1 JAN 1258	59	31.	*	1 JAN 1438	159	50.	*	1 JAN 1618	259	328.	*	1 JAN 1758	359	26.
1 JAN 1259	60	31.	*	1 JAN 1439	160	50.	*	1 JAN 1619	260	300.	*	1 JAN 1759	360	25.
1 JAN 1300	61	31.	*	1 JAN 1440	161	51.	*	1 JAN 1620	261	273.	*	1 JAN 1800	361	23.
1 JAN 1301	62	31.	*	1 JAN 1441	162	51.	*	1 JAN 1621	262	246.	*	1 JAN 1801	362	22.
1 JAN 1302	63	32.	*	1 JAN 1442	163	52.	*	1 JAN 1622	263	218.	*	1 JAN 1802	363	20.
1 JAN 1303	64	32.	*	1 JAN 1443	164	52.	*	1 JAN 1623	264	191.	*	1 JAN 1803	364	19.
1 JAN 1304	65	32.	*	1 JAN 1444	165	53.	*	1 JAN 1624	265	164.	*	1 JAN 1804	365	17.
1 JAN 1305	66	32.	*	1 JAN 1445	166	54.	*	1 JAN 1625	266	136.	*	1 JAN 1805	366	15.
1 JAN 1306	67	32.	*	1 JAN 1446	167	54.	*	1 JAN 1626	267	109.	*	1 JAN 1806	367	14.
1 JAN 1307	68	32.	*	1 JAN 1447	168	55.	*	1 JAN 1627	268	82.	*	1 JAN 1807	368	12.

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   1 JAN 1308   69       32.   *   1 JAN 1448  169       55.   *   1 JAN 1628  269       80.   *   1 JAN 1808  369       11.
   1 JAN 1309   70       33.   *   1 JAN 1449  170       56.   *   1 JAN 1629  270       79.   *   1 JAN 1809  370        9.
   1 JAN 1310   71       33.   *   1 JAN 1450  171       57.   *   1 JAN 1630  271       77.   *   1 JAN 1810  371        8.
   1 JAN 1311   72       33.   *   1 JAN 1451  172       57.   *   1 JAN 1631  272       76.   *   1 JAN 1811  372        6.
   1 JAN 1312   73       33.   *   1 JAN 1452  173       58.   *   1 JAN 1632  273       74.   *   1 JAN 1812  373        5.
   1 JAN 1313   74       33.   *   1 JAN 1453  174       58.   *   1 JAN 1633  274       73.   *   1 JAN 1813  374        3.
   1 JAN 1314   75       33.   *   1 JAN 1454  175       59.   *   1 JAN 1634  275       71.   *   1 JAN 1814  375        2.
   1 JAN 1315   76       33.   *   1 JAN 1455  176       60.   *   1 JAN 1635  276       70.   *   1 JAN 1815  376        0.
   1 JAN 1316   77       33.   *   1 JAN 1456  177       60.   *   1 JAN 1636  277       68.   *   1 JAN 1816  377        0.
   1 JAN 1317   78       33.   *   1 JAN 1457  178       61.   *   1 JAN 1637  278       67.   *   1 JAN 1817  378        0.
   1 JAN 1318   79       33.   *   1 JAN 1458  179       61.   *   1 JAN 1638  279       65.   *   1 JAN 1818  379        0.
   1 JAN 1319   80       33.   *   1 JAN 1459  180       62.   *   1 JAN 1639  280       64.   *   1 JAN 1819  380        0.
   1 JAN 1320   81       34.   *   1 JAN 1500  181       62.   *   1 JAN 1640  281       62.   *   1 JAN 1820  381        0.
   1 JAN 1321   82       34.   *   1 JAN 1501  182       63.   *   1 JAN 1641  282       61.   *   1 JAN 1821  382        0.
   1 JAN 1322   83       34.   *   1 JAN 1502  183       63.   *   1 JAN 1642  283       59.   *   1 JAN 1822  383        0.
   1 JAN 1323   84       34.   *   1 JAN 1503  184       64.   *   1 JAN 1643  284       58.   *   1 JAN 1823  384        0.
   1 JAN 1324   85       34.   *   1 JAN 1504  185       64.   *   1 JAN 1644  285       56.   *   1 JAN 1824  385        0.
   1 JAN 1325   86       34.   *   1 JAN 1505  186       65.   *   1 JAN 1645  286       55.   *   1 JAN 1825  386        0.
   1 JAN 1326   87       34.   *   1 JAN 1506  187       65.   *   1 JAN 1646  287       54.   *   1 JAN 1826  387        0.
   1 JAN 1327   88       34.   *   1 JAN 1507  188       66.   *   1 JAN 1647  288       53.   *   1 JAN 1827  388        0.
   1 JAN 1328   89       34.   *   1 JAN 1508  189       66.   *   1 JAN 1648  289       53.   *   1 JAN 1828  389        0.
   1 JAN 1329   90       35.   *   1 JAN 1509  190       67.   *   1 JAN 1649  290       52.   *   1 JAN 1829  390        0.
   1 JAN 1330   91       35.   *   1 JAN 1510  191       67.   *   1 JAN 1650  291       51.   *   1 JAN 1830  391        0.
   1 JAN 1331   92       35.   *   1 JAN 1511  192       68.   *   1 JAN 1651  292       51.   *   1 JAN 1831  392        0.
   1 JAN 1332   93       35.   *   1 JAN 1512  193       68.   *   1 JAN 1652  293       50.   *   1 JAN 1832  393        0.
   1 JAN 1333   94       35.   *   1 JAN 1513  194       68.   *   1 JAN 1653  294       49.   *   1 JAN 1833  394        0.
   1 JAN 1334   95       36.   *   1 JAN 1514  195       69.   *   1 JAN 1654  295       49.   *   1 JAN 1834  395        0.
   1 JAN 1335   96       36.   *   1 JAN 1515  196       69.   *   1 JAN 1655  296       48.   *   1 JAN 1835  396        0.
   1 JAN 1336   97       36.   *   1 JAN 1516  197       71.   *   1 JAN 1656  297       47.   *   1 JAN 1836  397        0.
   1 JAN 1337   98       36.   *   1 JAN 1517  198       73.   *   1 JAN 1657  298       47.   *   1 JAN 1837  398        0.
   1 JAN 1338   99       36.   *   1 JAN 1518  199       75.   *   1 JAN 1658  299       46.   *   1 JAN 1838  399        0.
   1 JAN 1339  100       37.   *   1 JAN 1519  200       77.   *   1 JAN 1659  300       45.   *   1 JAN 1839  400        0.
                               *                               *                               *
*******************************************************************************************************************************

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR      6.65-HR
+   (CFS)       (HR)
                          (CFS)
+     574.      4.15                   74.         67.         67.          67.
                        (INCHES)     1.177       1.182       1.182        1.182
                         (AC-FT)       37.         37.         37.          37.

                         CUMULATIVE AREA =     .59 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        .6

  19 SQ          DISCHARGE          0.      559.

  20 SE          ELEVATION      100.00    101.00
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HYDROGRAPH AT STATION DETAIN

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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	4.	.0	100.0	*	1	JAN	1414	135	43.	.0	100.1	*	1	JAN	1628	269	86.	.1	100.2
1	JAN	1201	2	5.	.0	100.0	*	1	JAN	1415	136	44.	.0	100.1	*	1	JAN	1629	270	81.	.1	100.1
1	JAN	1202	3	6.	.0	100.0	*	1	JAN	1416	137	44.	.0	100.1	*	1	JAN	1630	271	79.	.1	100.1
1	JAN	1203	4	8.	.0	100.0	*	1	JAN	1417	138	44.	.0	100.1	*	1	JAN	1631	272	77.	.1	100.1
1	JAN	1204	5	9.	.0	100.0	*	1	JAN	1418	139	45.	.0	100.1	*	1	JAN	1632	273	75.	.1	100.1
1	JAN	1205	6	11.	.0	100.0	*	1	JAN	1419	140	45.	.0	100.1	*	1	JAN	1633	274	74.	.1	100.1
1	JAN	1206	7	12.	.0	100.0	*	1	JAN	1420	141	45.	.0	100.1	*	1	JAN	1634	275	72.	.1	100.1
1	JAN	1207	8	14.	.0	100.0	*	1	JAN	1421	142	46.	.0	100.1	*	1	JAN	1635	276	71.	.1	100.1
1	JAN	1208	9	15.	.0	100.0	*	1	JAN	1422	143	46.	.0	100.1	*	1	JAN	1636	277	69.	.1	100.1
1	JAN	1209	10	17.	.0	100.0	*	1	JAN	1423	144	46.	.0	100.1	*	1	JAN	1637	278	68.	.1	100.1
1	JAN	1210	11	18.	.0	100.0	*	1	JAN	1424	145	46.	.0	100.1	*	1	JAN	1638	279	66.	.1	100.1
1	JAN	1211	12	20.	.0	100.0	*	1	JAN	1425	146	47.	.1	100.1	*	1	JAN	1639	280	65.	.1	100.1
1	JAN	1212	13	21.	.0	100.0	*	1	JAN	1426	147	47.	.1	100.1	*	1	JAN	1640	281	63.	.1	100.1
1	JAN	1213	14	23.	.0	100.0	*	1	JAN	1427	148	47.	.1	100.1	*	1	JAN	1641	282	62.	.1	100.1
1	JAN	1214	15	24.	.0	100.0	*	1	JAN	1428	149	47.	.1	100.1	*	1	JAN	1642	283	60.	.1	100.1
1	JAN	1215	16	26.	.0	100.0	*	1	JAN	1429	150	48.	.1	100.1	*	1	JAN	1643	284	59.	.1	100.1
1	JAN	1216	17	27.	.0	100.0	*	1	JAN	1430	151	48.	.1	100.1	*	1	JAN	1644	285	57.	.1	100.1
1	JAN	1217	18	27.	.0	100.0	*	1	JAN	1431	152	48.	.1	100.1	*	1	JAN	1645	286	56.	.1	100.1
1	JAN	1218	19	27.	.0	100.0	*	1	JAN	1432	153	48.	.1	100.1	*	1	JAN	1646	287	55.	.1	100.1
1	JAN	1219	20	27.	.0	100.0	*	1	JAN	1433	154	48.	.1	100.1	*	1	JAN	1647	288	54.	.1	100.1
1	JAN	1220	21	27.	.0	100.0	*	1	JAN	1434	155	49.	.1	100.1	*	1	JAN	1648	289	53.	.1	100.1
1	JAN	1221	22	27.	.0	100.0	*	1	JAN	1435	156	49.	.1	100.1	*	1	JAN	1649	290	53.	.1	100.1
1	JAN	1222	23	28.	.0	100.0	*	1	JAN	1436	157	49.	.1	100.1	*	1	JAN	1650	291	52.	.1	100.1
1	JAN	1223	24	28.	.0	100.0	*	1	JAN	1437	158	49.	.1	100.1	*	1	JAN	1651	292	51.	.1	100.1
1	JAN	1224	25	28.	.0	100.0	*	1	JAN	1438	159	50.	.1	100.1	*	1	JAN	1652	293	51.	.1	100.1
1	JAN	1225	26	28.	.0	100.0	*	1	JAN	1439	160	50.	.1	100.1	*	1	JAN	1653	294	50.	.1	100.1
1	JAN	1226	27	28.	.0	100.1	*	1	JAN	1440	161	50.	.1	100.1	*	1	JAN	1654	295	49.	.1	100.1
1	JAN	1227	28	28.	.0	100.1	*	1	JAN	1441	162	51.	.1	100.1	*	1	JAN	1655	296	49.	.1	100.1
1	JAN	1228	29	28.	.0	100.1	*	1	JAN	1442	163	51.	.1	100.1	*	1	JAN	1656	297	48.	.1	100.1
1	JAN	1229	30	28.	.0	100.1	*	1	JAN	1443	164	52.	.1	100.1	*	1	JAN	1657	298	47.	.1	100.1
1	JAN	1230	31	28.	.0	100.1	*	1	JAN	1444	165	52.	.1	100.1	*	1	JAN	1658	299	47.	.1	100.1
1	JAN	1231	32	29.	.0	100.1	*	1	JAN	1445	166	53.	.1	100.1	*	1	JAN	1659	300	46.	.0	100.1
1	JAN	1232	33	29.	.0	100.1	*	1	JAN	1446	167	54.	.1	100.1	*	1	JAN	1700	301	45.	.0	100.1
1	JAN	1233	34	29.	.0	100.1	*	1	JAN	1447	168	54.	.1	100.1	*	1	JAN	1701	302	45.	.0	100.1
1	JAN	1234	35	29.	.0	100.1	*	1	JAN	1448	169	55.	.1	100.1	*	1	JAN	1702	303	44.	.0	100.1
1	JAN	1235	36	29.	.0	100.1	*	1	JAN	1449	170	56.	.1	100.1	*	1	JAN	1703	304	43.	.0	100.1
1	JAN	1236	37	29.	.0	100.1	*	1	JAN	1450	171	56.	.1	100.1	*	1	JAN	1704	305	43.	.0	100.1
1	JAN	1237	38	29.	.0	100.1	*	1	JAN	1451	172	57.	.1	100.1	*	1	JAN	1705	306	42.	.0	100.1
1	JAN	1238	39	29.	.0	100.1	*	1	JAN	1452	173	57.	.1	100.1	*	1	JAN	1706	307	42.	.0	100.1
1	JAN	1239	40	29.	.0	100.1	*	1	JAN	1453	174	58.	.1	100.1	*	1	JAN	1707	308	42.	.0	100.1
1	JAN	1240	41	29.	.0	100.1	*	1	JAN	1454	175	59.	.1	100.1	*	1	JAN	1708	309	41.	.0	100.1
1	JAN	1241	42	29.	.0	100.1	*	1	JAN	1455	176	59.	.1	100.1	*	1	JAN	1709	310	41.	.0	100.1
1	JAN	1242	43	29.	.0	100.1	*	1	JAN	1456	177	60.	.1	100.1	*	1	JAN	1710	311	40.	.0	100.1
1	JAN	1243	44	29.	.0	100.1	*	1	JAN	1457	178	60.	.1	100.1	*	1	JAN	1711	312	40.	.0	100.1
1	JAN	1244	45	29.	.0	100.1	*	1	JAN	1458	179	61.	.1	100.1	*	1	JAN	1712	313	40.	.0	100.1
1	JAN	1245	46	30.	.0	100.1	*	1	JAN	1459	180	61.	.1	100.1	*	1	JAN	1713	314	39.	.0	100.1
1	JAN	1246	47	30.	.0	100.1	*	1	JAN	1500	181	62.	.1	100.1	*	1	JAN	1714	315	39.	.0	100.1
1	JAN	1247	48	30.	.0	100.1	*	1	JAN	1501	182	62.	.1	100.1	*	1	JAN	1715	316	38.	.0	100.1
1	JAN	1248	49	30.	.0	100.1	*	1	JAN	1502	183	63.	.1	100.1	*	1	JAN	1716	317	38.	.0	100.1
1	JAN	1249	50	30.	.0	100.1	*	1	JAN	1503	184	63.	.1	100.1	*	1	JAN	1717	318	38.	.0	100.1
1	JAN	1250	51	30.	.0	100.1	*	1	JAN	1504	185	64.	.1	100.1	*	1	JAN	1718	319	37.	.0	100.1
1	JAN	1251	52	30.	.0	100.1	*	1	JAN	1505	186	64.	.1	100.1	*	1	JAN	1719	320	37.	.0	100.1
1	JAN	1252	53	30.	.0	100.1	*	1	JAN	1506	187	65.	.1	100.1	*	1	JAN	1720	321	36.	.0	100.1
1	JAN	1253	54	30.	.0	100.1	*	1	JAN	1507	188	65.	.1	100.1	*	1	JAN	1721	322	36.	.0	100.1
1	JAN	1254	55	30.	.0	100.1	*	1	JAN	1508	189	66.	.1	100.1	*	1	JAN	1722	323	36.	.0	100.1
1	JAN	1255	56	30.	.0	100.1	*	1	JAN	1509	190	66.	.1	100.1	*	1	JAN	1723	324	35.	.0	100.1
1	JAN	1256	57	31.	.0	100.1	*	1	JAN	1510	191	67.	.1	100.1	*	1	JAN	1724	325	35.	.0	100.1
1	JAN	1257	58	31.	.0	100.1	*	1	JAN	1511	192	67.	.1	100.1	*	1	JAN	1725	326	35.	.0	100.1
1	JAN	1258	59	31.	.0	100.1	*	1	JAN	1512	193	68.	.1	100.1	*	1	JAN	1726	327	35.	.0	100.1
1	JAN	1259	60	31.	.0	100.1	*	1	JAN	1513	194	68.	.1	100.1	*	1	JAN	1727	328	34.	.0	100.1
1	JAN	1300	61	31.	.0	100.1	*	1	JAN	1514	195	69.	.1	100.1	*	1	JAN	1728	329	34.	.0	100.1

1 JAN 1301	62	31.	.0	100.1 *	1 JAN 1515	196	69.	.1	100.1 *	1 JAN 1729	330	34.	.0	100.1
1 JAN 1302	63	31.	.0	100.1 *	1 JAN 1516	197	70.	.1	100.1 *	1 JAN 1730	331	34.	.0	100.1
1 JAN 1303	64	32.	.0	100.1 *	1 JAN 1517	198	72.	.1	100.1 *	1 JAN 1731	332	33.	.0	100.1
1 JAN 1304	65	32.	.0	100.1 *	1 JAN 1518	199	73.	.1	100.1 *	1 JAN 1732	333	33.	.0	100.1
1 JAN 1305	66	32.	.0	100.1 *	1 JAN 1519	200	75.	.1	100.1 *	1 JAN 1733	334	33.	.0	100.1
1 JAN 1306	67	32.	.0	100.1 *	1 JAN 1520	201	77.	.1	100.1 *	1 JAN 1734	335	33.	.0	100.1
1 JAN 1307	68	32.	.0	100.1 *	1 JAN 1521	202	79.	.1	100.1 *	1 JAN 1735	336	32.	.0	100.1
1 JAN 1308	69	32.	.0	100.1 *	1 JAN 1522	203	81.	.1	100.1 *	1 JAN 1736	337	32.	.0	100.1
1 JAN 1309	70	32.	.0	100.1 *	1 JAN 1523	204	82.	.1	100.1 *	1 JAN 1737	338	32.	.0	100.1
1 JAN 1310	71	33.	.0	100.1 *	1 JAN 1524	205	84.	.1	100.2 *	1 JAN 1738	339	32.	.0	100.1
1 JAN 1311	72	33.	.0	100.1 *	1 JAN 1525	206	86.	.1	100.2 *	1 JAN 1739	340	31.	.0	100.1
1 JAN 1312	73	33.	.0	100.1 *	1 JAN 1526	207	88.	.1	100.2 *	1 JAN 1740	341	31.	.0	100.1
1 JAN 1313	74	33.	.0	100.1 *	1 JAN 1527	208	90.	.1	100.2 *	1 JAN 1741	342	31.	.0	100.1
1 JAN 1314	75	33.	.0	100.1 *	1 JAN 1528	209	91.	.1	100.2 *	1 JAN 1742	343	31.	.0	100.1
1 JAN 1315	76	33.	.0	100.1 *	1 JAN 1529	210	93.	.1	100.2 *	1 JAN 1743	344	31.	.0	100.1
1 JAN 1316	77	33.	.0	100.1 *	1 JAN 1530	211	95.	.1	100.2 *	1 JAN 1744	345	30.	.0	100.1
1 JAN 1317	78	33.	.0	100.1 *	1 JAN 1531	212	97.	.1	100.2 *	1 JAN 1745	346	30.	.0	100.1
1 JAN 1318	79	33.	.0	100.1 *	1 JAN 1532	213	99.	.1	100.2 *	1 JAN 1746	347	30.	.0	100.1
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1 JAN 1321	82	34.	.0	100.1 *	1 JAN 1535	216	101.	.1	100.2 *	1 JAN 1749	350	29.	.0	100.1
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1 JAN 1323	84	34.	.0	100.1 *	1 JAN 1537	218	99.	.1	100.2 *	1 JAN 1751	352	29.	.0	100.1
1 JAN 1324	85	34.	.0	100.1 *	1 JAN 1538	219	98.	.1	100.2 *	1 JAN 1752	353	29.	.0	100.1
1 JAN 1325	86	34.	.0	100.1 *	1 JAN 1539	220	97.	.1	100.2 *	1 JAN 1753	354	29.	.0	100.1
1 JAN 1326	87	34.	.0	100.1 *	1 JAN 1540	221	96.	.1	100.2 *	1 JAN 1754	355	29.	.0	100.1
1 JAN 1327	88	34.	.0	100.1 *	1 JAN 1541	222	95.	.1	100.2 *	1 JAN 1755	356	28.	.0	100.1
1 JAN 1328	89	34.	.0	100.1 *	1 JAN 1542	223	94.	.1	100.2 *	1 JAN 1756	357	28.	.0	100.1
1 JAN 1329	90	34.	.0	100.1 *	1 JAN 1543	224	93.	.1	100.2 *	1 JAN 1757	358	28.	.0	100.0
1 JAN 1330	91	35.	.0	100.1 *	1 JAN 1544	225	92.	.1	100.2 *	1 JAN 1758	359	27.	.0	100.0
1 JAN 1331	92	35.	.0	100.1 *	1 JAN 1545	226	91.	.1	100.2 *	1 JAN 1759	360	26.	.0	100.0
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1 JAN 1333	94	35.	.0	100.1 *	1 JAN 1547	228	89.	.1	100.2 *	1 JAN 1801	362	23.	.0	100.0
1 JAN 1334	95	35.	.0	100.1 *	1 JAN 1548	229	88.	.1	100.2 *	1 JAN 1802	363	21.	.0	100.0
1 JAN 1335	96	36.	.0	100.1 *	1 JAN 1549	230	87.	.1	100.2 *	1 JAN 1803	364	20.	.0	100.0
1 JAN 1336	97	36.	.0	100.1 *	1 JAN 1550	231	86.	.1	100.2 *	1 JAN 1804	365	18.	.0	100.0
1 JAN 1337	98	36.	.0	100.1 *	1 JAN 1551	232	85.	.1	100.2 *	1 JAN 1805	366	17.	.0	100.0
1 JAN 1338	99	36.	.0	100.1 *	1 JAN 1552	233	95.	.1	100.2 *	1 JAN 1806	367	15.	.0	100.0
1 JAN 1339	100	36.	.0	100.1 *	1 JAN 1553	234	119.	.1	100.2 *	1 JAN 1807	368	14.	.0	100.0
1 JAN 1340	101	37.	.0	100.1 *	1 JAN 1554	235	145.	.2	100.3 *	1 JAN 1808	369	12.	.0	100.0
1 JAN 1341	102	37.	.0	100.1 *	1 JAN 1555	236	172.	.2	100.3 *	1 JAN 1809	370	10.	.0	100.0
1 JAN 1342	103	37.	.0	100.1 *	1 JAN 1556	237	199.	.2	100.4 *	1 JAN 1810	371	9.	.0	100.0
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1 JAN 1353	114	39.	.0	100.1 *	1 JAN 1607	248	498.	.5	100.9 *	1 JAN 1821	382	0.	.0	100.0
1 JAN 1354	115	39.	.0	100.1 *	1 JAN 1608	249	525.	.6	100.9 *	1 JAN 1822	383	0.	.0	100.0
1 JAN 1355	116	39.	.0	100.1 *	1 JAN 1609	250	553.	.6	101.0 *	1 JAN 1823	384	0.	.0	100.0
1 JAN 1356	117	39.	.0	100.1 *	1 JAN 1610	251	558.	.6	101.0 *	1 JAN 1824	385	0.	.0	100.0
1 JAN 1357	118	39.	.0	100.1 *	1 JAN 1611	252	538.	.6	101.0 *	1 JAN 1825	386	0.	.0	100.0
1 JAN 1358	119	39.	.0	100.1 *	1 JAN 1612	253	513.	.6	100.9 *	1 JAN 1826	387	0.	.0	100.0
1 JAN 1359	120	39.	.0	100.1 *	1 JAN 1613	254	486.	.5	100.9 *	1 JAN 1827	388	0.	.0	100.0
1 JAN 1400	121	40.	.0	100.1 *	1 JAN 1614	255	458.	.5	100.8 *	1 JAN 1828	389	0.	.0	100.0
1 JAN 1401	122	40.	.0	100.1 *	1 JAN 1615	256	431.	.5	100.8 *	1 JAN 1829	390	0.	.0	100.0
1 JAN 1402	123	40.	.0	100.1 *	1 JAN 1616	257	404.	.4	100.7 *	1 JAN 1830	391	0.	.0	100.0
1 JAN 1403	124	40.	.0	100.1 *	1 JAN 1617	258	376.	.4	100.7 *	1 JAN 1831	392	0.	.0	100.0
1 JAN 1404	125	40.	.0	100.1 *	1 JAN 1618	259	349.	.4	100.6 *	1 JAN 1832	393	0.	.0	100.0
1 JAN 1405	126	41.	.0	100.1 *	1 JAN 1619	260	322.	.3	100.6 *	1 JAN 1833	394	0.	.0	100.0
1 JAN 1406	127	41.	.0	100.1 *	1 JAN 1620	261	294.	.3	100.5 *	1 JAN 1834	395	0.	.0	100.0
1 JAN 1407	128	41.	.0	100.1 *	1 JAN 1621	262	267.	.3	100.5 *	1 JAN 1835	396	0.	.0	100.0
1 JAN 1408	129	41.	.0	100.1 *	1 JAN 1622	263	240.	.3	100.4 *	1 JAN 1836	397	0.	.0	100.0
1 JAN 1409	130	42.	.0	100.1 *	1 JAN 1623	264	212.	.2	100.4 *	1 JAN 1837	398	0.	.0	100.0
1 JAN 1410	131	42.	.0	100.1 *	1 JAN 1624	265	185.	.2	100.3 *	1 JAN 1838	399	0.	.0	100.0
1 JAN 1411	132	42.	.0	100.1 *	1 JAN 1625	266	158.	.2	100.3 *	1 JAN 1839	400	0.	.0	100.0

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  1 JAN 1412 133      43.       .0   100.1 *  1 JAN 1626 267     130.       .1   100.2 *
  1 JAN 1413 134      43.       .0   100.1 *  1 JAN 1627 268     103.       .1   100.2 *
                                           *                                          *
*************************************************************************************************************************************

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR      72-HR     6.65-HR
+   (CFS)       (HR)
                         (CFS)
+     558.      4.17               74.         67.        67.         67.
                      (INCHES)    1.177       1.182      1.182       1.182
                       (AC-FT)     37.         37.        37.         37.

  PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR      72-HR     6.65-HR
+  (AC-FT)      (HR)
        1.      4.17                0.          0.         0.          0.

   PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR      72-HR     6.65-HR
+   (FEET)      (HR)
    101.00      4.17             100.13      100.12     100.12      100.12

                       CUMULATIVE AREA =     .59 SQ MI
```
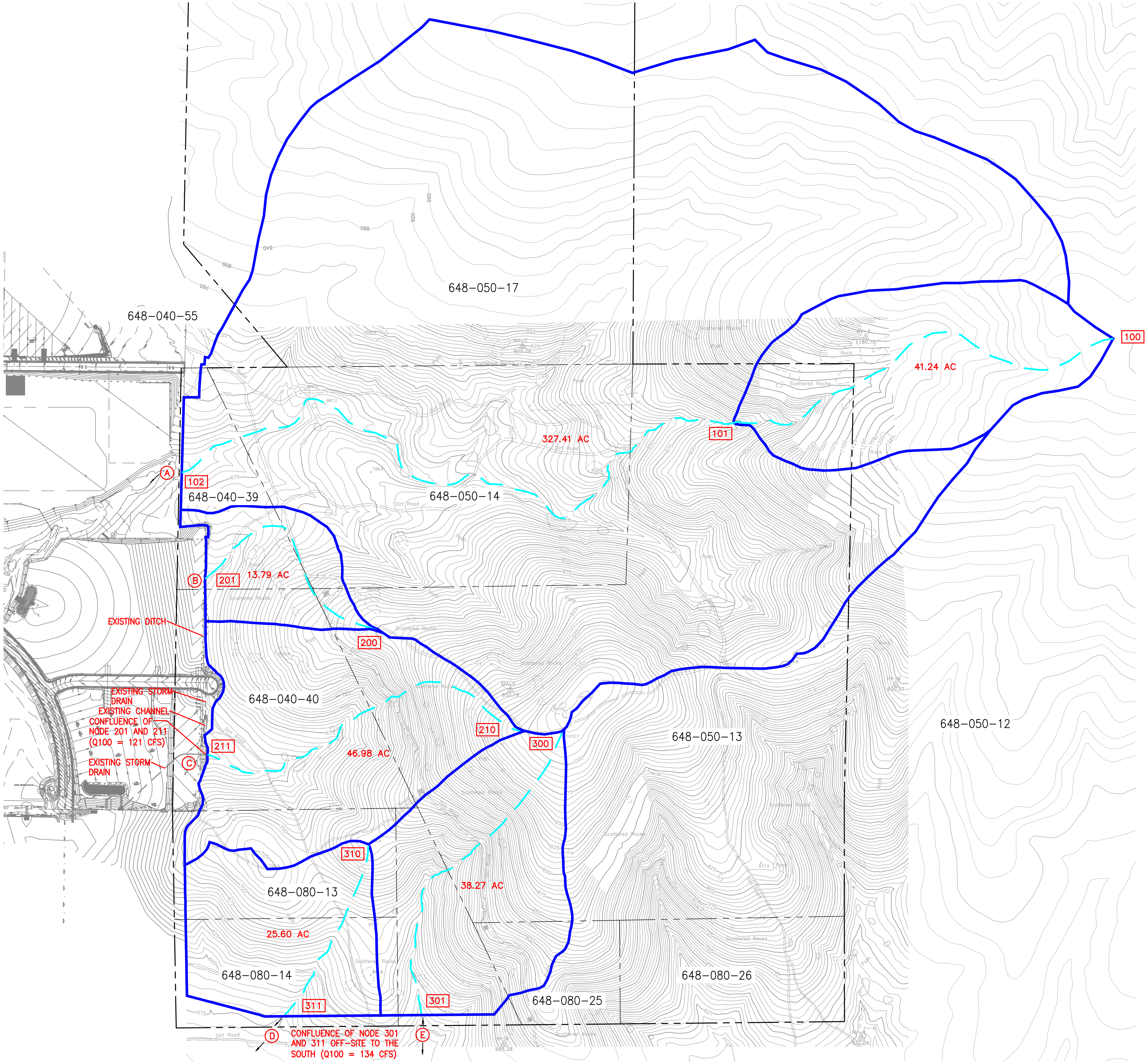
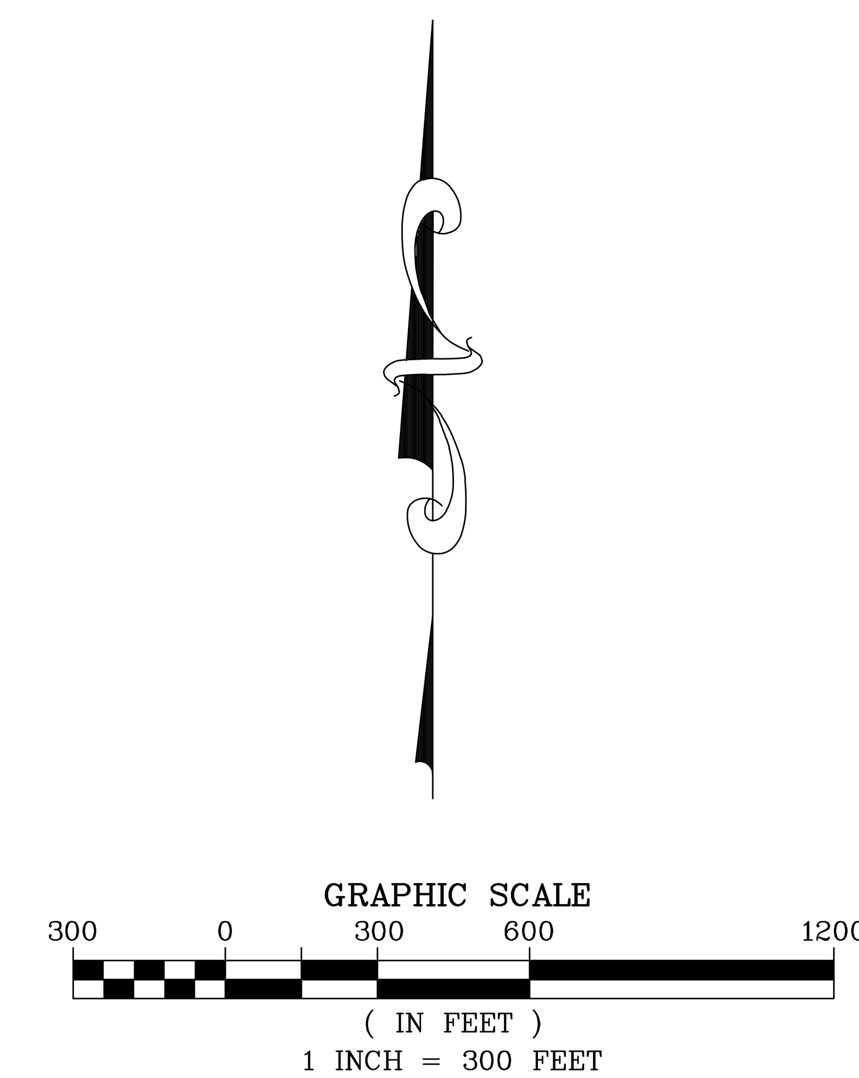

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		BASIN	574.	4.15	74.	67.	67.	.59		
	ROUTED TO									
+		DETAIN	558.	4.17	74.	67.	67.	.59		
+									101.00	4.17

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

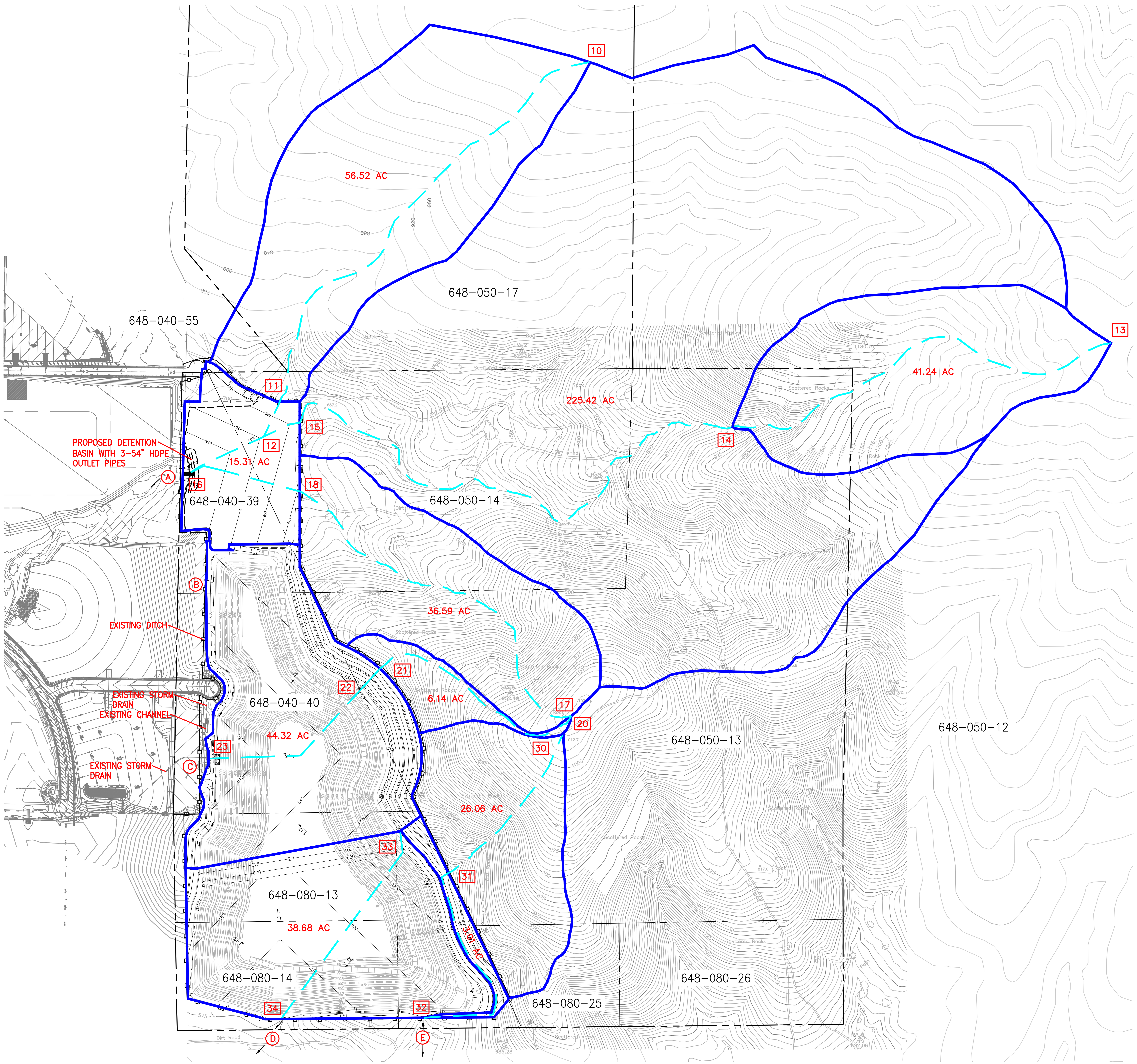




Discharge Location	Tributary Area	100-Year Flow, cfs
A	368.65	559
B	13.79	28
C	46.98	94
D	25.60	58
E	38.27	80

LEGEND:

- PARCEL BOUNDARIES
- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW PATH
- 3.62 AC — DRAINAGE BASIN AREA
- 100 — RATIONAL METHOD NODE NUMBER
- A — SITE DISCHARGE LOCATION



GRAPHIC SCALE

300 0 300 600 1200

(IN FEET)

1 INCH = 300 FEET

Discharge Location	Tributary Area	100-Year Flow, cfs
A	375.08	574
B	---	---
C	50.46	87
D	29.07	57
E	38.68	65

LEGEND:

- PARCEL BOUNDARIES
- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW PATH
- 3.62 AC DRAINAGE BASIN AREA
- 100 RATIONAL METHOD NODE NUMBER
- (A) SITE DISCHARGE LOCATION

Appendix E

Geologic Reconnaissance & Slope Stability Analysis

CHRISTIAN WHEELER
ENGINEERING

December 4, 2014

Superior Ready Mix Concrete, L.P. CWE 2110171.02R
1508 West Mission Road
Escondido, California 92029

Subject: **Revised Report of Supplemental Slope Stability Analyses and Reclamation Fill Settlement, Proposed Otay Hills Quarry, Alta Road and Otay Mesa Road, San Diego County, California.**

Dear Ladies and Gentlemen,

In accordance with your request and our Proposal dated March 17, 2011, Christian Wheeler Engineering has prepared this revised report to provide the results of our supplemental slope stability analyses for the subject project. Our supplemental analyses addressed the proposed Phase 2A, 2B, and 2C cut (extraction) slopes, the proposed Phases 3A, 3B, 3C, and 3D cut (extraction) slopes, the proposed Phases 4B, 4C, and 4D fill (reclamation) slopes, and the final (post reclamation) project cut and fill slopes. Full descriptions of the site's physical and geologic conditions as well as the scope of the proposed quarry project have been provided in our referenced Report of Geologic Reconnaissance (CWE, 2011).

SUPPLEMETNAL STABILITY ANALYSES: As described in our referenced report (CWE, 2011), "Global stability of steep rock slopes, such as those proposed for the quarry operation, depends on several factors such as type of rock, rock strength, orientation of fractures or other planes of weakness, and slope angles. In quarry operations with steep, high slopes, factors of safety typically range from approximately 1.2 to greater than 1.5. The previous slope stability analysis of the site performed by Testing Engineers in 2005 indicated that the proposed cut slopes should be adequately stable to the proposed heights for slopes as steep as 1:1 (horizontal to vertical), and possibly as steep as 0.5:1. Based on our review of those calculations, as well as our review of other available data pertaining to the stability of rock slopes in quarry operations, it is our opinion that the previous slope stability analysis by Testing Engineers adequately addresses the stability of the proposed cut slopes."

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Our initial supplemental analyses performed in the preparation of this report included rock slope stability analyses (modelling planar and wedge failures) of the steepest of the proposed extraction (cut) slopes during Phases 2A, 2B, 2C, 3A, 3B, 3C, and 3D of the project utilizing the referenced Rockpack III © software prepared by C.F. Watts & Associates. Analyses of the extraction slopes that will remain as part of the project after the completion of the Phase 4E reclamation phase were also conducted. The findings presented herein are based on the assumption that the geologic conditions at the site, including rock type, rock strength, and degree and pattern of fracturing, are similar to those described in the Geotechnical Evaluation Report, Proposed Otay Hills Quarry prepared by Testing Engineers in September 2005.

The following Table I presents the results (factors-of-safety against failure) of our static and pseudo-static rock slope analyses for the extraction slopes proposed for this project as well as the final cut slopes to remain upon completion of Phase 4E (completion of reclamation). It should be noted that within Phase 2 of the project the interim and side quarry slopes will be approximately 1:1 (H:V) and during Phase 3 the interim extraction slopes will be approximately 1:1 (H:V) while the side quarry slopes will be cut at inclinations of 0.5:1 (H:V). Our analyses of the Phase 3 slopes focused on the steeper, side quarry slopes.

TABLE I – EXTRACTION & FINAL CUT SLOPES

Phase	Description of Extraction Slope	Static F.O.S.	Pseudo-Static F.O.S.
2A	175' high @ 1:1 (H:V) inclination	4.1	3.2
2B	175' high @ 1:1 (H:V) inclination	4.1	3.2
2C	165' high @ 1:1 (H:V) inclination	4.3	3.4
3A	260' high @ 0.5:1 (H:V) inclination with 1:1 cut above	2.4	2.1
3B	525' high @ 0.5:1 (H:V) inclination with 1:1 cut above	1.4	1.2
3C	525' high @ 0.5:1 (H:V) inclination with 1:1 cut above	1.4	1.2
3D	500' high @ 0.5:1 (H:V) inclination with 1:1 cut above	1.5	1.2
Final Cut Slopes	200' high @ 1:1 (H:V) inclination	4.7	3.7

The results of our rock slope stability analyses indicate that the steepest of the proposed extraction slopes will demonstrate minimum factors-of-safety against static and pseudo-static failure in excess of the minimum County requirements for temporary slopes of 1.3 and 1.1, respectively. Based on these results along with the nature of the material at the site, it is our opinion that the risk of significant, deep-seated slope instability in the native materials at the site can be considered to be low. It should be noted localized areas of potentially unstable slopes might be present where intersecting fractures or other planes of weakness are exposed in steep cut slopes. The potential for such unforeseen areas of potentially unstable conditions could be mitigated during site extraction with recommendations presented by a qualified engineer that would be based on site observations by a qualified geologist.

Furthermore, the final cut slopes will demonstrate minimum factors-of-safety against static and pseudo-static failure in excess of the minimum County requirements for final or permanent slopes of 1.5 and 1.1, respectively. The final cut slopes are anticipated to be stable and should not endanger public or private property or result in the deposition of debris on any public way or interfere with any existing drainage courses. The need for rock fall or debris barriers or fences along final cut slopes should be addressed by a qualified engineer at the completion of site reclamation.

We have also performed supplemental slope stability analyses of the proposed fill slopes associated with the Phase 4 reclamation operations at the site. As described in our previous report, the site will be used as an Inert Debris Engineered Fill (landfill). The material placed in the Inert Debris Engineered Fill will be imported to the site over a space of approximately 90 to 95 years and will consist of a variety of materials (CWE, 2011). The results of the reclamation slope stability analyses herein are based on the assumption that the fill materials will have strength parameters similar to those described in our previous report (CWE, 2011). The following Table II presents the results of our analyses for the proposed fill slopes (reclamation and final) proposed for this project. As necessary, the inclinations of the temporary reclamation slopes were adjusted in our analyses in order to allow the proposed fill slopes to demonstrate minimum factors-of-safety against failure under static and pseudo-static conditions of 1.3 and 1.1, respectively, which are the minimums required by the County.

TABLE II –FILL SLOPES (RECLAMATION & FINAL)

Phase	Slope Description	Static F.O.S.	Pseudo-Static F.O.S.	Required Slope Inclination (max)
4A	285’ high @ 2.1:1 (H:V)	1.3	1.0 (inadequate)	**2.25:1**
4A	285’ high @ 2.25:1 (H:V)	-	1.1	
4B & 4C	550’ high @ 2.5:1 (H:V)	1.4	1.0 (inadequate)	**2.6:1**
4B & 4c	550’ high @ 2.6:1 (H:V)	-	1.1	
4D	450’ high @ 2.2:1 (H:V)	1.3	1.0 (inadequate)	**2.5:1**
4D	450’ high @ 2.5:1 (H:V)	-	1.1	
Final 4D/E	70’ high @ 2.0:1	1.5	1.1	**As steep as 2:1**

As demonstrated by the results of our reclamation slope stability analyses (included in Appendix A at the rear of this report), in order to demonstrate minimum factors-of-safety of 1.1 against pseudo-static, temporary slope failure, the temporary Phase 4A reclamation slope will need to be flattened to an inclination of 2.25:1 (H:V), the Phase 4B and 4C slopes will need to be flattened to inclinations of 2.6:1 (H:V), and the Phase 4D reclamation slope will need to be constructed at a 2.5:1 (H:V) inclination.

It should be noted that although the results of our pseudo-static analyses demonstrate that the proposed 450-foot-high 4D reclamation slope will need to constructed at a maximum inclination of 2.5:1 (H:V) in order to demonstrate adequate temporary stability, upon completion of Phase 4E, the proposed 70-foot-high fill slope that will remain could be steepened to 2.0:1 (H:V) and still demonstrate adequate stability.

Included in Appendix B of this report are the results of our surficial stability analysis of the final fill slope (following Phase 4E) that could be constructed as steeply as 2:1 (H:V). This analysis demonstrates that the proposed final fill slope will demonstrate a factor-of-safety against surficial failures of 1.5, which is the minimum that is generally considered to be stable.

From a geotechnical standpoint, the inclusion of drainage terraces on the final cut and fill slopes is not considered necessary as such terraces will not adversely affect or significantly improve the stabilities of the proposed slopes.

RECLAMATION FILL SETTLEMENT: As described on page 6 of our referenced report, "some settlement of the fill will occur. The amount of settlement is expected to range from approximately two percent to approximately five percent. The amount of settlement will depend on a variety of factors such as the type of material used in the fill, the degree of compaction of the fill, and the thickness of the fill. The deeper portions of the fill will probably experience greater settlement than the upper portions of the fill, due in part to the increased weight of the overlying fill. It is recommended that settlement monuments be installed and the potential fill settlement be evaluated by qualified personnel as the backfilling operations approach proposed finish grade elevations" (CWE, 2011). Although difficult to quantitatively predict given the potential variability in the factors described above, for planning purposes we expect that primary settlement of the deeper fill areas will occur from the beginning of reclamation and likely continue over several years. Secondary settlement of the fills may likely continue for a few decades after the completion of reclamation. As such, the placement and periodic monitoring of settlement monuments will be necessary to assist in future development of the site.

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

Respectfully submitted,

CHRISTIAN WHEELER ENGINEERING

REGISTERED GEOLOGIST
DAVID R. RUSSELL
No. 2215
CERTIFIED
ENGINEERING
GEOLOGIST
Exp. 09-15
STATE OF CALIFORNIA

David R. Russell, CEG 2215

Daniel B. Adler, RCE 36037

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DANIEL B. ADLER
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CIVIL
STATE OF CALIFORNIA

cc: (2) Submitted
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(1) via email: travisj@envirominec.com

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California Division of Mines and Geology, 1997, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117.

C.F. Watts & Associates, 2003, Rockpack III © for Windows.

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United States Geological Survey 2004, Geologic Map of the El Cajon 30' X 60' Quadrangle, California, Open-File Report 2004-1361; compiled by Victoria R. Todd.

PLANS AND TOPOGRAPHIC MAPS

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Chang Consultants, 2011, Reclamation Plan for Otay Hills, 3 Sheets; Scale: 1 inch = 200 feet, print date May 5, 2013.

County of San Diego, 1963, Topographic Map Sheet 242-1791; Scale: 1 inch = 200 feet

County of San Diego, 1963, Topographic Map Sheet 242-1797; Scale: 1 inch = 200 feet

County of San Diego, 1963, Topographic Map Sheet 246-1791; Scale: 1 inch = 200 feet

County of San Diego, 1963, Topographic Map Sheet 246-1797; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 242-1791; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 242-1797; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 246-1791; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 246-1797; Scale: 1 inch = 200 feet

United States Geological Survey, 1975, Otay Mesa Quadrangle; Scale 1 inch = 2000 feet

PHOTOGRAPHS

San Diego County, 1928, Flight 78A and 78B; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1953, Flight 3M, Photographs 23, 24, and 25, Scale: 1 inch = 1700 feet (approximate)

San Diego County, 1953, Flight 3M, Photographs 23, 24, and 25, Scale: 1 inch = 1700 feet (approximate)

San Diego County, 1960, Flight 14, Photographs 24 and 25; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1968, Flight 3JJ, Photographs 41 and 42; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1970, Flight 13, Photographs 1, 2, and 3; Scale: 1 inch = 2000 feet (approximate)

San Diego County, 1973, Flight 14, Photographs 1, 2, and 3; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1978, Flight 34D, Photographs 32, 33, and 34; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1983, Photographs 133 and 134; Scale: 1 inch = 2000 feet (approximate)

San Diego County, 1989, Photograph 18-45; Scale: 1 inch = 2640 feet (approximate)

Appendix A

Plots of Global Fill Slope (Reclamation and Final)

Stability Analyses

Otay Hills Quarry - RECLAMATION Phase 4A - 285 High (2.1:1)

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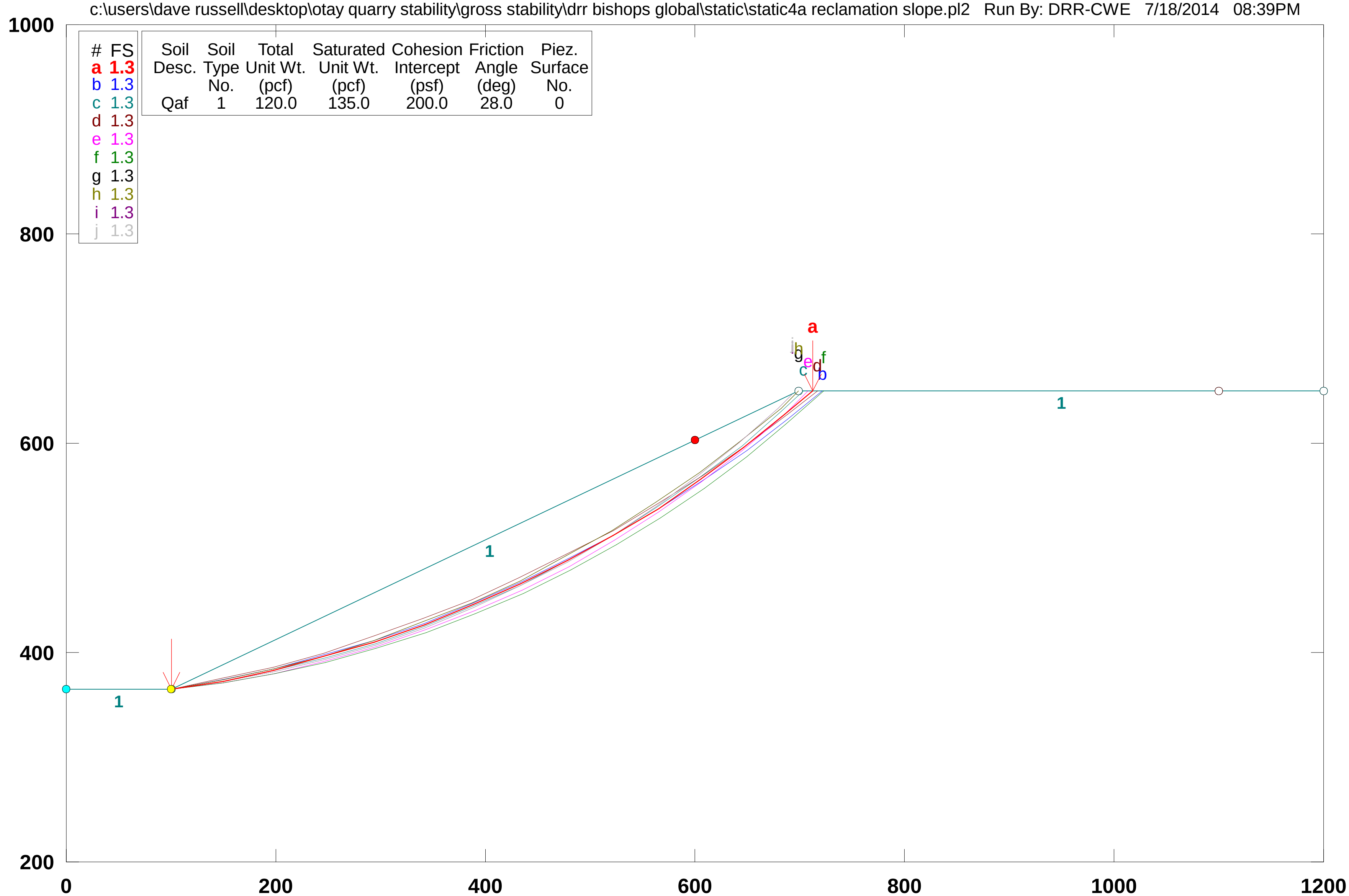

GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

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Otay Hills Quarry - RECLAMATION Phases 4B & 4C - 550' High (2.5:1)

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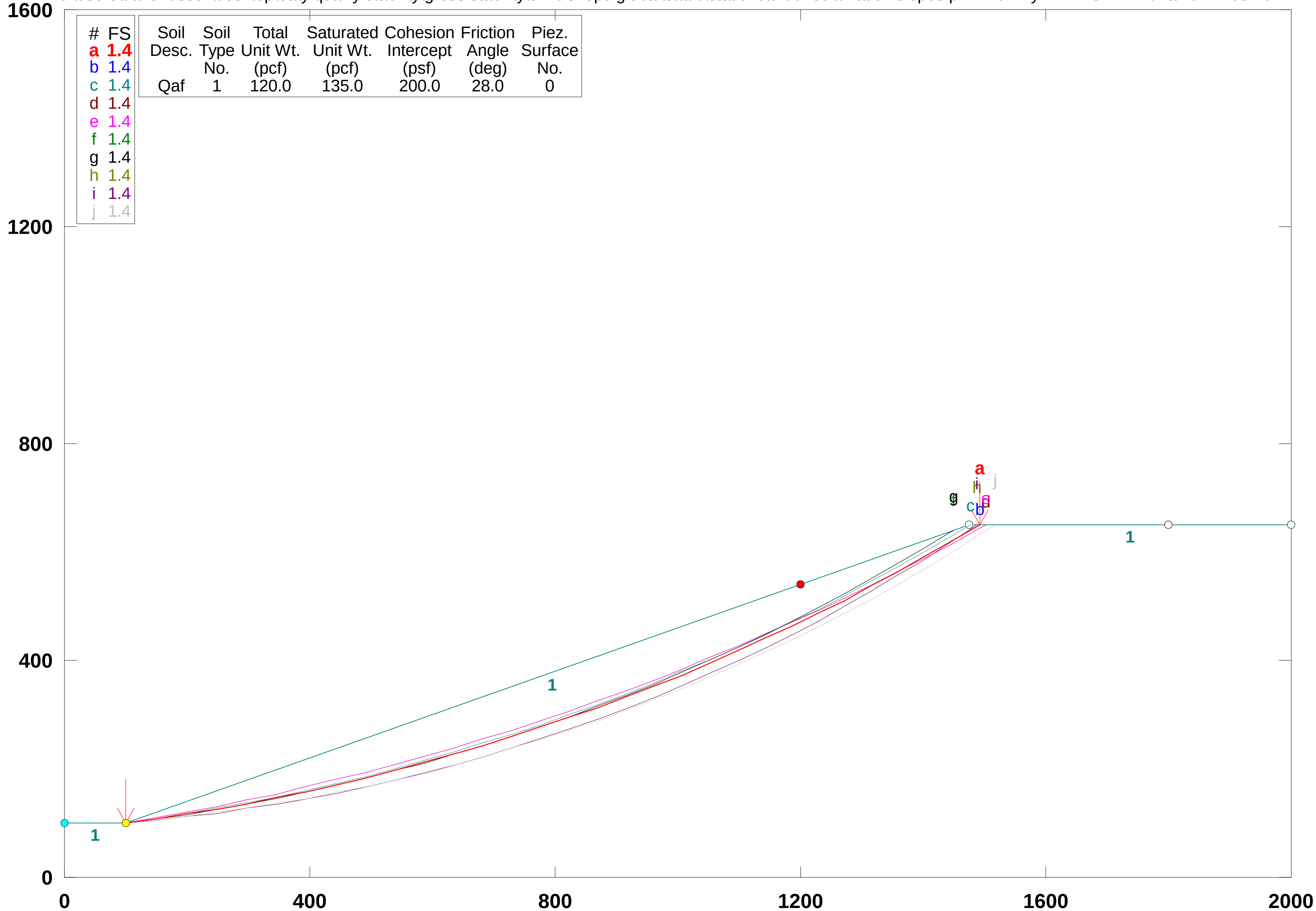

GSTABL7 v.2 FSmin=1.4

Safety Factors Are Calculated By The Modified Bishop Method

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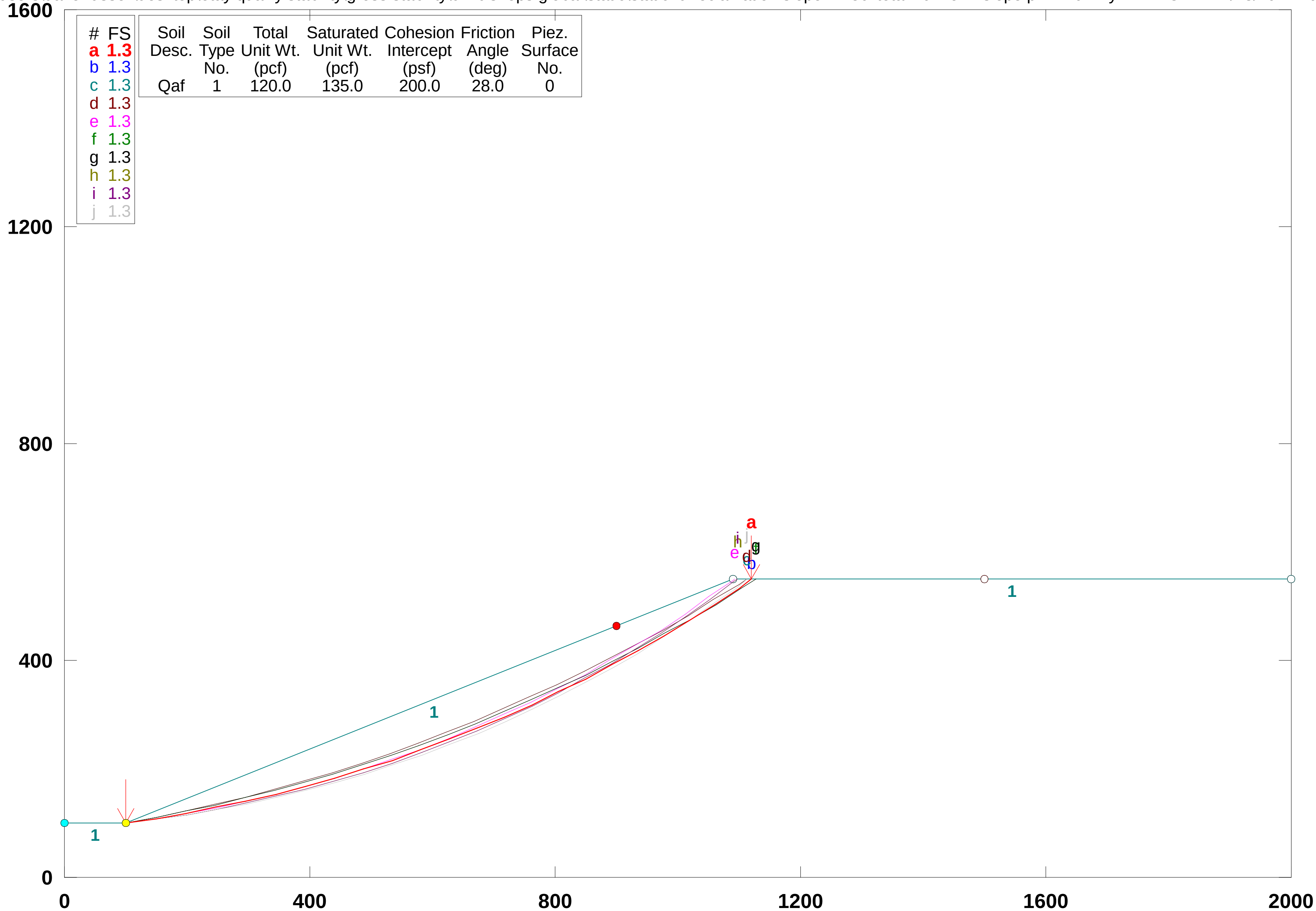
Otay Hills Quarry - RECLAMATION Phase 4D - 450' High (2.2:1 UNIFORM)

c:\users\dave russell\desktop\otay quarry stability\gross stability\drr bishops global\static\static4d reclamation slope - 450' total - uniform slope.pl2 Run By: DRR-CWE 7/18/2014 08:39PM



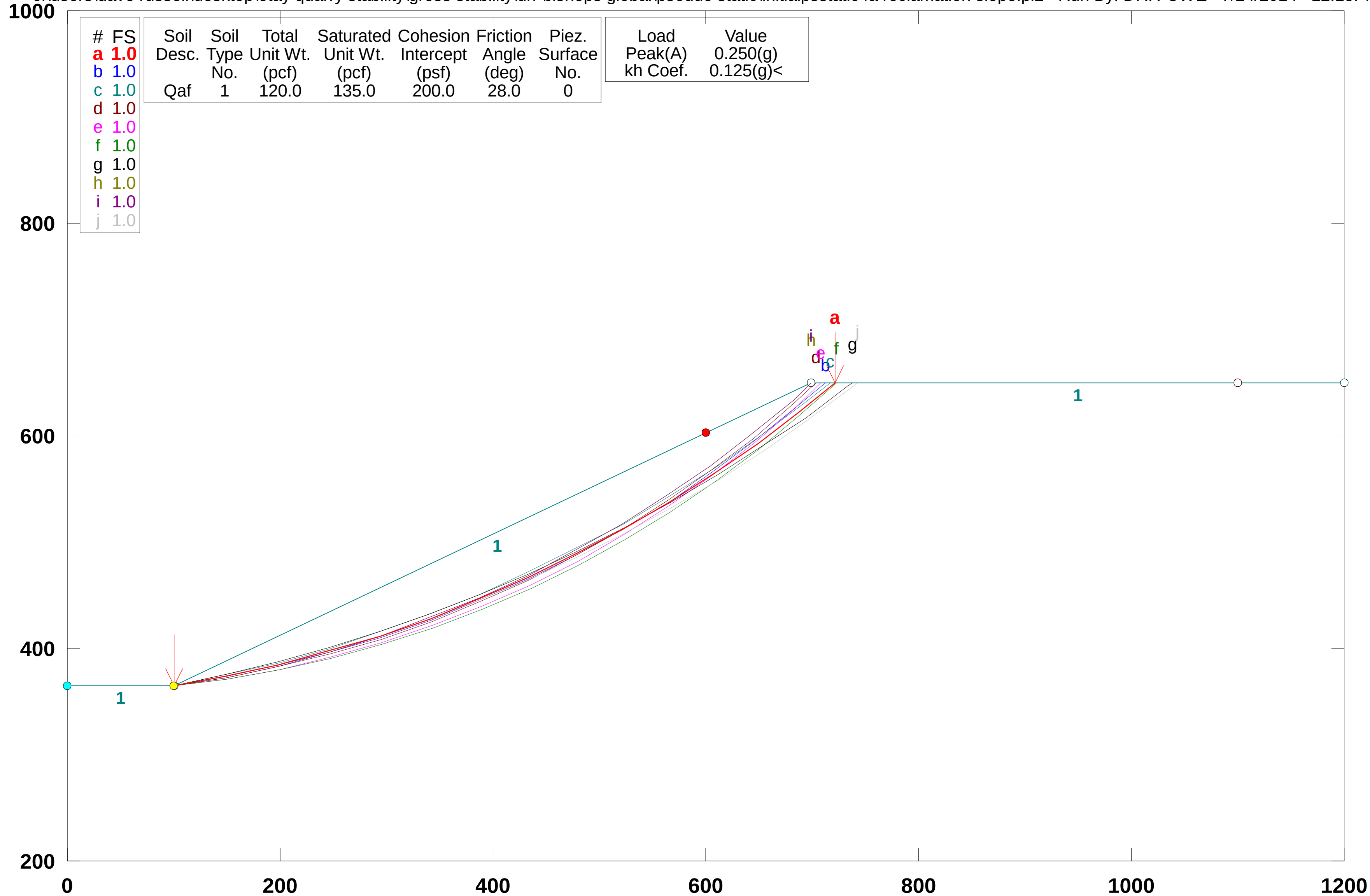
GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

CHRISTIAN WHEELER
ENGINEERING

Otay Hills Quarry - RECLAMATION Phase 4A - 285 High (2.1:1)

c:\users\dave russell\desktop\otay quarry stability\gross stability\drr bishops global\pseudo static\initialpsstatic4a reclamation slope.pl2   Run By: DRR-CWE   7/24/2014   12:15PM



GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Otay Hills Quarry - RECLAMATION Phase 4A - 285 High (2.25:1) PS

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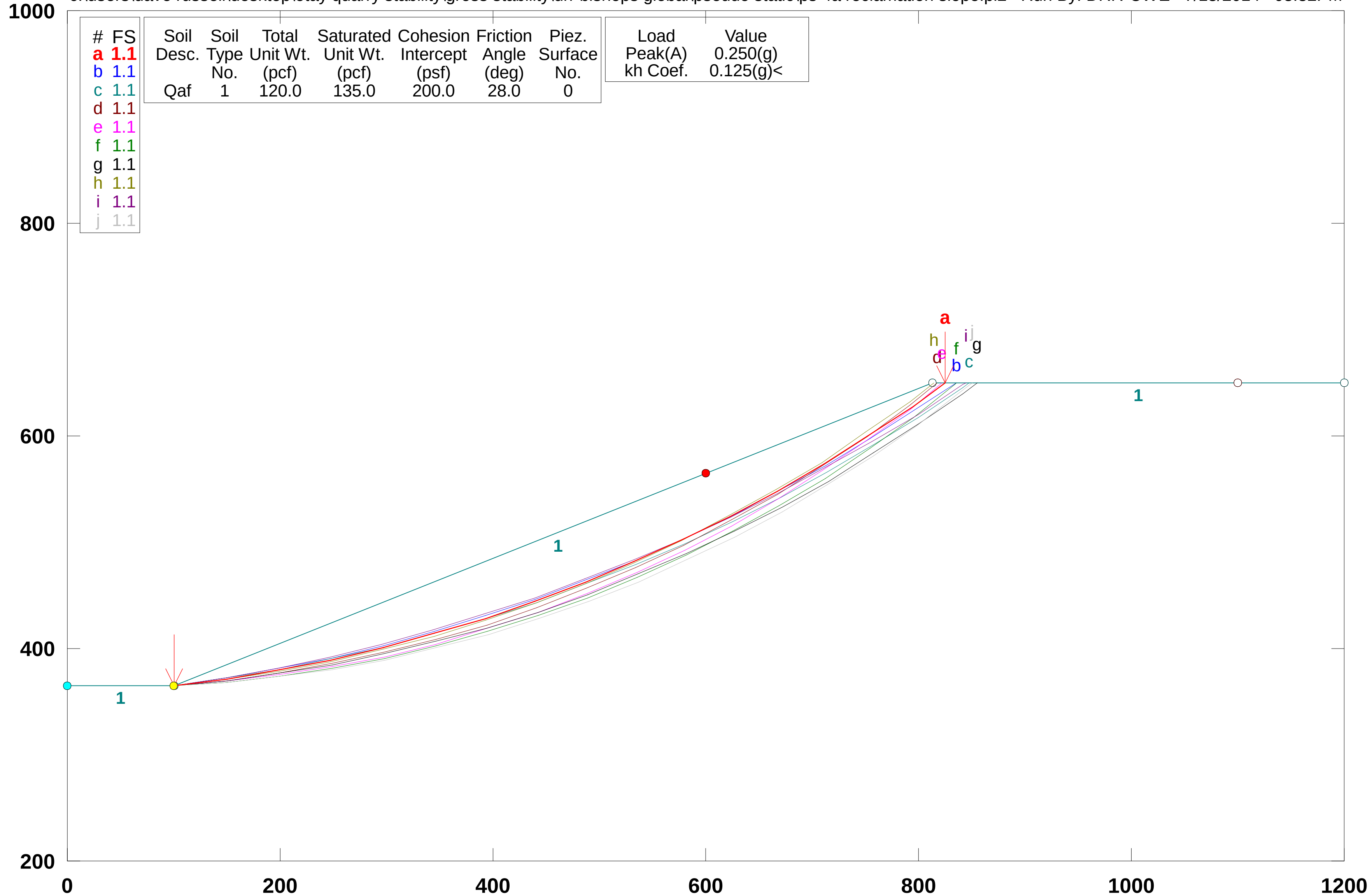

GSTABL7 v.2 FSmin=1.1

Safety Factors Are Calculated By The Modified Bishop Method

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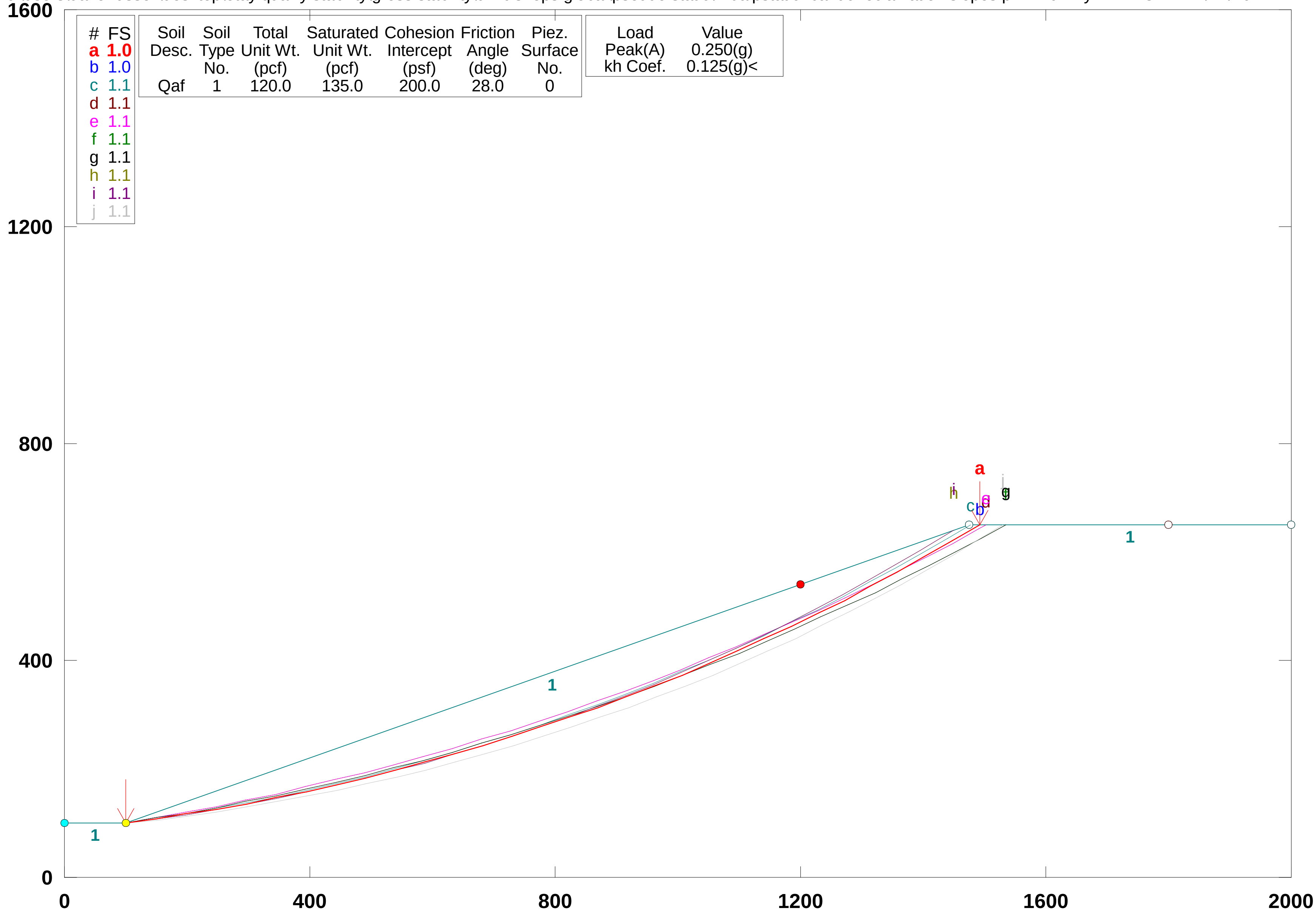
Otay Hills Quarry - RECLAMATION Phases 4B & 4C - 550' High (2.5:1)

c:\users\dave russell\desktop\otay quarry stability\gross stability\drr bishops global\pseudo static\initialpstatic4bandc reclamation slopes.pl2 Run By: DRR-CWE 7/24/2014 12:18PM



GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Otay Hills Quarry - RECLAMATION Phases 4B & 4C - 550' High (2.6:1)

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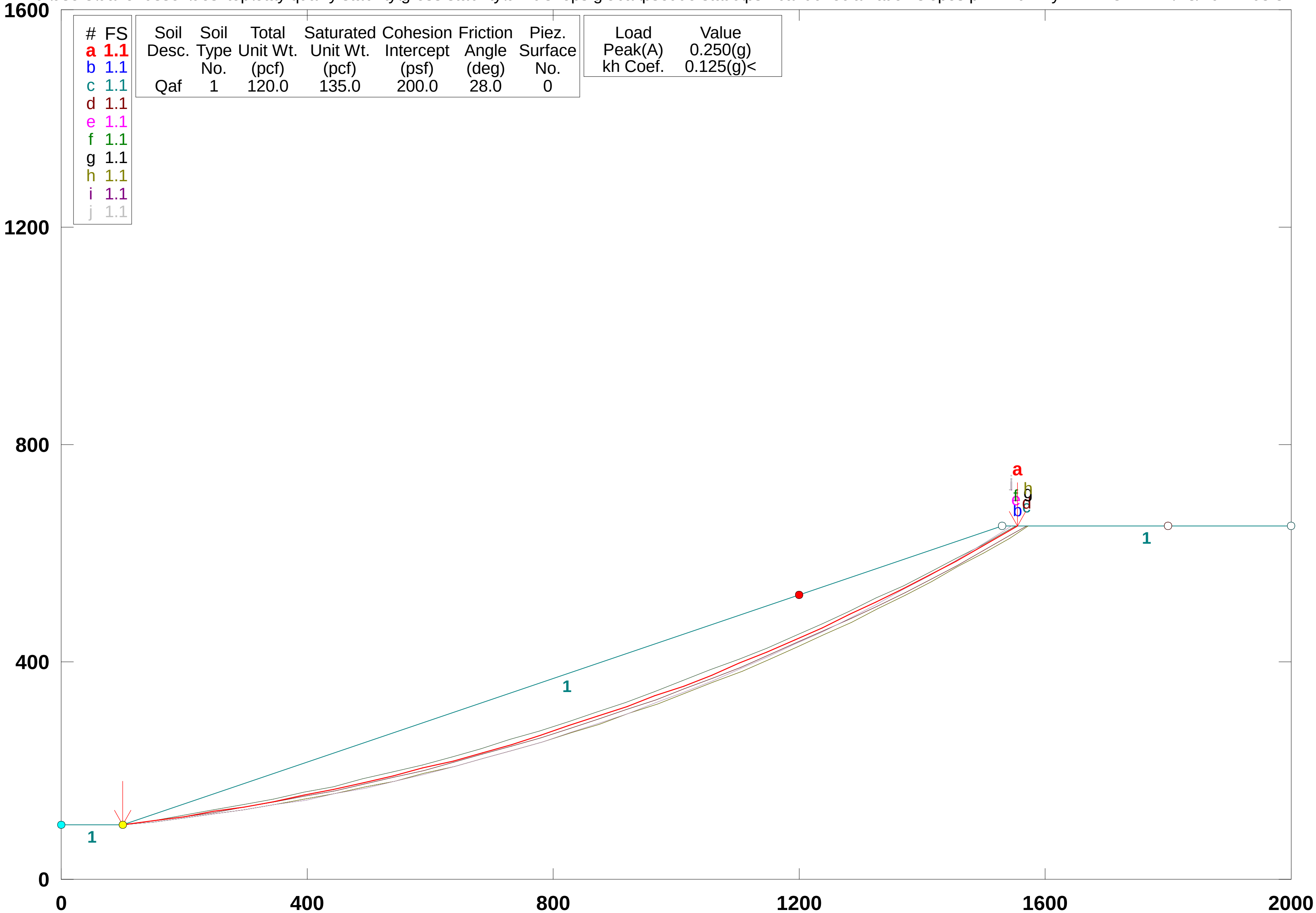

GSTABL7 v.2 FSmin=1.1

Safety Factors Are Calculated By The Modified Bishop Method

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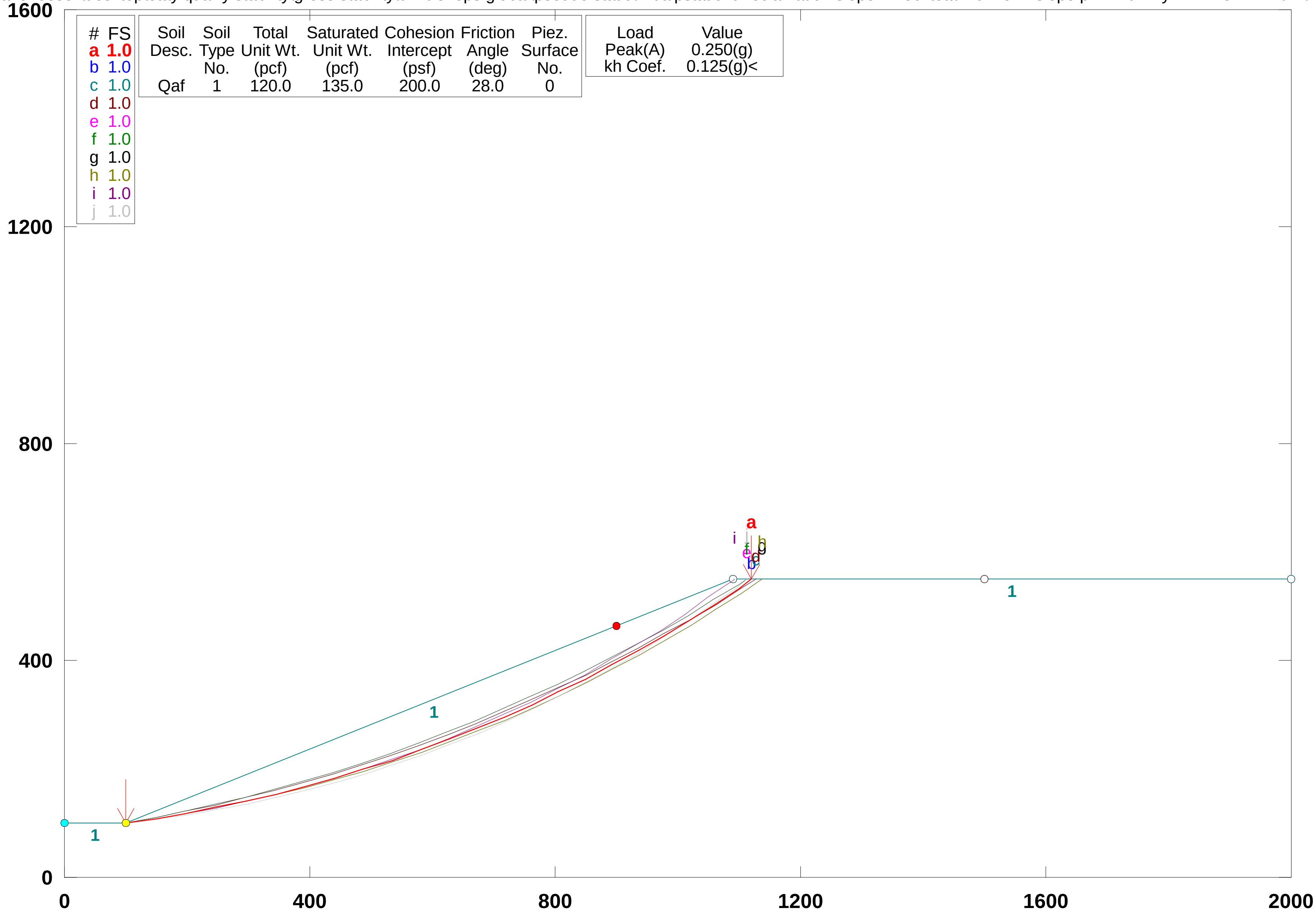
Otay Hills Quarry - RECLAMATION Phase 4D - 450' High (2.2:1 UNIFORM)

c:\users\dave russell\desktop\otay quarry stability\gross stability\drr bishops global\pseudo static\initialpstatic4d reclamation slope - 450' total - uniform slope.pl2 Run By: DRR-CWE 7/24/2014 12:20P

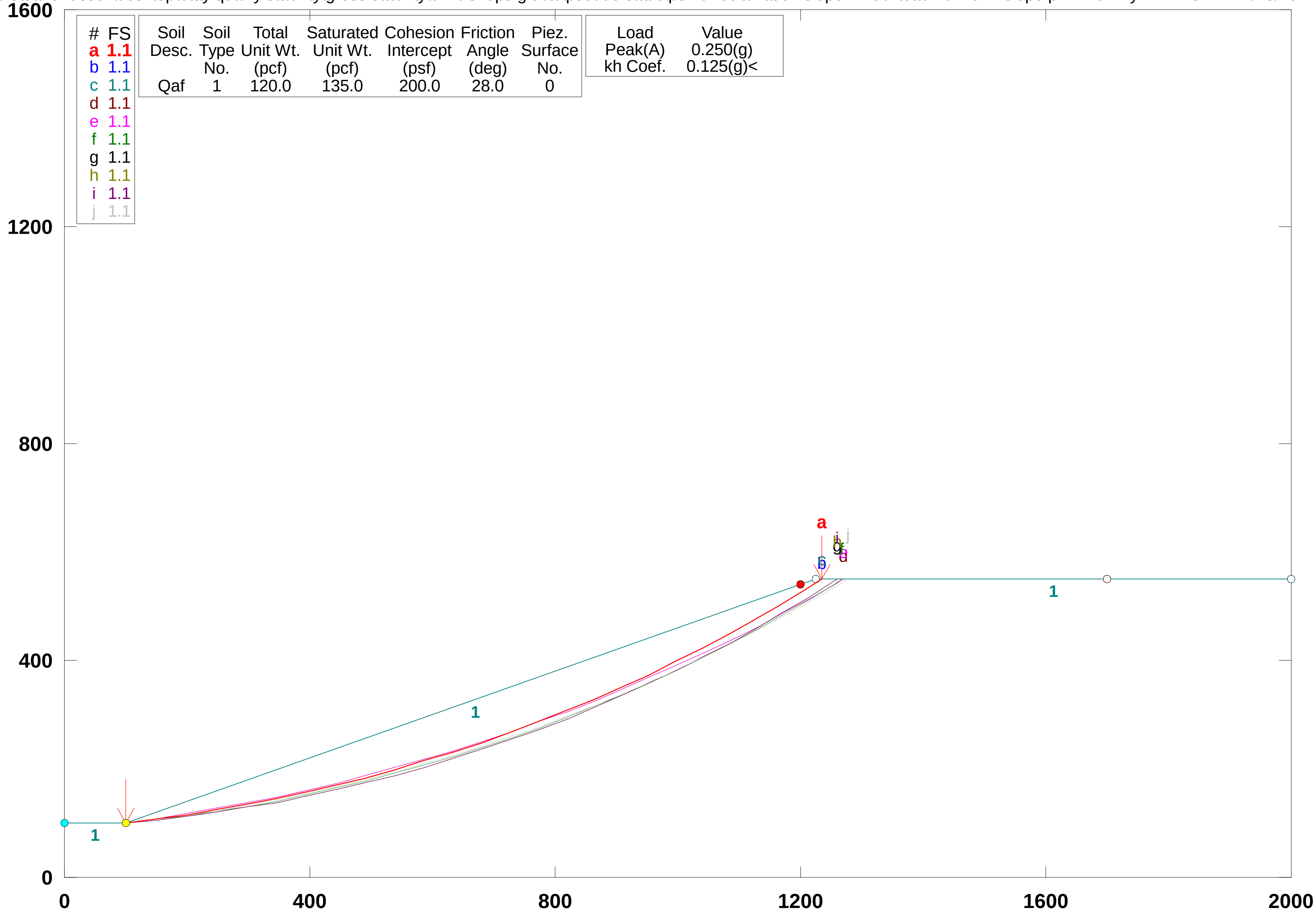


GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Otay Hills Quarry - RECLAMATION Phase 4D - 450' High (2.5:1) PS

c:\users\dave russell\desktop\otay quarry stability\gross stability\drr bishops global\pseudo static\ps 4d reclamation slope - 450' total - uniform slope.pl2 Run By: DRR-CWE 7/18/2014 08:34PM



GSTABL7 v.2 FSmin=1.1

Safety Factors Are Calculated By The Modified Bishop Method

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Otay Hills Quarry - FINAL FILL SLOPE FINAL 4D/E Fill Slope 70' (2:1) PS

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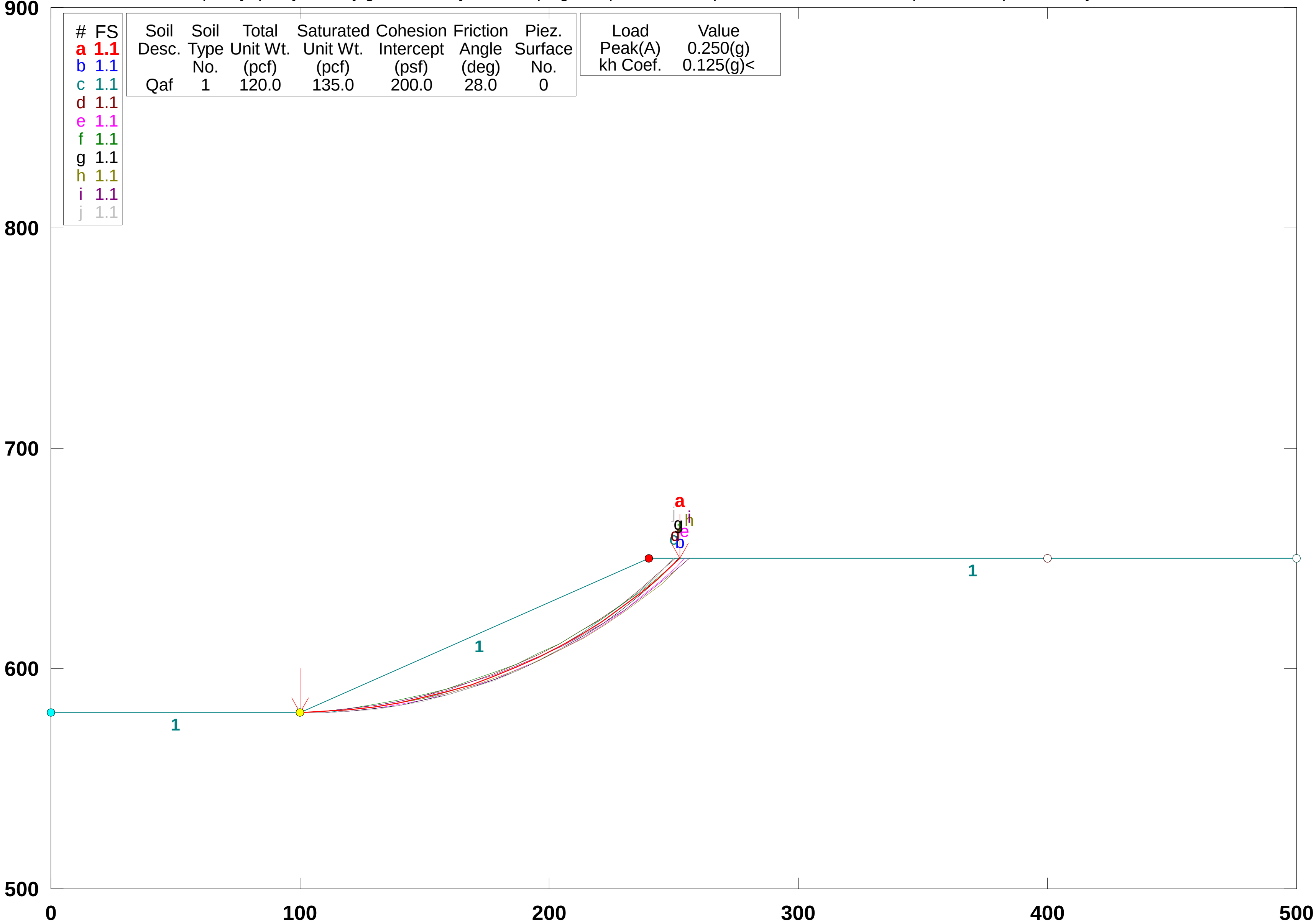


GSTABL7 v.2 FSmin=1.1

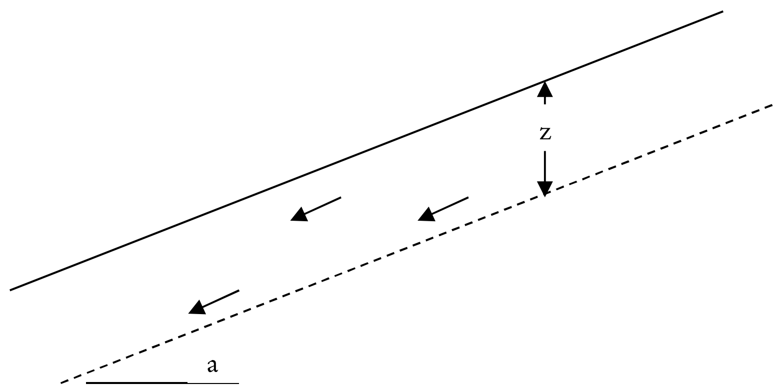
Safety Factors Are Calculated By The Modified Bishop Method

Appendix B

Plot of Surficial Stability Analysis

Final Phase 4D/E Fill Slope

SURFICIAL SLOPE STABILITY - 2:1 (H:V) FILL SLOPE



SEEPAGE PARALLEL TO SLOPE

ASSUMED PARAMETERS

z	Depth of Saturation (ft)	4
a	Slope Angle (H:1)	2
γ_W	Unit Weight of Water (pcf)	62.4
γ_T	Saturated Unit Weight of Soil (pcf)	125
ϕ	Angle of Internal Friction Along Plane of Failure (degrees)	28
c	Cohesion Along Plane of Failure (psf)	200

FACTOR OF SAFETY

$$FS = \frac{c + T(\tan\phi)}{T} \longrightarrow FS = \frac{c + (\gamma_T - \gamma_W)(z)(\cos^2 a)(\tan\phi)}{(\gamma_T)(z)(\sin a)(\cos a)}$$

FS = 1.5

CHRISTIAN WHEELER
ENGINEERING

OTAY HILLS QUARRY Final Fill Slope			
BY:	DRR	DATE:	Jul-14
JOB NO.:	2110171.02	Appendix B	

Appendix C

Landscape Architect Slope Certification

HELIX Environmental Planning, Inc.
7578 El Cajon Boulevard
Suite 200
La Mesa, CA 91942
619.462.1515 tel
619.462.0552 fax
www.helixepi.com

December 10, 2014

Mr. Travis Jokerst
EnviroMINE, Inc.
3511 Camino de Rio South, Suite 403
San Diego, CA

Subject: Otay Hills Quarry Steep Slope Certification

Dear Mr. Jokerst:

As per your request, I have reviewed the Landscape Concept Plan (prepared by HELIX) and the Revegetation Plan for Superior Ready Mix, LP, Otay Hills Quarry Project (prepared by others) and evaluated these documents as they relate to Section 87.401 (a) of the County of San Diego Grading Ordinance related to maximum cut-slopes.

As stated in the Revegetation Plan, slopes steeper than 2:1 are proposed as the final condition for much of the mineral extraction areas on site. These final cut slopes will be as steep as 1:1, graded to create a roughened surface with small benches carved into the cut slope. Revegetation operations will consist of spreading salvaged topsoil over these slopes and the small benches then hydroseeding these areas with a native seed mix. Hydroseeding is to be done between November 15 and January 15, when climatic conditions are expected to be most favorable. Rock outcrops and/or exposed bedrock areas that are not subject to excessive potential erosion and unlikely to support revegetation may be chemically stained to reduce visual contrast with surrounding areas.

I can certify that in my opinion, adherence to the approved Revegetation Plan for Superior Ready Mix, LP, Otay Hills Quarry Project, will support the proposed planting on slopes greater that 2:1 without significant or excessive erosion. If you have any questions or need any additional information please don't hesitate to contact me at (619) 462-1515.

Sincerely,

R. Brad Lewis, ASLA, LEED AP BD+C, CA QSD/QSP
Landscape Architecture Group Manager
CA Landscape Architect RLA #2657