APPENDIX G
HYDROLOGY AND WATER QUALITY

White Knob Haul Road Drainage Study and Plan of Development

Prepared for: Omya Incorporated

August 2011

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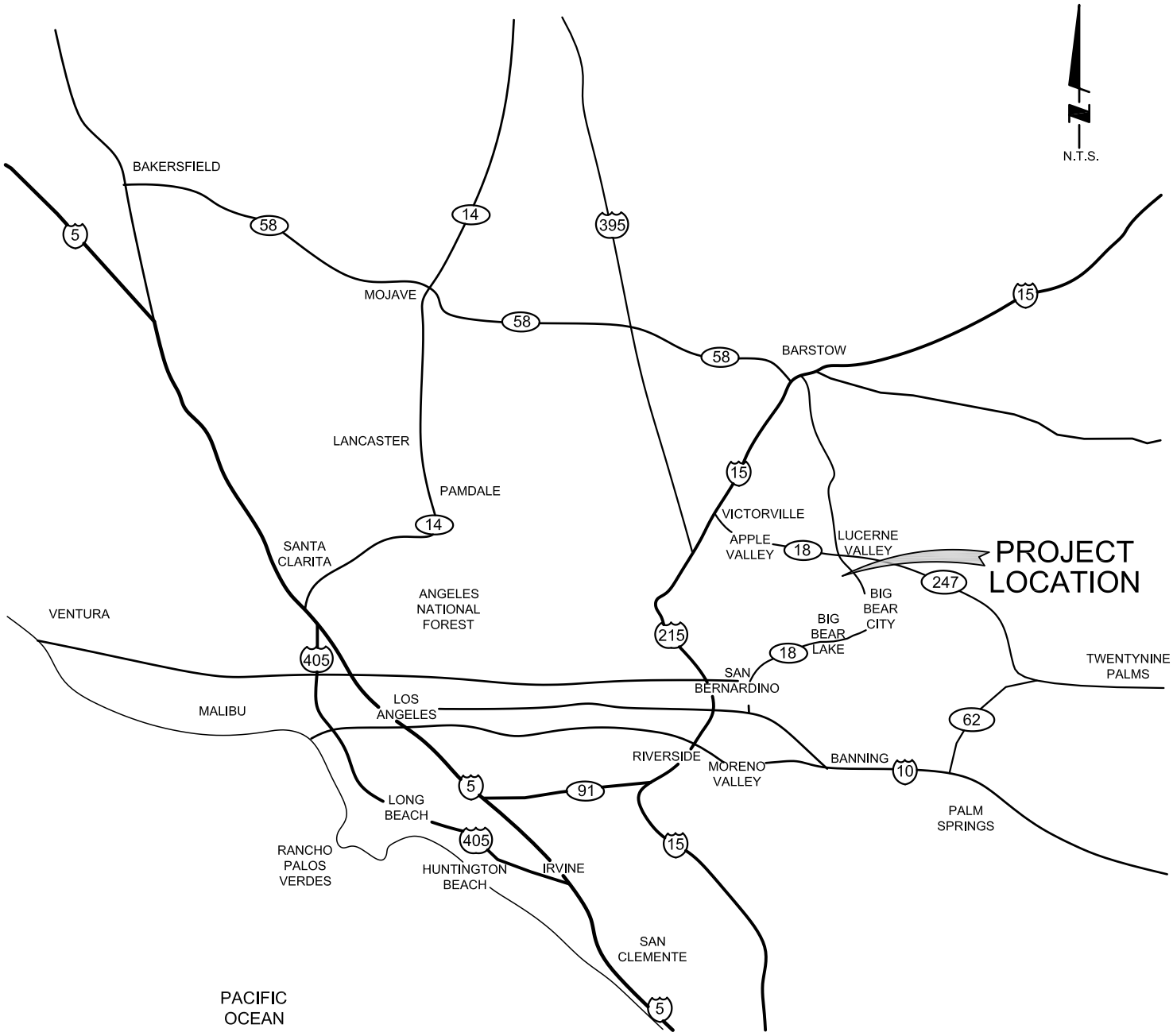
1.0 Background

Omya Incorporated operates a calcium carbonate mining and processing operation in San Bernardino County, south of the town of Lucerne Valley. Omya's plant is on Crystal Creek Road approximately 4 miles south of State Highway 18 (see Figure 1). The White Knob Quarry, where calcium carbonate is mined, is southwest of the plant in the San Bernardino National Forest. The haul road to bring materials mined at the White Knob Quarry to the plant is 5.1 miles long, going westerly from the plant for approximately 3.5 miles then turning southerly to climb at a 14% grade up to the quarry site (see Figure 2). Once in the quarry, the access road varies in grade from 12% to 18%.

The first 4.4 miles of the haul road crosses land managed by the US Department of Interior, Bureau of Land Management (BLM). Use and occupation of the haul road is authorized under a Federal Land Policy Management Act (FLPMA) right-of-way. On April 20, 2011 a Settlement Agreement was entered into by and between BLM and Omya regarding Omya's activities at the White Knob Quarry.

The Settlement Agreement has six separate remediation components (Parts A-F). Part B of the agreement is titled: "Repair, Remediate, and Monitor Improvements to the White Knob Quarry Right-Of-Way Access Road and Associated Facilities to Protect Drainages." The purpose of this Drainage Report and Plan of Development is to analyze the existing drainage conditions at the quarry and along the haul road and provide recommendations for facilities to control stormwater and sediment runoff and provide protection for the surrounding drainages. This report is intended to specifically comply with items 15 through 17 of part B of the agreement.



Project:	WHITE KNOB QUARRY
Description:	LOCATION MAP

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FIGURE
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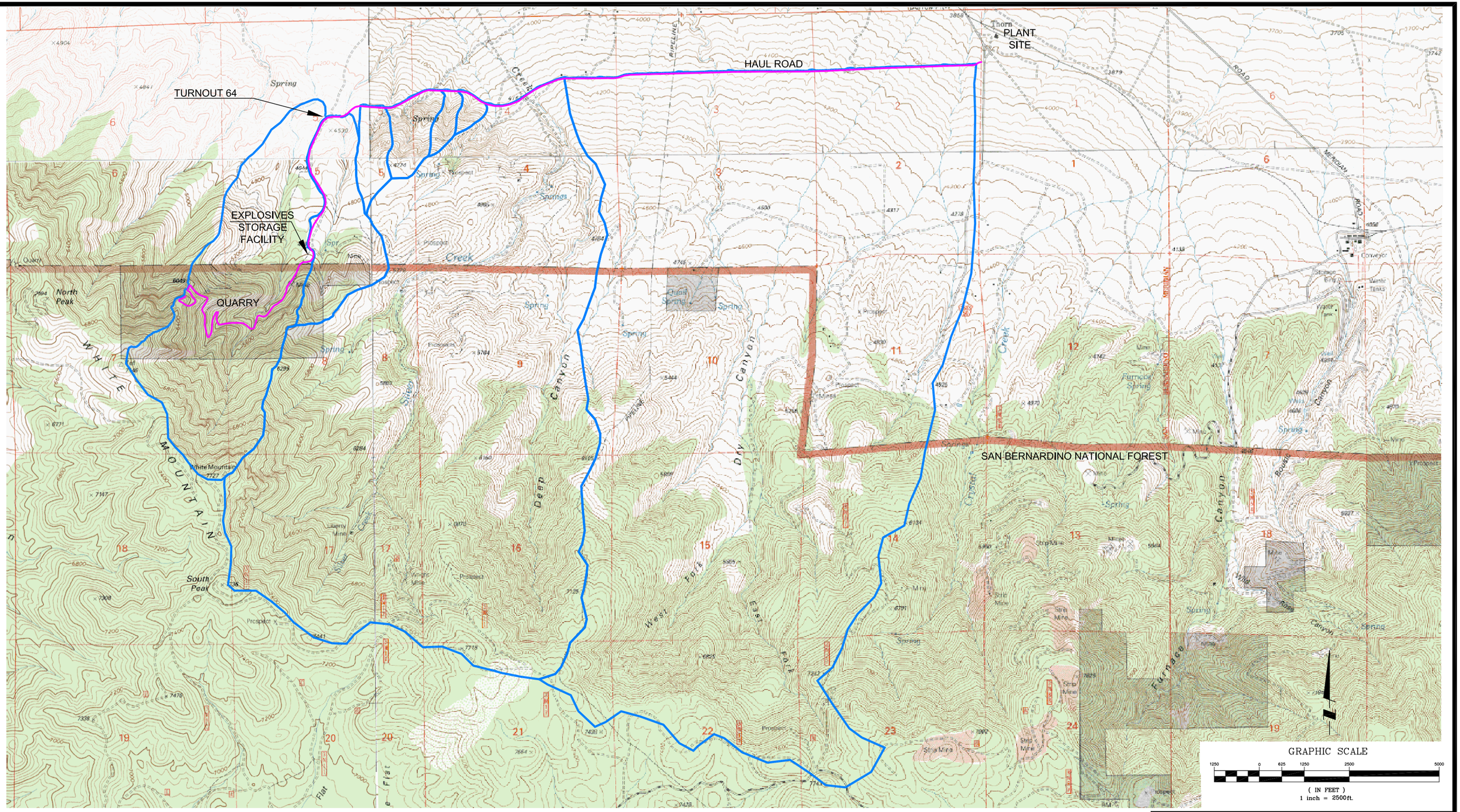

LEGEND

DRAINAGE AREA BOUNDARY

HAUL ROAD

Project:	WHITE KNOB QUARRY
Description:	SITE MAP

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FIGURE 2

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2.0 Drainage Study

2.1 EXISTING CONDITIONS

As stated above, the White Knob Quarry Haul Road is a 5.1 mile long roadway trending westerly and southerly from the Omya plant to the White Knob Quarry. The roadway averages 35 feet in width and is surfaced with aggregate base. Numbered turnouts are provided at about 1,000 foot intervals. The roadway is used primarily by large off-highway rock hauling trucks such as the Caterpillar 777D, which has a total width of 20 feet, and a maximum payload capacity of 100 tons. In compliance with Mine Safety and Health Administration protocols, earthen berms have been constructed on each side of the roadway at least as high as the axle of the largest trucks using the roadway (or about 4 feet for the Caterpillar 777D).

For about the first 2.5 miles going westerly from the plant, the haul road crosses an alluvial fan from three significant canyons with drainage areas of 2 to 8 square miles as shown on the USGS quadrangles for this area: Dry Canyon, Deep Canyon, and Silver Creek (see Site Map, Figure 2). Where the roadway crosses the major drainages, the road dips down to near the stream elevation and flow is allowed to go over the roadway, with no culverts provided. These types of crossings, commonly referred to as “Arizona Crossings,” are typically provided where the cost of raising the roadway and providing culverts/bridges is greater than the benefit of keeping the roadway open and lowering maintenance costs. These dip crossings have not been identified as areas of concern, and further investigation of these crossings is outside of the scope of this report.

In this stretch of the roadway, nine minor drainages are crossed where the roadway does not dip, and corrugated metal culverts ranging from 24 to 48 inches in diameter have been provided. The tributary area of these crossings is difficult to determine because of the nature of the alluvial fan. While a distinct drainage course is evident at the roadway, the drainage course, and the divide between drainage courses, tends to disappear within one or two thousand feet upstream of the roadway. This is very typical of alluvial fans in undeveloped areas, where there are several shallow drainage courses, and storm water from the main drainage can spread across a wide floodplain, entering the shallow drainages. While traditional hydrology methods would yield only minor amounts of runoff, overflow from the main drainage can result in significantly higher flows. That being said, these nine culverts have been in place for 24 years and according to quarry staff, there have not been capacity issues with these culverts. Based on this experience, as well as the nature of alluvial fans, the flows identified on the haul road improvement plans prepared in 1987 by Morrison Knudsen Engineers (see Appendix F) will be accepted for design of outlet riprap protection.

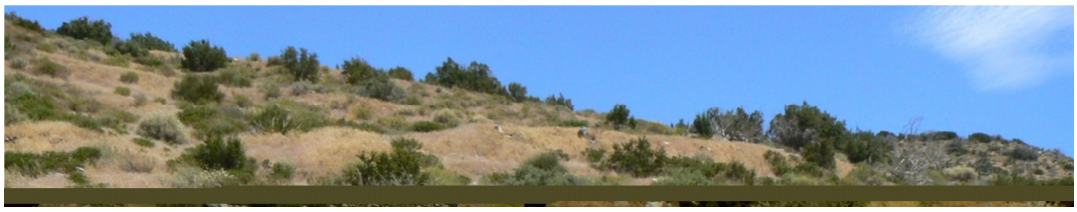
After crossing the main Silver Creek drainage, the roadway leaves the alluvial fan and starts to climb up to the quarry. Over the next mile of roadway five drainages are crossed. The first four drainages (nodes 30, 120, 230, and 330 as shown on the Hydrology Map in Appendix A) have

relatively small tributary areas ranging from 14 to 60 acres, and have existing 36 inch corrugated metal culverts to pass the storm flows under the haul road.

2.1.1 Turnout 64 Drainage

The fifth drainage is near the location mentioned in the background section where the haul road turns southerly to climb up to the quarry (see also node 465 on the Hydrology Map in Appendix A). The turnout just south of this crossing is number 64, which is used as a common identifier of this crossing. The tributary area at this crossing is 191.37 acres, and an existing 84 inch corrugated metal culvert is in place to pass storm flows under the haul road.

While this culvert primarily carries runoff from natural areas, it also carries runoff from about 0.8 miles of the haul road, accounting for 30.13 acres of the total drainage. Alongside this stretch of haul road are four debris catchment basins intended to remove sediment and debris from the storm flow before leaving the roadway. All four of these basins have existing spillway structures, two of them comprising of left over truck scale parts, and the other two being constructed of half pipes set in concrete.



Half pipe spillway structure

The invert of the 84 inch culvert is approximately 50 feet below the grade of the roadway, and storm flow leaving the roadway appraoching the culvert inlet has eroded a channel that is eight feet below the surrounding grade in some locations with a portion of the sidewalls being nearly vertical.

Erosion in channel from roadway to culvert inlet near turnout 64

Material that has eroded from this channel is evident in the area around the culvert inlet.

Inlet of 84 inch CMP near turnout 64

2.1.2 Quarry Drainage

The final drainage area in this report is that which includes the majority of the quarry itself as well as the upper portion of the haul road (Drainage to node 750 on Hydrology Map in Appendix A). The operation of the quarry over the years has led the natural drainage on to the haul road at the south-central portion of the quarry. Storm water then flows in the road for about 0.6 miles until it is able to leave the roadway in the vicinity of the existing explosives storage facility (at node 440 on the Hydrology Map). The tributary drainage area at this point is 350.81 acres; of which approximately 25.4 acres is disturbed (haul road and a portion of the quarry).

As with the turnout 64 drainage, there are four existing debris catchment basins intended to remove sediment and debris from the storm flow before leaving the roadway. However none of the basins in this drainage have been provided with spillways. Quarry staff indicates that overflow and failure of the basins has occurred, sending the sediment and debris downstream to the next basin or on to the natural stream course.

The northerly portion of the quarry is tributary to a natural stream that confluences with the flow from the roadway at a point (node 750 on the Hydrology Map in Appendix A) about 0.6 miles downstream of the roadway. The total area at this confluence is 638.31 acres. This northerly portion of the quarry is also the area where active mining is taking place, resulting in a depressed area that does not contribute to surface flows from the site. While this area will be included in the overall hydrology calculations, sediment and debris flow offsite from this part of the quarry is assumed to be negligible.

2.2 HYDROLOGY CALCULATIONS

All hydrologic calculations were performed in accordance with the latest version of the San Bernardino County Hydrology Manual. Since all drainages studied are smaller than 640 acres in size, the rational method was used for all calculations. CIVILDESIGN engineering software (Version 7.0) was utilized for the project hydrology analyses.

2.2.1 Rational Method

The Rational Method is applicable when the rainfall intensity can be assumed to be uniformly distributed over the entire drainage area. Beyond the 640 acre limit, rainfall data may vary considerably from one point to another and the use of the Rational Method will yield inappropriate results (San Bernardino County Hydrology Manual Section D.2 “Limitations of Rational Method”).

The Rational Method equation relates rainfall intensity, a runoff coefficient, and drainage area size to the peak runoff from the drainage area. This relationship is expressed by the equation:

$$Q = CIA$$

Where,

Q = the peak discharge in cubic feet per second (cfs)

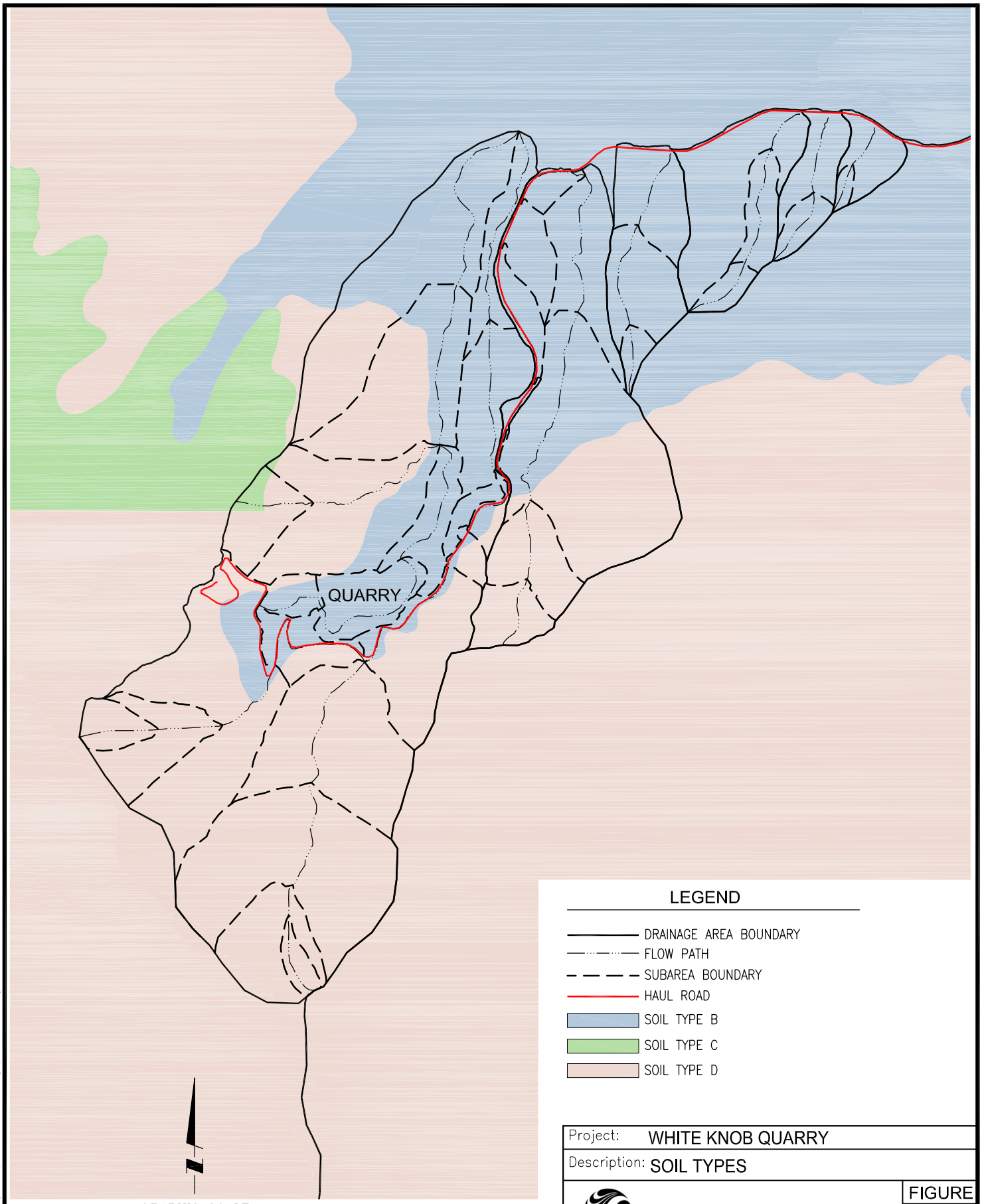
C = a runoff coefficient representing the ratio of runoff depth to rainfall depth (dimensionless)

I = the time-averaged rainfall intensity for a storm duration equal to the time of concentration (inches/hour)

A = drainage area (acres)

The runoff coefficient is based on soil types, type of ground cover, and the Antecedent Moisture Condition (AMC). Soil types for this study were obtained from the US Department of Agriculture Natural Resources Conservation Service’s Web Soil Survey (http://websoilsurvey.nrcs.usda.gov /app/WebSoilSurvey.aspx). Soil types used in the drainage calculations include Type B, C and D (the dominant soil types used were Type B and D). Hydrologic soil classifications range from Type A to Type D, where D is the least pervious. Figure 3 shows the soil types from the Web Soil Survey overlain by the project drainage areas.

The land use for the study area is undeveloped with no appreciable impervious areas. The only disturbed areas in the drainages are the quarry and the haul road. For areas above the quarry, the ground cover was assumed to be average, while the ground cover in the quarry and downstream of the quarry was assumed to be poor. Based on the recommendations in the San Bernardino Hydrology Manual AMC II was used for 2-year, 10-year, and 25-year calculations and AMC III was used for the 100-year calculation.



Project: WHITE KNOB QUARRY

Description: SOIL TYPES

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FIGURE 3

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Rainfall intensity was based on the National Oceanic and Atmospheric Administration's Precipitation Frequency Data Server Atlas 14 (http://hdsc.nws.noaa.gov/hdsc/pfds/). A point near the centroid of the drainage area was selected and one hour rainfall rates entered into the CIVILDESIGN software. Rainfall intensities for other time periods are then based on the slope of the intensity duration graph. For desert and mountain areas in San Bernardino County a value of 0.7 is used for the slope of this graph. Two different locations were selected for rainfall intensities, one for the quarry and turnout 64 drainages, and another for the four smaller culverts east of turnout 64. The intensities used are summarized below:

	One Hour Rainfall Depth	
Return Frequency (years)	**Quarry and Turnout 64 Drainages**	**Smaller Culvert Drainages**
2	0.491	0.45
10	0.811	0.745
25	1.03	0.944
100	1.39	1.28

Tributary drainage areas were determined from topographical maps of the area. A hydrology map was prepared to show the overall drainage areas, subareas, and nodes. This map is included in Appendix A of this report. This Hydrology Map shows the drainages for which detailed calculations were prepared. As mentioned in Section 2.1, the flows identified on the 1987 improvement plans in Appendix F will be accepted as the design flows for the first nine culverts heading easterly from the Plant Site.

2.2.2 Results

Hydrology calculations were performed using the CIVILDESIGN software for the drainages shown on the hydrology map for return frequencies of 2-, 10-, 25-, and 100-year storms. Following is a summary of results at key nodes in the study:

Node	Description	Tributary Area (Ac)	2-year Flow (cfs)	10-year Flow (cfs)	25-year Flow (cfs)	100-year Flow (cfs)
30	Culvert Crossing at Station 144+70	14.26	14.8	28.6	37.9	57.1
120	Culvert Crossing at Station 150+40	21.41	17.9	35.8	48.0	73.9
230	Culvert Crossing at Station 154+20	59.56	35.2	76.6	104.8	167.4
330	Culvert Crossing at Station 170+50	50.27	28.9	63.4	86.9	139.2
420	Flow From Offsite at Southernmost Basin	173.90	146.9	283.1	377.3	570.5
420	Flow From Quarry Road at Southernmost Basin	124.97	98.3	185.9	246.3	379.1
425	Flow in Haul Road	336.02	244.3	471.1	636.9	983.6
440	Flow Exiting Haul Road Near Explosives Storage	350.81	244.3	471.1	636.9	983.6
445	Flow in Haul Road Just North of Explosives Storage	0.53	0.7	1.3	1.7	2.4
455	Flow in Haul Road	11.85	3.2	10.7	16.0	28.4
465	Flow in Haul Road Near Culvert at Station 182+00	30.13	5.5	21.9	34.0	63.2
465	Culvert Crossing at Station 182+00	191.37	128.0	262.8	358.6	559.8
750	Downstream Confluence	638.31	399.6	774.9	1046.9	1609.1

Full results of the hydrology calculations are in Appendix B of this report.

2.3 DEBRIS PRODUCTION CALCULATIONS

Debris production calculations for this report utilize the methods outlined in the Los Angeles County Department of Public Works Sedimentation Manual, 2nd Edition. This method determines the debris production for a Design Debris Event, which is defined as the quantity of sediment produced by a saturated watershed significantly recovered from a burn (after four years) as a result of a 50-year, 24-hour rainfall amount. The project is on the north facing slope of the San Bernardino mountain range above the Lucerne Valley. For purposes of debris production, this area is assumed to be similar to the north facing slope of the San Gabriel mountain range above Antelope Valley.

The first step in calculating the expected debris potential is to determine the Debris Production Area (DPA) zones covered by the drainage. Using the Valyermo and Mescal Creek quadrangle maps in Appendix A of the LA County Sedimentation Manual, upper slope areas are in DPA zones 3 and 5, and the lower elevations are in DPA zones 8 and 9. The delineation between upper slopes and lower elevations varies from elevation 4500 to 5000.

Based on field observations and comments from quarry staff, the undisturbed land surrounding the quarry and haul road has relatively light debris production. Because of this, undisturbed areas will be assumed to be in DPA zone 9 and disturbed areas (quarry and haul road) will be assumed to be in DPA zone 5.

There are eight existing debris basins along the haul road from the quarry site to the drainage near turnout 64. According to quarry staff, the upper basins, from the quarry to the area near the explosives storage facility, routinely fill up with debris, fail, and allow debris to flow down to the next basin. These four basins are not provided with overflow spillways, which seem to be the primary cause of these failures. The four basins between the explosives storage facility and turnout 64 have not experienced failure, and are provided with spillway structures.

Because of this experience, the debris production calculations will be performed for two major areas, the entire area tributary to the two basins near the explosives storage facility, and the area between these two basins and turnout 64. The location of the explosives storage facility is also a logical breaking point in the study because at this point the drainage can easily leave the roadway and return to its natural drainage course.

The drainage tributary to the basins near the explosives storage facility is 350.81 acres, of which 25.40 acres is disturbed (a portion of the quarry and the haul road). Using the above assumptions for Debris Production Areas, this drainage area can be expected to produce 7,729 cubic yards of debris and sediment (3,254 cubic yards from the disturbed area and 4,475 from the undisturbed area).

The drainage tributary to the haul road from the explosives storage facility to turnout 64 is 30.13 acres, of which 3.62 acres is disturbed. Debris production from this area is expected to be 1,147 cubic yards of debris and sediment (464 cubic yards from the disturbed area and 683 from the undisturbed area).

Backup for the debris production calculations is included in Appendix C of this report.

2.4 CULVERT HYDRAULICS

Culvert capacities were checked using the Federal Highway Administration's HY-8 computer program (version 7.2). All of the culverts have sufficient capacity to pass the design storm (10 year return frequency) with one exception. Stationing callouts are based on the roadway stationing as shown on the Haul and Access Road Improvement Plans in Appendix F. The existing culvert at haul road station 54+35 has minimal cover, and overtops the roadway in the 10 year return frequency storm.

Following is a summary of the culvert data:

Station	CMP Culvert Size (in)	10 Yr. Flow (cfs)	Headwater Depth (ft.)	Outlet Velocity (fps)	Overtopping?
17+70	24	20	3.27	8.63	No
19+00	48	90	5.02	15.21	No
43+50	24	20	3.27	8.46	No
49+35	36	50	4.35	12.93	No
54+35	36	50	3.29	11.5	Yes
57+75	48	90	5.02	10.03	No
62+30	24	20	3.27	9.07	No
88+15	24	20	3.27	10.49	No
90+00	24	20	3.27	10.06	No
144+70	36	28.6	2.63	15.06	No
150+40	36	35.8	3.11	14.21	No
154+20	36	76.6	7.73	20.61	No
170+50	36	63.4	5.91	17.95	No
182+00	84	262.8	6.59	26.27	No

Full HY-8 results are included in Appendix D.

2.5 ROADWAY FLOW HYDRAULICS

Similar to the debris production calculations, roadway flow hydraulics were checked for two distinct sections of the haul route roadway. For both sections, a roadway width of 35 feet was assumed, with a constant cross fall of 2%. As stated earlier, Mine Safety and Health Administration protocols require that earthen berms be provided on each side of the roadway at least as high as the axle of the largest trucks using the roadway (or about 4 feet for the Caterpillar 777D). This berming was included in the typical section used for the calculations (see Figure 4). The irregular channel analysis option in the CIVILDESIGN program was used to determine the normal depth and velocities of flow for the 2-, 10-, 25-, and 100-year return frequencies.

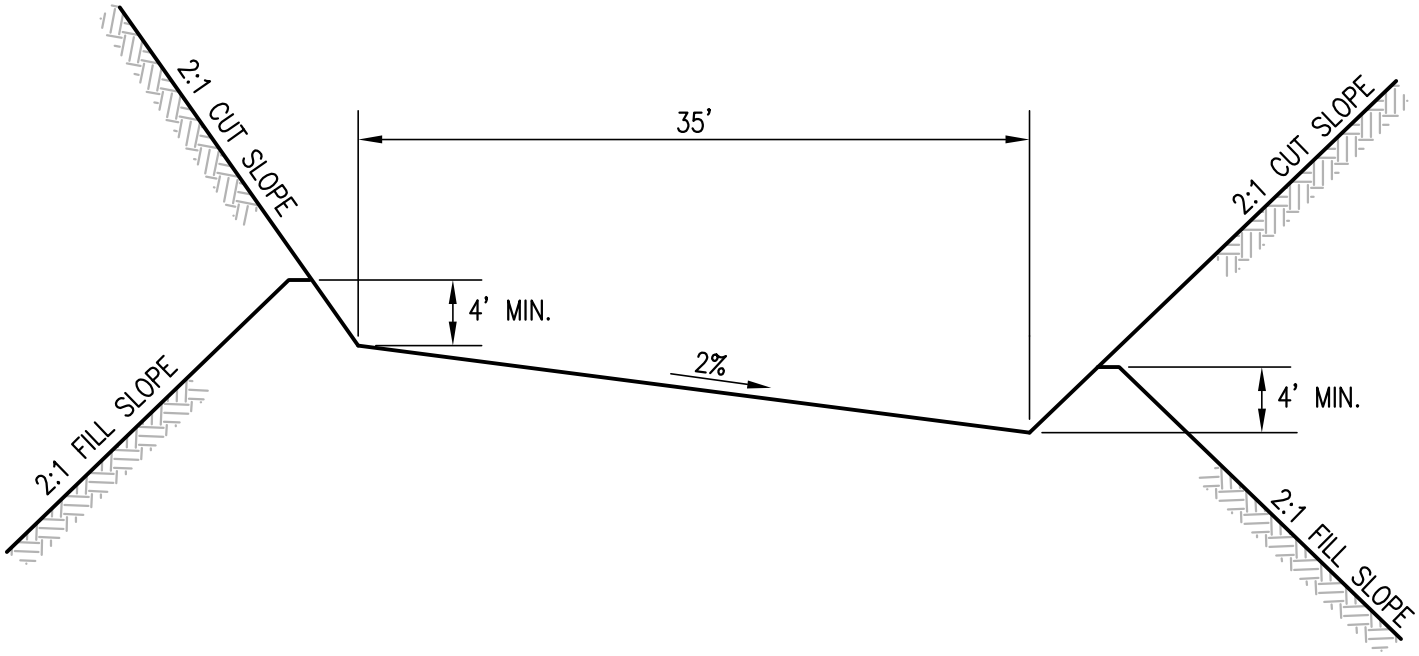
The first section is the upper haul road, from the quarry to the explosives storage site. This section of roadway carries significant flow from upstream as well as runoff from the quarry site and the haul road itself. The hydrology calculations indicate that, because of the size of the drainage, the predicted flow rates are fairly constant along this stretch of roadway. Following is a summary of results from the hydraulic calculations for this stretch of roadway:

Return Frequency (years)	Flow (cfs)	Depth (feet)	Velocity (fps)
2	244.3	0.96	10.91
10	471.1	1.26	14.00
25	636.9	1.44	15.66
100	983.6	1.76	18.37

The second section of haul route roadway continues downhill from the explosives storage site to the culvert near turnout 64. Major offsite flows upstream are allowed to flow through the basins near the explosive storage site, and then continue offsite. So for this section of roadway the majority of the flow comes from the road itself. The hydrology calculations indicate that the flow is constantly increasing along the length of this roadway. Because of that the design flows will be taken at the downstream end of this stretch of roadway. Following is a summary of results from the hydraulic calculations for this stretch of roadway:

Return Frequency (years)	Flow (cfs)	Depth (feet)	Velocity (fps)
2	5.5	0.23	3.78
10	21.9	0.40	5.33
25	34.0	0.47	5.95
100	63.2	0.59	6.95

Full CIVILDESIGN roadway hydraulic calculations results are included in Appendix E.



STREET TYPICAL FLOW SECTION

NOT TO SCALE

Project:	WHITE KNOB QUARRY
Description:	STREET TYPICAL FLOW SECTION

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FIGURE 4

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3.0 Plan of Development

The Settlement Agreement between BLM and Omya, Sections 15, 16, and 17 require the following:

15. Plan of Development. In connection with such right-of-way application, OMYA shall prepare a Plan of Development ("Plan of Development") that implements measures to assure that run-off and sediment accumulated in catchment basins do not enter into or adversely affect wildlife habitat within any active stream drainage. At a minimum, these measures are to include:

    a) The road surface shall be graded and sloped into the inside margin of the right-of-way. No carbonate materials shall be used to surface the road.

    b) Along the inside margin, a drainage ditch shall be constructed to an adequate capacity to concentrate and allow free flow of drain water from both road surface and slope wash from adjacent upland areas.

    c) The ditch shall be maintained to assure free flow of water and debris along its length. A catchment basin system shall be constructed of earthen materials and located immediately above (upslope) of an active drainage within the inside margin of the road. The basin system shall be designed to prevent discharge of sediment into the drainages and shall be incorporated into the Right-of-Way Plan of Development. All catchment basin system earthwork structures located on the downstream side of the structure shall have a concrete weir, or tile or steel culvert imbedded in the structure to assure that rain water overflow will pass through the catchment basin without eroding earthworks and emptying earthwork materials or aggregated debris into drainages. The catchment basin system will be cleaned of accumulated debris whenever the volume remaining cannot contain the sediment load.

16. The Plan of Development shall also contain measures to assure that free flow of water is maintained within drainage channels and erosion is maintained at or near a natural level which at a minimum are to include:

    a) Rip-rap shall be placed at the outflow end of each culvert where the road crosses an active drainage.

    b) Rip-rap shall be of a size and shape and distributed over an adequate area to an adequate depth down drainage from the outflow end of each culvert to assure adequate armor and protection during periods of high rainfall.

17. The Plan of Development shall also contain measures to assure that the use and occupation of public land for rights of way purposes related to the transport of equipment, ore, and personnel to the mine site from the mill and administration site are limited to those authorized on public land and at a minimum are to include:

a) A clear definition of the area of use and occupation, and such technical standards as are likely to assure that use and occupation is consistent with best business practices and will prevent unnecessary or undue degradation to public lands and drainages.

b) Measures and action items to reclaim the unoccupied or unauthorized areas of the right of way as nearly as practicable to the condition that existed prior to construction.

The discussion that follows is intended to comply with these requirements through analysis of the data provided in the Drainage Study and making recommendations regarding features to be constructed or revised in order to meet the intent of the Settlement Agreement.

3.1 ROADWAY GRADING AND DITCH

3.1.1 Analysis

As shown in Section 2.5 of this report, the existing roadway section has adequate capacity to carry the 100-year return flow within the roadway section. This capacity is based on the section shown in Figure 4, which includes the 4 foot high berms on each side of the roadway as required by Mine Safety and Health Administration protocols. In the upper portion of the haul road, the 10-year design flow is 1.26 feet deep, which allows for 2.76 feet of freeboard.

With the amount of debris being carried in the flow, some turbulence is to be expected. However given the shallow depth of flow relative to the width, a full hydraulic jump is not likely. Because of this, freeboard above the conjugate depth would not be a concern for flow in the roadway. Conjugate depths refer to the depths upstream and downstream of the hydraulic jump whose momentum functions are equal for a given flow. The subcritical depth downstream of a hydraulic jump is often significantly greater than the supercritical depth upstream.

The Settlement Agreement requires construction of a ditch along the side of the roadway to "concentrate and allow free flow of drain water from both road surface and slope wash from adjacent upland areas."

Using the 10-year design flow of 471.1 cfs, a riprap lined channel to carry this flow would need to be a trapezoidal channel with a 5-foot base width and 2:1 side slopes. Normal flow in this channel would be supercritical with a depth of 2.36 feet, and the normal velocity is 20.6 feet per second. Because of the narrower channel, a hydraulic jump caused by debris in the channel is more likely, so freeboard would need to be provided from the conjugate depth. The conjugate depth at the design flow is approximately 5.8 feet, meaning the channel would need to be 7 feet deep to contain the design flow. The total top width of this channel would then be 33 feet. Lining the ditch with concrete increases the velocity of flow to over 40 feet per second, and results in a conjugate depth of 9.8 feet.

3.1.2 Recommendations

Because of the large quantity of flow in the upper haul road, providing a separate channel to convey storm water would require essentially doubling the width of the road surface, with 35 feet for the road and 33 feet for the drainage ditch. Since there would be a steep drop off into the ditch from the roadway, Mine Safety and Health Administration protocols would require that an earthen berm at least as high as the axle of the largest trucks using the roadway be provided to prevent trucks from running into the ditch. This would also prevent runoff from the roadway surface from entering the ditch. Further complicating matters, for the upper portion of the haul road, sediment catchment basins are on both sides of the roadway, so this deep channel would need to be able to cross from one side of the roadway to the other.

Because of the above discussion, we do not recommend that a separate roadside ditch be constructed for this roadway. Quarry staff has stated that they are aware of the potential for storm damage to the roadway surface, and that they have adequate equipment on site to make repairs as needed. The earthen berms that are required for truck safety are adequate to contain both the design flow and the 100-year flow within the roadway with over two feet of freeboard.

Our recommendation is that the road be graded with a 2% cross fall. Which side of the road would be the low side of the roadway would be predicated on which side the next downstream catchment basin is on. The road surface should be an aggregate base course, free of calcium carbonate materials such as is currently being used by quarry staff. The four foot high earthen berms should continue to be provided, with the exception of breaks in the berms at the sediment catchment basins to allow stormwater and debris to flow in to the basins. A typical cross section of the roadway should be as shown on Figure 4 in Section 2.5 of this report.

3.2 SEDIMENT CATCHMENT BASINS

3.2.1 Analysis

In Section 2.3 of this report, the expected debris production volumes were identified as 7,759 cubic yards in the portion of the roadway tributary to the explosive storage site and 1,169 cubic yards for the roadway between this point and the culvert near turnout 64. There are eight existing sediment catchment basins intended to capture this volume of debris.

The locations of these basins, as well as two locations identified in a site visit as potential basin locations, are shown on a key map on Figure 5. On this map, basins 2 and 10 are the potential new basin locations, and the rest are existing basin locations. Figures 6 through 13 show the existing conditions at the eight existing basins. Each figure includes the depth and volume of the basin in its current configuration.

The upper portion of the haul route, between the quarry and the explosive storage site, currently passes through existing basins 1, 3, 4, and 5. The depths and volumes for these basins are summarized below:

Basin	Depth (ft)	Volume (CY)
1	5	280
3	14	840
4	14	1,690
5	10	470
Total Volume		3,280

The total volume of these basins of 3,280 cubic yards is less than half of the predicted debris generation volume of 7,729 cubic yards. This agrees with the experience of quarry staff that these basins routinely fill up and see failure of the basins.

The lower portion of the haul route, between the explosive storage site and the culvert at turnout 64, currently passes through basins 6, 7, 8, and 9. The depths and volumes for these basins are summarized below:

Basin	Depth (ft)	Volume (CY)
6	12	520
7	12	490
8	7	200
9	8	240
Total Volume		1,450

The total volume of these basins of 1,450 cubic yards compares favorably with the predicted debris generation volume of 1,147 cubic yards. This confirms the experience quarry staff that these basins have not experienced problems with capacity or failure.

3.2.2 Recommendations

As mentioned above, capacity problems are apparent for the basins servicing the upper portion of the haul road. Because of this we are recommending revisions to all four of the existing basins as well as grading to provide a fifth basin. Four of the basins should be provided with a concrete spillway sized to allow for overflow of the 10-year design storm without failure of the basin embankment. A typical spillway with preliminary sizing for these basins is shown in Figure 14.

Basin 1 is in a confined location with steep slopes and the existing roadway bordering the basin. This makes any expansion of the basin very difficult. Some additional volume may be possible by excavating deeper in this location, but the volume to be gained would be minimal, and maintenance of the basin would be more difficult. Because of this, our only recommendation for this basin is to provide a spillway as shown on Figure 15.

Basin 2 is a new recommended basin with the configuration as shown on Figure 16. The bottom of the basin is kept at a maximum grade of 10% to make maintenance of the basin easier. The basin is situated so that flow will enter the basin until the basin is full. At this point the flow will cease to enter the basin and remain in the roadway. Because of this Basin 2 will not be provided with a spillway. The volume of Basin 2 is 960 cubic yards.

Basin 3 is in a confined location similar to Basin 1. The bottom of the basin is already steeper than 20%, so deepening of the basin in place is not an option. Because of this, our only recommendation for this basin is to provide a spillway as shown on Figure 17.

Basins 4 and 5 are located in an area with the greatest opportunity to gain additional volume. These basins are located at the explosive storage site, and are adjacent to areas that are planned to be abandoned and reclaimed to their pre-disturbed state. These basins are close enough together that their grading will be combined in to a single grading operation as shown on Figure 18. A bench for continued access to the reclaimed area is provided on the west side of Basin 4. A spillway from Basin 4 drains directly to the bottom of Basin 5. The spillway for Basin 5 returns flow to the natural stream course. The new volume for Basin 4 is 2,420 cubic yards and the new volume for Basin 5 is 3,690 cubic yards. As with Basin 2, the bottoms of both of these basins are kept at a maximum grade of 10% to make maintenance of the basins easier. Detailed grading of basin 4 is shown on Figure 19 and detailed grading of Basin 5 is shown on Figure 20.

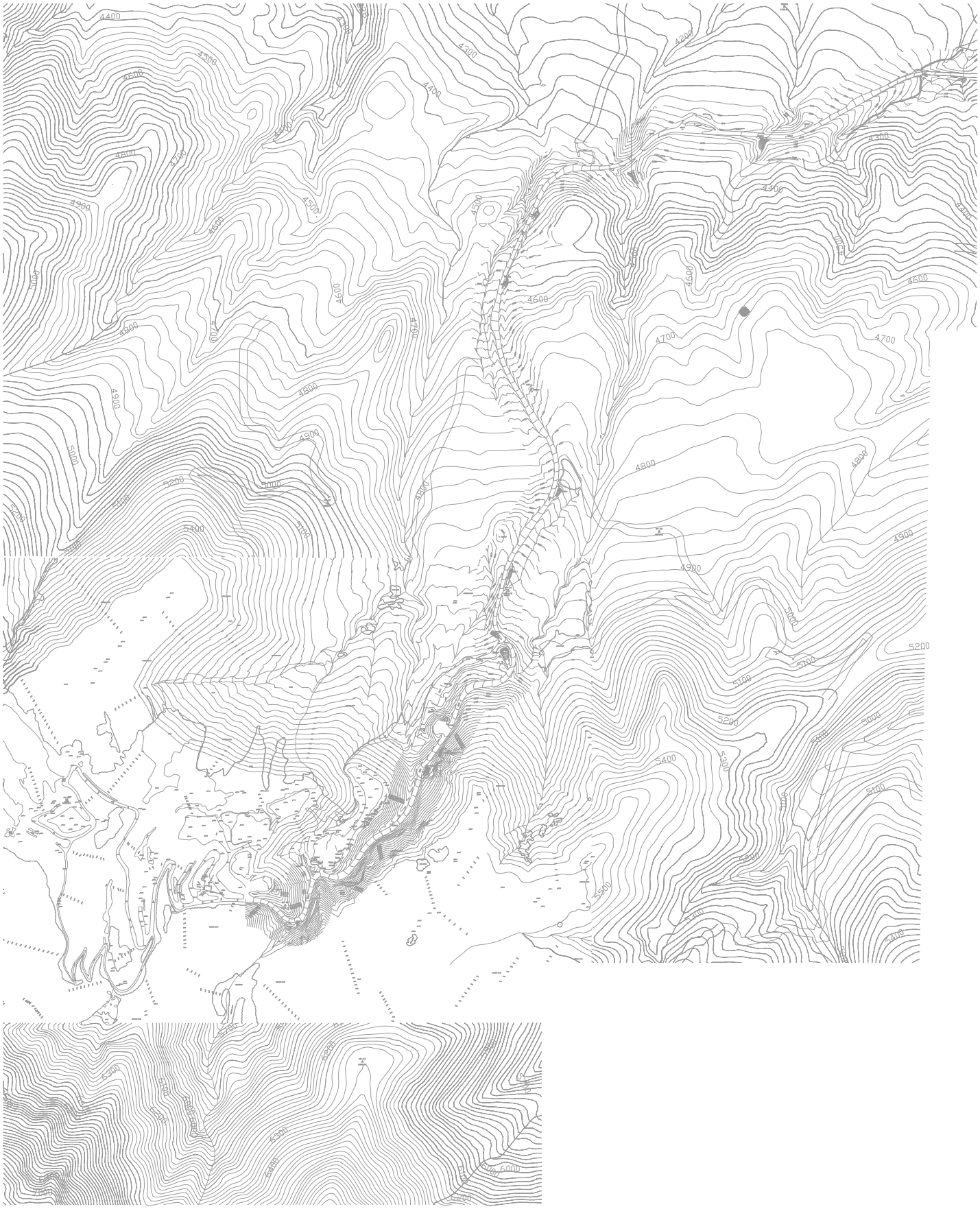
After the recommended improvements, the basins in the upper portion of the haul route can be summarized as follows:

Basin	Spillway Crest	Proposed Volume
1	5410	280
2	N/A	960
3	5163	840
4	5007.5	2,420
5	4974.5	3,690
Total Volume		8,190

The total volume of these basins of 8,190 cubic yards compares favorably with the predicted debris generation volume of 7,729 cubic yards.

Since Basins 6 through 9 already have sufficient capacity as well as spillway protection, we do not recommend any changes to these basins. However we do recommend that a new basin be constructed at location 10. Basin 9 is about 1,000 upstream from where the flow would leave the roadway toward the inlet to the 84 inch pipe near turnout 64. Since the flow can pick up additional debris in this stretch, we recommend that Basin 10 be graded as shown on Figure 21. In addition to debris capture, the spillway from this basin along with some riprap protection will help to stabilize the slope area that is mentioned in Section 2.1.1 of this report.

The proposed grading shown on Figures 15 through 21 is intended to show the intended locations and configurations of the basins. The finished basins may vary from these configurations based on field conditions as long as the volume of the basins are the same or larger, the relationship between the basin inlet and the spillway crest are the same, the spillway size is at least as large as shown, and the proposed grading is within the Right of Way.



GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

BASIN NO. 1

DEPTH = 5 FT.

VOLUME = 280 C.Y.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 1

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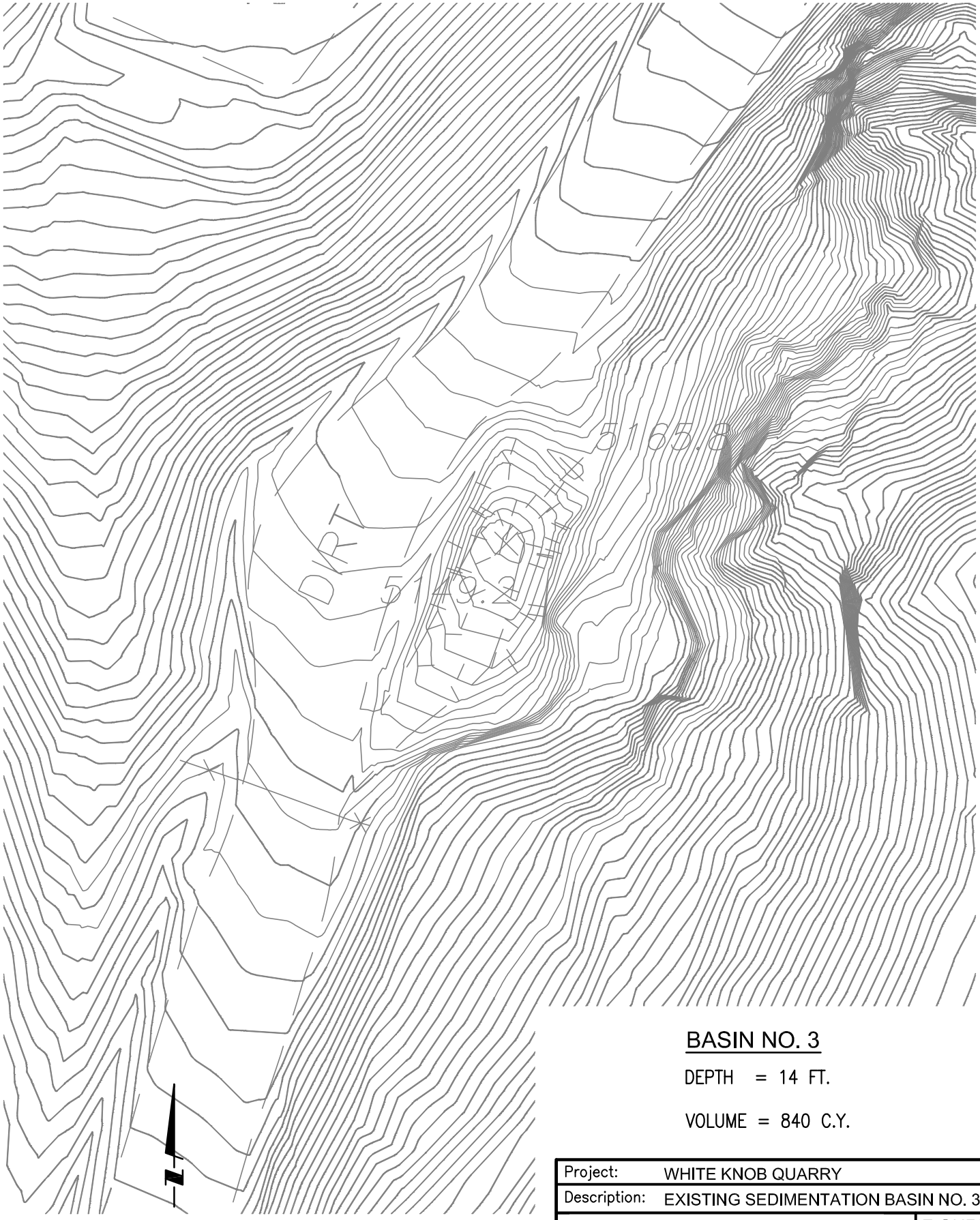
FIGURE 6

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0005.dwg PLOTTED: 7/29/2011 9:02 AM BY: Uribe Gonzales, Martha



BASIN NO. 3

DEPTH = 14 FT.

VOLUME = 840 C.Y.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 3

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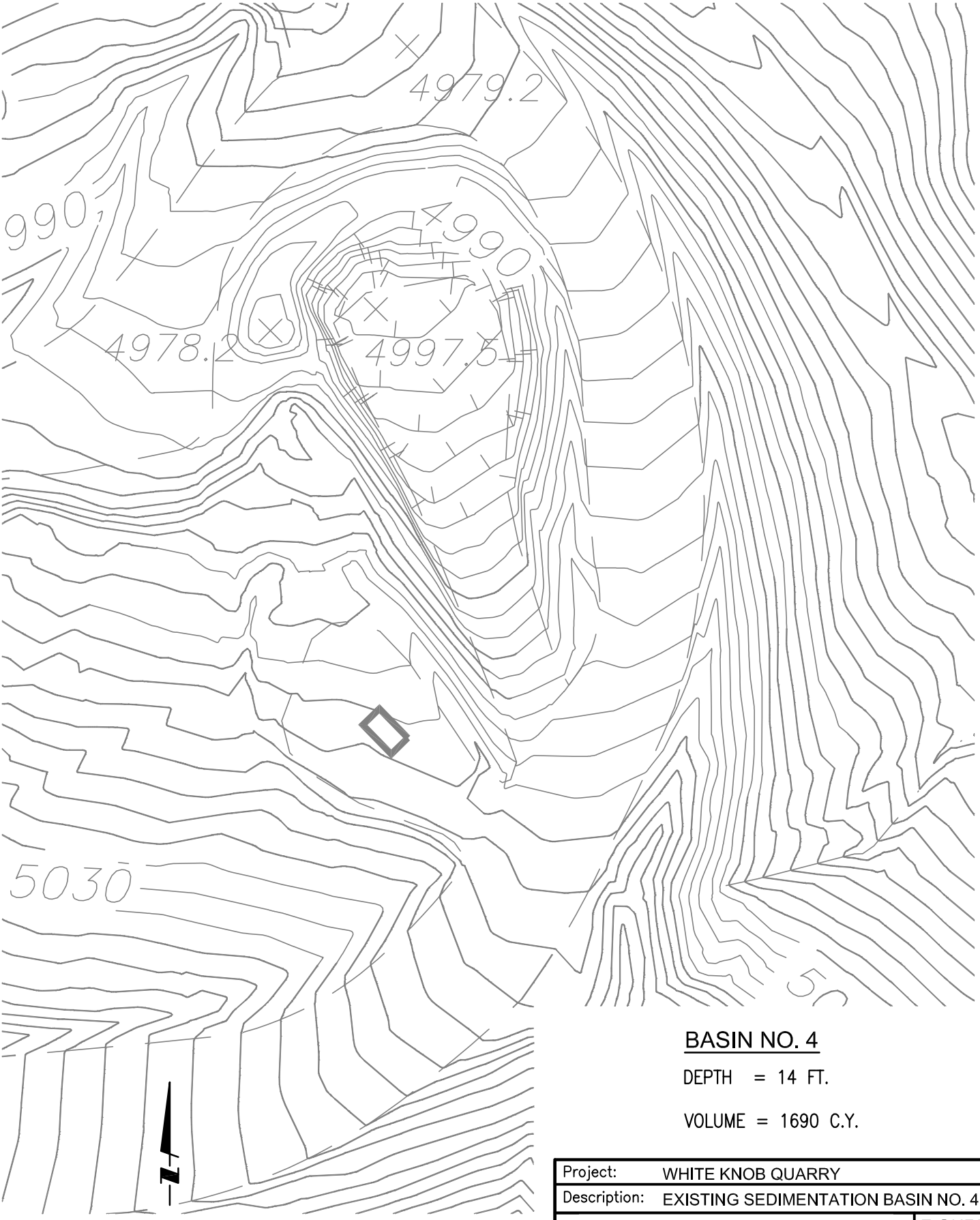
FIGURE 7

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0006.dwg PLOTTED: 7/29/2011 9:03 AM BY: Uribe Gonzales, Martha



BASIN NO. 4

DEPTH = 14 FT.

VOLUME = 1690 C.Y.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 4

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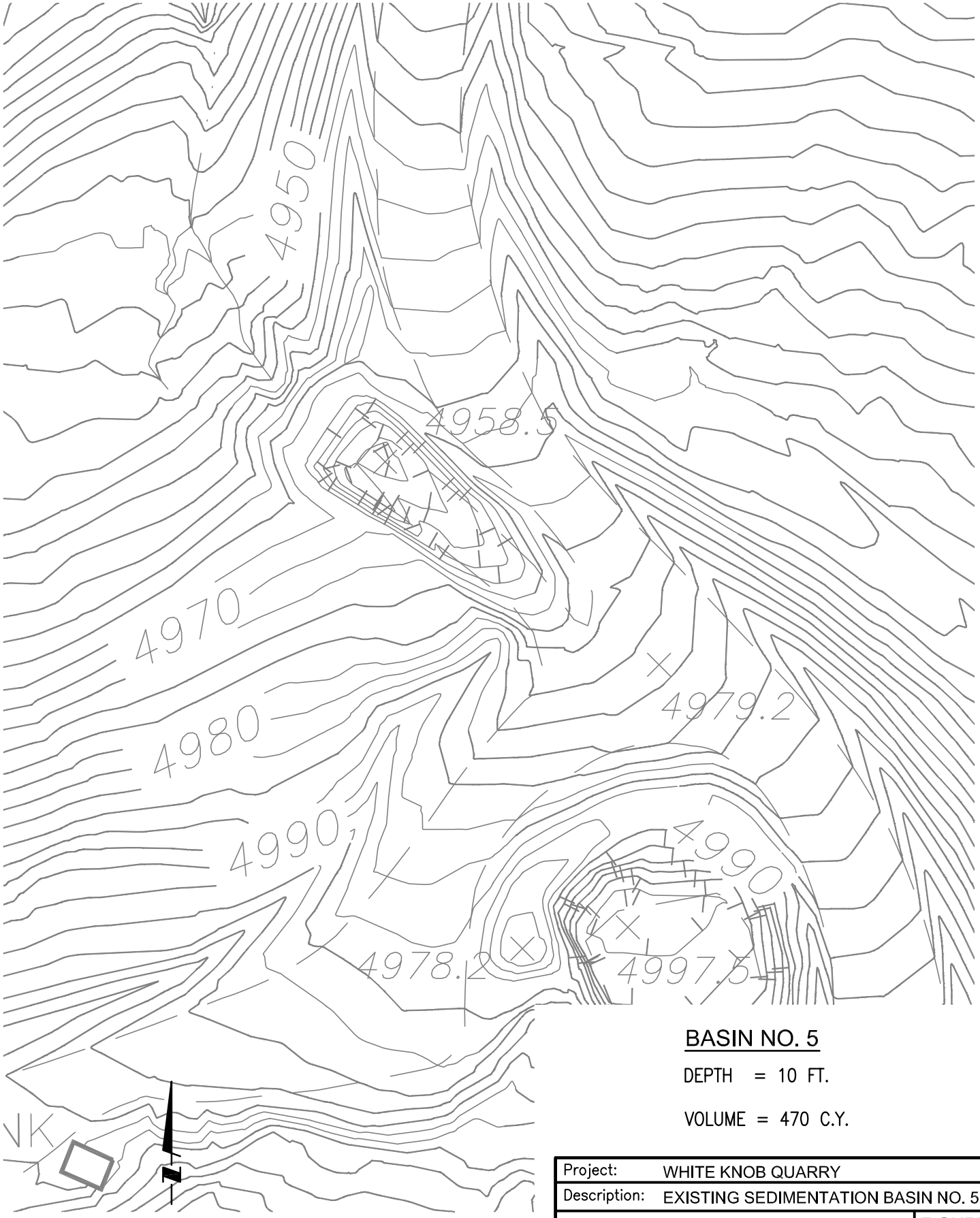
FIGURE

8

Job No.: 2042484500 | Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0007.dwg PLOTTED: 7/29/2011 9:04 AM BY: Uribe Gonzales, Martha



BASIN NO. 5

DEPTH = 10 FT.

VOLUME = 470 C.Y.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 5

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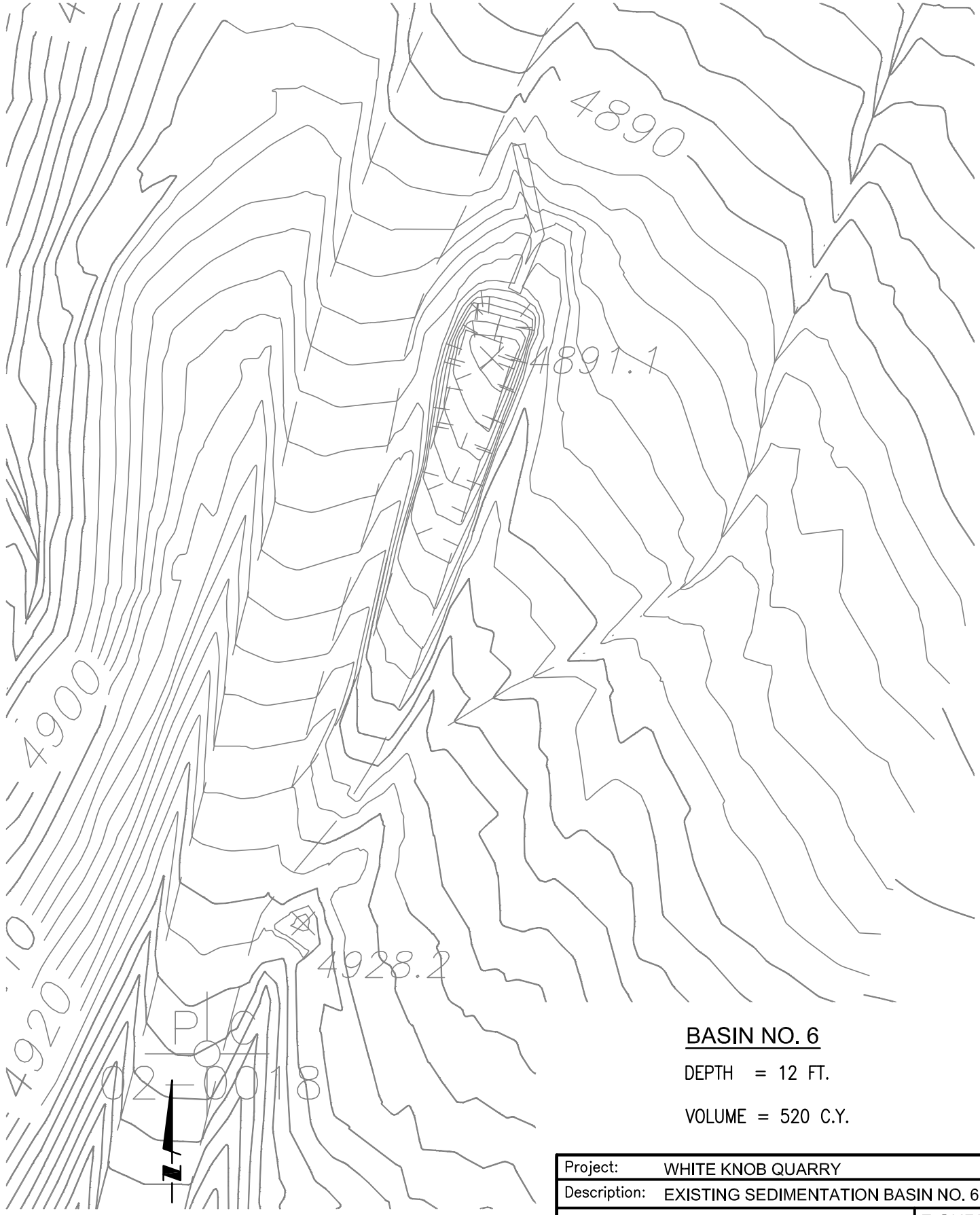
FIGURE

9

Job No.: 2042484500 | Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0008.dwg PLOTTED: 7/29/2011 9:06 AM BY: Uribe Gonzales, Martha



BASIN NO. 6

DEPTH = 12 FT.

VOLUME = 520 C.Y.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 6

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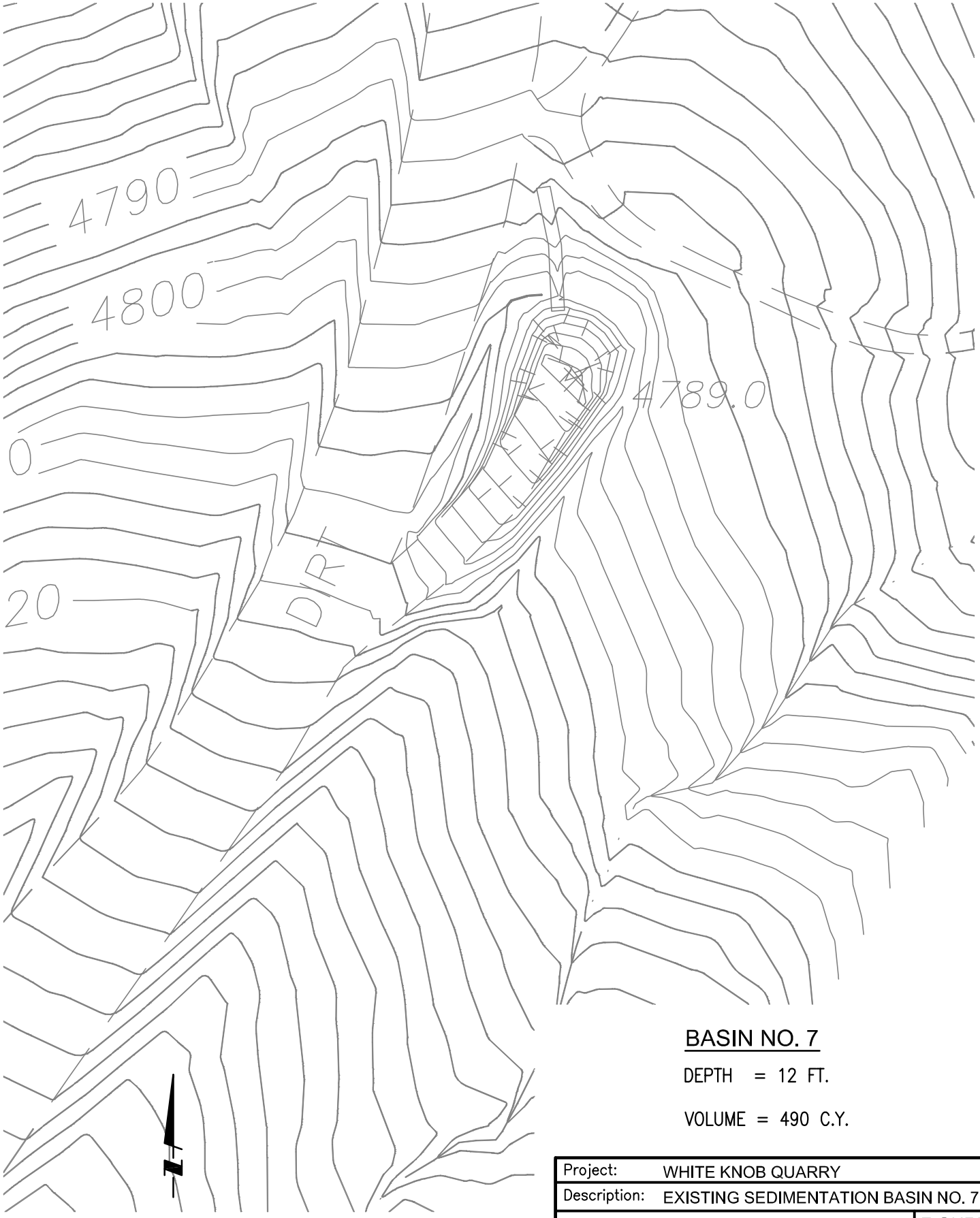
FIGURE 10

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0009.dwg PLOTTED: 7/29/2011 9:07 AM BY: Uribe Gonzales, Martha



BASIN NO. 7

DEPTH = 12 FT.

VOLUME = 490 C.Y.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 7

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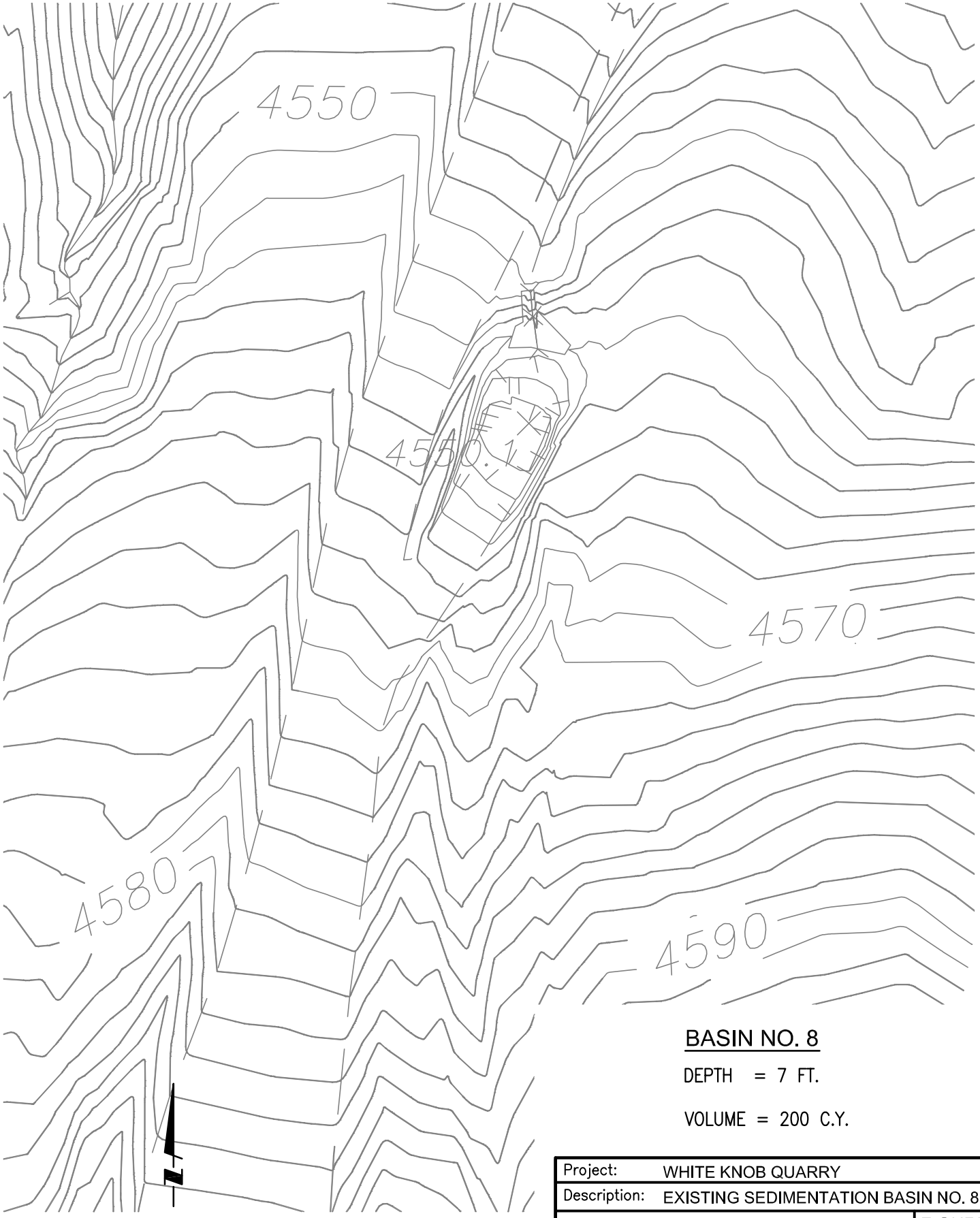
FIGURE 11

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0010.dwg PLOTTED: 7/29/2011 9:08 AM BY: Uribe Gonzales, Martha



BASIN NO. 8

DEPTH = 7 FT.

VOLUME = 200 C.Y.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 8

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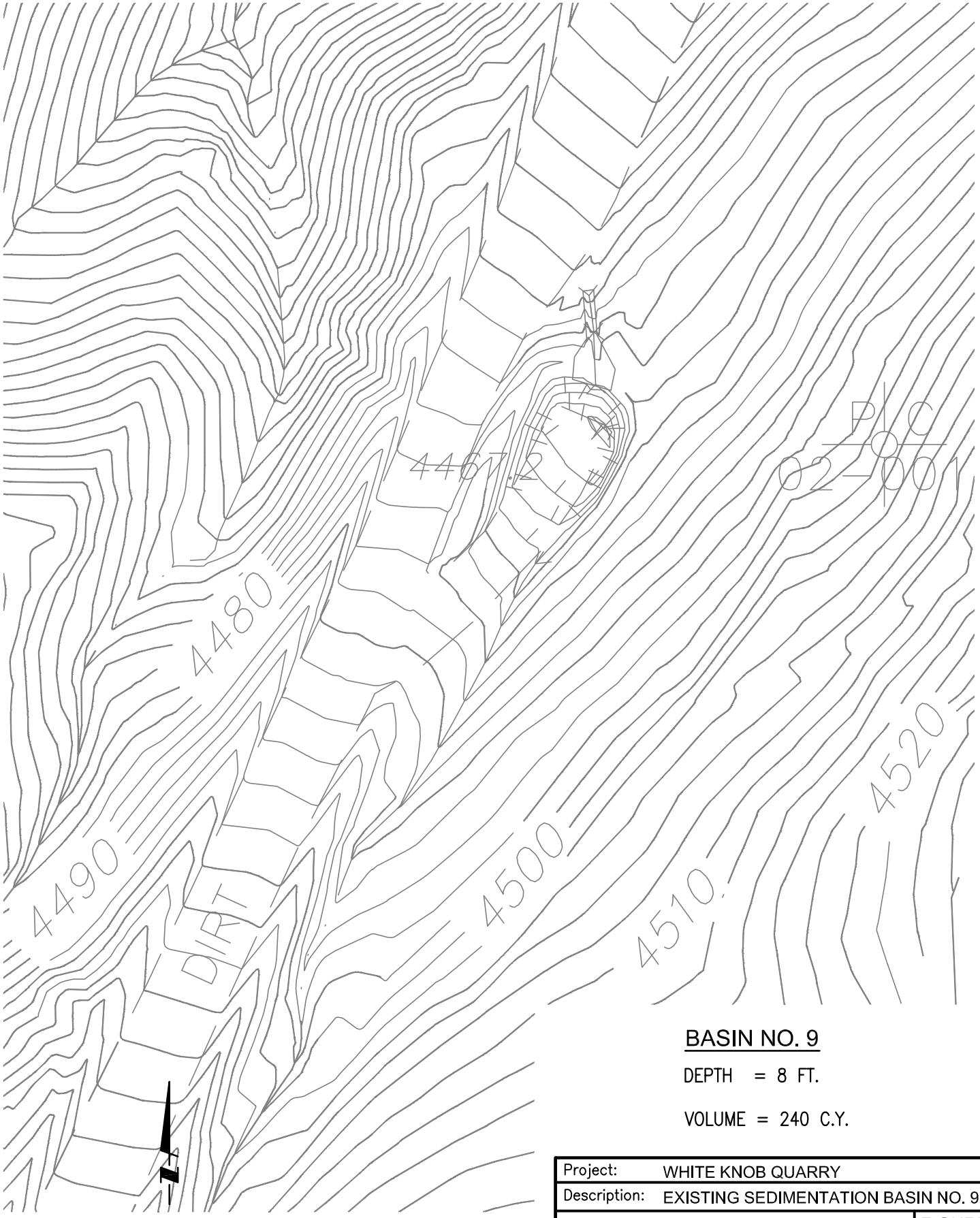
FIGURE 12

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0011.dwg PLOTTED: 7/29/2011 9:09 AM BY: Uribe Gonzales, Martha



BASIN NO. 9

DEPTH = 8 FT.

VOLUME = 240 C.Y.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Project:	WHITE KNOB QUARRY
Description:	EXISTING SEDIMENTATION BASIN NO. 9

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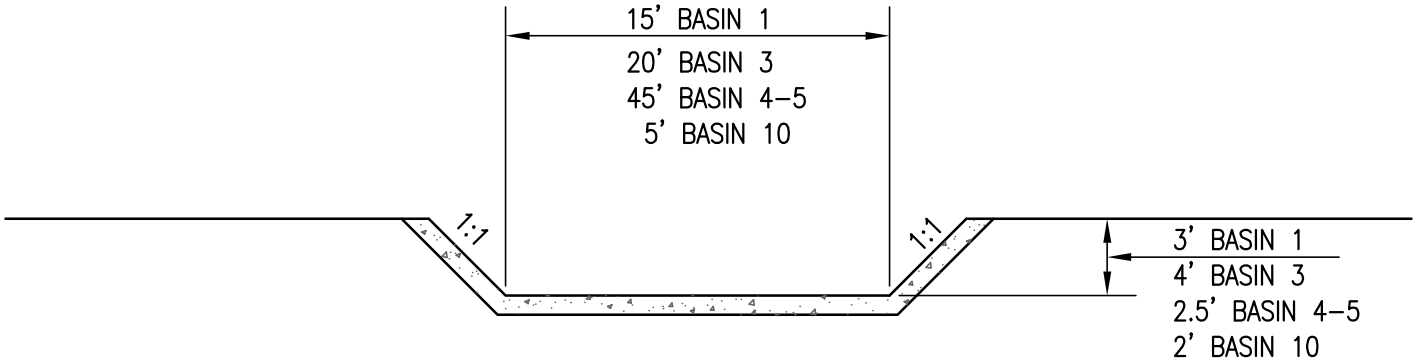
FIGURE 13

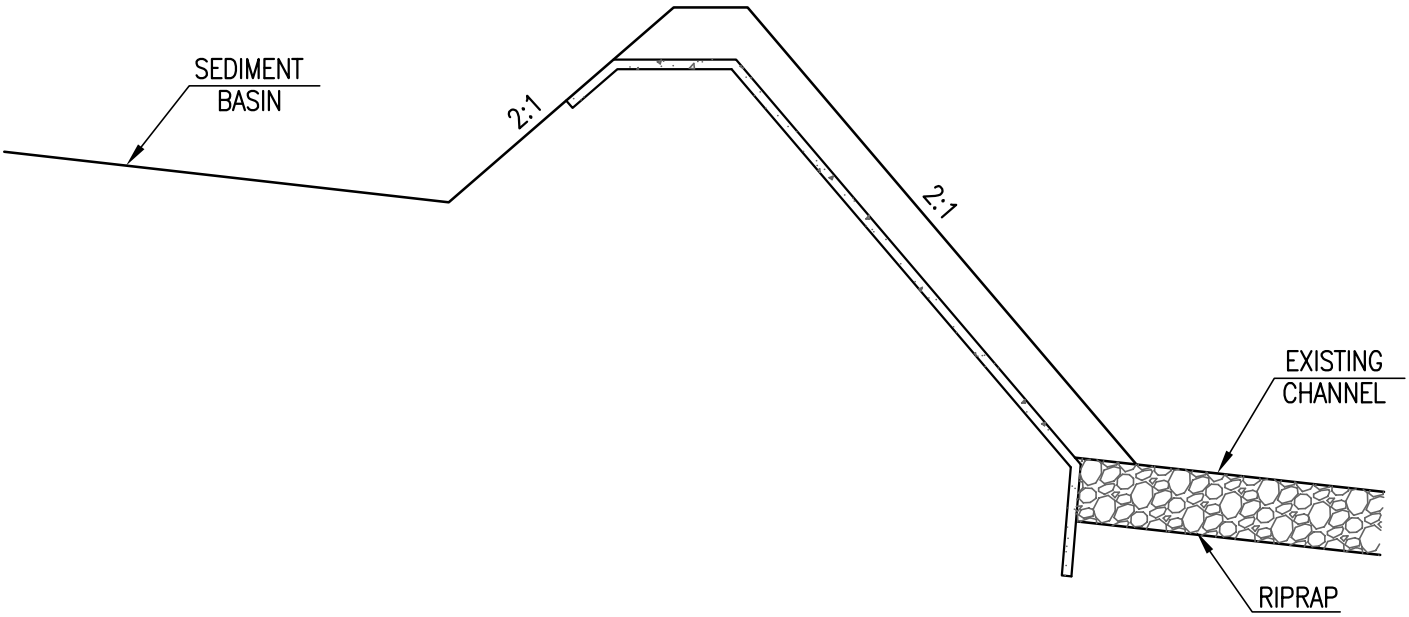
Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0012.dwg PLOTTED: 7/29/2011 9:10 AM BY: Uribe Gonzales, Martha



SPILLWAY CROSS SECTION

NOT TO SCALE



SPILLWAY PROFILE

NOT TO SCALE

Project:	WHITE KNOB QUARRY
Description:	SPILLWAY DETAILS

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FIGURE 14

Job No.: 2042484500 Date: 07–29–2011

DRAWING: v:\projects\2042484500\dwg\prdt0002.dwg PLOTTED: 8/11/2011 4:36 PM BY: Carey, Paul

BASIN NO. 1

SPILLWAY CREST ELEV. = 5410

VOLUME = 280 C.Y.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASIN NO. 1

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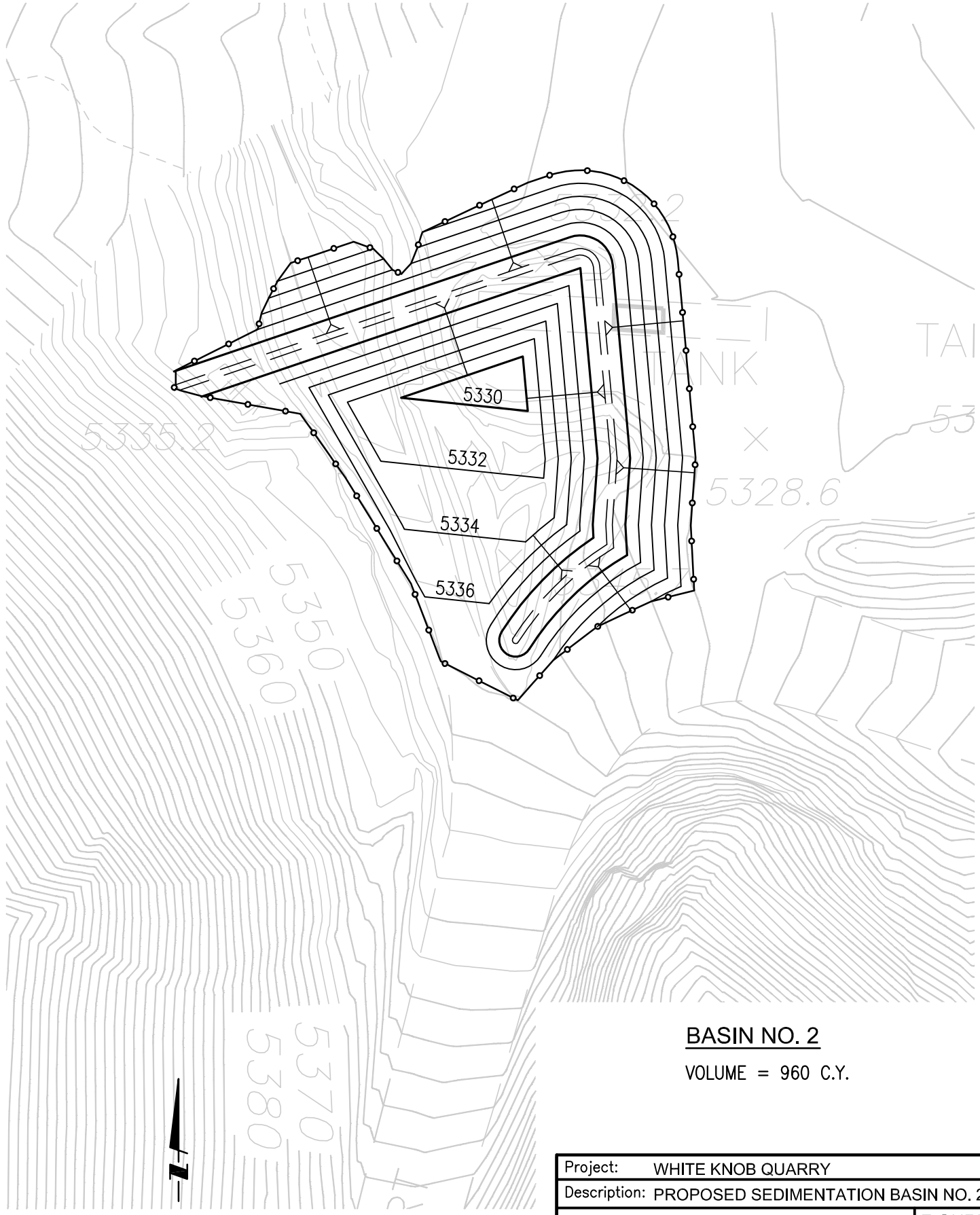
FIGURE 15

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0013.dwg PLOTTED: 7/29/2011 9:12 AM BY: Uribe Gonzales, Martha



BASIN NO. 2

VOLUME = 960 C.Y.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASIN NO. 2

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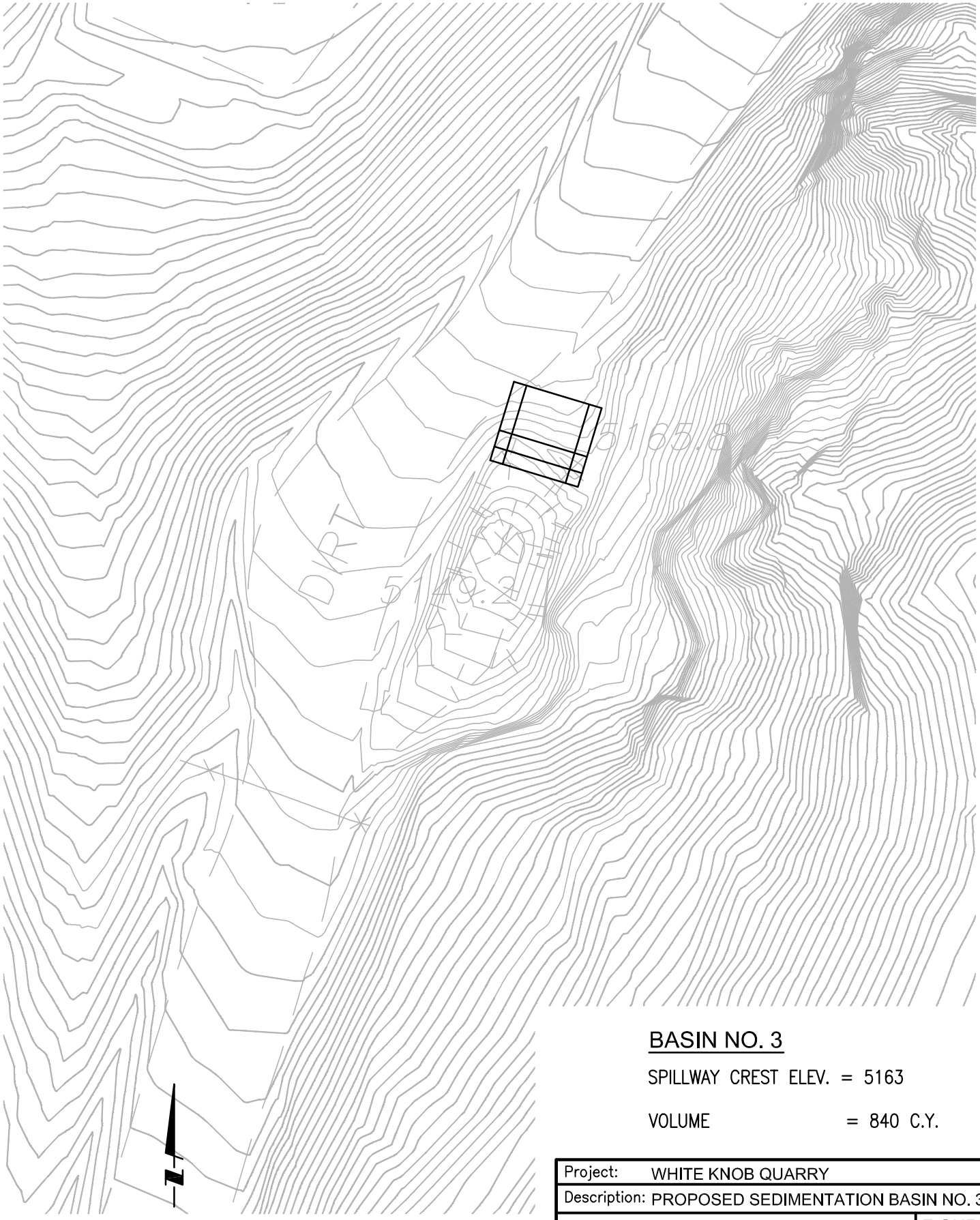
FIGURE 16

Job No.: 2042484500 Date: 08-11-2011

DRAWING: v:\projects\2042484500\dwg\prex0014.dwg PLOTTED: 8/11/2011 11:15 AM BY: Carey, Paul



BASIN NO. 3

SPILLWAY CREST ELEV. = 5163

VOLUME = 840 C.Y.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASIN NO. 3

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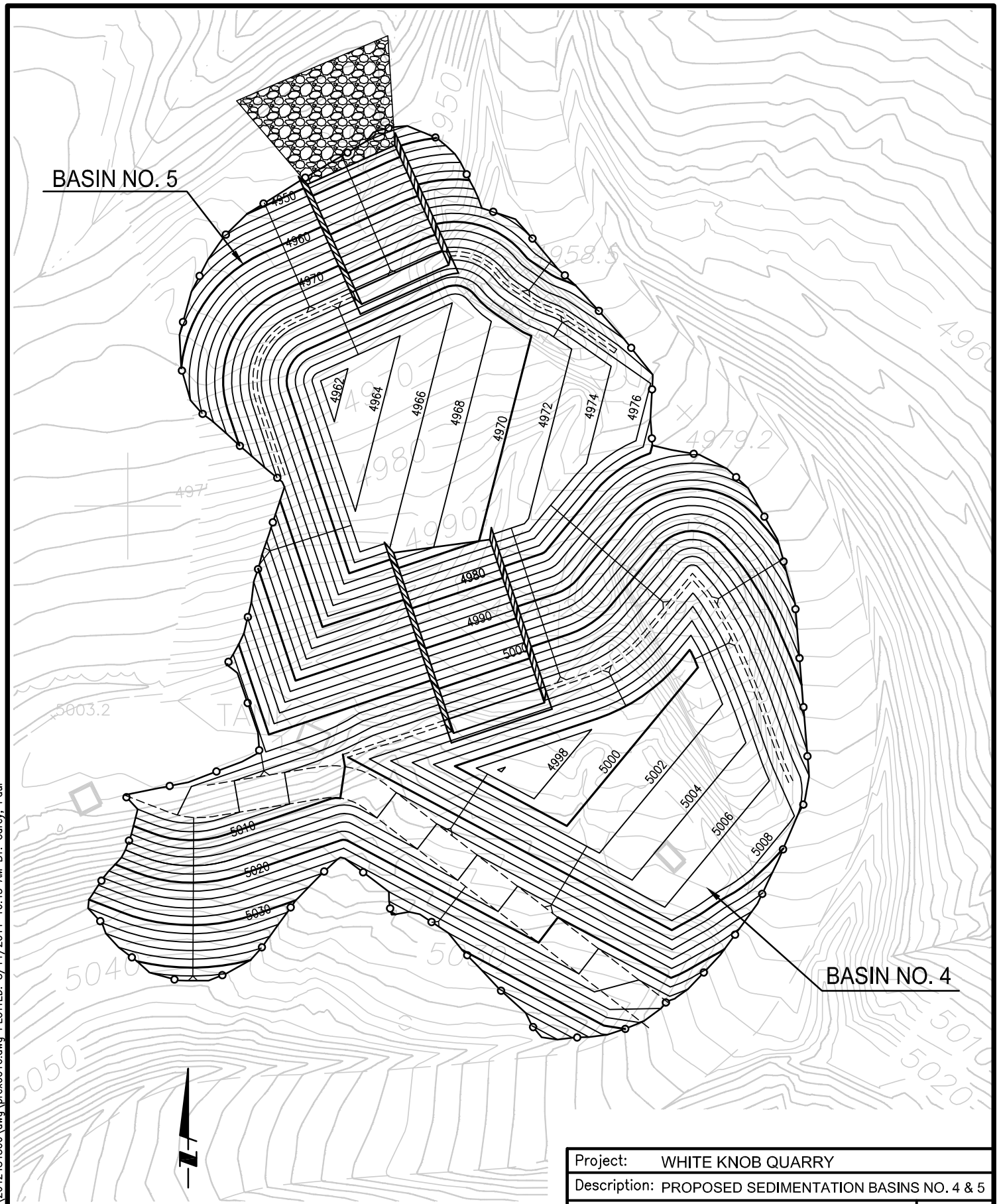
FIGURE 17

Job No.: 2042484500 Date: 07-29-2011

DRAWING: v:\projects\2042484500\dwg\prex0015.dwg PLOTTED: 7/29/2011 9:15 AM BY: Uribe Gonzales, Martha



GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 60 ft.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASINS NO. 4 & 5

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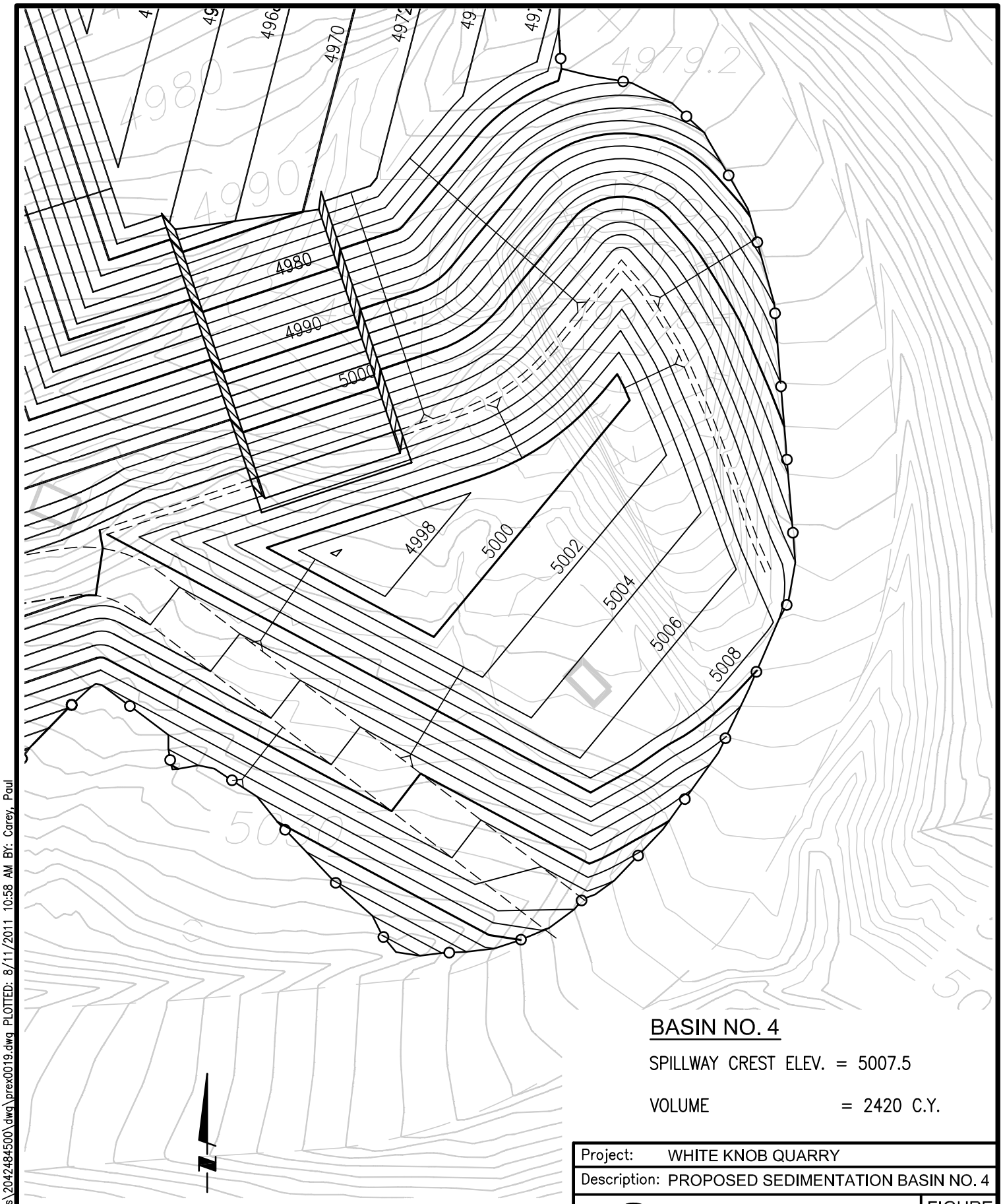
FIGURE
18

Job No.: 2042484500 | Date: 08-11-2011

DRAWING: v:\projects\2042484500\dwg\prex0016.dwg PLOTTED: 8/11/2011 10:45 AM BY: Carey, Paul



BASIN NO. 4

SPILLWAY CREST ELEV. = 5007.5

VOLUME = 2420 C.Y.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASIN NO. 4

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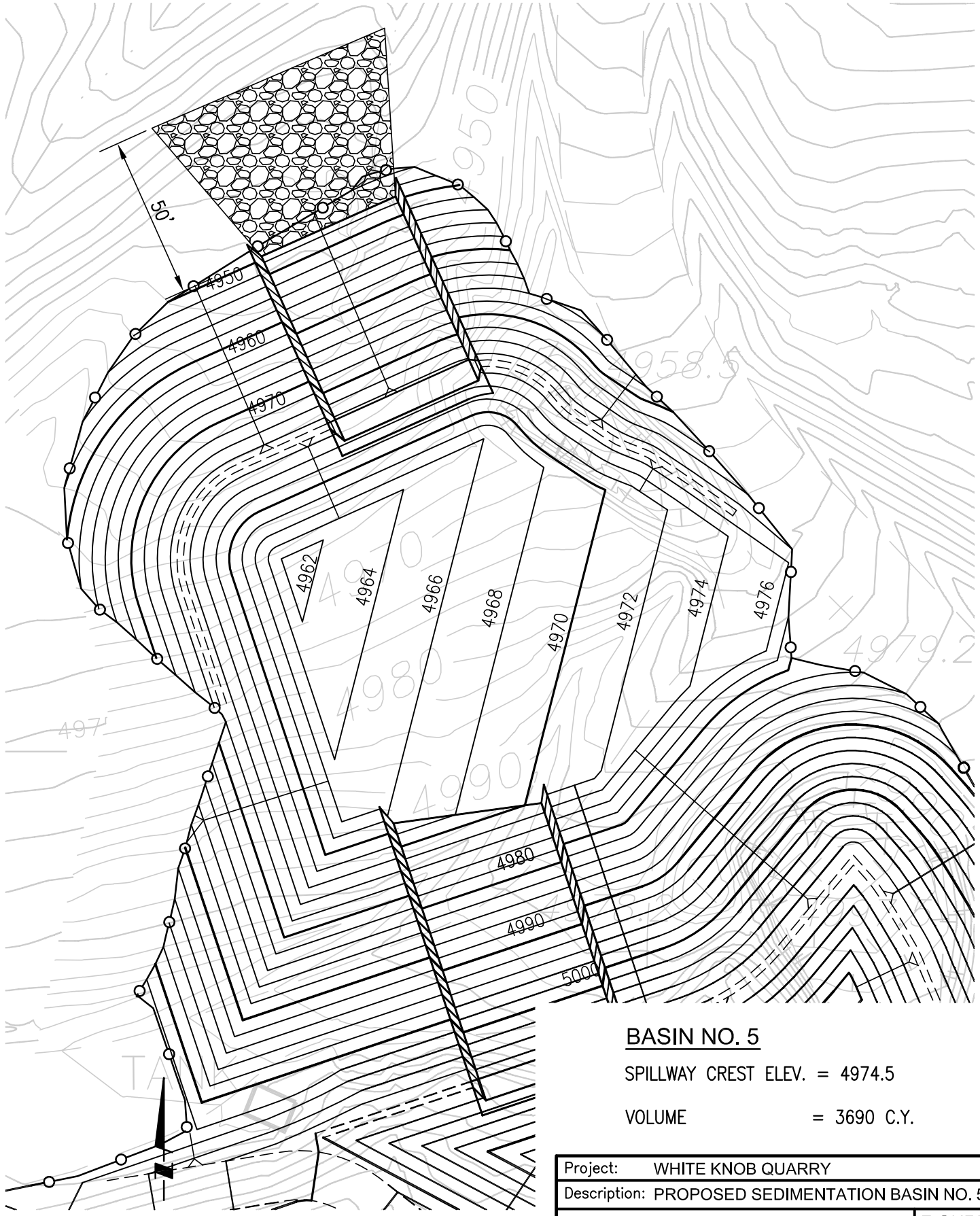
FIGURE 19

Job No.: 2042484500 Date: 08-11-2011

DRAWING: v:\projects\2042484500\dwg\prex0019.dwg PLOTTED: 8/11/2011 10:58 AM BY: Carey, Paul



BASIN NO. 5

SPILLWAY CREST ELEV. = 4974.5

VOLUME = 3690 C.Y.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASIN NO. 5

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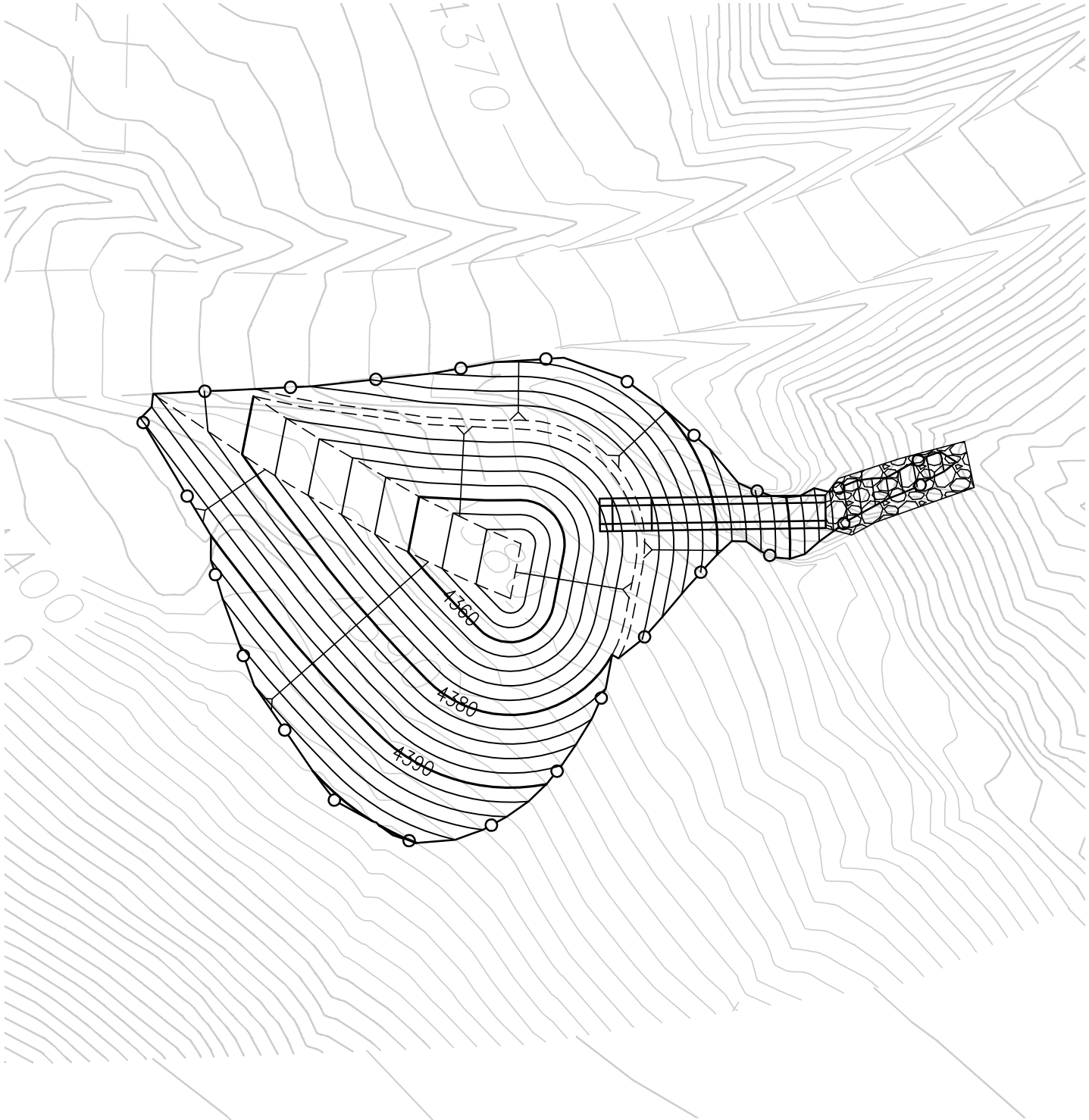
FIGURE 20

Job No.: 2042484500 Date: 08-11-2011

DRAWING: v:\projects\2042484500\dwg\prex0017.dwg PLOTTED: 8/11/2011 10:55 AM BY: Carey, Paul



BASIN NO. 10

SPILLWAY CREST ELEV. = 4398

VOLUME = 200 C.Y.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 40 ft.

Project:	WHITE KNOB QUARRY
Description:	PROPOSED SEDIMENTATION BASIN NO. 10

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FIGURE 21

Job No.: 2042484500 Date: 08-11-2011

DRAWING: v:\projects\2042484500\dwg\prex0018.dwg PLOTTED: 8/11/2011 11:12 AM BY: Carey, Paul

3.3 CULVERT RIPRAP

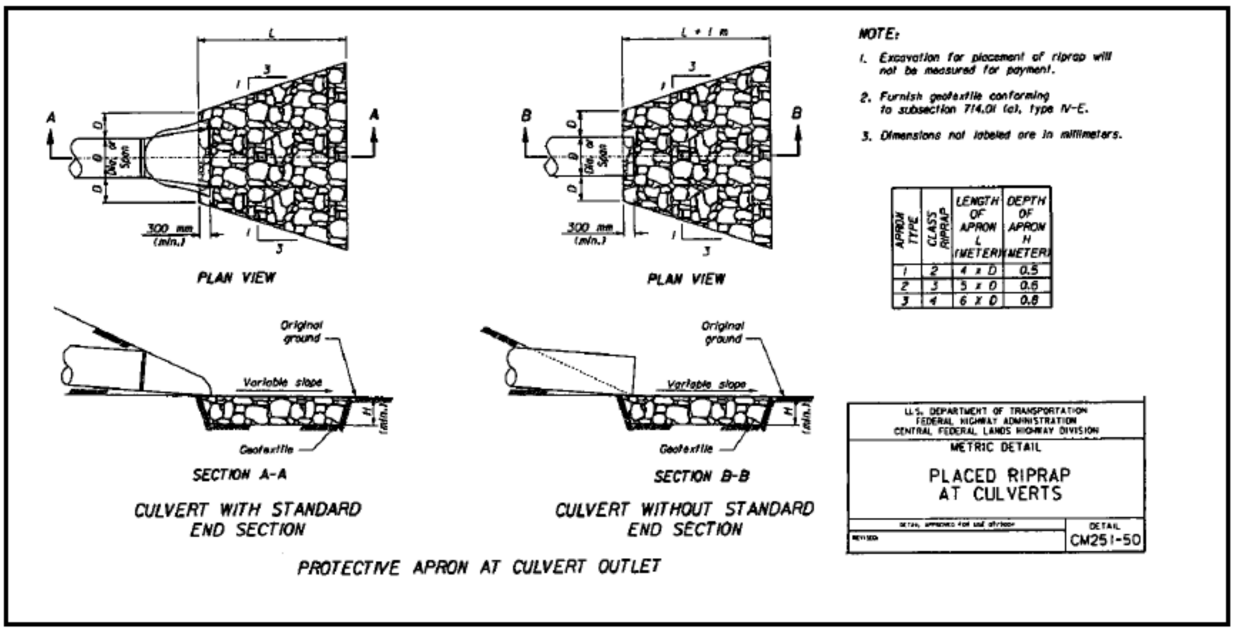
3.3.1 Analysis

In Section 2.4 of this report, the capacities of the existing haul road culverts were checked relative to the predicted 10-year stormwater flow. All culverts had adequate capacity with the exception of the 36 inch corrugated metal pipe at haul road station 54+35. Because of the difficult nature of predicting flows in an alluvial fan as mentioned in Section 2.1 of this report, we do not feel that this location is a concern. The pipe has limited capacity because it is in a very shallow channel, and hence there is very little allowable headwater depth related to the other culverts. Furthermore, the pipe has been in place for 24 years without reported problems. This leads us to believe that the actual 10-year flow at this culvert is somewhat less than that reported on the 1987 Morrison-Knudsen improvement plans (a copy of these plans is included in Appendix F).

The culverts appear to have been provided with outlet riprap protection in accordance with the 1987 plans. The design at that time was for a 2-foot thick riprap apron extending four pipe diameters downstream of the culvert outlet. While we have not seen the actual specifications for the riprap, both the thickness called out and our field observations indicate that it is equivalent to a Caltrans Light Class riprap gradation. The picture below shows a typical culvert outlet at haul road station 90+00:

Culvert Outlet at Station 90+00

To check the adequacy of the culvert outlet protection, we utilized the methods outlined in Section 10.2 of the Federal Highway Administration's Hydraulic Engineering Circular 14, Third Edition (HEC-14). This method sizes a riprap apron with the following configuration:



The required riprap rock size is determined based on the design discharge, culvert diameter, and tail water depth. All of the culverts are steep enough to have supercritical flow, so the culvert diameter used in the equation is adjusted based on the normal flow depth in the culvert. Once the rock size is determined, the apron dimensions are determined from the following table found in HEC-14:

Class	D_{50} (mm)	D_{50} (in)	Apron Length[1]	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

[1]D is the culvert rise.

Calculations for the individual culvert locations are included in Appendix G, and are summarized below. The Riprap class and required thickness are based on Caltrans Standard Specifications:

	Pipe Size	Apron Class	Apron Length	Required Riprap D_{50} Size (ft)	Required Riprap D_{50} Weight (lbs)	Specified Riprap Class	Riprap Thickness (ft)
Station 17+70	24" CMP	3	10	0.67	25.5	Light	2.5
Station 19+00	48" CMP	4	24	1.17	140.0	Light	2.5
Station 43+50	24" CMP	3	10	0.66	24.6	Light	2.5
Station 49+35	36" CMP	5	21	1.31	193.0	Light	2.5
Station 54+35	36" CMP	4	18	1.05	100.2	Light	2.5
Station 57+75	48" CMP	4	24	1.00	85.3	Light	2.5
Station 62+30	24" CMP	3	10	0.68	27.4	Light	2.5
Station 88+15	24" CMP	3	10	0.73	33.0	Light	2.5
Station 90+00	24" CMP	3	10	0.71	31.4	Light	2.5
Station 144+70	36" CMP	3	15	0.80	45.1	Light	2.5
Station 150+40	36" CMP	4	18	1.02	90.7	Light	2.5
Station 154+20	36" CMP	6	24	2.66	1634.2	1 Ton	5.4
Station 170+50	36" CMP	6	24	1.96	652.1	1/4 Ton	3.3
Station 182+00	84" CMP	5	49	1.56	330.6	1/4 Ton	3.3

3.3.2 Recommendations

With the exception of the culverts at Stations 154+20, 170+50, and 182+00, the riprap size provided in the 1987 Morrison-Knudsen plans are adequate. However the length of protection downstream of the culvert outlet should be extended in all locations to provide the length of protection shown in the table above. The culverts at Stations 154+20, 170+50, and 182+00 should have the existing outlet riprap protection removed and replaced with the appropriate riprap class and apron dimension shown in the table above.

4.0 Right Of Way Recommendations

The current Right of Way for the White Knob Quarry Haul Road is as described in the Amendment of Right of Way Grant from the Bureau of Land Management dated July 15, 1988 (see Appendix I). Exhibit C of this document describes the Right of Way in three pieces:

1. From the beginning at Station 0+00 to Station 117+00, a constant Right of Way width of 75 feet. This yields a total area of 20.145 acres.

2. From Station 117+00 to Station 245+00, a variable width Right of Way with an average width of 125 feet. This yields a total area of 36.731 acres.

3. A separate construction/maintenance yard with the dimensions of 660 feet by 660 feet. The area of this yard is 10 acres.

The total Right of Way area is stated as 66.876 acres.

In the past there has been some confusion concerning what areas are included within the Right of Way, particularly in the stretch of roadway that was given a variable width. Because of this, the quarry staff desires that a more formal Right of Way boundary be established. To accomplish this task, we have reviewed the existing topography along with aerial photos to determine the existing disturbed areas that will need to remain in a permanent Right of Way. We also reviewed the recommended improvements in this report, and came up with an overall extent of Right of Way to include both existing and proposed improvements.

Appendix H contains seven exhibits showing this proposed Right of Way delineation at a scale of 1” = 100’. Following is a summary of the areas to compare to the values in the existing Grant:

1. From the beginning at station 0+00 to station 117+00, an area of 38.601 acres. This includes the area being used for construction/maintenance purposes as mentioned in item three above.

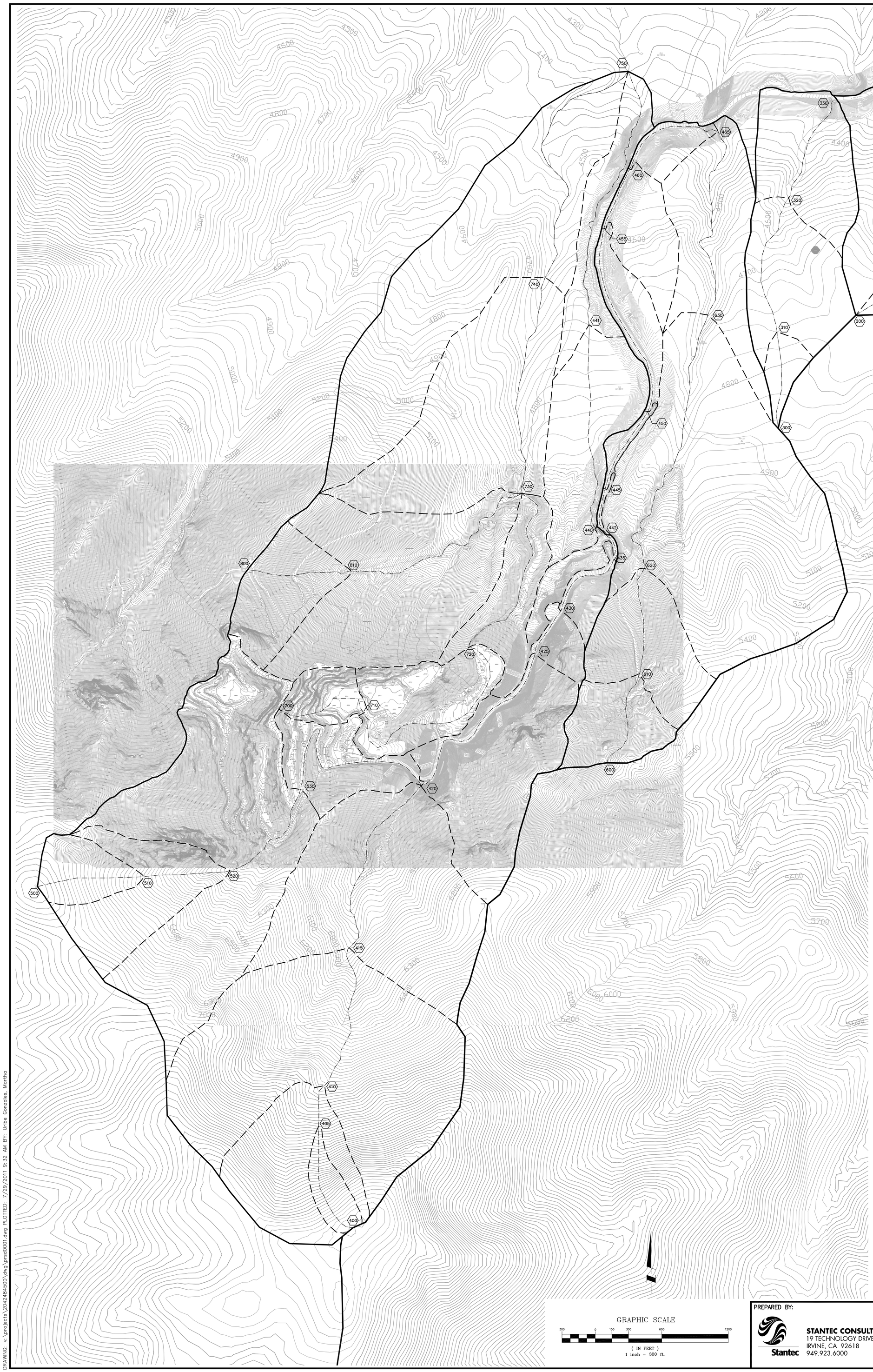
2. From station 117+00 to Station 237+73, an area of 48.684 acres. The ending station reflects the public/private property line where the haul road enters Omya’s patent property.

The total proposed Right of Way is 87.285 acres.

5.0 References

1. County of San Bernardino Hydrology Manual, published August 1986
2. County of San Bernardino Hydrology Manual Addendum for Arid Regions, published April 2010
3. Los Angeles County Department of Public Works Sedimentation Manual, published March 2006
4. Federal Highway Administration Hydraulic Engineering Circular No. 14, Third Edition, published July 2006

Appendix A – Hydrology Map



Node	Elev	Subarea	Total Area	Percent Subarea Soil Type Type B	Type C	Type D	Flow Length	Comments
10	4442							Initial Subarea
20	4220	2.18	2.18	100%			651	
30	4106	12.08	14.26	100%			527	End of Study
100	4654							Initial Subarea
110	4300	6.84	6.84	100%			1000	
120	4110	14.57	21.41	100%			964	End of Study
200	4770							Initial Subarea
210	4640	5.8	5.8	100%			990	
220	4220	11.98	17.78	100%			1468	
230	4128	41.78	59.56	100%			587	End of Study
300	4848							Initial Subarea
310	4760	4.4	4.4	100%			880	
320	4480	23.15	27.55	100%			1304	
330	4286	22.72	50.27	100%			982	End of Study
400	7705							Initial Subarea
405	6940	5.25	5.25			100%	1000	
410	6700	24.82	30.07			100%	435	
415	5900	83.66	113.73			100%	1352	
420	5405	60.17	173.9			100%	1764	Confluence
500	7120							Initial Subarea
510	6600	9.61	9.61			100%	970	
520	6100	21.24	30.85			100%	776	
530	5710	79.05	109.9	15%		85%	1052	
420	5405	15.07	124.97	50%		50%	1954	Confluence
420	5405		298.87					After Confluence
425	5169	37.15	336.02	17%		83%	1734	
430	5109	4.73	340.75	30%		70%	451	
435	5010	4.75	345.5	57%		43%	749	
440	4978	5.31	350.81	100%			241	
441	4700	27.26	378.07	100%			1878	
750	4300	15.77	393.84	100%			2527	Confluence
700	5851							Initial Subarea
710	5495	6.97	6.97	79%		21%	929	
720	5315	20.2	27.17	98%		2%	2034	
730	4829	16.25	43.42	100%			1756	Confluence
800	5664							Initial Subarea
810	5225	10	10		18%	82%	964	
730	4829	60.66	70.66	24%	1%	75%	1949	Confluence
730	4829		114.08					After Confluence
740	4580	55.13	169.21	38%		62%	2018	
750	4300	75.26	244.47	66%		34%	2432	Confluence
750	4300		638.31					After Confluence
442	4978							Initial Subarea
445	4918	0.53	0.53	100%			441	
450	4810	2.01	2.54	100%			804	
455	4562	9.31	11.85	100%			1778	
460	4482	12.86	24.71	100%			584	
465	4319	5.42	30.13	100%			1005	Confluence
600	5633							Initial Subarea
610	5200	10	10			100%	911	
620	4975	24.73	34.73			100%	984	
630	4640	97.45	132.18	46%		54%	2576	
465	4319	29.06	161.24	100%			1875	Confluence
465	4319		191.37				400	After Confluence

LEGEND

- DRAINAGE AREA BOUNDARY
- FLOW PATH
- SUBAREA BOUNDARY
- (123) NODE DESIGNATION

GRAPHIC SCALE

300 0 150 300 600 1200

(IN FEET)
1 inch = 300 ft.

PREPARED BY:

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB QUARRY HAUL ROAD HYDROLOGY MAP

PROJECT NO. 2042484500

DATE: 07-29-2011

SHEET 1 OF 1

DRAWING: v:\projects\2042484500\dwg\prsd0001.dwg PLOTTED: 7/29/2011 9:32 AM BY: Uribe Gonzales, Martha

Appendix B – Hydrology Calculations

Minor Culvert Crossings

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 144
2 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.450 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       20.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   651.000(Ft.)
Top (of initial area) elevation =  4442.000(Ft.)
Bottom (of initial area) elevation =  4220.000(Ft.)
Difference in elevation =   222.000(Ft.)
Slope =    0.34101  s(%)=      34.10
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.690 min.
Rainfall intensity =      1.740(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.691
Subarea runoff =      2.623(CFS)
Total initial stream area =        2.180(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       30.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.240(Ft.), Average velocity =   5.899(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =      8.761(CFS)
  '     '    flow top width =      7.396(Ft.)
  '     '    velocity=    5.899(Ft/s)
  '     '    area =      1.485(Sq.Ft)
  '     '    Froude number =     2.320

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4106.000(Ft.)
Flow length =   527.000(Ft.)
Travel time  =    1.49 min.
Time of concentration =   10.18 min.
Depth of flow =   0.240(Ft.)
Average velocity =   5.899(Ft/s)
Total irregular channel flow =     8.761(CFS)
Irregular channel normal depth above invert elev. =   0.240(Ft.)
Average velocity of channel(s) =   5.899(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.558(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.667
Subarea runoff =     12.192(CFS) for   12.080(Ac.)
Total runoff =     14.814(CFS)
Effective area this stream =       14.26(Ac.)
Total Study Area (Main Stream No. 1) =       14.26(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.321(Ft.), Average velocity =   6.976(Ft/s)
End of computations, Total Study Area =           14.26 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 144
10 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.745 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       20.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   651.000(Ft.)
Top (of initial area) elevation =  4442.000(Ft.)
Bottom (of initial area) elevation =  4220.000(Ft.)
Difference in elevation =   222.000(Ft.)
Slope =    0.34101  s(%)=      34.10
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.690 min.
Rainfall intensity =      2.881(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.774
Subarea runoff =      4.861(CFS)
Total initial stream area =        2.180(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       30.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.344(Ft.), Average velocity =   7.246(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     16.742(CFS)
  '     '    flow top width =      8.438(Ft.)
  '     '    velocity=    7.246(Ft/s)
  '     '    area =      2.310(Sq.Ft)
  '     '    Froude number =     2.441

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4106.000(Ft.)
Flow length =   527.000(Ft.)
Travel time  =    1.21 min.
Time of concentration =    9.90 min.
Depth of flow =   0.344(Ft.)
Average velocity =   7.246(Ft/s)
Total irregular channel flow =    16.742(CFS)
Irregular channel normal depth above invert elev. =   0.344(Ft.)
Average velocity of channel(s) =   7.246(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.629(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.762
Subarea runoff =     23.705(CFS) for   12.080(Ac.)
Total runoff =     28.566(CFS)
Effective area this stream =       14.26(Ac.)
Total Study Area (Main Stream No. 1) =       14.26(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.460(Ft.), Average velocity =   8.519(Ft/s)
End of computations, Total Study Area =           14.26 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 144
25 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    25.0
Computed rainfall intensity:
Storm year =    25.00   1 hour rainfall =     0.944 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       20.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   651.000(Ft.)
Top (of initial area) elevation =  4442.000(Ft.)
Bottom (of initial area) elevation =  4220.000(Ft.)
Difference in elevation =   222.000(Ft.)
Slope =    0.34101  s(%)=      34.10
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.690 min.
Rainfall intensity =      3.650(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.801
Subarea runoff =      6.371(CFS)
Total initial stream area =        2.180(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       30.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.401(Ft.), Average velocity =   7.895(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     22.160(CFS)
  '     '    flow top width =      9.008(Ft.)
  '     '    velocity=    7.895(Ft/s)
  '     '    area =      2.807(Sq.Ft)
  '     '    Froude number =     2.493

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4106.000(Ft.)
Flow length =   527.000(Ft.)
Travel time  =    1.11 min.
Time of concentration =    9.80 min.
Depth of flow =   0.401(Ft.)
Average velocity =   7.895(Ft/s)
Total irregular channel flow =    22.160(CFS)
Irregular channel normal depth above invert elev. =   0.401(Ft.)
Average velocity of channel(s) =   7.895(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      3.355(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.792
Subarea runoff =     31.513(CFS) for   12.080(Ac.)
Total runoff =     37.883(CFS)
Effective area this stream =       14.26(Ac.)
Total Study Area (Main Stream No. 1) =       14.26(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.534(Ft.), Average velocity =   9.254(Ft/s)
End of computations, Total Study Area =           14.26 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/19/11

White Knob Haul Road
Culvert Crossing at Station 144
100 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.280 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 10.000 to Point/Station 20.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.140(In/Hr)
Initial subarea data:
Initial area flow distance = 651.000(Ft.)
Top (of initial area) elevation = 4442.000(Ft.)
Bottom (of initial area) elevation = 4220.000(Ft.)
Difference in elevation = 222.000(Ft.)
Slope = 0.34101 s(%)= 34.10
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.690 min.
Rainfall intensity = 4.950(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.875
Subarea runoff = 9.437(CFS)
Total initial stream area = 2.180(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.140(In/Hr)

++

```
Process from Point/Station       20.000 to Point/Station       30.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.499(Ft.), Average velocity =   8.914(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     33.322(CFS)
  '     '    flow top width =      9.988(Ft.)
  '     '    velocity=    8.914(Ft/s)
  '     '    area =      3.738(Sq.Ft)
  '     '    Froude number =     2.568

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4106.000(Ft.)
Flow length =   527.000(Ft.)
Travel time  =    0.99 min.
Time of concentration =    9.68 min.
Depth of flow =   0.499(Ft.)
Average velocity =   8.914(Ft/s)
Total irregular channel flow =    33.322(CFS)
Irregular channel normal depth above invert elev. =   0.499(Ft.)
Average velocity of channel(s) =   8.914(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      4.591(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.873
Subarea runoff =     47.691(CFS) for   12.080(Ac.)
Total runoff =     57.128(CFS)
Effective area this stream =       14.26(Ac.)
Total Study Area (Main Stream No. 1) =       14.26(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.661(Ft.), Average velocity =  10.408(Ft/s)
End of computations, Total Study Area =           14.26 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/19/11

White Knob Haul Road
Culvert Crossing at Station 150
2 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 2.0
Computed rainfall intensity:
Storm year = 2.00 1 hour rainfall = 0.450 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 100.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****
_____
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.404(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 4654.000(Ft.)
Bottom (of initial area) elevation = 4300.000(Ft.)
Difference in elevation = 354.000(Ft.)
Slope = 0.35400 s(%)= 35.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.241 min.
Rainfall intensity = 1.551(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.666
Subarea runoff = 7.065(CFS)
Total initial stream area = 6.840(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.404(In/Hr)

++
Process from Point/Station 110.000 to Point/Station 120.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.300(Ft.), Average velocity =   6.407(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     12.507(CFS)
  '     '    flow top width =      8.003(Ft.)
  '     '    velocity=    6.407(Ft/s)
  '     '    area =      1.952(Sq.Ft)
  '     '    Froude number =     2.286

Upstream point elevation =  4300.000(Ft.)
Downstream point elevation =  4110.000(Ft.)
Flow length =   964.000(Ft.)
Travel time  =    2.51 min.
Time of concentration =   12.75 min.
Depth of flow =   0.300(Ft.)
Average velocity =   6.407(Ft/s)
Total irregular channel flow =    12.507(CFS)
Irregular channel normal depth above invert elev. =   0.300(Ft.)
Average velocity of channel(s) =   6.407(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.331(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.627
Subarea runoff =     10.801(CFS) for   14.570(Ac.)
Total runoff =     17.866(CFS)
Effective area this stream =       21.41(Ac.)
Total Study Area (Main Stream No. 1) =       21.41(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.366(Ft.), Average velocity =   7.159(Ft/s)
End of computations, Total Study Area =           21.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 150
10 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.745 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      110.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  4654.000(Ft.)
Bottom (of initial area) elevation =  4300.000(Ft.)
Difference in elevation =   354.000(Ft.)
Slope =    0.35400  s(%)=      35.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.241 min.
Rainfall intensity =      2.568(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.759
Subarea runoff =     13.325(CFS)
Total initial stream area =        6.840(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      120.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.435(Ft.), Average velocity =   7.886(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     24.594(CFS)
  '     '    flow top width =      9.348(Ft.)
  '     '    velocity=    7.886(Ft/s)
  '     '    area =      3.119(Sq.Ft)
  '     '    Froude number =     2.406

Upstream point elevation =  4300.000(Ft.)
Downstream point elevation =  4110.000(Ft.)
Flow length =   964.000(Ft.)
Travel time  =    2.04 min.
Time of concentration =   12.28 min.
Depth of flow =   0.435(Ft.)
Average velocity =   7.886(Ft/s)
Total irregular channel flow =    24.594(CFS)
Irregular channel normal depth above invert elev. =   0.435(Ft.)
Average velocity of channel(s) =   7.886(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.262(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.739
Subarea runoff =     22.482(CFS) for   14.570(Ac.)
Total runoff =     35.807(CFS)
Effective area this stream =       21.41(Ac.)
Total Study Area (Main Stream No. 1) =       21.41(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.531(Ft.), Average velocity =   8.808(Ft/s)
End of computations, Total Study Area =           21.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/19/11

White Knob Haul Road
Culvert Crossing at Station 150
25 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 25.0
Computed rainfall intensity:
Storm year = 25.00 1 hour rainfall = 0.944 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 100.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.404(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 4654.000(Ft.)
Bottom (of initial area) elevation = 4300.000(Ft.)
Difference in elevation = 354.000(Ft.)
Slope = 0.35400 s(%)= 35.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.241 min.
Rainfall intensity = 3.254(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.788
Subarea runoff = 17.548(CFS)
Total initial stream area = 6.840(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.404(In/Hr)

++
Process from Point/Station 110.000 to Point/Station 120.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.507(Ft.), Average velocity =   8.586(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     32.795(CFS)
  '     '    flow top width =     10.069(Ft.)
  '     '    velocity=    8.586(Ft/s)
  '     '    area =      3.820(Sq.Ft)
  '     '    Froude number =     2.457

Upstream point elevation =  4300.000(Ft.)
Downstream point elevation =  4110.000(Ft.)
Flow length =   964.000(Ft.)
Travel time  =    1.87 min.
Time of concentration =   12.11 min.
Depth of flow =   0.507(Ft.)
Average velocity =   8.586(Ft/s)
Total irregular channel flow =    32.795(CFS)
Irregular channel normal depth above invert elev. =   0.507(Ft.)
Average velocity of channel(s) =   8.586(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.893(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.774
Subarea runoff =     30.430(CFS) for   14.570(Ac.)
Total runoff =     47.978(CFS)
Effective area this stream =       21.41(Ac.)
Total Study Area (Main Stream No. 1) =       21.41(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.619(Ft.), Average velocity =   9.581(Ft/s)
End of computations, Total Study Area =           21.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/19/11

White Knob Haul Road
Culvert Crossing at Station 150
100 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.280 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 100.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.140(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 4654.000(Ft.)
Bottom (of initial area) elevation = 4300.000(Ft.)
Difference in elevation = 354.000(Ft.)
Slope = 0.35400 s(%)= 35.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.241 min.
Rainfall intensity = 4.412(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.871
Subarea runoff = 26.300(CFS)
Total initial stream area = 6.840(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.140(In/Hr)

++

```
Process from Point/Station      110.000 to Point/Station      120.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.633(Ft.), Average velocity =   9.700(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     50.114(CFS)
  '     '    flow top width =     11.328(Ft.)
  '     '    velocity=    9.700(Ft/s)
  '     '    area =      5.166(Sq.Ft)
  '     '    Froude number =     2.531

Upstream point elevation =  4300.000(Ft.)
Downstream point elevation =  4110.000(Ft.)
Flow length =   964.000(Ft.)
Travel time  =    1.66 min.
Time of concentration =   11.90 min.
Depth of flow =   0.633(Ft.)
Average velocity =   9.700(Ft/s)
Total irregular channel flow =    50.114(CFS)
Irregular channel normal depth above invert elev. =   0.633(Ft.)
Average velocity of channel(s) =   9.700(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.973(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.868
Subarea runoff =     47.553(CFS) for   14.570(Ac.)
Total runoff =     73.853(CFS)
Effective area this stream =       21.41(Ac.)
Total Study Area (Main Stream No. 1) =       21.41(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.771(Ft.), Average velocity =  10.813(Ft/s)
End of computations, Total Study Area =           21.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 154
2 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.450 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      210.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   990.000(Ft.)
Top (of initial area) elevation =  4770.000(Ft.)
Bottom (of initial area) elevation =  4640.000(Ft.)
Difference in elevation =   130.000(Ft.)
Slope =    0.13131  s(%)=      13.13
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.438 min.
Rainfall intensity =      1.354(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.632
Subarea runoff =      4.961(CFS)
Total initial stream area =        5.800(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      220.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.214(Ft.), Average velocity =   6.356(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =      8.260(CFS)
  '     '    flow top width =      7.141(Ft.)
  '     '    velocity=    6.356(Ft/s)
  '     '    area =      1.300(Sq.Ft)
  '     '    Froude number =     2.626

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4220.000(Ft.)
Flow length =  1468.000(Ft.)
Travel time  =    3.85 min.
Time of concentration =   16.29 min.
Depth of flow =   0.214(Ft.)
Average velocity =   6.356(Ft/s)
Total irregular channel flow =     8.260(CFS)
Irregular channel normal depth above invert elev. =   0.214(Ft.)
Average velocity of channel(s) =   6.356(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.121(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.576
Subarea runoff =      6.521(CFS) for   11.980(Ac.)
Total runoff =     11.482(CFS)
Effective area this stream =       17.78(Ac.)
Total Study Area (Main Stream No. 1) =       17.78(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.258(Ft.), Average velocity =   7.078(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.450(Ft.), Average velocity =   7.165(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     23.354(CFS)
  '     '    flow top width =      9.497(Ft.)
  '     '    velocity=    7.165(Ft/s)
  '     '    area =      3.259(Sq.Ft)
  '     '    Froude number =     2.155

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4128.000(Ft.)
Flow length =   587.000(Ft.)
Travel time  =    1.37 min.
Time of concentration =   17.65 min.
Depth of flow =   0.450(Ft.)
Average velocity =   7.165(Ft/s)
Total irregular channel flow =    23.354(CFS)
Irregular channel normal depth above invert elev. =   0.450(Ft.)
Average velocity of channel(s) =   7.165(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.060(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.557
Subarea runoff =     23.688(CFS) for   41.780(Ac.)
Total runoff =     35.170(CFS)
Effective area this stream =       59.56(Ac.)
Total Study Area (Main Stream No. 1) =       59.56(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.559(Ft.), Average velocity =   8.077(Ft/s)
End of computations, Total Study Area =           59.56 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 154
10 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.745 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      210.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   990.000(Ft.)
Top (of initial area) elevation =  4770.000(Ft.)
Bottom (of initial area) elevation =  4640.000(Ft.)
Difference in elevation =   130.000(Ft.)
Slope =    0.13131  s(%)=      13.13
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.438 min.
Rainfall intensity =      2.241(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.738
Subarea runoff =      9.594(CFS)
Total initial stream area =        5.800(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      220.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.321(Ft.), Average velocity =   8.017(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     16.997(CFS)
  '     '    flow top width =      8.210(Ft.)
  '     '    velocity=    8.017(Ft/s)
  '     '    area =      2.120(Sq.Ft)
  '     '    Froude number =     2.780

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4220.000(Ft.)
Flow length =  1468.000(Ft.)
Travel time  =    3.05 min.
Time of concentration =   15.49 min.
Depth of flow =   0.321(Ft.)
Average velocity =   8.017(Ft/s)
Total irregular channel flow =    16.997(CFS)
Irregular channel normal depth above invert elev. =   0.321(Ft.)
Average velocity of channel(s) =   8.017(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.922(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.711
Subarea runoff =     14.710(CFS) for   11.980(Ac.)
Total runoff =     24.304(CFS)
Effective area this stream =       17.78(Ac.)
Total Study Area (Main Stream No. 1) =       17.78(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.391(Ft.), Average velocity =   8.950(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.674(Ft.), Average velocity =   8.954(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     50.499(CFS)
  '     '    flow top width =     11.739(Ft.)
  '     '    velocity=    8.954(Ft/s)
  '     '    area =      5.640(Sq.Ft)
  '     '    Froude number =     2.277

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4128.000(Ft.)
Flow length =   587.000(Ft.)
Travel time  =    1.09 min.
Time of concentration =   16.58 min.
Depth of flow =   0.674(Ft.)
Average velocity =   8.954(Ft/s)
Total irregular channel flow =    50.499(CFS)
Irregular channel normal depth above invert elev. =   0.674(Ft.)
Average velocity of channel(s) =   8.954(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.833(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.702
Subarea runoff =     52.309(CFS) for   41.780(Ac.)
Total runoff =     76.613(CFS)
Effective area this stream =       59.56(Ac.)
Total Study Area (Main Stream No. 1) =       59.56(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.832(Ft.), Average velocity =  10.053(Ft/s)
End of computations, Total Study Area =           59.56 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

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            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 154
25 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    25.0
Computed rainfall intensity:
Storm year =    25.00   1 hour rainfall =     0.944 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      210.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   990.000(Ft.)
Top (of initial area) elevation =  4770.000(Ft.)
Bottom (of initial area) elevation =  4640.000(Ft.)
Difference in elevation =   130.000(Ft.)
Slope =    0.13131  s(%)=      13.13
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.438 min.
Rainfall intensity =      2.840(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.772
Subarea runoff =     12.720(CFS)
Total initial stream area =        5.800(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      220.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.378(Ft.), Average velocity =   8.788(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     22.888(CFS)
  '     '    flow top width =      8.780(Ft.)
  '     '    velocity=    8.788(Ft/s)
  '     '    area =      2.604(Sq.Ft)
  '     '    Froude number =     2.844

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4220.000(Ft.)
Flow length =  1468.000(Ft.)
Travel time  =    2.78 min.
Time of concentration =   15.22 min.
Depth of flow =   0.378(Ft.)
Average velocity =   8.788(Ft/s)
Total irregular channel flow =    22.888(CFS)
Irregular channel normal depth above invert elev. =   0.378(Ft.)
Average velocity of channel(s) =   8.788(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.466(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.753
Subarea runoff =     20.280(CFS) for   11.980(Ac.)
Total runoff =     33.000(CFS)
Effective area this stream =       17.78(Ac.)
Total Study Area (Main Stream No. 1) =       17.78(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.461(Ft.), Average velocity =   9.810(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.789(Ft.), Average velocity =   9.765(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     68.935(CFS)
  '     '    flow top width =     12.891(Ft.)
  '     '    velocity=    9.765(Ft/s)
  '     '    area =      7.059(Sq.Ft)
  '     '    Froude number =     2.326

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4128.000(Ft.)
Flow length =   587.000(Ft.)
Travel time  =    1.00 min.
Time of concentration =   16.22 min.
Depth of flow =   0.789(Ft.)
Average velocity =   9.765(Ft/s)
Total irregular channel flow =    68.935(CFS)
Irregular channel normal depth above invert elev. =   0.789(Ft.)
Average velocity of channel(s) =   9.765(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.358(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.746
Subarea runoff =     71.776(CFS) for   41.780(Ac.)
Total runoff =    104.776(CFS)
Effective area this stream =       59.56(Ac.)
Total Study Area (Main Stream No. 1) =       59.56(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.971(Ft.), Average velocity =  10.947(Ft/s)
End of computations, Total Study Area =           59.56 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/19/11

White Knob Haul Road
Culvert Crossing at Station 154
100 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.280 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 200.000 to Point/Station 210.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.140(In/Hr)
Initial subarea data:
Initial area flow distance = 990.000(Ft.)
Top (of initial area) elevation = 4770.000(Ft.)
Bottom (of initial area) elevation = 4640.000(Ft.)
Difference in elevation = 130.000(Ft.)
Slope = 0.13131 s(%)= 13.13
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.438 min.
Rainfall intensity = 3.851(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.867
Subarea runoff = 19.372(CFS)
Total initial stream area = 5.800(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.140(In/Hr)

++

```
Process from Point/Station      210.000 to Point/Station      220.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.481(Ft.), Average velocity =  10.048(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     35.787(CFS)
  '     '    flow top width =      9.810(Ft.)
  '     '    velocity=   10.048(Ft/s)
  '     '    area =      3.562(Sq.Ft)
  '     '    Froude number =     2.939

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4220.000(Ft.)
Flow length =  1468.000(Ft.)
Travel time  =    2.43 min.
Time of concentration =   14.87 min.
Depth of flow =   0.481(Ft.)
Average velocity =  10.048(Ft/s)
Total irregular channel flow =    35.787(CFS)
Irregular channel normal depth above invert elev. =   0.481(Ft.)
Average velocity of channel(s) =  10.048(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.398(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.863
Subarea runoff =     32.764(CFS) for   11.980(Ac.)
Total runoff =     52.136(CFS)
Effective area this stream =       17.78(Ac.)
Total Study Area (Main Stream No. 1) =       17.78(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.586(Ft.), Average velocity =  11.208(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.994(Ft.), Average velocity =  11.087(Ft/s)
```

```
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    109.820(CFS)
  '     '    flow top width =     14.937(Ft.)
  '     '    velocity=   11.087(Ft/s)
  '     '    area =      9.905(Sq.Ft)
  '     '    Froude number =     2.399

Upstream point elevation =  4220.000(Ft.)
Downstream point elevation =  4128.000(Ft.)
Flow length =   587.000(Ft.)
Travel time  =    0.88 min.
Time of concentration =   15.76 min.
Depth of flow =   0.994(Ft.)
Average velocity =  11.087(Ft/s)
Total irregular channel flow =   109.819(CFS)
Irregular channel normal depth above invert elev. =   0.994(Ft.)
Average velocity of channel(s) =  11.087(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.264(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.861
Subarea runoff =    115.308(CFS) for   41.780(Ac.)
Total runoff =    167.444(CFS)
Effective area this stream =       59.56(Ac.)
Total Study Area (Main Stream No. 1) =       59.56(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   1.217(Ft.), Average velocity =  12.408(Ft/s)
End of computations, Total Study Area =           59.56 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/19/11

White Knob Haul Road
Culvert Crossing at Station 171
2 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 2.0
Computed rainfall intensity:
Storm year = 2.00 1 hour rainfall = 0.450 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 300.000 to Point/Station 310.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.404(In/Hr)
Initial subarea data:
Initial area flow distance = 880.000(Ft.)
Top (of initial area) elevation = 4848.000(Ft.)
Bottom (of initial area) elevation = 4760.000(Ft.)
Difference in elevation = 88.000(Ft.)
Slope = 0.10000 s(%)= 10.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.530 min.
Rainfall intensity = 1.347(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.630
Subarea runoff = 3.736(CFS)
Total initial stream area = 4.400(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.404(In/Hr)

++
Process from Point/Station 310.000 to Point/Station 320.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.273(Ft.), Average velocity =   6.331(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     10.989(CFS)
  '     '    flow top width =      7.727(Ft.)
  '     '    velocity=    6.331(Ft/s)
  '     '    area =      1.736(Sq.Ft)
  '     '    Froude number =     2.354

Upstream point elevation =  4760.000(Ft.)
Downstream point elevation =  4480.000(Ft.)
Flow length =  1304.000(Ft.)
Travel time  =    3.43 min.
Time of concentration =   15.96 min.
Depth of flow =   0.273(Ft.)
Average velocity =   6.331(Ft/s)
Total irregular channel flow =    10.990(CFS)
Irregular channel normal depth above invert elev. =   0.273(Ft.)
Average velocity of channel(s) =   6.331(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.137(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.581
Subarea runoff =     14.450(CFS) for   23.150(Ac.)
Total runoff =     18.186(CFS)
Effective area this stream =       27.55(Ac.)
Total Study Area (Main Stream No. 1) =       27.55(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.361(Ft.), Average velocity =   7.415(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      320.000 to Point/Station      330.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.425(Ft.), Average velocity =   7.794(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     23.591(CFS)
  '     '    flow top width =      9.248(Ft.)
  '     '    velocity=    7.794(Ft/s)
  '     '    area =      3.027(Sq.Ft)
  '     '    Froude number =     2.401

Upstream point elevation =  4480.000(Ft.)
Downstream point elevation =  4286.000(Ft.)
Flow length =   982.000(Ft.)
Travel time  =    2.10 min.
Time of concentration =   18.06 min.
Depth of flow =   0.425(Ft.)
Average velocity =   7.794(Ft/s)
Total irregular channel flow =    23.591(CFS)
Irregular channel normal depth above invert elev. =   0.425(Ft.)
Average velocity of channel(s) =   7.794(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.043(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.552
Subarea runoff =     10.735(CFS) for   22.720(Ac.)
Total runoff =     28.920(CFS)
Effective area this stream =       50.27(Ac.)
Total Study Area (Main Stream No. 1) =       50.27(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.474(Ft.), Average velocity =   8.281(Ft/s)
End of computations, Total Study Area =           50.27 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

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            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 171
10 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.745 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      310.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   880.000(Ft.)
Top (of initial area) elevation =  4848.000(Ft.)
Bottom (of initial area) elevation =  4760.000(Ft.)
Difference in elevation =    88.000(Ft.)
Slope =    0.10000  s(%)=      10.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.530 min.
Rainfall intensity =      2.230(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.737
Subarea runoff =      7.233(CFS)
Total initial stream area =        4.400(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      310.000 to Point/Station      320.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.407(Ft.), Average velocity =   7.935(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     22.722(CFS)
  '     '    flow top width =      9.070(Ft.)
  '     '    velocity=    7.935(Ft/s)
  '     '    area =      2.864(Sq.Ft)
  '     '    Froude number =     2.489

Upstream point elevation =  4760.000(Ft.)
Downstream point elevation =  4480.000(Ft.)
Flow length =  1304.000(Ft.)
Travel time  =    2.74 min.
Time of concentration =   15.27 min.
Depth of flow =   0.407(Ft.)
Average velocity =   7.935(Ft/s)
Total irregular channel flow =    22.722(CFS)
Irregular channel normal depth above invert elev. =   0.407(Ft.)
Average velocity of channel(s) =   7.935(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.942(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.713
Subarea runoff =     30.908(CFS) for   23.150(Ac.)
Total runoff =     38.141(CFS)
Effective area this stream =       27.55(Ac.)
Total Study Area (Main Stream No. 1) =       27.55(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.537(Ft.), Average velocity =   9.248(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      320.000 to Point/Station      330.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.637(Ft.), Average velocity =   9.746(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     50.800(CFS)
  '     '    flow top width =     11.369(Ft.)
  '     '    velocity=    9.746(Ft/s)
  '     '    area =      5.212(Sq.Ft)
  '     '    Froude number =     2.537

Upstream point elevation =  4480.000(Ft.)
Downstream point elevation =  4286.000(Ft.)
Flow length =   982.000(Ft.)
Travel time  =    1.68 min.
Time of concentration =   16.95 min.
Depth of flow =   0.637(Ft.)
Average velocity =   9.746(Ft/s)
Total irregular channel flow =    50.800(CFS)
Irregular channel normal depth above invert elev. =   0.637(Ft.)
Average velocity of channel(s) =   9.746(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.805(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.699
Subarea runoff =     25.266(CFS) for   22.720(Ac.)
Total runoff =     63.406(CFS)
Effective area this stream =       50.27(Ac.)
Total Study Area (Main Stream No. 1) =       50.27(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.713(Ft.), Average velocity =  10.373(Ft/s)
End of computations, Total Study Area =           50.27 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

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            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 171
25 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    25.0
Computed rainfall intensity:
Storm year =    25.00   1 hour rainfall =     0.944 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      310.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Initial subarea data:
Initial area flow distance =   880.000(Ft.)
Top (of initial area) elevation =  4848.000(Ft.)
Bottom (of initial area) elevation =  4760.000(Ft.)
Difference in elevation =    88.000(Ft.)
Slope =    0.10000  s(%)=      10.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.530 min.
Rainfall intensity =      2.826(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.771
Subarea runoff =      9.591(CFS)
Total initial stream area =        4.400(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.404(In/Hr)


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Process from Point/Station      310.000 to Point/Station      320.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.478(Ft.), Average velocity =   8.677(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     30.668(CFS)
  '     '    flow top width =      9.782(Ft.)
  '     '    velocity=    8.677(Ft/s)
  '     '    area =      3.534(Sq.Ft)
  '     '    Froude number =     2.544

Upstream point elevation =  4760.000(Ft.)
Downstream point elevation =  4480.000(Ft.)
Flow length =  1304.000(Ft.)
Travel time  =    2.50 min.
Time of concentration =   15.03 min.
Depth of flow =   0.478(Ft.)
Average velocity =   8.677(Ft/s)
Total irregular channel flow =    30.668(CFS)
Irregular channel normal depth above invert elev. =   0.478(Ft.)
Average velocity of channel(s) =   8.677(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.487(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.754
Subarea runoff =     42.073(CFS) for   23.150(Ac.)
Total runoff =     51.665(CFS)
Effective area this stream =       27.55(Ac.)
Total Study Area (Main Stream No. 1) =       27.55(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.629(Ft.), Average velocity =  10.089(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      320.000 to Point/Station      330.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.746(Ft.), Average velocity =  10.633(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     69.289(CFS)
  '     '    flow top width =     12.463(Ft.)
  '     '    velocity=   10.633(Ft/s)
  '     '    area =      6.517(Sq.Ft)
  '     '    Froude number =     2.591

Upstream point elevation =  4480.000(Ft.)
Downstream point elevation =  4286.000(Ft.)
Flow length =   982.000(Ft.)
Travel time  =    1.54 min.
Time of concentration =   16.57 min.
Depth of flow =   0.746(Ft.)
Average velocity =  10.633(Ft/s)
Total irregular channel flow =    69.289(CFS)
Irregular channel normal depth above invert elev. =   0.746(Ft.)
Average velocity of channel(s) =  10.633(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.323(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.744
Subarea runoff =     35.185(CFS) for   22.720(Ac.)
Total runoff =     86.850(CFS)
Effective area this stream =       50.27(Ac.)
Total Study Area (Main Stream No. 1) =       50.27(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.836(Ft.), Average velocity =  11.317(Ft/s)
End of computations, Total Study Area =           50.27 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/19/11
----------------------------------------------------------------------
White Knob Haul Road
Culvert Crossing at Station 171
100 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.280 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      310.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   880.000(Ft.)
Top (of initial area) elevation =  4848.000(Ft.)
Bottom (of initial area) elevation =  4760.000(Ft.)
Difference in elevation =    88.000(Ft.)
Slope =    0.10000  s(%)=      10.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.530 min.
Rainfall intensity =      3.831(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.867
Subarea runoff =     14.618(CFS)
Total initial stream area =        4.400(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.140(In/Hr)


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```
Process from Point/Station      310.000 to Point/Station      320.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.605(Ft.), Average velocity =   9.882(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     48.035(CFS)
  '     '    flow top width =     11.055(Ft.)
  '     '    velocity=    9.882(Ft/s)
  '     '    area =      4.861(Sq.Ft)
  '     '    Froude number =     2.626

Upstream point elevation =  4760.000(Ft.)
Downstream point elevation =  4480.000(Ft.)
Flow length =  1304.000(Ft.)
Travel time  =    2.20 min.
Time of concentration =   14.73 min.
Depth of flow =   0.605(Ft.)
Average velocity =   9.882(Ft/s)
Total irregular channel flow =    48.035(CFS)
Irregular channel normal depth above invert elev. =   0.605(Ft.)
Average velocity of channel(s) =   9.882(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.421(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.863
Subarea runoff =     66.742(CFS) for   23.150(Ac.)
Total runoff =     81.359(CFS)
Effective area this stream =       27.55(Ac.)
Total Study Area (Main Stream No. 1) =       27.55(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.792(Ft.), Average velocity =  11.456(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      320.000 to Point/Station      330.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.941(Ft.), Average velocity =  12.079(Ft/s)
```

```
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    110.322(CFS)
  '     '    flow top width =     14.410(Ft.)
  '     '    velocity=   12.079(Ft/s)
  '     '    area =      9.133(Sq.Ft)
  '     '    Froude number =     2.674

Upstream point elevation =  4480.000(Ft.)
Downstream point elevation =  4286.000(Ft.)
Flow length =   982.000(Ft.)
Travel time  =    1.35 min.
Time of concentration =   16.08 min.
Depth of flow =   0.941(Ft.)
Average velocity =  12.079(Ft/s)
Total irregular channel flow =   110.322(CFS)
Irregular channel normal depth above invert elev. =   0.941(Ft.)
Average velocity of channel(s) =  12.079(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.217(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.861
Subarea runoff =     57.848(CFS) for   22.720(Ac.)
Total runoff =    139.207(CFS)
Effective area this stream =       50.27(Ac.)
Total Study Area (Main Stream No. 1) =       50.27(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   1.054(Ft.), Average velocity =  12.860(Ft/s)
End of computations, Total Study Area =           50.27 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
```

Quarry Drainage

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            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/21/11
----------------------------------------------------------------------
White Knob Haul Road
Quarry Drainage
2 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.491 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      405.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  7705.000(Ft.)
Bottom (of initial area) elevation =  6940.000(Ft.)
Difference in elevation =   765.000(Ft.)
Slope =    0.76500  s(%)=      76.50
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.805 min.
Rainfall intensity =      1.532(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.723
Subarea runoff =      5.820(CFS)
Total initial stream area =        5.250(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.301(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      405.000 to Point/Station      410.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.283(Ft.), Average velocity =  10.359(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     18.784(CFS)
  '     '    flow top width =      7.827(Ft.)
  '     '    velocity=   10.359(Ft/s)
  '     '    area =      1.813(Sq.Ft)
  '     '    Froude number =     3.793

Upstream point elevation =  6940.000(Ft.)
Downstream point elevation =  6700.000(Ft.)
Flow length =   435.000(Ft.)
Travel time  =    0.70 min.
Time of concentration =   12.51 min.
Depth of flow =   0.283(Ft.)
Average velocity =  10.359(Ft/s)
Total irregular channel flow =    18.784(CFS)
Irregular channel normal depth above invert elev. =   0.283(Ft.)
Average velocity of channel(s) =  10.359(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      1.472(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.716
Subarea runoff =     25.875(CFS) for   24.820(Ac.)
Total runoff =     31.695(CFS)
Effective area this stream =       30.07(Ac.)
Total Study Area (Main Stream No. 1) =       30.07(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.377(Ft.), Average velocity =  12.194(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      410.000 to Point/Station      415.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.567(Ft.), Average velocity =  15.827(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     70.357(CFS)
  '     '    flow top width =     10.673(Ft.)
  '     '    velocity=   15.827(Ft/s)
  '     '    area =      4.445(Sq.Ft)
  '     '    Froude number =     4.322

Upstream point elevation =  6700.000(Ft.)
Downstream point elevation =  5900.000(Ft.)
Flow length =  1352.000(Ft.)
Travel time  =    1.42 min.
Time of concentration =   13.93 min.
Depth of flow =   0.567(Ft.)
Average velocity =  15.827(Ft/s)
Total irregular channel flow =    70.357(CFS)
Irregular channel normal depth above invert elev. =   0.567(Ft.)
Average velocity of channel(s) =  15.827(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      1.365(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.702
Subarea runoff =     77.229(CFS) for   83.660(Ac.)
Total runoff =    108.924(CFS)
Effective area this stream =      113.73(Ac.)
Total Study Area (Main Stream No. 1) =      113.73(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.711(Ft.), Average velocity =  17.915(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      415.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.929(Ft.), Average velocity =  14.291(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
```

```
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    127.963(CFS)
  '     '    flow top width =     14.286(Ft.)
  '     '    velocity=   14.291(Ft/s)
  '     '    area =      8.954(Sq.Ft)
  '     '    Froude number =     3.181

Upstream point elevation =  5900.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    2.06 min.
Time of concentration =   15.99 min.
Depth of flow =   0.929(Ft.)
Average velocity =  14.291(Ft/s)
Total irregular channel flow =   127.963(CFS)
Irregular channel normal depth above invert elev. =   0.929(Ft.)
Average velocity of channel(s) =  14.291(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      1.239(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.682
Subarea runoff =     37.992(CFS) for   60.170(Ac.)
Total runoff =    146.915(CFS)
Effective area this stream =      173.90(Ac.)
Total Study Area (Main Stream No. 1) =      173.90(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.994(Ft.), Average velocity =  14.834(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      415.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    173.900(Ac.)
Runoff from this stream =    146.915(CFS)
Time of concentration =   15.99 min.
Rainfall intensity =     1.239(In/Hr)
Area averaged loss rate (Fm) =    0.3006(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      500.000 to Point/Station      510.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Initial subarea data:
Initial area flow distance =   970.000(Ft.)
Top (of initial area) elevation =  7120.000(Ft.)
Bottom (of initial area) elevation =  6600.000(Ft.)
Difference in elevation =   520.000(Ft.)
Slope =    0.53608  s(%)=      53.61
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.522 min.
Rainfall intensity =      1.470(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.716
Subarea runoff =     10.117(CFS)
Total initial stream area =        9.610(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.301(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      510.000 to Point/Station      520.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.281(Ft.), Average velocity =  11.162(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     20.113(CFS)
  '     '    flow top width =      7.813(Ft.)
  '     '    velocity=   11.162(Ft/s)
  '     '    area =      1.802(Sq.Ft)
  '     '    Froude number =     4.096

Upstream point elevation =  6600.000(Ft.)
Downstream point elevation =  6100.000(Ft.)
Flow length =   776.000(Ft.)
Travel time  =    1.16 min.
Time of concentration =   13.68 min.
Depth of flow =   0.281(Ft.)
Average velocity =  11.162(Ft/s)
Total irregular channel flow =    20.113(CFS)
Irregular channel normal depth above invert elev. =   0.281(Ft.)
Average velocity of channel(s) =  11.162(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      1.382(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.704
Subarea runoff =     19.909(CFS) for   21.240(Ac.)
Total runoff =     30.026(CFS)
Effective area this stream =       30.85(Ac.)
Total Study Area (Main Stream No. 1) =      204.75(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.351(Ft.), Average velocity =  12.656(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      520.000 to Point/Station      530.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.611(Ft.), Average velocity =  13.048(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     64.195(CFS)
  '     '    flow top width =     11.108(Ft.)
  '     '    velocity=   13.048(Ft/s)
  '     '    area =      4.920(Sq.Ft)
  '     '    Froude number =     3.455

Upstream point elevation =  6100.000(Ft.)
Downstream point elevation =  5710.000(Ft.)
Flow length =  1052.000(Ft.)
Travel time  =    1.34 min.
Time of concentration =   15.02 min.
Depth of flow =   0.611(Ft.)
Average velocity =  13.048(Ft/s)
Total irregular channel flow =    64.195(CFS)
Irregular channel normal depth above invert elev. =   0.611(Ft.)
Average velocity of channel(s) =  13.048(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      1.294(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.691
```

```
Subarea runoff =     68.262(CFS) for   79.050(Ac.)
Total runoff =     98.288(CFS)
Effective area this stream =      109.90(Ac.)
Total Study Area (Main Stream No. 1) =      283.80(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.760(Ft.), Average velocity =  14.707(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.393(Ft.), Average velocity =   8.121(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     98.314(CFS)
  '     '    flow top width =     31.573(Ft.)
  '     '    velocity=    8.121(Ft/s)
  '     '    area =     12.106(Sq.Ft)
  '     '    Froude number =     2.311

Upstream point elevation =  5710.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    3.62 min.
Time of concentration =   18.64 min.
Depth of flow =   0.393(Ft.)
Average velocity =   8.121(Ft/s)
Total irregular channel flow =    98.314(CFS)
Irregular channel normal depth above invert elev. =   0.393(Ft.)
Average velocity of channel(s) =   8.121(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.500
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 83.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.309(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =     91.229(CFS)
therefore the upstream flow rate of Q =     98.288(CFS) is being used
Rainfall intensity =      1.113(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.656
Subarea runoff =      0.000(CFS) for   15.070(Ac.)
Total runoff =     98.288(CFS)
Effective area this stream =      124.97(Ac.)
```

```
Total Study Area (Main Stream No. 1) =      298.87(Ac.)
Area averaged Fm value =    0.302(In/Hr)
Depth of flow =   0.393(Ft.), Average velocity =   8.120(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    124.970(Ac.)
Runoff from this stream =     98.288(CFS)
Time of concentration =   18.64 min.
Rainfall intensity =     1.113(In/Hr)
Area averaged loss rate (Fm) =    0.3016(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    146.92   173.900     15.99    0.301      1.239
2     98.29   124.970     18.64    0.302      1.113
Qmax(1) =
         1.000 *    1.000 *   146.915) +
         1.156 *    0.857 *    98.288) + =     244.334
Qmax(2) =
         0.865 *    1.000 *   146.915) +
         1.000 *    1.000 *    98.288) + =     225.402

Total of 2 streams to confluence:
Flow rates before confluence point:
     146.915      98.288
Maximum flow rates at confluence using above data:
      244.334      225.402
Area of streams before confluence:
      173.900      124.970
Effective area values after confluence:
      281.051      298.870
Results of confluence:
Total flow rate =    244.334(CFS)
Time of concentration =    15.986 min.
Effective stream area after confluence =    281.051(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.301(In/Hr)
Study area total (this main stream) =     298.87(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      420.000 to Point/Station      425.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.727(Ft.), Average velocity =  10.681(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    244.366(CFS)
  '     '    flow top width =     32.909(Ft.)
  '     '    velocity=   10.681(Ft/s)
  '     '    area =     22.878(Sq.Ft)
  '     '    Froude number =     2.258

Upstream point elevation =  5405.000(Ft.)
Downstream point elevation =  5169.000(Ft.)
Flow length =  1734.000(Ft.)
Travel time  =    2.71 min.
Time of concentration =   18.69 min.
Depth of flow =   0.727(Ft.)
Average velocity =  10.681(Ft/s)
Total irregular channel flow =   244.365(CFS)
Irregular channel normal depth above invert elev. =   0.727(Ft.)
Average velocity of channel(s) =  10.681(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.170
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.830
SCS curve number for soil(AMC 2)  = 87.13
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.245(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    233.782(CFS)
therefore the upstream flow rate of Q =    244.334(CFS) is being used
Rainfall intensity =      1.111(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.661
Subarea runoff =      0.000(CFS) for   37.150(Ac.)
Total runoff =    244.334(CFS)
Effective area this stream =      318.20(Ac.)
Total Study Area (Main Stream No. 1) =      336.02(Ac.)
Area averaged Fm value =    0.294(In/Hr)
Depth of flow =   0.727(Ft.), Average velocity =  10.681(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      425.000 to Point/Station      430.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.732(Ft.), Average velocity =  10.606(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
```

```
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    244.362(CFS)
  '     '    flow top width =     32.929(Ft.)
  '     '    velocity=   10.606(Ft/s)
  '     '    area =     23.041(Sq.Ft)
  '     '    Froude number =     2.234

Upstream point elevation =  5169.000(Ft.)
Downstream point elevation =  5109.000(Ft.)
Flow length =   451.000(Ft.)
Travel time  =    0.71 min.
Time of concentration =   19.40 min.
Depth of flow =   0.732(Ft.)
Average velocity =  10.606(Ft/s)
Total irregular channel flow =   244.362(CFS)
Irregular channel normal depth above invert elev. =   0.732(Ft.)
Average velocity of channel(s) =  10.606(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.300
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.700
SCS curve number for soil(AMC 2)  = 85.70
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.270(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    229.058(CFS)
therefore the upstream flow rate of Q =    244.334(CFS) is being used
Rainfall intensity =      1.082(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.655
Subarea runoff =      0.000(CFS) for    4.730(Ac.)
Total runoff =    244.334(CFS)
Effective area this stream =      322.93(Ac.)
Total Study Area (Main Stream No. 1) =      340.75(Ac.)
Area averaged Fm value =    0.294(In/Hr)
Depth of flow =   0.732(Ft.), Average velocity =  10.605(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      430.000 to Point/Station      435.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.734(Ft.), Average velocity =  10.584(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
```

```
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    244.362(CFS)
  '     '    flow top width =     32.935(Ft.)
  '     '    velocity=   10.584(Ft/s)
  '     '    area =     23.088(Sq.Ft)
  '     '    Froude number =     2.228

Upstream point elevation =  5109.000(Ft.)
Downstream point elevation =  5010.000(Ft.)
Flow length =   749.000(Ft.)
Travel time  =    1.18 min.
Time of concentration =   20.58 min.
Depth of flow =   0.734(Ft.)
Average velocity =  10.584(Ft/s)
Total irregular channel flow =   244.362(CFS)
Irregular channel normal depth above invert elev. =   0.734(Ft.)
Average velocity of channel(s) =  10.584(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.323(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    219.388(CFS)
therefore the upstream flow rate of Q =    244.334(CFS) is being used
Rainfall intensity =      1.038(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.645
Subarea runoff =      0.000(CFS) for    4.750(Ac.)
Total runoff =    244.334(CFS)
Effective area this stream =      327.68(Ac.)
Total Study Area (Main Stream No. 1) =      345.50(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   0.734(Ft.), Average velocity =  10.584(Ft/s)


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Process from Point/Station      435.000 to Point/Station      440.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.733(Ft.), Average velocity =  10.599(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    244.365(CFS)
```

```
  '     '    flow top width =     32.931(Ft.)
  '     '    velocity=   10.599(Ft/s)
  '     '    area =     23.055(Sq.Ft)
  '     '    Froude number =     2.232

Upstream point elevation =  5010.000(Ft.)
Downstream point elevation =  4978.000(Ft.)
Flow length =   241.000(Ft.)
Travel time  =    0.38 min.
Time of concentration =   20.96 min.
Depth of flow =   0.733(Ft.)
Average velocity =  10.599(Ft/s)
Total irregular channel flow =   244.364(CFS)
Irregular channel normal depth above invert elev. =   0.733(Ft.)
Average velocity of channel(s) =  10.599(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.323(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    218.858(CFS)
therefore the upstream flow rate of Q =    244.334(CFS) is being used
Rainfall intensity =      1.025(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.641
Subarea runoff =      0.000(CFS) for    5.310(Ac.)
Total runoff =    244.334(CFS)
Effective area this stream =      332.99(Ac.)
Total Study Area (Main Stream No. 1) =      350.81(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   0.733(Ft.), Average velocity =  10.599(Ft/s)


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Process from Point/Station      440.000 to Point/Station      441.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.473(Ft.), Average velocity =  13.419(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    244.373(CFS)
  '     '    flow top width =     19.729(Ft.)
  '     '    velocity=   13.419(Ft/s)
  '     '    area =     18.211(Sq.Ft)
```

```
  '     '    Froude number =     2.461

Upstream point elevation =  4978.000(Ft.)
Downstream point elevation =  4700.000(Ft.)
Flow length =  1878.000(Ft.)
Travel time  =    2.33 min.
Time of concentration =   23.29 min.
Depth of flow =   1.473(Ft.)
Average velocity =  13.419(Ft/s)
Total irregular channel flow =   244.373(CFS)
Irregular channel normal depth above invert elev. =   1.473(Ft.)
Average velocity of channel(s) =  13.419(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    210.442(CFS)
therefore the upstream flow rate of Q =    244.334(CFS) is being used
Rainfall intensity =      0.952(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.613
Subarea runoff =      0.000(CFS) for   27.260(Ac.)
Total runoff =    244.334(CFS)
Effective area this stream =      360.25(Ac.)
Total Study Area (Main Stream No. 1) =      378.07(Ac.)
Area averaged Fm value =    0.303(In/Hr)
Depth of flow =   1.473(Ft.), Average velocity =  13.418(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      441.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.450(Ft.), Average velocity =  13.755(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    244.375(CFS)
  '     '    flow top width =     19.502(Ft.)
  '     '    velocity=   13.755(Ft/s)
  '     '    area =     17.766(Sq.Ft)
  '     '    Froude number =     2.540

Upstream point elevation =  4700.000(Ft.)
```

```
Downstream point elevation =  4300.000(Ft.)
Flow length =  2527.000(Ft.)
Travel time  =    3.06 min.
Time of concentration =   26.35 min.
Depth of flow =   1.450(Ft.)
Average velocity =  13.755(Ft/s)
Total irregular channel flow =   244.375(CFS)
Irregular channel normal depth above invert elev. =   1.450(Ft.)
Average velocity of channel(s) =  13.755(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    191.540(CFS)
therefore the upstream flow rate of Q =    244.334(CFS) is being used
Rainfall intensity =      0.873(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.583
Subarea runoff =      0.000(CFS) for   15.770(Ac.)
Total runoff =    244.334(CFS)
Effective area this stream =      376.02(Ac.)
Total Study Area (Main Stream No. 1) =      393.84(Ac.)
Area averaged Fm value =    0.307(In/Hr)
Depth of flow =   1.450(Ft.), Average velocity =  13.755(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      441.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =    376.021(Ac.)
Runoff from this stream =    244.334(CFS)
Time of concentration =   26.35 min.
Rainfall intensity =     0.873(In/Hr)
Area averaged loss rate (Fm) =    0.3074(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      700.000 to Point/Station      710.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.790
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.210
SCS curve number for soil(AMC 2)  = 80.31
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.365(In/Hr)
```

```
Initial subarea data:
Initial area flow distance =   929.000(Ft.)
Top (of initial area) elevation =  5851.000(Ft.)
Bottom (of initial area) elevation =  5495.000(Ft.)
Difference in elevation =   356.000(Ft.)
Slope =    0.38321  s(%)=      38.32
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.788 min.
Rainfall intensity =      1.747(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.712
Subarea runoff =      8.673(CFS)
Total initial stream area =        6.970(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.365(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      710.000 to Point/Station      720.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.405(Ft.), Average velocity =   5.079(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     14.449(CFS)
  '     '    flow top width =      9.049(Ft.)
  '     '    velocity=    5.079(Ft/s)
  '     '    area =      2.845(Sq.Ft)
  '     '    Froude number =     1.597

Upstream point elevation =  5495.000(Ft.)
Downstream point elevation =  5315.000(Ft.)
Flow length =  2034.000(Ft.)
Travel time  =    6.67 min.
Time of concentration =   16.46 min.
Depth of flow =   0.405(Ft.)
Average velocity =   5.079(Ft/s)
Total irregular channel flow =    14.449(CFS)
Irregular channel normal depth above invert elev. =   0.405(Ft.)
Average velocity of channel(s) =   5.079(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.980
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.020
SCS curve number for soil(AMC 2)  = 78.22
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.400(In/Hr)
Rainfall intensity =      1.214(In/Hr) for a     2.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.610
Subarea runoff =     11.460(CFS) for   20.200(Ac.)
Total runoff =     20.133(CFS)
Effective area this stream =       27.17(Ac.)
Total Study Area (Main Stream No. 2) =      421.01(Ac.)
Area averaged Fm value =    0.391(In/Hr)
Depth of flow =   0.484(Ft.), Average velocity =   5.607(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      720.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.384(Ft.), Average velocity =   8.723(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     23.200(CFS)
  '     '    flow top width =      8.843(Ft.)
  '     '    velocity=    8.723(Ft/s)
  '     '    area =      2.659(Sq.Ft)
  '     '    Froude number =     2.803

Upstream point elevation =  5315.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1756.000(Ft.)
Travel time  =    3.35 min.
Time of concentration =   19.82 min.
Depth of flow =   0.384(Ft.)
Average velocity =   8.723(Ft/s)
Total irregular channel flow =    23.200(CFS)
Irregular channel normal depth above invert elev. =   0.384(Ft.)
Average velocity of channel(s) =   8.723(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.066(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.566
Subarea runoff =      6.078(CFS) for   16.250(Ac.)
Total runoff =     26.210(CFS)
Effective area this stream =       43.42(Ac.)
Total Study Area (Main Stream No. 2) =      437.26(Ac.)
```

```
Area averaged Fm value =    0.396(In/Hr)
Depth of flow =   0.411(Ft.), Average velocity =   9.052(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      720.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =     43.420(Ac.)
Runoff from this stream =     26.210(CFS)
Time of concentration =   19.82 min.
Rainfall intensity =     1.066(In/Hr)
Area averaged loss rate (Fm) =    0.3955(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      800.000 to Point/Station      810.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.180
Decimal fraction soil group D = 0.820
SCS curve number for soil(AMC 2)  = 88.46
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.221(In/Hr)
Initial subarea data:
Initial area flow distance =   964.000(Ft.)
Top (of initial area) elevation =  5664.000(Ft.)
Bottom (of initial area) elevation =  5225.000(Ft.)
Difference in elevation =   439.000(Ft.)
Slope =    0.45539  s(%)=      45.54
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.596 min.
Rainfall intensity =      1.771(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.788
Subarea runoff =     13.957(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.221(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      810.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.590(Ft.), Average velocity =   9.476(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
```

```
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     44.427(CFS)
  '     '    flow top width =     10.898(Ft.)
  '     '    velocity=    9.476(Ft/s)
  '     '    area =      4.689(Sq.Ft)
  '     '    Froude number =     2.546

Upstream point elevation =  5225.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1949.000(Ft.)
Travel time  =    3.43 min.
Time of concentration =   13.02 min.
Depth of flow =   0.590(Ft.)
Average velocity =   9.476(Ft/s)
Total irregular channel flow =    44.427(CFS)
Irregular channel normal depth above invert elev. =   0.590(Ft.)
Average velocity of channel(s) =   9.476(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.240
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 86.33
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.259(In/Hr)
Rainfall intensity =      1.430(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.740
Subarea runoff =     60.871(CFS) for   60.660(Ac.)
Total runoff =     74.828(CFS)
Effective area this stream =       70.66(Ac.)
Total Study Area (Main Stream No. 2) =      507.92(Ac.)
Area averaged Fm value =    0.254(In/Hr)
Depth of flow =   0.770(Ft.), Average velocity =  10.973(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      810.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =     70.660(Ac.)
Runoff from this stream =     74.828(CFS)
Time of concentration =   13.02 min.
Rainfall intensity =     1.430(In/Hr)
Area averaged loss rate (Fm) =    0.2537(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1     26.21    43.420     19.82    0.396      1.066
2     74.83    70.660     13.02    0.254      1.430
```

```
Qmax(1) =
         1.000 *    1.000 *    26.210) +
         0.691 *    1.000 *    74.828) + =      77.882
Qmax(2) =
         1.543 *    0.657 *    26.210) +
         1.000 *    1.000 *    74.828) + =     101.407

Total of 2 streams to confluence:
Flow rates before confluence point:
      26.210      74.828
Maximum flow rates at confluence using above data:
       77.882      101.407
Area of streams before confluence:
       43.420       70.660
Effective area values after confluence:
      114.080       99.198
Results of confluence:
Total flow rate =    101.407(CFS)
Time of concentration =    13.025 min.
Effective stream area after confluence =     99.198(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.308(In/Hr)
Study area total (this main stream) =     114.08(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      730.000 to Point/Station      740.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.076(Ft.), Average velocity =  10.280(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =    114.807(CFS)
  '     '    flow top width =     15.759(Ft.)
  '     '    velocity=   10.280(Ft/s)
  '     '    area =     11.168(Sq.Ft)
  '     '    Froude number =     2.152

Upstream point elevation =  4829.000(Ft.)
Downstream point elevation =  4580.000(Ft.)
Flow length =  2018.000(Ft.)
Travel time  =    3.27 min.
Time of concentration =   16.30 min.
Depth of flow =   1.076(Ft.)
Average velocity =  10.280(Ft/s)
Total irregular channel flow =   114.807(CFS)
Irregular channel normal depth above invert elev. =   1.076(Ft.)
Average velocity of channel(s) =  10.280(Ft/s)
```

```
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.380
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.610
SCS curve number for soil(AMC 2)  = 84.79
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.287(In/Hr)
Rainfall intensity =      1.223(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.679
Subarea runoff =     26.729(CFS) for   55.130(Ac.)
Total runoff =    128.136(CFS)
Effective area this stream =      154.33(Ac.)
Total Study Area (Main Stream No. 2) =      563.05(Ac.)
Area averaged Fm value =    0.300(In/Hr)
Depth of flow =   1.134(Ft.), Average velocity =  10.586(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      740.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.206(Ft.), Average velocity =  10.579(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =    140.701(CFS)
  '     '    flow top width =     17.058(Ft.)
  '     '    velocity=   10.579(Ft/s)
  '     '    area =     13.300(Sq.Ft)
  '     '    Froude number =     2.111

Upstream point elevation =  4580.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2432.000(Ft.)
Travel time  =    3.83 min.
Time of concentration =   20.13 min.
Depth of flow =   1.206(Ft.)
Average velocity =  10.579(Ft/s)
Total irregular channel flow =   140.701(CFS)
Irregular channel normal depth above invert elev. =   1.206(Ft.)
Average velocity of channel(s) =  10.579(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.660
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.330
```

```
SCS curve number for soil(AMC 2)  = 81.71
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.340(In/Hr)
Rainfall intensity =      1.055(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.633
Subarea runoff =     25.042(CFS) for   75.260(Ac.)
Total runoff =    153.177(CFS)
Effective area this stream =      229.59(Ac.)
Total Study Area (Main Stream No. 2) =      638.31(Ac.)
Area averaged Fm value =    0.313(In/Hr)
Depth of flow =   1.255(Ft.), Average velocity =  10.820(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      740.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =    229.588(Ac.)
Runoff from this stream =    153.177(CFS)
Time of concentration =   20.13 min.
Rainfall intensity =     1.055(In/Hr)
Area averaged loss rate (Fm) =    0.3134(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    244.33   376.021     26.35    0.307      0.873
2    153.18   229.588     20.13    0.313      1.055
Qmax(1) =
         1.000 *    1.000 *   244.334) +
         0.755 *    1.000 *   153.177) + =     360.043
Qmax(2) =
         1.320 *    0.764 *   244.334) +
         1.000 *    1.000 *   153.177) + =     399.576

Total of 2 main streams to confluence:
Flow rates before confluence point:
     245.334     154.177
Maximum flow rates at confluence using above data:
      360.043      399.576
Area of streams before confluence:
      376.021      229.588
Effective area values after confluence:
      605.609      516.779


Results of confluence:
Total flow rate =    399.576(CFS)
Time of concentration =    20.128 min.
Effective stream area after confluence  =    516.779(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.310(In/Hr)
```

Study area total = 605.61(Ac.)
End of computations, Total Study Area = 638.31 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 83.5

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/21/11

White Knob Haul Road
Quarry Drainage
10 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.811 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 400.000 to Point/Station 405.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2) = 84.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.301(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 7705.000(Ft.)
Bottom (of initial area) elevation = 6940.000(Ft.)
Difference in elevation = 765.000(Ft.)
Slope = 0.76500 s(%)= 76.50
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.805 min.
Rainfall intensity = 2.531(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.793
Subarea runoff = 10.538(CFS)
Total initial stream area = 5.250(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.301(In/Hr)

++
Process from Point/Station 405.000 to Point/Station 410.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.394(Ft.), Average velocity =  12.496(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     34.355(CFS)
  '     '    flow top width =      8.943(Ft.)
  '     '    velocity=   12.496(Ft/s)
  '     '    area =      2.749(Sq.Ft)
  '     '    Froude number =     3.972

Upstream point elevation =  6940.000(Ft.)
Downstream point elevation =  6700.000(Ft.)
Flow length =   435.000(Ft.)
Travel time  =    0.58 min.
Time of concentration =   12.39 min.
Depth of flow =   0.394(Ft.)
Average velocity =  12.496(Ft/s)
Total irregular channel flow =    34.354(CFS)
Irregular channel normal depth above invert elev. =   0.394(Ft.)
Average velocity of channel(s) =  12.496(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.447(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.789
Subarea runoff =     47.559(CFS) for   24.820(Ac.)
Total runoff =     58.097(CFS)
Effective area this stream =       30.07(Ac.)
Total Study Area (Main Stream No. 1) =       30.07(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.523(Ft.), Average velocity =  14.606(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      410.000 to Point/Station      415.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.781(Ft.), Average velocity =  18.863(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    131.131(CFS)
  '     '    flow top width =     12.808(Ft.)
  '     '    velocity=   18.863(Ft/s)
  '     '    area =      6.952(Sq.Ft)
  '     '    Froude number =     4.512

Upstream point elevation =  6700.000(Ft.)
Downstream point elevation =  5900.000(Ft.)
Flow length =  1352.000(Ft.)
Travel time  =    1.19 min.
Time of concentration =   13.58 min.
Depth of flow =   0.781(Ft.)
Average velocity =  18.863(Ft/s)
Total irregular channel flow =   131.131(CFS)
Irregular channel normal depth above invert elev. =   0.781(Ft.)
Average velocity of channel(s) =  18.863(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.295(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.782
Subarea runoff =    146.000(CFS) for   83.660(Ac.)
Total runoff =    204.097(CFS)
Effective area this stream =      113.73(Ac.)
Total Study Area (Main Stream No. 1) =      113.73(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.972(Ft.), Average velocity =  21.286(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      415.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.267(Ft.), Average velocity =  16.975(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
```

```
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    243.647(CFS)
  '     '    flow top width =     17.665(Ft.)
  '     '    velocity=   16.975(Ft/s)
  '     '    area =     14.353(Sq.Ft)
  '     '    Froude number =     3.319

Upstream point elevation =  5900.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    1.73 min.
Time of concentration =   15.31 min.
Depth of flow =   1.267(Ft.)
Average velocity =  16.975(Ft/s)
Total irregular channel flow =   243.648(CFS)
Irregular channel normal depth above invert elev. =   1.267(Ft.)
Average velocity of channel(s) =  16.975(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.110(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.772
Subarea runoff =     79.038(CFS) for   60.170(Ac.)
Total runoff =    283.135(CFS)
Effective area this stream =      173.90(Ac.)
Total Study Area (Main Stream No. 1) =      173.90(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   1.359(Ft.), Average velocity =  17.659(Ft/s)


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Process from Point/Station      415.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    173.900(Ac.)
Runoff from this stream =    283.135(CFS)
Time of concentration =   15.31 min.
Rainfall intensity =     2.110(In/Hr)
Area averaged loss rate (Fm) =    0.3006(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      500.000 to Point/Station      510.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Initial subarea data:
Initial area flow distance =   970.000(Ft.)
Top (of initial area) elevation =  7120.000(Ft.)
Bottom (of initial area) elevation =  6600.000(Ft.)
Difference in elevation =   520.000(Ft.)
Slope =    0.53608  s(%)=      53.61
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.522 min.
Rainfall intensity =      2.429(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.789
Subarea runoff =     18.405(CFS)
Total initial stream area =        9.610(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.301(In/Hr)


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Process from Point/Station      510.000 to Point/Station      520.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.394(Ft.), Average velocity =  13.499(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     37.078(CFS)
  '     '    flow top width =      8.941(Ft.)
  '     '    velocity=   13.499(Ft/s)
  '     '    area =      2.747(Sq.Ft)
  '     '    Froude number =     4.292

Upstream point elevation =  6600.000(Ft.)
Downstream point elevation =  6100.000(Ft.)
Flow length =   776.000(Ft.)
Travel time  =    0.96 min.
Time of concentration =   13.48 min.
Depth of flow =   0.394(Ft.)
Average velocity =  13.499(Ft/s)
Total irregular channel flow =    37.078(CFS)
Irregular channel normal depth above invert elev. =   0.394(Ft.)
Average velocity of channel(s) =  13.499(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.306(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.783
Subarea runoff =     37.288(CFS) for   21.240(Ac.)
Total runoff =     55.693(CFS)
Effective area this stream =       30.85(Ac.)
Total Study Area (Main Stream No. 1) =      204.75(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.490(Ft.), Average velocity =  15.241(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      520.000 to Point/Station      530.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.843(Ft.), Average velocity =  15.569(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    120.844(CFS)
  '     '    flow top width =     13.425(Ft.)
  '     '    velocity=   15.569(Ft/s)
  '     '    area =      7.762(Sq.Ft)
  '     '    Froude number =     3.608

Upstream point elevation =  6100.000(Ft.)
Downstream point elevation =  5710.000(Ft.)
Flow length =  1052.000(Ft.)
Travel time  =    1.13 min.
Time of concentration =   14.61 min.
Depth of flow =   0.843(Ft.)
Average velocity =  15.569(Ft/s)
Total irregular channel flow =   120.844(CFS)
Irregular channel normal depth above invert elev. =   0.843(Ft.)
Average velocity of channel(s) =  15.569(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.180(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.776
```

```
Subarea runoff =    130.248(CFS) for   79.050(Ac.)
Total runoff =    185.941(CFS)
Effective area this stream =      109.90(Ac.)
Total Study Area (Main Stream No. 1) =      283.80(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   1.041(Ft.), Average velocity =  17.498(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.576(Ft.), Average velocity =  10.374(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    185.991(CFS)
  '     '    flow top width =     32.302(Ft.)
  '     '    velocity=   10.374(Ft/s)
  '     '    area =     17.928(Sq.Ft)
  '     '    Froude number =     2.454

Upstream point elevation =  5710.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    2.83 min.
Time of concentration =   17.44 min.
Depth of flow =   0.576(Ft.)
Average velocity =  10.374(Ft/s)
Total irregular channel flow =   185.991(CFS)
Irregular channel normal depth above invert elev. =   0.576(Ft.)
Average velocity of channel(s) =  10.374(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.500
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 83.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.309(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    182.691(CFS)
therefore the upstream flow rate of Q =    185.941(CFS) is being used
Rainfall intensity =      1.926(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.759
Subarea runoff =      0.000(CFS) for   15.070(Ac.)
Total runoff =    185.941(CFS)
Effective area this stream =      124.97(Ac.)
```

```
Total Study Area (Main Stream No. 1) =      298.87(Ac.)
Area averaged Fm value =    0.302(In/Hr)
Depth of flow =   0.575(Ft.), Average velocity =  10.373(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    124.970(Ac.)
Runoff from this stream =    185.941(CFS)
Time of concentration =   17.44 min.
Rainfall intensity =     1.926(In/Hr)
Area averaged loss rate (Fm) =    0.3016(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    283.13   173.900     15.31    0.301      2.110
2    185.94   124.970     17.44    0.302      1.926
Qmax(1) =
         1.000 *    1.000 *   283.135) +
         1.113 *    0.878 *   185.941) + =     464.848
Qmax(2) =
         0.898 *    1.000 *   283.135) +
         1.000 *    1.000 *   185.941) + =     440.327

Total of 2 streams to confluence:
Flow rates before confluence point:
     283.135     185.941
Maximum flow rates at confluence using above data:
      464.848      440.327
Area of streams before confluence:
      173.900      124.970
Effective area values after confluence:
      283.621      298.870
Results of confluence:
Total flow rate =    464.848(CFS)
Time of concentration =    15.312 min.
Effective stream area after confluence =    283.621(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.301(In/Hr)
Study area total (this main stream) =     298.87(Ac.)


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Process from Point/Station      420.000 to Point/Station      425.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.070(Ft.), Average velocity =  13.604(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    467.990(CFS)
  '     '    flow top width =     34.281(Ft.)
  '     '    velocity=   13.604(Ft/s)
  '     '    area =     34.401(Sq.Ft)
  '     '    Froude number =     2.393

Upstream point elevation =  5405.000(Ft.)
Downstream point elevation =  5169.000(Ft.)
Flow length =  1734.000(Ft.)
Travel time  =    2.12 min.
Time of concentration =   17.44 min.
Depth of flow =   1.070(Ft.)
Average velocity =  13.604(Ft/s)
Total irregular channel flow =   467.990(CFS)
Irregular channel normal depth above invert elev. =   1.070(Ft.)
Average velocity of channel(s) =  13.604(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.170
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.830
SCS curve number for soil(AMC 2)  = 87.13
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.245(In/Hr)
Rainfall intensity =      1.926(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.762
Subarea runoff =      6.220(CFS) for   37.150(Ac.)
Total runoff =    471.068(CFS)
Effective area this stream =      320.77(Ac.)
Total Study Area (Main Stream No. 1) =      336.02(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   1.075(Ft.), Average velocity =  13.637(Ft/s)


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Process from Point/Station      425.000 to Point/Station      430.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.082(Ft.), Average velocity =  13.539(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
```

```
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    471.096(CFS)
  '     '    flow top width =     34.327(Ft.)
  '     '    velocity=   13.539(Ft/s)
  '     '    area =     34.795(Sq.Ft)
  '     '    Froude number =     2.370

Upstream point elevation =  5169.000(Ft.)
Downstream point elevation =  5109.000(Ft.)
Flow length =   451.000(Ft.)
Travel time  =    0.56 min.
Time of concentration =   17.99 min.
Depth of flow =   1.082(Ft.)
Average velocity =  13.539(Ft/s)
Total irregular channel flow =   471.095(CFS)
Irregular channel normal depth above invert elev. =   1.082(Ft.)
Average velocity of channel(s) =  13.539(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.300
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.700
SCS curve number for soil(AMC 2)  = 85.70
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.270(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    465.871(CFS)
therefore the upstream flow rate of Q =    471.068(CFS) is being used
Rainfall intensity =      1.884(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.760
Subarea runoff =      0.000(CFS) for    4.730(Ac.)
Total runoff =    471.068(CFS)
Effective area this stream =      325.50(Ac.)
Total Study Area (Main Stream No. 1) =      340.75(Ac.)
Area averaged Fm value =    0.294(In/Hr)
Depth of flow =   1.082(Ft.), Average velocity =  13.539(Ft/s)


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Process from Point/Station      430.000 to Point/Station      435.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.084(Ft.), Average velocity =  13.511(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    471.096(CFS)
```

```
  '     '    flow top width =     34.336(Ft.)
  '     '    velocity=   13.511(Ft/s)
  '     '    area =     34.867(Sq.Ft)
  '     '    Froude number =     2.363

Upstream point elevation =  5109.000(Ft.)
Downstream point elevation =  5010.000(Ft.)
Flow length =   749.000(Ft.)
Travel time  =    0.92 min.
Time of concentration =   18.92 min.
Depth of flow =   1.084(Ft.)
Average velocity =  13.511(Ft/s)
Total irregular channel flow =   471.095(CFS)
Irregular channel normal depth above invert elev. =   1.084(Ft.)
Average velocity of channel(s) =  13.511(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.323(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    453.253(CFS)
therefore the upstream flow rate of Q =    471.068(CFS) is being used
Rainfall intensity =      1.820(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.754
Subarea runoff =      0.000(CFS) for    4.750(Ac.)
Total runoff =    471.068(CFS)
Effective area this stream =      330.25(Ac.)
Total Study Area (Main Stream No. 1) =      345.50(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   1.084(Ft.), Average velocity =  13.511(Ft/s)


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Process from Point/Station      435.000 to Point/Station      440.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.082(Ft.), Average velocity =  13.531(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    471.098(CFS)
  '     '    flow top width =     34.330(Ft.)
  '     '    velocity=   13.531(Ft/s)
  '     '    area =     34.817(Sq.Ft)
```

```
  '     '    Froude number =     2.368

Upstream point elevation =  5010.000(Ft.)
Downstream point elevation =  4978.000(Ft.)
Flow length =   241.000(Ft.)
Travel time  =    0.30 min.
Time of concentration =   19.21 min.
Depth of flow =   1.082(Ft.)
Average velocity =  13.531(Ft/s)
Total irregular channel flow =   471.098(CFS)
Irregular channel normal depth above invert elev. =   1.082(Ft.)
Average velocity of channel(s) =  13.531(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.323(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    454.448(CFS)
therefore the upstream flow rate of Q =    471.068(CFS) is being used
Rainfall intensity =      1.800(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.752
Subarea runoff =      0.000(CFS) for    5.310(Ac.)
Total runoff =    471.068(CFS)
Effective area this stream =      335.56(Ac.)
Total Study Area (Main Stream No. 1) =      350.81(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   1.082(Ft.), Average velocity =  13.531(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      440.000 to Point/Station      441.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.985(Ft.), Average velocity =  15.903(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    471.106(CFS)
  '     '    flow top width =     24.849(Ft.)
  '     '    velocity=   15.903(Ft/s)
  '     '    area =     29.624(Sq.Ft)
  '     '    Froude number =     2.567

Upstream point elevation =  4978.000(Ft.)
```

```
Downstream point elevation =  4700.000(Ft.)
Flow length =  1878.000(Ft.)
Travel time  =    1.97 min.
Time of concentration =   21.18 min.
Depth of flow =   1.985(Ft.)
Average velocity =  15.903(Ft/s)
Total irregular channel flow =   471.106(CFS)
Irregular channel normal depth above invert elev. =   1.985(Ft.)
Average velocity of channel(s) =  15.903(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    449.920(CFS)
therefore the upstream flow rate of Q =    471.068(CFS) is being used
Rainfall intensity =      1.681(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.738
Subarea runoff =      0.000(CFS) for   27.260(Ac.)
Total runoff =    471.068(CFS)
Effective area this stream =      362.82(Ac.)
Total Study Area (Main Stream No. 1) =      378.07(Ac.)
Area averaged Fm value =    0.303(In/Hr)
Depth of flow =   1.985(Ft.), Average velocity =  15.903(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      441.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.955(Ft.), Average velocity =  16.304(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    471.109(CFS)
  '     '    flow top width =     24.554(Ft.)
  '     '    velocity=   16.304(Ft/s)
  '     '    area =     28.895(Sq.Ft)
  '     '    Froude number =     2.649

Upstream point elevation =  4700.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2527.000(Ft.)
Travel time  =    2.58 min.
```

```
Time of concentration =   23.76 min.
Depth of flow =   1.955(Ft.)
Average velocity =  16.304(Ft/s)
Total irregular channel flow =   471.108(CFS)
Irregular channel normal depth above invert elev. =   1.955(Ft.)
Average velocity of channel(s) =  16.304(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    423.721(CFS)
therefore the upstream flow rate of Q =    471.068(CFS) is being used
Rainfall intensity =      1.551(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.722
Subarea runoff =      0.000(CFS) for   15.770(Ac.)
Total runoff =    471.068(CFS)
Effective area this stream =      378.59(Ac.)
Total Study Area (Main Stream No. 1) =      393.84(Ac.)
Area averaged Fm value =    0.307(In/Hr)
Depth of flow =   1.955(Ft.), Average velocity =  16.304(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      441.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =    378.591(Ac.)
Runoff from this stream =    471.068(CFS)
Time of concentration =   23.76 min.
Rainfall intensity =     1.551(In/Hr)
Area averaged loss rate (Fm) =    0.3074(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      700.000 to Point/Station      710.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.790
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.210
SCS curve number for soil(AMC 2)  = 80.31
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.365(In/Hr)
Initial subarea data:
Initial area flow distance =   929.000(Ft.)
Top (of initial area) elevation =  5851.000(Ft.)
```

```
Bottom (of initial area) elevation =  5495.000(Ft.)
Difference in elevation =   356.000(Ft.)
Slope =    0.38321  s(%)=      38.32
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.788 min.
Rainfall intensity =      2.886(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.786
Subarea runoff =     15.815(CFS)
Total initial stream area =        6.970(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.365(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      710.000 to Point/Station      720.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.587(Ft.), Average velocity =   6.238(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     29.060(CFS)
  '     '    flow top width =     10.871(Ft.)
  '     '    velocity=    6.238(Ft/s)
  '     '    area =      4.659(Sq.Ft)
  '     '    Froude number =     1.679

Upstream point elevation =  5495.000(Ft.)
Downstream point elevation =  5315.000(Ft.)
Flow length =  2034.000(Ft.)
Travel time  =    5.43 min.
Time of concentration =   15.22 min.
Depth of flow =   0.587(Ft.)
Average velocity =   6.238(Ft/s)
Total irregular channel flow =    29.060(CFS)
Irregular channel normal depth above invert elev. =   0.587(Ft.)
Average velocity of channel(s) =   6.238(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.980
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.020
SCS curve number for soil(AMC 2)  = 78.22
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.400(In/Hr)
Rainfall intensity =      2.118(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.734
Subarea runoff =     26.428(CFS) for   20.200(Ac.)
```

```
Total runoff =     42.243(CFS)
Effective area this stream =       27.17(Ac.)
Total Study Area (Main Stream No. 2) =      421.01(Ac.)
Area averaged Fm value =    0.391(In/Hr)
Depth of flow =   0.712(Ft.), Average velocity =   6.934(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      720.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.581(Ft.), Average velocity =  10.969(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     50.398(CFS)
  '     '    flow top width =     10.812(Ft.)
  '     '    velocity=   10.969(Ft/s)
  '     '    area =      4.594(Sq.Ft)
  '     '    Froude number =     2.965

Upstream point elevation =  5315.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1756.000(Ft.)
Travel time  =    2.67 min.
Time of concentration =   17.89 min.
Depth of flow =   0.581(Ft.)
Average velocity =  10.969(Ft/s)
Total irregular channel flow =    50.398(CFS)
Irregular channel normal depth above invert elev. =   0.581(Ft.)
Average velocity of channel(s) =  10.969(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.892(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.712
Subarea runoff =     16.230(CFS) for   16.250(Ac.)
Total runoff =     58.473(CFS)
Effective area this stream =       43.42(Ac.)
Total Study Area (Main Stream No. 2) =      437.26(Ac.)
Area averaged Fm value =    0.396(In/Hr)
Depth of flow =   0.628(Ft.), Average velocity =  11.445(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      720.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =     43.420(Ac.)
Runoff from this stream =     58.473(CFS)
Time of concentration =   17.89 min.
Rainfall intensity =     1.892(In/Hr)
Area averaged loss rate (Fm) =    0.3955(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      800.000 to Point/Station      810.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.180
Decimal fraction soil group D = 0.820
SCS curve number for soil(AMC 2)  = 88.46
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.221(In/Hr)
Initial subarea data:
Initial area flow distance =   964.000(Ft.)
Top (of initial area) elevation =  5664.000(Ft.)
Bottom (of initial area) elevation =  5225.000(Ft.)
Difference in elevation =   439.000(Ft.)
Slope =    0.45539  s(%)=      45.54
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.596 min.
Rainfall intensity =      2.926(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.832
Subarea runoff =     24.347(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.221(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      810.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.804(Ft.), Average velocity =  11.235(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
```

```
Sub-Channel flow  =     81.521(CFS)
  '     '    flow top width =     13.043(Ft.)
  '     '    velocity=   11.235(Ft/s)
  '     '    area =      7.256(Sq.Ft)
  '     '    Froude number =     2.655

Upstream point elevation =  5225.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1949.000(Ft.)
Travel time  =    2.89 min.
Time of concentration =   12.49 min.
Depth of flow =   0.804(Ft.)
Average velocity =  11.235(Ft/s)
Total irregular channel flow =    81.521(CFS)
Irregular channel normal depth above invert elev. =   0.804(Ft.)
Average velocity of channel(s) =  11.235(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.240
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 86.33
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.259(In/Hr)
Rainfall intensity =      2.433(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.806
Subarea runoff =    114.259(CFS) for   60.660(Ac.)
Total runoff =    138.606(CFS)
Effective area this stream =       70.66(Ac.)
Total Study Area (Main Stream No. 2) =      507.92(Ac.)
Area averaged Fm value =    0.254(In/Hr)
Depth of flow =   1.045(Ft.), Average velocity =  12.978(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      810.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =     70.660(Ac.)
Runoff from this stream =    138.606(CFS)
Time of concentration =   12.49 min.
Rainfall intensity =     2.433(In/Hr)
Area averaged loss rate (Fm) =    0.2537(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1     58.47    43.420     17.89    0.396      1.892
2    138.61    70.660     12.49    0.254      2.433
Qmax(1) =
         1.000 *    1.000 *    58.473) +
         0.752 *    1.000 *   138.606) + =     162.649
```

```
Qmax(2) =
        1.362 *    0.698 *    58.473) +
        1.000 *    1.000 *   138.606) + =     194.188

Total of 2 streams to confluence:
Flow rates before confluence point:
      58.473     138.606
Maximum flow rates at confluence using above data:
      162.649      194.188
Area of streams before confluence:
       43.420       70.660
Effective area values after confluence:
      114.080      100.967
Results of confluence:
Total flow rate =    194.188(CFS)
Time of concentration =    12.488 min.
Effective stream area after confluence =    100.967(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.308(In/Hr)
Study area total (this main stream) =     114.08(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      730.000 to Point/Station      740.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.478(Ft.), Average velocity =  12.275(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    224.791(CFS)
  '     '    flow top width =     19.780(Ft.)
  '     '    velocity=   12.275(Ft/s)
  '     '    area =     18.313(Sq.Ft)
  '     '    Froude number =     2.248

Upstream point elevation =  4829.000(Ft.)
Downstream point elevation =  4580.000(Ft.)
Flow length =  2018.000(Ft.)
Travel time  =    2.74 min.
Time of concentration =   15.23 min.
Depth of flow =   1.478(Ft.)
Average velocity =  12.275(Ft/s)
Total irregular channel flow =   224.791(CFS)
Irregular channel normal depth above invert elev. =   1.478(Ft.)
Average velocity of channel(s) =  12.275(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
```

```
Decimal fraction soil group B = 0.380
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.610
SCS curve number for soil(AMC 2)  = 84.79
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.287(In/Hr)
Rainfall intensity =      2.118(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.772
Subarea runoff =     61.153(CFS) for   55.130(Ac.)
Total runoff =    255.341(CFS)
Effective area this stream =      156.10(Ac.)
Total Study Area (Main Stream No. 2) =      563.05(Ac.)
Area averaged Fm value =    0.300(In/Hr)
Depth of flow =   1.567(Ft.), Average velocity =  12.689(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      740.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.683(Ft.), Average velocity =  12.763(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    288.185(CFS)
  '     '    flow top width =     21.831(Ft.)
  '     '    velocity=   12.763(Ft/s)
  '     '    area =     22.581(Sq.Ft)
  '     '    Froude number =     2.211

Upstream point elevation =  4580.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2432.000(Ft.)
Travel time  =    3.18 min.
Time of concentration =   18.40 min.
Depth of flow =   1.683(Ft.)
Average velocity =  12.763(Ft/s)
Total irregular channel flow =   288.185(CFS)
Irregular channel normal depth above invert elev. =   1.683(Ft.)
Average velocity of channel(s) =  12.763(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.660
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.330
SCS curve number for soil(AMC 2)  = 81.71
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.340(In/Hr)
Rainfall intensity =      1.855(In/Hr) for a    10.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.748
Subarea runoff =     65.621(CFS) for   75.260(Ac.)
Total runoff =    320.962(CFS)
Effective area this stream =      231.36(Ac.)
Total Study Area (Main Stream No. 2) =      638.31(Ac.)
Area averaged Fm value =    0.313(In/Hr)
Depth of flow =   1.768(Ft.), Average velocity =  13.123(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      740.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =    231.357(Ac.)
Runoff from this stream =    320.962(CFS)
Time of concentration =   18.40 min.
Rainfall intensity =     1.855(In/Hr)
Area averaged loss rate (Fm) =    0.3133(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    471.07   378.591     23.76    0.307      1.551
2    320.96   231.357     18.40    0.313      1.855
Qmax(1) =
         1.000 *    1.000 *   471.068) +
         0.803 *    1.000 *   320.962) + =     728.756
Qmax(2) =
         1.244 *    0.774 *   471.068) +
         1.000 *    1.000 *   320.962) + =     774.924

Total of 2 main streams to confluence:
Flow rates before confluence point:
     472.068     321.962
Maximum flow rates at confluence using above data:
      728.756      774.924
Area of streams before confluence:
      378.591      231.357
Effective area values after confluence:
      609.948      524.554


Results of confluence:
Total flow rate =    774.924(CFS)
Time of concentration =    18.404 min.
Effective stream area after confluence  =    524.554(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.310(In/Hr)
Study area total =     609.95(Ac.)
End of computations, Total Study Area =          638.31 (Ac.)
The following figures may
```

be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 83.5

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2005 Version 7.1
      Rational Hydrology Study        Date: 07/21/11
----------------------------------------------------------------------
White Knob Haul Road
Quarry Drainage
25 Year Flow

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


Program License Serial Number 6026

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

----------------------------------------------------------------------
Rational hydrology study storm event year is    25.0
Computed rainfall intensity:
Storm year =    25.00   1 hour rainfall =     1.030 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      405.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  7705.000(Ft.)
Bottom (of initial area) elevation =  6940.000(Ft.)
Difference in elevation =   765.000(Ft.)
Slope =    0.76500  s(%)=      76.50
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.805 min.
Rainfall intensity =      3.214(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.816
Subarea runoff =     13.768(CFS)
Total initial stream area =        5.250(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.301(In/Hr)


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Process from Point/Station      405.000 to Point/Station      410.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.456(Ft.), Average velocity =  13.552(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     45.026(CFS)
  '     '    flow top width =      9.563(Ft.)
  '     '    velocity=   13.552(Ft/s)
  '     '    area =      3.322(Sq.Ft)
  '     '    Froude number =     4.052

Upstream point elevation =  6940.000(Ft.)
Downstream point elevation =  6700.000(Ft.)
Flow length =   435.000(Ft.)
Travel time  =    0.53 min.
Time of concentration =   12.34 min.
Depth of flow =   0.456(Ft.)
Average velocity =  13.552(Ft/s)
Total irregular channel flow =    45.026(CFS)
Irregular channel normal depth above invert elev. =   0.456(Ft.)
Average velocity of channel(s) =  13.552(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      3.116(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.813
Subarea runoff =     62.430(CFS) for   24.820(Ac.)
Total runoff =     76.198(CFS)
Effective area this stream =       30.07(Ac.)
Total Study Area (Main Stream No. 1) =       30.07(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.602(Ft.), Average velocity =  15.794(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      410.000 to Point/Station      415.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.896(Ft.), Average velocity =  20.350(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    172.926(CFS)
  '     '    flow top width =     13.962(Ft.)
  '     '    velocity=   20.351(Ft/s)
  '     '    area =      8.497(Sq.Ft)
  '     '    Froude number =     4.597

Upstream point elevation =  6700.000(Ft.)
Downstream point elevation =  5900.000(Ft.)
Flow length =  1352.000(Ft.)
Travel time  =    1.11 min.
Time of concentration =   13.45 min.
Depth of flow =   0.896(Ft.)
Average velocity =  20.350(Ft/s)
Total irregular channel flow =   172.926(CFS)
Irregular channel normal depth above invert elev. =   0.896(Ft.)
Average velocity of channel(s) =  20.350(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.934(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.808
Subarea runoff =    193.376(CFS) for   83.660(Ac.)
Total runoff =    269.574(CFS)
Effective area this stream =      113.73(Ac.)
Total Study Area (Main Stream No. 1) =      113.73(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   1.113(Ft.), Average velocity =  22.935(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      415.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.446(Ft.), Average velocity =  18.286(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
```

```
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    323.468(CFS)
  '     '    flow top width =     19.462(Ft.)
  '     '    velocity=   18.286(Ft/s)
  '     '    area =     17.689(Sq.Ft)
  '     '    Froude number =     3.380

Upstream point elevation =  5900.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    1.61 min.
Time of concentration =   15.06 min.
Depth of flow =   1.446(Ft.)
Average velocity =  18.286(Ft/s)
Total irregular channel flow =   323.468(CFS)
Irregular channel normal depth above invert elev. =   1.446(Ft.)
Average velocity of channel(s) =  18.286(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.711(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.800
Subarea runoff =    107.714(CFS) for   60.170(Ac.)
Total runoff =    377.287(CFS)
Effective area this stream =      173.90(Ac.)
Total Study Area (Main Stream No. 1) =      173.90(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   1.553(Ft.), Average velocity =  19.035(Ft/s)


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Process from Point/Station      415.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    173.900(Ac.)
Runoff from this stream =    377.287(CFS)
Time of concentration =   15.06 min.
Rainfall intensity =     2.711(In/Hr)
Area averaged loss rate (Fm) =    0.3006(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


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Process from Point/Station      500.000 to Point/Station      510.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
```

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Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Initial subarea data:
Initial area flow distance =   970.000(Ft.)
Top (of initial area) elevation =  7120.000(Ft.)
Bottom (of initial area) elevation =  6600.000(Ft.)
Difference in elevation =   520.000(Ft.)
Slope =    0.53608  s(%)=      53.61
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.522 min.
Rainfall intensity =      3.084(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.812
Subarea runoff =     24.078(CFS)
Total initial stream area =        9.610(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.301(In/Hr)


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Process from Point/Station      510.000 to Point/Station      520.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.457(Ft.), Average velocity =  14.651(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     48.725(CFS)
  '     '    flow top width =      9.566(Ft.)
  '     '    velocity=   14.651(Ft/s)
  '     '    area =      3.326(Sq.Ft)
  '     '    Froude number =     4.379

Upstream point elevation =  6600.000(Ft.)
Downstream point elevation =  6100.000(Ft.)
Flow length =   776.000(Ft.)
Travel time  =    0.88 min.
Time of concentration =   13.40 min.
Depth of flow =   0.457(Ft.)
Average velocity =  14.651(Ft/s)
Total irregular channel flow =    48.725(CFS)
Irregular channel normal depth above invert elev. =   0.457(Ft.)
Average velocity of channel(s) =  14.651(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.941(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.808
Subarea runoff =     49.228(CFS) for   21.240(Ac.)
Total runoff =     73.306(CFS)
Effective area this stream =       30.85(Ac.)
Total Study Area (Main Stream No. 1) =      204.75(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   0.567(Ft.), Average velocity =  16.509(Ft/s)


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Process from Point/Station      520.000 to Point/Station      530.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.967(Ft.), Average velocity =  16.799(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =    159.821(CFS)
  '     '    flow top width =     14.672(Ft.)
  '     '    velocity=   16.799(Ft/s)
  '     '    area =      9.513(Sq.Ft)
  '     '    Froude number =     3.677

Upstream point elevation =  6100.000(Ft.)
Downstream point elevation =  5710.000(Ft.)
Flow length =  1052.000(Ft.)
Travel time  =    1.04 min.
Time of concentration =   14.45 min.
Depth of flow =   0.967(Ft.)
Average velocity =  16.799(Ft/s)
Total irregular channel flow =   159.820(CFS)
Irregular channel normal depth above invert elev. =   0.967(Ft.)
Average velocity of channel(s) =  16.799(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.301(In/Hr)
Rainfall intensity =      2.790(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.803
```

```
Subarea runoff =    172.966(CFS) for   79.050(Ac.)
Total runoff =    246.272(CFS)
Effective area this stream =      109.90(Ac.)
Total Study Area (Main Stream No. 1) =      283.80(Ac.)
Area averaged Fm value =    0.301(In/Hr)
Depth of flow =   1.192(Ft.), Average velocity =  18.859(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.680(Ft.), Average velocity =  11.542(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    246.307(CFS)
  '     '    flow top width =     32.722(Ft.)
  '     '    velocity=   11.542(Ft/s)
  '     '    area =     21.340(Sq.Ft)
  '     '    Froude number =     2.519

Upstream point elevation =  5710.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    2.55 min.
Time of concentration =   17.00 min.
Depth of flow =   0.680(Ft.)
Average velocity =  11.542(Ft/s)
Total irregular channel flow =   246.307(CFS)
Irregular channel normal depth above invert elev. =   0.680(Ft.)
Average velocity of channel(s) =  11.542(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.500
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 83.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.309(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    246.202(CFS)
therefore the upstream flow rate of Q =    246.272(CFS) is being used
Rainfall intensity =      2.491(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.791
Subarea runoff =      0.000(CFS) for   15.070(Ac.)
Total runoff =    246.272(CFS)
Effective area this stream =      124.97(Ac.)
```

```
Total Study Area (Main Stream No. 1) =      298.87(Ac.)
Area averaged Fm value =    0.302(In/Hr)
Depth of flow =   0.680(Ft.), Average velocity =  11.541(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    124.970(Ac.)
Runoff from this stream =    246.272(CFS)
Time of concentration =   17.00 min.
Rainfall intensity =     2.491(In/Hr)
Area averaged loss rate (Fm) =    0.3016(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    377.29   173.900     15.06    0.301      2.711
2    246.27   124.970     17.00    0.302      2.491
Qmax(1) =
         1.000 *    1.000 *   377.287) +
         1.101 *    0.886 *   246.272) + =     617.426
Qmax(2) =
         0.908 *    1.000 *   377.287) +
         1.000 *    1.000 *   246.272) + =     589.036

Total of 2 streams to confluence:
Flow rates before confluence point:
     377.287     246.272
Maximum flow rates at confluence using above data:
      617.426      589.036
Area of streams before confluence:
      173.900      124.970
Effective area values after confluence:
      284.603      298.870
Results of confluence:
Total flow rate =    617.426(CFS)
Time of concentration =    15.055 min.
Effective stream area after confluence =    284.603(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.301(In/Hr)
Study area total (this main stream) =     298.87(Ac.)


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Process from Point/Station      420.000 to Point/Station      425.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.273(Ft.), Average velocity =  15.138(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    627.181(CFS)
  '     '    flow top width =     35.092(Ft.)
  '     '    velocity=   15.138(Ft/s)
  '     '    area =     41.432(Sq.Ft)
  '     '    Froude number =     2.455

Upstream point elevation =  5405.000(Ft.)
Downstream point elevation =  5169.000(Ft.)
Flow length =  1734.000(Ft.)
Travel time  =    1.91 min.
Time of concentration =   16.96 min.
Depth of flow =   1.273(Ft.)
Average velocity =  15.138(Ft/s)
Total irregular channel flow =   627.181(CFS)
Irregular channel normal depth above invert elev. =   1.273(Ft.)
Average velocity of channel(s) =  15.138(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.170
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.830
SCS curve number for soil(AMC 2)  = 87.13
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.245(In/Hr)
Rainfall intensity =      2.494(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.794
Subarea runoff =     19.442(CFS) for   37.150(Ac.)
Total runoff =    636.868(CFS)
Effective area this stream =      321.75(Ac.)
Total Study Area (Main Stream No. 1) =      336.02(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   1.285(Ft.), Average velocity =  15.222(Ft/s)


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Process from Point/Station      425.000 to Point/Station      430.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.293(Ft.), Average velocity =  15.112(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
```

```
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    636.905(CFS)
  '     '    flow top width =     35.173(Ft.)
  '     '    velocity=   15.112(Ft/s)
  '     '    area =     42.146(Sq.Ft)
  '     '    Froude number =     2.433

Upstream point elevation =  5169.000(Ft.)
Downstream point elevation =  5109.000(Ft.)
Flow length =   451.000(Ft.)
Travel time  =    0.50 min.
Time of concentration =   17.46 min.
Depth of flow =   1.293(Ft.)
Average velocity =  15.112(Ft/s)
Total irregular channel flow =   636.904(CFS)
Irregular channel normal depth above invert elev. =   1.293(Ft.)
Average velocity of channel(s) =  15.112(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.300
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.700
SCS curve number for soil(AMC 2)  = 85.70
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.270(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    631.658(CFS)
therefore the upstream flow rate of Q =    636.868(CFS) is being used
Rainfall intensity =      2.444(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.792
Subarea runoff =      0.000(CFS) for    4.730(Ac.)
Total runoff =    636.868(CFS)
Effective area this stream =      326.48(Ac.)
Total Study Area (Main Stream No. 1) =      340.75(Ac.)
Area averaged Fm value =    0.294(In/Hr)
Depth of flow =   1.293(Ft.), Average velocity =  15.112(Ft/s)


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Process from Point/Station      430.000 to Point/Station      435.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.296(Ft.), Average velocity =  15.081(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    636.904(CFS)
```

```
  '     '    flow top width =     35.183(Ft.)
  '     '    velocity=   15.081(Ft/s)
  '     '    area =     42.233(Sq.Ft)
  '     '    Froude number =     2.426

Upstream point elevation =  5109.000(Ft.)
Downstream point elevation =  5010.000(Ft.)
Flow length =   749.000(Ft.)
Travel time  =    0.83 min.
Time of concentration =   18.29 min.
Depth of flow =   1.296(Ft.)
Average velocity =  15.081(Ft/s)
Total irregular channel flow =   636.904(CFS)
Irregular channel normal depth above invert elev. =   1.296(Ft.)
Average velocity of channel(s) =  15.081(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.323(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    617.485(CFS)
therefore the upstream flow rate of Q =    636.868(CFS) is being used
Rainfall intensity =      2.366(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.788
Subarea runoff =      0.000(CFS) for    4.750(Ac.)
Total runoff =    636.868(CFS)
Effective area this stream =      331.23(Ac.)
Total Study Area (Main Stream No. 1) =      345.50(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   1.296(Ft.), Average velocity =  15.080(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      435.000 to Point/Station      440.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.294(Ft.), Average velocity =  15.103(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    636.908(CFS)
  '     '    flow top width =     35.176(Ft.)
  '     '    velocity=   15.103(Ft/s)
  '     '    area =     42.172(Sq.Ft)
```

```
  '     '    Froude number =     2.431

Upstream point elevation =  5010.000(Ft.)
Downstream point elevation =  4978.000(Ft.)
Flow length =   241.000(Ft.)
Travel time  =    0.27 min.
Time of concentration =   18.56 min.
Depth of flow =   1.294(Ft.)
Average velocity =  15.103(Ft/s)
Total irregular channel flow =   636.908(CFS)
Irregular channel normal depth above invert elev. =   1.294(Ft.)
Average velocity of channel(s) =  15.103(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.323(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    620.043(CFS)
therefore the upstream flow rate of Q =    636.868(CFS) is being used
Rainfall intensity =      2.342(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.787
Subarea runoff =      0.000(CFS) for    5.310(Ac.)
Total runoff =    636.868(CFS)
Effective area this stream =      336.54(Ac.)
Total Study Area (Main Stream No. 1) =      350.81(Ac.)
Area averaged Fm value =    0.295(In/Hr)
Depth of flow =   1.294(Ft.), Average velocity =  15.102(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      440.000 to Point/Station      441.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   2.268(Ft.), Average velocity =  17.180(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    636.893(CFS)
  '     '    flow top width =     27.685(Ft.)
  '     '    velocity=   17.180(Ft/s)
  '     '    area =     37.073(Sq.Ft)
  '     '    Froude number =     2.616

Upstream point elevation =  4978.000(Ft.)
```

```
Downstream point elevation =  4700.000(Ft.)
Flow length =  1878.000(Ft.)
Travel time  =    1.82 min.
Time of concentration =   20.38 min.
Depth of flow =   2.268(Ft.)
Average velocity =  17.180(Ft/s)
Total irregular channel flow =   636.893(CFS)
Irregular channel normal depth above invert elev. =   2.268(Ft.)
Average velocity of channel(s) =  17.180(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    618.940(CFS)
therefore the upstream flow rate of Q =    636.868(CFS) is being used
Rainfall intensity =      2.194(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.776
Subarea runoff =      0.000(CFS) for   27.260(Ac.)
Total runoff =    636.868(CFS)
Effective area this stream =      363.80(Ac.)
Total Study Area (Main Stream No. 1) =      378.07(Ac.)
Area averaged Fm value =    0.303(In/Hr)
Depth of flow =   2.268(Ft.), Average velocity =  17.179(Ft/s)


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Process from Point/Station      441.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   2.235(Ft.), Average velocity =  17.614(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    636.895(CFS)
  '     '    flow top width =     27.353(Ft.)
  '     '    velocity=   17.614(Ft/s)
  '     '    area =     36.159(Sq.Ft)
  '     '    Froude number =     2.700

Upstream point elevation =  4700.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2527.000(Ft.)
Travel time  =    2.39 min.
```

```
Time of concentration =   22.77 min.
Depth of flow =   2.235(Ft.)
Average velocity =  17.614(Ft/s)
Total irregular channel flow =   636.895(CFS)
Irregular channel normal depth above invert elev. =   2.235(Ft.)
Average velocity of channel(s) =  17.614(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    588.349(CFS)
therefore the upstream flow rate of Q =    636.868(CFS) is being used
Rainfall intensity =      2.030(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.764
Subarea runoff =      0.000(CFS) for   15.770(Ac.)
Total runoff =    636.868(CFS)
Effective area this stream =      379.57(Ac.)
Total Study Area (Main Stream No. 1) =      393.84(Ac.)
Area averaged Fm value =    0.307(In/Hr)
Depth of flow =   2.235(Ft.), Average velocity =  17.613(Ft/s)


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Process from Point/Station      441.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =    379.573(Ac.)
Runoff from this stream =    636.868(CFS)
Time of concentration =   22.77 min.
Rainfall intensity =     2.030(In/Hr)
Area averaged loss rate (Fm) =    0.3073(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2


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Process from Point/Station      700.000 to Point/Station      710.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.790
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.210
SCS curve number for soil(AMC 2)  = 80.31
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.365(In/Hr)
Initial subarea data:
Initial area flow distance =   929.000(Ft.)
Top (of initial area) elevation =  5851.000(Ft.)
```

```
Bottom (of initial area) elevation =  5495.000(Ft.)
Difference in elevation =   356.000(Ft.)
Slope =    0.38321  s(%)=      38.32
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.788 min.
Rainfall intensity =      3.665(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
Subarea runoff =     20.704(CFS)
Total initial stream area =        6.970(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.365(In/Hr)


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Process from Point/Station      710.000 to Point/Station      720.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.685(Ft.), Average velocity =   6.789(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     39.187(CFS)
  '     '    flow top width =     11.850(Ft.)
  '     '    velocity=    6.789(Ft/s)
  '     '    area =      5.772(Sq.Ft)
  '     '    Froude number =     1.714

Upstream point elevation =  5495.000(Ft.)
Downstream point elevation =  5315.000(Ft.)
Flow length =  2034.000(Ft.)
Travel time  =    4.99 min.
Time of concentration =   14.78 min.
Depth of flow =   0.685(Ft.)
Average velocity =   6.789(Ft/s)
Total irregular channel flow =    39.187(CFS)
Irregular channel normal depth above invert elev. =   0.685(Ft.)
Average velocity of channel(s) =   6.789(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.980
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.020
SCS curve number for soil(AMC 2)  = 78.22
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.400(In/Hr)
Rainfall intensity =      2.746(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.772
Subarea runoff =     36.897(CFS) for   20.200(Ac.)
```

```
Total runoff =     57.601(CFS)
Effective area this stream =       27.17(Ac.)
Total Study Area (Main Stream No. 2) =      421.01(Ac.)
Area averaged Fm value =    0.391(In/Hr)
Depth of flow =   0.832(Ft.), Average velocity =   7.555(Ft/s)


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Process from Point/Station      720.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.685(Ft.), Average velocity =  12.009(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     69.344(CFS)
  '     '    flow top width =     11.853(Ft.)
  '     '    velocity=   12.009(Ft/s)
  '     '    area =      5.774(Sq.Ft)
  '     '    Froude number =     3.032

Upstream point elevation =  5315.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1756.000(Ft.)
Travel time  =    2.44 min.
Time of concentration =   17.22 min.
Depth of flow =   0.685(Ft.)
Average velocity =  12.009(Ft/s)
Total irregular channel flow =    69.344(CFS)
Irregular channel normal depth above invert elev. =   0.685(Ft.)
Average velocity of channel(s) =  12.009(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.468(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.756
Subarea runoff =     23.390(CFS) for   16.250(Ac.)
Total runoff =     80.991(CFS)
Effective area this stream =       43.42(Ac.)
Total Study Area (Main Stream No. 2) =      437.26(Ac.)
Area averaged Fm value =    0.396(In/Hr)
Depth of flow =   0.742(Ft.), Average velocity =  12.541(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      720.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =     43.420(Ac.)
Runoff from this stream =     80.991(CFS)
Time of concentration =   17.22 min.
Rainfall intensity =     2.468(In/Hr)
Area averaged loss rate (Fm) =    0.3955(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


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Process from Point/Station      800.000 to Point/Station      810.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.180
Decimal fraction soil group D = 0.820
SCS curve number for soil(AMC 2)  = 88.46
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.221(In/Hr)
Initial subarea data:
Initial area flow distance =   964.000(Ft.)
Top (of initial area) elevation =  5664.000(Ft.)
Bottom (of initial area) elevation =  5225.000(Ft.)
Difference in elevation =   439.000(Ft.)
Slope =    0.45539  s(%)=      45.54
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.596 min.
Rainfall intensity =      3.716(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.847
Subarea runoff =     31.457(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.221(In/Hr)


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Process from Point/Station      810.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.921(Ft.), Average velocity =  12.106(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
```

```
Sub-Channel flow  =    107.113(CFS)
  '     '    flow top width =     14.211(Ft.)
  '     '    velocity=   12.106(Ft/s)
  '     '    area =      8.848(Sq.Ft)
  '     '    Froude number =     2.704

Upstream point elevation =  5225.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1949.000(Ft.)
Travel time  =    2.68 min.
Time of concentration =   12.28 min.
Depth of flow =   0.921(Ft.)
Average velocity =  12.106(Ft/s)
Total irregular channel flow =   107.113(CFS)
Irregular channel normal depth above invert elev. =   0.921(Ft.)
Average velocity of channel(s) =  12.106(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.240
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 86.33
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.259(In/Hr)
Rainfall intensity =      3.127(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.827
Subarea runoff =    151.258(CFS) for   60.660(Ac.)
Total runoff =    182.716(CFS)
Effective area this stream =       70.66(Ac.)
Total Study Area (Main Stream No. 2) =      507.92(Ac.)
Area averaged Fm value =    0.254(In/Hr)
Depth of flow =   1.193(Ft.), Average velocity =  13.970(Ft/s)


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Process from Point/Station      810.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =     70.660(Ac.)
Runoff from this stream =    182.716(CFS)
Time of concentration =   12.28 min.
Rainfall intensity =     3.127(In/Hr)
Area averaged loss rate (Fm) =    0.2537(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1     80.99    43.420     17.22    0.396      2.468
2    182.72    70.660     12.28    0.254      3.127
Qmax(1) =
         1.000 *    1.000 *    80.991) +
         0.771 *    1.000 *   182.716) + =     221.810
```

```
Qmax(2) =
        1.318 *    0.713 *    80.991) +
        1.000 *    1.000 *   182.716) + =     258.839

Total of 2 streams to confluence:
Flow rates before confluence point:
      80.991     182.716
Maximum flow rates at confluence using above data:
      221.810      258.839
Area of streams before confluence:
       43.420       70.660
Effective area values after confluence:
      114.080      101.627
Results of confluence:
Total flow rate =    258.839(CFS)
Time of concentration =    12.280 min.
Effective stream area after confluence =    101.627(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.308(In/Hr)
Study area total (this main stream) =     114.08(Ac.)


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Process from Point/Station      730.000 to Point/Station      740.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.692(Ft.), Average velocity =  13.250(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    301.657(CFS)
  '     '    flow top width =     21.916(Ft.)
  '     '    velocity=   13.250(Ft/s)
  '     '    area =     22.766(Sq.Ft)
  '     '    Froude number =     2.291

Upstream point elevation =  4829.000(Ft.)
Downstream point elevation =  4580.000(Ft.)
Flow length =  2018.000(Ft.)
Travel time  =    2.54 min.
Time of concentration =   14.82 min.
Depth of flow =   1.692(Ft.)
Average velocity =  13.250(Ft/s)
Total irregular channel flow =   301.657(CFS)
Irregular channel normal depth above invert elev. =   1.692(Ft.)
Average velocity of channel(s) =  13.250(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
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Decimal fraction soil group B = 0.380
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.610
SCS curve number for soil(AMC 2)  = 84.79
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.287(In/Hr)
Rainfall intensity =      2.742(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.801
Subarea runoff =     85.571(CFS) for   55.130(Ac.)
Total runoff =    344.410(CFS)
Effective area this stream =      156.76(Ac.)
Total Study Area (Main Stream No. 2) =      563.05(Ac.)
Area averaged Fm value =    0.300(In/Hr)
Depth of flow =   1.796(Ft.), Average velocity =  13.712(Ft/s)


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Process from Point/Station      740.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.933(Ft.), Average velocity =  13.815(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    391.764(CFS)
  '     '    flow top width =     24.335(Ft.)
  '     '    velocity=   13.815(Ft/s)
  '     '    area =     28.358(Sq.Ft)
  '     '    Froude number =     2.255

Upstream point elevation =  4580.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2432.000(Ft.)
Travel time  =    2.93 min.
Time of concentration =   17.75 min.
Depth of flow =   1.933(Ft.)
Average velocity =  13.815(Ft/s)
Total irregular channel flow =   391.764(CFS)
Irregular channel normal depth above invert elev. =   1.933(Ft.)
Average velocity of channel(s) =  13.815(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.660
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.330
SCS curve number for soil(AMC 2)  = 81.71
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.340(In/Hr)
Rainfall intensity =      2.416(In/Hr) for a    25.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.783
Subarea runoff =     94.626(CFS) for   75.260(Ac.)
Total runoff =    439.036(CFS)
Effective area this stream =      232.02(Ac.)
Total Study Area (Main Stream No. 2) =      638.31(Ac.)
Area averaged Fm value =    0.313(In/Hr)
Depth of flow =   2.034(Ft.), Average velocity =  14.225(Ft/s)


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Process from Point/Station      740.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =    232.017(Ac.)
Runoff from this stream =    439.036(CFS)
Time of concentration =   17.75 min.
Rainfall intensity =     2.416(In/Hr)
Area averaged loss rate (Fm) =    0.3133(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    636.87   379.573     22.77    0.307      2.030
2    439.04   232.017     17.75    0.313      2.416
Qmax(1) =
         1.000 *    1.000 *   636.868) +
         0.816 *    1.000 *   439.036) + =     995.249
Qmax(2) =
         1.224 *    0.780 *   636.868) +
         1.000 *    1.000 *   439.036) + =    1046.948

Total of 2 main streams to confluence:
Flow rates before confluence point:
     637.868     440.036
Maximum flow rates at confluence using above data:
      995.249     1046.948
Area of streams before confluence:
      379.573      232.017
Effective area values after confluence:
      611.590      527.961


Results of confluence:
Total flow rate =   1046.948(CFS)
Time of concentration =    17.752 min.
Effective stream area after confluence  =    527.961(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.310(In/Hr)
Study area total =     611.59(Ac.)
End of computations, Total Study Area =          638.31 (Ac.)
The following figures may
```

be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 83.5

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/21/11

White Knob Haul Road
Quarry Drainage
100 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.390 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 400.000 to Point/Station 405.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2) = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.071(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 7705.000(Ft.)
Bottom (of initial area) elevation = 6940.000(Ft.)
Difference in elevation = 765.000(Ft.)
Slope = 0.76500 s(%)= 76.50
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.805 min.
Rainfall intensity = 4.338(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.885
Subarea runoff = 20.161(CFS)
Total initial stream area = 5.250(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.071(In/Hr)

++

```
Process from Point/Station      405.000 to Point/Station      410.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.560(Ft.), Average velocity =  15.172(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     66.235(CFS)
  '     '    flow top width =     10.598(Ft.)
  '     '    velocity=   15.172(Ft/s)
  '     '    area =      4.366(Sq.Ft)
  '     '    Froude number =     4.166

Upstream point elevation =  6940.000(Ft.)
Downstream point elevation =  6700.000(Ft.)
Flow length =   435.000(Ft.)
Travel time  =    0.48 min.
Time of concentration =   12.28 min.
Depth of flow =   0.560(Ft.)
Average velocity =  15.172(Ft/s)
Total irregular channel flow =    66.235(CFS)
Irregular channel normal depth above invert elev. =   0.560(Ft.)
Average velocity of channel(s) =  15.172(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.071(In/Hr)
Rainfall intensity =      4.219(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =     92.096(CFS) for   24.820(Ac.)
Total runoff =    112.257(CFS)
Effective area this stream =       30.07(Ac.)
Total Study Area (Main Stream No. 1) =       30.07(Ac.)
Area averaged Fm value =    0.071(In/Hr)
Depth of flow =   0.735(Ft.), Average velocity =  17.616(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      410.000 to Point/Station      415.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.087(Ft.), Average velocity =  22.645(Ft/s)
```

```
      ******* Irregular Channel Data ***********
-------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------
Sub-Channel flow  =    257.005(CFS)
  '     '    flow top width =     15.874(Ft.)
  '     '    velocity=   22.645(Ft/s)
  '     '    area =     11.349(Sq.Ft)
  '     '    Froude number =     4.720

Upstream point elevation =  6700.000(Ft.)
Downstream point elevation =  5900.000(Ft.)
Flow length =  1352.000(Ft.)
Travel time  =    1.00 min.
Time of concentration =   13.28 min.
Depth of flow =   1.087(Ft.)
Average velocity =  22.645(Ft/s)
Total irregular channel flow =   257.005(CFS)
Irregular channel normal depth above invert elev. =   1.087(Ft.)
Average velocity of channel(s) =  22.645(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.071(In/Hr)
Rainfall intensity =      3.995(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =    289.400(CFS) for   83.660(Ac.)
Total runoff =    401.657(CFS)
Effective area this stream =      113.73(Ac.)
Total Study Area (Main Stream No. 1) =      113.73(Ac.)
Area averaged Fm value =    0.071(In/Hr)
Depth of flow =   1.344(Ft.), Average velocity =  25.487(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      415.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.743(Ft.), Average velocity =  20.328(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
```

```
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    486.127(CFS)
  '     '    flow top width =     22.434(Ft.)
  '     '    velocity=   20.328(Ft/s)
  '     '    area =     23.914(Sq.Ft)
  '     '    Froude number =     3.470

Upstream point elevation =  5900.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    1.45 min.
Time of concentration =   14.72 min.
Depth of flow =   1.743(Ft.)
Average velocity =  20.328(Ft/s)
Total irregular channel flow =   486.127(CFS)
Irregular channel normal depth above invert elev. =   1.743(Ft.)
Average velocity of channel(s) =  20.328(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.071(In/Hr)
Rainfall intensity =      3.716(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.883
Subarea runoff =    168.847(CFS) for   60.170(Ac.)
Total runoff =    570.504(CFS)
Effective area this stream =      173.90(Ac.)
Total Study Area (Main Stream No. 1) =      173.90(Ac.)
Area averaged Fm value =    0.071(In/Hr)
Depth of flow =   1.874(Ft.), Average velocity =  21.185(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      415.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    173.900(Ac.)
Runoff from this stream =    570.504(CFS)
Time of concentration =   14.72 min.
Rainfall intensity =     3.716(In/Hr)
Area averaged loss rate (Fm) =    0.0710(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      500.000 to Point/Station      510.000
**** INITIAL AREA EVALUATION ****
```

```
____________________________________________________________________
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.071(In/Hr)
Initial subarea data:
Initial area flow distance =   970.000(Ft.)
Top (of initial area) elevation =  7120.000(Ft.)
Bottom (of initial area) elevation =  6600.000(Ft.)
Difference in elevation =   520.000(Ft.)
Slope =    0.53608  s(%)=      53.61
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.522 min.
Rainfall intensity =      4.162(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.885
Subarea runoff =     35.387(CFS)
Total initial stream area =        9.610(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.071(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      510.000 to Point/Station      520.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.562(Ft.), Average velocity =  16.431(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     72.119(CFS)
  '     '    flow top width =     10.620(Ft.)
  '     '    velocity=   16.431(Ft/s)
  '     '    area =      4.389(Sq.Ft)
  '     '    Froude number =     4.504

Upstream point elevation =  6600.000(Ft.)
Downstream point elevation =  6100.000(Ft.)
Flow length =   776.000(Ft.)
Travel time  =    0.79 min.
Time of concentration =   13.31 min.
Depth of flow =   0.562(Ft.)
Average velocity =  16.431(Ft/s)
Total irregular channel flow =    72.119(CFS)
Irregular channel normal depth above invert elev. =   0.562(Ft.)
Average velocity of channel(s) =  16.431(Ft/s)
```

```
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.071(In/Hr)
Rainfall intensity =      3.989(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =     73.385(CFS) for   21.240(Ac.)
Total runoff =    108.772(CFS)
Effective area this stream =       30.85(Ac.)
Total Study Area (Main Stream No. 1) =      204.75(Ac.)
Area averaged Fm value =    0.071(In/Hr)
Depth of flow =   0.695(Ft.), Average velocity =  18.466(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      520.000 to Point/Station      530.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.175(Ft.), Average velocity =  18.710(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    238.994(CFS)
  '     '    flow top width =     16.747(Ft.)
  '     '    velocity=   18.710(Ft/s)
  '     '    area =     12.774(Sq.Ft)
  '     '    Froude number =     3.775

Upstream point elevation =  6100.000(Ft.)
Downstream point elevation =  5710.000(Ft.)
Flow length =  1052.000(Ft.)
Travel time  =    0.94 min.
Time of concentration =   14.25 min.
Depth of flow =   1.175(Ft.)
Average velocity =  18.710(Ft/s)
Total irregular channel flow =   238.994(CFS)
Irregular channel normal depth above invert elev. =   1.175(Ft.)
Average velocity of channel(s) =  18.710(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
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
SCS curve number for soil(AMC 2)  = 84.00
Adjusted SCS curve number for AMC 3 = 96.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.071(In/Hr)
Rainfall intensity =      3.803(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.883
Subarea runoff =    260.367(CFS) for   79.050(Ac.)
Total runoff =    369.139(CFS)
Effective area this stream =      109.90(Ac.)
Total Study Area (Main Stream No. 1) =      283.80(Ac.)
Area averaged Fm value =    0.071(In/Hr)
Depth of flow =   1.441(Ft.), Average velocity =  20.979(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.873(Ft.), Average velocity =  13.504(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    374.190(CFS)
  '     '    flow top width =     33.492(Ft.)
  '     '    velocity=   13.504(Ft/s)
  '     '    area =     27.710(Sq.Ft)
  '     '    Froude number =     2.616

Upstream point elevation =  5710.000(Ft.)
Downstream point elevation =  5405.000(Ft.)
Flow length =  1764.000(Ft.)
Travel time  =    2.18 min.
Time of concentration =   16.42 min.
Depth of flow =   0.873(Ft.)
Average velocity =  13.504(Ft/s)
Total irregular channel flow =   374.189(CFS)
Irregular channel normal depth above invert elev. =   0.873(Ft.)
Average velocity of channel(s) =  13.504(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.500
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 83.50
Adjusted SCS curve number for AMC 3 = 96.10
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.077(In/Hr)
Rainfall intensity =      3.443(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =     10.007(CFS) for   15.070(Ac.)
Total runoff =    379.147(CFS)
Effective area this stream =      124.97(Ac.)
Total Study Area (Main Stream No. 1) =      298.87(Ac.)
Area averaged Fm value =    0.072(In/Hr)
Depth of flow =   0.880(Ft.), Average velocity =  13.570(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      530.000 to Point/Station      420.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    124.970(Ac.)
Runoff from this stream =    379.147(CFS)
Time of concentration =   16.42 min.
Rainfall intensity =     3.443(In/Hr)
Area averaged loss rate (Fm) =    0.0717(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    570.50   173.900     14.72    0.071      3.716
2    379.15   124.970     16.42    0.072      3.443
Qmax(1) =
         1.000 *    1.000 *   570.504) +
         1.081 *    0.897 *   379.147) + =     938.006
Qmax(2) =
         0.925 *    1.000 *   570.504) +
         1.000 *    1.000 *   379.147) + =     906.852

Total of 2 streams to confluence:
Flow rates before confluence point:
     570.504     379.147
Maximum flow rates at confluence using above data:
      938.006      906.852
Area of streams before confluence:
      173.900      124.970
Effective area values after confluence:
      285.943      298.870
Results of confluence:
Total flow rate =    938.006(CFS)
Time of concentration =    14.724 min.
Effective stream area after confluence =    285.943(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.071(In/Hr)
Study area total (this main stream) =     298.87(Ac.)


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Process from Point/Station      420.000 to Point/Station      425.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
```

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_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.637(Ft.), Average velocity =  17.636(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =    960.849(CFS)
  '     '    flow top width =     36.549(Ft.)
  '     '    velocity=   17.636(Ft/s)
  '     '    area =     54.481(Sq.Ft)
  '     '    Froude number =     2.546

Upstream point elevation =  5405.000(Ft.)
Downstream point elevation =  5169.000(Ft.)
Flow length =  1734.000(Ft.)
Travel time  =    1.64 min.
Time of concentration =   16.36 min.
Depth of flow =   1.637(Ft.)
Average velocity =  17.636(Ft/s)
Total irregular channel flow =   960.848(CFS)
Irregular channel normal depth above invert elev. =   1.637(Ft.)
Average velocity of channel(s) =  17.636(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.170
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.830
SCS curve number for soil(AMC 2)  = 87.13
Adjusted SCS curve number for AMC 3 = 97.43
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.051(In/Hr)
Rainfall intensity =      3.452(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =     45.600(CFS) for   37.150(Ac.)
Total runoff =    983.606(CFS)
Effective area this stream =      323.09(Ac.)
Total Study Area (Main Stream No. 1) =      336.02(Ac.)
Area averaged Fm value =    0.069(In/Hr)
Depth of flow =   1.660(Ft.), Average velocity =  17.783(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      425.000 to Point/Station      430.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.671(Ft.), Average velocity =  17.653(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    983.634(CFS)
  '     '    flow top width =     36.685(Ft.)
  '     '    velocity=   17.653(Ft/s)
  '     '    area =     55.722(Sq.Ft)
  '     '    Froude number =     2.524

Upstream point elevation =  5169.000(Ft.)
Downstream point elevation =  5109.000(Ft.)
Flow length =   451.000(Ft.)
Travel time  =    0.43 min.
Time of concentration =   16.79 min.
Depth of flow =   1.671(Ft.)
Average velocity =  17.653(Ft/s)
Total irregular channel flow =   983.634(CFS)
Irregular channel normal depth above invert elev. =   1.671(Ft.)
Average velocity of channel(s) =  17.653(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.300
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.700
SCS curve number for soil(AMC 2)  = 85.70
Adjusted SCS curve number for AMC 3 = 97.14
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.057(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    979.909(CFS)
therefore the upstream flow rate of Q =    983.606(CFS) is being used
Rainfall intensity =      3.390(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      0.000(CFS) for    4.730(Ac.)
Total runoff =    983.606(CFS)
Effective area this stream =      327.82(Ac.)
Total Study Area (Main Stream No. 1) =      340.75(Ac.)
Area averaged Fm value =    0.069(In/Hr)
Depth of flow =   1.671(Ft.), Average velocity =  17.652(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      430.000 to Point/Station      435.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.674(Ft.), Average velocity =  17.616(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
```

```
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =    983.634(CFS)
  '     '    flow top width =     36.698(Ft.)
  '     '    velocity=   17.616(Ft/s)
  '     '    area =     55.839(Sq.Ft)
  '     '    Froude number =     2.517

Upstream point elevation =  5109.000(Ft.)
Downstream point elevation =  5010.000(Ft.)
Flow length =   749.000(Ft.)
Travel time  =    0.71 min.
Time of concentration =   17.50 min.
Depth of flow =   1.674(Ft.)
Average velocity =  17.616(Ft/s)
Total irregular channel flow =   983.634(CFS)
Irregular channel normal depth above invert elev. =   1.674(Ft.)
Average velocity of channel(s) =  17.616(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Adjusted SCS curve number for AMC 3 = 95.64
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.086(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    965.091(CFS)
therefore the upstream flow rate of Q =    983.606(CFS) is being used
Rainfall intensity =      3.293(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =      0.000(CFS) for    4.750(Ac.)
Total runoff =    983.606(CFS)
Effective area this stream =      332.57(Ac.)
Total Study Area (Main Stream No. 1) =      345.50(Ac.)
Area averaged Fm value =    0.069(In/Hr)
Depth of flow =   1.674(Ft.), Average velocity =  17.615(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      435.000 to Point/Station      440.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.672(Ft.), Average velocity =  17.642(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
```

```
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    983.637(CFS)
  '     '    flow top width =     36.689(Ft.)
  '     '    velocity=   17.642(Ft/s)
  '     '    area =     55.757(Sq.Ft)
  '     '    Froude number =     2.522

Upstream point elevation =  5010.000(Ft.)
Downstream point elevation =  4978.000(Ft.)
Flow length =   241.000(Ft.)
Travel time  =    0.23 min.
Time of concentration =   17.73 min.
Depth of flow =   1.672(Ft.)
Average velocity =  17.642(Ft/s)
Total irregular channel flow =   983.637(CFS)
Irregular channel normal depth above invert elev. =   1.672(Ft.)
Average velocity of channel(s) =  17.642(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.570
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.430
SCS curve number for soil(AMC 2)  = 82.73
Adjusted SCS curve number for AMC 3 = 95.64
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.086(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    971.397(CFS)
therefore the upstream flow rate of Q =    983.606(CFS) is being used
Rainfall intensity =      3.264(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =      0.000(CFS) for    5.310(Ac.)
Total runoff =    983.606(CFS)
Effective area this stream =      337.88(Ac.)
Total Study Area (Main Stream No. 1) =      350.81(Ac.)
Area averaged Fm value =    0.069(In/Hr)
Depth of flow =   1.672(Ft.), Average velocity =  17.641(Ft/s)


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Process from Point/Station      440.000 to Point/Station      441.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   2.741(Ft.), Average velocity =  19.191(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
```

```
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    983.814(CFS)
  '     '    flow top width =     32.408(Ft.)
  '     '    velocity=   19.191(Ft/s)
  '     '    area =     51.264(Sq.Ft)
  '     '    Froude number =     2.689

Upstream point elevation =  4978.000(Ft.)
Downstream point elevation =  4700.000(Ft.)
Flow length =  1878.000(Ft.)
Travel time  =    1.63 min.
Time of concentration =   19.36 min.
Depth of flow =   2.741(Ft.)
Average velocity =  19.191(Ft/s)
Total irregular channel flow =   983.815(CFS)
Irregular channel normal depth above invert elev. =   2.741(Ft.)
Average velocity of channel(s) =  19.191(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.069(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff =      0.336(CFS) for   27.260(Ac.)
Total runoff =    983.942(CFS)
Effective area this stream =      365.14(Ac.)
Total Study Area (Main Stream No. 1) =      378.07(Ac.)
Area averaged Fm value =    0.075(In/Hr)
Depth of flow =   2.741(Ft.), Average velocity =  19.192(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      441.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   2.702(Ft.), Average velocity =  19.678(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    983.983(CFS)
  '     '    flow top width =     32.017(Ft.)
  '     '    velocity=   19.678(Ft/s)
```

```
  '     '    area =     50.005(Sq.Ft)
  '     '    Froude number =     2.775

Upstream point elevation =  4700.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2527.000(Ft.)
Travel time  =    2.14 min.
Time of concentration =   21.50 min.
Depth of flow =   2.702(Ft.)
Average velocity =  19.678(Ft/s)
Total irregular channel flow =   983.983(CFS)
Irregular channel normal depth above invert elev. =   2.702(Ft.)
Average velocity of channel(s) =  19.678(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    951.042(CFS)
therefore the upstream flow rate of Q =    983.942(CFS) is being used
Rainfall intensity =      2.851(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =      0.000(CFS) for   15.770(Ac.)
Total runoff =    983.942(CFS)
Effective area this stream =      380.91(Ac.)
Total Study Area (Main Stream No. 1) =      393.84(Ac.)
Area averaged Fm value =    0.077(In/Hr)
Depth of flow =   2.702(Ft.), Average velocity =  19.678(Ft/s)


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Process from Point/Station      441.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =    380.913(Ac.)
Runoff from this stream =    983.942(CFS)
Time of concentration =   21.50 min.
Rainfall intensity =     2.851(In/Hr)
Area averaged loss rate (Fm) =    0.0773(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      700.000 to Point/Station      710.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
```

```
Decimal fraction soil group B = 0.790
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.210
SCS curve number for soil(AMC 2)  = 80.31
Adjusted SCS curve number for AMC 3 = 94.19
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.114(In/Hr)
Initial subarea data:
Initial area flow distance =   929.000(Ft.)
Top (of initial area) elevation =  5851.000(Ft.)
Bottom (of initial area) elevation =  5495.000(Ft.)
Difference in elevation =   356.000(Ft.)
Slope =    0.38321  s(%)=      38.32
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.788 min.
Rainfall intensity =      4.946(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.879
Subarea runoff =     30.313(CFS)
Total initial stream area =        6.970(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.114(In/Hr)


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Process from Point/Station      710.000 to Point/Station      720.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.850(Ft.), Average velocity =   7.645(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     60.143(CFS)
  '     '    flow top width =     13.503(Ft.)
  '     '    velocity=    7.645(Ft/s)
  '     '    area =      7.867(Sq.Ft)
  '     '    Froude number =     1.765

Upstream point elevation =  5495.000(Ft.)
Downstream point elevation =  5315.000(Ft.)
Flow length =  2034.000(Ft.)
Travel time  =    4.43 min.
Time of concentration =   14.22 min.
Depth of flow =   0.850(Ft.)
Average velocity =   7.645(Ft/s)
Total irregular channel flow =    60.143(CFS)
Irregular channel normal depth above invert elev. =   0.850(Ft.)
Average velocity of channel(s) =   7.645(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
```

```
Decimal fraction soil group B = 0.980
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.020
SCS curve number for soil(AMC 2)  = 78.22
Adjusted SCS curve number for AMC 3 = 92.93
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.138(In/Hr)
Rainfall intensity =      3.808(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.869
Subarea runoff =     59.582(CFS) for   20.200(Ac.)
Total runoff =     89.895(CFS)
Effective area this stream =       27.17(Ac.)
Total Study Area (Main Stream No. 2) =      421.01(Ac.)
Area averaged Fm value =    0.131(In/Hr)
Depth of flow =   1.036(Ft.), Average velocity =   8.525(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      720.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.864(Ft.), Average velocity =  13.638(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =    109.774(CFS)
  '     '    flow top width =     13.638(Ft.)
  '     '    velocity=   13.638(Ft/s)
  '     '    area =      8.049(Sq.Ft)
  '     '    Froude number =     3.128

Upstream point elevation =  5315.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1756.000(Ft.)
Travel time  =    2.15 min.
Time of concentration =   16.37 min.
Depth of flow =   0.864(Ft.)
Average velocity =  13.638(Ft/s)
Total irregular channel flow =   109.774(CFS)
Irregular channel normal depth above invert elev. =   0.864(Ft.)
Average velocity of channel(s) =  13.638(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
```

```
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.451(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.865
Subarea runoff =     39.698(CFS) for   16.250(Ac.)
Total runoff =    129.592(CFS)
Effective area this stream =       43.42(Ac.)
Total Study Area (Main Stream No. 2) =      437.26(Ac.)
Area averaged Fm value =    0.135(In/Hr)
Depth of flow =   0.938(Ft.), Average velocity =  14.268(Ft/s)


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Process from Point/Station      720.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =     43.420(Ac.)
Runoff from this stream =    129.592(CFS)
Time of concentration =   16.37 min.
Rainfall intensity =     3.451(In/Hr)
Area averaged loss rate (Fm) =    0.1346(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


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Process from Point/Station      800.000 to Point/Station      810.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.180
Decimal fraction soil group D = 0.820
SCS curve number for soil(AMC 2)  = 88.46
Adjusted SCS curve number for AMC 3 = 97.69
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.046(In/Hr)
Initial subarea data:
Initial area flow distance =   964.000(Ft.)
Top (of initial area) elevation =  5664.000(Ft.)
Bottom (of initial area) elevation =  5225.000(Ft.)
Difference in elevation =   439.000(Ft.)
Slope =    0.45539  s(%)=      45.54
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.596 min.
Rainfall intensity =      5.015(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =     44.720(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.046(In/Hr)


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Process from Point/Station      810.000 to Point/Station      730.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
```

```
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.109(Ft.), Average velocity =  13.416(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------
Sub-Channel flow  =    156.925(CFS)
  '     '    flow top width =     16.092(Ft.)
  '     '    velocity=   13.416(Ft/s)
  '     '    area =     11.697(Sq.Ft)
  '     '    Froude number =     2.773

Upstream point elevation =  5225.000(Ft.)
Downstream point elevation =  4829.000(Ft.)
Flow length =  1949.000(Ft.)
Travel time  =    2.42 min.
Time of concentration =   12.02 min.
Depth of flow =   1.109(Ft.)
Average velocity =  13.416(Ft/s)
Total irregular channel flow =   156.925(CFS)
Irregular channel normal depth above invert elev. =   1.109(Ft.)
Average velocity of channel(s) =  13.416(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.240
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 86.33
Adjusted SCS curve number for AMC 3 = 97.27
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.054(In/Hr)
Rainfall intensity =      4.284(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =    224.348(CFS) for   60.660(Ac.)
Total runoff =    269.068(CFS)
Effective area this stream =       70.66(Ac.)
Total Study Area (Main Stream No. 2) =      507.92(Ac.)
Area averaged Fm value =    0.053(In/Hr)
Depth of flow =   1.431(Ft.), Average velocity =  15.468(Ft/s)


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Process from Point/Station      810.000 to Point/Station      730.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =     70.660(Ac.)
Runoff from this stream =    269.068(CFS)
Time of concentration =   12.02 min.
Rainfall intensity =     4.284(In/Hr)
```

```
Area averaged loss rate (Fm) =    0.0529(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    129.59    43.420     16.37    0.135      3.451
2    269.07    70.660     12.02    0.053      4.284
Qmax(1) =
         1.000 *    1.000 *   129.592) +
         0.803 *    1.000 *   269.068) + =     345.682
Qmax(2) =
         1.251 *    0.734 *   129.592) +
         1.000 *    1.000 *   269.068) + =     388.123

Total of 2 streams to confluence:
Flow rates before confluence point:
     129.592     269.068
Maximum flow rates at confluence using above data:
      345.682      388.123
Area of streams before confluence:
       43.420       70.660
Effective area values after confluence:
      114.080      102.541
Results of confluence:
Total flow rate =    388.123(CFS)
Time of concentration =    12.018 min.
Effective stream area after confluence =    102.541(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.084(In/Hr)
Study area total (this main stream) =     114.08(Ac.)


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Process from Point/Station      730.000 to Point/Station      740.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   2.041(Ft.), Average velocity =  14.754(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    457.848(CFS)
  '     '    flow top width =     25.410(Ft.)
  '     '    velocity=   14.754(Ft/s)
  '     '    area =     31.032(Sq.Ft)
  '     '    Froude number =     2.353
```

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Upstream point elevation =  4829.000(Ft.)
Downstream point elevation =  4580.000(Ft.)
Flow length =  2018.000(Ft.)
Travel time  =    2.28 min.
Time of concentration =   14.30 min.
Depth of flow =   2.041(Ft.)
Average velocity =  14.754(Ft/s)
Total irregular channel flow =   457.848(CFS)
Irregular channel normal depth above invert elev. =   2.041(Ft.)
Average velocity of channel(s) =  14.754(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.380
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.610
SCS curve number for soil(AMC 2)  = 84.79
Adjusted SCS curve number for AMC 3 = 96.87
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      3.794(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =    139.371(CFS) for   55.130(Ac.)
Total runoff =    527.494(CFS)
Effective area this stream =      157.67(Ac.)
Total Study Area (Main Stream No. 2) =      563.05(Ac.)
Area averaged Fm value =    0.076(In/Hr)
Depth of flow =   2.173(Ft.), Average velocity =  15.299(Ft/s)


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Process from Point/Station      740.000 to Point/Station      750.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   2.350(Ft.), Average velocity =  15.464(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =    608.490(CFS)
  '     '    flow top width =     28.496(Ft.)
  '     '    velocity=   15.464(Ft/s)
  '     '    area =     39.350(Sq.Ft)
  '     '    Froude number =     2.319

Upstream point elevation =  4580.000(Ft.)
Downstream point elevation =  4300.000(Ft.)
Flow length =  2432.000(Ft.)
Travel time  =    2.62 min.
Time of concentration =   16.92 min.
```

```
Depth of flow =   2.350(Ft.)
Average velocity =  15.464(Ft/s)
Total irregular channel flow =   608.490(CFS)
Irregular channel normal depth above invert elev. =   2.350(Ft.)
Average velocity of channel(s) =  15.464(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.660
Decimal fraction soil group C = 0.010
Decimal fraction soil group D = 0.330
SCS curve number for soil(AMC 2)  = 81.71
Adjusted SCS curve number for AMC 3 = 95.03
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.098(In/Hr)
Rainfall intensity =      3.372(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff =    161.941(CFS) for   75.260(Ac.)
Total runoff =    689.435(CFS)
Effective area this stream =      232.93(Ac.)
Total Study Area (Main Stream No. 2) =      638.31(Ac.)
Area averaged Fm value =    0.083(In/Hr)
Depth of flow =   2.481(Ft.), Average velocity =  15.964(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      740.000 to Point/Station      750.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =    232.931(Ac.)
Runoff from this stream =    689.435(CFS)
Time of concentration =   16.92 min.
Rainfall intensity =     3.372(In/Hr)
Area averaged loss rate (Fm) =    0.0831(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1    983.94   380.913     21.50    0.077      2.851
2    689.44   232.931     16.92    0.083      3.372
Qmax(1) =
         1.000 *    1.000 *   983.942) +
         0.842 *    1.000 *   689.435) + =    1564.282
Qmax(2) =
         1.188 *    0.787 *   983.942) +
         1.000 *    1.000 *   689.435) + =    1609.103

Total of 2 main streams to confluence:
Flow rates before confluence point:
     984.942     690.435
Maximum flow rates at confluence using above data:
     1564.282     1609.103
```

```
Area of streams before confluence:
      380.913      232.931
Effective area values after confluence:
      613.844      532.724


Results of confluence:
Total flow rate =   1609.103(CFS)
Time of concentration =    16.919 min.
Effective stream area after confluence  =    532.724(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total =     613.84(Ac.)
End of computations, Total Study Area =          638.31 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.5
```

Haul Road and Drainage East of Quarry

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/22/11

White Knob Haul Road
Haul Road and Drainage East of Quarry
2 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 2.0
Computed rainfall intensity:
Storm year = 2.00 1 hour rainfall = 0.491 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 442.000 to Point/Station 445.000
**** INITIAL AREA EVALUATION ****
_____
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.404(In/Hr)
Initial subarea data:
Initial area flow distance = 441.000(Ft.)
Top (of initial area) elevation = 4978.000(Ft.)
Bottom (of initial area) elevation = 4918.000(Ft.)
Difference in elevation = 60.000(Ft.)
Slope = 0.13605 s(%)= 13.61
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.937 min.
Rainfall intensity = 1.862(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.705
Subarea runoff = 0.696(CFS)
Total initial stream area = 0.530(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.404(In/Hr)

++
Process from Point/Station 445.000 to Point/Station 450.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.030(Ft.), Average velocity =   1.311(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =      1.180(CFS)
  '     '    flow top width =     30.120(Ft.)
  '     '    velocity=    1.311(Ft/s)
  '     '    area =      0.900(Sq.Ft)
  '     '    Froude number =     1.336

Upstream point elevation =  4918.000(Ft.)
Downstream point elevation =  4810.000(Ft.)
Flow length =   804.000(Ft.)
Travel time  =   10.22 min.
Time of concentration =   19.16 min.
Depth of flow =   0.030(Ft.)
Average velocity =   1.311(Ft/s)
Total irregular channel flow =     1.180(CFS)
Irregular channel normal depth above invert elev. =   0.030(Ft.)
Average velocity of channel(s) =   1.311(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.092(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.567
Subarea runoff =      0.878(CFS) for    2.010(Ac.)
Total runoff =      1.573(CFS)
Effective area this stream =        2.54(Ac.)
Total Study Area (Main Stream No. 1) =        2.54(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.036(Ft.), Average velocity =   1.470(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      450.000 to Point/Station      455.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.046(Ft.), Average velocity =   1.767(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =      2.425(CFS)
  '     '    flow top width =     30.182(Ft.)
  '     '    velocity=    1.767(Ft/s)
  '     '    area =      1.373(Sq.Ft)
  '     '    Froude number =     1.460

Upstream point elevation =  4810.000(Ft.)
Downstream point elevation =  4562.000(Ft.)
Flow length =  1778.000(Ft.)
Travel time  =   16.77 min.
Time of concentration =   35.93 min.
Depth of flow =   0.046(Ft.)
Average velocity =   1.767(Ft/s)
Total irregular channel flow =     2.425(CFS)
Irregular channel normal depth above invert elev. =   0.046(Ft.)
Average velocity of channel(s) =   1.767(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      0.703(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.383
Subarea runoff =      1.621(CFS) for    9.310(Ac.)
Total runoff =      3.194(CFS)
Effective area this stream =       11.85(Ac.)
Total Study Area (Main Stream No. 1) =       11.85(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.054(Ft.), Average velocity =   1.972(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      455.000 to Point/Station      460.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.065(Ft.), Average velocity =   2.221(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
```

```
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =      4.366(CFS)
  '     '    flow top width =     30.261(Ft.)
  '     '    velocity=    2.221(Ft/s)
  '     '    area =      1.966(Sq.Ft)
  '     '    Froude number =     1.535

Upstream point elevation =  4562.000(Ft.)
Downstream point elevation =  4482.000(Ft.)
Flow length =   584.000(Ft.)
Travel time  =    4.38 min.
Time of concentration =   40.31 min.
Depth of flow =   0.065(Ft.)
Average velocity =   2.221(Ft/s)
Total irregular channel flow =     4.366(CFS)
Irregular channel normal depth above invert elev. =   0.065(Ft.)
Average velocity of channel(s) =   2.221(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      0.649(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.340
Subarea runoff =      2.256(CFS) for   12.860(Ac.)
Total runoff =      5.450(CFS)
Effective area this stream =       24.71(Ac.)
Total Study Area (Main Stream No. 1) =       24.71(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.075(Ft.), Average velocity =   2.425(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.071(Ft.), Average velocity =   2.559(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =      5.487(CFS)
  '     '    flow top width =     30.285(Ft.)
  '     '    velocity=    2.559(Ft/s)
  '     '    area =      2.144(Sq.Ft)
```

```
  '     '    Froude number =     1.695

Upstream point elevation =  4482.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1005.000(Ft.)
Travel time  =    6.55 min.
Time of concentration =   46.86 min.
Depth of flow =   0.071(Ft.)
Average velocity =   2.559(Ft/s)
Total irregular channel flow =     5.487(CFS)
Irregular channel normal depth above invert elev. =   0.071(Ft.)
Average velocity of channel(s) =   2.559(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      4.887(CFS)
therefore the upstream flow rate of Q =      5.450(CFS) is being used
Rainfall intensity =      0.584(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.278
Subarea runoff =      0.000(CFS) for    5.420(Ac.)
Total runoff =      5.450(CFS)
Effective area this stream =       30.13(Ac.)
Total Study Area (Main Stream No. 1) =       30.13(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.071(Ft.), Average velocity =   2.552(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     30.130(Ac.)
Runoff from this stream =      5.450(CFS)
Time of concentration =   46.86 min.
Rainfall intensity =     0.584(In/Hr)
Area averaged loss rate (Fm) =    0.4035(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      600.000 to Point/Station      610.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
```

```
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.211(In/Hr)
Initial subarea data:
Initial area flow distance =   911.000(Ft.)
Top (of initial area) elevation =  5633.000(Ft.)
Bottom (of initial area) elevation =  5200.000(Ft.)
Difference in elevation =   433.000(Ft.)
Slope =    0.47530  s(%)=      47.53
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.302 min.
Rainfall intensity =      1.810(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.795
Subarea runoff =     14.397(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.211(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      610.000 to Point/Station      620.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.455(Ft.), Average velocity =   8.708(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     28.805(CFS)
  '     '    flow top width =      9.548(Ft.)
  '     '    velocity=    8.708(Ft/s)
  '     '    area =      3.308(Sq.Ft)
  '     '    Froude number =     2.607

Upstream point elevation =  5200.000(Ft.)
Downstream point elevation =  4975.000(Ft.)
Flow length =   984.000(Ft.)
Travel time  =    1.88 min.
Time of concentration =   11.19 min.
Depth of flow =   0.455(Ft.)
Average velocity =   8.708(Ft/s)
Total irregular channel flow =    28.805(CFS)
Irregular channel normal depth above invert elev. =   0.455(Ft.)
Average velocity of channel(s) =   8.708(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.211(In/Hr)
```

```
Rainfall intensity =      1.591(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.781
Subarea runoff =     28.753(CFS) for   24.730(Ac.)
Total runoff =     43.150(CFS)
Effective area this stream =       34.73(Ac.)
Total Study Area (Main Stream No. 1) =       64.86(Ac.)
Area averaged Fm value =    0.211(In/Hr)
Depth of flow =   0.563(Ft.), Average velocity =   9.801(Ft/s)


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Process from Point/Station      620.000 to Point/Station      630.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.889(Ft.), Average velocity =   9.497(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     79.721(CFS)
  '     '    flow top width =     13.888(Ft.)
  '     '    velocity=    9.497(Ft/s)
  '     '    area =      8.394(Sq.Ft)
  '     '    Froude number =     2.153

Upstream point elevation =  4975.000(Ft.)
Downstream point elevation =  4640.000(Ft.)
Flow length =  2576.000(Ft.)
Travel time  =    4.52 min.
Time of concentration =   15.71 min.
Depth of flow =   0.889(Ft.)
Average velocity =   9.497(Ft/s)
Total irregular channel flow =    79.721(CFS)
Irregular channel normal depth above invert elev. =   0.889(Ft.)
Average velocity of channel(s) =   9.497(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.460
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.540
SCS curve number for soil(AMC 2)  = 83.94
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.302(In/Hr)
Rainfall intensity =      1.255(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.701
Subarea runoff =     73.070(CFS) for   97.450(Ac.)
Total runoff =    116.220(CFS)
Effective area this stream =      132.18(Ac.)
```

```
Total Study Area (Main Stream No. 1) =      162.31(Ac.)
Area averaged Fm value =    0.278(In/Hr)
Depth of flow =   1.069(Ft.), Average velocity =  10.514(Ft/s)


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Process from Point/Station      630.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.007(Ft.), Average velocity =  11.672(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    117.902(CFS)
  '     '    flow top width =     15.068(Ft.)
  '     '    velocity=   11.672(Ft/s)
  '     '    area =     10.102(Sq.Ft)
  '     '    Froude number =     2.512

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1875.000(Ft.)
Travel time  =    2.68 min.
Time of concentration =   18.38 min.
Depth of flow =   1.007(Ft.)
Average velocity =  11.672(Ft/s)
Total irregular channel flow =   117.902(CFS)
Irregular channel normal depth above invert elev. =   1.007(Ft.)
Average velocity of channel(s) =  11.672(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.124(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.659
Subarea runoff =      3.266(CFS) for   29.060(Ac.)
Total runoff =    119.485(CFS)
Effective area this stream =      161.24(Ac.)
Total Study Area (Main Stream No. 1) =      191.37(Ac.)
Area averaged Fm value =    0.300(In/Hr)
Depth of flow =   1.013(Ft.), Average velocity =  11.714(Ft/s)


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```
Process from Point/Station      630.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    161.240(Ac.)
Runoff from this stream =    119.485(CFS)
Time of concentration =   18.38 min.
Rainfall intensity =     1.124(In/Hr)
Area averaged loss rate (Fm) =    0.3004(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1      5.45    30.130     46.86    0.404      0.584
2    119.49   161.240     18.38    0.300      1.124
Qmax(1) =
         1.000 *    1.000 *     5.450) +
         0.344 *    1.000 *   119.485) + =      46.564
Qmax(2) =
         3.997 *    0.392 *     5.450) +
         1.000 *    1.000 *   119.485) + =     128.030

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.450     119.485
Maximum flow rates at confluence using above data:
       46.564      128.030
Area of streams before confluence:
       30.130      161.240
Effective area values after confluence:
      191.370      173.060
Results of confluence:
Total flow rate =    128.030(CFS)
Time of concentration =    18.383 min.
Effective stream area after confluence =    173.060(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.317(In/Hr)
Study area total (this main stream) =     191.37(Ac.)
End of computations, Total Study Area =          191.37 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/22/11

White Knob Haul Road
Haul Road and Drainage East of Quarry
10 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.811 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 442.000 to Point/Station 445.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.404(In/Hr)
Initial subarea data:
Initial area flow distance = 441.000(Ft.)
Top (of initial area) elevation = 4978.000(Ft.)
Bottom (of initial area) elevation = 4918.000(Ft.)
Difference in elevation = 60.000(Ft.)
Slope = 0.13605 s(%)= 13.61
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.937 min.
Rainfall intensity = 3.075(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.782
Subarea runoff = 1.274(CFS)
Total initial stream area = 0.530(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.404(In/Hr)

++
Process from Point/Station 445.000 to Point/Station 450.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.047(Ft.), Average velocity =   1.766(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =      2.494(CFS)
  '     '    flow top width =     30.188(Ft.)
  '     '    velocity=    1.767(Ft/s)
  '     '    area =      1.412(Sq.Ft)
  '     '    Froude number =     1.440

Upstream point elevation =  4918.000(Ft.)
Downstream point elevation =  4810.000(Ft.)
Flow length =   804.000(Ft.)
Travel time  =    7.59 min.
Time of concentration =   16.52 min.
Depth of flow =   0.047(Ft.)
Average velocity =   1.766(Ft/s)
Total irregular channel flow =     2.494(CFS)
Irregular channel normal depth above invert elev. =   0.047(Ft.)
Average velocity of channel(s) =   1.766(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.000(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.718
Subarea runoff =      2.376(CFS) for    2.010(Ac.)
Total runoff =      3.650(CFS)
Effective area this stream =        2.54(Ac.)
Total Study Area (Main Stream No. 1) =        2.54(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.059(Ft.), Average velocity =   2.056(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      450.000 to Point/Station      455.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.088(Ft.), Average velocity =   2.724(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =      7.204(CFS)
  '     '    flow top width =     30.351(Ft.)
  '     '    velocity=    2.724(Ft/s)
  '     '    area =      2.644(Sq.Ft)
  '     '    Froude number =     1.627

Upstream point elevation =  4810.000(Ft.)
Downstream point elevation =  4562.000(Ft.)
Flow length =  1778.000(Ft.)
Travel time  =   10.88 min.
Time of concentration =   27.40 min.
Depth of flow =   0.088(Ft.)
Average velocity =   2.724(Ft/s)
Total irregular channel flow =     7.204(CFS)
Irregular channel normal depth above invert elev. =   0.088(Ft.)
Average velocity of channel(s) =   2.724(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.404(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.641
Subarea runoff =      7.018(CFS) for    9.310(Ac.)
Total runoff =     10.668(CFS)
Effective area this stream =       11.85(Ac.)
Total Study Area (Main Stream No. 1) =       11.85(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.111(Ft.), Average velocity =   3.183(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      455.000 to Point/Station      460.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.140(Ft.), Average velocity =   3.671(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
```

```
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     15.513(CFS)
  '     '    flow top width =     30.558(Ft.)
  '     '    velocity=    3.671(Ft/s)
  '     '    area =      4.225(Sq.Ft)
  '     '    Froude number =     1.740

Upstream point elevation =  4562.000(Ft.)
Downstream point elevation =  4482.000(Ft.)
Flow length =   584.000(Ft.)
Travel time  =    2.65 min.
Time of concentration =   30.05 min.
Depth of flow =   0.140(Ft.)
Average velocity =   3.671(Ft/s)
Total irregular channel flow =    15.513(CFS)
Irregular channel normal depth above invert elev. =   0.140(Ft.)
Average velocity of channel(s) =   3.671(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.316(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.624
Subarea runoff =      9.623(CFS) for   12.860(Ac.)
Total runoff =     20.291(CFS)
Effective area this stream =       24.71(Ac.)
Total Study Area (Main Stream No. 1) =       24.71(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.164(Ft.), Average velocity =   4.082(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.160(Ft.), Average velocity =   4.365(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     21.126(CFS)
  '     '    flow top width =     30.639(Ft.)
  '     '    velocity=    4.365(Ft/s)
  '     '    area =      4.840(Sq.Ft)
```

```
  '     '    Froude number =     1.935

Upstream point elevation =  4482.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1005.000(Ft.)
Travel time  =    3.84 min.
Time of concentration =   33.89 min.
Depth of flow =   0.160(Ft.)
Average velocity =   4.365(Ft/s)
Total irregular channel flow =    21.126(CFS)
Irregular channel normal depth above invert elev. =   0.160(Ft.)
Average velocity of channel(s) =   4.365(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.210(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.600
Subarea runoff =      1.572(CFS) for    5.420(Ac.)
Total runoff =     21.862(CFS)
Effective area this stream =       30.13(Ac.)
Total Study Area (Main Stream No. 1) =       30.13(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.163(Ft.), Average velocity =   4.424(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     30.130(Ac.)
Runoff from this stream =     21.862(CFS)
Time of concentration =   33.89 min.
Rainfall intensity =     1.210(In/Hr)
Area averaged loss rate (Fm) =    0.4035(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      600.000 to Point/Station      610.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.211(In/Hr)
Initial subarea data:
Initial area flow distance =   911.000(Ft.)
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```
Top (of initial area) elevation =  5633.000(Ft.)
Bottom (of initial area) elevation =  5200.000(Ft.)
Difference in elevation =   433.000(Ft.)
Slope =    0.47530  s(%)=      47.53
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.302 min.
Rainfall intensity =      2.990(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.837
Subarea runoff =     25.017(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.211(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      610.000 to Point/Station      620.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.615(Ft.), Average velocity =  10.287(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     51.095(CFS)
  '     '    flow top width =     11.151(Ft.)
  '     '    velocity=   10.287(Ft/s)
  '     '    area =      4.967(Sq.Ft)
  '     '    Froude number =     2.716

Upstream point elevation =  5200.000(Ft.)
Downstream point elevation =  4975.000(Ft.)
Flow length =   984.000(Ft.)
Travel time  =    1.59 min.
Time of concentration =   10.90 min.
Depth of flow =   0.615(Ft.)
Average velocity =  10.287(Ft/s)
Total irregular channel flow =    51.094(CFS)
Irregular channel normal depth above invert elev. =   0.615(Ft.)
Average velocity of channel(s) =  10.287(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.211(In/Hr)
Rainfall intensity =      2.677(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.829
```

```
Subarea runoff =     52.068(CFS) for   24.730(Ac.)
Total runoff =     77.084(CFS)
Effective area this stream =       34.73(Ac.)
Total Study Area (Main Stream No. 1) =       64.86(Ac.)
Area averaged Fm value =    0.211(In/Hr)
Depth of flow =   0.759(Ft.), Average velocity =  11.546(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      620.000 to Point/Station      630.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.212(Ft.), Average velocity =  11.276(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    151.162(CFS)
  '     '    flow top width =     17.121(Ft.)
  '     '    velocity=   11.276(Ft/s)
  '     '    area =     13.406(Sq.Ft)
  '     '    Froude number =     2.246

Upstream point elevation =  4975.000(Ft.)
Downstream point elevation =  4640.000(Ft.)
Flow length =  2576.000(Ft.)
Travel time  =    3.81 min.
Time of concentration =   14.70 min.
Depth of flow =   1.212(Ft.)
Average velocity =  11.276(Ft/s)
Total irregular channel flow =   151.162(CFS)
Irregular channel normal depth above invert elev. =   1.212(Ft.)
Average velocity of channel(s) =  11.276(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.460
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.540
SCS curve number for soil(AMC 2)  = 83.94
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.302(In/Hr)
Rainfall intensity =      2.170(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.785
Subarea runoff =    148.061(CFS) for   97.450(Ac.)
Total runoff =    225.145(CFS)
Effective area this stream =      132.18(Ac.)
Total Study Area (Main Stream No. 1) =      162.31(Ac.)
Area averaged Fm value =    0.278(In/Hr)
Depth of flow =   1.461(Ft.), Average velocity =  12.521(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      630.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.394(Ft.), Average velocity =  13.991(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    233.443(CFS)
  '     '    flow top width =     18.940(Ft.)
  '     '    velocity=   13.991(Ft/s)
  '     '    area =     16.686(Sq.Ft)
  '     '    Froude number =     2.627

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1875.000(Ft.)
Travel time  =    2.23 min.
Time of concentration =   16.94 min.
Depth of flow =   1.394(Ft.)
Average velocity =  13.991(Ft/s)
Total irregular channel flow =   233.443(CFS)
Irregular channel normal depth above invert elev. =   1.394(Ft.)
Average velocity of channel(s) =  13.991(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.966(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.762
Subarea runoff =     16.524(CFS) for   29.060(Ac.)
Total runoff =    241.669(CFS)
Effective area this stream =      161.24(Ac.)
Total Study Area (Main Stream No. 1) =      191.37(Ac.)
Area averaged Fm value =    0.300(In/Hr)
Depth of flow =   1.417(Ft.), Average velocity =  14.118(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      630.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
```

```
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    161.240(Ac.)
Runoff from this stream =    241.669(CFS)
Time of concentration =   16.94 min.
Rainfall intensity =     1.966(In/Hr)
Area averaged loss rate (Fm) =    0.3004(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1     21.86    30.130     33.89    0.404      1.210
2    241.67   161.240     16.94    0.300      1.966
Qmax(1) =
         1.000 *    1.000 *    21.862) +
         0.546 *    1.000 *   241.669) + =     153.817
Qmax(2) =
         1.938 *    0.500 *    21.862) +
         1.000 *    1.000 *   241.669) + =     262.843

Total of 2 streams to confluence:
Flow rates before confluence point:
      21.862     241.669
Maximum flow rates at confluence using above data:
      153.817      262.843
Area of streams before confluence:
       30.130      161.240
Effective area values after confluence:
      191.370      176.299
Results of confluence:
Total flow rate =    262.843(CFS)
Time of concentration =    16.937 min.
Effective stream area after confluence =    176.299(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.317(In/Hr)
Study area total (this main stream) =     191.37(Ac.)
End of computations, Total Study Area =          191.37 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/22/11

White Knob Haul Road
Haul Road and Drainage East of Quarry
25 Year Flow

Program License Serial Number 6026

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

Rational hydrology study storm event year is 25.0
Computed rainfall intensity:
Storm year = 25.00 1 hour rainfall = 1.030 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 442.000 to Point/Station 445.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 78.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.404(In/Hr)
Initial subarea data:
Initial area flow distance = 441.000(Ft.)
Top (of initial area) elevation = 4978.000(Ft.)
Bottom (of initial area) elevation = 4918.000(Ft.)
Difference in elevation = 60.000(Ft.)
Slope = 0.13605 s(%)= 13.61
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.937 min.
Rainfall intensity = 3.906(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.807
Subarea runoff = 1.671(CFS)
Total initial stream area = 0.530(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.404(In/Hr)

++
Process from Point/Station 445.000 to Point/Station 450.000

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.057(Ft.), Average velocity =   2.005(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =      3.430(CFS)
  '     '    flow top width =     30.227(Ft.)
  '     '    velocity=    2.006(Ft/s)
  '     '    area =      1.710(Sq.Ft)
  '     '    Froude number =     1.486

Upstream point elevation =  4918.000(Ft.)
Downstream point elevation =  4810.000(Ft.)
Flow length =   804.000(Ft.)
Travel time  =    6.68 min.
Time of concentration =   15.62 min.
Depth of flow =   0.057(Ft.)
Average velocity =   2.005(Ft/s)
Total irregular channel flow =     3.430(CFS)
Irregular channel normal depth above invert elev. =   0.057(Ft.)
Average velocity of channel(s) =   2.005(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.642(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.763
Subarea runoff =      3.447(CFS) for    2.010(Ac.)
Total runoff =      5.118(CFS)
Effective area this stream =        2.54(Ac.)
Total Study Area (Main Stream No. 1) =        2.54(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.072(Ft.), Average velocity =   2.352(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      450.000 to Point/Station      455.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.110(Ft.), Average velocity =   3.173(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     10.586(CFS)
  '     '    flow top width =     30.442(Ft.)
  '     '    velocity=    3.173(Ft/s)
  '     '    area =      3.336(Sq.Ft)
  '     '    Froude number =     1.689

Upstream point elevation =  4810.000(Ft.)
Downstream point elevation =  4562.000(Ft.)
Flow length =  1778.000(Ft.)
Travel time  =    9.34 min.
Time of concentration =   24.96 min.
Depth of flow =   0.110(Ft.)
Average velocity =   3.173(Ft/s)
Total irregular channel flow =    10.585(CFS)
Irregular channel normal depth above invert elev. =   0.110(Ft.)
Average velocity of channel(s) =   3.173(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.903(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.709
Subarea runoff =     10.877(CFS) for    9.310(Ac.)
Total runoff =     15.995(CFS)
Effective area this stream =       11.85(Ac.)
Total Study Area (Main Stream No. 1) =       11.85(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.141(Ft.), Average velocity =   3.736(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      455.000 to Point/Station      460.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.179(Ft.), Average velocity =   4.323(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
```

```
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     23.475(CFS)
  '     '    flow top width =     30.715(Ft.)
  '     '    velocity=    4.323(Ft/s)
  '     '    area =      5.430(Sq.Ft)
  '     '    Froude number =     1.812

Upstream point elevation =  4562.000(Ft.)
Downstream point elevation =  4482.000(Ft.)
Flow length =   584.000(Ft.)
Travel time  =    2.25 min.
Time of concentration =   27.21 min.
Depth of flow =   0.179(Ft.)
Average velocity =   4.323(Ft/s)
Total irregular channel flow =    23.475(CFS)
Irregular channel normal depth above invert elev. =   0.179(Ft.)
Average velocity of channel(s) =   4.323(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.792(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.697
Subarea runoff =     14.875(CFS) for   12.860(Ac.)
Total runoff =     30.871(CFS)
Effective area this stream =       24.71(Ac.)
Total Study Area (Main Stream No. 1) =       24.71(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.211(Ft.), Average velocity =   4.815(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.206(Ft.), Average velocity =   5.168(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     32.448(CFS)
  '     '    flow top width =     30.826(Ft.)
  '     '    velocity=    5.168(Ft/s)
  '     '    area =      6.278(Sq.Ft)
```

```
  '     '    Froude number =     2.018

Upstream point elevation =  4482.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1005.000(Ft.)
Travel time  =    3.24 min.
Time of concentration =   30.45 min.
Depth of flow =   0.206(Ft.)
Average velocity =   5.168(Ft/s)
Total irregular channel flow =    32.448(CFS)
Irregular channel normal depth above invert elev. =   0.206(Ft.)
Average velocity of channel(s) =   5.168(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      1.656(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.681
Subarea runoff =      3.091(CFS) for    5.420(Ac.)
Total runoff =     33.962(CFS)
Effective area this stream =       30.13(Ac.)
Total Study Area (Main Stream No. 1) =       30.13(Ac.)
Area averaged Fm value =    0.404(In/Hr)
Depth of flow =   0.212(Ft.), Average velocity =   5.262(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     30.130(Ac.)
Runoff from this stream =     33.962(CFS)
Time of concentration =   30.45 min.
Rainfall intensity =     1.656(In/Hr)
Area averaged loss rate (Fm) =    0.4035(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      600.000 to Point/Station      610.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.211(In/Hr)
Initial subarea data:
Initial area flow distance =   911.000(Ft.)
```

```
Top (of initial area) elevation =  5633.000(Ft.)
Bottom (of initial area) elevation =  5200.000(Ft.)
Difference in elevation =   433.000(Ft.)
Slope =    0.47530  s(%)=      47.53
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.302 min.
Rainfall intensity =      3.798(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =     32.284(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.211(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      610.000 to Point/Station      620.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.704(Ft.), Average velocity =  11.076(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     66.399(CFS)
  '     '    flow top width =     12.037(Ft.)
  '     '    velocity=   11.076(Ft/s)
  '     '    area =      5.995(Sq.Ft)
  '     '    Froude number =     2.766

Upstream point elevation =  5200.000(Ft.)
Downstream point elevation =  4975.000(Ft.)
Flow length =   984.000(Ft.)
Travel time  =    1.48 min.
Time of concentration =   10.78 min.
Depth of flow =   0.704(Ft.)
Average velocity =  11.076(Ft/s)
Total irregular channel flow =    66.399(CFS)
Irregular channel normal depth above invert elev. =   0.704(Ft.)
Average velocity of channel(s) =  11.076(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.211(In/Hr)
Rainfall intensity =      3.425(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.845
```

```
Subarea runoff =     68.177(CFS) for   24.730(Ac.)
Total runoff =    100.462(CFS)
Effective area this stream =       34.73(Ac.)
Total Study Area (Main Stream No. 1) =       64.86(Ac.)
Area averaged Fm value =    0.211(In/Hr)
Depth of flow =   0.867(Ft.), Average velocity =  12.419(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      620.000 to Point/Station      630.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.385(Ft.), Average velocity =  12.151(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    200.789(CFS)
  '     '    flow top width =     18.854(Ft.)
  '     '    velocity=   12.151(Ft/s)
  '     '    area =     16.524(Sq.Ft)
  '     '    Froude number =     2.287

Upstream point elevation =  4975.000(Ft.)
Downstream point elevation =  4640.000(Ft.)
Flow length =  2576.000(Ft.)
Travel time  =    3.53 min.
Time of concentration =   14.32 min.
Depth of flow =   1.385(Ft.)
Average velocity =  12.151(Ft/s)
Total irregular channel flow =   200.790(CFS)
Irregular channel normal depth above invert elev. =   1.385(Ft.)
Average velocity of channel(s) =  12.151(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.460
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.540
SCS curve number for soil(AMC 2)  = 83.94
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.302(In/Hr)
Rainfall intensity =      2.808(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.811
Subarea runoff =    200.599(CFS) for   97.450(Ac.)
Total runoff =    301.061(CFS)
Effective area this stream =      132.18(Ac.)
Total Study Area (Main Stream No. 1) =      162.31(Ac.)
Area averaged Fm value =    0.278(In/Hr)
Depth of flow =   1.670(Ft.), Average velocity =  13.504(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      630.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.599(Ft.), Average velocity =  15.118(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    314.195(CFS)
  '     '    flow top width =     20.992(Ft.)
  '     '    velocity=   15.118(Ft/s)
  '     '    area =     20.783(Sq.Ft)
  '     '    Froude number =     2.677

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1875.000(Ft.)
Travel time  =    2.07 min.
Time of concentration =   16.38 min.
Depth of flow =   1.599(Ft.)
Average velocity =  15.118(Ft/s)
Total irregular channel flow =   314.195(CFS)
Irregular channel normal depth above invert elev. =   1.599(Ft.)
Average velocity of channel(s) =  15.118(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Rainfall intensity =      2.555(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.794
Subarea runoff =     26.182(CFS) for   29.060(Ac.)
Total runoff =    327.242(CFS)
Effective area this stream =      161.24(Ac.)
Total Study Area (Main Stream No. 1) =      191.37(Ac.)
Area averaged Fm value =    0.300(In/Hr)
Depth of flow =   1.629(Ft.), Average velocity =  15.278(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      630.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
```

```
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    161.240(Ac.)
Runoff from this stream =    327.242(CFS)
Time of concentration =   16.38 min.
Rainfall intensity =     2.555(In/Hr)
Area averaged loss rate (Fm) =    0.3004(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1     33.96    30.130     30.45    0.404      1.656
2    327.24   161.240     16.38    0.300      2.555
Qmax(1) =
         1.000 *    1.000 *    33.962) +
         0.601 *    1.000 *   327.242) + =     230.666
Qmax(2) =
         1.718 *    0.538 *    33.962) +
         1.000 *    1.000 *   327.242) + =     358.639

Total of 2 streams to confluence:
Flow rates before confluence point:
      33.962     327.242
Maximum flow rates at confluence using above data:
      230.666      358.639
Area of streams before confluence:
       30.130      161.240
Effective area values after confluence:
      191.370      177.451
Results of confluence:
Total flow rate =    358.639(CFS)
Time of concentration =    16.383 min.
Effective stream area after confluence =    177.451(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.317(In/Hr)
Study area total (this main stream) =     191.37(Ac.)
End of computations, Total Study Area =          191.37 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 07/22/11

White Knob Haul Road
Haul Road and Drainage East of Quarry
100 Year Flow

Program License Serial Number 6026

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

```
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.390 (In.)
Slope used for rainfall intensity curve b =  0.7000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      442.000 to Point/Station      445.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   441.000(Ft.)
Top (of initial area) elevation =  4978.000(Ft.)
Bottom (of initial area) elevation =  4918.000(Ft.)
Difference in elevation =    60.000(Ft.)
Slope =    0.13605  s(%)=      13.61
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.937 min.
Rainfall intensity =      5.271(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.876
Subarea runoff =      2.447(CFS)
Total initial stream area =        0.530(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.140(In/Hr)


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```
Process from Point/Station      445.000 to Point/Station      450.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.075(Ft.), Average velocity =   2.401(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =      5.393(CFS)
  '     '    flow top width =     30.298(Ft.)
  '     '    velocity=    2.401(Ft/s)
  '     '    area =      2.246(Sq.Ft)
  '     '    Froude number =     1.554

Upstream point elevation =  4918.000(Ft.)
Downstream point elevation =  4810.000(Ft.)
Flow length =   804.000(Ft.)
Travel time  =    5.58 min.
Time of concentration =   14.52 min.
Depth of flow =   0.075(Ft.)
Average velocity =   2.401(Ft/s)
Total irregular channel flow =     5.393(CFS)
Irregular channel normal depth above invert elev. =   0.075(Ft.)
Average velocity of channel(s) =   2.401(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.753(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.866
Subarea runoff =      5.812(CFS) for    2.010(Ac.)
Total runoff =      8.259(CFS)
Effective area this stream =        2.54(Ac.)
Total Study Area (Main Stream No. 1) =        2.54(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.096(Ft.), Average velocity =   2.844(Ft/s)


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Process from Point/Station      450.000 to Point/Station      455.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.154(Ft.), Average velocity =   3.946(Ft/s)
```

```
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
-------------------------------------------------------------------
Sub-Channel flow  =     18.363(CFS)
  '     '    flow top width =     30.614(Ft.)
  '     '    velocity=    3.946(Ft/s)
  '     '    area =      4.654(Sq.Ft)
  '     '    Froude number =     1.783

Upstream point elevation =  4810.000(Ft.)
Downstream point elevation =  4562.000(Ft.)
Flow length =  1778.000(Ft.)
Travel time  =    7.51 min.
Time of concentration =   22.03 min.
Depth of flow =   0.154(Ft.)
Average velocity =   3.946(Ft/s)
Total irregular channel flow =    18.363(CFS)
Irregular channel normal depth above invert elev. =   0.154(Ft.)
Average velocity of channel(s) =   3.946(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      2.803(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.855
Subarea runoff =     20.142(CFS) for    9.310(Ac.)
Total runoff =     28.401(CFS)
Effective area this stream =       11.85(Ac.)
Total Study Area (Main Stream No. 1) =       11.85(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.199(Ft.), Average velocity =   4.685(Ft/s)


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Process from Point/Station      455.000 to Point/Station      460.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.254(Ft.), Average velocity =   5.442(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
```

```
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     42.183(CFS)
  '     '    flow top width =     31.016(Ft.)
  '     '    velocity=    5.442(Ft/s)
  '     '    area =      7.752(Sq.Ft)
  '     '    Froude number =     1.918

Upstream point elevation =  4562.000(Ft.)
Downstream point elevation =  4482.000(Ft.)
Flow length =   584.000(Ft.)
Travel time  =    1.79 min.
Time of concentration =   23.82 min.
Depth of flow =   0.254(Ft.)
Average velocity =   5.442(Ft/s)
Total irregular channel flow =    42.183(CFS)
Irregular channel normal depth above invert elev. =   0.254(Ft.)
Average velocity of channel(s) =   5.442(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      2.654(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.853
Subarea runoff =     27.507(CFS) for   12.860(Ac.)
Total runoff =     55.908(CFS)
Effective area this stream =       24.71(Ac.)
Total Study Area (Main Stream No. 1) =       24.71(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.301(Ft.), Average velocity =   6.074(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.297(Ft.), Average velocity =   6.557(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             20.00              0.00
      3             50.00              0.00
      4             70.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
```

```
Sub-Channel flow  =     59.605(CFS)
  '     '    flow top width =     31.188(Ft.)
  '     '    velocity=    6.557(Ft/s)
  '     '    area =      9.090(Sq.Ft)
  '     '    Froude number =     2.140

Upstream point elevation =  4482.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1005.000(Ft.)
Travel time  =    2.55 min.
Time of concentration =   26.37 min.
Depth of flow =   0.297(Ft.)
Average velocity =   6.557(Ft/s)
Total irregular channel flow =    59.604(CFS)
Irregular channel normal depth above invert elev. =   0.297(Ft.)
Average velocity of channel(s) =   6.557(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      2.471(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.849
Subarea runoff =      7.309(CFS) for    5.420(Ac.)
Total runoff =     63.217(CFS)
Effective area this stream =       30.13(Ac.)
Total Study Area (Main Stream No. 1) =       30.13(Ac.)
Area averaged Fm value =    0.140(In/Hr)
Depth of flow =   0.308(Ft.), Average velocity =   6.709(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      460.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     30.130(Ac.)
Runoff from this stream =     63.217(CFS)
Time of concentration =   26.37 min.
Rainfall intensity =     2.471(In/Hr)
Area averaged loss rate (Fm) =    0.1400(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      600.000 to Point/Station      610.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Adjusted SCS curve number for AMC 3 = 97.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.044(In/Hr)
Initial subarea data:
Initial area flow distance =   911.000(Ft.)
Top (of initial area) elevation =  5633.000(Ft.)
Bottom (of initial area) elevation =  5200.000(Ft.)
Difference in elevation =   433.000(Ft.)
Slope =    0.47530  s(%)=      47.53
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.302 min.
Rainfall intensity =      5.125(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =     45.735(CFS)
Total initial stream area =       10.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.044(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      610.000 to Point/Station      620.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.843(Ft.), Average velocity =  12.235(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     95.115(CFS)
  '     '    flow top width =     13.434(Ft.)
  '     '    velocity=   12.235(Ft/s)
  '     '    area =      7.774(Sq.Ft)
  '     '    Froude number =     2.834

Upstream point elevation =  5200.000(Ft.)
Downstream point elevation =  4975.000(Ft.)
Flow length =   984.000(Ft.)
Travel time  =    1.34 min.
Time of concentration =   10.64 min.
Depth of flow =   0.843(Ft.)
Average velocity =  12.235(Ft/s)
Total irregular channel flow =    95.115(CFS)
Irregular channel normal depth above invert elev. =   0.843(Ft.)
Average velocity of channel(s) =  12.235(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
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
SCS curve number for soil(AMC 2)  = 89.00
Adjusted SCS curve number for AMC 3 = 97.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.044(In/Hr)
Rainfall intensity =      4.664(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =     98.696(CFS) for   24.730(Ac.)
Total runoff =    144.431(CFS)
Effective area this stream =       34.73(Ac.)
Total Study Area (Main Stream No. 1) =       64.86(Ac.)
Area averaged Fm value =    0.044(In/Hr)
Depth of flow =   1.036(Ft.), Average velocity =  13.702(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      620.000 to Point/Station      630.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.666(Ft.), Average velocity =  13.485(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    299.418(CFS)
  '     '    flow top width =     21.658(Ft.)
  '     '    velocity=   13.485(Ft/s)
  '     '    area =     22.204(Sq.Ft)
  '     '    Froude number =     2.347

Upstream point elevation =  4975.000(Ft.)
Downstream point elevation =  4640.000(Ft.)
Flow length =  2576.000(Ft.)
Travel time  =    3.18 min.
Time of concentration =   13.83 min.
Depth of flow =   1.666(Ft.)
Average velocity =  13.485(Ft/s)
Total irregular channel flow =   299.418(CFS)
Irregular channel normal depth above invert elev. =   1.666(Ft.)
Average velocity of channel(s) =  13.485(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.460
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.540
SCS curve number for soil(AMC 2)  = 83.94
Adjusted SCS curve number for AMC 3 = 96.36
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.072(In/Hr)
Rainfall intensity =      3.884(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =    309.911(CFS) for   97.450(Ac.)
Total runoff =    454.342(CFS)
Effective area this stream =      132.18(Ac.)
Total Study Area (Main Stream No. 1) =      162.31(Ac.)
Area averaged Fm value =    0.064(In/Hr)
Depth of flow =   2.010(Ft.), Average velocity =  15.015(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      630.000 to Point/Station      465.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.937(Ft.), Average velocity =  16.863(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00             10.00
      2             50.00              0.00
      3             55.00              0.00
      4            105.00             10.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    479.573(CFS)
  '     '    flow top width =     24.368(Ft.)
  '     '    velocity=   16.863(Ft/s)
  '     '    area =     28.440(Sq.Ft)
  '     '    Froude number =     2.751

Upstream point elevation =  4640.000(Ft.)
Downstream point elevation =  4319.000(Ft.)
Flow length =  1875.000(Ft.)
Travel time  =    1.85 min.
Time of concentration =   15.68 min.
Depth of flow =   1.937(Ft.)
Average velocity =  16.863(Ft/s)
Total irregular channel flow =   479.573(CFS)
Irregular channel normal depth above invert elev. =   1.937(Ft.)
Average velocity of channel(s) =  16.863(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Rainfall intensity =      3.556(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.880
Subarea runoff =     50.409(CFS) for   29.060(Ac.)
Total runoff =    504.751(CFS)
Effective area this stream =      161.24(Ac.)
```

```
Total Study Area (Main Stream No. 1) =      191.37(Ac.)
Area averaged Fm value =    0.078(In/Hr)
Depth of flow =   1.982(Ft.), Average velocity =  17.086(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      630.000 to Point/Station      465.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    161.240(Ac.)
Runoff from this stream =    504.751(CFS)
Time of concentration =   15.68 min.
Rainfall intensity =     3.556(In/Hr)
Area averaged loss rate (Fm) =    0.0780(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

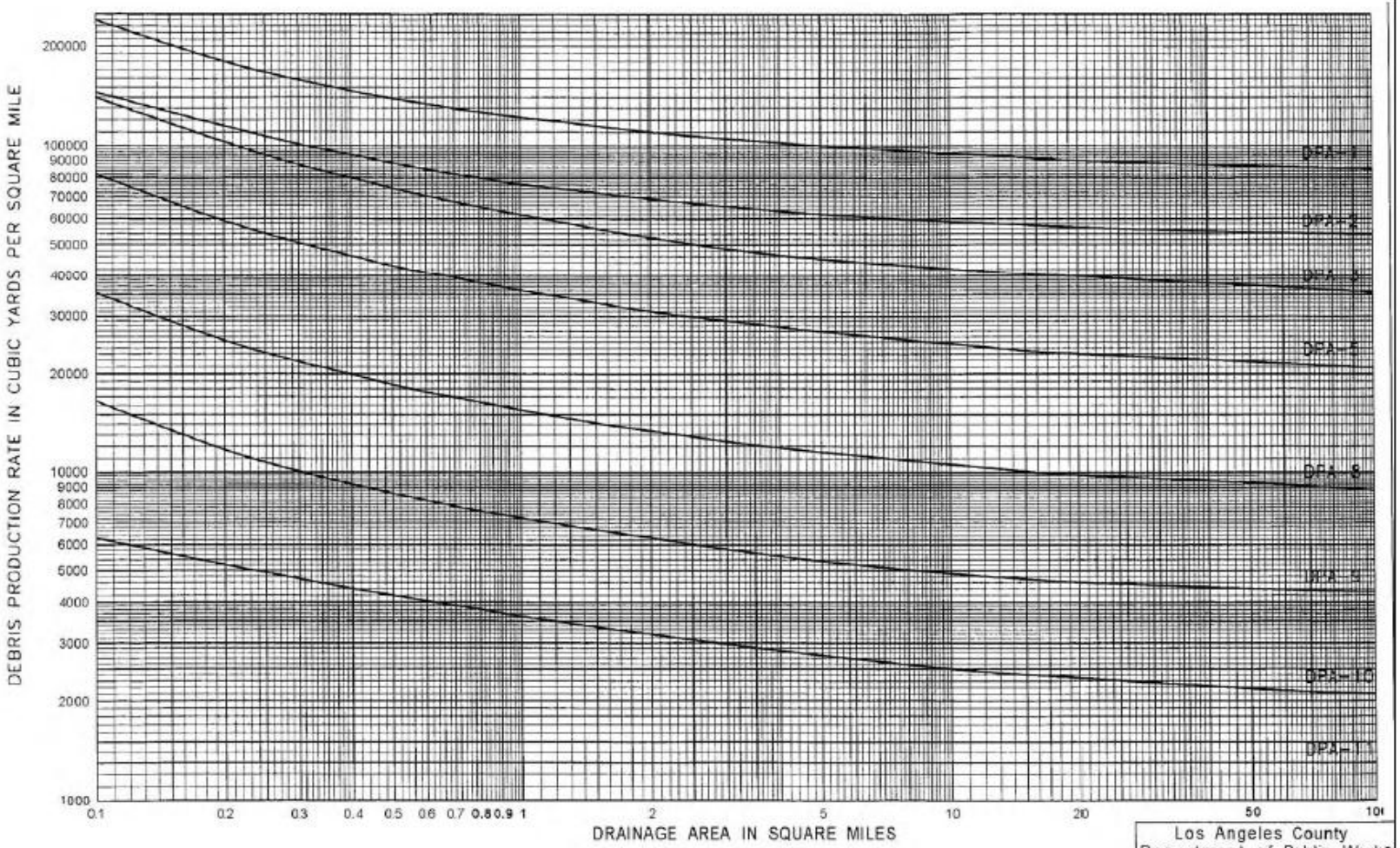
Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     63.22    30.130     26.37    0.140      2.471
2    504.75   161.240     15.68    0.078      3.556
Qmax(1) =
         1.000 *    1.000 *    63.217) +
         0.688 *    1.000 *   504.751) + =     410.529
Qmax(2) =
         1.465 *    0.595 *    63.217) +
         1.000 *    1.000 *   504.751) + =     559.830

Total of 2 streams to confluence:
Flow rates before confluence point:
      63.217     504.751
Maximum flow rates at confluence using above data:
      410.529      559.830
Area of streams before confluence:
       30.130      161.240
Effective area values after confluence:
      191.370      179.154
Results of confluence:
Total flow rate =    559.830(CFS)
Time of concentration =    15.679 min.
Effective stream area after confluence =    179.154(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.088(In/Hr)
Study area total (this main stream) =     191.37(Ac.)
End of computations, Total Study Area =          191.37 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.0
```

Appendix C – Sedimentation Calculations



Los Angeles County
Department of Public Works

DEBRIS PRODUCTION RATES
for Antelope Valley

White Knob Haul Road
Debris Production Calculations

At Node 440 (Basin 5)

Total Area	=	350.81	Ac
Undisturbed Area	=	325.41	Ac
	=	0.508	Sq Mi
Debris Production Rate (DPA 9)	=	8,800	CY/Sq Mi
Debris Production	=	4,474	CY
Disturbed Area	=	25.4	Ac
	=	0.040	Sq Mi
Debris Production Rate (DPA 5)	=	82,000	CY/Sq Mi
Debris Production	=	3,254	CY
Total Debris Production	**=**	**7,729**	**CY**

Node 442 to 465

Total Area	=	30.13	Ac
Undisturbed Area	=	26.51	Ac
	=	0.041	Sq Mi
Debris Production Rate (DPA 9)	=	16,500	CY/Sq Mi
Debris Production	=	683	CY
Disturbed Area	=	3.62	Ac
	=	0.006	Sq Mi
Debris Production Rate (DPA 5)	=	82,000	CY/Sq Mi
Debris Production	=	464	CY
Total Debris Production	**=**	**1,147**	**CY**

Appendix D – Culvert Hydraulic Calculations

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: Station 17+70

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3998.74	5.00	5.00	0.00	1
3999.14	8.50	8.50	0.00	1
3999.55	12.00	12.00	0.00	1
4000.04	15.50	15.50	0.00	1
4000.67	19.00	19.00	0.00	1
4000.87	20.00	20.00	0.00	1
4002.01	26.00	24.94	0.83	26
4002.03	29.50	25.02	4.34	5
4002.05	33.00	25.08	7.80	4
4002.06	36.50	25.13	11.14	3
4002.07	40.00	25.18	14.66	3
4002.00	24.90	24.90	0.00	Overtopping

Rating Curve Plot for Crossing: Station 17+70

Table 2 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	3998.74	1.141	0.0*	1-S2n	0.614	0.786	0.615	0.245	6.107	2.745
8.50	8.50	3999.14	1.545	0.0*	1-S2n	0.815	1.036	0.815	0.323	7.066	3.200
12.00	12.00	3999.55	1.947	0.0*	1-S2n	0.992	1.241	0.992	0.385	7.713	3.524
15.50	15.50	4000.04	2.442	0.0*	5-S2n	1.160	1.417	1.161	0.437	8.196	3.782
19.00	19.00	4000.67	3.067	0.0*	5-S2n	1.333	1.565	1.334	0.483	8.549	3.998
20.00	20.00	4000.87	3.270	0.0*	5-S2n	1.382	1.605	1.384	0.496	8.628	4.054
26.00	24.94	4002.01	4.410	0.0*	5-S2n	1.709	1.750	1.709	0.563	8.752	4.349
29.50	25.02	4002.03	4.432	0.0*	5-S2n	1.717	1.753	1.722	0.598	8.728	4.499
33.00	25.08	4002.05	4.447	0.0*	5-S2n	1.723	1.755	1.724	0.630	8.741	4.634
36.50	25.13	4002.06	4.460	0.0*	5-S2n	1.727	1.756	1.729	0.661	8.735	4.759
40.00	25.18	4002.07	4.472	0.0*	5-S2n	1.732	1.758	1.737	0.690	8.719	4.876

* theoretical depth is impractical. Depth reported is corrected.

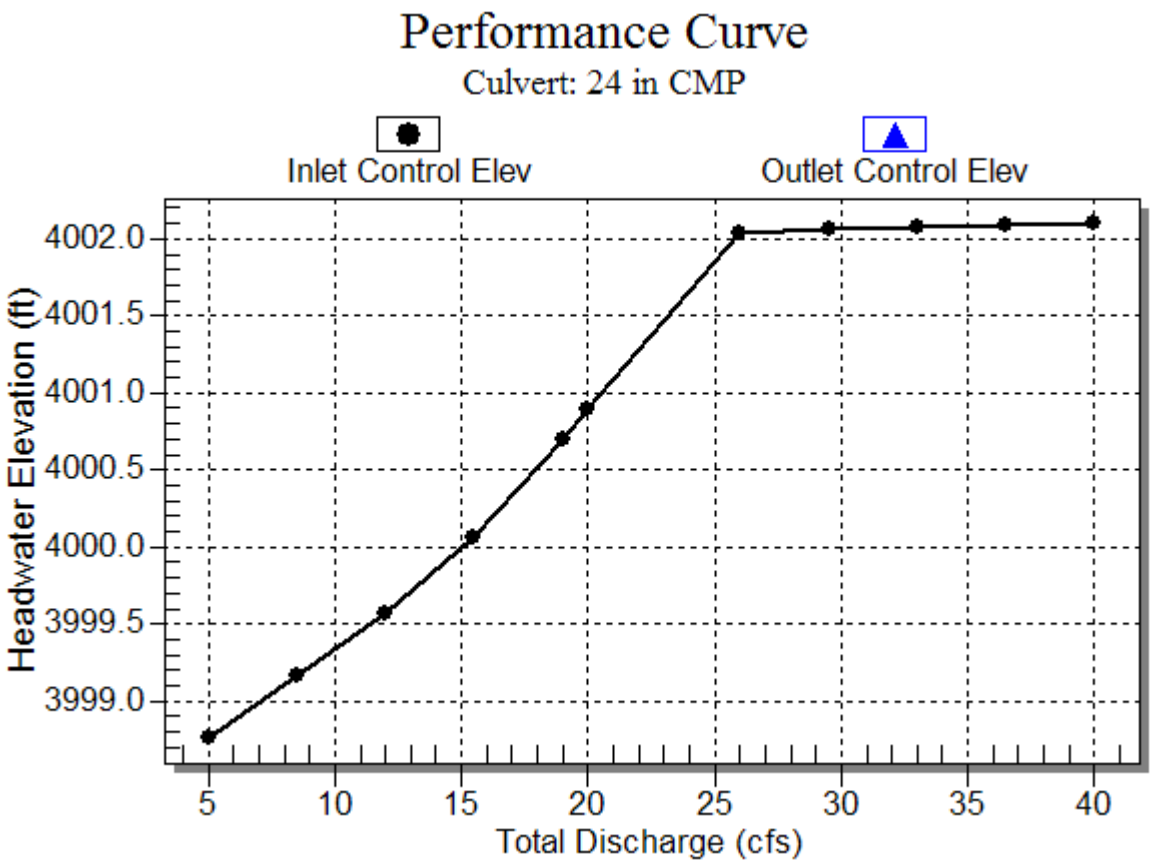
****

Inlet Elevation (invert): 3997.60 ft, Outlet Elevation (invert): 3994.62 ft

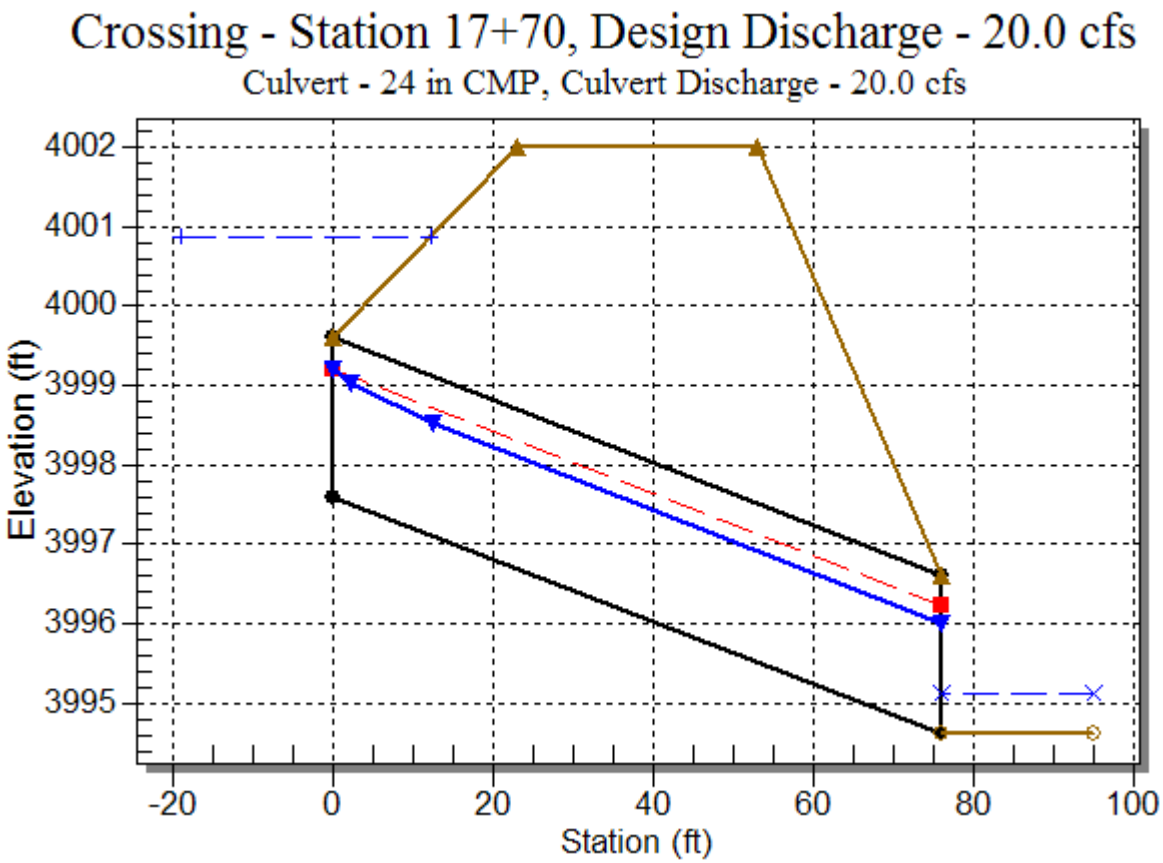
Culvert Length: 76.06 ft, Culvert Slope: 0.0392

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 3997.60 ft

Outlet Station: 76.00 ft

Outlet Elevation: 3994.62 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Station 17+70)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	3994.86	0.24	2.75	0.61	1.13
8.50	3994.94	0.32	3.20	0.81	1.17
12.00	3995.00	0.38	3.52	0.96	1.20
15.50	3995.06	0.44	3.78	1.09	1.22
19.00	3995.10	0.48	4.00	1.21	1.24
20.00	3995.12	0.50	4.05	1.24	1.24
26.00	3995.18	0.56	4.35	1.40	1.26
29.50	3995.22	0.60	4.50	1.49	1.27
33.00	3995.25	0.63	4.63	1.57	1.28
36.50	3995.28	0.66	4.76	1.65	1.29
40.00	3995.31	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 17+70

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 3994.62 ft

Roadway Data for Crossing: Station 17+70

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4002.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 4 - Summary of Culvert Flows at Crossing: Station 19+00

Headwater Elevation (ft)	Total Discharge (cfs)	48 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4005.69	5.00	5.00	0.00	1
4006.64	19.50	19.50	0.00	1
4007.32	34.00	34.00	0.00	1
4007.90	48.50	48.50	0.00	1
4008.47	63.00	63.00	0.00	1
4009.14	77.50	77.50	0.00	1
4009.81	90.00	90.00	0.00	1
4010.06	106.50	94.30	11.89	11
4010.10	121.00	94.99	25.84	5
4010.14	135.50	95.54	39.74	4
4010.17	150.00	96.02	53.43	3
4010.00	93.25	93.25	0.00	Overtopping

Rating Curve Plot for Crossing: Station 19+00

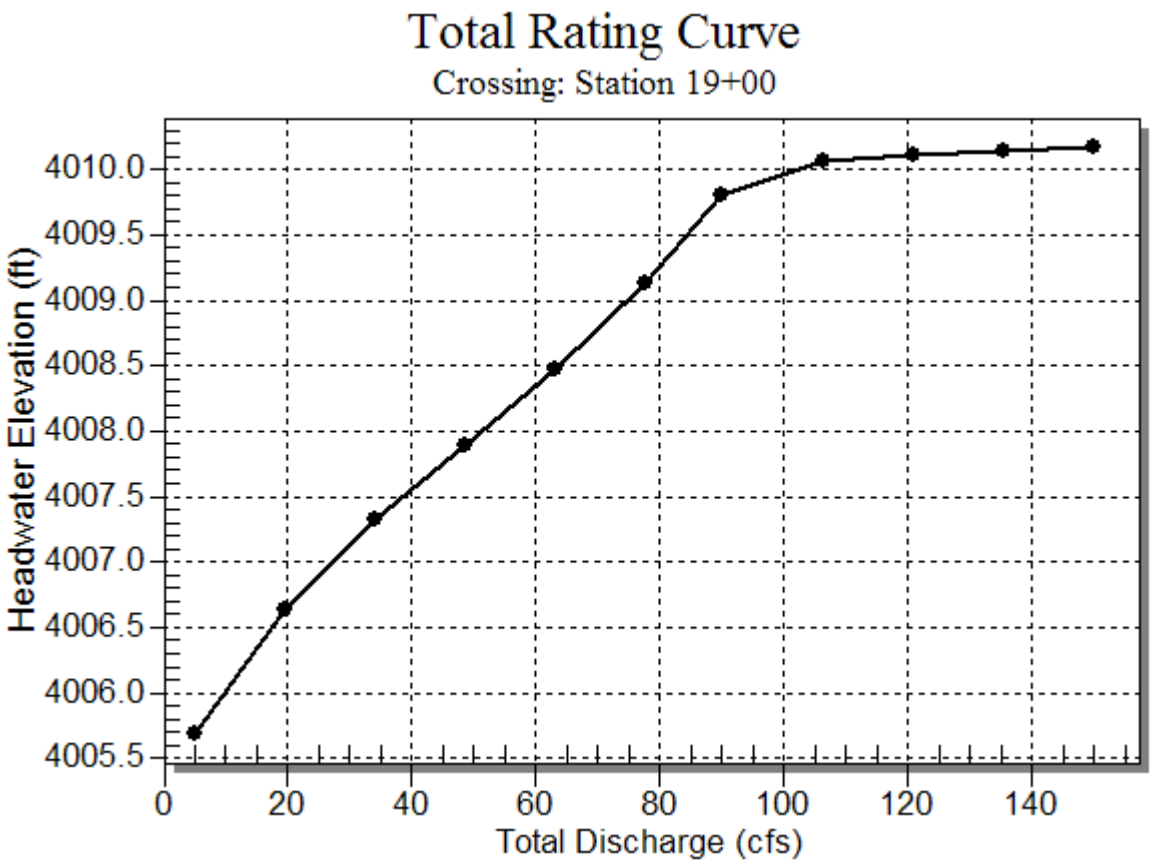


Table 5 - Culvert Summary Table: 48 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4005.69	0.901	0.0*	1-S2n	0.428	0.617	0.447	0.245	7.751	2.745
19.50	19.50	4006.64	1.853	0.0*	1-S2n	0.844	1.289	0.850	0.490	9.937	4.025
34.00	34.00	4007.32	2.531	0.0*	1-S2n	1.117	1.725	1.124	0.639	11.693	4.671
48.50	48.50	4007.90	3.105	0.0*	1-S2n	1.346	2.082	1.356	0.754	12.880	5.127
63.00	63.00	4008.47	3.684	0.0*	1-S2n	1.555	2.393	1.562	0.850	13.845	5.489
77.50	77.50	4009.14	4.346	0.0*	5-S2n	1.743	2.657	1.747	0.934	14.678	5.791
90.00	90.00	4009.81	5.017	0.0*	5-S2n	1.899	2.869	1.908	0.998	15.207	6.018
106.50	94.30	4010.06	5.273	0.0*	5-S2n	1.953	2.933	1.958	1.076	15.417	6.284
121.00	94.99	4010.10	5.314	0.0*	5-S2n	1.962	2.943	1.966	1.138	15.447	6.493
135.50	95.54	4010.14	5.348	0.0*	5-S2n	1.969	2.952	1.971	1.196	15.494	6.684
150.00	96.02	4010.17	5.378	0.0*	5-S2n	1.975	2.959	1.978	1.250	15.500	6.859

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 4004.79 ft, Outlet Elevation (invert): 3997.83 ft

Culvert Length: 110.22 ft, Culvert Slope: 0.0633

****

Culvert Performance Curve Plot: 48 in CMP

Water Surface Profile Plot for Culvert: 48 in CMP

Site Data - 48 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4004.79 ft

Outlet Station: 110.00 ft

Outlet Elevation: 3997.83 ft

Number of Barrels: 1

Culvert Data Summary - 48 in CMP

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 6 - Downstream Channel Rating Curve (Crossing: Station 19+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	3998.07	0.24	2.75	0.61	1.13
19.50	3998.32	0.49	4.03	1.22	1.24
34.00	3998.47	0.64	4.67	1.60	1.29
48.50	3998.58	0.75	5.13	1.88	1.32
63.00	3998.68	0.85	5.49	2.12	1.34
77.50	3998.76	0.93	5.79	2.33	1.36
90.00	3998.83	1.00	6.02	2.49	1.37
106.50	3998.91	1.08	6.28	2.68	1.39
121.00	3998.97	1.14	6.49	2.84	1.40
135.50	3999.03	1.20	6.68	2.98	1.41
150.00	3999.08	1.25	6.86	3.12	1.42

Tailwater Channel Data - Station 19+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 3997.83 ft

Roadway Data for Crossing: Station 19+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4010.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 7 - Summary of Culvert Flows at Crossing: Station 43+50

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4116.93	5.00	5.00	0.00	1
4117.33	8.50	8.50	0.00	1
4117.74	12.00	12.00	0.00	1
4118.23	15.50	15.50	0.00	1
4118.86	19.00	19.00	0.00	1
4119.06	20.00	20.00	0.00	1
4120.59	26.00	26.00	0.00	1
4122.01	29.50	28.05	1.20	38
4122.03	33.00	28.07	4.62	4
4122.05	36.50	28.10	8.29	4
4122.06	40.00	28.11	11.67	3
4122.00	28.03	28.03	0.00	Overtopping

Rating Curve Plot for Crossing: Station 43+50

Table 8 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4116.93	1.141	0.0*	1-S2n	0.621	0.786	0.625	0.245	5.981	2.745
8.50	8.50	4117.33	1.545	0.0*	1-S2n	0.826	1.036	0.826	0.323	6.945	3.200
12.00	12.00	4117.74	1.947	0.0*	1-S2n	1.007	1.241	1.007	0.385	7.569	3.524
15.50	15.50	4118.23	2.442	0.0*	5-S2n	1.178	1.417	1.179	0.437	8.043	3.782
19.00	19.00	4118.86	3.067	0.0*	5-S2n	1.356	1.565	1.358	0.483	8.376	3.998
20.00	20.00	4119.06	3.270	0.0*	5-S2n	1.408	1.605	1.408	0.496	8.458	4.054
26.00	26.00	4120.59	4.680	4.805	7-M2c	2.000	1.782	1.783	0.563	8.790	4.349
29.50	28.05	4122.01	5.219	6.223	7-M2c	2.000	1.842	1.832	0.598	9.301	4.499
33.00	28.07	4122.03	5.226	6.243	7-M2c	2.000	1.843	1.833	0.630	9.308	4.634
36.50	28.10	4122.05	5.232	6.259	7-M2c	2.000	1.843	1.833	0.661	9.313	4.759
40.00	28.11	4122.06	5.237	6.271	7-M2c	2.000	1.844	1.834	0.690	9.318	4.876

* theoretical depth is impractical. Depth reported is corrected.

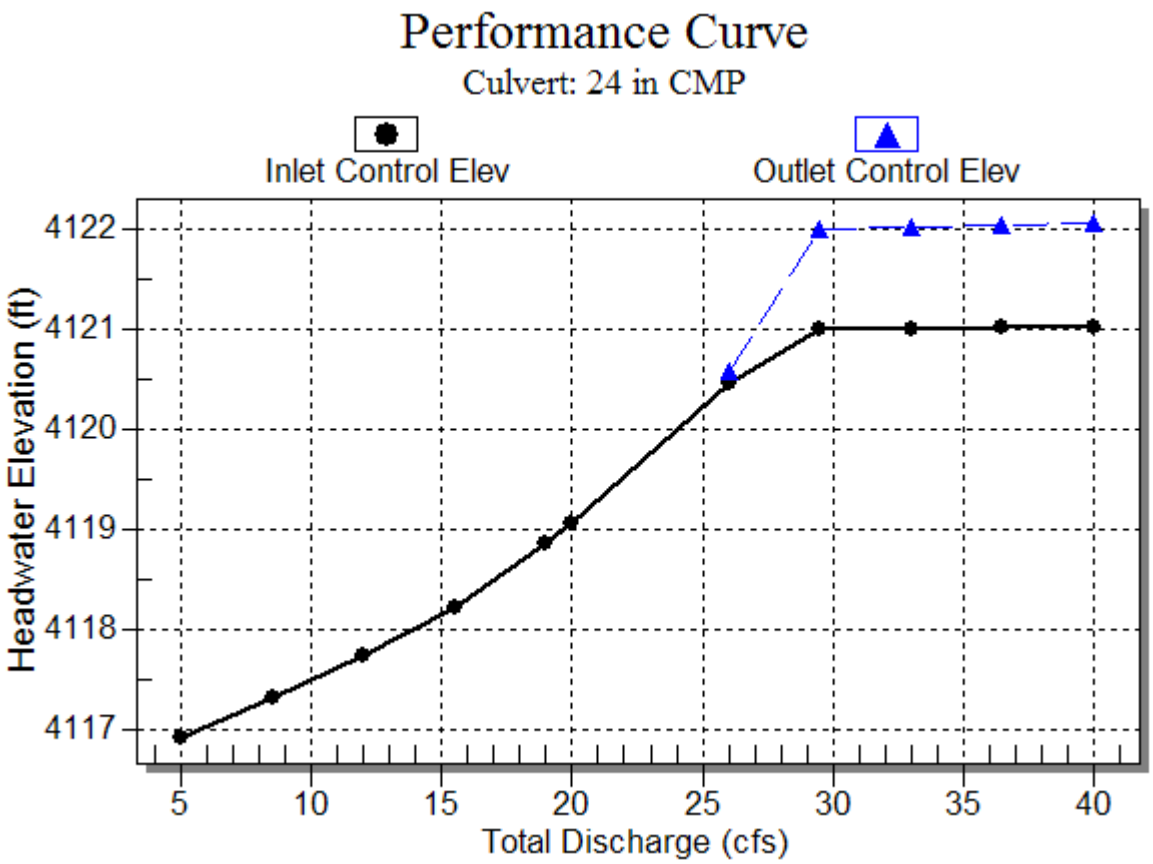
****

Inlet Elevation (invert): 4115.79 ft, Outlet Elevation (invert): 4110.19 ft

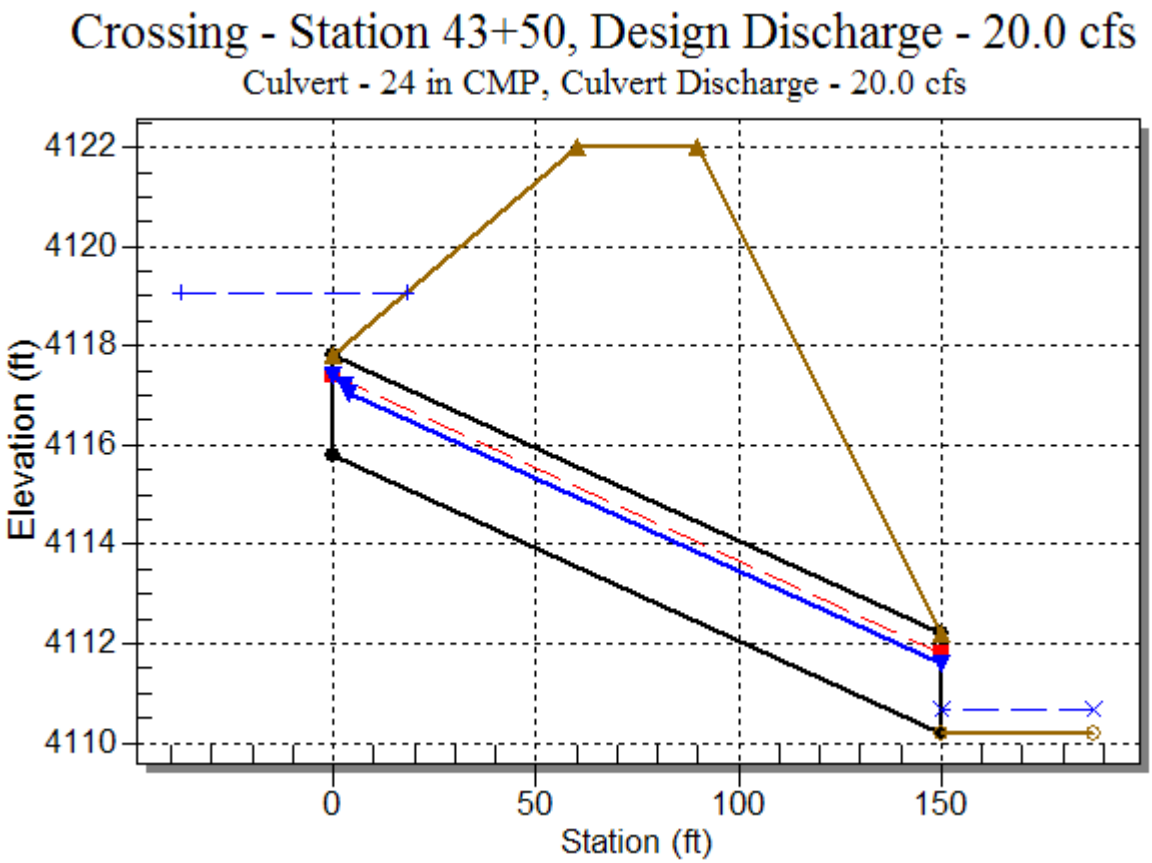
Culvert Length: 150.10 ft, Culvert Slope: 0.0373

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4115.79 ft

Outlet Station: 150.00 ft

Outlet Elevation: 4110.19 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 9 - Downstream Channel Rating Curve (Crossing: Station 43+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4110.43	0.24	2.75	0.61	1.13
8.50	4110.51	0.32	3.20	0.81	1.17
12.00	4110.57	0.38	3.52	0.96	1.20
15.50	4110.63	0.44	3.78	1.09	1.22
19.00	4110.67	0.48	4.00	1.21	1.24
20.00	4110.69	0.50	4.05	1.24	1.24
26.00	4110.75	0.56	4.35	1.40	1.26
29.50	4110.79	0.60	4.50	1.49	1.27
33.00	4110.82	0.63	4.63	1.57	1.28
36.50	4110.85	0.66	4.76	1.65	1.29
40.00	4110.88	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 43+50

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4110.19 ft

Roadway Data for Crossing: Station 43+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4122.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 10 - Summary of Culvert Flows at Crossing: Station 49+35

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4135.15	5.00	5.00	0.00	1
4135.92	14.50	14.50	0.00	1
4136.51	24.00	24.00	0.00	1
4137.11	33.50	33.50	0.00	1
4137.85	43.00	43.00	0.00	1
4138.51	50.00	50.00	0.00	1
4139.89	62.00	62.00	0.00	1
4140.05	71.50	63.23	8.02	10
4140.08	81.00	63.47	17.14	4
4140.11	90.50	63.68	26.65	4
4140.13	100.00	63.86	35.76	3
4140.00	62.85	62.85	0.00	Overtopping

Rating Curve Plot for Crossing: Station 49+35

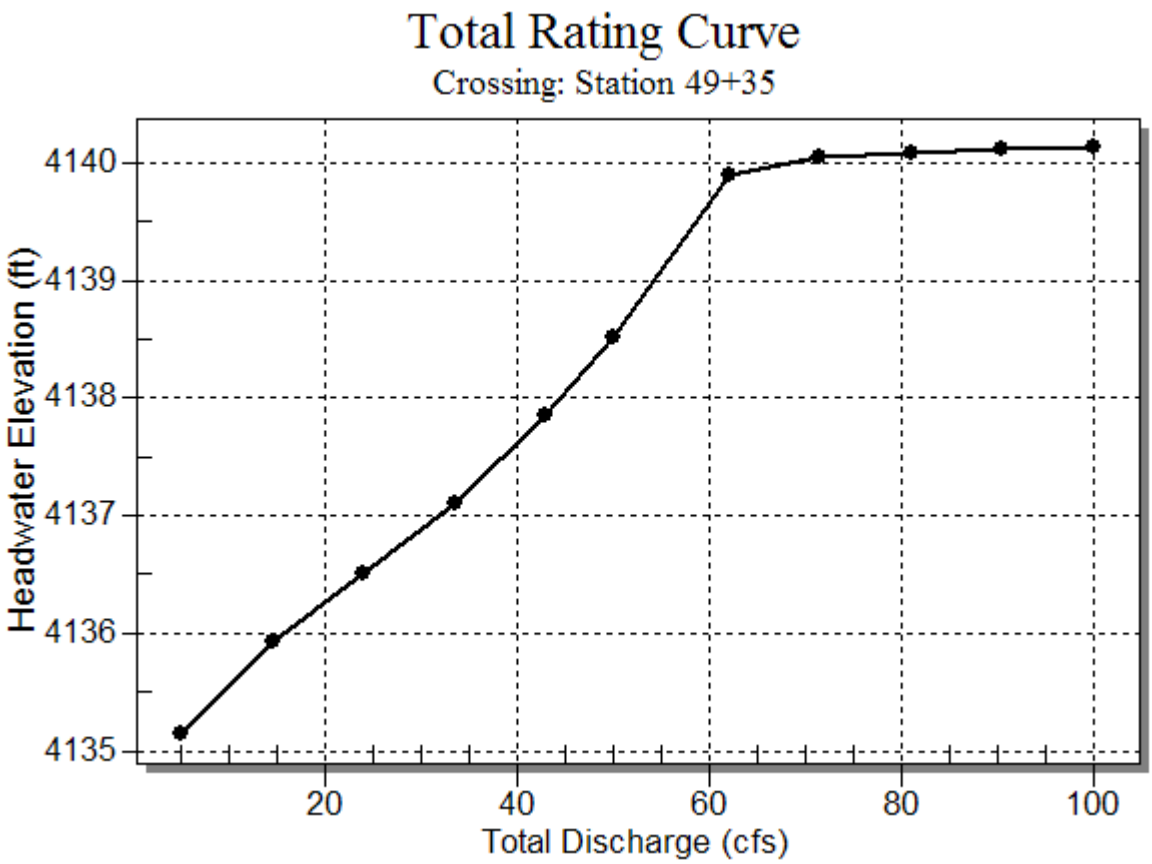


Table 11 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4135.15	0.988	0.0*	1-S2n	0.458	0.688	0.478	0.245	6.701	2.745
14.50	14.50	4135.92	1.761	0.0*	1-S2n	0.808	1.212	0.811	0.423	9.339	3.714
24.00	24.00	4136.51	2.351	0.0*	1-S2n	1.056	1.574	1.064	0.541	10.661	4.257
33.50	33.50	4137.11	2.951	0.0*	1-S2n	1.271	1.874	1.273	0.635	11.719	4.653
43.00	43.00	4137.85	3.688	0.0*	5-S2n	1.468	2.133	1.472	0.713	12.465	4.969
50.00	50.00	4138.51	4.353	0.0*	5-S2n	1.606	2.293	1.612	0.765	12.927	5.169
62.00	62.00	4139.89	5.732	0.0*	5-S2n	1.843	2.518	1.843	0.844	13.607	5.465
71.50	63.23	4140.05	5.888	0.0*	5-S2n	1.868	2.537	1.871	0.900	13.650	5.672
81.00	63.47	4140.08	5.919	0.0*	5-S2n	1.873	2.541	1.880	0.952	13.628	5.857
90.50	63.68	4140.11	5.946	0.0*	5-S2n	1.877	2.545	1.884	1.001	13.645	6.027
100.00	63.86	4140.13	5.969	0.0*	5-S2n	1.881	2.547	1.886	1.046	13.659	6.184

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 4134.16 ft, Outlet Elevation (invert): 4128.34 ft

Culvert Length: 96.18 ft, Culvert Slope: 0.0606

****

Culvert Performance Curve Plot: 36 in CMP

Water Surface Profile Plot for Culvert: 36 in CMP

Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4134.16 ft

Outlet Station: 96.00 ft

Outlet Elevation: 4128.34 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 12 - Downstream Channel Rating Curve (Crossing: Station 49+35)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4128.58	0.24	2.75	0.61	1.13
14.50	4128.76	0.42	3.71	1.06	1.22
24.00	4128.88	0.54	4.26	1.35	1.26
33.50	4128.97	0.63	4.65	1.58	1.29
43.00	4129.05	0.71	4.97	1.78	1.31
50.00	4129.10	0.76	5.17	1.91	1.32
62.00	4129.18	0.84	5.47	2.11	1.34
71.50	4129.24	0.90	5.67	2.25	1.35
81.00	4129.29	0.95	5.86	2.38	1.36
90.50	4129.34	1.00	6.03	2.50	1.37
100.00	4129.39	1.05	6.18	2.61	1.38

Tailwater Channel Data - Station 49+35

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4128.34 ft

Roadway Data for Crossing: Station 49+35

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4140.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 13 - Summary of Culvert Flows at Crossing: Station 54+35

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4136.56	5.00	5.00	0.00	1
4137.33	14.50	14.50	0.00	1
4137.92	24.00	24.00	0.00	1
4138.52	33.50	33.50	0.00	1
4138.84	43.00	37.83	4.96	17
4138.86	50.00	38.18	11.64	5
4138.90	62.00	38.63	23.10	4
4138.92	71.50	38.93	32.10	3
4138.94	81.00	39.21	41.48	3
4138.96	90.50	39.45	50.88	3
4138.98	100.00	39.69	60.23	3
4138.80	37.37	37.37	0.00	Overtopping

Rating Curve Plot for Crossing: Station 54+35

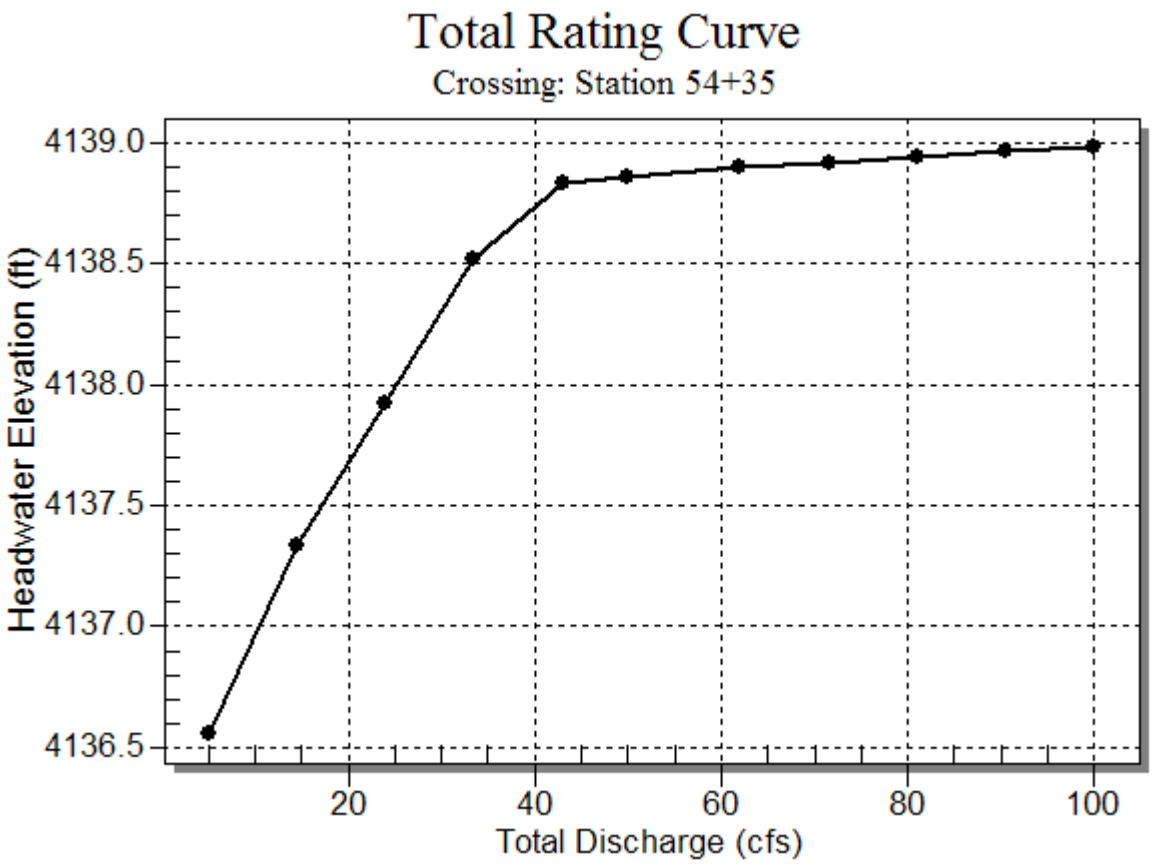


Table 14 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4136.56	0.988	0.0*	1-S2n	0.476	0.688	0.478	0.245	6.701	2.745
14.50	14.50	4137.33	1.761	0.0*	1-S2n	0.839	1.212	0.846	0.423	8.823	3.714
24.00	24.00	4137.92	2.351	0.0*	1-S2n	1.096	1.574	1.103	0.541	10.158	4.257
33.50	33.50	4138.52	2.951	0.0*	1-S2n	1.320	1.874	1.323	0.635	11.138	4.653
43.00	37.83	4138.84	3.265	0.0*	5-S2n	1.415	1.995	1.415	0.713	11.527	4.969
50.00	38.18	4138.86	3.292	0.0*	5-S2n	1.423	2.005	1.428	0.765	11.497	5.169
62.00	38.63	4138.90	3.327	0.0*	5-S2n	1.433	2.018	1.437	0.844	11.547	5.465
71.50	38.93	4138.92	3.350	0.0*	5-S2n	1.439	2.026	1.445	0.900	11.551	5.672
81.00	39.21	4138.94	3.372	0.0*	5-S2n	1.446	2.034	1.453	0.952	11.554	5.857
90.50	39.45	4138.96	3.392	0.0*	5-S2n	1.451	2.041	1.454	1.001	11.617	6.027
100.00	39.69	4138.98	3.411	0.0*	5-S2n	1.456	2.047	1.460	1.046	11.617	6.184

* theoretical depth is impractical. Depth reported is corrected.

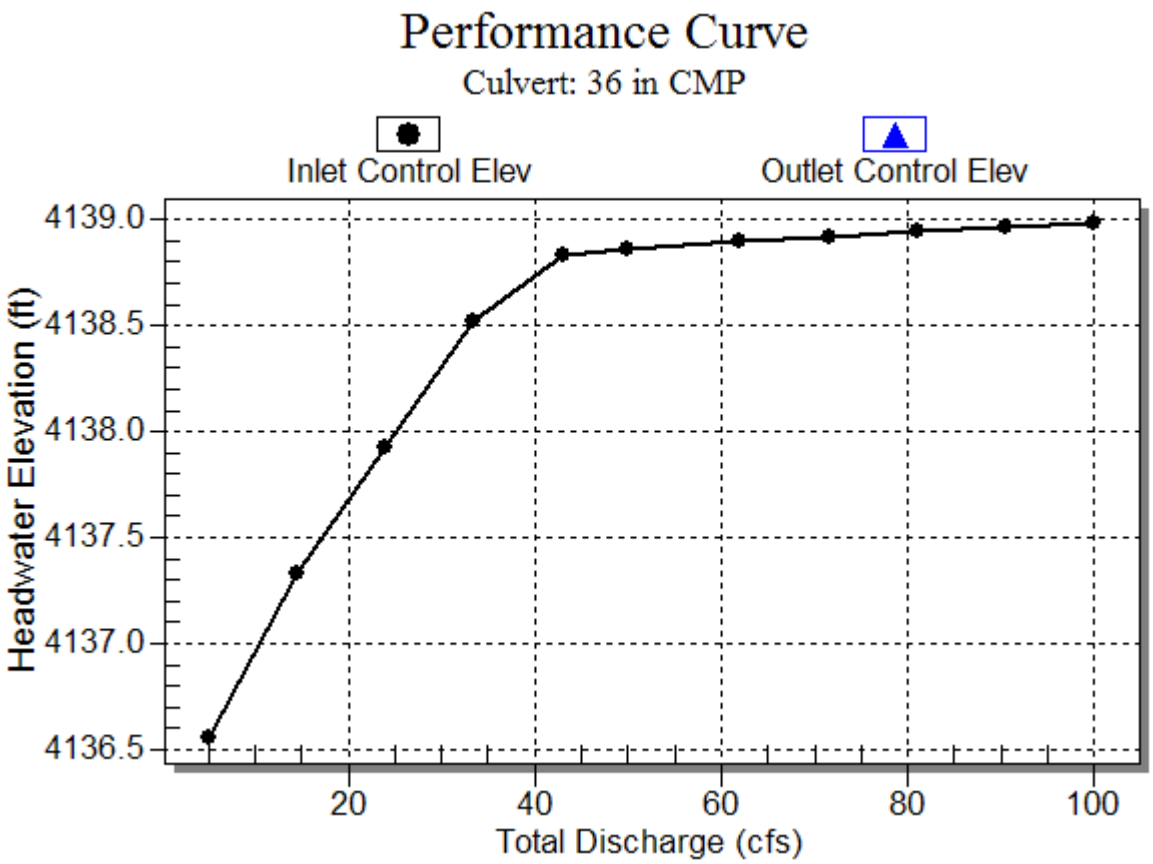
****

Inlet Elevation (invert): 4135.57 ft, Outlet Elevation (invert): 4131.86 ft

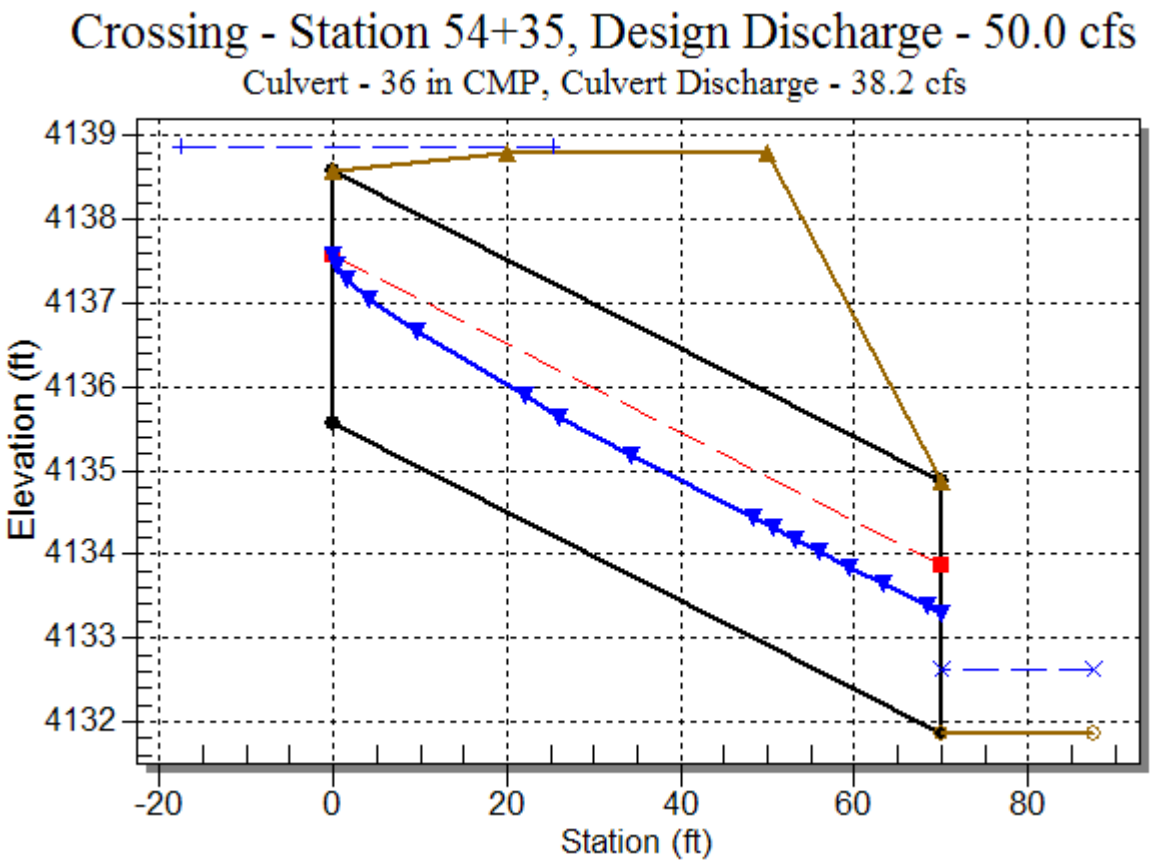
Culvert Length: 70.10 ft, Culvert Slope: 0.0530

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4135.57 ft

Outlet Station: 70.00 ft

Outlet Elevation: 4131.86 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 15 - Downstream Channel Rating Curve (Crossing: Station 54+35)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4132.10	0.24	2.75	0.61	1.13
14.50	4132.28	0.42	3.71	1.06	1.22
24.00	4132.40	0.54	4.26	1.35	1.26
33.50	4132.49	0.63	4.65	1.58	1.29
43.00	4132.57	0.71	4.97	1.78	1.31
50.00	4132.62	0.76	5.17	1.91	1.32
62.00	4132.70	0.84	5.47	2.11	1.34
71.50	4132.76	0.90	5.67	2.25	1.35
81.00	4132.81	0.95	5.86	2.38	1.36
90.50	4132.86	1.00	6.03	2.50	1.37
100.00	4132.91	1.05	6.18	2.61	1.38

Tailwater Channel Data - Station 54+35

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4131.86 ft

Roadway Data for Crossing: Station 54+35

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4138.80 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 16 - Summary of Culvert Flows at Crossing: Station 57+75

Headwater Elevation (ft)	Total Discharge (cfs)	48 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4131.42	5.00	5.00	0.00	1
4132.37	19.50	19.50	0.00	1
4133.05	34.00	34.00	0.00	1
4133.63	48.50	48.50	0.00	1
4134.20	63.00	63.00	0.00	1
4134.87	77.50	77.50	0.00	1
4135.54	90.00	90.00	0.00	1
4136.59	106.50	106.50	0.00	1
4137.05	121.00	112.95	7.79	18
4137.09	135.50	113.57	21.66	5
4137.13	150.00	114.05	35.65	4
4137.00	112.30	112.30	0.00	Overtopping

Rating Curve Plot for Crossing: Station 57+75

Table 17 - Culvert Summary Table: 48 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4131.42	0.901	0.0*	1-S2n	0.538	0.617	0.557	0.245	4.551	2.745
19.50	19.50	4132.37	1.853	0.0*	1-S2n	1.110	1.289	1.118	0.490	6.752	4.025
34.00	34.00	4133.05	2.531	0.0*	1-S2n	1.492	1.725	1.495	0.639	7.919	4.671
48.50	48.50	4133.63	3.105	0.0*	1-S2n	1.819	2.082	1.822	0.754	8.699	5.127
63.00	63.00	4134.20	3.684	0.0*	1-S2n	2.125	2.393	2.132	0.850	9.253	5.489
77.50	77.50	4134.87	4.346	0.0*	5-S2n	2.423	2.657	2.423	0.934	9.730	5.791
90.00	90.00	4135.54	5.017	0.0*	5-S2n	2.689	2.869	2.689	0.998	10.029	6.018
106.50	106.50	4136.59	6.067	0.0*	5-S2n	3.083	3.115	3.084	1.076	10.264	6.284
121.00	112.95	4137.05	6.527	6.060	2-M2c	3.270	3.207	3.209	1.138	10.449	6.493
135.50	113.57	4137.09	6.572	6.077	2-M2c	3.295	3.214	3.217	1.196	10.480	6.684
150.00	114.05	4137.13	6.609	6.098	2-M2c	3.314	3.219	3.225	1.250	10.500	6.859

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 4130.52 ft, Outlet Elevation (invert): 4129.03 ft

Culvert Length: 70.02 ft, Culvert Slope: 0.0213

****

Culvert Performance Curve Plot: 48 in CMP

Water Surface Profile Plot for Culvert: 48 in CMP

Site Data - 48 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4130.52 ft

Outlet Station: 70.00 ft

Outlet Elevation: 4129.03 ft

Number of Barrels: 1

Culvert Data Summary - 48 in CMP

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 18 - Downstream Channel Rating Curve (Crossing: Station 57+75)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4129.27	0.24	2.75	0.61	1.13
19.50	4129.52	0.49	4.03	1.22	1.24
34.00	4129.67	0.64	4.67	1.60	1.29
48.50	4129.78	0.75	5.13	1.88	1.32
63.00	4129.88	0.85	5.49	2.12	1.34
77.50	4129.96	0.93	5.79	2.33	1.36
90.00	4130.03	1.00	6.02	2.49	1.37
106.50	4130.11	1.08	6.28	2.68	1.39
121.00	4130.17	1.14	6.49	2.84	1.40
135.50	4130.23	1.20	6.68	2.98	1.41
150.00	4130.28	1.25	6.86	3.12	1.42

Tailwater Channel Data - Station 57+75

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4129.03 ft

Roadway Data for Crossing: Station 57+75

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4137.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 19 - Summary of Culvert Flows at Crossing: Station 62+30

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4124.82	5.00	5.00	0.00	1
4125.22	8.50	8.50	0.00	1
4125.63	12.00	12.00	0.00	1
4126.12	15.50	15.50	0.00	1
4126.75	19.00	19.00	0.00	1
4126.95	20.00	20.00	0.00	1
4128.01	26.00	24.63	1.22	15
4128.03	29.50	24.71	4.50	4
4128.05	33.00	24.77	8.11	4
4128.06	36.50	24.82	11.46	3
4128.07	40.00	24.87	14.98	3
4128.00	24.57	24.57	0.00	Overtopping

Rating Curve Plot for Crossing: Station 62+30

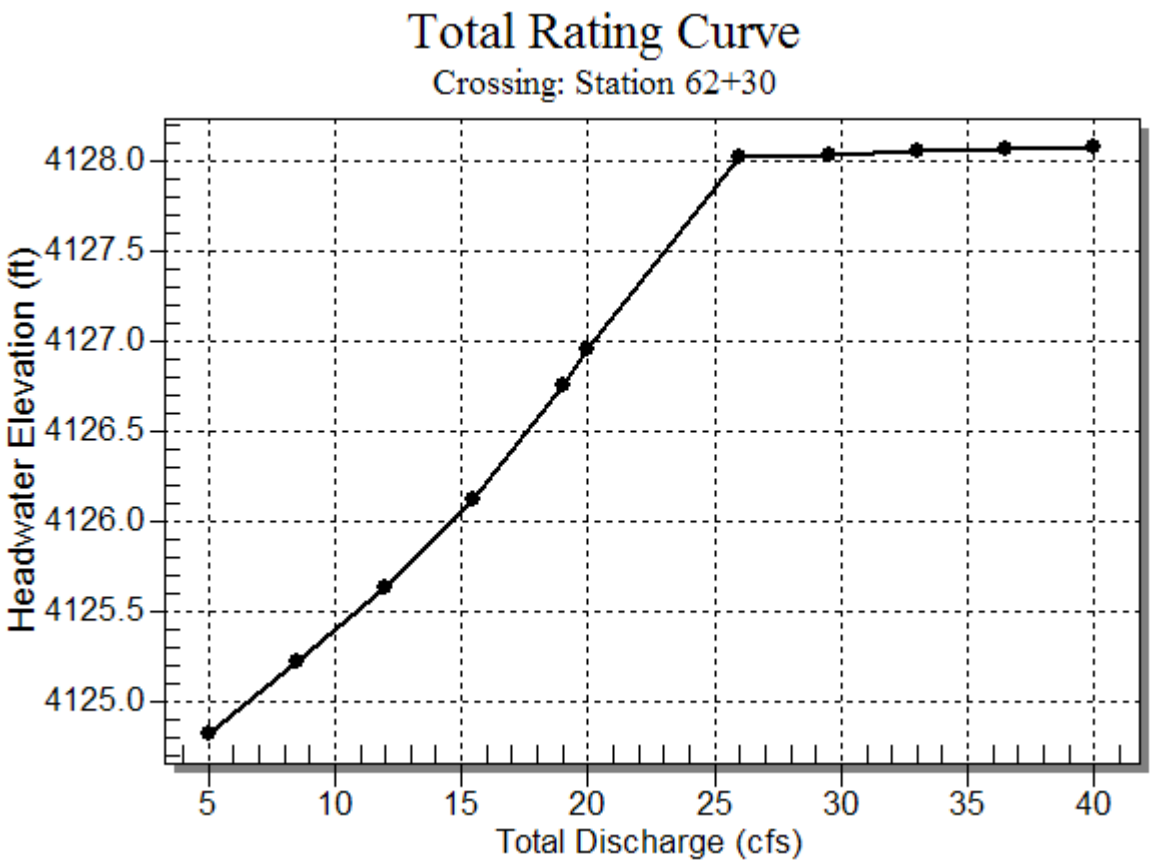


Table 20 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4124.82	1.141	0.0*	1-S2n	0.596	0.786	0.596	0.245	6.363	2.745
8.50	8.50	4125.22	1.545	0.0*	1-S2n	0.789	1.036	0.789	0.323	7.369	3.200
12.00	12.00	4125.63	1.947	0.0*	1-S2n	0.957	1.241	0.960	0.385	8.042	3.524
15.50	15.50	4126.12	2.442	0.0*	5-S2n	1.117	1.417	1.117	0.437	8.594	3.782
19.00	19.00	4126.75	3.067	0.0*	5-S2n	1.278	1.565	1.280	0.483	8.963	3.998
20.00	20.00	4126.95	3.270	0.0*	5-S2n	1.324	1.605	1.325	0.496	9.069	4.054
26.00	24.63	4128.01	4.333	0.0*	5-S2n	1.567	1.741	1.570	0.563	9.319	4.349
29.50	24.71	4128.03	4.352	0.0*	5-S2n	1.571	1.744	1.573	0.598	9.334	4.499
33.00	24.77	4128.05	4.368	0.0*	5-S2n	1.574	1.745	1.574	0.630	9.347	4.634
36.50	24.82	4128.06	4.381	0.0*	5-S2n	1.577	1.747	1.579	0.661	9.339	4.759
40.00	24.87	4128.07	4.393	0.0*	5-S2n	1.580	1.748	1.581	0.690	9.342	4.876

* theoretical depth is impractical. Depth reported is corrected.

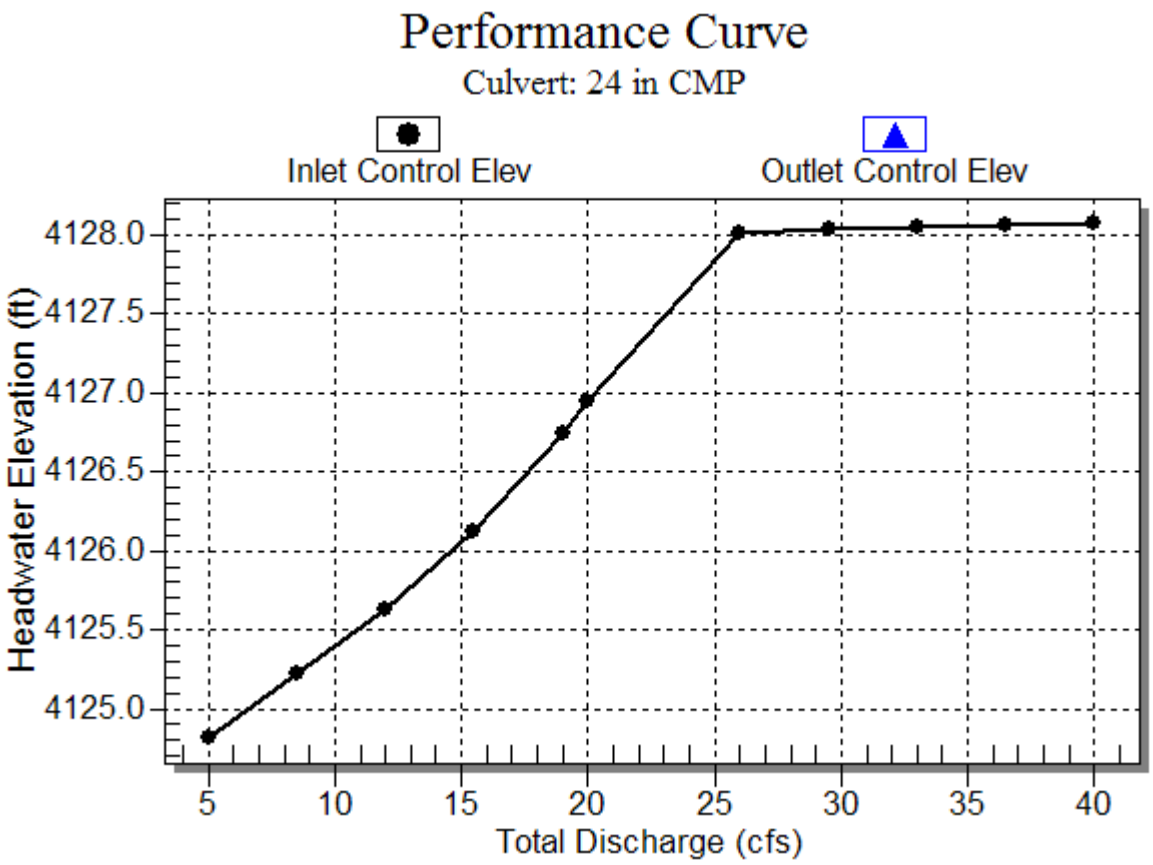
****

Inlet Elevation (invert): 4123.68 ft, Outlet Elevation (invert): 4120.32 ft

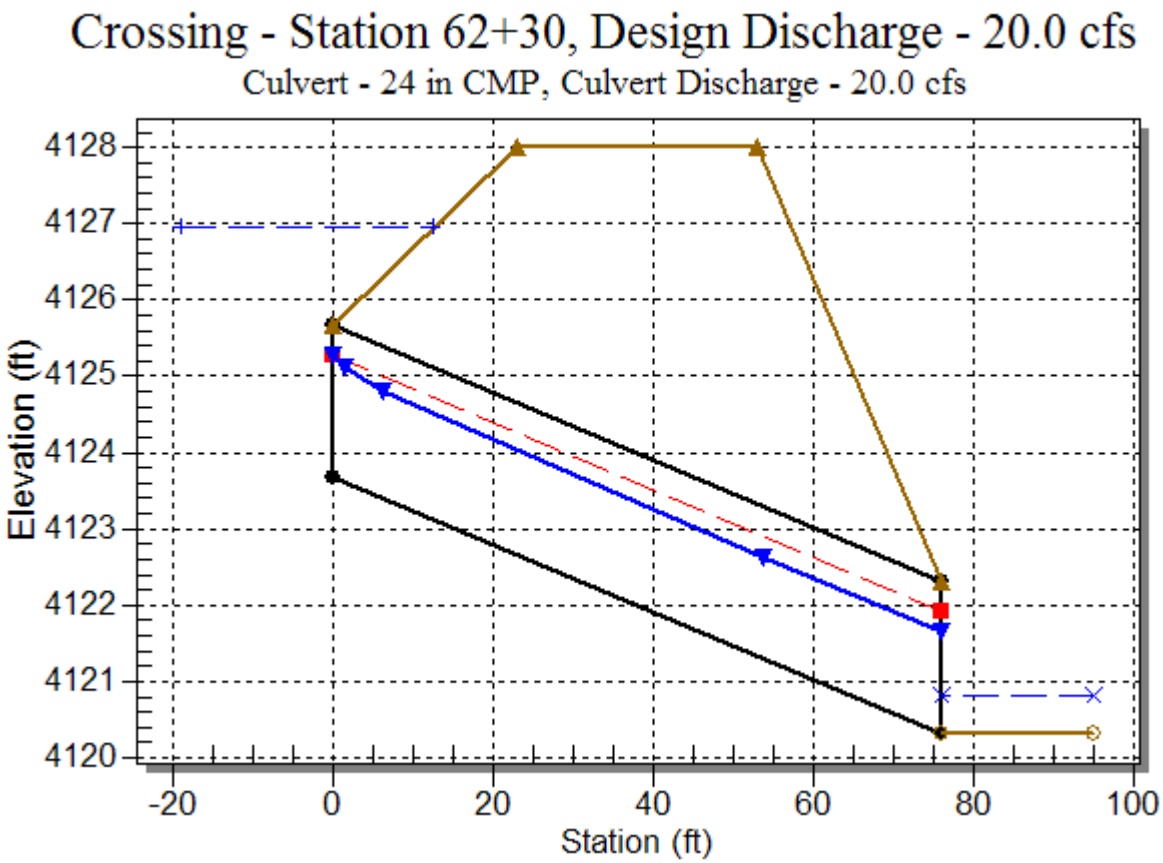
Culvert Length: 76.07 ft, Culvert Slope: 0.0442

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4123.68 ft

Outlet Station: 76.00 ft

Outlet Elevation: 4120.32 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 21 - Downstream Channel Rating Curve (Crossing: Station 62+30)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4120.56	0.24	2.75	0.61	1.13
8.50	4120.64	0.32	3.20	0.81	1.17
12.00	4120.70	0.38	3.52	0.96	1.20
15.50	4120.76	0.44	3.78	1.09	1.22
19.00	4120.80	0.48	4.00	1.21	1.24
20.00	4120.82	0.50	4.05	1.24	1.24
26.00	4120.88	0.56	4.35	1.40	1.26
29.50	4120.92	0.60	4.50	1.49	1.27
33.00	4120.95	0.63	4.63	1.57	1.28
36.50	4120.98	0.66	4.76	1.65	1.29
40.00	4121.01	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 62+30

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4120.32 ft

Roadway Data for Crossing: Station 62+30

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4128.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 22 - Summary of Culvert Flows at Crossing: Station 88+15

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4134.04	5.00	5.00	0.00	1
4134.44	8.50	8.50	0.00	1
4134.85	12.00	12.00	0.00	1
4135.34	15.50	15.50	0.00	1
4135.97	19.00	19.00	0.00	1
4136.17	20.00	20.00	0.00	1
4137.58	26.00	26.00	0.00	1
4138.52	29.50	29.50	0.00	1
4139.61	33.00	33.00	0.00	1
4140.88	36.50	36.50	0.00	1
4142.01	40.00	38.60	1.21	23
4142.00	38.58	38.58	0.00	Overtopping

Rating Curve Plot for Crossing: Station 88+15

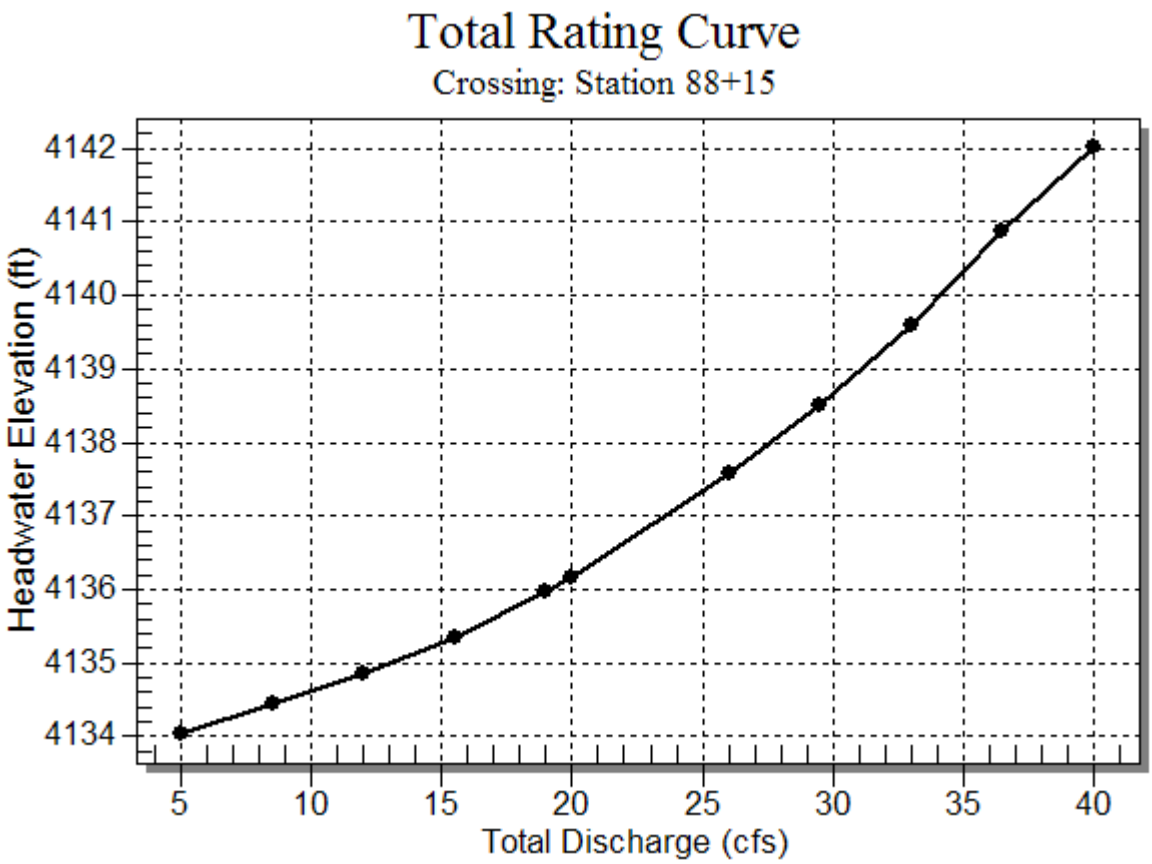


Table 23 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4134.04	1.141	0.0*	1-S2n	0.535	0.786	0.536	0.245	7.329	2.745
8.50	8.50	4134.44	1.545	0.0*	1-S2n	0.710	1.036	0.715	0.323	8.395	3.200
12.00	12.00	4134.85	1.947	0.0*	1-S2n	0.860	1.241	0.860	0.385	9.277	3.524
15.50	15.50	4135.34	2.442	0.0*	5-S2n	0.998	1.417	0.998	0.437	9.889	3.782
19.00	19.00	4135.97	3.067	0.0*	5-S2n	1.129	1.565	1.134	0.483	10.347	3.998
20.00	20.00	4136.17	3.270	0.0*	5-S2n	1.167	1.605	1.169	0.496	10.493	4.054
26.00	26.00	4137.58	4.680	0.0*	5-S2n	1.399	1.782	1.401	0.563	11.063	4.349
29.50	29.50	4138.52	5.615	0.0*	5-S2n	1.559	1.885	1.564	0.598	11.209	4.499
33.00	33.00	4139.61	6.706	0.0*	5-S2n	1.790	1.988	1.888	0.630	10.819	4.634
36.50	36.50	4140.88	7.981	7.750	6-FFc	2.000	2.000	2.000	0.661	11.618	4.759
40.00	38.60	4142.01	8.807	9.114	6-FFc	2.000	2.000	2.000	0.690	12.287	4.876

* theoretical depth is impractical. Depth reported is corrected.

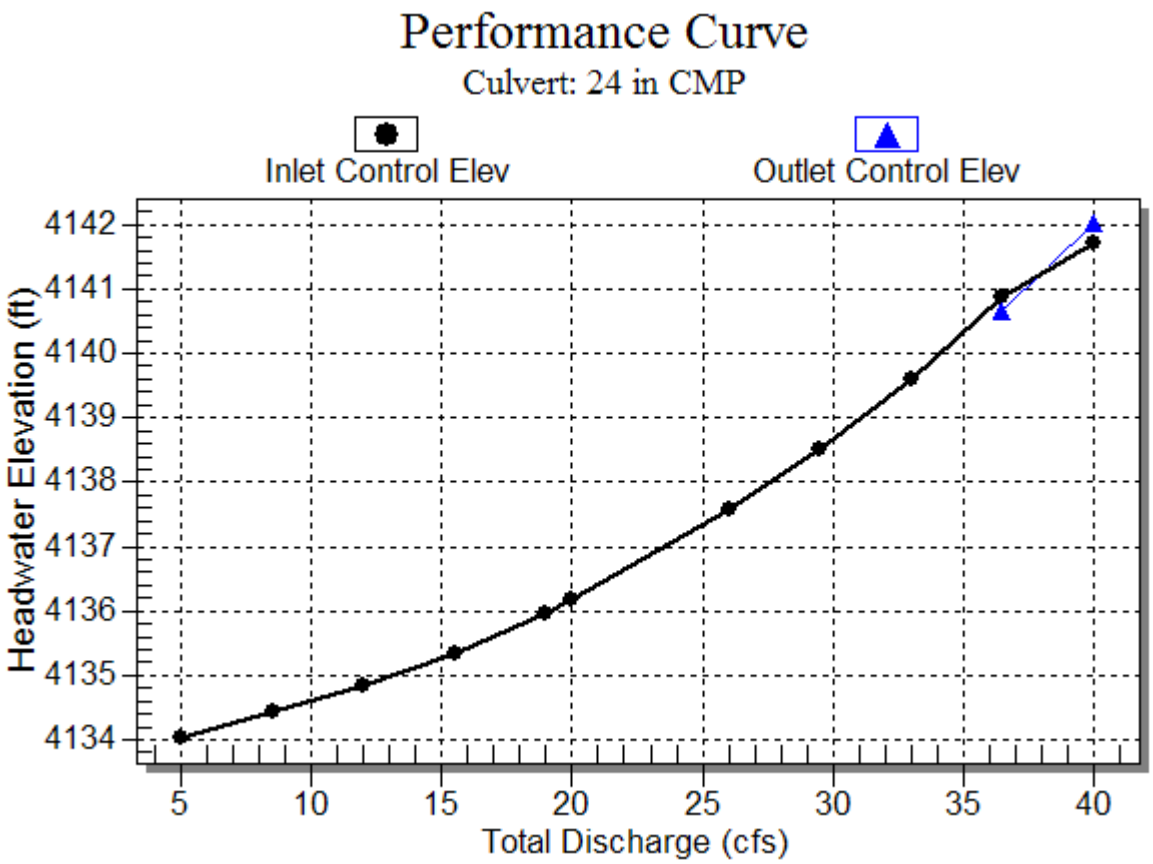
****

Inlet Elevation (invert): 4132.90 ft, Outlet Elevation (invert): 4127.13 ft

Culvert Length: 90.18 ft, Culvert Slope: 0.0641

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP

Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4132.90 ft

Outlet Station: 90.00 ft

Outlet Elevation: 4127.13 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 24 - Downstream Channel Rating Curve (Crossing: Station 88+15)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4127.37	0.24	2.75	0.61	1.13
8.50	4127.45	0.32	3.20	0.81	1.17
12.00	4127.51	0.38	3.52	0.96	1.20
15.50	4127.57	0.44	3.78	1.09	1.22
19.00	4127.61	0.48	4.00	1.21	1.24
20.00	4127.63	0.50	4.05	1.24	1.24
26.00	4127.69	0.56	4.35	1.40	1.26
29.50	4127.73	0.60	4.50	1.49	1.27
33.00	4127.76	0.63	4.63	1.57	1.28
36.50	4127.79	0.66	4.76	1.65	1.29
40.00	4127.82	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 88+15

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4127.13 ft

Roadway Data for Crossing: Station 88+15

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4142.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 25 - Summary of Culvert Flows at Crossing: Station 90+00

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4140.99	5.00	5.00	0.00	1
4141.39	8.50	8.50	0.00	1
4141.80	12.00	12.00	0.00	1
4142.29	15.50	15.50	0.00	1
4142.92	19.00	19.00	0.00	1
4143.12	20.00	20.00	0.00	1
4144.02	26.00	23.96	1.89	27
4144.04	29.50	24.03	5.24	4
4144.05	33.00	24.09	8.81	4
4144.06	36.50	24.14	12.17	3
4144.08	40.00	24.19	15.68	3
4144.00	23.88	23.88	0.00	Overtopping

Rating Curve Plot for Crossing: Station 90+00

Table 26 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	4140.99	1.141	0.0*	1-S2n	0.552	0.786	0.555	0.245	6.992	2.745
8.50	8.50	4141.39	1.545	0.0*	1-S2n	0.732	1.036	0.735	0.323	8.090	3.200
12.00	12.00	4141.80	1.947	0.0*	1-S2n	0.887	1.241	0.890	0.385	8.868	3.524
15.50	15.50	4142.29	2.442	0.0*	5-S2n	1.031	1.417	1.032	0.437	9.489	3.782
19.00	19.00	4142.92	3.067	0.0*	5-S2n	1.170	1.565	1.174	0.483	9.918	3.998
20.00	20.00	4143.12	3.270	0.0*	5-S2n	1.210	1.605	1.210	0.496	10.060	4.054
26.00	23.96	4144.02	4.168	0.0*	5-S2n	1.372	1.721	1.373	0.563	10.424	4.349
29.50	24.03	4144.04	4.185	0.0*	5-S2n	1.375	1.724	1.377	0.598	10.428	4.499
33.00	24.09	4144.05	4.200	0.0*	5-S2n	1.378	1.725	1.379	0.630	10.431	4.634
36.50	24.14	4144.06	4.213	0.0*	5-S2n	1.380	1.727	1.381	0.661	10.440	4.759
40.00	24.19	4144.08	4.224	0.0*	5-S2n	1.382	1.728	1.383	0.690	10.440	4.876

* theoretical depth is impractical. Depth reported is corrected.

****

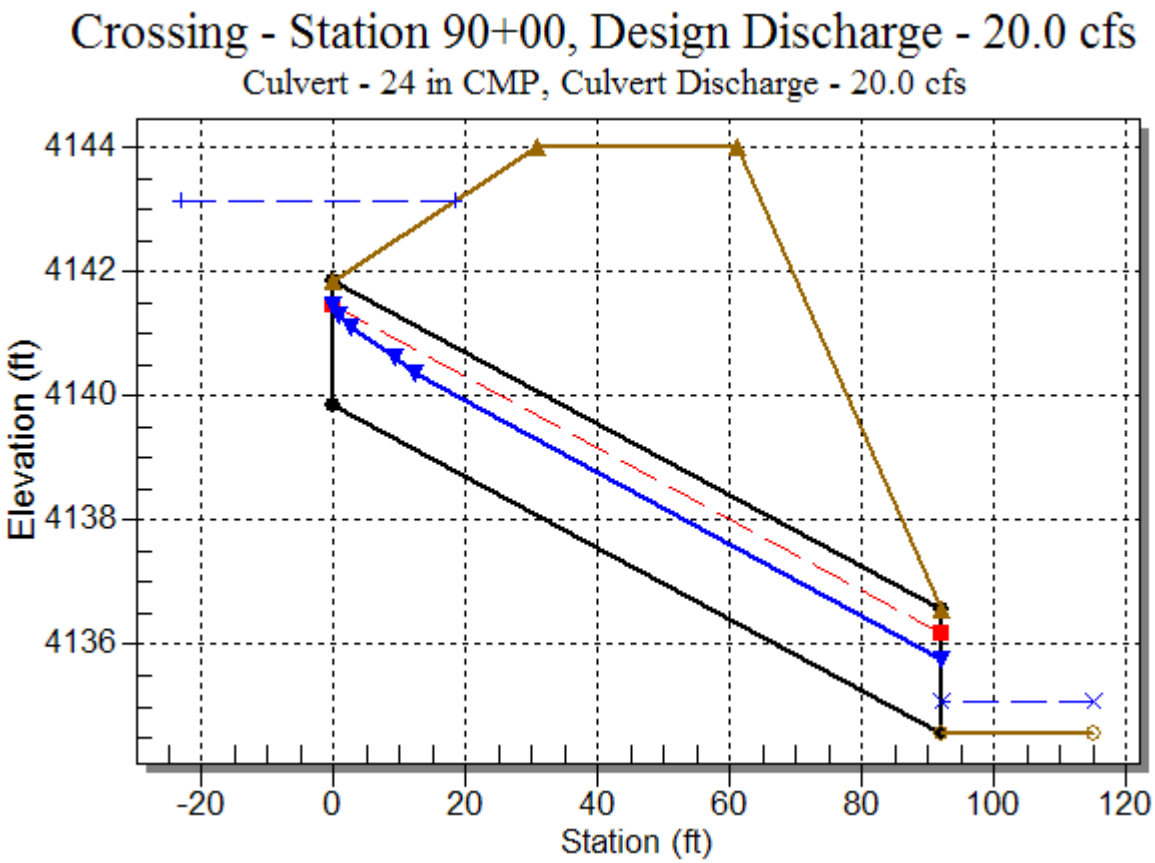
Inlet Elevation (invert): 4139.85 ft, Outlet Elevation (invert): 4134.57 ft

Culvert Length: 92.15 ft, Culvert Slope: 0.0574

****

Culvert Performance Curve Plot: 24 in CMP

Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4139.85 ft

Outlet Station: 92.00 ft

Outlet Elevation: 4134.57 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 27 - Downstream Channel Rating Curve (Crossing: Station 90+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4134.81	0.24	2.75	0.61	1.13
8.50	4134.89	0.32	3.20	0.81	1.17
12.00	4134.95	0.38	3.52	0.96	1.20
15.50	4135.01	0.44	3.78	1.09	1.22
19.00	4135.05	0.48	4.00	1.21	1.24
20.00	4135.07	0.50	4.05	1.24	1.24
26.00	4135.13	0.56	4.35	1.40	1.26
29.50	4135.17	0.60	4.50	1.49	1.27
33.00	4135.20	0.63	4.63	1.57	1.28
36.50	4135.23	0.66	4.76	1.65	1.29
40.00	4135.26	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 90+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4134.57 ft

Roadway Data for Crossing: Station 90+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4144.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 28 - Summary of Culvert Flows at Crossing: Station 144+70

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4108.05	14.80	14.80	0.00	1
4108.32	19.03	19.03	0.00	1
4108.58	23.26	23.26	0.00	1
4108.83	27.49	27.49	0.00	1
4108.90	28.60	28.60	0.00	1
4109.39	35.95	35.95	0.00	1
4109.72	40.18	40.18	0.00	1
4110.08	44.41	44.41	0.00	1
4110.49	48.64	48.64	0.00	1
4110.93	52.87	52.87	0.00	1
4111.40	57.10	57.10	0.00	1
4118.10	99.90	99.90	0.00	Overtopping

Rating Curve Plot for Crossing: Station 144+70

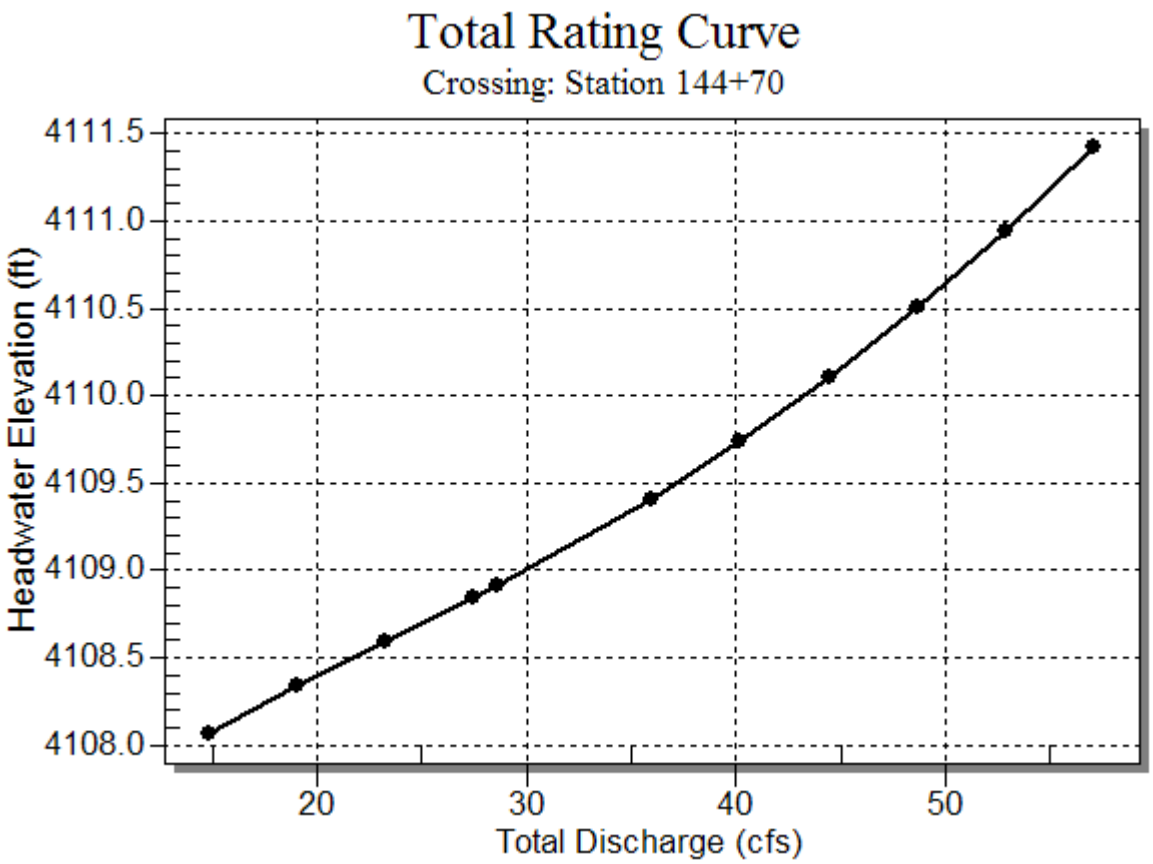


Table 29 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
14.80	14.80	4108.05	1.782	0.0*	1-S2n	0.668	1.224	0.673	0.427	12.385	3.735
19.03	19.03	4108.32	2.053	0.0*	1-S2n	0.756	1.391	0.761	0.484	13.358	4.000
23.26	23.26	4108.58	2.307	0.0*	1-S2n	0.845	1.549	0.848	0.533	14.100	4.222
27.49	27.49	4108.83	2.561	0.0*	1-S2n	0.926	1.689	0.928	0.578	14.808	4.414
28.60	28.60	4108.90	2.630	0.0*	1-S2n	0.943	1.726	0.945	0.589	15.055	4.462
35.95	35.95	4109.39	3.124	0.0*	5-S2n	1.062	1.943	1.063	0.656	15.990	4.740
40.18	40.18	4109.72	3.451	0.0*	5-S2n	1.130	2.061	1.135	0.691	16.370	4.880
44.41	44.41	4110.08	3.814	0.0*	5-S2n	1.198	2.165	1.198	0.724	16.859	5.010
48.64	48.64	4110.49	4.216	0.0*	5-S2n	1.257	2.262	1.261	0.755	17.239	5.131
52.87	52.87	4110.93	4.657	0.0*	5-S2n	1.316	2.359	1.318	0.785	17.676	5.244
57.10	57.10	4111.40	5.135	0.0*	5-S2n	1.375	2.439	1.378	0.813	18.009	5.351

* theoretical depth is impractical. Depth reported is corrected.

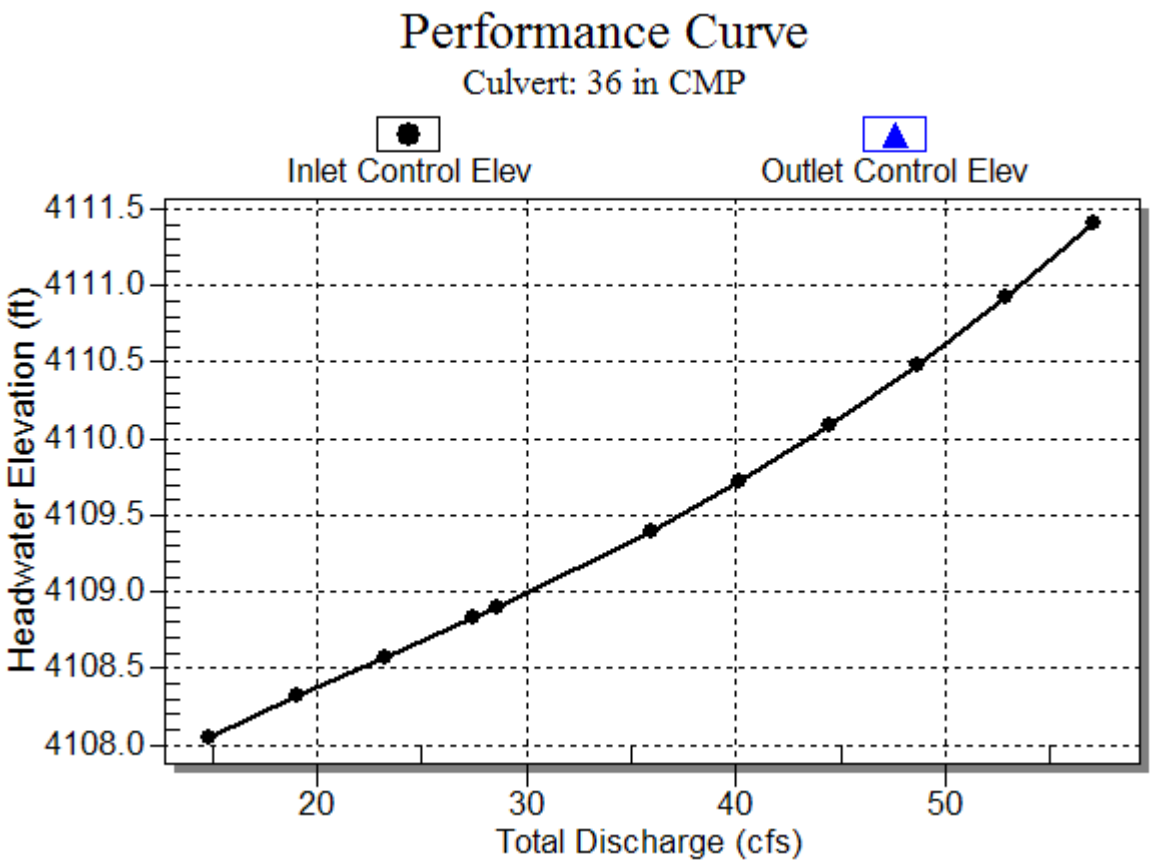
****

Inlet Elevation (invert): 4106.27 ft, Outlet Elevation (invert): 4088.54 ft

Culvert Length: 134.08 ft, Culvert Slope: 0.1334

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP

Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4106.27 ft

Outlet Station: 132.90 ft

Outlet Elevation: 4088.54 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 30 - Downstream Channel Rating Curve (Crossing: Station 144+70)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
14.80	4088.97	0.43	3.73	1.07	1.22
19.03	4089.02	0.48	4.00	1.21	1.24
23.26	4089.07	0.53	4.22	1.33	1.25
27.49	4089.12	0.58	4.41	1.44	1.27
28.60	4089.13	0.59	4.46	1.47	1.27
35.95	4089.20	0.66	4.74	1.64	1.29
40.18	4089.23	0.69	4.88	1.73	1.30
44.41	4089.26	0.72	5.01	1.81	1.31
48.64	4089.30	0.76	5.13	1.88	1.32
52.87	4089.32	0.78	5.24	1.96	1.32
57.10	4089.35	0.81	5.35	2.03	1.33

Tailwater Channel Data - Station 144+70

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4088.54 ft

Roadway Data for Crossing: Station 144+70

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4118.10 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Table 31 - Summary of Culvert Flows at Crossing: Station 150+40

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4112.54	17.90	17.90	0.00	1
4112.88	23.50	23.50	0.00	1
4113.22	29.10	29.10	0.00	1
4113.59	34.70	34.70	0.00	1
4113.67	35.80	35.80	0.00	1
4114.51	45.90	45.90	0.00	1
4115.07	51.50	51.50	0.00	1
4115.69	57.10	57.10	0.00	1
4116.38	62.70	62.70	0.00	1
4117.12	68.30	68.30	0.00	1
4117.90	73.90	73.90	0.00	1
4128.00	124.10	124.10	0.00	Overtopping

Rating Curve Plot for Crossing: Station 150+40

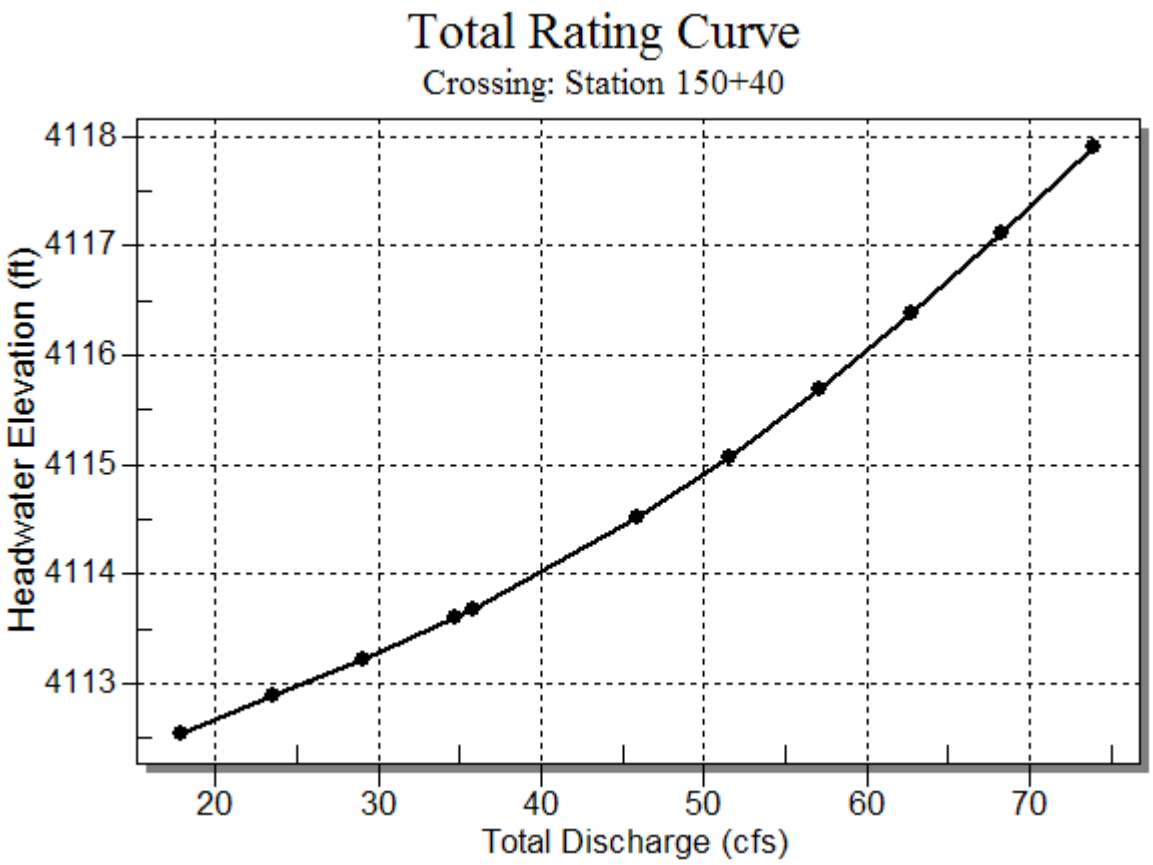


Table 32 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
17.90	17.90	4112.54	1.983	0.0*	1-S2n	0.791	1.347	0.801	0.469	11.728	3.933
23.50	23.50	4112.88	2.321	0.0*	1-S2n	0.920	1.557	0.926	0.536	12.692	4.234
29.10	29.10	4113.22	2.661	0.0*	1-S2n	1.024	1.742	1.032	0.594	13.462	4.482
34.70	34.70	4113.59	3.034	0.0*	5-S2n	1.128	1.908	1.137	0.645	14.107	4.696
35.80	35.80	4113.67	3.113	0.0*	5-S2n	1.149	1.939	1.158	0.655	14.212	4.735
45.90	45.90	4114.51	3.951	0.0*	5-S2n	1.318	2.199	1.319	0.735	15.326	5.054
51.50	51.50	4115.07	4.510	0.0*	5-S2n	1.408	2.327	1.417	0.775	15.663	5.208
57.10	57.10	4115.69	5.135	0.0*	5-S2n	1.498	2.439	1.499	0.813	16.171	5.351
62.70	62.70	4116.38	5.820	0.0*	5-S2n	1.584	2.529	1.588	0.848	16.517	5.482
68.30	68.30	4117.12	6.558	0.0*	5-S2n	1.669	2.619	1.678	0.882	16.806	5.604
73.90	73.90	4117.90	7.339	0.0*	5-S2n	1.755	2.709	1.758	0.914	17.178	5.720

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 4110.56 ft, Outlet Elevation (invert): 4093.34 ft

Culvert Length: 173.31 ft, Culvert Slope: 0.0999

****

Culvert Performance Curve Plot: 36 in CMP

Water Surface Profile Plot for Culvert: 36 in CMP

Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4110.56 ft

Outlet Station: 172.45 ft

Outlet Elevation: 4093.34 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 33 - Downstream Channel Rating Curve (Crossing: Station 150+40)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
17.90	4093.91	0.47	3.93	1.17	1.23
23.50	4093.98	0.54	4.23	1.34	1.26
29.10	4094.03	0.59	4.48	1.48	1.27
34.70	4094.09	0.65	4.70	1.61	1.29
35.80	4094.09	0.65	4.74	1.63	1.29
45.90	4094.18	0.74	5.05	1.84	1.31
51.50	4094.22	0.78	5.21	1.94	1.32
57.10	4094.25	0.81	5.35	2.03	1.33
62.70	4094.29	0.85	5.48	2.12	1.34
68.30	4094.32	0.88	5.60	2.20	1.35
73.90	4094.35	0.91	5.72	2.28	1.35

Tailwater Channel Data - Station 150+40

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4093.44 ft

Roadway Data for Crossing: Station 150+40

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4128.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Table 34 - Summary of Culvert Flows at Crossing: Station 154+20

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4131.13	35.20	35.20	0.00	1
4132.25	48.42	48.42	0.00	1
4133.75	61.64	61.64	0.00	1
4135.54	74.86	74.86	0.00	1
4135.79	76.60	76.60	0.00	1
4136.09	101.30	78.68	22.26	9
4136.13	114.52	78.91	35.24	4
4136.16	127.74	79.11	48.45	4
4136.18	140.96	79.29	61.19	3
4136.21	154.18	79.45	74.36	3
4136.23	167.40	79.61	87.55	3
4136.00	78.04	78.04	0.00	Overtopping

Rating Curve Plot for Crossing: Station 154+20

Table 35 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
35.20	35.20	4131.13	3.070	0.0*	5-S2n	1.003	1.922	1.012	0.650	16.740	4.714
48.42	48.42	4132.25	4.194	0.0*	5-S2n	1.198	2.257	1.199	0.754	18.363	5.125
61.64	61.64	4133.75	5.686	0.0*	5-S2n	1.367	2.512	1.371	0.842	19.572	5.458
74.86	74.86	4135.54	7.477	0.0*	5-S2n	1.534	2.724	1.535	0.919	20.575	5.740
76.60	76.60	4135.79	7.729	0.0*	5-S2n	1.555	2.752	1.561	0.929	20.614	5.773
101.30	78.68	4136.09	8.034	0.0*	5-S2n	1.581	2.785	1.614	1.052	20.304	6.204
114.52	78.91	4136.13	8.068	0.0*	5-S2n	1.583	2.789	1.617	1.111	20.322	6.403
127.74	79.11	4136.16	8.097	0.0*	5-S2n	1.586	2.792	1.620	1.165	20.326	6.584
140.96	79.29	4136.18	8.123	0.0*	5-S2n	1.588	2.795	1.622	1.216	20.340	6.751
154.18	79.45	4136.21	8.148	0.0*	5-S2n	1.590	2.798	1.624	1.265	20.356	6.907
167.40	79.61	4136.23	8.172	0.0*	5-S2n	1.592	2.800	1.626	1.311	20.357	7.054

* theoretical depth is impractical. Depth reported is corrected.

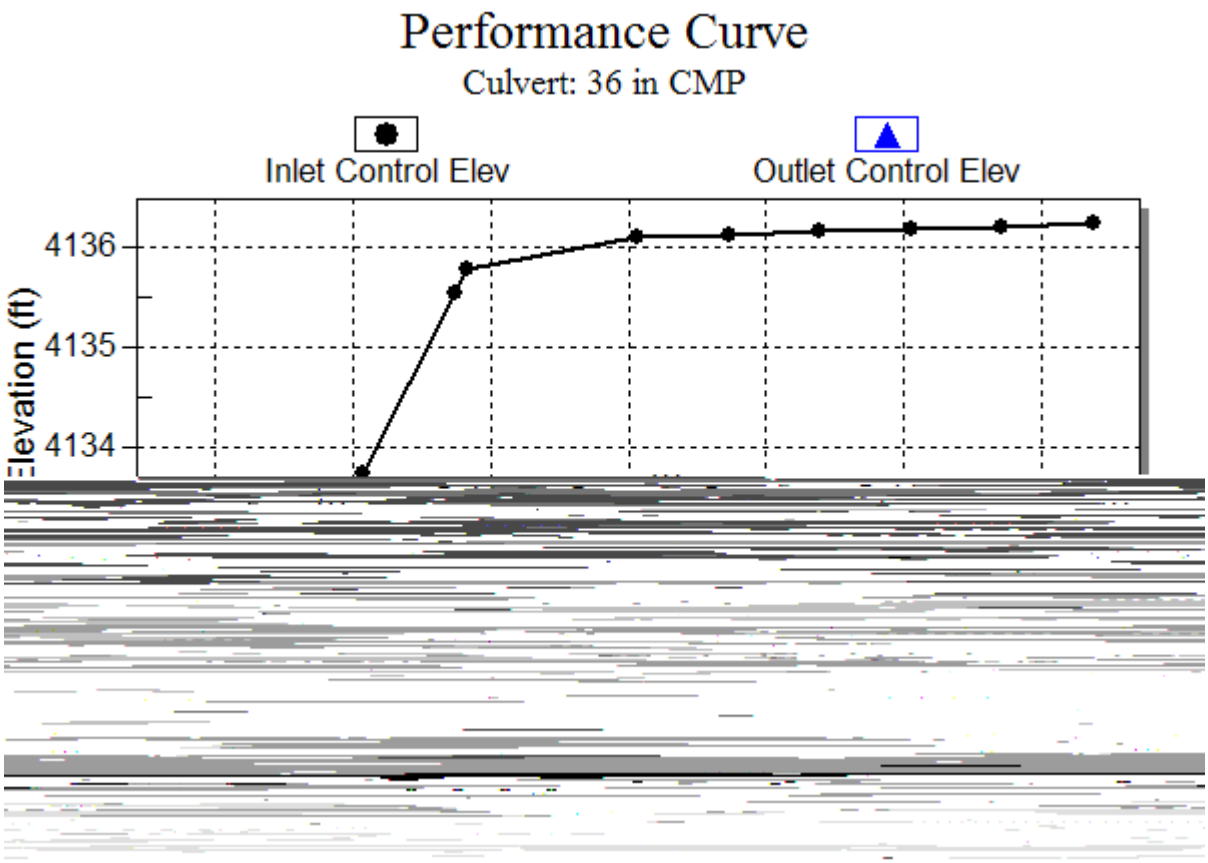
****

Inlet Elevation (invert): 4128.06 ft, Outlet Elevation (invert): 4116.34 ft

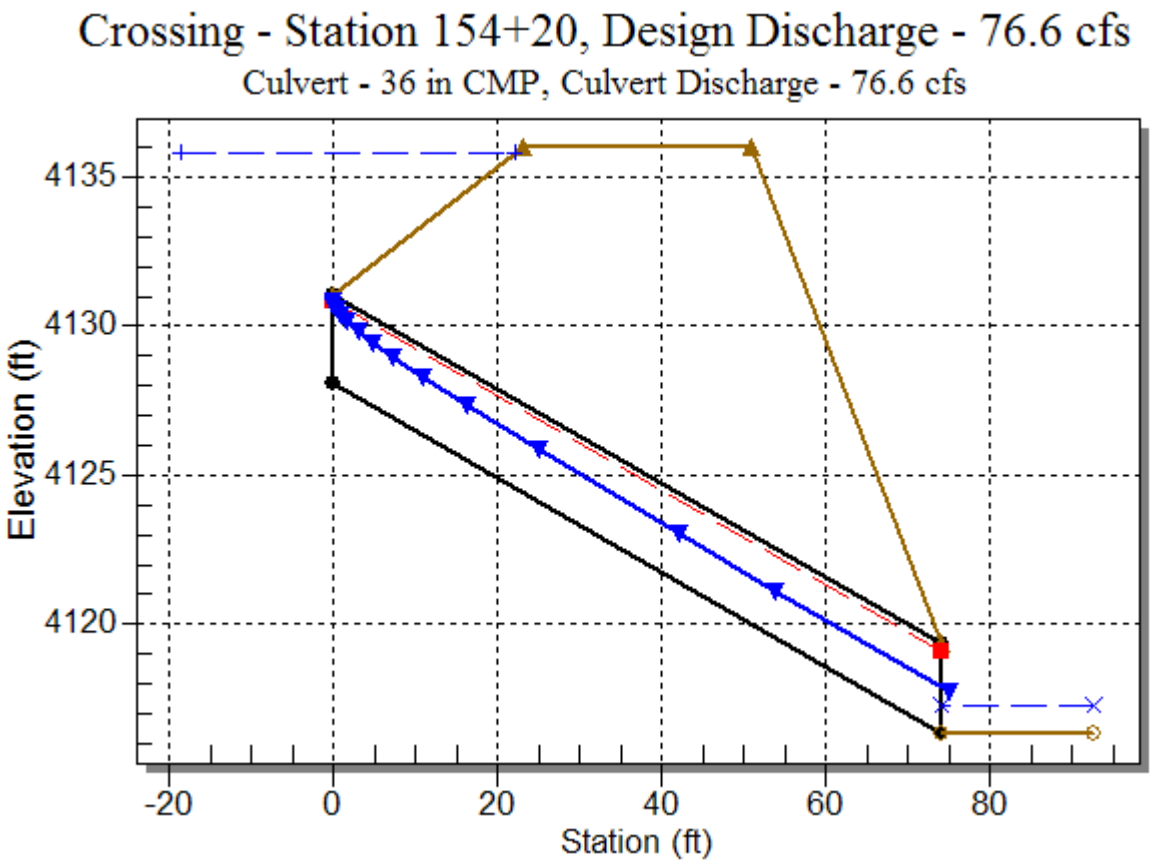
Culvert Length: 74.92 ft, Culvert Slope: 0.1584

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4128.06 ft

Outlet Station: 74.00 ft

Outlet Elevation: 4116.34 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 36 - Downstream Channel Rating Curve (Crossing: Station 154+20)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
35.20	4116.99	0.65	4.71	1.62	1.29
48.42	4117.09	0.75	5.12	1.88	1.32
61.64	4117.18	0.84	5.46	2.10	1.34
74.86	4117.26	0.92	5.74	2.29	1.35
76.60	4117.27	0.93	5.77	2.32	1.36
101.30	4117.39	1.05	6.20	2.63	1.38
114.52	4117.45	1.11	6.40	2.77	1.39
127.74	4117.51	1.17	6.58	2.91	1.40
140.96	4117.56	1.22	6.75	3.04	1.41
154.18	4117.60	1.26	6.91	3.16	1.42
167.40	4117.65	1.31	7.05	3.27	1.43

Tailwater Channel Data - Station 154+20

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4116.34 ft

Roadway Data for Crossing: Station 154+20

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4136.00 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Table 37 - Summary of Culvert Flows at Crossing: Station 170+50

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4288.64	28.90	28.90	0.00	1
4289.42	39.93	39.93	0.00	1
4290.44	50.96	50.96	0.00	1
4291.72	61.99	61.99	0.00	1
4291.90	63.40	63.40	0.00	1
4294.83	84.05	84.05	0.00	1
4296.85	95.08	95.08	0.00	1
4298.03	106.11	100.93	4.72	17
4298.08	117.14	101.12	15.64	5
4298.11	128.17	101.27	26.52	4
4298.13	139.20	101.40	37.61	4
4298.00	100.76	100.76	0.00	Overtopping

Rating Curve Plot for Crossing: Station 170+50

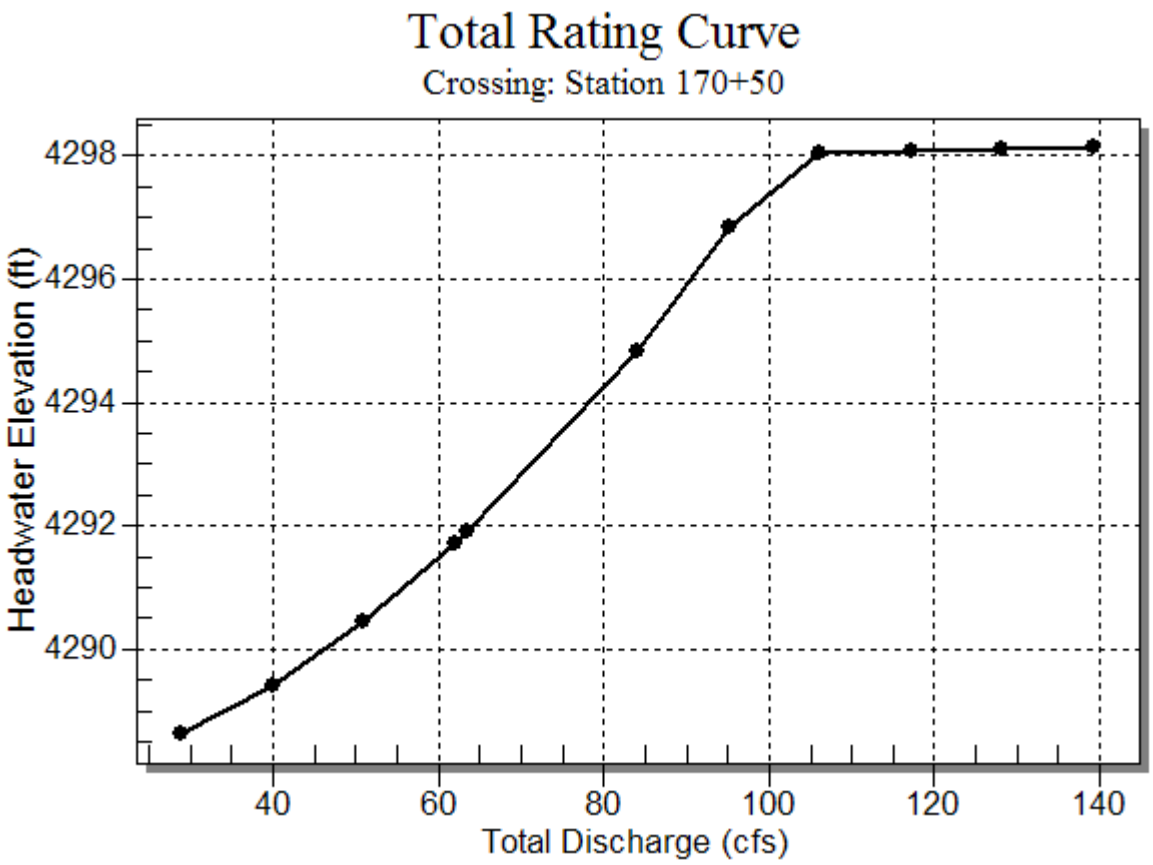


Table 38 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
28.90	28.90	4288.64	2.649	0.0*	1-S2n	0.966	1.736	0.975	0.592	14.471	4.474
39.93	39.93	4289.42	3.430	0.0*	5-S2n	1.150	2.054	1.153	0.689	15.935	4.873
50.96	50.96	4290.44	4.453	0.0*	5-S2n	1.316	2.315	1.324	0.772	16.932	5.194
61.99	61.99	4291.72	5.730	0.0*	5-S2n	1.475	2.517	1.476	0.844	17.895	5.466
63.40	63.40	4291.90	5.910	0.0*	5-S2n	1.496	2.540	1.499	0.853	17.952	5.498
84.05	84.05	4294.83	8.840	0.0*	5-S2n	1.779	2.872	1.781	0.968	19.232	5.914
95.08	95.08	4296.85	10.857	0.552	5-S2n	1.935	3.000	1.939	1.023	19.705	6.105
106.11	100.93	4298.03	12.043	2.326	5-S2n	2.019	3.000	2.023	1.074	19.925	6.279
117.14	101.12	4298.08	12.084	2.387	5-S2n	2.021	3.000	2.029	1.122	19.897	6.439
128.17	101.27	4298.11	12.115	2.434	5-S2n	2.024	3.000	2.029	1.167	19.927	6.589
139.20	101.40	4298.13	12.143	2.475	5-S2n	2.025	3.000	2.029	1.210	19.952	6.730

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 4285.99 ft, Outlet Elevation (invert): 4269.55 ft

Culvert Length: 133.81 ft, Culvert Slope: 0.1238

****

Culvert Performance Curve Plot: 36 in CMP

Water Surface Profile Plot for Culvert: 36 in CMP

Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4285.99 ft

Outlet Station: 132.80 ft

Outlet Elevation: 4269.55 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 39 - Downstream Channel Rating Curve (Crossing: Station 170+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
28.90	4270.14	0.59	4.47	1.48	1.27
39.93	4270.24	0.69	4.87	1.72	1.30
50.96	4270.32	0.77	5.19	1.93	1.32
61.99	4270.39	0.84	5.47	2.11	1.34
63.40	4270.40	0.85	5.50	2.13	1.34
84.05	4270.52	0.97	5.91	2.42	1.36
95.08	4270.57	1.02	6.10	2.55	1.38
106.11	4270.62	1.07	6.28	2.68	1.38
117.14	4270.67	1.12	6.44	2.80	1.39
128.17	4270.72	1.17	6.59	2.91	1.40
139.20	4270.76	1.21	6.73	3.02	1.41

Tailwater Channel Data - Station 170+50

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4269.55 ft

Roadway Data for Crossing: Station 170+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4298.00 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Table 40 - Summary of Culvert Flows at Crossing: Station 182+00

Headwater Elevation (ft)	Total Discharge (cfs)	84 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4323.41	128.00	128.00	0.00	1
4324.17	171.18	171.18	0.00	1
4324.89	214.36	214.36	0.00	1
4325.65	257.54	257.54	0.00	1
4325.75	262.80	262.80	0.00	1
4327.44	343.90	343.90	0.00	1
4328.52	387.08	387.08	0.00	1
4329.74	430.26	430.26	0.00	1
4331.09	473.44	473.44	0.00	1
4332.57	516.62	516.62	0.00	1
4334.15	559.80	559.80	0.00	1
4344.00	781.74	781.74	0.00	Overtopping

Rating Curve Plot for Crossing: Station 182+00

Table 41 - Culvert Summary Table: 84 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
128.00	128.00	4323.41	4.250	0.0*	1-S2n	1.477	2.910	1.500	1.166	21.036	6.587
171.18	171.18	4324.17	5.011	0.0*	1-S2n	1.694	3.390	1.710	1.323	23.273	7.094
214.36	214.36	4324.89	5.734	0.0*	1-S2n	1.910	3.809	1.919	1.458	24.877	7.512
257.54	257.54	4325.65	6.489	0.0*	1-S2n	2.121	4.208	2.127	1.576	26.082	7.869
262.80	262.80	4325.75	6.586	0.0*	1-S2n	2.141	4.249	2.148	1.590	26.273	7.910
343.90	343.90	4327.44	8.277	0.0*	5-S2n	2.454	4.885	2.475	1.781	28.165	8.467
387.08	387.08	4328.52	9.360	0.0*	5-S2n	2.620	5.165	2.625	1.871	29.298	8.724
430.26	430.26	4329.74	10.581	0.0*	5-S2n	2.786	5.443	2.792	1.956	30.042	8.960
473.44	473.44	4331.09	11.934	0.0*	5-S2n	2.932	5.684	2.934	2.035	30.923	9.179
516.62	516.62	4332.57	13.409	0.0*	5-S2n	3.076	5.879	3.108	2.110	31.285	9.382
559.80	559.80	4334.15	14.991	0.0*	5-S2n	3.220	6.073	3.223	2.181	32.323	9.575

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 4319.16 ft, Outlet Elevation (invert): 4278.92 ft

Culvert Length: 294.66 ft, Culvert Slope: 0.1379

****

Culvert Performance Curve Plot: 84 in CMP

Water Surface Profile Plot for Culvert: 84 in CMP

Site Data - 84 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4319.16 ft

Outlet Station: 291.90 ft

Outlet Elevation: 4278.92 ft

Number of Barrels: 1

Culvert Data Summary - 84 in CMP

Barrel Shape: Circular

Barrel Diameter: 7.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Mitered to Conform to Slope

Inlet Depression: NONE

Table 42 - Downstream Channel Rating Curve (Crossing: Station 182+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
128.00	4280.09	1.17	6.59	2.91	1.40
171.18	4280.24	1.32	7.09	3.30	1.43
214.36	4280.38	1.46	7.51	3.64	1.45
257.54	4280.50	1.58	7.87	3.93	1.47
262.80	4280.51	1.59	7.91	3.97	1.47
343.90	4280.70	1.78	8.47	4.44	1.49
387.08	4280.79	1.87	8.72	4.67	1.50
430.26	4280.88	1.96	8.96	4.88	1.51
473.44	4280.95	2.03	9.18	5.08	1.52
516.62	4281.03	2.11	9.38	5.27	1.53
559.80	4281.10	2.18	9.57	5.44	1.54

Tailwater Channel Data - Station 182+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4278.92 ft

Roadway Data for Crossing: Station 182+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4344.00 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Appendix E – Roadway Hydraulic Calculations

```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
---------------------------------------------------------------------
Lower Haul Road from Explosives Site to Culvert
Road Capacity Calculations
2 Year Flow

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

Program License Serial Number 6026

---------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   4562.000(Ft.)
      Downstream (outlet) Elevation =   4482.000(Ft.)
      Runoff/Flow Distance =    584.000(Ft.)
      Maximum flow rate in channel(s) =      5.500(CFS)
---------------------------------------------------------------------

Depth of flow =   0.237(Ft.)
Average velocity =   3.776(Ft/s)
Total flow rate in 1/2 street =   5.500(CFS)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-------------------------------------------------------------------
Sub-Channel flow  =      5.500(CFS)
  '     '    flow top width =     12.308(Ft.)
  '     '    wetted perimeter =     12.366(Ft.)
  '     '    velocity=    3.776(Ft/s)
  '     '    area =      1.457(Sq.Ft)
  '     '    Froude number =     1.934

Upstream point elevation = 4562.000(Ft.)
Downstream point elevation = 4482.000(Ft.)
Flow length =   584.000(Ft.)
Depth of flow =   0.237(Ft.)
Average velocity =   3.776(Ft/s)
Total irregular channel flow =     5.500(CFS)
Irregular channel normal depth above invert elev. =   0.237(Ft.)
Average velocity of channel(s) =   3.776(Ft/s)
-------------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      0.309(Ft.)
  '     '       '     Critical flow top width =     16.047(Ft.)
  '     '       '     Critical flow velocity=    2.221(Ft/s)
  '     '       '     Critical flow area =      2.476(Sq.Ft)

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  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0

------------------------------------------------------------------
Lower Haul Road from Explosives Site to Culvert
Road Capacity Calculations
10 Year Flow

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

Program License Serial Number 6026

------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   4562.000(Ft.)
      Downstream (outlet) Elevation =   4482.000(Ft.)
      Runoff/Flow Distance =    584.000(Ft.)
      Maximum flow rate in channel(s) =     21.900(CFS)
------------------------------------------------------------------

Depth of flow =   0.397(Ft.)
Average velocity =   5.334(Ft/s)
Total flow rate in 1/2 street =  21.900(CFS)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     21.900(CFS)
  '     '    flow top width =     20.664(Ft.)
  '     '    wetted perimeter =     20.762(Ft.)
  '     '    velocity=    5.334(Ft/s)
  '     '    area =      4.106(Sq.Ft)
  '     '    Froude number =     2.109

Upstream point elevation = 4562.000(Ft.)
Downstream point elevation = 4482.000(Ft.)
Flow length =   584.000(Ft.)
Depth of flow =   0.397(Ft.)
Average velocity =   5.334(Ft/s)
Total irregular channel flow =    21.900(CFS)
Irregular channel normal depth above invert elev. =   0.397(Ft.)
Average velocity of channel(s) =   5.334(Ft/s)
-----------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      0.535(Ft.)
  '     '       '     Critical flow top width =     27.828(Ft.)
  '     '       '     Critical flow velocity=    2.941(Ft/s)
  '     '       '     Critical flow area =      7.446(Sq.Ft)

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```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
-------------------------------------------------------------------
Lower Haul Road from Explosives Site to Culvert
Road Capacity Calculations
25 Year Flow

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

Program License Serial Number 6026

-------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   4562.000(Ft.)
      Downstream (outlet) Elevation =   4482.000(Ft.)
      Runoff/Flow Distance =    584.000(Ft.)
      Maximum flow rate in channel(s) =     34.000(CFS)
-------------------------------------------------------------------

Depth of flow =   0.469(Ft.)
Average velocity =   5.954(Ft/s)
Total flow rate in 1/2 street =  34.000(CFS)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     34.000(CFS)
  '     '    flow top width =     24.370(Ft.)
  '     '    wetted perimeter =     24.485(Ft.)
  '     '    velocity=    5.954(Ft/s)
  '     '    area =      5.711(Sq.Ft)
  '     '    Froude number =     2.168

Upstream point elevation = 4562.000(Ft.)
Downstream point elevation = 4482.000(Ft.)
Flow length =   584.000(Ft.)
Depth of flow =   0.469(Ft.)
Average velocity =   5.954(Ft/s)
Total irregular channel flow =    34.000(CFS)
Irregular channel normal depth above invert elev. =   0.469(Ft.)
Average velocity of channel(s) =   5.954(Ft/s)
-----------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      0.641(Ft.)
  '     '       '     Critical flow top width =     33.313(Ft.)
  '     '       '     Critical flow velocity=    3.186(Ft/s)
  '     '       '     Critical flow area =     10.670(Sq.Ft)

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  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
-------------------------------------------------------------------
Lower Haul Road from Explosives Site to Culvert
Road Capacity Calculations
100 Year Flow

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

Program License Serial Number 6026

-------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   4562.000(Ft.)
      Downstream (outlet) Elevation =   4482.000(Ft.)
      Runoff/Flow Distance =    584.000(Ft.)
      Maximum flow rate in channel(s) =     63.200(CFS)
-------------------------------------------------------------------

Depth of flow =   0.591(Ft.)
Average velocity =   6.952(Ft/s)
Total flow rate in 1/2 street =  63.200(CFS)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     63.200(CFS)
  '     '    flow top width =     30.748(Ft.)
  '     '    wetted perimeter =     30.894(Ft.)
  '     '    velocity=    6.952(Ft/s)
  '     '    area =      9.091(Sq.Ft)
  '     '    Froude number =     2.253

Upstream point elevation = 4562.000(Ft.)
Downstream point elevation = 4482.000(Ft.)
Flow length =   584.000(Ft.)
Depth of flow =   0.591(Ft.)
Average velocity =   6.952(Ft/s)
Total irregular channel flow =    63.200(CFS)
Irregular channel normal depth above invert elev. =   0.591(Ft.)
Average velocity of channel(s) =   6.952(Ft/s)
-----------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      0.805(Ft.)
  '     '       '     Critical flow top width =     36.819(Ft.)
  '     '       '     Critical flow velocity=    3.814(Ft/s)
  '     '       '     Critical flow area =     16.573(Sq.Ft)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
---------------------------------------------------------------------
Upper Haul Road from Quarry to Explosives Site
Road Capacity Calculations
2 Year Flow

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

Program License Serial Number 6026

---------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   5169.000(Ft.)
      Downstream (outlet) Elevation =   4978.000(Ft.)
      Runoff/Flow Distance =   1441.000(Ft.)
      Maximum flow rate in channel(s) =    244.300(CFS)
---------------------------------------------------------------------

Depth of flow =   0.961(Ft.)
Average velocity =  10.913(Ft/s)
Total flow rate in 1/2 street = 244.300(CFS)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-------------------------------------------------------------------
Sub-Channel flow  =    244.301(CFS)
  '     '    flow top width =     37.445(Ft.)
  '     '    wetted perimeter =     37.741(Ft.)
  '     '    velocity=   10.913(Ft/s)
  '     '    area =     22.387(Sq.Ft)
  '     '    Froude number =     2.487

Upstream point elevation = 5169.000(Ft.)
Downstream point elevation = 4978.000(Ft.)
Flow length =  1441.000(Ft.)
Depth of flow =   0.961(Ft.)
Average velocity =  10.913(Ft/s)
Total irregular channel flow =   244.300(CFS)
Irregular channel normal depth above invert elev. =   0.961(Ft.)
Average velocity of channel(s) =  10.913(Ft/s)
-------------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      1.469(Ft.)
  '     '       '     Critical flow top width =     39.475(Ft.)
  '     '       '     Critical flow velocity=    5.830(Ft/s)
  '     '       '     Critical flow area =     41.904(Sq.Ft)

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```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
---------------------------------------------------------------------
Upper Haul Road from Quarry to Explosives Site
Road Capacity Calculations
10 Year Flow

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

Program License Serial Number 6026

---------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   5169.000(Ft.)
      Downstream (outlet) Elevation =   4978.000(Ft.)
      Runoff/Flow Distance =   1441.000(Ft.)
      Maximum flow rate in channel(s) =    471.100(CFS)
---------------------------------------------------------------------

Depth of flow =   1.258(Ft.)
Average velocity =  13.996(Ft/s)
Total flow rate in 1/2 street = 471.100(CFS)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-------------------------------------------------------------------
Sub-Channel flow  =    471.100(CFS)
  '     '    flow top width =     38.630(Ft.)
  '     '    wetted perimeter =     39.066(Ft.)
  '     '    velocity=   13.996(Ft/s)
  '     '    area =     33.659(Sq.Ft)
  '     '    Froude number =     2.642

Upstream point elevation = 5169.000(Ft.)
Downstream point elevation = 4978.000(Ft.)
Flow length =  1441.000(Ft.)
Depth of flow =   1.258(Ft.)
Average velocity =  13.996(Ft/s)
Total irregular channel flow =   471.100(CFS)
Irregular channel normal depth above invert elev. =   1.258(Ft.)
Average velocity of channel(s) =  13.996(Ft/s)
-------------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      2.063(Ft.)
  '     '       '     Critical flow top width =     41.850(Ft.)
  '     '       '     Critical flow velocity=    7.133(Ft/s)
  '     '       '     Critical flow area =     66.048(Sq.Ft)

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```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
-------------------------------------------------------------------
Upper Haul Road from Quarry to Explosives Site
Road Capacity Calculations
25 Year Flow

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

Program License Serial Number 6026

-------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   5169.000(Ft.)
      Downstream (outlet) Elevation =   4978.000(Ft.)
      Runoff/Flow Distance =   1441.000(Ft.)
      Maximum flow rate in channel(s) =    636.900(CFS)
-------------------------------------------------------------------

Depth of flow =   1.437(Ft.)
Average velocity =  15.662(Ft/s)
Total flow rate in 1/2 street = 636.900(CFS)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =    636.899(CFS)
  '     '    flow top width =     39.349(Ft.)
  '     '    wetted perimeter =     39.870(Ft.)
  '     '    velocity=   15.662(Ft/s)
  '     '    area =     40.665(Sq.Ft)
  '     '    Froude number =     2.715

Upstream point elevation = 5169.000(Ft.)
Downstream point elevation = 4978.000(Ft.)
Flow length =  1441.000(Ft.)
Depth of flow =   1.437(Ft.)
Average velocity =  15.662(Ft/s)
Total irregular channel flow =   636.900(CFS)
Irregular channel normal depth above invert elev. =   1.437(Ft.)
Average velocity of channel(s) =  15.662(Ft/s)
-----------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      2.438(Ft.)
  '     '       '     Critical flow top width =     43.350(Ft.)
  '     '       '     Critical flow velocity=    7.765(Ft/s)
  '     '       '     Critical flow area =     82.023(Sq.Ft)

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```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
-------------------------------------------------------------------
Upper Haul Road from Quarry to Explosives Site
Road Capacity Calculations
100 Year Flow

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

Program License Serial Number 6026

-------------------------------------------------------------------
            *** Irregular Channel Analysis ***

      Upstream (headworks) Elevation =   5169.000(Ft.)
      Downstream (outlet) Elevation =   4978.000(Ft.)
      Runoff/Flow Distance =   1441.000(Ft.)
      Maximum flow rate in channel(s) =    983.600(CFS)
-------------------------------------------------------------------

Depth of flow =   1.759(Ft.)
Average velocity =  18.374(Ft/s)
Total flow rate in 1/2 street = 983.600(CFS)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              4.00
      2              8.00              0.00
      3             43.00              0.70
      4             49.60              4.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =    983.600(CFS)
  '     '    flow top width =     40.636(Ft.)
  '     '    wetted perimeter =     41.309(Ft.)
  '     '    velocity=   18.374(Ft/s)
  '     '    area =     53.534(Sq.Ft)
  '     '    Froude number =     2.821

Upstream point elevation = 5169.000(Ft.)
Downstream point elevation = 4978.000(Ft.)
Flow length =  1441.000(Ft.)
Depth of flow =   1.759(Ft.)
Average velocity =  18.374(Ft/s)
Total irregular channel flow =   983.600(CFS)
Irregular channel normal depth above invert elev. =   1.759(Ft.)
Average velocity of channel(s) =  18.374(Ft/s)
-----------------------------------------------------------------

Sub-Channel No. 1 Critical depth =      3.094(Ft.)
  '     '       '     Critical flow top width =     45.975(Ft.)
  '     '       '     Critical flow velocity=    8.835(Ft/s)
  '     '       '     Critical flow area =    111.333(Sq.Ft)

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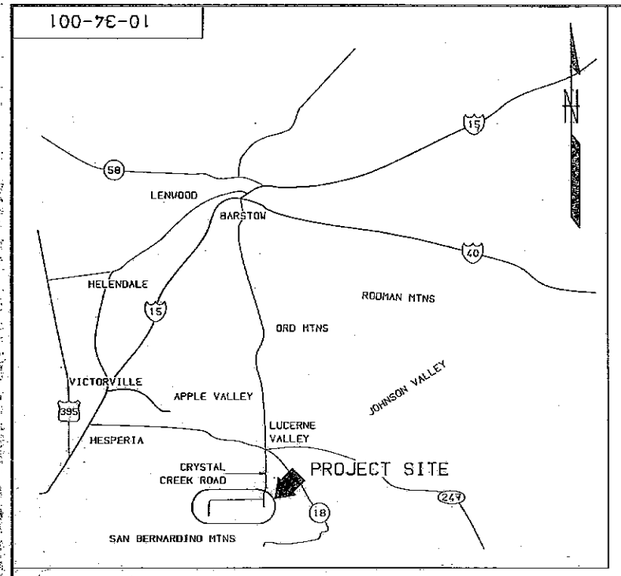
Appendix F –Haul & Access Road Improvement Plans by Morrison-Knudsen Engineers Prepared in 1987

10-34-001



VICINITY MAP
NOT TO SCALE

HAUL & ACCESS ROAD
for
PLUESS-STAUFER (CALIFORNIA), INC.
WHITE KNOB/WHITE RIDGE PROJECT

San Bernardino, County, California
T.3N., R.1W., SBM

GENERAL LEGEND

- SET 2" x 2" HUB & TACK AT PANEL POINT - UNLESS OTHERWISE NOTED
- SET 3'x 3' x 3' TRIANGULAR PANEL
- R/W — RIGHT OF WAY
- T1 — TEST HOLE #1 APPROXIMATE LOCATION, AUGER HOLES & SHALLOW PITS DUG BY HAND
- ROAD SIGN
- (1) — SIGN DESIGNATOR (SEE SIGN LEGEND)
- TOP OF CUT
- ℄ ROAD /W STATIONING AND GRAVEL EDGES
- TOE OF FILL
- SAFETY BERM
- CULVERT W/FLARED INLET
- CULVERT W/DROP INLET

SIGN LEGEND

(1) → R1-1 "STOP"
(2) → W3-1a "STOP AHEAD"
(3) → W2-4 "T" INTERSECTION
(4) → W8-2 "DIP"
(5) → R2-1 (10mph) "SPEED SIGN" @ 10 MILES PER HOUR
(6) → W2-1 "CROSS ROAD"
(7) → W1-4R "REVERSE TURN"
(8) → W7-1, W7-3 (7%) "DOWN GRADE" @ 7%
W7-2 "TRUCKS USE LOWER GEAR"
W7-3a "NEXT 2 MILES"
(9) → W7-1a, W7-3 (7%) "UPGRADE" @ 7%
W7-2 "TRUCKS USE LOWER GEAR"
W7-3a "NEXT 2 MILES"
(10) → W1-5 "WINDING ROAD SIGN"

GENERAL NOTES

1. THE BASE MAPPING WAS PROVIDED TO MKE BY BAUGHMAN & TURNER ENGINEERS & SURVEYORS FROM LAS VEGAS, NEVADA.

2. ALL USGS, COUNTY, PRIVATE & STATE BENCH MARKS, TOWNSHIPS & SECTION CORNERS SHALL NOT BE DISTURBED WITHOUT PRIOR WRITTEN APPROVAL FROM THE PARTY GOVERNING THE MONUMENTS.

3. A SOILS REPORT ENTITLED "GEOTECHNICAL INVESTIGATION FOR WHITE KNOB/ WHITE RIDGE HAUL ROAD" PREPARED BY MKE (MAY 4, 1987) IS A PART OF THIS CONTRACT.

4. DURING CLEARING AND GRUBBING OF THE ROAD R/W, REMOVAL AND RELOCATION OF JOSHUA TREES, MOJAVE YUCCAS AND CACTI PLANT SPECIES SHALL BE COMPLETED IN ACCORDANCE WITH THE SAN BERNARDINO COUNTY ENVIRONMENTAL ANALYSIS SECTION DURING ROAD CONSTRUCTION ACTIVITIES. (REF. SPEC. #34-0213)

5. HAUL ROAD DESIGN IS BASED ON THE FOLLOWING CRITERIA:

   - BLM & BUREAU OF MINE STANDARDS
   - 85 TON HAUL TRUCKS
   - ONE WAY TRAFFIC W/ NUMBERED TURNOUTS SPACED APPROX. 1000' APART
   - DESIGN SPEED = 25 MPH WITH SLOWER SPEEDS AT DIPS (FORD CROSSINGS), STEEP DOWN GRADES, AND SHARP CURVES: ROAD CROWNED @ ℄ =3%
   - SUPER ELEVATION WHERE POSSIBLE SHOULD START 2/3 OF THE RUNOUT LENGTH ON THE TANGENT W/ 1/3 OF THE LENGTH IN THE CURVE OR AS NOTED ON THE PLANS. SUPERELEVATIONS & RUNOUT LENGTHS SHALL BE 4% AND 100' UNLESS OTHERWISE NOTED IN THE CURVE DATA ON THE P&P SHEETS.
   - POINT OF REVERSE CURVES SHALL BE 0.0% CROSS SLOPE
   - CURVE WIDENING ON INSIDE OF CURVE = 400/R (ROUND OFF TO NEXT LARGEST EVEN FOOT). IF POSSIBLE START WIDENING AT START OF SUPERELEVATION.
   - CATTLE GUARDS AND FENCING ARE NOT REQUIRED.
   - LOCKED ACCESS GATE WITH WARNING SIGNS TO TRESPASSERS AT ENTRANCE TO BE SUPPLIED BY OWNER AND INSTALLED BY CONTRACTOR.
   - TRAFFIC CONTROL SIGNS - REF. SPECIFICATION SECTION 34-0213.
   - MAXIMUM 14% GRADE (PER OWNER'S DIRECTION)
   - DIPS AT DRAINAGE CROSSING WHERE POSSIBLE, HYDROLOGY DESIGN BASED ON A 10 YEAR 24 HRS. STORM FREQUENCY USING THE TR-20 COMPUTER DESIGN.

6. THE CLEARING AND GRUBBING LIMITS SHALL BE A LINE 10' OUT SIDE THE TOE OF CUT/FILL LIMITS SHOWN ON THE PLANS. ALL CUT/FILL SLOPES IN UNCLASSIFIED MATERIAL AND DISTRUBED AREAS OUTSIDE THESE SLOPES SHALL BE SEEDED AND MULCHED PER THE SPECIFICATIONS. ROCK CUT/FILL SLOPES DO NOT REQUIRE TOPSOIL, SEEDING AND MULCHING. ALSO, THE CONTRACTOR SHALL PAY SPECIAL ATTENTION TO DUST AND EROSION CONTROL.

7. SAFETY BERM LOCATIONS ARE SHOWN AND/OR CALLED OUT WITH A NOTE ON THE PLAN & PROFILE DRAWINGS. PROVIDE 3' WIDE BREAKS IN BERMS AT 300' AND AT ALL LOW POINTS TO ALLOW FOR SURFACE DRAINAGE.

8. PROPER TRAFFIC CONTROL SIGNS SHALL BE SUPPLIED AND INSTALLED IN ACCORDANCE WITH THESE DRAWINGS, LOCAL, STATE AND FEDERAL LAWS BY OTHERS.

9. WILDLIFE GUZZLERS HAVE BEEN INSTALLED BY THE OWNER TO COMPLY WITH THE "ENVIRONMENTAL IMPACT REPORT".

10. PROPERTY BOUNDARY, PERMITS, AND EASEMENTS TO BE PROVIDED BY THE OWNER.

11. UNLESS OTHERWISE NOTED IN THE PROFILE THE CUT SLOPES SHALL BE 2:1. AREAS VARYING FROM THIS SLOPE ARE CALLED OUT ON THE PROFILE. FINAL CUT & FILLS MAY BE ADJUSTED IN THE FIELD BY THE SOILS ENGINEER.

SPECIFICATION LIST

SPEC. NO.	TITLE
34-0211A	CONSTRUCTION SURVEYING
34-0213	HAUL/ACCESS ROAD
34-0227	CORRUGATED STEEL CULVERT PIPE
34-0228	TOPSOIL STRIPPING & STOCKPILING
34-0229	SEEDING & MULCHING (BY OTHERS)
34-0230	TEMPORARY EROSION CONTROL
34-0243	RIPRAP

DRAWING LIST

DRAWING NO.	REF. NO.	TITLE
10-34-001	10C-1	LOCATION PLAN & TITLE SHEET
10-34-002	10C-2	HAUL/ACCESS ROAD PLAN & PROFILE #1 (0+00 TO 30+00)
10-34-003	10C-3	HAUL/ACCESS ROAD PLAN & PROFILE #2 (30+00 TO 60+00)
10-34-004	10C-4	HAUL/ACCESS ROAD PLAN & PROFILE #3 (60+00 TO 90+00)
10-34-005	10C-5	HAUL/ACCESS ROAD PLAN & PROFILE #4 (90+00 TO 117+00)
10-34-006	10C-6	HAUL/ACCESS ROAD PLAN & PROFILE #5 (117+00 TO 138+00)
10-34-007	10C-7	HAUL/ACCESS ROAD PLAN & PROFILE #6 (138+00 TO 166+00)
10-34-008	10C-8	HAUL/ACCESS ROAD PLAN & PROFILE #7 (166+00 TO 191+00)
10-34-009	10C-9	HAUL/ACCESS ROAD PLAN & PROFILE #8 (191+00 TO 216+50)
10-34-010	10C-10	HAUL/ACCESS ROAD PLAN & PROFILE #9 (216+50 TO 245+00)
10-34-011	10C-11	HAUL/ACCESS ROAD PLAN & PROFILE #10 (245+00 TO 272+50)
10-34-012	10C-12	HAUL/ACCESS ROAD TYPICAL SECTIONS & DETAILS
10-34-013	10C-13	HAUL/ACCESS ROAD DRAINAGE DETAILS NO. 1
10-34-014	10C-14	HAUL/ACCESS ROAD DRAINAGE DETAILS NO. 2

REFERENCE DWGS

DRAWING NO.	TITLE

REVISIONS

NO.	BY	DATE	CKD	DESCRIPTION
0	CF	5/10/88		ISSUE FOR CONSTRUCTION BUL.0-001
D	RA	1/10/87	SKM	ISSUE FOR OWNER APPROVAL TL# 003
C	KF	10/21/87	MLT	ISSUE FOR BID ADDENDUM NO. 1 TL# 007
B	EB	10/7/87	MLT	ISSUE FOR BID TL#006
A	RA	7/2/87	SKM	ISSUE FOR OWNER APPROVAL TL#003

APPROVALS

DEPT \ REV	A	B	C	D	0
ARCH					
CIV/STRL	MLT	MLT	MLT	MLT	
MECH					
ELECT					
INSTM					
PIPING					
SAFETY					
SOILS					
DEPT MGR	JAB	JAB	JAB	JAB	
PROJECT	JAB	JAB	JAB	JAB	

SCALE	NONE	DATE
DRAWN BY	RARA	6/17/87
DESIGNED BY	MLT	6/17/87
CHECKED BY	SKM	6/30/87

CLIENT APPROVALS

REV	BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A DOORNBOOF-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.
WHITE KNOB/WHITE RIDGE PROJECT

DRAWING TITLE
LOCATION PLAN & TITLE SHEET

CONTRACT NO. 1928
24 x 36
DRAWING NO. 10-34-001
REFERENCE NO. 10C-1
REV 0

10C-2

BASIS OF BEARINGS

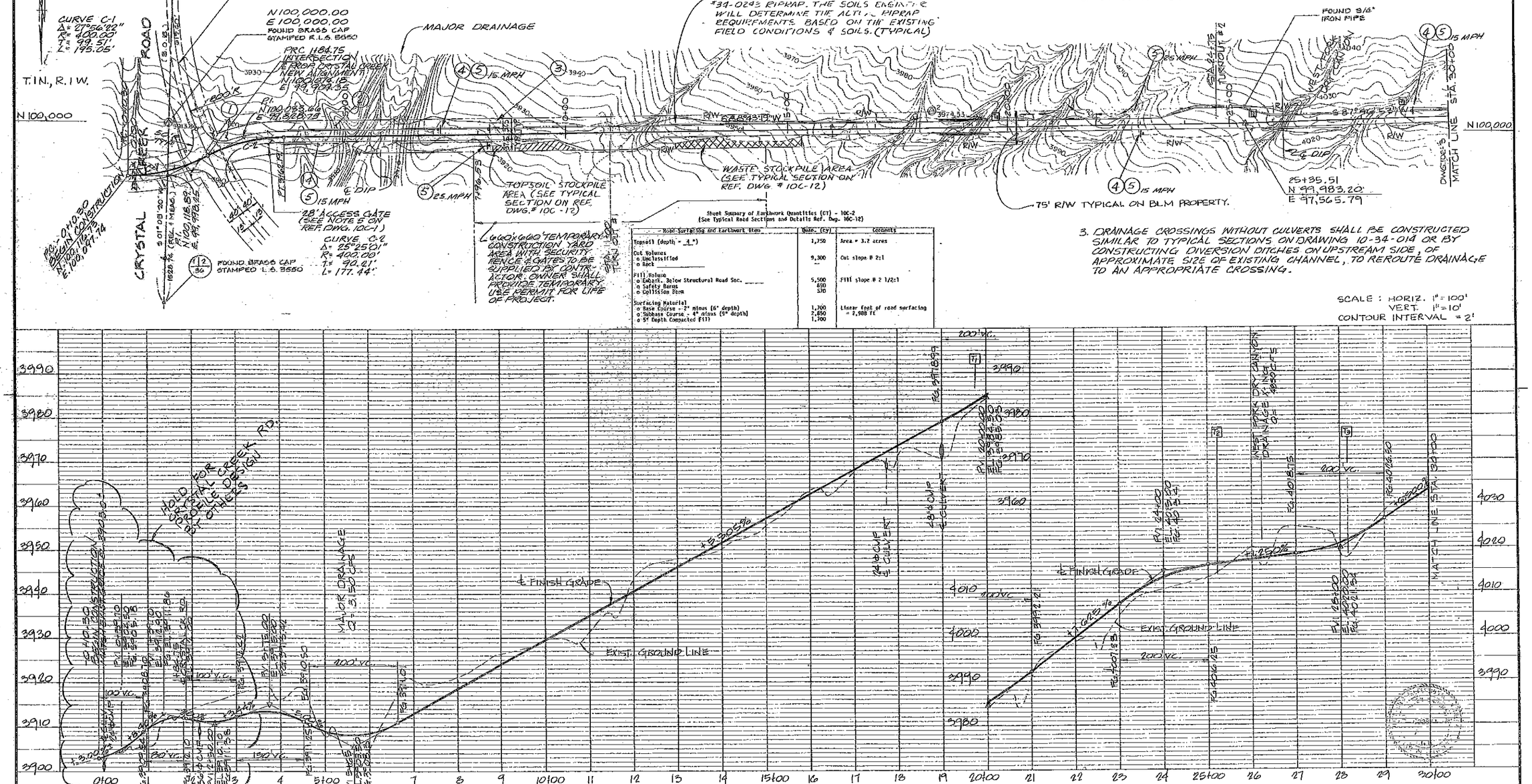
N 01°03'20" E - THE EASTERLY LINE OF FRACTIONAL SECTION 2, TOWNSHIP 3 NORTH, RANGE 1 WEST, S.B.B. & M. AS SHOWN ON RECORD OF SURVEY FILE 35, PAGE 94.

BENCH MARK

AERIAL PANEL POINTS SHOWN ON AERIAL SURVEY MAP BY AMERICAN AERIAL SURVEYS OF COVINA, CALIFORNIA. SEE
"J7" ELEV. = 5322.91
"J6" ELEV. = 5536.8

NOTES

1. SEE DWG. 10-34-001 FOR GENERAL NOTES (TYPICAL ALL DWGS).
2. SEE DWG. 10-34-001 FOR SIGN DESIGNATOR EXPLANATIONS.



Sheet Summary of Earthwork Quantities (CY) - 10C-2
(See Typical Road Sections and Details Ref. Dwg. 10C-12)

Road Surfacing and Earthwork Item	Quan. (CY)	Comments
Topsoil (depth = 4")	1,750	Area = 3.2 acres
Cut Volumes o Unclassified o Rock	9,300 —	Cut slope @ 2:1
Fill Volume o Embank. Below Structural Road Sec. o Safety Berms o Collision Berm	5,500 690 570	Fill slope @ 2 1/2:1
Surfacing Material o Base Course - 2" minus (6" depth) o Subbase Course - 4" minus (9" depth) o 5" Depth Compacted Fill	1,700 2,850 1,700	Linear feet of road surfacing = 2,988 ft

3. DRAINAGE CROSSINGS WITHOUT CULVERTS SHALL BE CONSTRUCTED SIMILAR TO TYPICAL SECTIONS ON DRAWING 10-34-014 OR BY CONSTRUCTING DIVERSION DITCHES ON UPSTREAM SIDE OF APPROXIMATE SIZE OF EXISTING CHANNEL, TO REROUTE DRAINAGE TO AN APPROPRIATE CROSSING.

SCALE : HORIZ. 1" = 100'
VERT. 1" = 10'
CONTOUR INTERVAL = 2'

REFERENCE DWGS DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-003	HAUL/ACCESS ROAD PLAN & PROFILE #2
10-34-012	HAUL/ACCESS ROAD TYP. SECT. & DETAILS
10-34-013	HAUL/ACCESS ROAD DRAINAGE DETAILS #1
10-34-014	HAUL/ACCESS ROAD DRAINAGE DETAILS #2
10-34-015	EMERGENCY ESCAPE RAMP DETAILS

REVISIONS NO.	BY	DATE	CKD	DESCRIPTION
O	RJ	5/10/88	MLT	ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	SKM	ISSUE FOR OWNER APPROVAL TL# 009
D	KF	10-22-87	MLT	ISSUE FOR BID ADDENDUM #1 TL# 007
C	RA	10-7-87	MLT	ISSUE FOR BIDS TL #006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL# 005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL TL# 003

APPROVALS DEPT	REV A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	SKM
MECH						
ELECT						
INSTR						
PIPING						
SAFETY						
DEPT MGR		SKM	MLT	MLT	MLT	SKM
PROJECT	MLT	MLT	MLT	MLT	MLT	SKM

SCALE AS SHOWN	DATE
DRAWN BY KFF	5/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87
CLIENT APPROVALS	
REV / BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

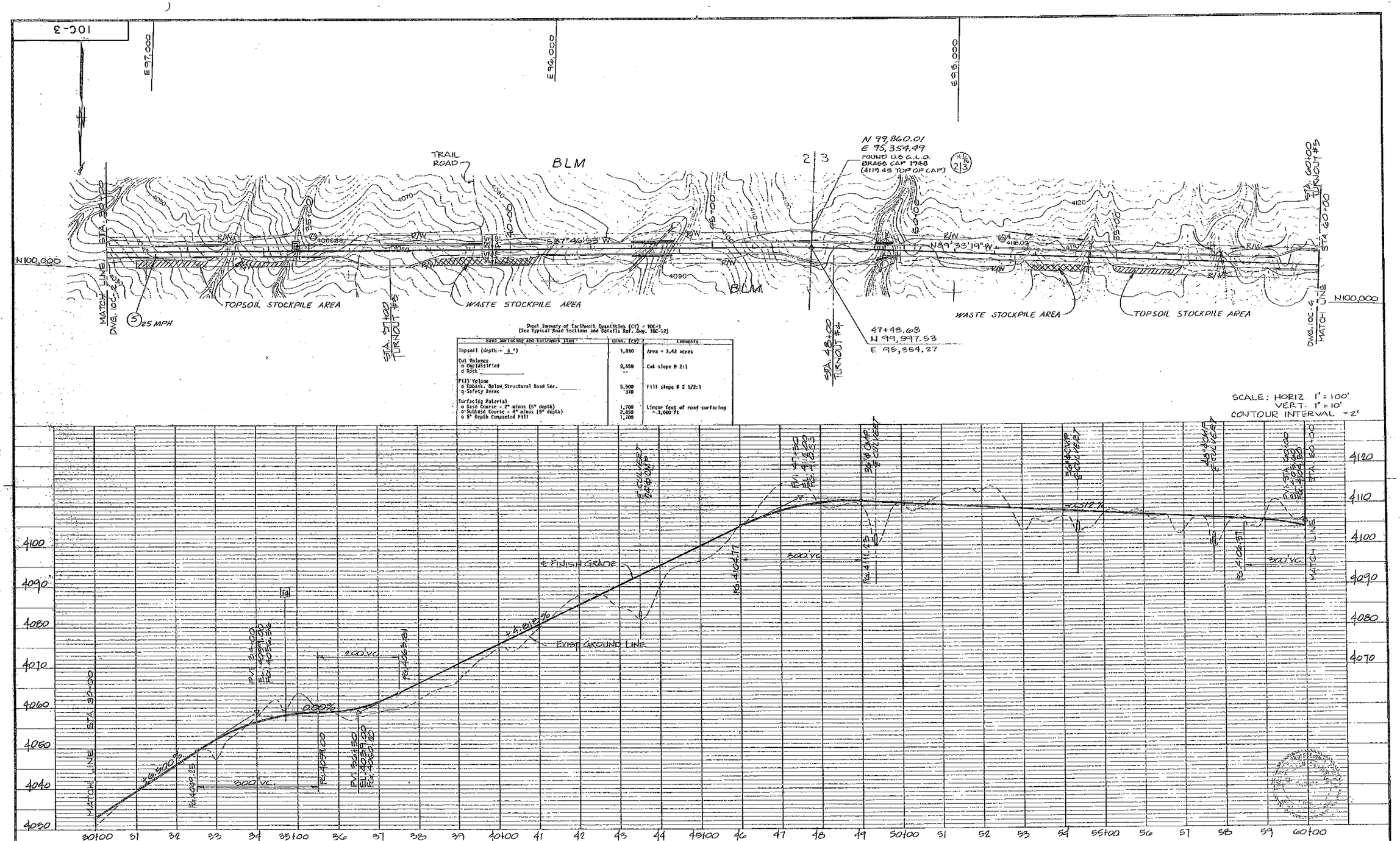
PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE #1

CONTRACT NO. 1928
24 II 36
DRAWING NO. 10-34-002
REFERENCE NO. 10C-2
REV O

BRUNING 441/32 65738



Sheet Summary of Earthwork Quantities (CY) - 10C-3
(See Typical Road Sections and Details Ref. Dwg. 10C-12)

Road Surfacing and Earthwork Item	Quan. (Cy)	Comments
Topsoil (depth = 4 ")	1,840	Area = 3.42 acres
Cut Volumes o Unclassified o Rock _____	 9,650 --	 Cut slope @ 2:1
Fill Volume o Embank. Below Structural Road Sec. _____ o Safety Berms	 5,900 370	 Fill slope @ 2 1/2:1
Surfacing Material o Base Course - 2" minus (6" depth) o Subbase Course - 4" minus (9" depth) o 5" Depth Compacted Fill	 1,700 2,850 1,700	 Linear feet of road surfacing = 3,000 ft

DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-002	HAUL/ACCESS ROAD P & P #1
10-34-004	HAUL/ACCESS ROAD P & P #3
10-34-012	HAUL/ACCESS ROAD TYP. SECT. & DETAILS
10-34-013	HAUL/ACCESS ROAD DRAINAGE DETAILS #1
10-34-014	HAUL/ACCESS ROAD DRAINAGE DETAILS #2

REFERENCE DWGS

NO.	BY	DATE	CKD	DESCRIPTION
O	RJ	6/10/88		ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	SKM	ISSUE FOR OWNER APPROVAL TL#009
D	KF	10-22-87	MLT	ISSUE FOR BID ADDENDUM #1 TL #007
C	RA	10-7-87	MLT	ISSUE FOR BIDS TL #006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL TL#003

REVISIONS

APPROVALS	REV A	B	C	D	E	O
ARCH						
CIV/STRL						
MECH						
ELECT						
INSTM.						
PIPING						
SAFETY						
DEPT MGR						
PROJECT						

SCALE AS SHOWN	DATE
DRAWN BY KFF	5/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87
CLIENT APPROVALS	
REV / BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE # 2

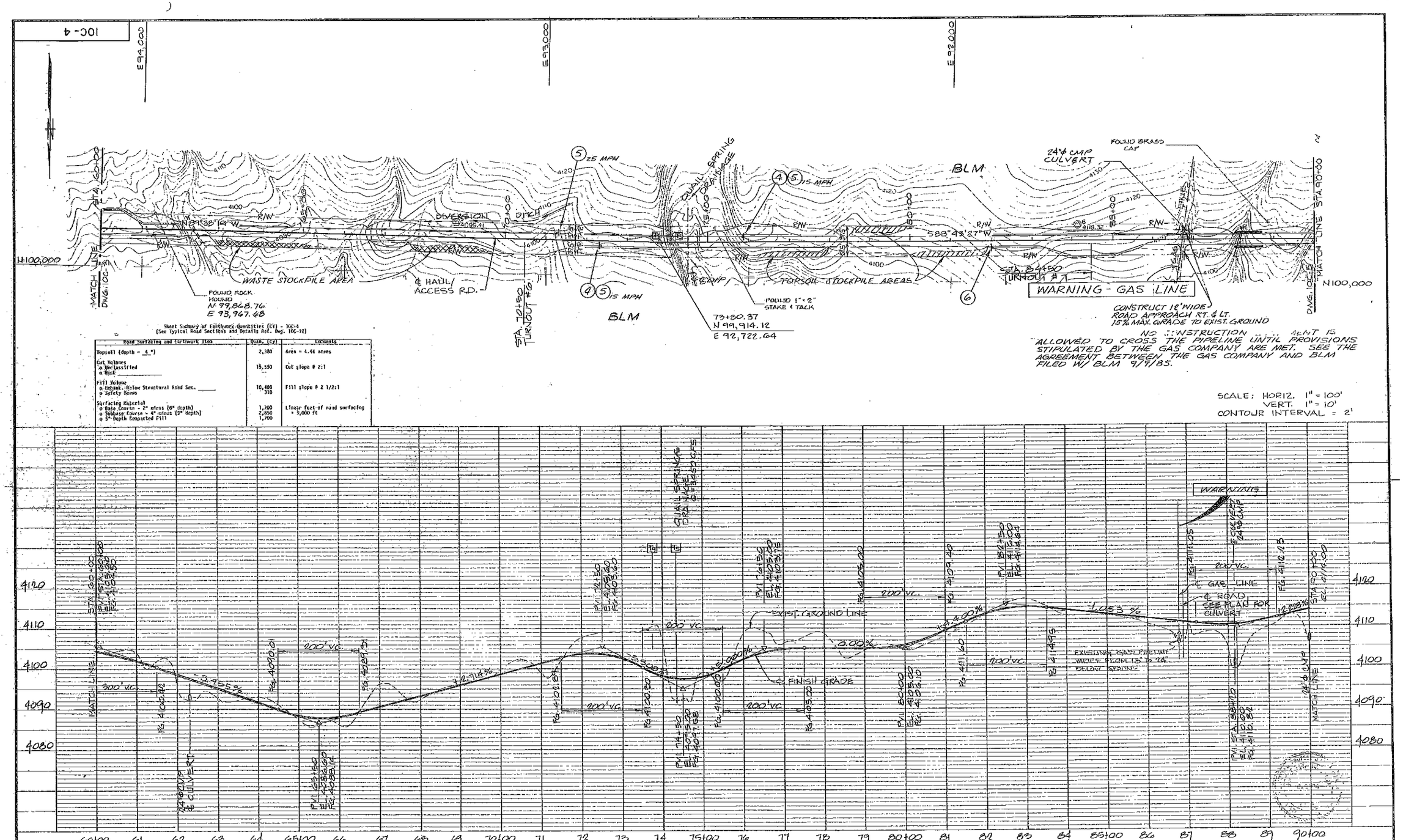
CONTRACT NO. 1928

24 II 36

DRAWING NO. 10-34-003

REFERENCE NO. 10C-3

REV O



Sheet Summary of Earthwork Quantities (CY) - 10C-4
(See Typical Road Sections and Details Ref. Dwg. 10C-12)

Road Surfacing and Earthwork Item	Quan. (CY)	Comments
Topsoil (depth = 4 ")	2,380	Area = 4.44 acres
Cut Volumes o Unclassified o Rock	13,550 --	Cut slope @ 2:1
Fill Volume o Embank. Below Structural Road Sec. _____ o Safety Berms	10,400 310	Fill slope @ 2 1/2:1
Surfacing Material o Base Course - 2" minus (6" depth) o Subbase Course - 4" minus (9" depth) o 5" Depth Compacted Fill	1,200 2,850 1,900	Linear feet of road surfacing = 3,000 ft

DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-003	HAUL/ACCESS ROAD P & P # 2
10-34-005	" " " P & P # 4
10-34-012	" " " TYP. SECT. & DETAILS
10-34-013	" " " DRAINAGE DETAILS #1
10-34-014	" " " " " #2

REFERENCE DWGS

NO.	BY	DATE	CKD.	DESCRIPTION
O	RJ	5/10/88		ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87		ISSUE FOR OWNER APPROVAL TL#009
D	KF	10-22-87		ISSUE FOR BID ADDENDUM #1 TL#007
C	RA	10-7-87	MLT	ISSUE FOR BID TL#006
B	GM	9-16-87		ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87		ISSUE FOR OWNER APPROVAL TL#003

REVISIONS

DEPT \ REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	SKM
MECH						
ELECT						
INSTM.						
PIPING						
SAFETY						
DEPT MGR						
PROJECT						

APPROVALS

SCALE AS SHOWN	DATE	
DRAWN BY KFF	5/87	
DESIGNED BY MLT	6/87	
CHECKED BY SKM	6/87	
CLIENT APPROVALS		
REV	BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

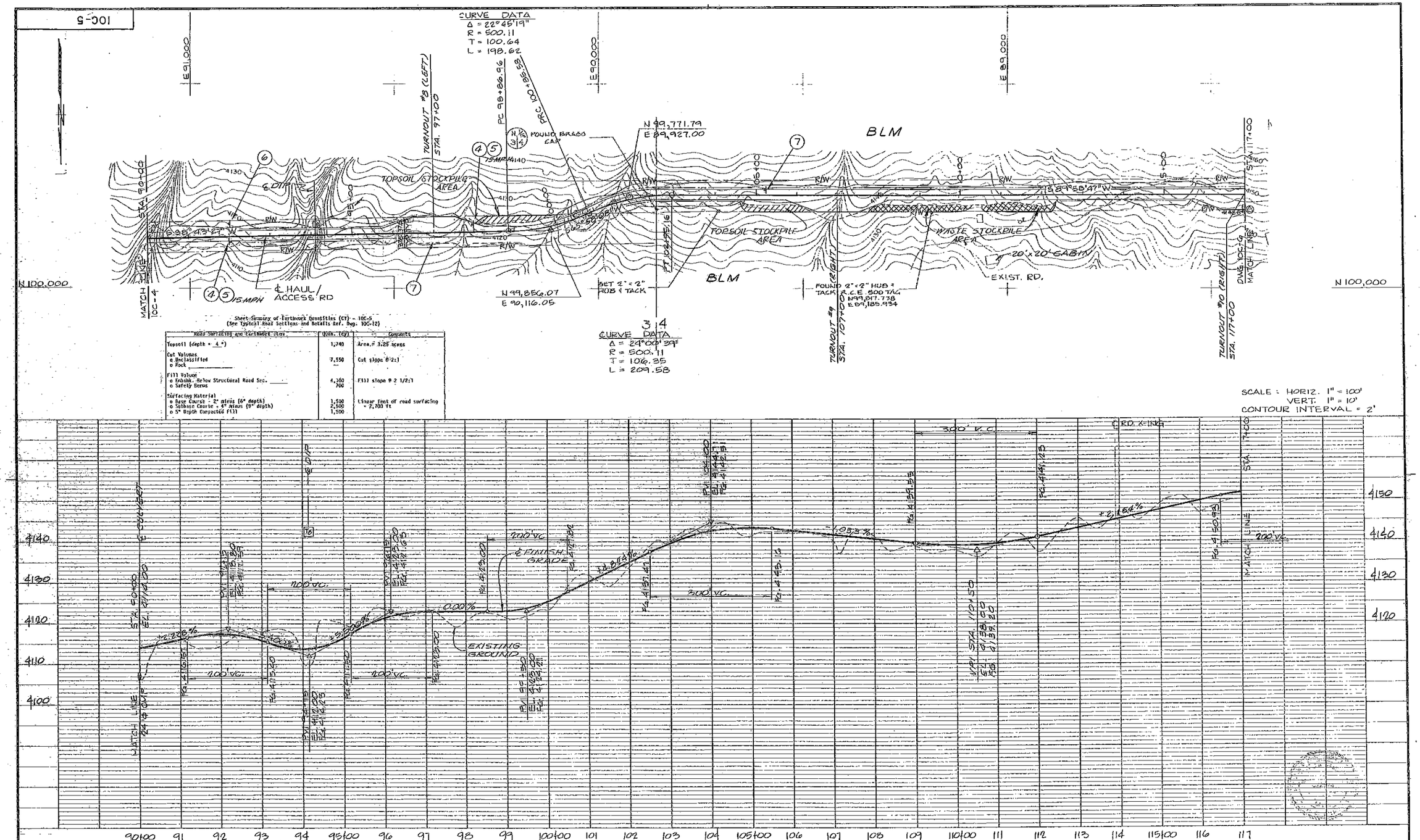
WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE # 3

CONTRACT NO. 1928 — 24 X 36

DRAWING NO. 10-34-004

REFERENCE NO. 10C-4 — REV O



Sheet Summary of Earthwork Quantities (CY) - 10C-5
(See Typical Road Sections and Details Ref. Dwg. 10C-12)

Road Surfacing and Earthwork Items	Qtn. (CY)	Comments
Topsoil (depth = 4")	1,740	Area = 3.25 acres
Cut Volumes o Unclassified o Rock	7,550 —	Cut slope @ 2:1
Fill Volume o Embnk. Below Structural Road Sec. o Safety Berms	4,300 700	Fill slope @ 2 1/2:1
Surfacing Material o Base Course - 2" minus (6" depth) o Subbase Course - 4" Minus (9" depth) o 5" Depth Compacted Fill	1,500 2,500 1,500	Linear feet of road surfacing = 2,703 ft

REFERENCE DWGS	
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-004	HAUL/ACCESS ROAD PLAN & PROFILE # 3
10-34-006	" " " PLAN & PROFILE # 5.
10-34-012	" " " TYP SECT'S & DETAILS
10-34-013	" " " DRAINAGE DETAILS #1
10-34-014	" " " " " #2
DRAWING NO.	TITLE

REVISIONS				
NO.	BY	DATE	CKD	DESCRIPTION
O	RJ	5/10/88	MLT	ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	SKM	ISSUE FOR OWNER APPROVAL TL#009
D	KF	10-22-87	MLT	ISSUE FOR BID ADDENDUM #1 TL#007
C	RA	10-7-87	MLT	ISSUE FOR BID TL#006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL TL#003

APPROVALS	A	B	C	D	E	O
DEPT REV						
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	SKM
MECH						
ELECT						
INSTM						
PIPING						
SAFETY						
DEPT MGR						
PROJECT						

SCALE AS SHOWN	DATE
DRAWN BY KFF	5/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87
CLIENT APPROVALS	
REV BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE #4

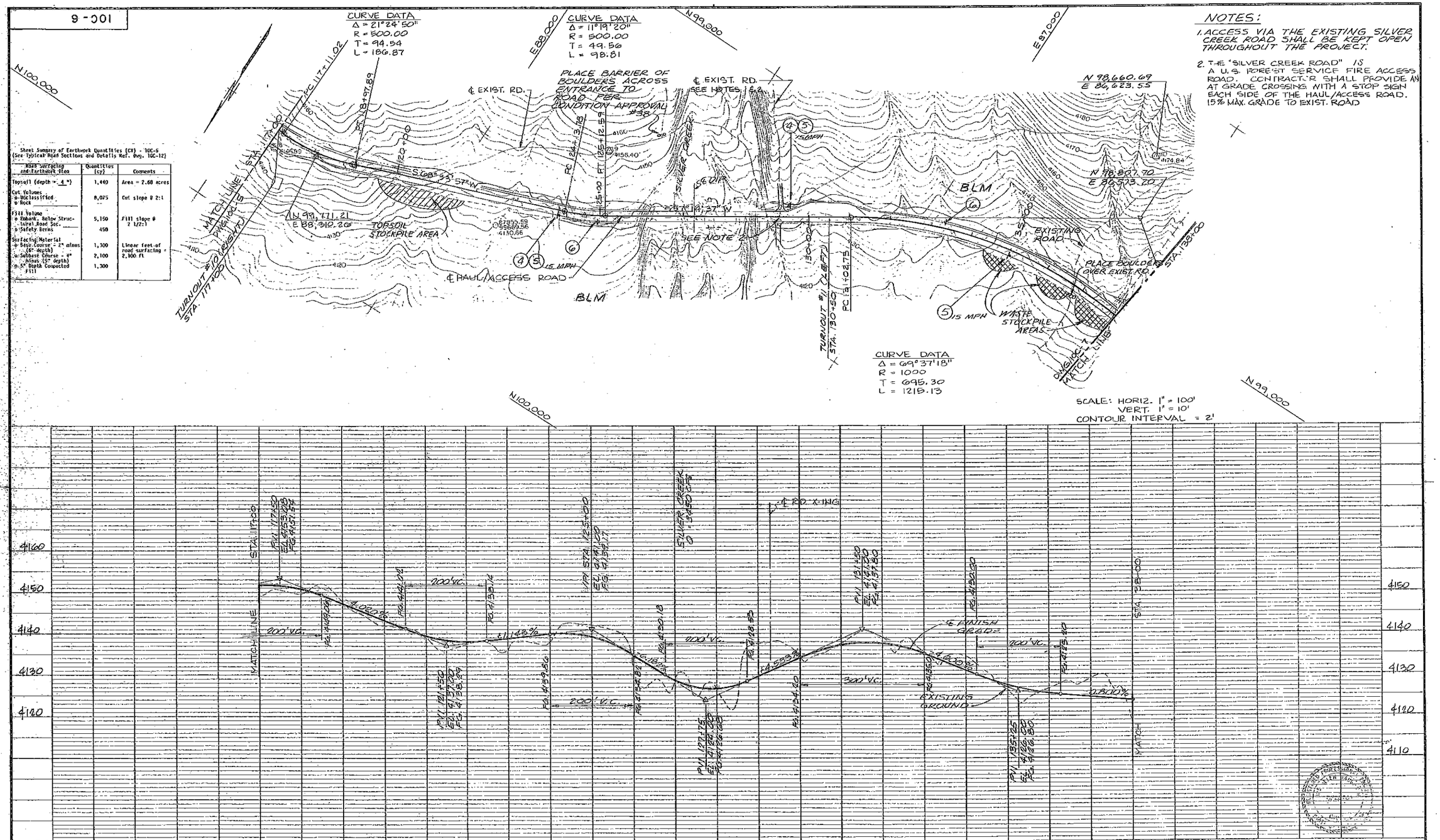
CONTRACT NO. 1928 — 24 of 36

DRAWING NO. 10-34-005

REFERENCE NO. 10C-5 — REV O

BRUNING 44-132 65738

10C-6



Sheet Summary of Earthwork Quantities (CY) - 10C-6
(See Typical Road Sections and Details Ref. Dwg. 10C-12)

Road Surfacing and Earthwork Item	Quantities (cy)	Comments
Topsoil (depth = 4 ")	1,440	Area = 2.68 acres
Cut Volumes		
o Unclassified	8,075	Cut slope @ 2:1
o Rock	--	
Fill Volume		
o Embank. Below Structural Road Sec.	5,150	Fill slope @ 2 1/2:1
o Safety Berms	450	
Surfacing Material		
o Base Course - 2" minus (6" depth)	1,300	Linear feet of road surfacing = 2,900 ft
o Subbase Course - 4" minus (9" depth)	2,100	
o 5" Depth Compacted Fill	1,300	

DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-005	HAUL/ACCESS ROAD PLAN & PROFILE # 4
10-34-007	" " " " " # 6
10-34-012	" " " TYP. SECT'S & DETAILS
10-34-013	" " " DRAINAGE DETAILS #1
10-34-014	" " " " " #2

REFERENCE DWGS

NO.	BY	DATE	CKD	DESCRIPTION
O	RJ	5/10/88		ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	SKM	ISSUE FOR OWNER APPROVAL TL#009
D	KF	10-22-87	MLT	ISSUE FOR BID ADDENDUM #1 TL#007
C	RA	10-7-87	MLT	ISSUE FOR BID T.L. #006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL TL#003

REVISIONS

DEPT \ REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	SKM
MECH						
ELECT						
INSTM						
PIPING						
SAFETY						
DEPT MGR						
PROJECT						

APPROVALS

SCALE AS SHOWN	DATE
DRAWN BY KFF	5/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87
CLIENT APPROVALS	
REV / BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE # 5

CONTRACT NO. 1928 — 24 X 36

DRAWING NO. 10-34-006

REFERENCE NO. 10C-6 — REV O

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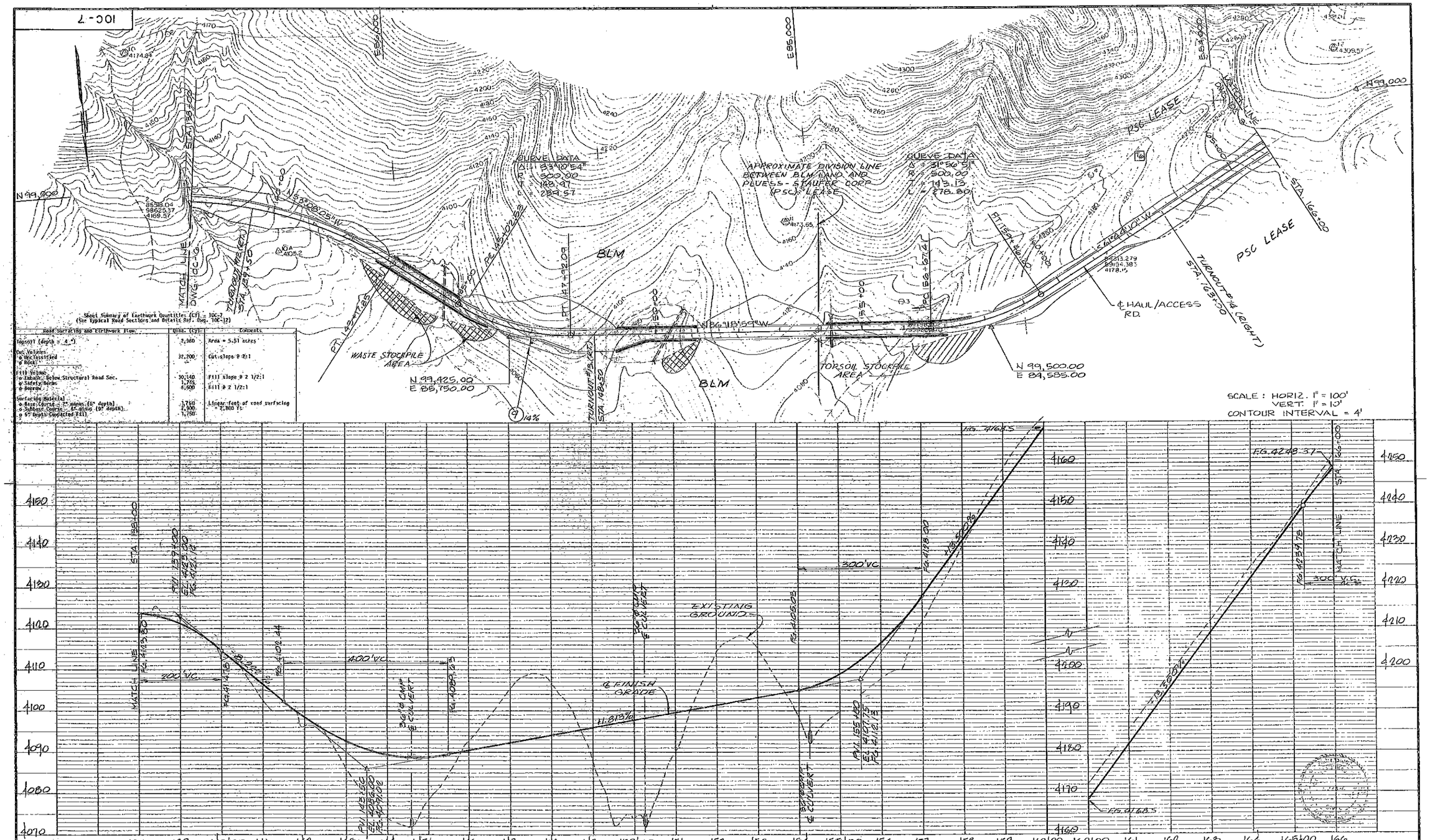


Sheet Summary of Earthwork Quantities (CY) - 10C-7
(See Typical Road Sections and Details Dwg. 10C-12)

Road Surfacing and Earthwork Item	Quan. (CY)	Comments
Topsoil (depth = 4")	2,360	Area = 5.51 acres
Cut Volume:		
o Unclassified	37,200	Cut slopes @ 2:1
o Rock		
Fill Volume:		
o Subgrade Below Structural Road Sec. ____	30,340	Fill slope @ 2 1/2:1
o Safety Berms	1,745	
o Borrow	8,900	Fill @ 2 1/2:1
Surfacing Material		
o Base Course (2" minus (6" depth)	1,750	Linear feet of road surfacing
o Subbase Course (4" minus (9" depth)	2,900	= 2,800 ft
o 6" Depth Compacted Fill	1,750	

DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-006	HAUL/ACCESS ROAD PLAN & PROFILE #5
10-34-008	" " " " " #7
10-34-012	" " " TYP. SECT'S & DETAILS
10-34-013	" " " DRAINAGE DETAILS #1
10-34-014	" " " " " #2

REFERENCE DWGS

NO.	BY	DATE	CKD	DESCRIPTION
O	KJ	5/10/88		ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87		ISSUE FOR OWNER APPROVAL TL#009
D	KF	10-22-87		ISSUE FOR BID ADDENDUM #1 TL#007
C	RA	10-7-87	MLT	ISSUE FOR BID TL#006
B	GM	9-16-87		ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87		ISSUE FOR OWNER APPROVAL TL#003

REVISIONS

DEPT. \ REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	
MECH						
ELECT						
INSTM						
PIPING						
SAFETY						
DEPT. MGR						
PROJECT						

APPROVALS

SCALE AS SHOWN	DATE
DRAWN BY KFF	5/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87

CLIENT APPROVALS

REV	BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE # 6

CONTRACT NO. 1928

24 of 36

DRAWING NO. 10-34-007

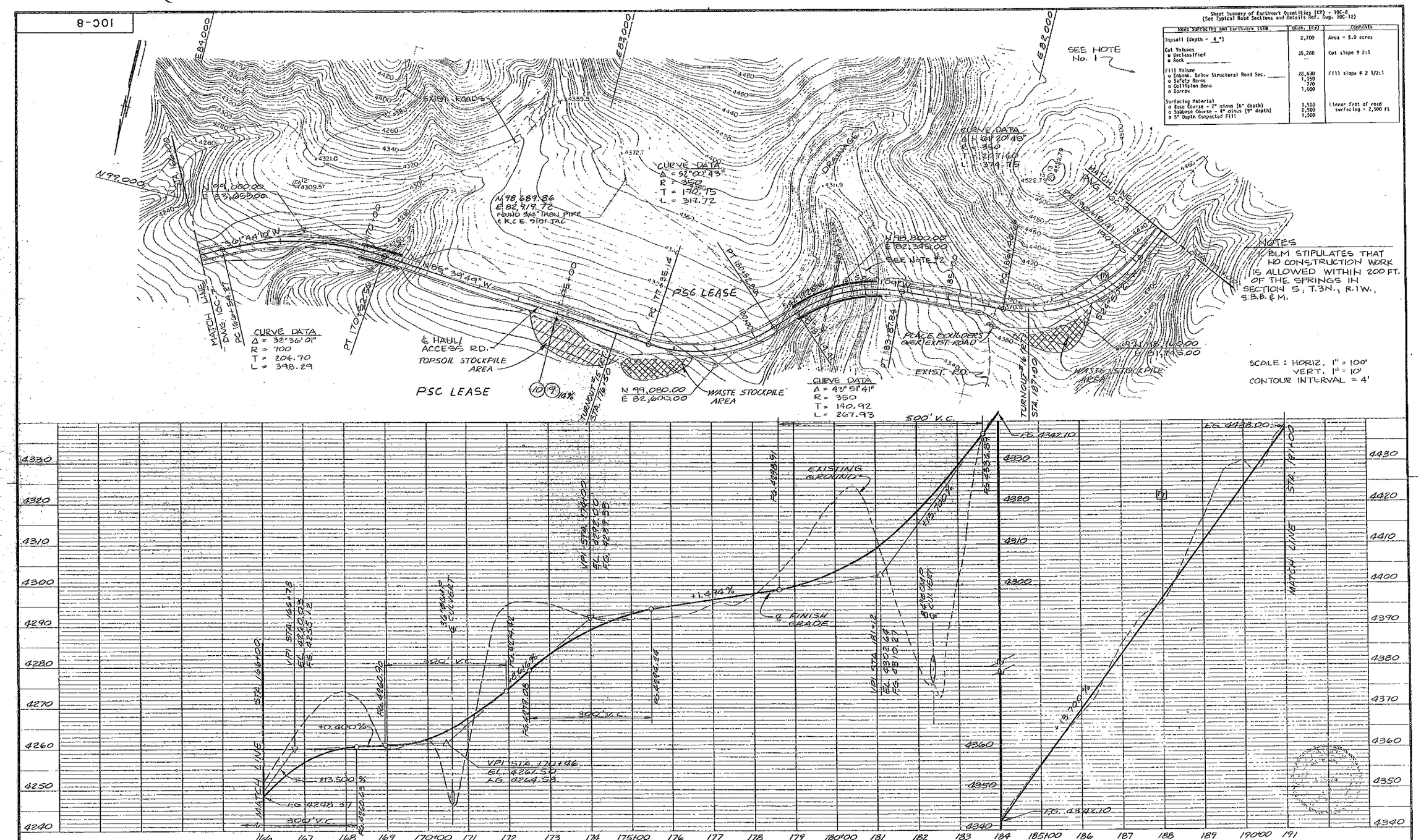
REFERENCE NO. 10C-7

REV O

BRUNING 44-132 80735

Sheet Summary of Earthwork Quantities (CY) - 10C-8
(See Typical Road Sections and Details Ref. Dwg. 10C-12)

Road Surfacing and Earthwork Item	Quan. (CY)	Comments
Topsoil (depth = 4 ")	2,700	Area = 5.0 acres
Cut Volumes		
o Unclassified	35,260	Cut slope @ 2:1
o Rock ____	—	
Fill Volume		
o Embank. Below Structural Road Sec. ____	28,630	Fill slope @ 2 1/2:1
o Safety Berms	1,150	
o Collision Berm	700	
o Berms	1,000	
Surfacing Material		
o Base Course - 2" minus (6" depth)	1,500	Linear feet of road surfacing = 2,500 ft
o Subbase Course - 4" minus (9" depth)	2,500	
o 5" Depth Compacted Fill	1,500	



DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-007	HAUL/ACCESS ROAD PLAN & PROFILE #6
10-34-009	" " " " " #8
10-34-012	" " " TYP. SECT. & DETAILS
10-34-013	" " " DRAINAGE DETAILS #1
10-34-014	" " " " " #2
10-34-015	EMERGENCY ESCAPE RAMP DETAILS

REFERENCE DWGS

NO.	BY	DATE	CKD	DESCRIPTION
O	RJ	5/10/88	MLT	ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	SKM	ISSUE FOR OWNER APPROVAL TL# 009
D	KF	10-22-87	MLT	ISSUE FOR BID ADDENDUM #1 TL# 007
C	RA	10-7-87	MLT	ISSUE FOR BID T.L. #006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL# 005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL TL# 003

REVISIONS

DEPT \ REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	SKM
MECH						
ELECT						
INSTM						
PIPING						
SAFETY						
DEPT MGR	MLT	MLT	MLT	MLT	MLT	MLT
PROJECT	SKM	SKM	SKM	SKM	SKM	SKM

APPROVALS

SCALE AS SHOWN	DATE
DRAWN BY KFF	5/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87

CLIENT APPROVALS

REV	BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE # 7

CONTRACT NO. 1928

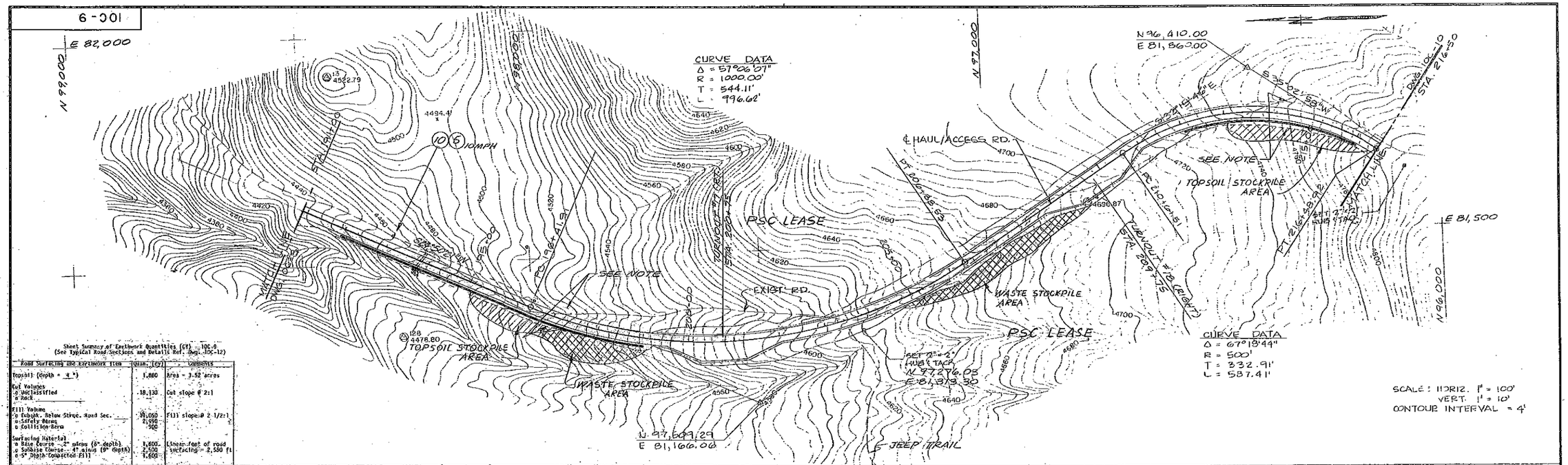
24 of 36

DRAWING NO. 10-34-008

REFERENCE NO. 10C-8

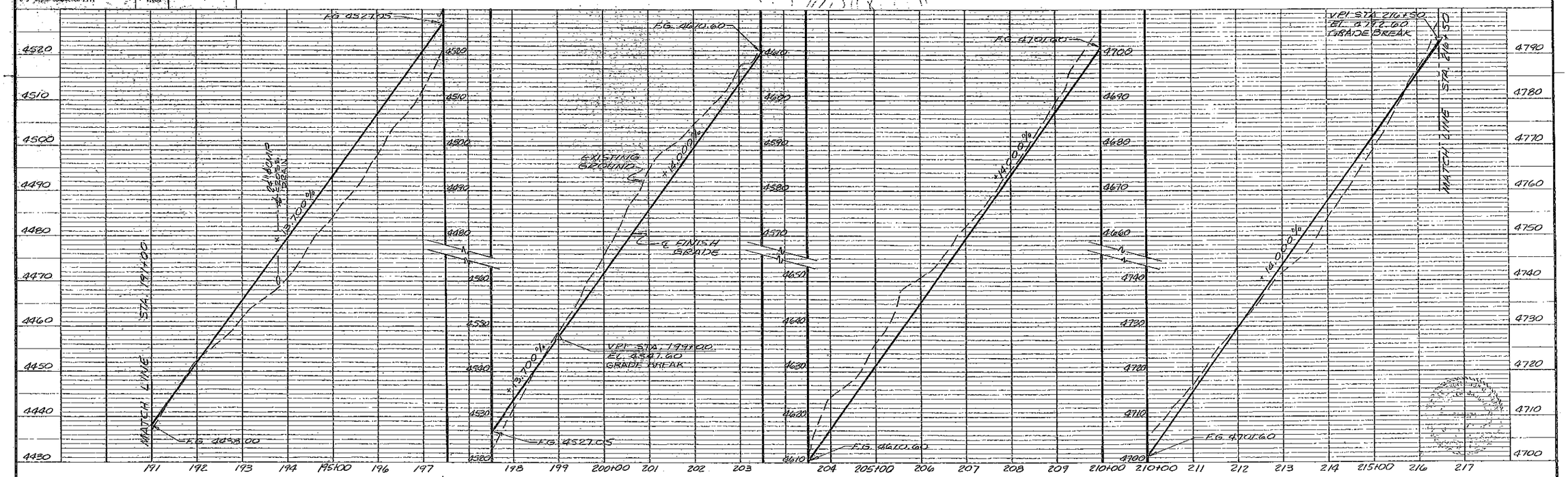
REV O

DRAWING 44-132 65738



Sheet Summary of Earthwork Quantities (CY) - 10C-9
(See Typical Road Sections and Details Ref. Dwgs. 10C-12)

Road Surfacing and Earthwork Item	Quan. (CY)	Comments
Topsoil (Depth = 4")	1,880	Area = 3.52 acres
Cut Volumes		
a Unclassified	18,130	Cut slope @ 2:1
b Rock		
Fill Volume		
a Subgrd. Below Struc. Road Sec.	19,050	Fill slope @ 2 1/2:1
b Safety Berms	2,990	
c Collision Berm	500	
Surfacing Material		
a Base Course - 2" minus (8" depth)	1,600	Linear feet of road surfacing = 2,550 ft
b Subbase Course - 4" minus (8" depth)	2,500	
c 5" Depth Compacted Fill	1,600	



DRAWING NO.	TITLE
10-34-001	LOCATION PLAN & TITLE SHEET
10-34-008	HAUL/ACCESS ROAD PLAN & PROFILE # 7
10-34-010	" " " " " # 9
10-34-012	" " " TYP. SECT'S & DETAILS
10-34-013	" " " DRAINAGE DETAILS #1
10-34-014	" " " " " #2
10-34-015	EMERGENCY ESCAPE RAMP DETAILS

REFERENCE DWGS

NO.	BY	DATE	CKD	DESCRIPTION
O	RJ	5/10/88	MLT	ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	MLT	ISSUE FOR OWNER APPROVAL TL#009
D	KF	10-22-87	MLT	ISSUE FOR BID ADDENDUM #1 TL#007
C	RA	10-7-87	MLT	ISSUE FOR BID TL#006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL TL#003

REVISIONS

DEPT \ REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	SKM
MECH						
ELECT						
INSTM						
PIPING						
SAFETY						
DEPT MGR						
PROJECT						

APPROVALS

SCALE AS SHOWN	DATE
DRAWN BY KFF	6/87
DESIGNED BY MLT	6/87
CHECKED BY SKM	6/87

CLIENT APPROVALS

REV	BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
PLAN & PROFILE # 8

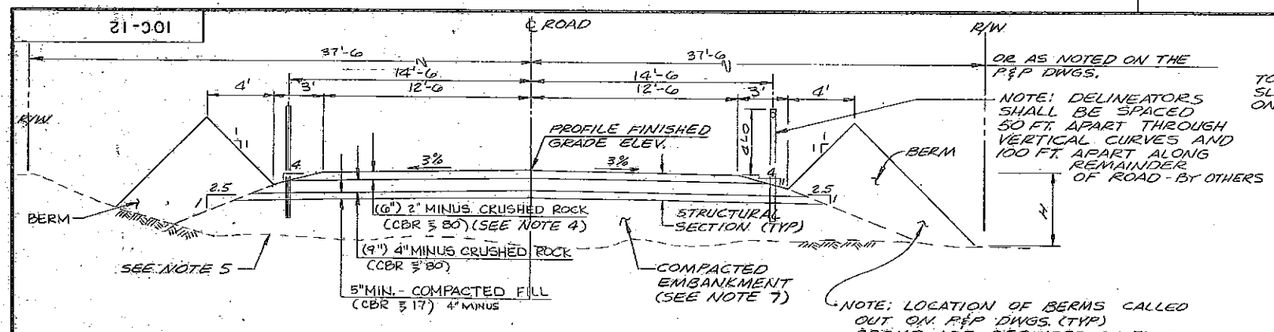
CONTRACT NO. 1928

24 of 36

DRAWING NO. 10-34-009

REFERENCE NO. 10C-9

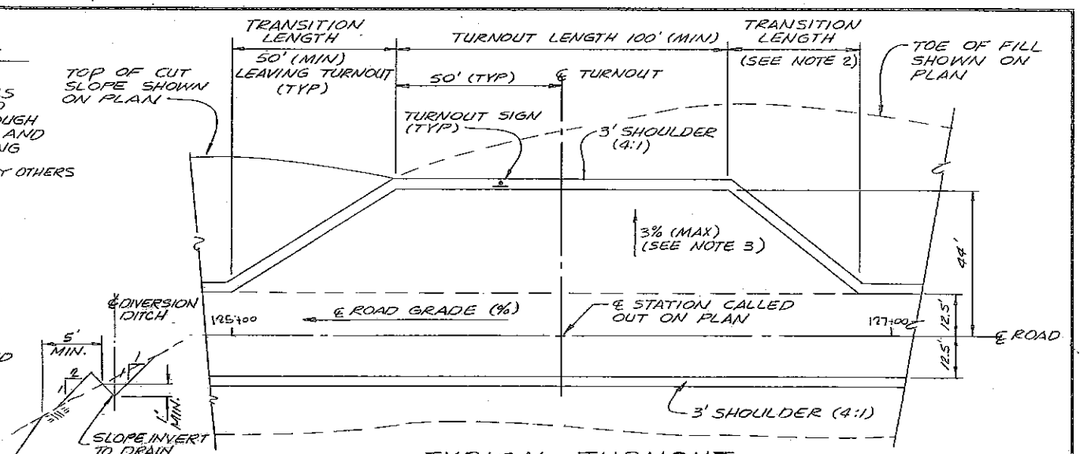
REV O



NOTE: LOCATION OF BERMS CALLED OUT ON P&P DWGS. (TYP) BERMS ARE REQUIRED ON FILLS WHERE H > 10' & ON DOWN HILL SIDE WHERE THE EXISTING GROUND CROSS-SLOPE IS CONSIDERED A SAFETY HAZARD

TYPICAL FILL SECTION

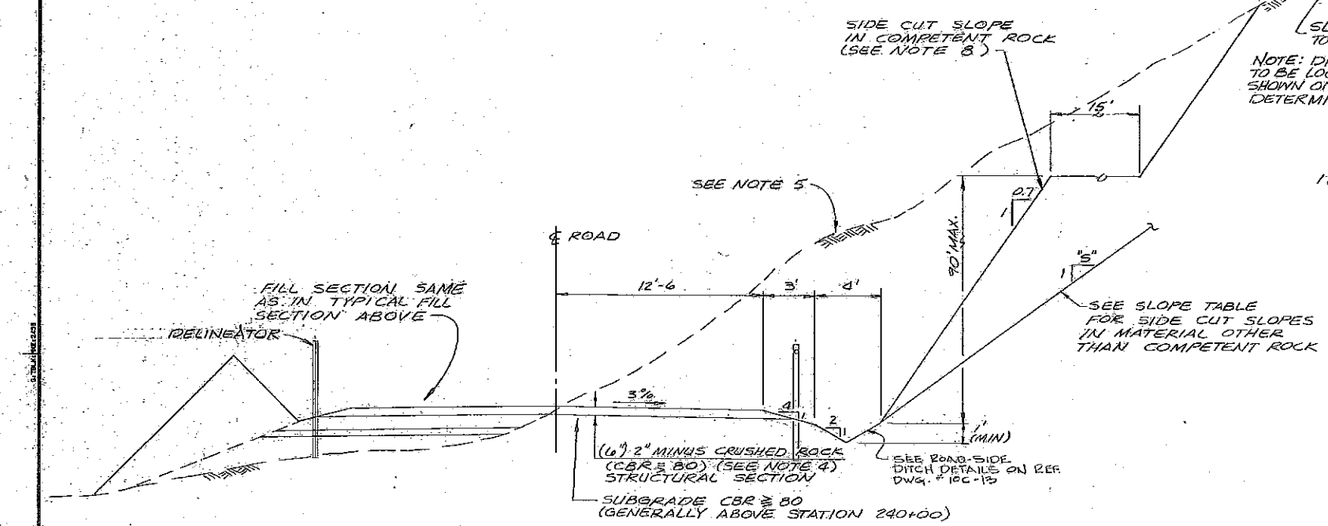
1/4" = 1'-0



NOTE: DIVERSION DITCHES TO BE LOCATED WHERE SHOWN ON THE PLANS OR AS DETERMINED IN THE FIELD.

TYPICAL TURNOUT PLAN

NOT TO SCALE



TYPICAL CUT/FILL SECTION

1/4" = 1'-0

NOTES (CONTINUED)

12. THE QUANTITIES SHOWN ON THE P&P SHEET IS OUR BEST ESTIMATE BASED ON THE LIMITED SOILS DATA. THEREFORE, THESE QUANTITIES MAY VARY DURING THE ACTUAL CONSTRUCTION.

NOTES

1. SEE THE LOCATION OF TURNOUTS SHOWN ON THE PLAN VIEW OF THE P&P PROFILE SHEETS. THIS PLAN SHOWS THE TURNOUT ON THE LEFT SIDE OF THE ROAD (LOOKING UP STATION) THE TURNOUTS WILL BE CALLED OUT LEFT OR RIGHT AND WILL BE NUMBERED CONSECUTIVELY.
2. TRANSITION LENGTH TABLE:

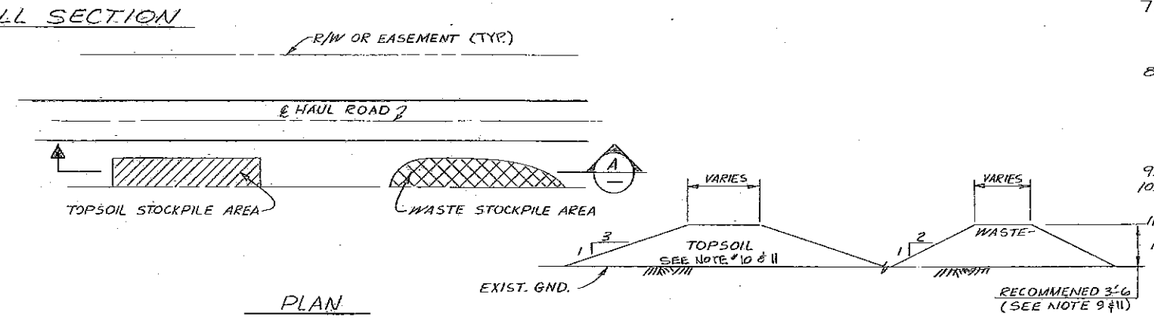
℄ ROAD GRADE	TRANSITION ENTRANCE LENGTH
0% - 5%	50'
5% - 10%	100'
10% - 14%	200'

3. IF TURNOUT IS ON THE OUTSIDE OF A CURVE IN A SUPERELEVATION, THE 3% GRADE SHALL SLOPE THE OPPOSITE DIRECTION THAN AS SHOWN.
4. 3" OF QUARRY FINES MAY BE SUBSTITUTED FOR UPPER 1" OF CRUSHED ROCK.
5. ALL TOPSOIL IN THE ROAD SECTION AREA SHALL BE STRIPPED AND STOCKPILED (THICKNESS GENERALLY VARIES FROM 1" TO 6"; AVERAGE = 4").
6. ALL CRUSHED ROCK SHALL BE WELL GRADED.
7. THE OVERALL SIDE SLOPE (INCLINATION) OF THE NATURAL SOIL TO RECEIVE THE FILL (AFTER STRIPPING AND PREPARATION OF STEPPED BASE ON WHICH TO CONSTRUCT THE FILL) SHALL BE ≧ 20%.
8. CUT SLOPES IN COMPETENT ROCK SHOULD BE NO STEEPER THAN 0.7H:1.0V UNLESS OTHERWISE NOTED ON THE PROFILE AND APPROVED BY THE ENGINEER. HORIZONTAL BENCHES WITH A MINIMUM WIDTH OF 15' SHALL BE CONSTRUCTED AT MAXIMUM VERTICAL INTERVALS OF 90'. MAXIMUM.
9. THE ENGINEER MAY VARY THE FILL SLOPES & HEIGHTS.
10. PERMANENT TOPSOIL STOCKPILES SHALL BE SEEDED & MULCHED BY OTHERS.
11. ALL TOPSOIL/WASTE AREAS TO BE GRADED TO DRAIN.
12. ROAD SURFACING SHALL BE BY OTHERS.

SLOPE TABLE

S	CUT SLOPE MATERIAL
1 (MIN)	ROCK CUTS IN FAULT ZONES OR HIGHLY FRACTURED ROCK
1.2	SIDE CUT SLOPE IN WELL CONSOLIDATED ALLUVIUM AND FAN GRAVELS
1.4	SIDE CUT SLOPE IN ROCK TALUS
2	SIDE CUT SLOPE IN LOOSE ALLUVIUM OR GRAVELS

NOTE: SEE THE SOILS REPORT NOTED ON DWG. 10C-1 FOR ADDITIONAL SOILS DATA.



PLAN

TYPICAL TOPSOIL/WASTE STOCKPILE

SECTION A — NTS

REFERENCE DWGS	
10-34-002	HAUL/ACCESS ROAD PLAN & PROFILE THRU #1 THRU #10
10-34-013	HAUL/ACCESS ROAD DRAINAGE DET.
10-34-001	LOCATION PLAN & TITLE SHEET
DRAWING NO.	TITLE

REVISIONS					
O	RJ	5/10/88	VB	ISSUE FOR CONSTRUCTION	BUL. D-001
E	RA	11-10-87	MM	ISSUE FOR OWNER APPROVAL	TL#009
D	KF	10-22-87	MM	ISSUE FOR BID ADDENDUM #1	TL#007
C	RA	10-7-87	MLT	ISSUE FOR BID	TL#006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL	TL#005
A	RA	7-2-87	SKM	ISSUE FOR OWNER APPROVAL	TL#003
NO.	BY	DATE	CKD	DESCRIPTION	

APPROVALS: DEPT / REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MLT	MLT	MLT	MLT	SKM	
MECH						
ELECT						
INSTM						
PIPING						
SAFETY						
SOILS						
DEPT MGR						
PROJECT						

SCALE AS NOTED	DATE
DRAWN BY KF / RA	6-1-87
DESIGNED BY MLT	6-1-87
CHECKED BY SKM	6-30-87
CLIENT APPROVALS	
REV / BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

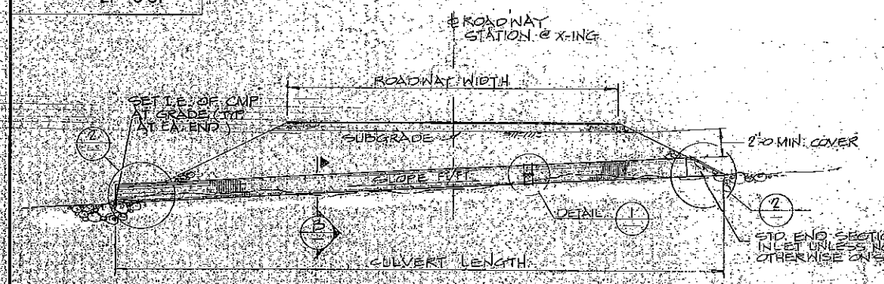
WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
TYPICAL SECTIONS & DETAILS

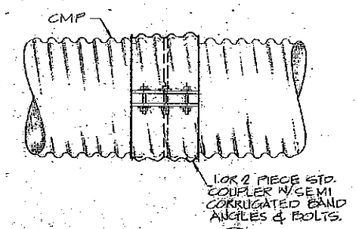
CONTRACT NO. 1928 — 24 II 36

DRAWING NO. 10-34-012

REFERENCE NO. 10C-12 — REV O

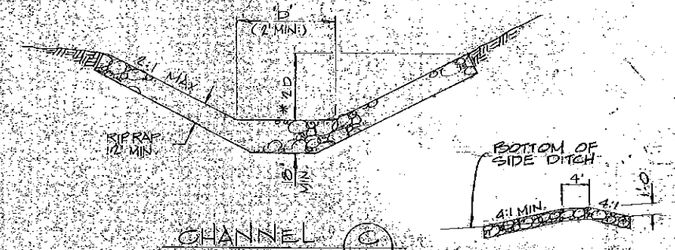


CULVERT SECTION (A)



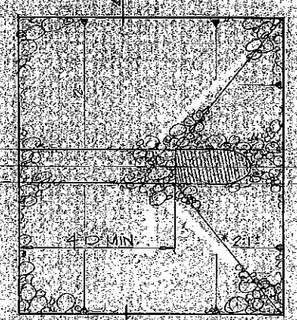
SPLICE (1)

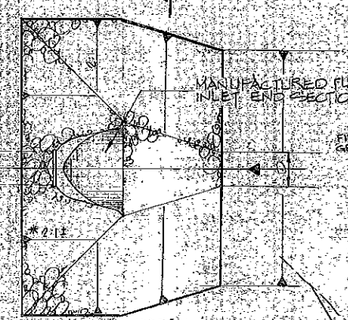
CULVERT TRENCH (B)



CHANNEL (C)

RIPRAP DIKE DETAIL



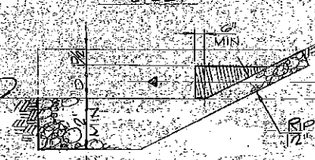


PLAN

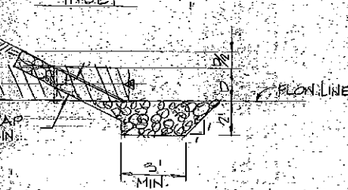
* FOR ROADWAY FILL/CUT SLOPES - SEE ROAD PLAN, SECTIONS & DETAILS.

TYP. ROAD SIDE DITCH DETAIL

3/8" = 1'-0

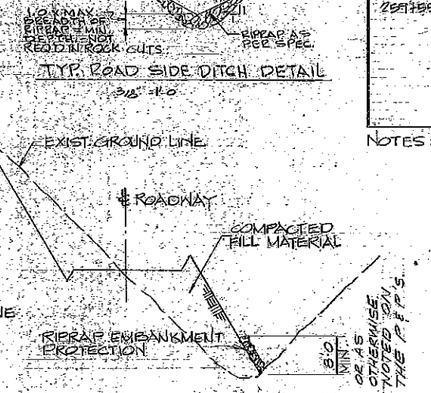


SECTION ON ℄ CULVERT



Bottom of Culvert on Flow Line

END TREATMENT (2)



TYPICAL FROM STA. 248+00 TO 261+00
OR AS REQUIRED BY FIELD CONDITIONS IN DRAINAGE AREAS

DETAIL (3)
NTS.

DRAINAGE STRUCTURE TABLE

STA.	DRWG. REF.	CULVERT TYPE	SIZE (IN.)	LENGTH (FT.)	SLOPE (FT./FT.)	Q 10 (6) (CFS)	GAGE	CORRUGATION	(1)(7) END SECTION	REMARKS
0+00	10C-2	CMP	24"Φ	60'	0.071	10	14	2 2/3" x 1/2"	FLARED INLET	
2+15	↓	↓	36"Φ	100'	0.071	50	14		↓	
17+70			24"Φ	66'	0.083	20	16			
19+00			48"Φ	120'	0.091	90	12			
45+30	10C-3	CMP	24"Φ	150'	0.071	20	16			
49+35			36"Φ	96'	0.083	50	14			
54+35			36"Φ	70'	0.100	50	14			
57+75			48"Φ	70'	0.080	90	12			
62+30	10C-4	CMP	24"Φ	76'	0.080	20	16			
86+85			24"Φ	20'	0.020	—	16			18' LT. OF ℄
88+15			24"Φ	90'	0.118	20	16			
90+00	10C-5	CMP	24"Φ	92'	0.077	20	16			
144+55	10C-7	CMP	36"Φ	136'	0.133	50	14			
150+25			36"Φ	140'	0.111	50	14			
154+25			36"Φ	70'	0.125	50	14		FLARED INLET	
170+50	10C-8	CMP	36"Φ	100'	0.125	50	14		FLARED INLET	
182+20			84"Φ	190'	0.091	900	8		FLARED INLET	
193+80	10C-9	CMP	24"Φ	70'	0.100	20	16		FLARED INLET	
248+65	10C-10	CMP	24"Φ	70'	0.100	20	16		DROP INLET	SEE NOTE 6
258+55	10C-11	CMP	84"Φ	100'	0.250	700	8		FLARED INLET	

NOTES:
1. END SECTIONS SHALL BE MANUFACTURED GALVANIZED STEEL FLARED TYPE WITH END TOE PLATES AND CONNECTION FOR PIPE ENDS.
2. ALL CULVERTS SHALL BE PROVIDED WITH RIPRAP CHANNEL PROTECTION ON INLET AND OUTLET ENDS UNLESS NOTED OTHERWISE. SEE DETAILS THIS DRAWING.
3. SKEW ANGLES FOR CULVERTS SHALL MAINTAIN NATURAL EXISTING DRAINAGE CROSSINGS.
4. DITCHES THAT ARE IN ALLUVIAL DEPOSITS SHALL BE RIPRAPED. SEE SECTION C THIS DWG.
5. HYDROLOGIC DESIGN STORM BASIS = 10 YR - 24 HOUR STORM EVENT.
6. FOR DROP INLET DETAILS, SEE DRWG. 10C-14.
7. FOR ADDITIONAL NOTES, SEE DRWG. 10C-1.
8. FOR CORRUGATED METAL PIPE (CMP) CULVERTS, SEE SPEC. 34-0227.
9. FOR RIP RAP, SEE SPEC. 34-0243.
10. FIELD LOCATE INVERT ELEVATIONS TO MATCH EXISTING FLOW LINE.

REGISTERED PROFESSIONAL ENGINEER JOE ALLEN BAUGHMAN C22874 CIVIL STATE OF CALIFORNIA 5-10-88

REFERENCE DWGS	
DRAWING NO.	TITLE

REVISIONS				
NO.	BY	DATE	CKD	DESCRIPTION
D	RJ	5/10/88	MJ	ISSUE FOR CONSTRUCTION BUL. 0.001
E	RA		MJ	ISSUE FOR OWNER APPROVAL TL#009
D	KE	10-22-87	MJ	ISSUE FOR BID ADDENDUM #1 TL#007
C	RA	10-7-87	MJ	ISSUE FOR BID TL#006
B	GM	9-16-87	MJ	ISSUE FOR OWNER APPROVAL TL#005
A	RA	7-2-87	MJ	ISSUE FOR OWNER APPROVAL TL#003

APPROVALS	REV	A	B	C	D	E	O
DEPT							
ARCH							
CIV/STRL		MJ	MJ	MJ	MJ	SKM	SKM
MECH							
ELECT							
INSTM							
PIPING							
SAFETY							
DEPT MGR			JAB	JAB	JAB	JAB	JAB
PROJECT							

SCALE NONE	DATE
DRAWN BY RJHJ	JUNE '87
DESIGNED BY SKM	JUNE '87
CHECKED BY MLT	JUNE '87
CLIENT APPROVALS	
REV BY	DATE

MORRISON-KNUDSEN COMPANY, INC.

PLUESS-STAUFER (CALIFORNIA) INC.

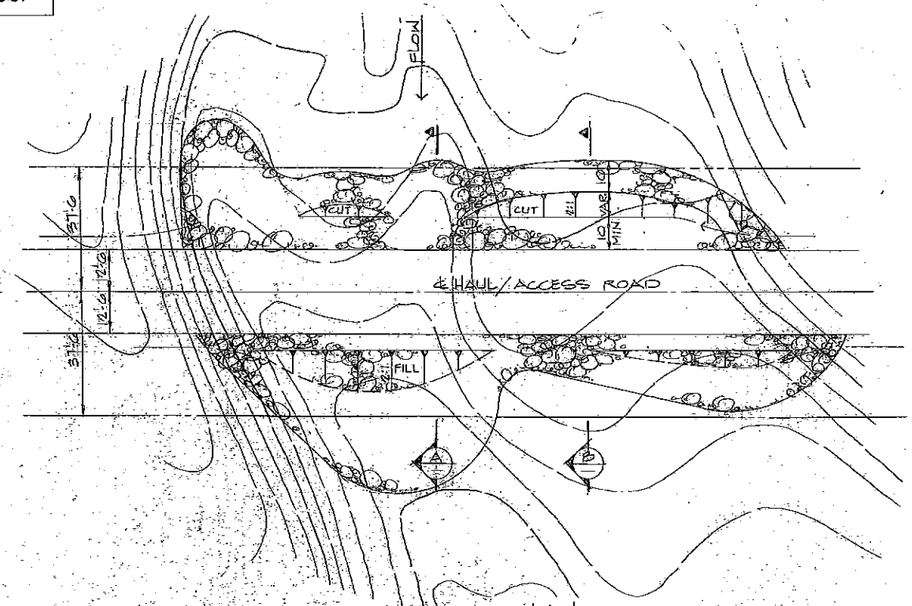
WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
CULVERT DETAILS & SCHEDULE

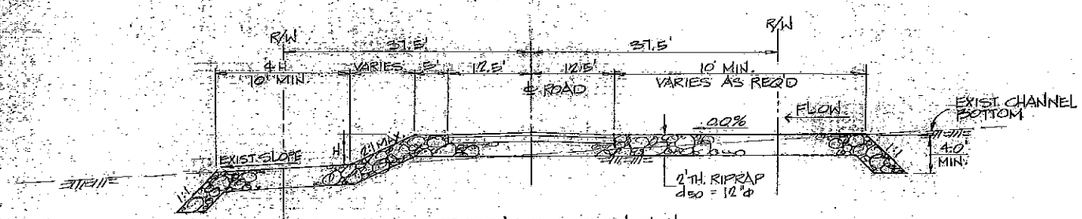
CONTRACT NO. 1928 — JI 24 36

DRAWING NO. 10-34-013

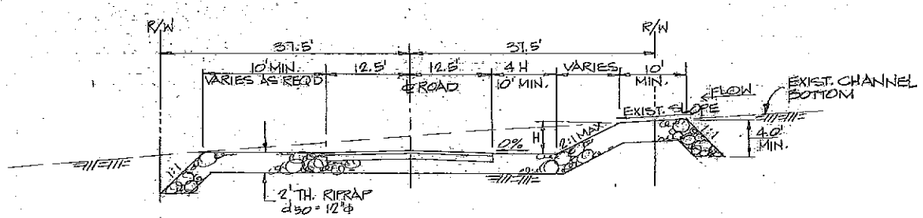
REFERENCE NO. 10C-13 — REV O



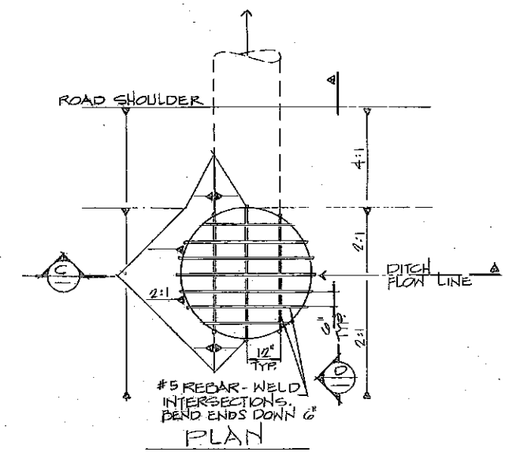
TYPICAL DIP PLAN
SCALE: 1"=20'



TYPICAL SECTION WITH
ROAD PROFILE ABOVE CHANNEL BOTTOM
SCALE: 1"=10'

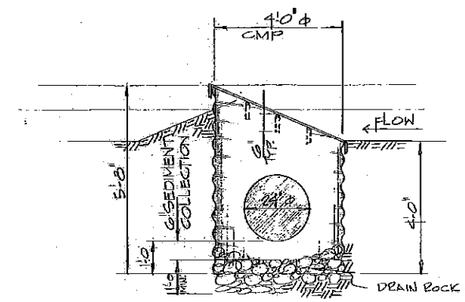


TYPICAL SECTION WITH
ROAD PROFILE BELOW CHANNEL BOTTOM
SCALE: 1"=10'

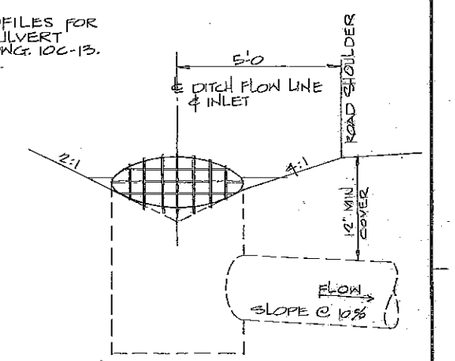


PLAN

SEE PLAN & PROFILES FOR LOCATIONS & CULVERT SCHEDULE ON DWG. 10C-13.



SECTION C



SECTION D

TYPICAL DROP INLET DETAIL
SCALE: 1/2"=1'-0

NOTES:
1. SEE RIPRAP SPECIFICATION 34-0243 FOR CLASSIFICATIONS AT DIPS.
2. DRAIN ROCK SHALL CONSIST OF HARD, DURABLE, PERMEABLE, CLEAN SAND AND RIVER ROCK FREE FROM ORGANIC MATERIAL, CLAY BALLS, OR OTHER DELETERIOUS SUBSTANCES. GRADATION SHALL BE AS FOLLOWS:

US SIEVE OR SCREEN SIZE	PERCENT PASSING
2"	100
No 4	0-15

REVISIONS				
NO.	BY	DATE	CKD	DESCRIPTION
C	RJ	5/18/88	MJ	ISSUE FOR CONSTRUCTION BUL. D-001
E	RA	11-10-87	MM	ISSUE FOR OWNER APPROVAL TL# 009
D	KF	10-22-87	MM	ISSUE FOR BID ADDENDUM #1 TL# - 007
C	RA	10-7-87	MLT	ISSUE FOR BID TL #006
B	GM	9-16-87	SKM	ISSUE FOR OWNER APPROVAL TL# 005
A	RA	7-2-87	MM	ISSUE FOR OWNER APPROVAL TL# 003

APPROVALS						
DEPT \ REV	A	B	C	D	E	O
ARCH						
CIV/STRL	MM	MM	MM	MM	SKM	
MECH						
ELECT.						
INSTM						
PIPING						
SAFETY						
DEPT MGR						
PROJECT						

SCALE AS NOTED	DATE
DRAWN BY RJJJ	JUNE '87
DESIGNED BY S.M.	JUNE '87
CHECKED BY MLT	JUNE '87

CLIENT APPROVALS		
REV	BY	DATE

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

PLUESS-STAUFER (CALIFORNIA) INC.

WHITE KNOB / WHITE RIDGE PROJECT

DRAWING TITLE
HAUL / ACCESS ROAD
DRAINAGE DETAILS

CONTRACT NO. 1928

24 H 36

DRAWING NO. 10-34-014

REFERENCE NO. 10C-14

REV O

REFERENCE DWGS.

DRAWING NO. | TITLE

Appendix G – Culvert Riprap Calculations

Several relationships have been proposed for riprap sizing for culvert aprons and several of these are discussed in greater detail in Appendix D. The independent variables in these relationships include one or more of the following variables: outlet velocity, rock specific gravity, pipe dimension (e.g. diameter), outlet Froude number, and tailwater. The following equation (Fletcher and Grace, 1972) is recommended for circular culverts:

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right) \tag{10.4}$$

where,

D_{50} = riprap size, m (ft)
Q = design discharge, m^3/s (ft^3/s)
D = culvert diameter (circular), m (ft)
TW = tailwater depth, m (ft)
g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

Tailwater depth for Equation 10.4 should be limited to between 0.4D and 1.0D. If tailwater is unknown, use 0.4D.

Whenever the flow is supercritical in the culvert, the culvert diameter is adjusted as follows:

$$D' = \frac{D + y_n}{2} \tag{10.5}$$

where,

D' = adjusted culvert rise, m (ft)
y_n = normal (supercritical) depth in the culvert, m (ft)

Equation 10.4 assumes that the rock specific gravity is 2.65. If the actual specific gravity differs significantly from this value, the D_{50} should be adjusted inversely to specific gravity.

White Knob Haul Road
Riprap Apron Design
Method from HEC 14 by FHWA

Station 17+70

Q	20	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.29	
Yn	1.38	Ft
D'	1.69	
D_{50}	0.67	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 19+00

Q	90	cfs
D	4	Ft
TW	1.6	Ft
Froude	1.94	
Yn	1.91	Ft
D'	2.955	
D_{50}	1.17	

Use Class 4 Apron.
Apron Length = 6D = 24 Ft.

Station 43+50

Q	20	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.26	
Yn	1.41	Ft
D'	1.705	
D_{50}	0.66	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 49+35

Q	50	cfs
D	3	Ft
TW	1.2	Ft
Froude	1.79	
Yn	0.76	Ft
D'	1.88	
D_{50}	1.31	

Use Class 5 Apron.
Apron Length = 7D = 21 Ft.

Station 54+35

Q	50	cfs
D	3	Ft
TW	1.2	Ft
Froude	1.7	
Yn	1.43	Ft
D'	2.215	
D_{50}	1.05	

Use Class 4 Apron.
Apron Length = 6D = 18 Ft.

Station 57+75

Q	90	cfs
D	4	Ft
TW	1.6	Ft
Froude	1.08	
Yn	2.69	Ft
D'	3.345	
D_{50}	1.00	

Use Class 4 Apron.
Apron Length = 6D = 24 Ft.

White Knob Haul Road
Riprap Apron Design
Method from HEC 14 by FHWA

Station 62+30

Q	20	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.39	
Yn	1.32	Ft
D'	1.66	
D_{50}	0.68	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 88+15

Q	20	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.71	
Yn	1.17	Ft
D'	1.585	
D_{50}	0.73	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 90+00

Q	20	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.61	
Yn	1.21	Ft
D'	1.605	
D_{50}	0.71	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 144+70

Q	37.9	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.72	
Yn	1.1	Ft
D'	2.05	
D_{50}	0.80	

Use Class 3 Apron.
Apron Length = 5D = 15 Ft.

White Knob Haul Road
Riprap Apron Design
Method from HEC 14 by FHWA

Station 150+40

Q	48	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.34	
Yn	1.36	Ft
D'	2.18	
D_{50}	1.02	

Use Class 4 Apron.
Apron Length = 6D = 18 Ft.

Station 154+20

Q	104.8	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.82	
Yn	1.62	Ft
D'	2.31	
D_{50}	2.66	

Use Class 6 Apron.
Apron Length = 8D = 24 Ft.

Station 170+50

Q	86.9	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.53	
Yn	1.82	Ft
D'	2.41	
D_{50}	1.96	

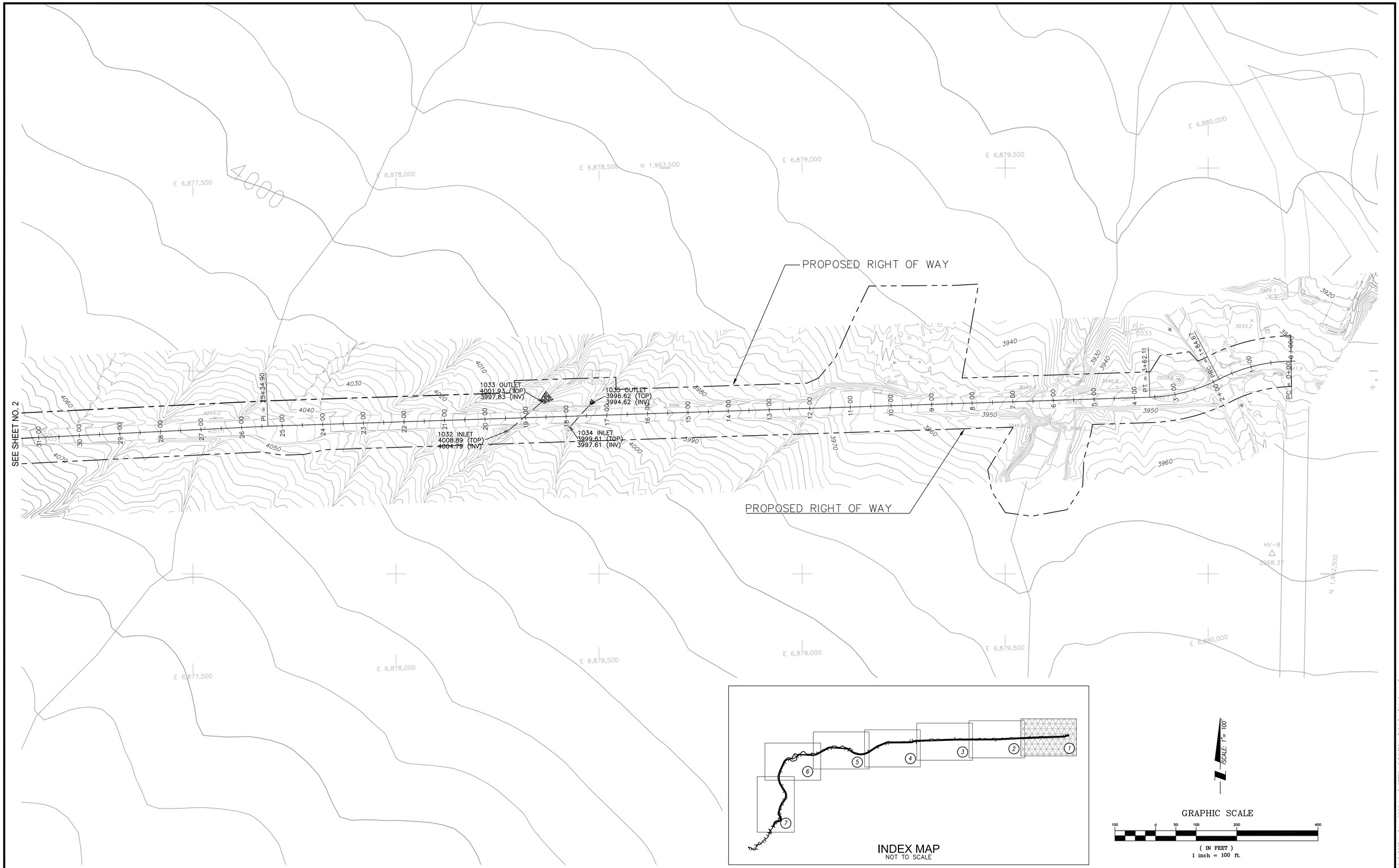
Use Class 6 Apron.
Apron Length = 8D = 24 Ft.

Station 182+00

Q	262.8	cfs
D	7	Ft
TW	2.8	Ft
Froude	3.16	
Yn	2.15	Ft
D'	4.575	
D_{50}	1.56	

Use Class 5 Apron.
Apron Length = 7D = 49 Ft.

Appendix H – Proposed Right Of Way Maps



NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

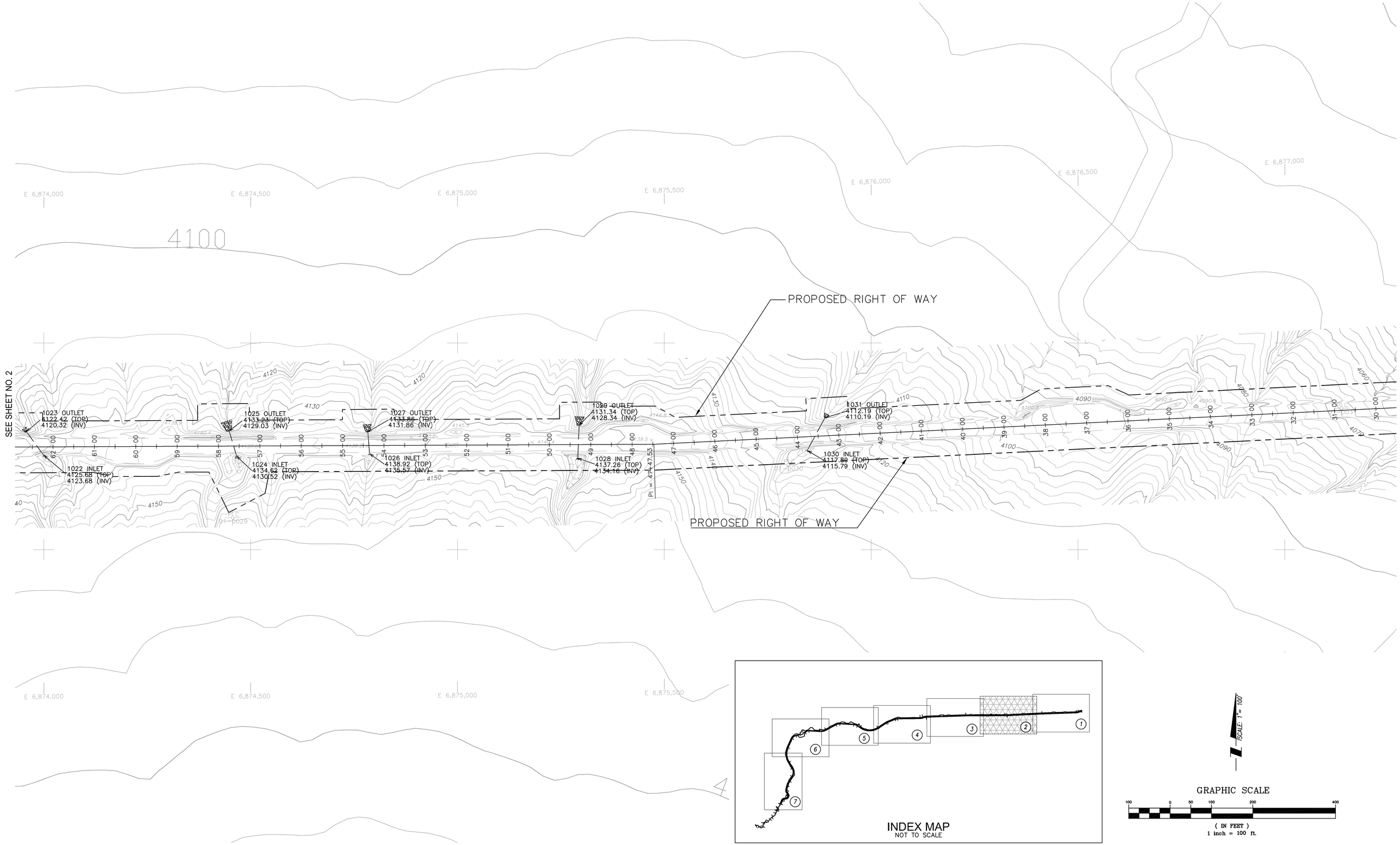
WHITE KNOB HAUL ROAD RIGHT OF WAY

FROM STA 0+00 TO STA 30+00

PROJECT NO. 2042484500

SHEET 1 OF 7

DRAWING: v:\projects\2042484500\dwg\prsd0002.dwg PLOTTED: 8/12/2011 3:04 PM BY: Carey, Paul



NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

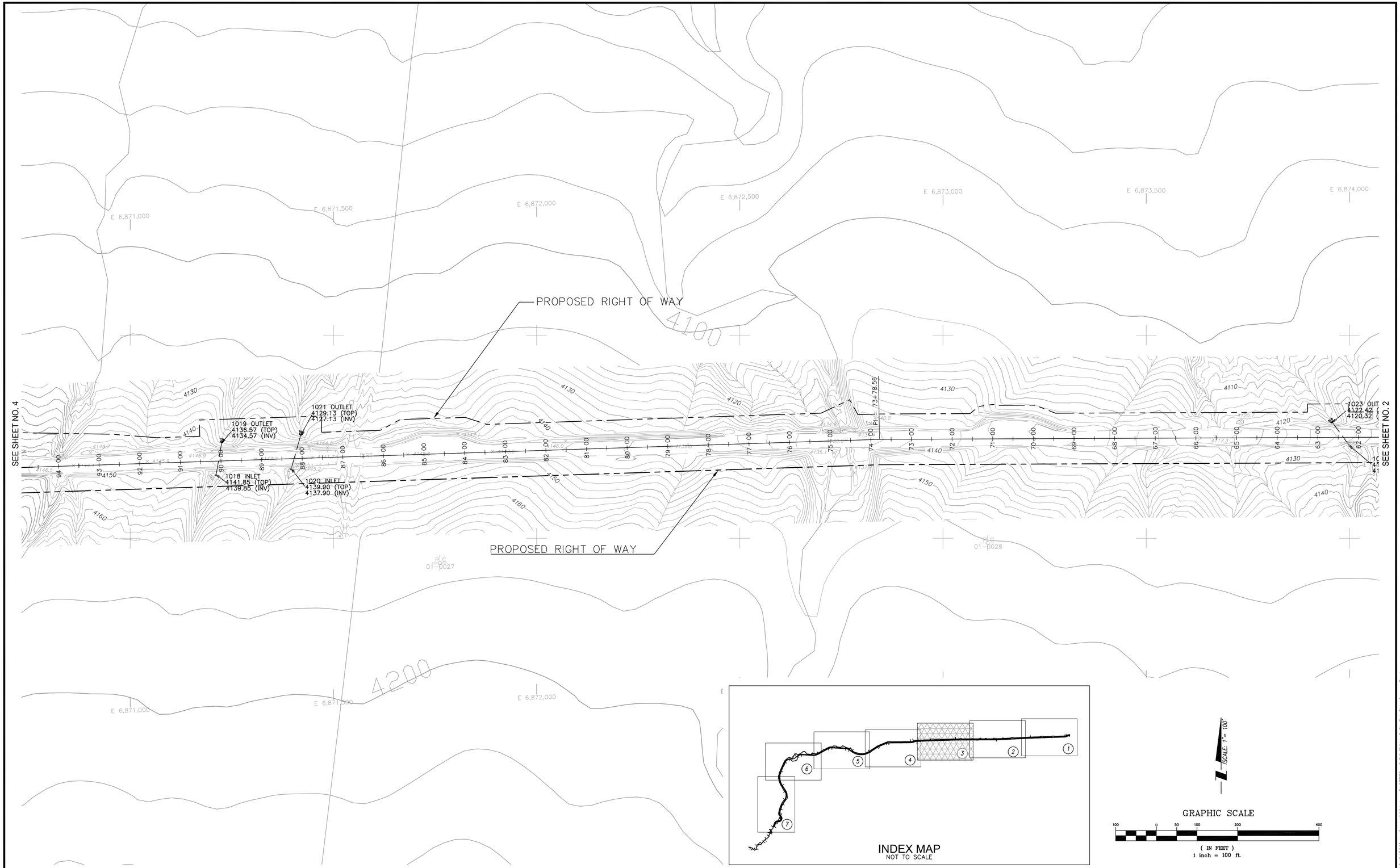
STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB HAUL ROAD RIGHT OF WAY

FROM STA 30+00 TO STA 62+00

PROJECT NO. 2042484500

SHEET 2 OF 7



NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB HAUL ROAD RIGHT OF WAY

FROM STA 62+00 TO STA 94+00

PROJECT NO. 2042484500

SHEET 3 OF 7

DRAWING: v:\projects\2042484500\dwg\prsd0004.dwg PLOTTED: 8/12/2011 3:31 PM BY: Carey, Paul

PROPOSED RIGHT OF WAY

PROPOSED RIGHT OF WAY

SEE SHEET NO. 3

SEE SHEET NO. 5

INDEX MAP
NOT TO SCALE

GRAPHIC SCALE

(IN FEET)
1 inch = 100 ft.

SCALE: 1" = 100'

NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB HAUL ROAD RIGHT OF WAY

FROM STA 94+00 TO STA 127+00

PROJECT NO. 2042484500

SHEET 4 OF 7

DRAWING: v:\projects\2042484500\dwg\grsd005.dwg PLOTTED: 8/12/2011 3:33 PM BY: Carey, Paul

SEE SHEET NO. 6

PROPOSED RIGHT OF WAY

1005 OUTLET
4119.44 (TOP)
4116.34 (INV)

1007 OUTLET
4093.44 (TOP)
4090.34 (INV)

1004 INLET
4131.16 (TOP)
4128.06 (INV)

1006 INLET
4113.66 (TOP)
4110.56 (INV)

1009 OUTLET
4091.54 (TOP)
4088.54 (INV)

1008 INLET
4109.37 (TOP)
4106.27 (INV)

PC = 156+63.68

PT = 147+88.58

PC = 143+99.08

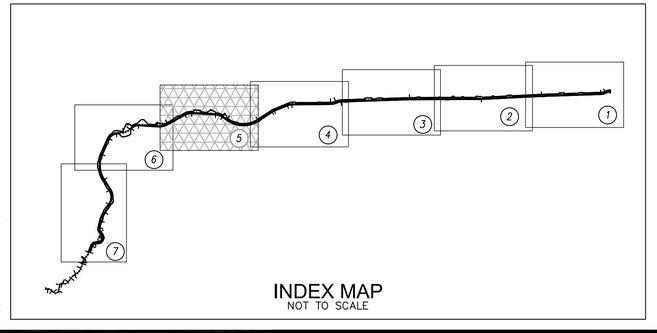
PT = 143+14.21

PLC 01-0022

PLC 01-0023

PROPOSED RIGHT OF WAY

SEE SHEET NO. 4



INDEX MAP
NOT TO SCALE

SCALE: 1" = 100'

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

Stantec

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB HAUL ROAD RIGHT OF WAY

FROM STA 127+00 TO STA 162+00

PROJECT NO. 2042484500

SHEET 5 OF 7

DRAWING: v:\projects\2042484500\dwg\prsd0006.dwg PLOTTED: 8/12/2011 3:34 PM BY: Carey, Paul

PROPOSED RIGHT OF WAY

1001 OUTLET
4286.12 (TOP)
4278.92 (INV)

1000 INLET
4326.46 (TOP)
4319.16 (INV)

1003 OUTLET
4272.65 (TOP)
4269.55 (INV)

1002 INLET
4289.09 (TOP)
4285.99 (INV)

PROPOSED RIGHT OF WAY

1010 OUTLET
4469.31 (INV)

1011 INLET
4474.25 (INV)

1012 OUTLET
4475.08 (INV)

1013 INLET
4476.44 (INV)

1014 OUTLET
4551.33 (INV)

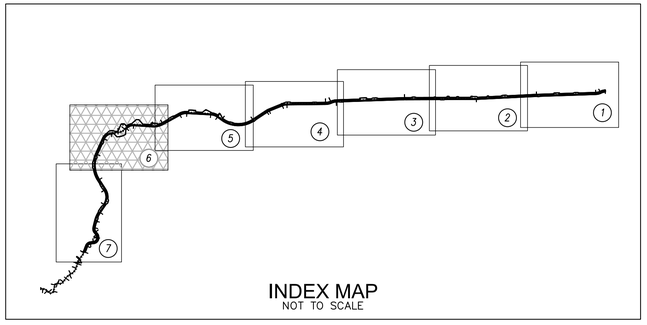
1015 INLET
4555.08 (INV)

1016 OUTLET
4556.05 (INV)

1017 INLET
4557.10 (INV)

SEE SHEET NO. 5

SEE SHEET NO. 7



INDEX MAP
NOT TO SCALE

SCALE: 1" = 100'

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

Stantec

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB HAUL ROAD RIGHT OF WAY

FROM STA 162+00 TO STA 200+00

PROJECT NO. 2042484500

SHEET 6 OF 7

DRAWING: v:\projects\2042484500\dwg\prsd0007.dwg PLOTTED: 8/12/2011 3:36 PM BY: Carey, Paul

PROPOSED RIGHT OF WAY

PROPOSED RIGHT OF WAY

SEE SHEET NO. 6

INDEX MAP
NOT TO SCALE

SCALE: 1"= 100'

GRAPHIC SCALE

(IN FEET)
1 inch = 100 ft.

NO.	DATE	REVISIONS

DESIGNED BY:
DRAFTED BY:
CHECKED BY:
DATE:

PREPARED UNDER THE SUPERVISION OF:

NAME DATE

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

WHITE KNOB HAUL ROAD
RIGHT OF WAY
FROM STA 200+00 TO STA 237+84

PROJECT NO. 2042484500

SHEET 7 OF 7

DRAWING: v:\projects\2042484500\dwg\prs40008.dwg PLOTTED: 8/12/2011 3:38 PM BY: Carey, Paul

Appendix I – 1988 Amendment of Right of Way Grant

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Barstow Resource Area
150 Coolwater Lane
Barstow, CA 92311
(619) 256-3591

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
CA-16644
2800 (CA-068.22)

JUL 15 1988

DECISION

Pluess-Staufer (California) Inc. :
P.O. Box 825 : Right-of-Way CA-16644
Lucerne Valley, CA 92356

Amendment of Right-of-Way Grant Approved
Rental Rate Adjusted

On December 31, 1985, right-of-way CA-16644 was granted to Pluess-Staufer (California) Inc., for a 25 year term, for construction, use, and maintenance of the "White Knob" mine access/haul road across public lands near Lucerne Valley, California. The right-of-way was granted pursuant to Title V of the Act of October 21, 1976 (43 U.S.C. 1761) for a strip of land 75 feet wide and approximately 23,200 feet long within Sections 2 through 5, T.3N., R.1W., SBM, as shown on the right-of-way map filed October 18, 1985. The right-of-way contains 39.98 acres, more or less.

On October 22, 1987, Pluess-Staufer (California) Inc. filed an application to amend the right-of-way for a realignment of the roadway, and addition of a 660 foot by 660 foot construction/maintenance yard within Section 2, T.3N., R.1W., SBM. Revised right-of-way maps were filed on April 13, 1988 and June 3, 1988.

A favorable field report concerning the Pluess-Staufer (California) Inc. application has been approved. Accordingly, right-of-way amendment CA-16644 is approved pursuant to Title V of the Act of October 21, 1976, Supra, subject to the terms and conditions identified below. The Holder's revised right-of-way maps filed April 13, 1988 and June 3, 1988 supersede the original right-of-way map filed October 18, 1985. The amended right-of-way contains 66.88 acres, more or less, and is described in Exhibit C, attached to and made a part of the grant.

The rental provisions in Section B.9. of this grant are hereby amended to read as follows:

In consideration for these uses, the Holder shall pay to the Bureau of Land Management rental in the sum of eight-hundred twenty-five dollars ($825.00) for the period from December 31, 1985 through December 31, 1988. Thereafter, an annual rental payment, calculated in accordance with the linear right-of-way fee schedule in 43 CFR 2803.1-2, shall be paid in advance of each calendar year. Rental charges may be made or readjusted whenever necessary to place the charges on the basis of fair market value for the uses authorized under this grant. This right-of-way is not in force unless the Holder has paid the annual rental in advance. That portion of the right-of-way between Stations 154.00 and 245.00 (9,100 feet by variable width averaging 125 feet; 25.113 acres) is not subject to rental as long as a possessory interest in the surface is maintained by pre-P.L. 167 mining claim locator(s).

Stipulation 1 in Exhibit B of the grant is amended to read as follows:

The BLM Authorized Officer for the administration of this grant is the Area Manager, Barstow Resource Area, 150 Coolwater Lane, Barstow, CA 92311.

All other existing grant terms and conditions in the original grant remain in effect.

You have the right of appeal to the Board of Land Appeals, Office of the Secretary, in accordance with the regulations contained in 43 CFR Part 4 and the enclosed Form 1842-1. If an appeal is taken, your Notice of Appeal must be filed in this office so that the case file can be promptly transmitted to the Board. A copy of the Notice of Appeal and of any statement of reasons, written arguments, or briefs must be served on the Regional Solicitor, Pacific Southwest Region, U.S. Department of the Interior, 2800 Cottage Way, Room E-2753, Sacramento, California 95825 within 15 days of the filing of any such document. If the procedures set forth in the regulations are not followed, an appeal is subject to dismissal.

Alden Sievers
Area Manager

Enclosures: Form 1842-1
Exhibit C

CA-16644
2800 (CA-068.22)

EXHIBIT C

Amended R/W Description and Acreage

Access/Haul Road

Sta. 0.00-Sta. 117.00	11,700 ft x 75 ft wide	20.145 ac.
Sta. 117.00-Sta. 245.00	12,800 ft x variable width (average 125 feet)	36.731 ac.
Construction/Maintenance Yard 660 ft x 660 ft		10.000 ac.
Total Right-of-Way Area		66.876 ac.

Technical Memorandum

White Knob Quarry and Haul Road

Prepared for:
OMYA, Incorporated

Prepared by:
Stantec Consulting Services Inc.

September 12, 2013

1.0 Introduction and Purpose

Omya Incorporated operates a calcium carbonate mining and processing operation in San Bernardino County, south of the town of Lucerne Valley. Omya's plant is on Crystal Creek Road approximately 4 miles south of State Highway 18. The White Knob Quarry, where calcium carbonate is mined, is southwest of the plant in the San Bernardino National Forest. The haul road to bring materials mined at the White Knob Quarry to the plant is 5.1 miles long, going westerly from the plant for approximately 3.5 miles then turning southerly to climb at a 14% grade up to the quarry site. Once in the quarry, the access road varies in grade from 12% to 18%.

The first 4.4 miles of the haul road crosses land managed by the US Department of Interior, Bureau of Land Management (BLM). Use and occupation of the haul road is authorized under a Federal Land Policy Management Act (FLPMA) right-of-way. On April 20, 2011 a Settlement Agreement was entered into by and between BLM and Omya regarding Omya's activities at the White Knob Quarry.

Stantec Consulting prepared a Drainage Report and Plan of Development in August 2011 to analyze the existing drainage conditions at the quarry and along the haul road and provide recommendations for facilities to control stormwater and sediment runoff and provide protection for the surrounding drainages. This report was intended to specifically comply with items 15 through 17 of part B of the agreement.

Subsequently, Omya is applying for permits to cover approximately the next 40 years of their operation at the White Knob Quarry. As part of this application effort, Omya has retained the services of PMC to prepare an Environmental Impact Report for the quarry and haul road. The intent of this Technical Memorandum is to support PMC in their preparation of that EIR. Specifically, there are three areas of further investigation to be explored in this Technical Memorandum:

1. The previous report utilized a 50-year, 24-hour storm event for design of the sedimentation basins, and a 10-year return storm for culvert and riprap design. SMARA CCR 3706(d) requires that erosion control measures be designed for not less than a 20-year, 1-hour intensity storm. The design of the sedimentation basins exceeds this requirement, but it could be argued that the design of the haul road culverts and outlet riprap aprons should be designed for a 20-year storm. This technical memo will investigate the adequacy of the existing culverts and proposed riprap aprons in light of the 20-year storm.

2. The Soils map in Figure 3 of Stantec's 2011 Drainage Report and Plan of Development will be compared to the 2008 report on Soil Resources by Webber and Webber Mining Consultants. This comparison will determine if there is any correlation or conflicts between the reports.

3. DCI prepared a report titled: Sedimentation and Erosion Monitoring, 2011–2012 Reporting Period dated July 2012. The reported sedimentation volumes from this report will be compared to Stantec's 2011 Drainage Report and Plan of Development predicted sedimentation values to see if there is any correlation or conflict.

2.0 20-Year Return Flow Calculations

2.1 BACKGROUND

As mentioned above, SMARA CCR 3706(d) requires that erosion control measures be designed for not less than a 20-year, 1-hour intensity storm. Specifically, section 3706(d) reads:

(d) Surface runoff and drainage from surface mining activities shall be controlled by berms, silt fences, sediment ponds, revegetation, hay bales, or other erosion control measures, to ensure that surrounding land and water resources are protected from erosion, gullying, sedimentation and contamination. Erosion control methods shall be designed to handle runoff from not less than the 20 year/l hour intensity storm event.

This designation, with a return frequency and a time designation, is generally useful for sizing volumetric measures, such as sedimentation basins. Culverts and riprap aprons are generally based on peak flows, with the intensity of the storm used for design based on the size and configuration of the tributary area. Generally speaking, for smaller tributary areas, the time of concentration is also smaller, with a corresponding higher intensity storm to be used for peak flow determination.

From the previous design report, the lowest intensity used for the 10-year flow design was 1.551 inches per hour for a 34 minute time of concentration. While NOAA does not report intensities for a 20-year 1-hour storm, this intensity would be somewhere between the reported 10-year 1-hour storm of 0.745 inches and the 25-year, 1-hour storm of 0.944. An estimate of approximately 0.9 inches per hour for a 20-year, 1-hour storm in this location would be appropriate. In other words, the design storm with a 10-year frequency for determining peak flows in the drainages looked at in the previous report has a higher intensity than the 20-year, 1-hour storm event required by SMARA. Therefore, we will investigate the 20-year return frequency peak flow to check the capacity of the existing culverts and adequacy of the previous riprap design.

The previous report investigated flow conditions at 14 corrugated metal pipe (CMP) culverts ranging in size from 24” to 84”. For the five culverts closest to the quarry, full hydrology calculations were prepared, determining flows for the 2-year, 10-year, 25-year, and 100-year return storms. The other nine culverts are in minor drainages on an alluvial fan, where drainage basins are difficult to determine, and are subject to change with each major storm event. The previous report mentioned that these culverts have been in place for 24 years, with no capacity problems identified. Because of that, the 10-year flows identified on the haul road improvement plans prepared in 1987 by Morrison Knudsen Engineers were accepted for design of the riprap outlet protection.

2.2 20-YEAR HYDROLOGY METHOD

Given that NOAA does not publish rainfall data for 20-year return frequency storms, and roughly 2/3 of the culvert locations were not designed based on traditional hydrology calculations, an alternative method of determining a 20-year peak flow at each location will be used. We will determine the 20-year flow at a

few representative locations where we had previous hydrology calculations, then determine a factor to be applied against the previous 10-year flow rates to arrive at 20-year design flows at all locations.

To determine predicted flow frequencies at a location with a stream gauge and adequate historical flow data, a log-Pearson type III distribution is typically utilized. For this distribution, the flows of record are ranked and given a plotting position based on the total years of record. These flows are then plotted on log-normal probability paper from which the desired return frequencies can be determined graphically.

To determine 20-year return flows, we can use a similar process, but with calculated flows rather than gauged flows. The 2-year, 10-year, 25-year, and 100-year flows for three representative locations were plotted on log-normal probability paper using the inverse of the return frequency for the storm probability (2-year storm has a probability of 50%; a 25-year storm has a probability of 4%, etc.). For this exercise, we chose the following three locations from the previous drainage report:

Node	**Description**	**Tributary Area (Ac)**	**2-year Flow (cfs)**	**10-year Flow (cfs)**	**25-year Flow (cfs)**	**100-year Flow (cfs)**
30	Culvert Crossing at Station 144+70	14.26	14.8	28.6	37.9	57.1
230	Culvert Crossing at Station 154+20	59.56	35.2	76.6	104.8	167.4
465	Culvert Crossing at Station 182+00	191.37	128.0	262.8	358.6	559.8

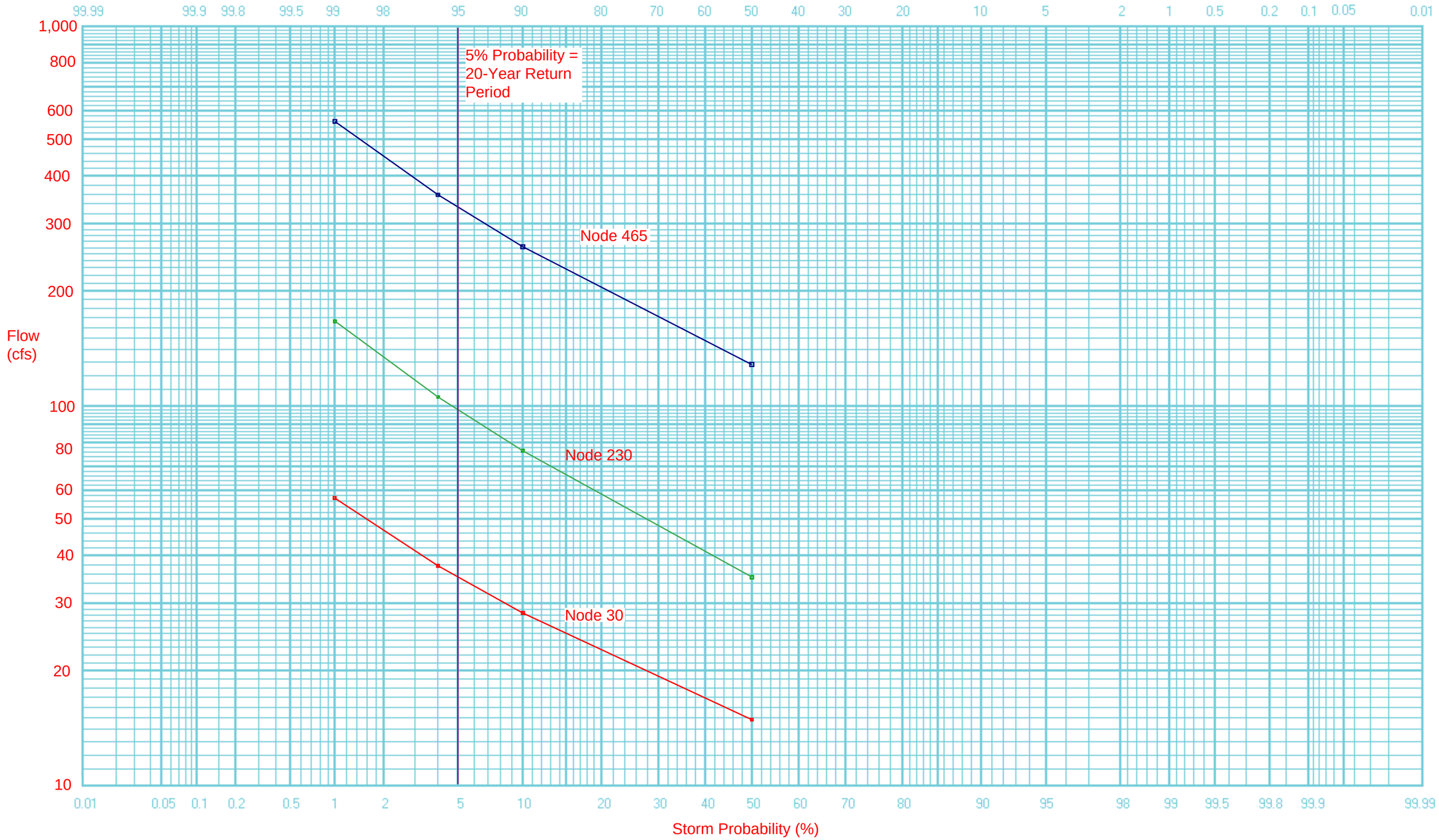


Chart 1 - Log Probability Plot of Calculated Flows

www.PrintablePaper.net

The graph of these values is shown on Chart 1. The results and determination of a design factor are summarized in the following table:

Node	Description	Calculated 10-year Flow (cfs)	Graphical 20-year Flow (cfs)	Q20/Q10
30	Culvert Crossing at Station 144+70	28.6	35.5	1.241
230	Culvert Crossing at Station 154+20	76.6	98	1.279
465	Culvert Crossing at Station 182+00	262.8	327	1.244

Based on this approach, the expected 20-year design flow will be determined by increasing the 10-year flow value by a factor of 24%. This results in the following flow information:

Station	Culvert Size	10 Yr Flow (cfs)	20 Yr Flow (cfs)
17+70	24 in CMP	20	25
19+00	48 in CMP	90	112
43+50	24 in CMP	20	25
49+35	36 in CMP	50	62
54+35	36 in CMP	50	62
57+75	48 in CMP	90	112
62+30	24 in CMP	20	25
88+15	24 in CMP	20	25
90+00	24 in CMP	20	25
144+70	36 in CMP	28.6	35
150+40	36 in CMP	35.8	44
154+20	36 in CMP	76.6	95
170+50	36 in CMP	63.4	79
182+00	84 in CMP	262.8	326

2.3 CULVERT FLOW CALCULATIONS

As with the previous report, culvert capacities were checked using the Federal Highway Administration's HY-8 computer program (version 7.2), this time using the 20-year design flows identified in Section 2.2 of this report. Full results of the calculations using the HY-8 program are included in Appendix A. Following is a summary of those results:

Station	Culvert Size	20 Yr Flow (cfs)	Headwater Depth (ft)	Outlet Velocity (fps)	Overtopping?	Culvert Capacity (cfs)
17+70	24 in CMP	25	4.40	8.74	Yes	24.7
19+00	48 in CMP	112	5.30	15.37	Yes	90.3
43+50	24 in CMP	25	4.48	8.53	No	28
49+35	36 in CMP	62	5.81	13.48	Yes	61.9
54+35	36 in CMP	62	3.33	11.48	Yes	35.9
57+75	48 in CMP	112	6.48	10.39	Yes	111.5
62+30	24 in CMP	25	4.33	9.33	Yes	24.3
88+15	24 in CMP	25	4.52	10.92	No	38.6
90+00	24 in CMP	25	4.16	10.4	Yes	23.6
144+70	36 in CMP	35	3.34	15.84	No	97.8
150+40	36 in CMP	44	3.99	15.16	No	122.1
154+20	36 in CMP	95	8.02	20.16	Yes	75.8
170+50	36 in CMP	79	8.34	18.98	No	98.8
182+00	84 in CMP	326	8.54	27.85	No	764

In the previous report, only the culvert at Station 54+35 overtopped the roadway at the 10-year flow. Investigating the 20-year flow, 8 of the 14 culverts would overtop the roadway. However for 5 of those 8 culverts, the overtopping capacity is very close to the 20-year flow. For the culverts at stations 19+00 and 54+35, the difficulty in predicting flows in an alluvial fan, along with the fact that the culverts have been in place for 26 years without problems lead us to conclude that the culverts are adequately sized. For the culvert at station 154+20, flow exceeding the capacity of the culvert will most likely enter the roadway prism and run along the roadway to the culvert at station 150+40, which has excess capacity. This condition has also been in place for at least 26 years without causing problems, so replacement of this culvert is not recommended.

2.4 CULVERT RIPRAP CALCULATIONS

Riprap sizing calculations were performed using the same methodology as described in the previous report. Calculations for the individual culvert locations are included in Appendix B, and are summarized below. The riprap class and required thickness are based on Caltrans Standard Specifications:

	Pipe Size	Apron Class	Apron Length	Required Riprap D_{50} Size (ft)	Required Riprap D_{50} Weight (lbs)	Specified Riprap Class	Riprap Thickness (ft)
Station 17+70	24" CMP	3	10	0.80	44.4	Light	2.5
Station 19+00	48" CMP	5	28	1.57	333.6	1/4 Ton	3.3
Station 43+50	24" CMP	3	10	0.82	48.4	Light	2.5
Station 49+35	36" CMP	5	21	1.24	166.2	Light	2.5
Station 54+35	36" CMP	5	21	1.41	243.3	1/4 Ton	3.3
Station 57+75	48" CMP	5	28	1.21	153.3	Light	2.5
Station 62+30	24" CMP	4	12	0.84	51.2	Light	2.5
Station 88+15	24" CMP	4	12	0.90	63.1	Light	2.5
Station 90+00	24" CMP	4	12	0.90	63.8	Light	2.5
Station 144+70	36" CMP	3	15	0.74	34.4	Light	2.5
Station 150+40	36" CMP	4	18	0.92	68.3	Light	2.5
Station 154+20	36" CMP	6	24	2.36	1142.5	1 Ton	5.4
Station 170+50	36" CMP	6	24	1.78	488.5	1/4 Ton	3.3
Station 182+00	84" CMP	6	56	2.01	702.9	1/2 Ton	4.3

Compared to the previous results, the specified riprap class increased at stations 19+00, 54+35, and 182+00. The apron length increased at stations 19+00, 54+35, 57+75, 62+30, 88+15, 90+00, and 182+00.

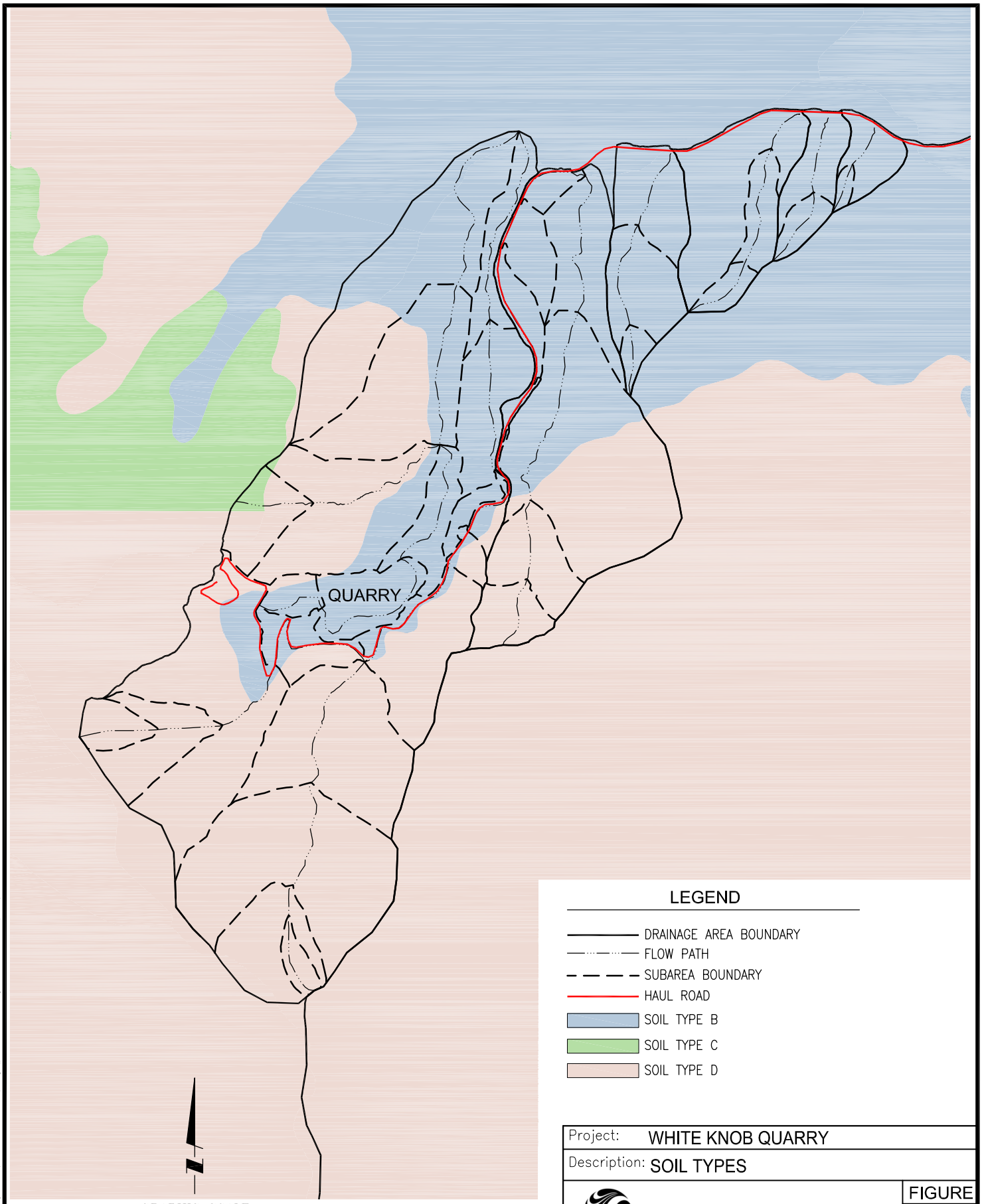
3.0 Soils Map Comparison

In reviewing the Webber and Webber Mining Consultants, Inc. report titled "Soil Resources at White Knob Quarry – OMYA California, Inc. – CA Mine ID #91-36-0067" dated October 2008, the source of their soils mapping data is the same as for our hydrologic soils map. The descriptions are different because the reports are looking at different soils qualities. The Stantec report investigated the hydrologic runoff characteristics of the soil, and the Webber and Webber report investigated the structural characteristics. Even though the reports were for different purposes, there is some correlation between the soil types.

Figure 3 from the previous Stantec report is reproduced on the next page, which shows the hydrologic soil types that were used in our hydrologic calculations. We have also included a printout from the USDA Natural Resources Conservation Service's Web Soil Survey website in Appendix C. The Area of Interest shown is similar to the extent of the map on Figure 3.

The Area of Interest covers two separate soil surveys as noted in the Webber and Webber report. The boundary between surveys is evident in the straight east-west line across the Area of Interest. In compiling information to perform the hydrologic calculations, we noted that there were unnatural boundaries between hydrologic sol types along the boundary between soil surveys. Most concerning to us was the appearance that map symbol 101 (Arrastre – Rock Outcrop) from the Soil Survey of San Bernardino County, California, Mojave River Area (CA671) and map symbol DxG (Wapi-Pacifico families, dry-rock outcrop) from the San Bernardino Forest Area (CA777) soil survey appear to be mapping similar soil types. However, map symbol 101 is shown as soil type B and map symbol DxG is shown as soil type D. We chose to map both symbols as soil type D for our calculations, which would yield higher runoff rates.

There is a similar anomaly between map symbol 121 (Crafton-Sheephead-Rock Outcrop) and map symbol DxF (Wapi-Pacifico families, dry-rock outcrop), which are mapped as soil types C and D, respectively. Since this is such a minor area of the studied tributary areas, and is likely to have minimal impact on the quantity of flow calculations, we chose to accept the mapped soil type designations.



Project: WHITE KNOB QUARRY

Description: SOIL TYPES

STANTEC CONSULTING INC.
19 TECHNOLOGY DRIVE
IRVINE, CA 92618
949.923.6000
stantec.com

Job No.: 2042484500 | Date: 07-29-2011

FIGURE 3

DRAWING: v:\projects\2042484500\dwg\prex0003.dwg PLOTTED: 7/29/2011 8:58 AM BY: Uribe Gonzales, Martha

4.0 Sedimentation Comparison

The DCI report titled: Sedimentation and Erosion Monitoring, 2011–2012 Reporting Period investigated the erosion and sedimentation volumes for the water year 2011-2012 in what is termed the western drainage. The western drainage is westerly and northerly of the quarry, and is not included in the drainage study previously prepared by Stantec. However, since this is an adjacent drainage, sedimentation rates can be expected to be similar to the areas investigated by Stantec.

The previous Stantec report calculated expected sediment volumes for a 50-year, 24-hour storm event. According to the National Oceanic and Atmospheric Administration's Precipitation Frequency Data Server Atlas 14 (http://hdsc.nws.noaa.gov/hdsc/pfds/), the 50-year, 24-hour rainfall depth for the vicinity of the White Knob quarry is 5.84 inches. In contrast, the total rainfall for the 2011-2012 water year according to the DCI report was 3.98 inches. Because of this, we would expect the sediment generation rate to be much lower in the DCI report.

The Stantec report looked at sediment generation from two drainage tributary areas. The first was the area tributary to the existing basin near the explosives storage facility. This tributary has a total drainage area of 350.81 acres, and is expected to generate 7,729 cubic yards of debris and sediment from a 50-year, 24-hour storm event. The second area is the drainage tributary to the haul road from the explosives storage facility to turnout 64. This tributary has a total drainage area of 30.13 acres, and is expected to generate 1,147 cubic yards of debris and sediment from a 50-year, 24-hour storm event.

The DCI report calculates the surface changes (either erosion or sedimentation) for 19 reaches of the western drainage covering a distance along the drainage course of about 7,500 feet. The total drainage area is not reported, but appears to be in the order of magnitude of 600 acres. Of the 19 reaches, 2 were not measured due to site hazards and vegetation constraints. One additional reach had no measurable net change in the surface. A total of nine reaches experienced sedimentation, with a total volume of 32 cubic yards. The remaining seven reaches experienced erosion, with a total volume of 15 cubic yards.

As mentioned above, the sediment generation rate measured in the DCI report is much lower than that predicted in the Stantec report. This is to be expected, since the measured sediment generation was for a relatively dry year, and the predicted sediment generation rates are for a 50-year, 24-hour storm.

Appendix A – Culvert Hydraulic Calculations

HY-8 Culvert Analysis Report

Crossing Discharge Data Sta 17+70

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 25 cfs

Maximum Flow: 40 cfs

Table 1 - Summary of Culvert Flows at Crossing: Station 17+70

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3998.80	5.00	5.00	0.00	1
3999.20	8.50	8.50	0.00	1
3999.60	12.00	12.00	0.00	1
4000.10	15.50	15.50	0.00	1
4000.72	19.00	19.00	0.00	1
4001.48	22.50	22.50	0.00	1
4002.00	25.00	24.69	0.08	80
4002.03	29.50	24.81	4.48	5
4002.05	33.00	24.87	8.02	4
4002.06	36.50	24.92	11.36	3
4002.07	40.00	24.97	14.88	3
4002.00	24.68	24.68	0.00	Overtopping

Rating Curve Plot for Crossing: Station 17+70

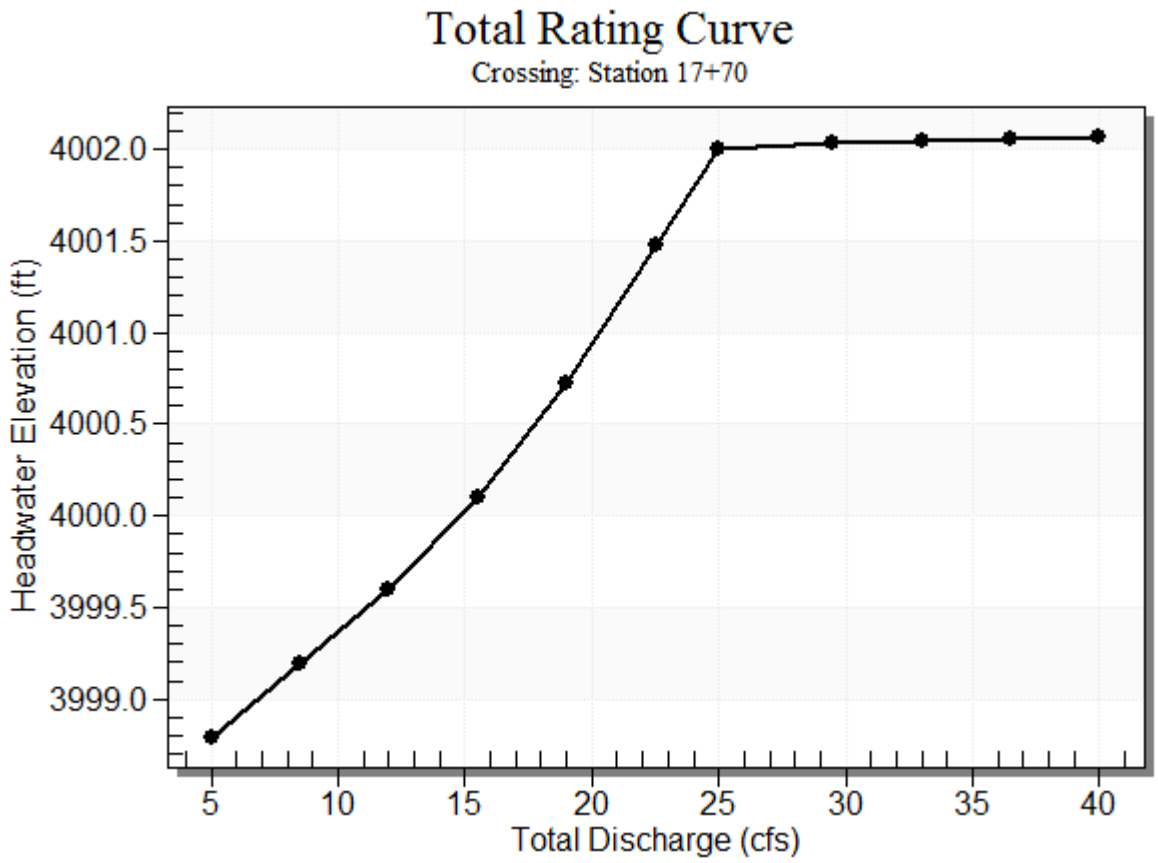


Table 2 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	3998.80	1.196	0.0*	1-S2n	0.611	0.783	0.611	0.245	6.132
	8.50	8.50	3999.20	1.599	0.0*	1-S2n	0.814	1.038	0.814	0.323	7.074
	12.00	12.00	3999.60	2.002	0.0*	5-S2n	0.991	1.239	0.991	0.385	7.725
	15.50	15.50	4000.10	2.497	0.287	5-S2n	1.161	1.415	1.161	0.437	8.205
	19.00	19.00	4000.72	3.122	1.587	5-S2n	1.333	1.566	1.333	0.483	8.556
	22.50	22.50	4001.48	3.876	2.769	5-S2n	1.525	1.690	1.525	0.525	8.769
	25.00	24.69	4002.00	4.402	3.596	5-S2n	1.679	1.753	1.679	0.552	8.743
	29.50	24.81	4002.03	4.433	3.644	5-S2n	1.692	1.757	1.692	0.598	8.773
	33.00	24.87	4002.05	4.448	3.669	5-S2n	1.699	1.758	1.699	0.630	8.768
	36.50	24.92	4002.06	4.460	3.687	5-S2n	1.704	1.759	1.704	0.661	8.763
	40.00	24.97	4002.07	4.472	3.707	5-S2n	1.709	1.761	1.709	0.690	8.759

* Full Flow Headwater elevation is below inlet invert.

****

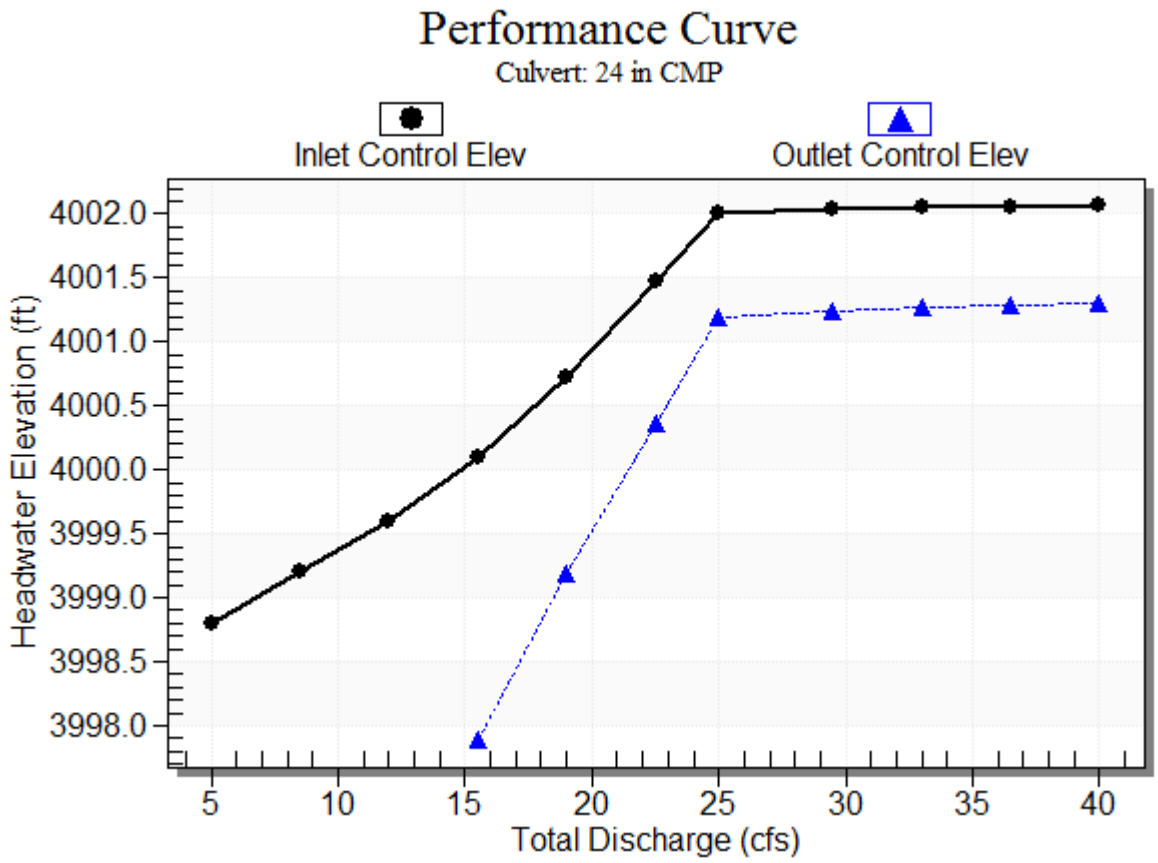
Straight Culvert

Inlet Elevation (invert): 3997.60 ft, Outlet Elevation (invert): 3994.62 ft

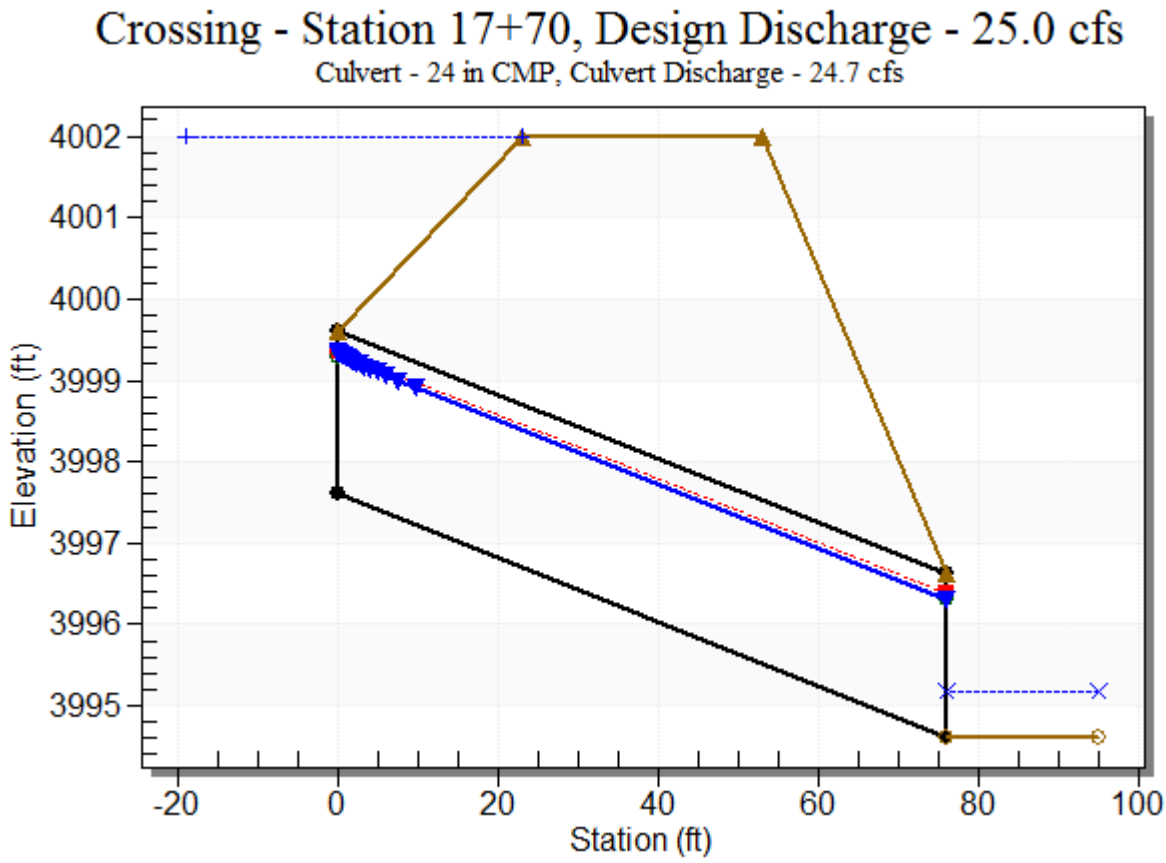
Culvert Length: 76.06 ft, Culvert Slope: 0.0392

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 3997.60 ft

Outlet Station: 76.00 ft

Outlet Elevation: 3994.62 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Station 17+70)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	3994.86	0.24	2.75	0.61	1.13
8.50	3994.94	0.32	3.20	0.81	1.17
12.00	3995.00	0.38	3.52	0.96	1.20
15.50	3995.06	0.44	3.78	1.09	1.22
19.00	3995.10	0.48	4.00	1.21	1.24
22.50	3995.14	0.52	4.18	1.31	1.25
25.00	3995.17	0.55	4.30	1.38	1.26
29.50	3995.22	0.60	4.50	1.49	1.27
33.00	3995.25	0.63	4.63	1.57	1.28
36.50	3995.28	0.66	4.76	1.65	1.29
40.00	3995.31	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 17+70

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 3994.62 ft

Roadway Data for Crossing: Station 17+70

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4002.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 19+00

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 112 cfs

Maximum Flow: 150 cfs

Table 4 - Summary of Culvert Flows at Crossing: Station 19+00

Headwater Elevation (ft)	Total Discharge (cfs)	48 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4005.77	5.00	5.00	0.00	1
4006.81	19.50	19.50	0.00	1
4007.50	34.00	34.00	0.00	1
4008.07	48.50	48.50	0.00	1
4008.65	63.00	63.00	0.00	1
4009.31	77.50	77.50	0.00	1
4010.01	92.00	90.49	1.10	40
4010.07	106.50	91.50	14.72	6
4010.09	112.00	91.77	19.93	4
4010.14	135.50	92.72	42.43	4
4010.17	150.00	93.21	56.27	3
4010.00	90.27	90.27	0.00	Overtopping

Rating Curve Plot for Crossing: Station 19+00

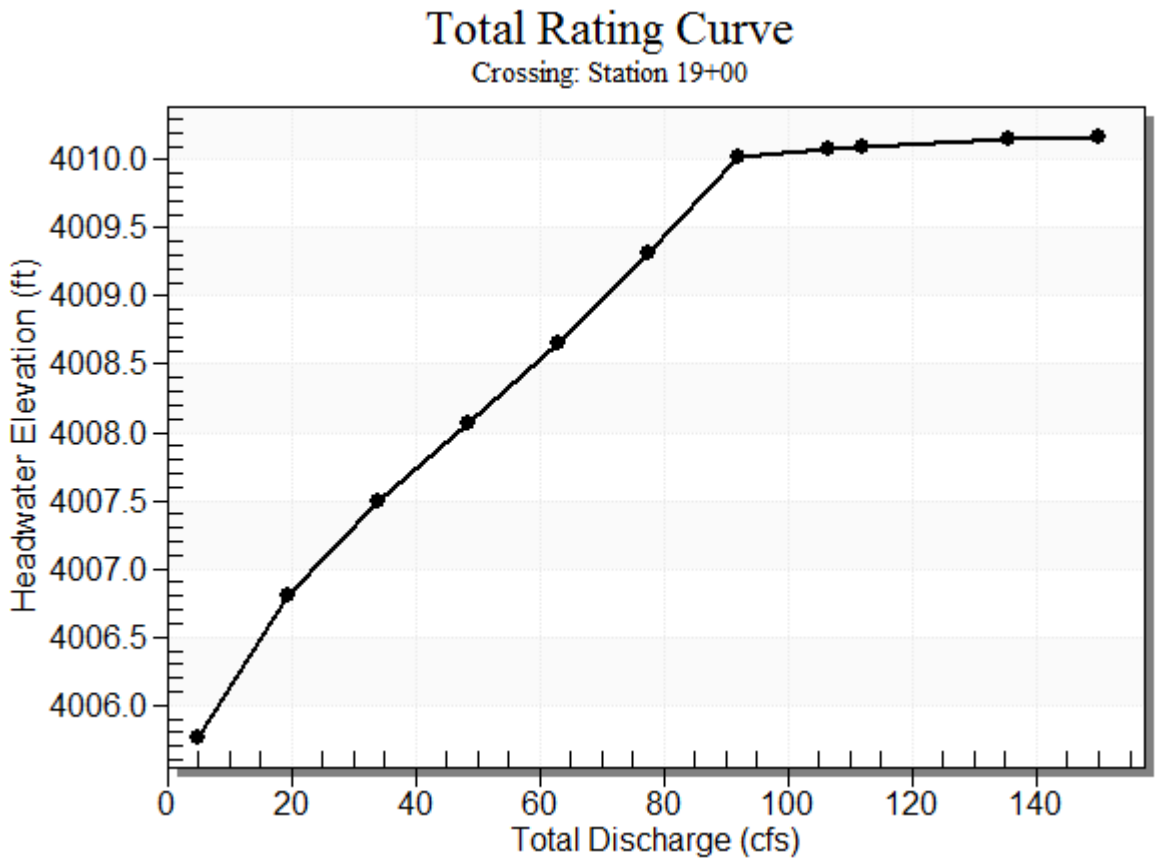


Table 5 - Culvert Summary Table: 48 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4005.77	0.979	0.0*	1-S2n	0.419	0.643	0.439	0.245	6.459
	19.50	19.50	4006.81	2.019	0.0*	1-S2n	0.837	1.294	0.837	0.490	10.119
	34.00	34.00	4007.50	2.708	0.0*	1-S2n	1.123	1.732	1.123	0.639	11.784
	48.50	48.50	4008.07	3.282	0.0*	1-S2n	1.348	2.086	1.379	0.754	12.605
	63.00	63.00	4008.65	3.861	0.0*	1-S2n	1.554	2.391	1.583	0.850	13.599
	77.50	77.50	4009.31	4.523	0.0*	5-S2n	1.744	2.663	1.744	0.934	14.716
	92.00	90.49	4010.01	5.223	0.0*	5-S2n	1.907	2.881	1.907	1.008	15.311
	106.50	91.50	4010.07	5.282	0.0*	5-S2n	1.919	2.897	1.919	1.076	15.355
	112.00	91.77	4010.09	5.298	0.0*	5-S2n	1.922	2.901	1.922	1.100	15.367
	135.50	92.72	4010.14	5.354	0.0*	5-S2n	1.934	2.916	1.964	1.196	15.102
	150.00	93.21	4010.17	5.384	0.0*	5-S2n	1.939	2.923	1.970	1.250	15.121

* Full Flow Headwater elevation is below inlet invert.

****

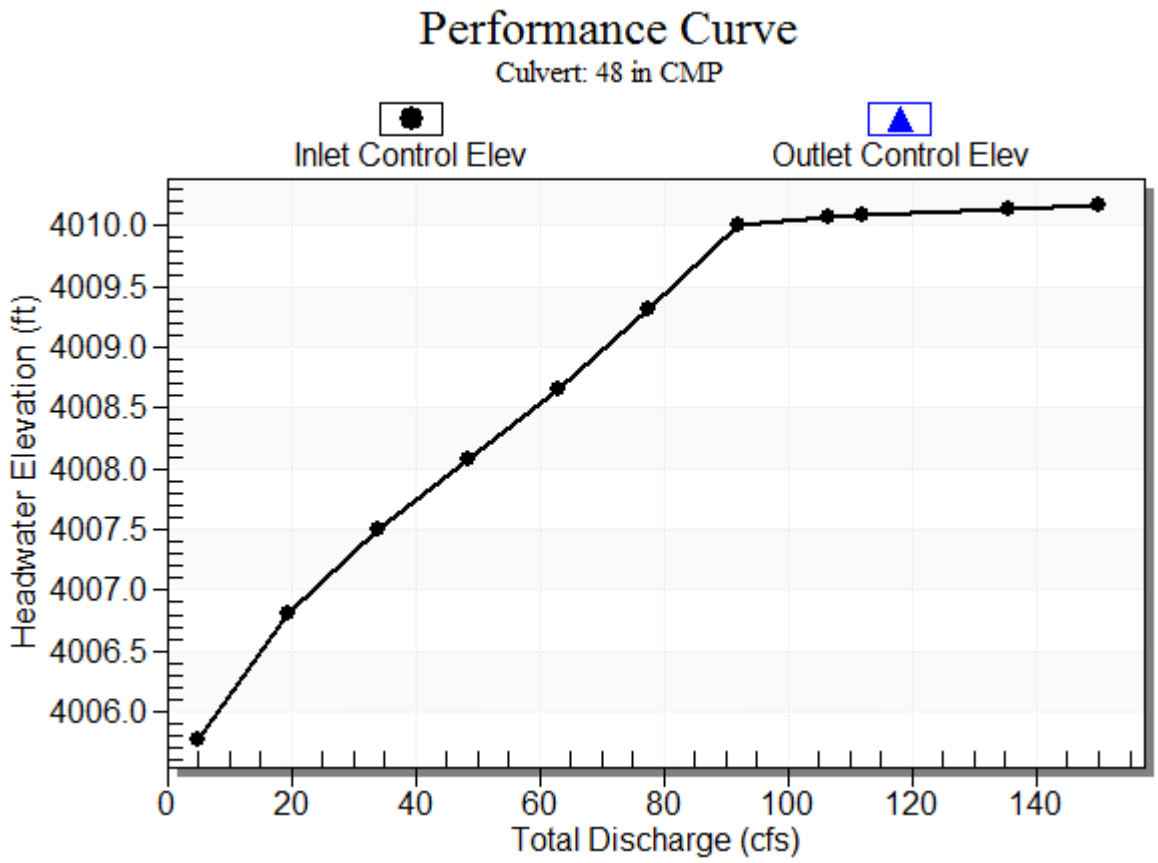
Straight Culvert

Inlet Elevation (invert): 4004.79 ft, Outlet Elevation (invert): 3997.83 ft

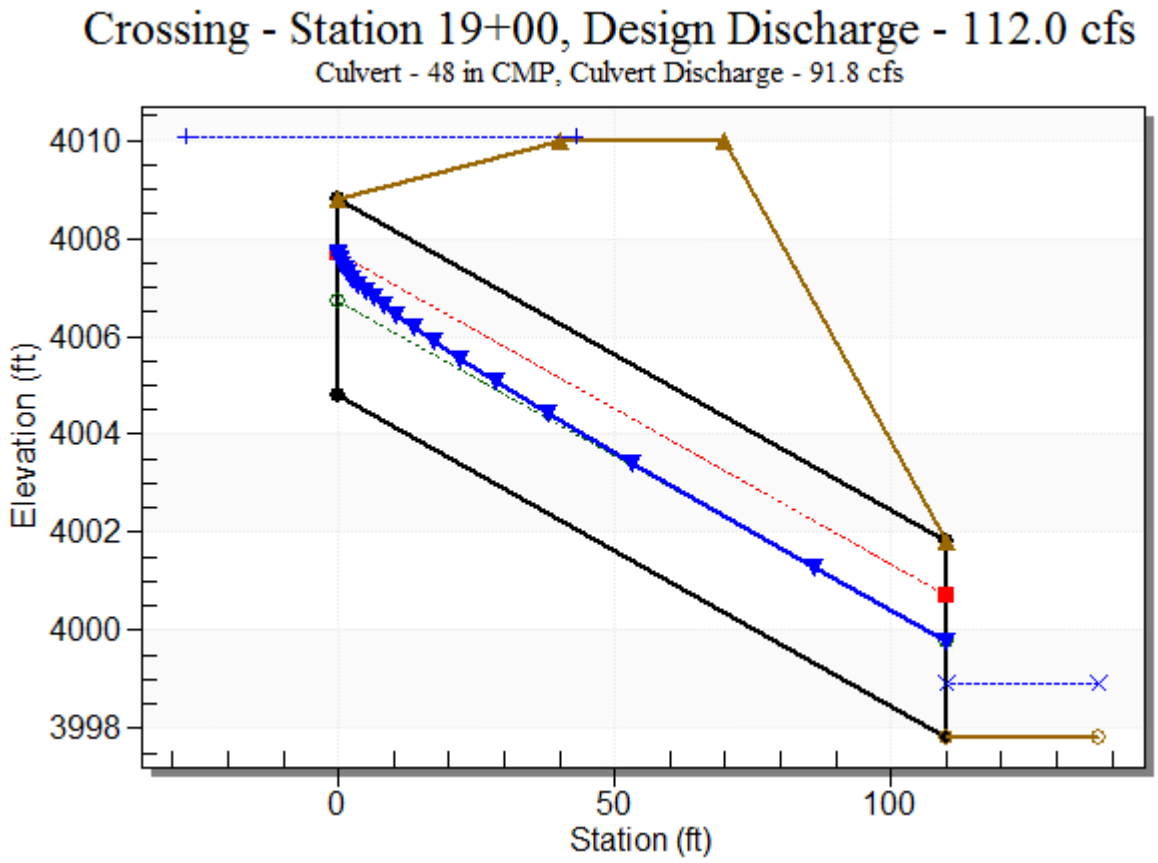
Culvert Length: 110.22 ft, Culvert Slope: 0.0633

****

Culvert Performance Curve Plot: 48 in CMP



Water Surface Profile Plot for Culvert: 48 in CMP



Site Data - 48 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4004.79 ft

Outlet Station: 110.00 ft

Outlet Elevation: 3997.83 ft

Number of Barrels: 1

Culvert Data Summary - 48 in CMP

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 6 - Downstream Channel Rating Curve (Crossing: Station 19+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	3998.07	0.24	2.75	0.61	1.13
19.50	3998.32	0.49	4.03	1.22	1.24
34.00	3998.47	0.64	4.67	1.60	1.29
48.50	3998.58	0.75	5.13	1.88	1.32
63.00	3998.68	0.85	5.49	2.12	1.34
77.50	3998.76	0.93	5.79	2.33	1.36
92.00	3998.84	1.01	6.05	2.52	1.37
106.50	3998.91	1.08	6.28	2.68	1.39
112.00	3998.93	1.10	6.37	2.75	1.39
135.50	3999.03	1.20	6.68	2.98	1.41
150.00	3999.08	1.25	6.86	3.12	1.42

Tailwater Channel Data - Station 19+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 3997.83 ft

Roadway Data for Crossing: Station 19+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4010.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 43+50

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 25 cfs

Maximum Flow: 40 cfs

Table 7 - Summary of Culvert Flows at Crossing: Station 43+50

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4116.98	5.00	5.00	0.00	1
4117.39	8.50	8.50	0.00	1
4117.79	12.00	12.00	0.00	1
4118.28	15.50	15.50	0.00	1
4118.91	19.00	19.00	0.00	1
4119.66	22.50	22.50	0.00	1
4120.27	25.00	25.00	0.00	1
4122.01	29.50	28.05	1.27	47
4122.03	33.00	28.08	4.63	4
4122.05	36.50	28.09	8.29	4
4122.06	40.00	28.11	11.67	3
4122.00	28.03	28.03	0.00	Overtopping

Rating Curve Plot for Crossing: Station 43+50

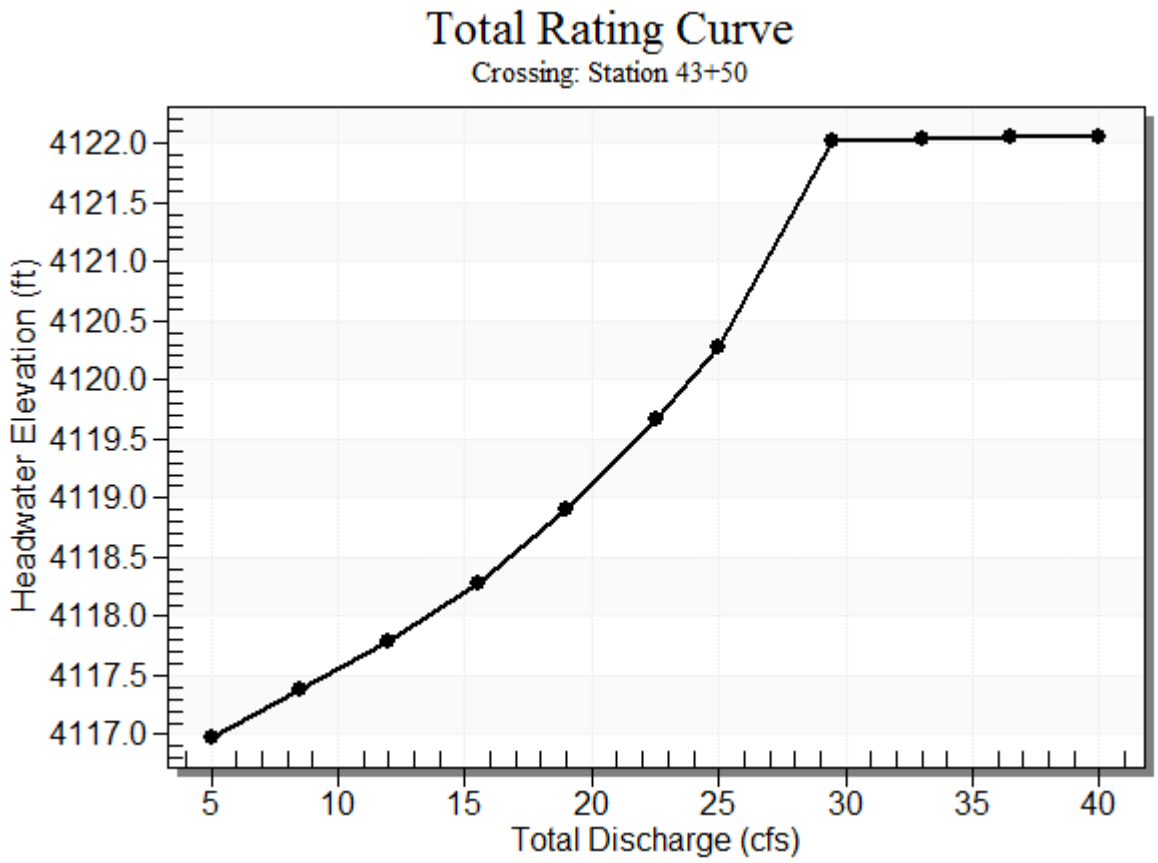


Table 8 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4116.98	1.193	0.0*	1-S2n	0.618	0.783	0.618	0.245	6.026
	8.50	8.50	4117.39	1.597	0.0*	1-S2n	0.825	1.038	0.825	0.323	6.948
	12.00	12.00	4117.79	2.000	0.0*	1-S2n	1.006	1.239	1.006	0.385	7.584
	15.50	15.50	4118.28	2.495	0.0*	5-S2n	1.179	1.415	1.179	0.437	8.050
	19.00	19.00	4118.91	3.120	0.737	5-S2n	1.357	1.566	1.355	0.483	8.398
	22.50	22.50	4119.66	3.874	2.631	5-S2n	1.560	1.690	1.560	0.525	8.574
	25.00	25.00	4120.27	4.478	3.674	7-M2c	1.777	1.761	1.761	0.552	8.533
	29.50	28.05	4122.01	5.271	6.225	7-M2c	2.000	1.829	1.829	0.598	9.311
	33.00	28.08	4122.03	5.279	6.244	7-M2c	2.000	1.830	1.830	0.630	9.319
	36.50	28.09	4122.05	5.284	6.260	7-M2c	2.000	1.830	1.830	0.661	9.323
	40.00	28.11	4122.06	5.290	6.272	7-M2c	2.000	1.831	1.831	0.690	9.329

* Full Flow Headwater elevation is below inlet invert.

****

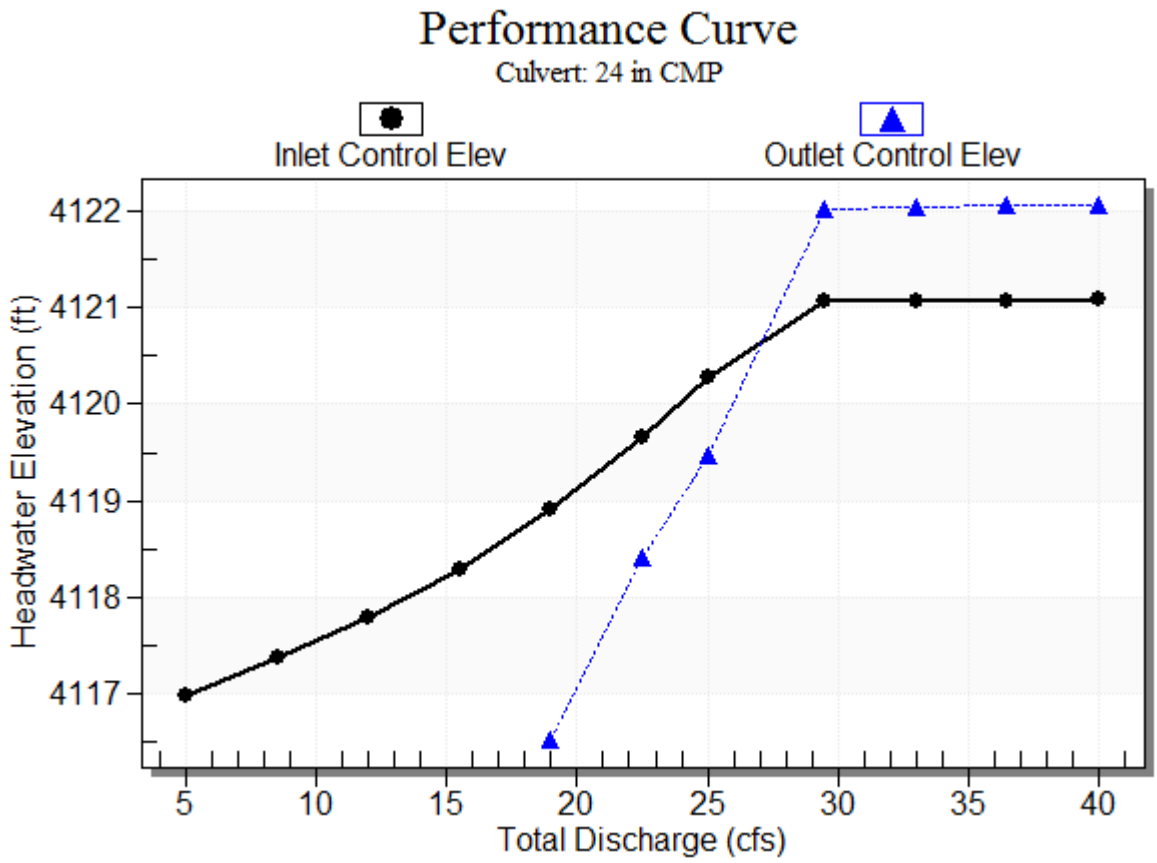
Straight Culvert

Inlet Elevation (invert): 4115.79 ft, Outlet Elevation (invert): 4110.19 ft

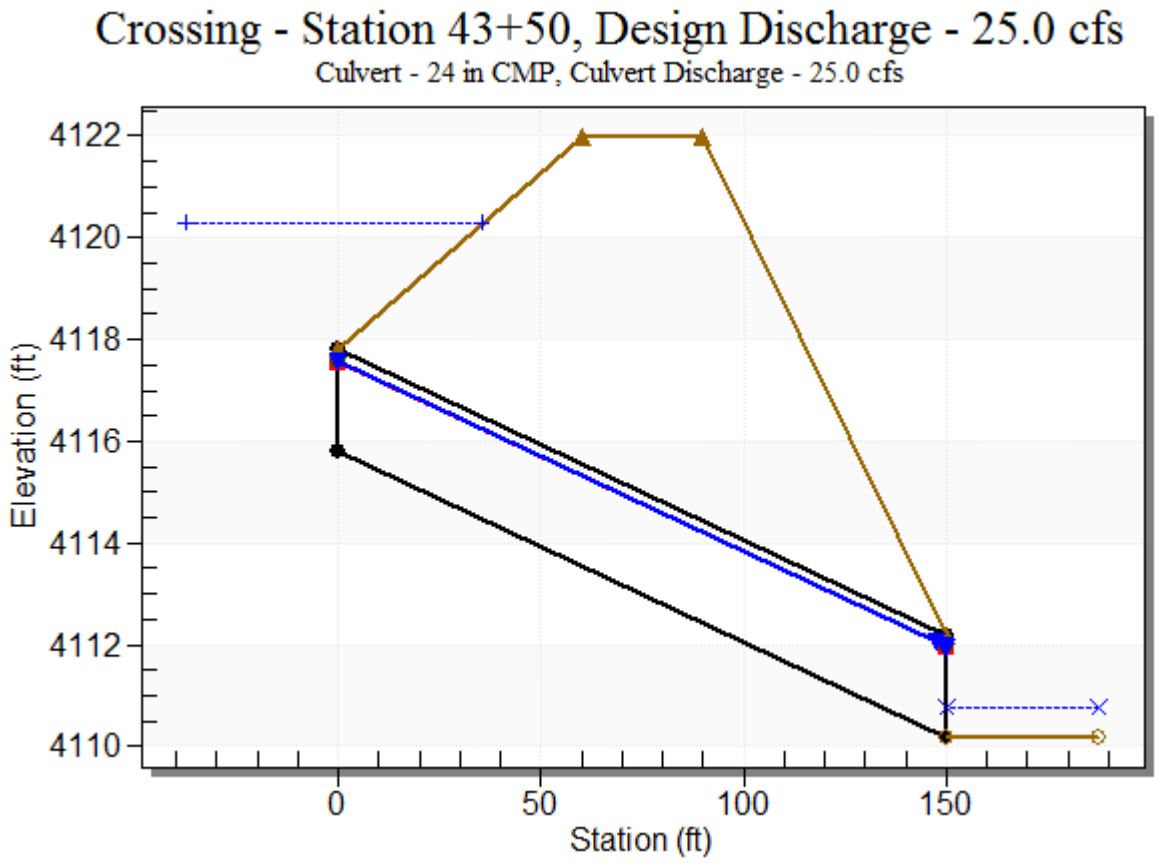
Culvert Length: 150.10 ft, Culvert Slope: 0.0373

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4115.79 ft

Outlet Station: 150.00 ft

Outlet Elevation: 4110.19 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 9 - Downstream Channel Rating Curve (Crossing: Station 43+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4110.43	0.24	2.75	0.61	1.13
8.50	4110.51	0.32	3.20	0.81	1.17
12.00	4110.57	0.38	3.52	0.96	1.20
15.50	4110.63	0.44	3.78	1.09	1.22
19.00	4110.67	0.48	4.00	1.21	1.24
22.50	4110.71	0.52	4.18	1.31	1.25
25.00	4110.74	0.55	4.30	1.38	1.26
29.50	4110.79	0.60	4.50	1.49	1.27
33.00	4110.82	0.63	4.63	1.57	1.28
36.50	4110.85	0.66	4.76	1.65	1.29
40.00	4110.88	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 43+50

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4110.19 ft

Roadway Data for Crossing: Station 43+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4122.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 49+35

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 62 cfs

Maximum Flow: 100 cfs

Table 10 - Summary of Culvert Flows at Crossing: Station 49+35

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4135.23	5.00	5.00	0.00	1
4136.05	14.50	14.50	0.00	1
4136.64	24.00	24.00	0.00	1
4137.24	33.50	33.50	0.00	1
4137.98	43.00	43.00	0.00	1
4138.90	52.50	52.50	0.00	1
4139.97	62.00	61.64	0.00	40
4140.05	71.50	62.26	8.96	7
4140.08	81.00	62.50	18.14	4
4140.11	90.50	62.71	27.64	4
4140.13	100.00	62.89	36.76	3
4140.00	61.85	61.85	0.00	Overtopping

Rating Curve Plot for Crossing: Station 49+35

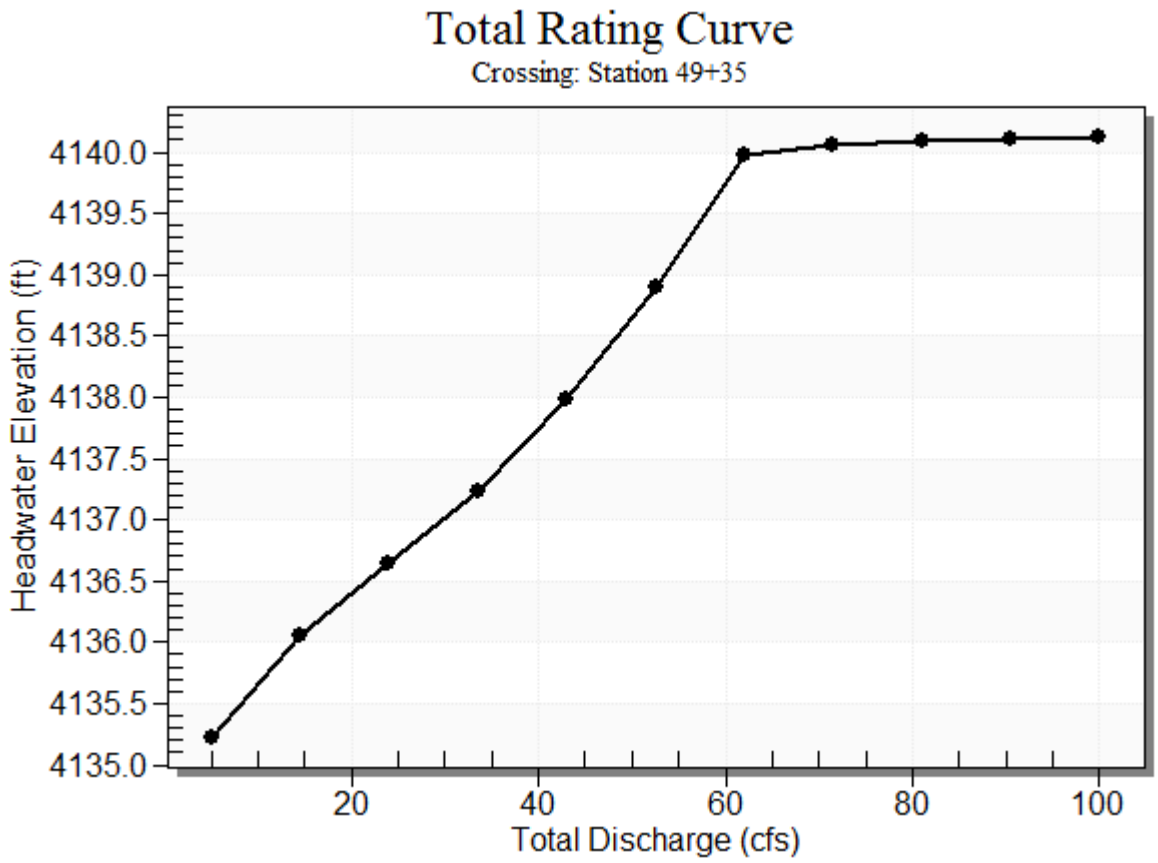


Table 11 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4135.23	1.069	0.0*	1-S2n	0.466	0.697	0.466	0.245	6.992
	14.50	14.50	4136.05	1.889	0.0*	1-S2n	0.818	1.208	0.818	0.423	9.284
	24.00	24.00	4136.64	2.478	0.0*	1-S2n	1.061	1.577	1.061	0.541	10.722
	33.50	33.50	4137.24	3.078	0.0*	5-S2n	1.271	1.876	1.271	0.635	11.745
	43.00	43.00	4137.98	3.816	0.0*	5-S2n	1.467	2.134	1.467	0.713	12.515
	52.50	52.50	4138.90	4.744	0.332	5-S2n	1.656	2.353	1.662	0.782	13.063
	62.00	61.64	4139.97	5.813	1.735	5-S2n	1.835	2.529	1.851	0.844	13.477
	71.50	62.26	4140.05	5.892	1.838	5-S2n	1.848	2.539	1.865	0.900	13.488
	81.00	62.50	4140.08	5.923	1.878	5-S2n	1.852	2.543	1.871	0.952	13.492
	90.50	62.71	4140.11	5.949	1.913	5-S2n	1.856	2.547	1.875	1.001	13.496
	100.00	62.89	4140.13	5.971	1.942	5-S2n	1.860	2.550	1.879	1.046	13.499

* Full Flow Headwater elevation is below inlet invert.

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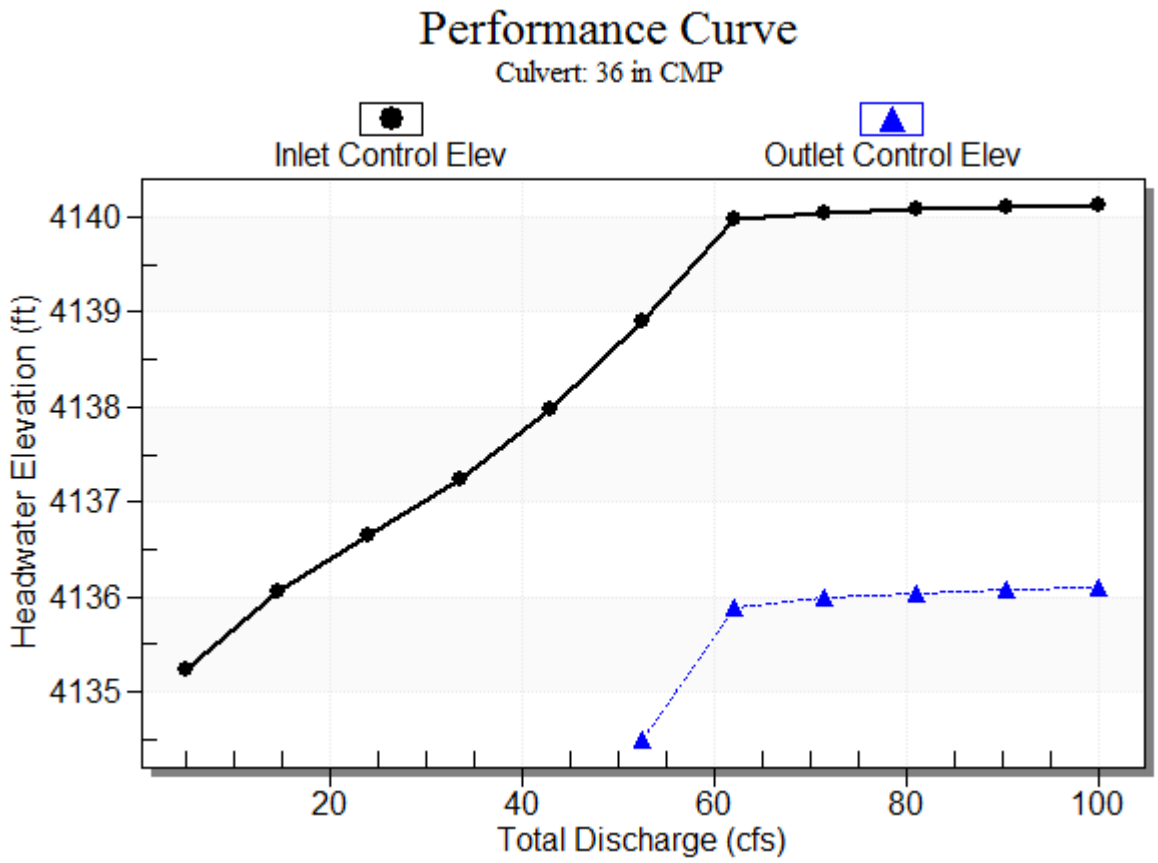
Straight Culvert

Inlet Elevation (invert): 4134.16 ft, Outlet Elevation (invert): 4128.34 ft

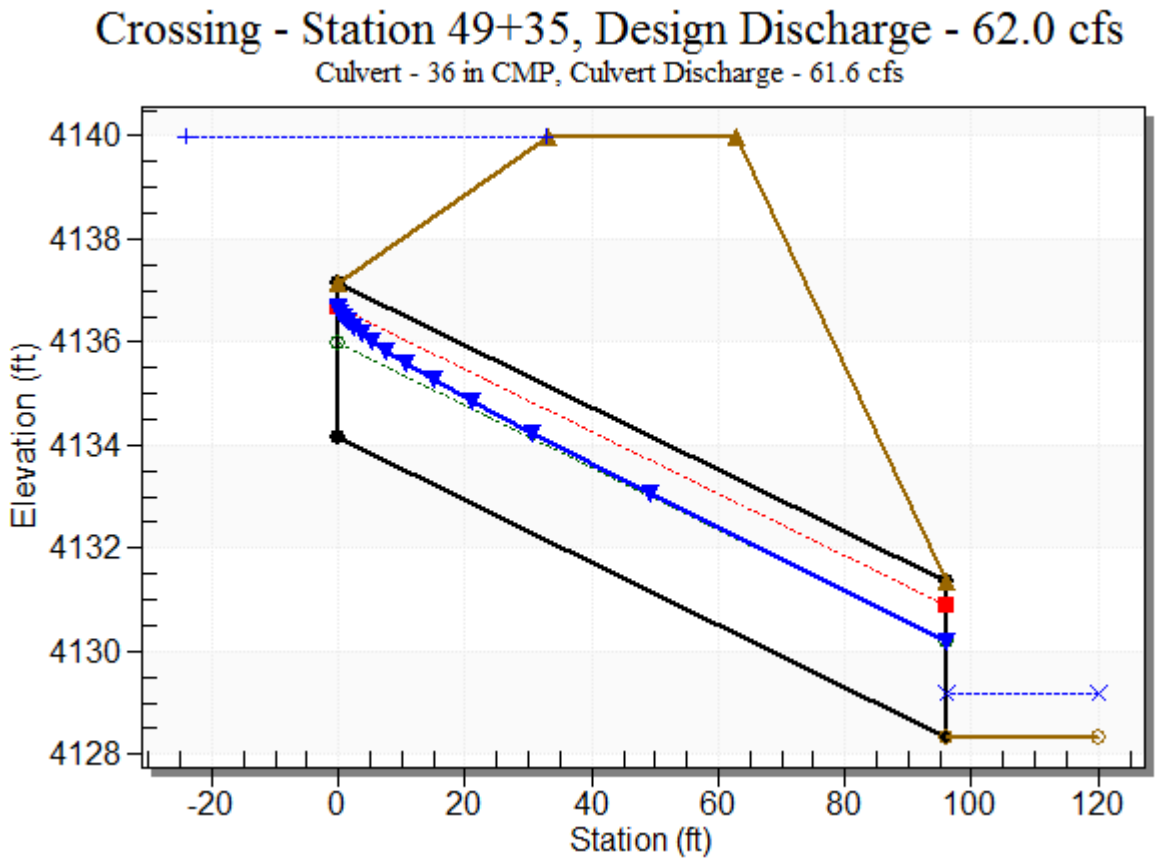
Culvert Length: 96.18 ft, Culvert Slope: 0.0606

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4134.16 ft

Outlet Station: 96.00 ft

Outlet Elevation: 4128.34 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 12 - Downstream Channel Rating Curve (Crossing: Station 49+35)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4128.58	0.24	2.75	0.61	1.13
14.50	4128.76	0.42	3.71	1.06	1.22
24.00	4128.88	0.54	4.26	1.35	1.26
33.50	4128.97	0.63	4.65	1.58	1.29
43.00	4129.05	0.71	4.97	1.78	1.31
52.50	4129.12	0.78	5.23	1.95	1.32
62.00	4129.18	0.84	5.47	2.11	1.34
71.50	4129.24	0.90	5.67	2.25	1.35
81.00	4129.29	0.95	5.86	2.38	1.36
90.50	4129.34	1.00	6.03	2.50	1.37
100.00	4129.39	1.05	6.18	2.61	1.38

Tailwater Channel Data - Station 49+35

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4128.34 ft

Roadway Data for Crossing: Station 49+35

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4140.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 54+35

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 62 cfs

Maximum Flow: 100 cfs

Table 13 - Summary of Culvert Flows at Crossing: Station 54+35

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4136.63	5.00	5.00	0.00	1
4137.44	14.50	14.50	0.00	1
4138.03	24.00	24.00	0.00	1
4138.63	33.50	33.50	0.00	1
4138.84	43.00	36.43	6.22	12
4138.87	52.50	36.87	15.16	4
4138.90	62.00	37.23	24.57	4
4138.92	71.50	37.54	33.54	3
4138.95	81.00	37.82	42.90	3
4138.97	90.50	38.08	52.26	3
4138.98	100.00	38.32	61.60	3
4138.80	35.87	35.87	0.00	Overtopping

Rating Curve Plot for Crossing: Station 54+35

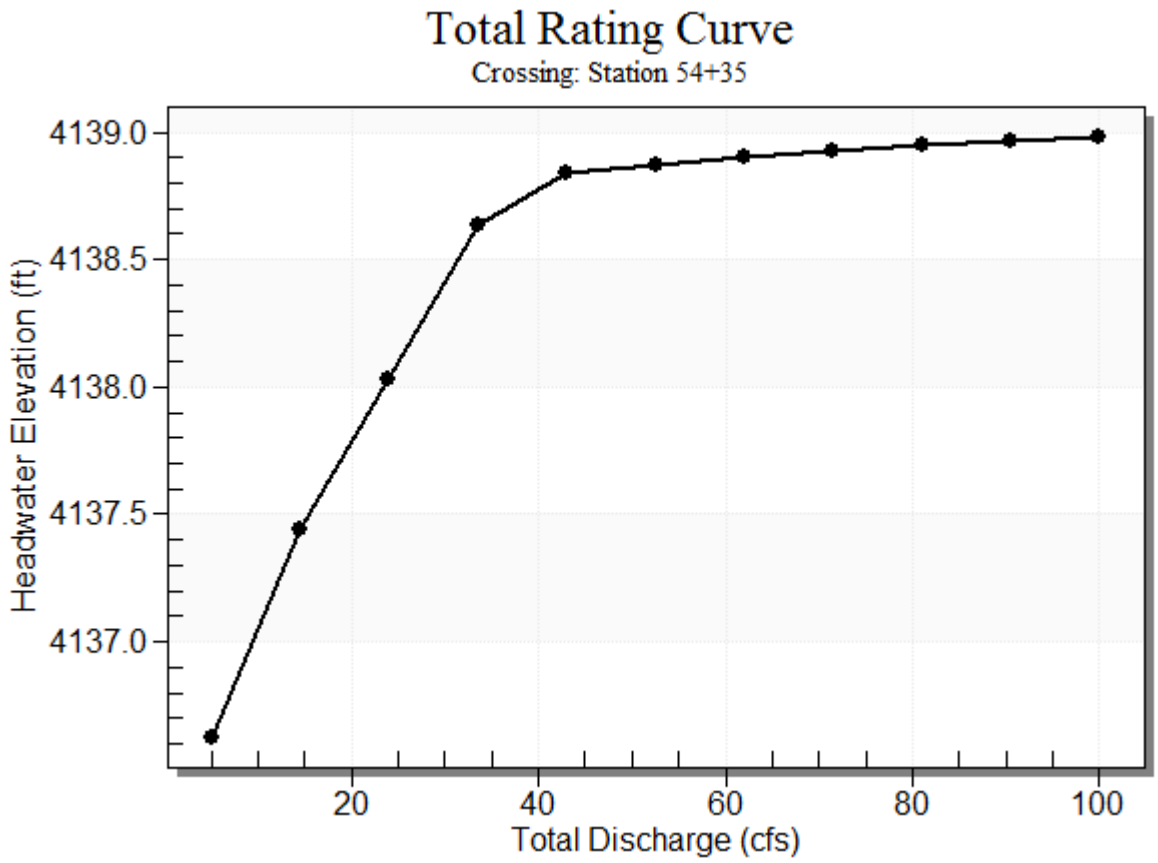


Table 14 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4136.63	1.058	0.0*	1-S2n	0.485	0.697	0.485	0.245	6.626
	14.50	14.50	4137.44	1.873	0.0*	1-S2n	0.844	1.208	0.844	0.423	8.915
	24.00	24.00	4138.03	2.462	0.0*	1-S2n	1.101	1.577	1.101	0.541	10.205
	33.50	33.50	4138.63	3.062	0.0*	5-S2n	1.321	1.876	1.321	0.635	11.164
	43.00	36.43	4138.84	3.271	0.0*	5-S2n	1.387	1.958	1.387	0.713	11.404
	52.50	36.87	4138.87	3.303	0.0*	5-S2n	1.396	1.970	1.396	0.782	11.443
	62.00	37.23	4138.90	3.331	0.0*	5-S2n	1.404	1.980	1.404	0.844	11.475
	71.50	37.54	4138.92	3.354	0.0*	5-S2n	1.410	1.988	1.410	0.900	11.501
	81.00	37.82	4138.95	3.376	0.0*	5-S2n	1.416	1.996	1.445	0.952	11.223
	90.50	38.08	4138.97	3.396	0.0*	5-S2n	1.422	2.003	1.450	1.001	11.249
	100.00	38.32	4138.98	3.414	0.0*	5-S2n	1.427	2.009	1.455	1.046	11.274

* Full Flow Headwater elevation is below inlet invert.

****

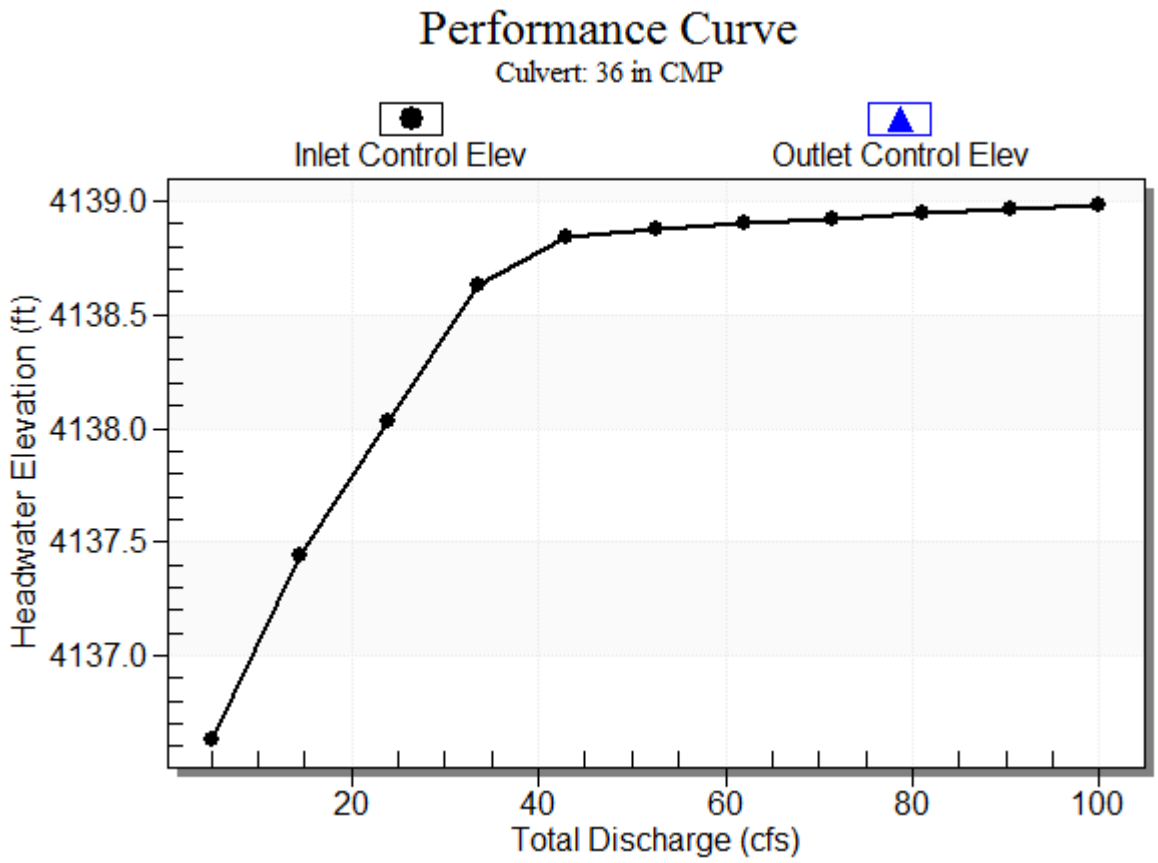
Straight Culvert

Inlet Elevation (invert): 4135.57 ft, Outlet Elevation (invert): 4131.86 ft

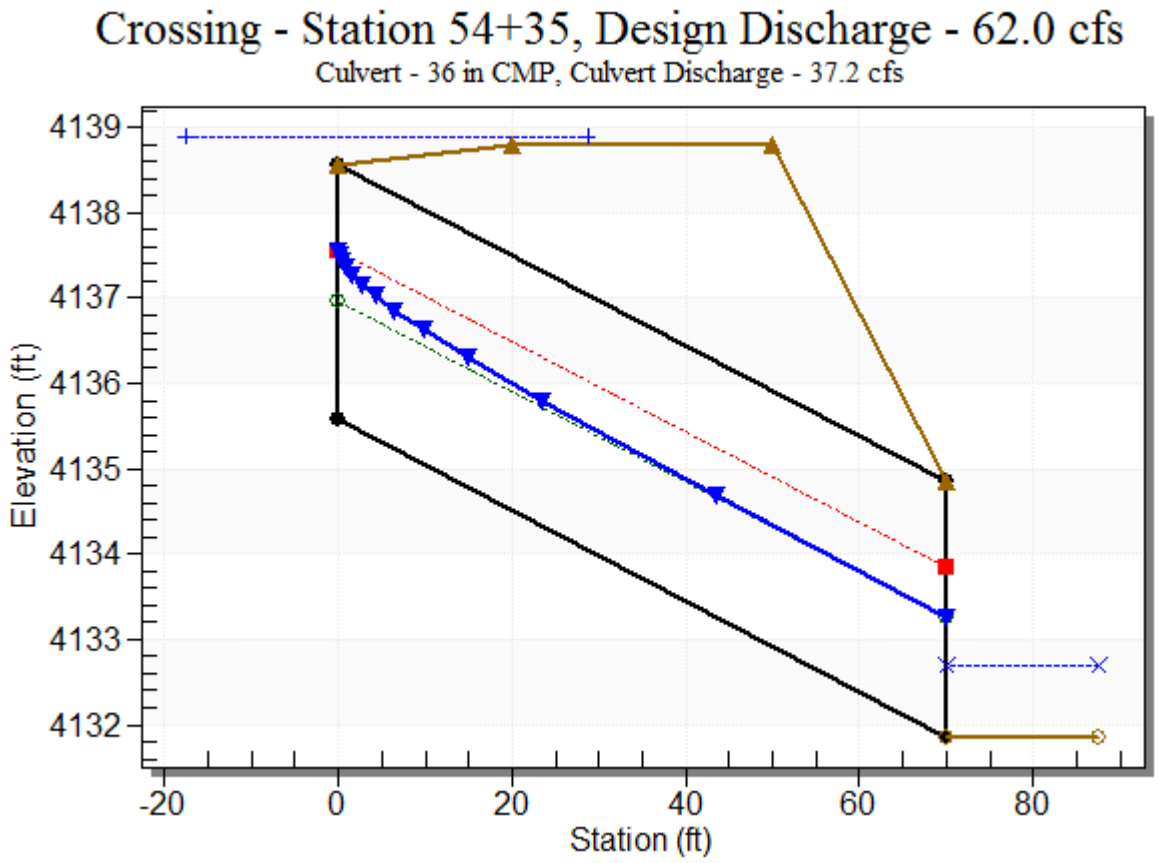
Culvert Length: 70.10 ft, Culvert Slope: 0.0530

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4135.57 ft

Outlet Station: 70.00 ft

Outlet Elevation: 4131.86 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 15 - Downstream Channel Rating Curve (Crossing: Station 54+35)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4132.10	0.24	2.75	0.61	1.13
14.50	4132.28	0.42	3.71	1.06	1.22
24.00	4132.40	0.54	4.26	1.35	1.26
33.50	4132.49	0.63	4.65	1.58	1.29
43.00	4132.57	0.71	4.97	1.78	1.31
52.50	4132.64	0.78	5.23	1.95	1.32
62.00	4132.70	0.84	5.47	2.11	1.34
71.50	4132.76	0.90	5.67	2.25	1.35
81.00	4132.81	0.95	5.86	2.38	1.36
90.50	4132.86	1.00	6.03	2.50	1.37
100.00	4132.91	1.05	6.18	2.61	1.38

Tailwater Channel Data - Station 54+35

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4131.86 ft

Roadway Data for Crossing: Station 54+35

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4138.80 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 57+75

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 112 cfs

Maximum Flow: 150 cfs

Table 16 - Summary of Culvert Flows at Crossing: Station 57+75

Headwater Elevation (ft)	Total Discharge (cfs)	48 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4131.45	5.00	5.00	0.00	1
4132.42	19.50	19.50	0.00	1
4133.11	34.00	34.00	0.00	1
4133.68	48.50	48.50	0.00	1
4134.26	63.00	63.00	0.00	1
4134.93	77.50	77.50	0.00	1
4135.71	92.00	92.00	0.00	1
4136.65	106.50	106.50	0.00	1
4137.00	112.00	111.50	0.04	63
4137.10	135.50	112.79	22.47	6
4137.13	150.00	113.27	36.44	4
4137.00	111.48	111.48	0.00	Overtopping

Rating Curve Plot for Crossing: Station 57+75

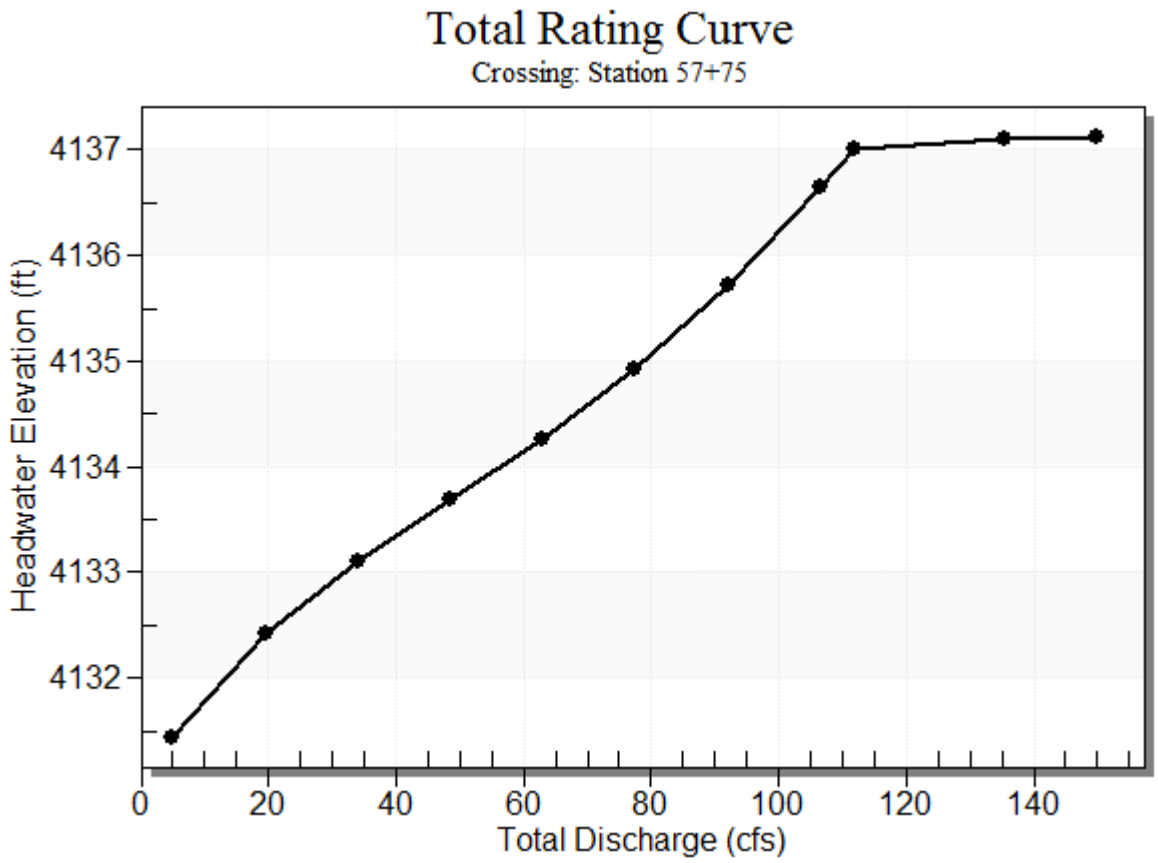


Table 17 - Culvert Summary Table: 48 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4131.45	0.926	0.0*	1-S2n	0.541	0.643	0.541	0.245	4.750
	19.50	19.50	4132.42	1.905	0.0*	1-S2n	1.118	1.294	1.118	0.490	6.805
	34.00	34.00	4133.11	2.591	0.568	1-S2n	1.497	1.732	1.505	0.639	7.856
	48.50	48.50	4133.68	3.165	1.259	1-S2n	1.824	2.086	1.824	0.754	8.693
	63.00	63.00	4134.26	3.743	2.021	1-S2n	2.125	2.391	2.125	0.850	9.288
	77.50	77.50	4134.93	4.405	2.868	5-S2n	2.423	2.663	2.423	0.934	9.738
	92.00	92.00	4135.71	5.194	3.803	5-S2n	2.734	2.904	2.734	1.008	10.068
	106.50	106.50	4136.65	6.126	5.270	5-S2n	3.084	3.119	3.084	1.076	10.266
	112.00	111.50	4137.00	6.481	6.016	7-M2c	3.217	3.187	3.187	1.100	10.386
	135.50	112.79	4137.10	6.575	6.059	7-M2c	3.252	3.204	3.204	1.196	10.453
	150.00	113.27	4137.13	6.610	6.076	7-M2c	3.265	3.210	3.210	1.250	10.478

* Full Flow Headwater elevation is below inlet invert.

****

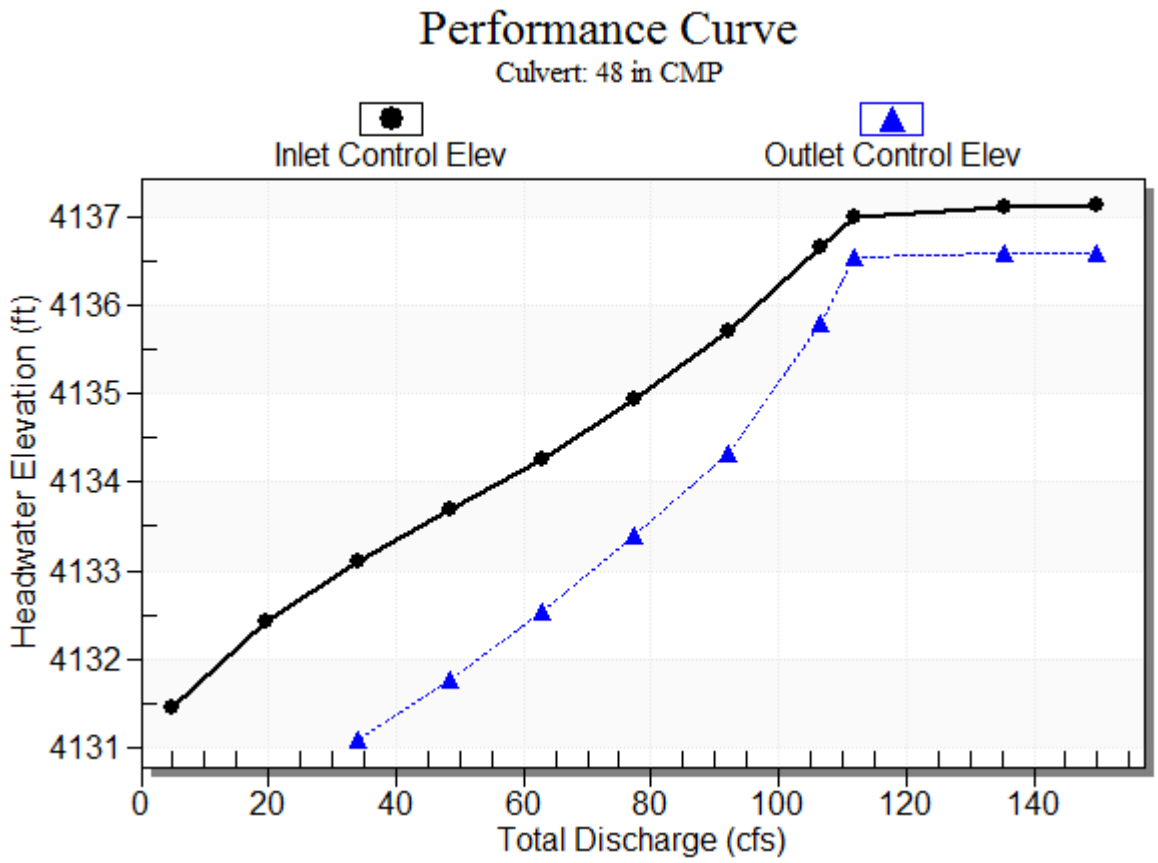
Straight Culvert

Inlet Elevation (invert): 4130.52 ft, Outlet Elevation (invert): 4129.03 ft

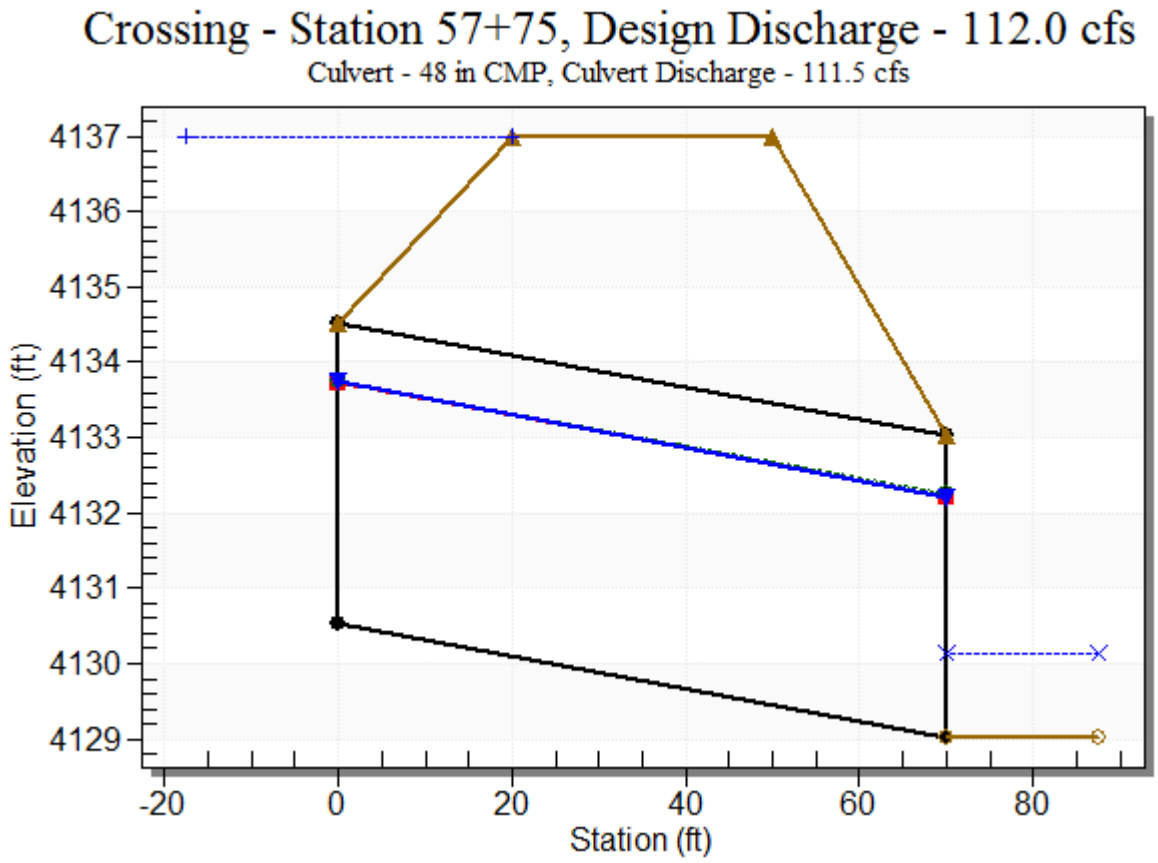
Culvert Length: 70.02 ft, Culvert Slope: 0.0213

****

Culvert Performance Curve Plot: 48 in CMP



Water Surface Profile Plot for Culvert: 48 in CMP



Site Data - 48 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4130.52 ft

Outlet Station: 70.00 ft

Outlet Elevation: 4129.03 ft

Number of Barrels: 1

Culvert Data Summary - 48 in CMP

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 18 - Downstream Channel Rating Curve (Crossing: Station 57+75)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4129.27	0.24	2.75	0.61	1.13
19.50	4129.52	0.49	4.03	1.22	1.24
34.00	4129.67	0.64	4.67	1.60	1.29
48.50	4129.78	0.75	5.13	1.88	1.32
63.00	4129.88	0.85	5.49	2.12	1.34
77.50	4129.96	0.93	5.79	2.33	1.36
92.00	4130.04	1.01	6.05	2.52	1.37
106.50	4130.11	1.08	6.28	2.68	1.39
112.00	4130.13	1.10	6.37	2.75	1.39
135.50	4130.23	1.20	6.68	2.98	1.41
150.00	4130.28	1.25	6.86	3.12	1.42

Tailwater Channel Data - Station 57+75

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4129.03 ft

Roadway Data for Crossing: Station 57+75

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4137.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 62+30

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 25 cfs

Maximum Flow: 40 cfs

Table 19 - Summary of Culvert Flows at Crossing: Station 62+30

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4124.88	5.00	5.00	0.00	1
4125.29	8.50	8.50	0.00	1
4125.69	12.00	12.00	0.00	1
4126.18	15.50	15.50	0.00	1
4126.81	19.00	19.00	0.00	1
4127.56	22.50	22.50	0.00	1
4128.01	25.00	24.35	0.46	53
4128.03	29.50	24.47	4.88	5
4128.05	33.00	24.53	8.37	4
4128.06	36.50	24.58	11.72	3
4128.07	40.00	24.62	15.23	3
4128.00	24.33	24.33	0.00	Overtopping

Rating Curve Plot for Crossing: Station 62+30

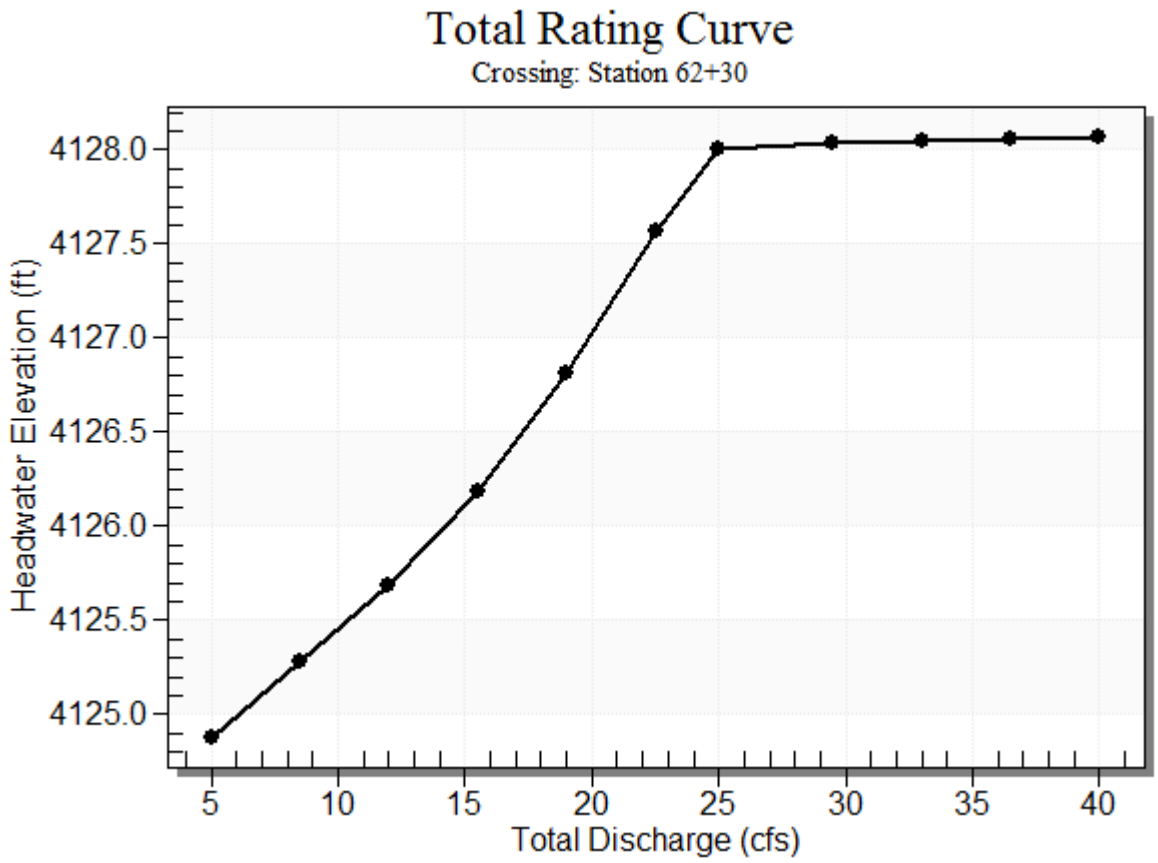


Table 20 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4124.88	1.203	0.0*	1-S2n	0.593	0.783	0.593	0.245	6.470
	8.50	8.50	4125.29	1.606	0.0*	1-S2n	0.787	1.038	0.787	0.323	7.391
	12.00	12.00	4125.69	2.009	0.0*	5-S2n	0.957	1.239	0.957	0.385	8.087
	15.50	15.50	4126.18	2.504	0.0*	5-S2n	1.117	1.415	1.117	0.437	8.588
	19.00	19.00	4126.81	3.129	1.207	5-S2n	1.276	1.566	1.276	0.483	8.983
	22.50	22.50	4127.56	3.883	2.389	5-S2n	1.445	1.690	1.445	0.525	9.258
	25.00	24.35	4128.01	4.327	3.087	5-S2n	1.553	1.744	1.553	0.552	9.326
	29.50	24.47	4128.03	4.355	3.130	5-S2n	1.559	1.747	1.559	0.598	9.330
	33.00	24.53	4128.05	4.370	3.154	5-S2n	1.563	1.749	1.563	0.630	9.331
	36.50	24.58	4128.06	4.382	3.173	5-S2n	1.566	1.750	1.566	0.661	9.333
	40.00	24.62	4128.07	4.394	3.192	5-S2n	1.568	1.752	1.568	0.690	9.334

* Full Flow Headwater elevation is below inlet invert.

****

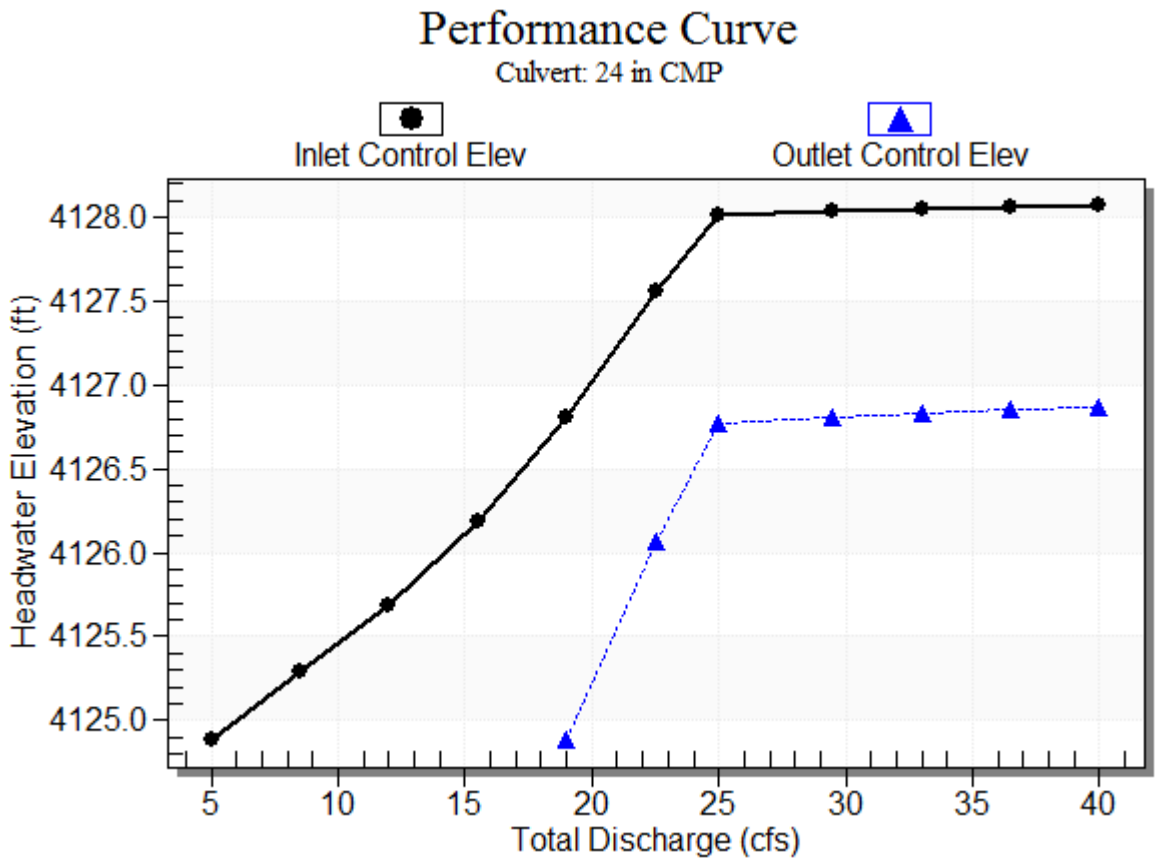
Straight Culvert

Inlet Elevation (invert): 4123.68 ft, Outlet Elevation (invert): 4120.32 ft

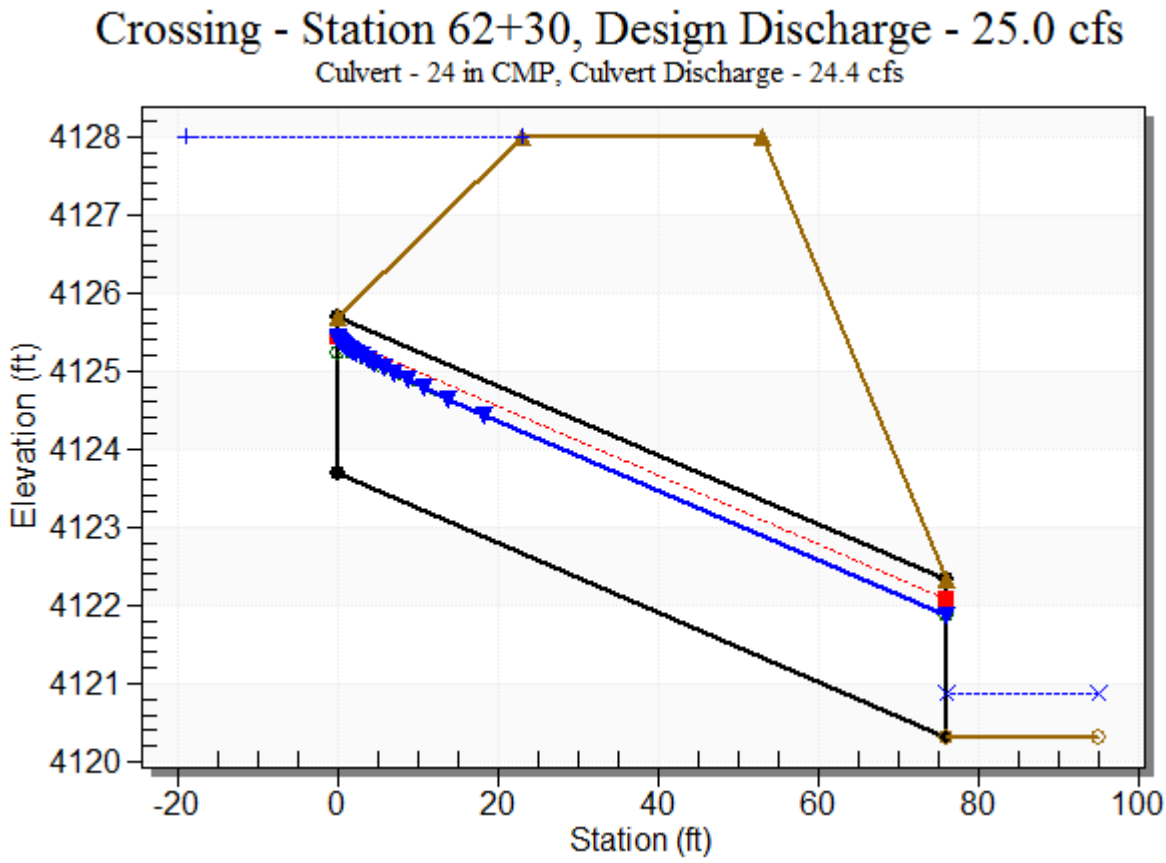
Culvert Length: 76.07 ft, Culvert Slope: 0.0442

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4123.68 ft

Outlet Station: 76.00 ft

Outlet Elevation: 4120.32 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 21 - Downstream Channel Rating Curve (Crossing: Station 62+30)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4120.56	0.24	2.75	0.61	1.13
8.50	4120.64	0.32	3.20	0.81	1.17
12.00	4120.70	0.38	3.52	0.96	1.20
15.50	4120.76	0.44	3.78	1.09	1.22
19.00	4120.80	0.48	4.00	1.21	1.24
22.50	4120.84	0.52	4.18	1.31	1.25
25.00	4120.87	0.55	4.30	1.38	1.26
29.50	4120.92	0.60	4.50	1.49	1.27
33.00	4120.95	0.63	4.63	1.57	1.28
36.50	4120.98	0.66	4.76	1.65	1.29
40.00	4121.01	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 62+30

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4120.32 ft

Roadway Data for Crossing: Station 62+30

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4128.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 88+15

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 25 cfs

Maximum Flow: 40 cfs

Table 22 - Summary of Culvert Flows at Crossing: Station 88+15

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4134.13	5.00	5.00	0.00	1
4134.53	8.50	8.50	0.00	1
4134.94	12.00	12.00	0.00	1
4135.43	15.50	15.50	0.00	1
4136.06	19.00	19.00	0.00	1
4136.81	22.50	22.50	0.00	1
4137.42	25.00	25.00	0.00	1
4138.60	29.50	29.50	0.00	1
4139.73	33.00	33.00	0.00	1
4141.03	36.50	36.50	0.00	1
4142.01	40.00	38.65	1.32	9
4142.00	38.63	38.63	0.00	Overtopping

Rating Curve Plot for Crossing: Station 88+15

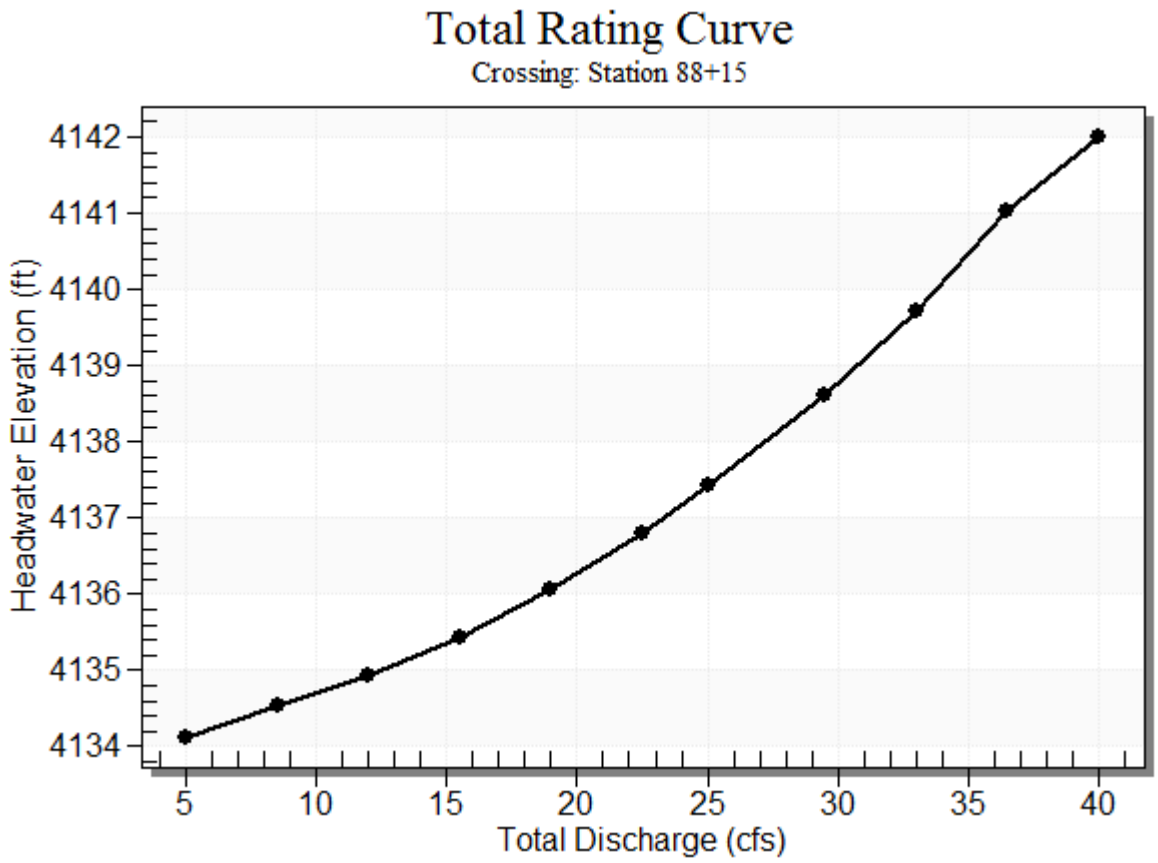


Table 23 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4134.13	1.230	0.0*	1-S2n	0.542	0.783	0.542	0.245	7.267
	8.50	8.50	4134.53	1.634	0.0*	1-S2n	0.713	1.038	0.713	0.323	8.445
	12.00	12.00	4134.94	2.037	0.0*	5-S2n	0.860	1.239	0.860	0.385	9.278
	15.50	15.50	4135.43	2.532	0.0*	5-S2n	0.997	1.415	0.997	0.437	9.903
	19.00	19.00	4136.06	3.157	0.0*	5-S2n	1.130	1.566	1.122	0.483	10.469
	22.50	22.50	4136.81	3.911	0.452	5-S2n	1.261	1.690	1.286	0.525	10.540
	25.00	25.00	4137.42	4.516	1.515	5-S2n	1.361	1.761	1.369	0.552	10.922
	29.50	29.50	4138.60	5.705	3.681	5-S2n	1.561	1.853	1.561	0.598	11.236
	33.00	33.00	4139.73	6.826	5.595	5-S2n	1.797	1.897	1.797	0.630	11.109
	36.50	36.50	4141.03	8.127	0.000	7-M2c	2.000	1.744	1.744	0.661	12.558
	40.00	38.65	4142.01	8.991	9.114	7-M2c	2.000	1.940	1.940	0.690	12.412

* Full Flow Headwater elevation is below inlet invert.

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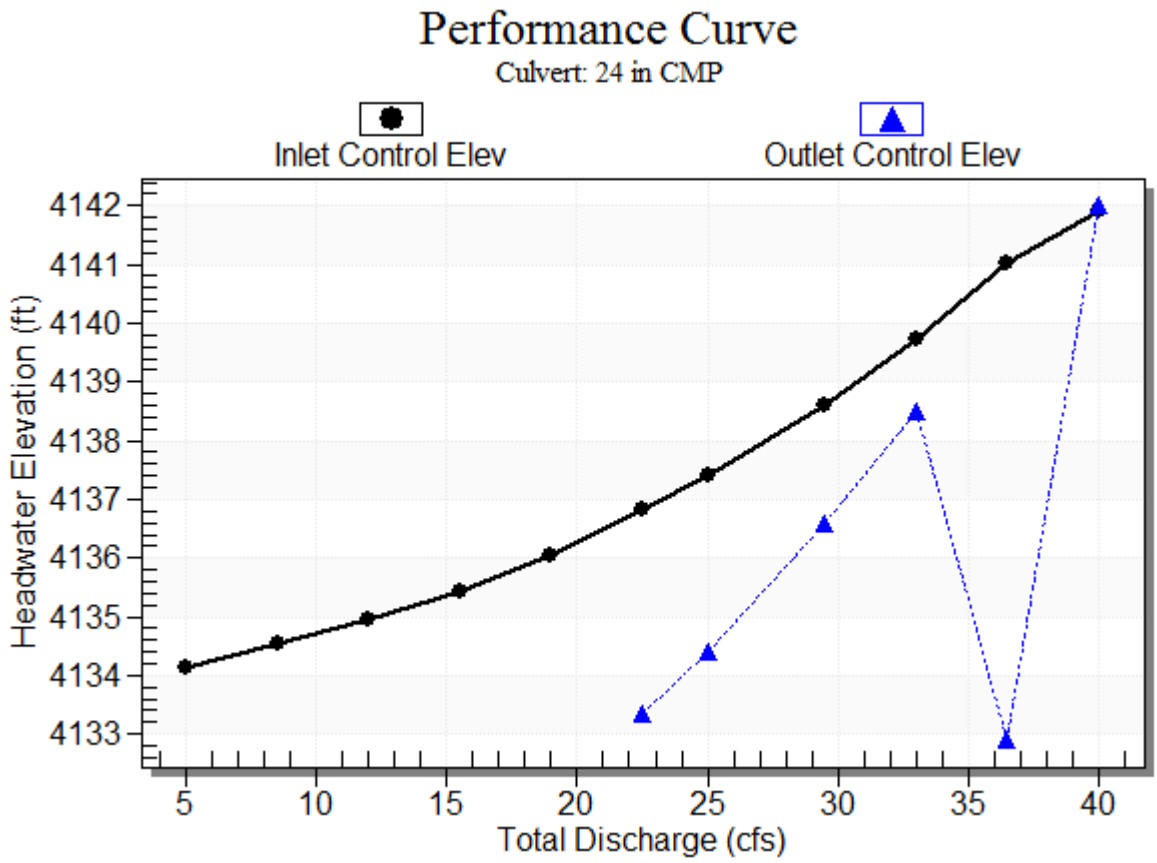
Straight Culvert

Inlet Elevation (invert): 4132.90 ft, Outlet Elevation (invert): 4127.13 ft

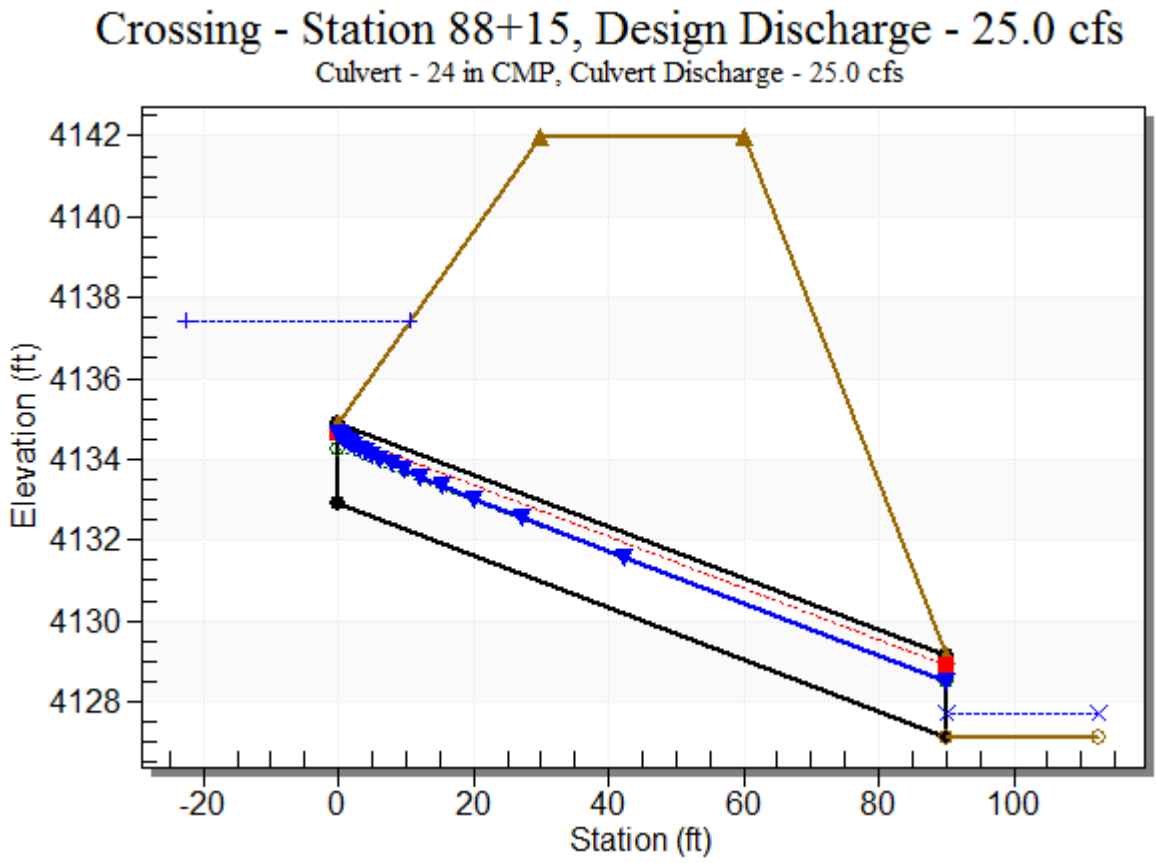
Culvert Length: 90.18 ft, Culvert Slope: 0.0641

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4132.90 ft

Outlet Station: 90.00 ft

Outlet Elevation: 4127.13 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 24 - Downstream Channel Rating Curve (Crossing: Station 88+15)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4127.37	0.24	2.75	0.61	1.13
8.50	4127.45	0.32	3.20	0.81	1.17
12.00	4127.51	0.38	3.52	0.96	1.20
15.50	4127.57	0.44	3.78	1.09	1.22
19.00	4127.61	0.48	4.00	1.21	1.24
22.50	4127.65	0.52	4.18	1.31	1.25
25.00	4127.68	0.55	4.30	1.38	1.26
29.50	4127.73	0.60	4.50	1.49	1.27
33.00	4127.76	0.63	4.63	1.57	1.28
36.50	4127.79	0.66	4.76	1.65	1.29
40.00	4127.82	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 88+15

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4127.13 ft

Roadway Data for Crossing: Station 88+15

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4142.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 90+00

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 25 cfs

Maximum Flow: 40 cfs

Table 25 - Summary of Culvert Flows at Crossing: Station 90+00

Headwater Elevation (ft)	Total Discharge (cfs)	24 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4141.07	5.00	5.00	0.00	1
4141.47	8.50	8.50	0.00	1
4141.88	12.00	12.00	0.00	1
4142.37	15.50	15.50	0.00	1
4143.00	19.00	19.00	0.00	1
4143.75	22.50	22.50	0.00	1
4144.01	25.00	23.61	1.23	28
4144.04	29.50	23.71	5.69	5
4144.05	33.00	23.77	8.93	3
4144.06	36.50	23.82	12.46	3
4144.08	40.00	23.87	16.00	3
4144.00	23.55	23.55	0.00	Overtopping

Rating Curve Plot for Crossing: Station 90+00

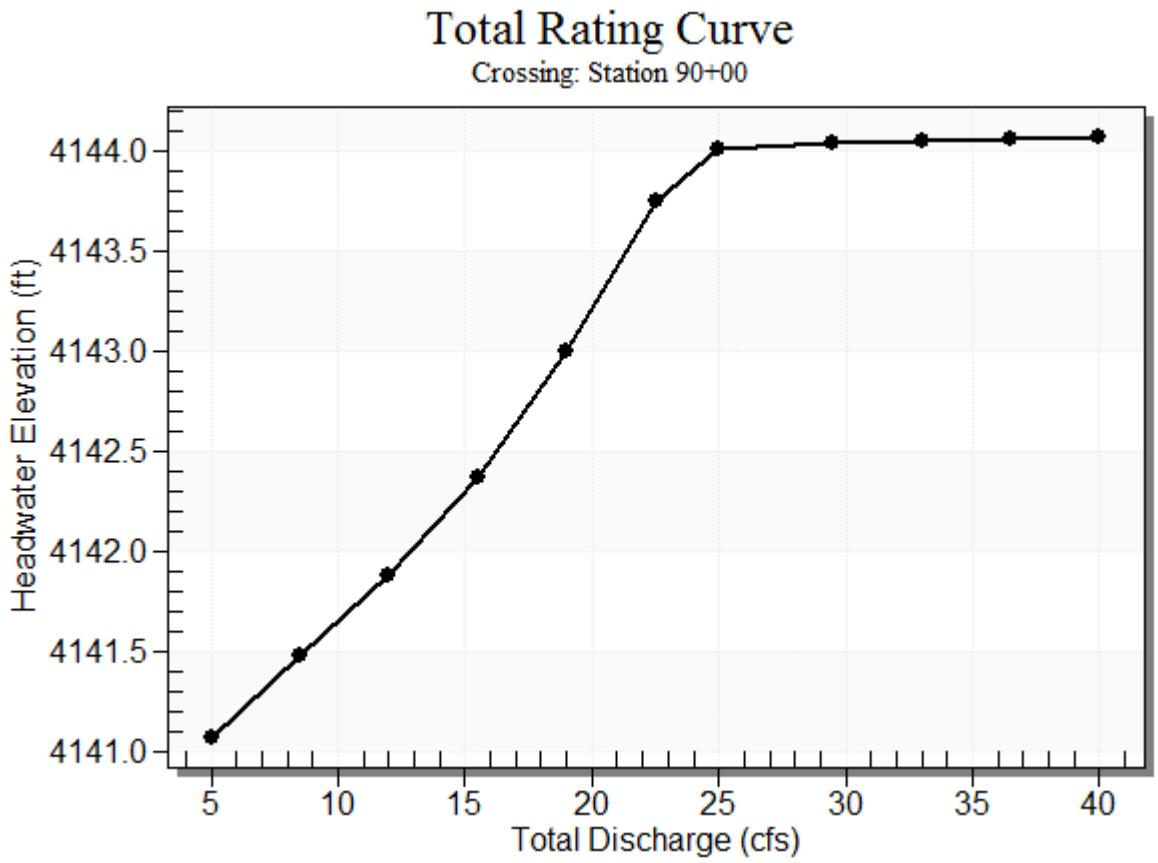


Table 26 - Culvert Summary Table: 24 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	5.00	5.00	4141.07	1.221	0.0*	1-S2n	0.557	0.783	0.557	0.245	7.016
	8.50	8.50	4141.47	1.625	0.0*	1-S2n	0.736	1.038	0.736	0.323	8.114
	12.00	12.00	4141.88	2.028	0.0*	5-S2n	0.888	1.239	0.888	0.385	8.897
	15.50	15.50	4142.37	2.523	0.0*	5-S2n	1.031	1.415	1.041	0.437	9.383
	19.00	19.00	4143.00	3.148	0.0*	5-S2n	1.170	1.566	1.170	0.483	9.956
	22.50	22.50	4143.75	3.902	1.008	5-S2n	1.312	1.690	1.314	0.525	10.275
	25.00	23.61	4144.01	4.164	1.474	5-S2n	1.359	1.723	1.359	0.552	10.400
	29.50	23.71	4144.04	4.188	1.518	5-S2n	1.363	1.726	1.370	0.598	10.349
	33.00	23.77	4144.05	4.202	1.541	5-S2n	1.366	1.728	1.373	0.630	10.354
	36.50	23.82	4144.06	4.214	1.564	5-S2n	1.368	1.729	1.375	0.661	10.358
	40.00	23.87	4144.08	4.226	1.585	5-S2n	1.370	1.731	1.370	0.690	10.420

* Full Flow Headwater elevation is below inlet invert.

****

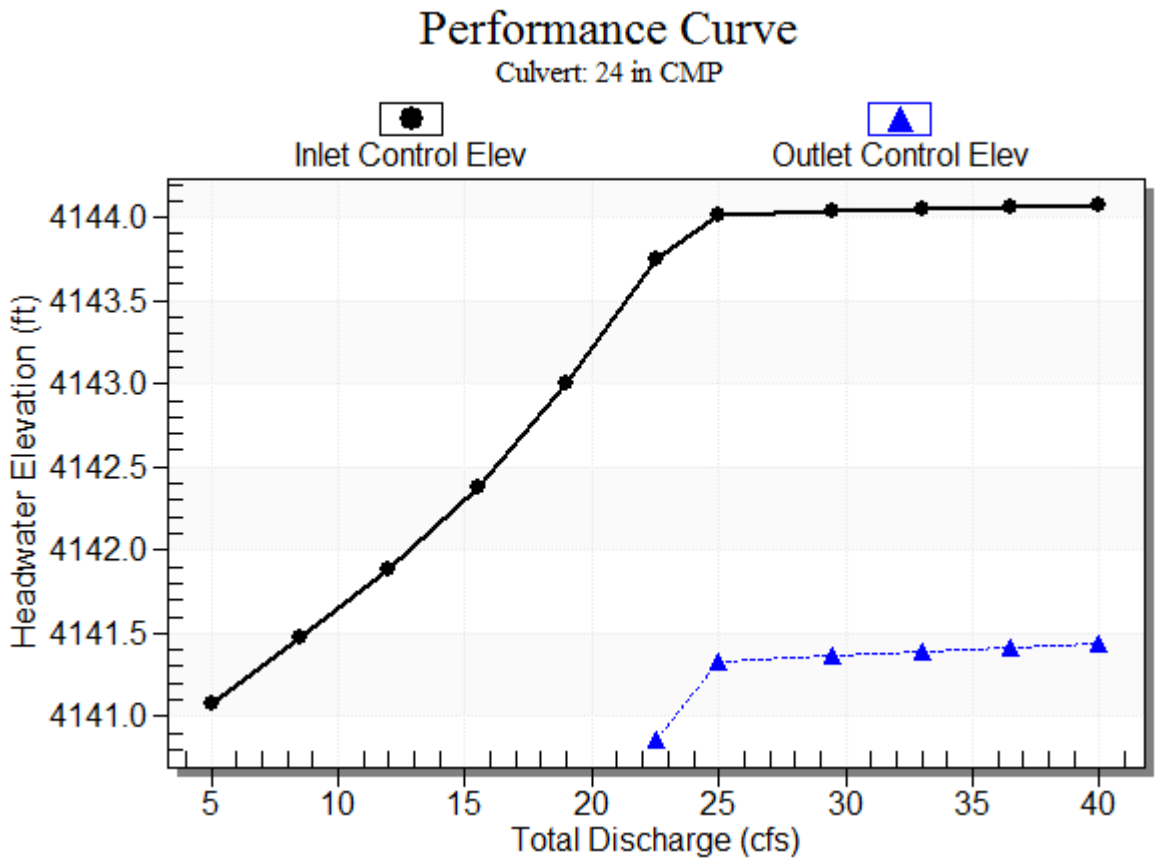
Straight Culvert

Inlet Elevation (invert): 4139.85 ft, Outlet Elevation (invert): 4134.57 ft

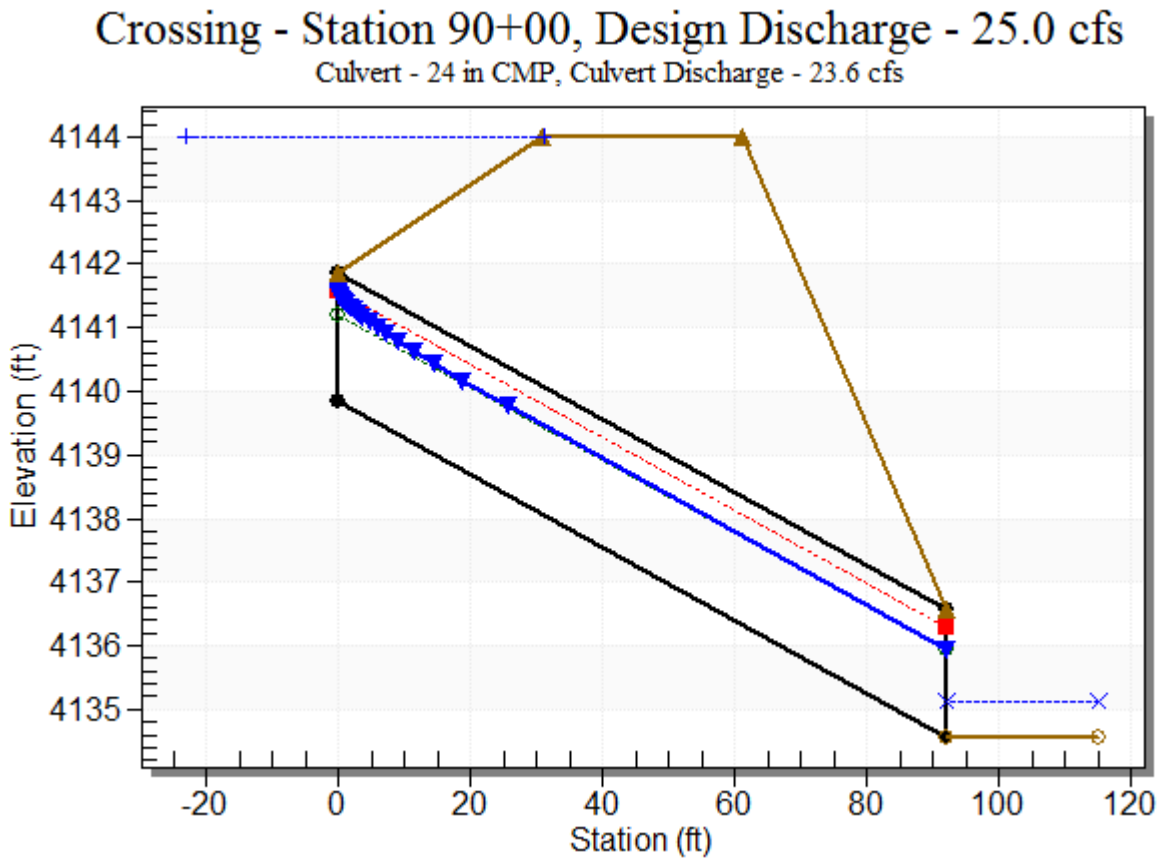
Culvert Length: 92.15 ft, Culvert Slope: 0.0574

****

Culvert Performance Curve Plot: 24 in CMP



Water Surface Profile Plot for Culvert: 24 in CMP



Site Data - 24 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4139.85 ft

Outlet Station: 92.00 ft

Outlet Elevation: 4134.57 ft

Number of Barrels: 1

Culvert Data Summary - 24 in CMP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 27 - Downstream Channel Rating Curve (Crossing: Station 90+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	4134.81	0.24	2.75	0.61	1.13
8.50	4134.89	0.32	3.20	0.81	1.17
12.00	4134.95	0.38	3.52	0.96	1.20
15.50	4135.01	0.44	3.78	1.09	1.22
19.00	4135.05	0.48	4.00	1.21	1.24
22.50	4135.09	0.52	4.18	1.31	1.25
25.00	4135.12	0.55	4.30	1.38	1.26
29.50	4135.17	0.60	4.50	1.49	1.27
33.00	4135.20	0.63	4.63	1.57	1.28
36.50	4135.23	0.66	4.76	1.65	1.29
40.00	4135.26	0.69	4.88	1.72	1.30

Tailwater Channel Data - Station 90+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4134.57 ft

Roadway Data for Crossing: Station 90+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4144.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 144+70

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 14.8 cfs

Design Flow: 35 cfs

Maximum Flow: 57.1 cfs

Table 28 - Summary of Culvert Flows at Crossing: Station 144+70

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4108.33	14.80	14.80	0.00	1
4108.60	19.03	19.03	0.00	1
4108.86	23.26	23.26	0.00	1
4109.11	27.49	27.49	0.00	1
4109.38	31.72	31.72	0.00	1
4109.61	35.00	35.00	0.00	1
4110.00	40.18	40.18	0.00	1
4110.36	44.41	44.41	0.00	1
4110.77	48.64	48.64	0.00	1
4111.21	52.87	52.87	0.00	1
4111.68	57.10	57.10	0.00	1
4118.10	97.76	97.76	0.00	Overtopping

Rating Curve Plot for Crossing: Station 144+70

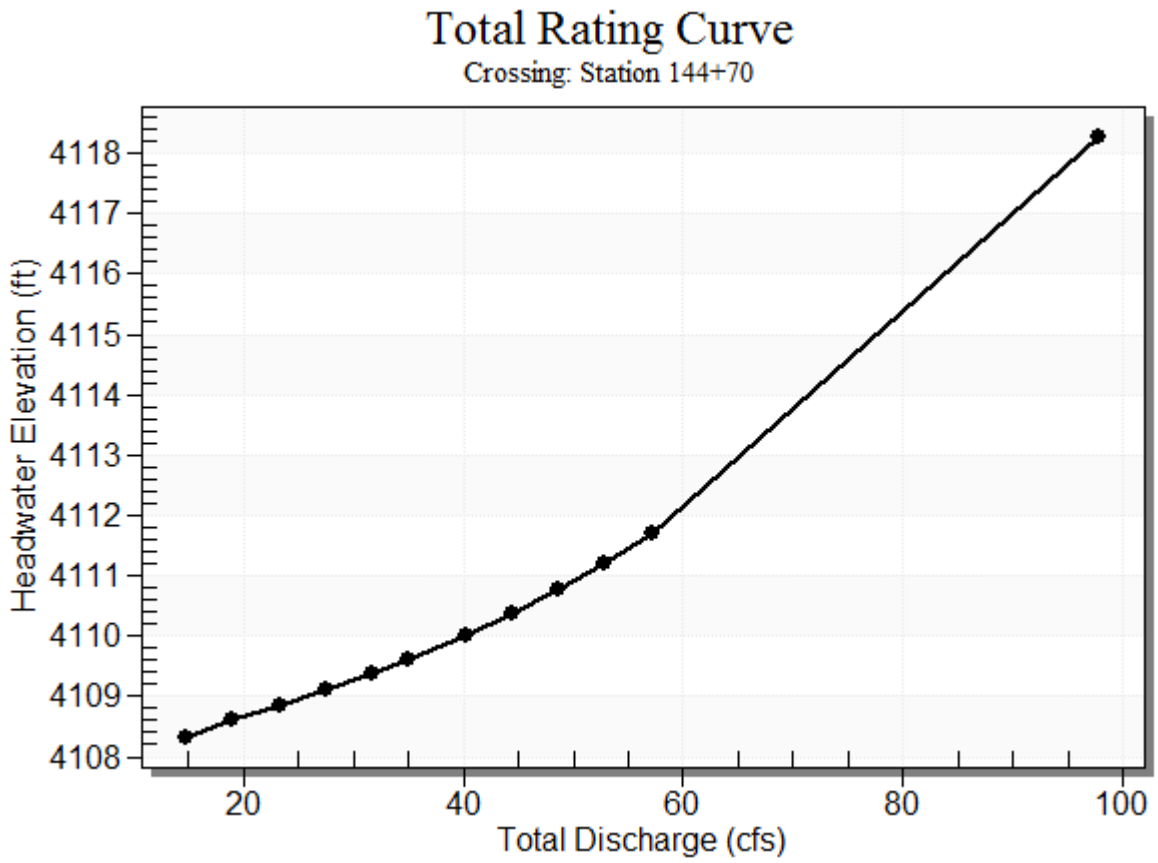


Table 29 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	14.80	14.80	4108.33	2.062	0.0*	1-S2n	0.665	1.222	0.665	0.427	12.559
	19.03	19.03	4108.60	2.333	0.0*	1-S2n	0.762	1.399	0.784	0.484	12.896
	23.26	23.26	4108.86	2.587	0.0*	1-S2n	0.848	1.552	0.848	0.533	14.205
	27.49	27.49	4109.11	2.842	0.0*	1-S2n	0.921	1.692	0.921	0.578	14.868
	31.72	31.72	4109.38	3.111	0.0*	5-S2n	0.994	1.824	0.994	0.619	15.458
	35.00	35.00	4109.61	3.336	0.0*	5-S2n	1.050	1.919	1.050	0.648	15.841
	40.18	40.18	4110.00	3.731	0.0*	5-S2n	1.132	2.062	1.132	0.691	16.485
	44.41	44.41	4110.36	4.094	0.0*	5-S2n	1.194	2.168	1.194	0.724	16.915
	48.64	48.64	4110.77	4.496	0.0*	5-S2n	1.255	2.268	1.255	0.755	17.328
	52.87	52.87	4111.21	4.937	0.0*	5-S2n	1.317	2.360	1.313	0.785	17.765
	57.10	57.10	4111.68	5.415	0.0*	5-S2n	1.378	2.446	1.378	0.813	18.031

* Full Flow Headwater elevation is below inlet invert.

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Straight Culvert

Inlet Elevation (invert): 4106.27 ft, Outlet Elevation (invert): 4088.54 ft

Culvert Length: 134.08 ft, Culvert Slope: 0.1334

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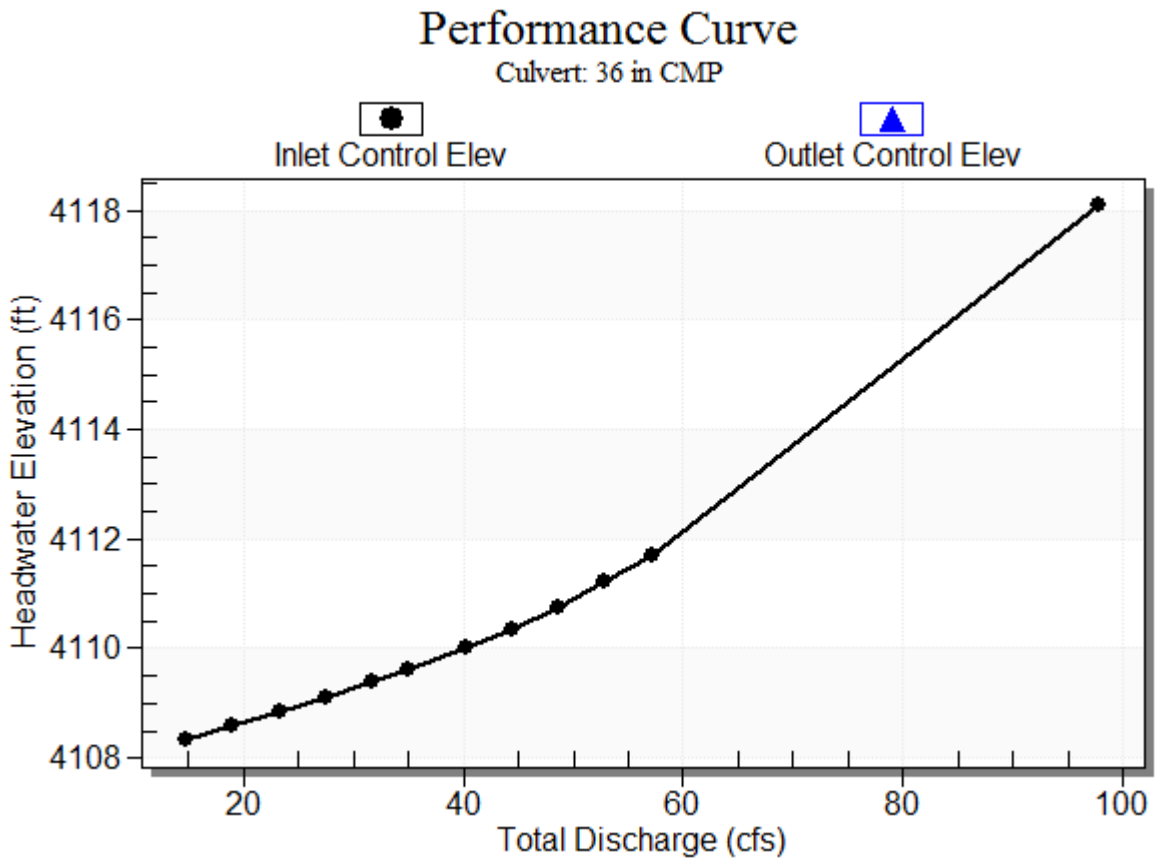
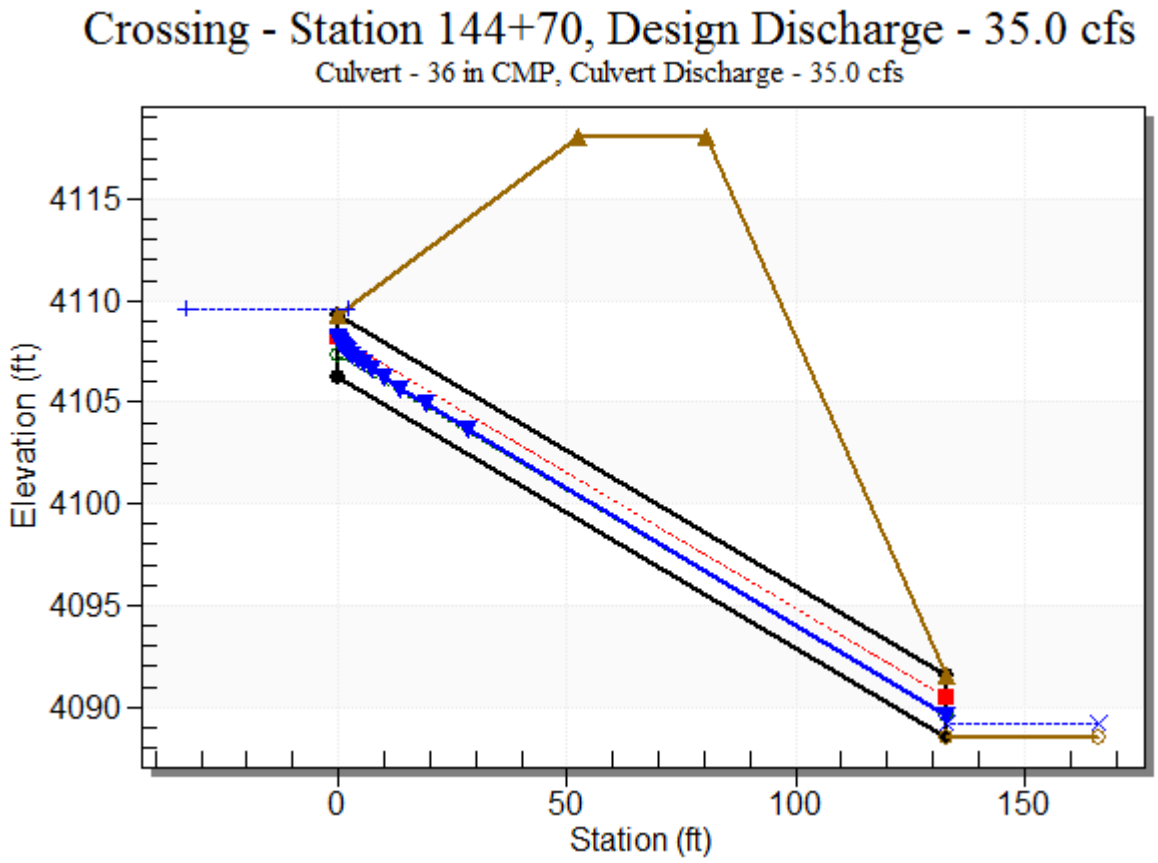
Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4106.27 ft

Outlet Station: 132.90 ft

Outlet Elevation: 4088.54 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 30 - Downstream Channel Rating Curve (Crossing: Station 144+70)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
14.80	4088.97	0.43	3.73	1.07	1.22
19.03	4089.02	0.48	4.00	1.21	1.24
23.26	4089.07	0.53	4.22	1.33	1.25
27.49	4089.12	0.58	4.41	1.44	1.27
31.72	4089.16	0.62	4.59	1.54	1.28
35.00	4089.19	0.65	4.71	1.62	1.29
40.18	4089.23	0.69	4.88	1.73	1.30
44.41	4089.26	0.72	5.01	1.81	1.31
48.64	4089.30	0.76	5.13	1.88	1.32
52.87	4089.32	0.78	5.24	1.96	1.32
57.10	4089.35	0.81	5.35	2.03	1.33

Tailwater Channel Data - Station 144+70

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4088.54 ft

Roadway Data for Crossing: Station 144+70

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4118.10 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Crossing Discharge Data Sta 150+40

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 17.9 cfs

Design Flow: 44 cfs

Maximum Flow: 73.9 cfs

Table 31 - Summary of Culvert Flows at Crossing: Station 150+40

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4112.75	17.90	17.90	0.00	1
4113.09	23.50	23.50	0.00	1
4113.43	29.10	29.10	0.00	1
4113.80	34.70	34.70	0.00	1
4114.23	40.30	40.30	0.00	1
4114.55	44.00	44.00	0.00	1
4115.28	51.50	51.50	0.00	1
4115.90	57.10	57.10	0.00	1
4116.59	62.70	62.70	0.00	1
4117.33	68.30	68.30	0.00	1
4118.11	73.90	73.90	0.00	1
4128.00	122.11	122.11	0.00	Overtopping

Rating Curve Plot for Crossing: Station 150+40

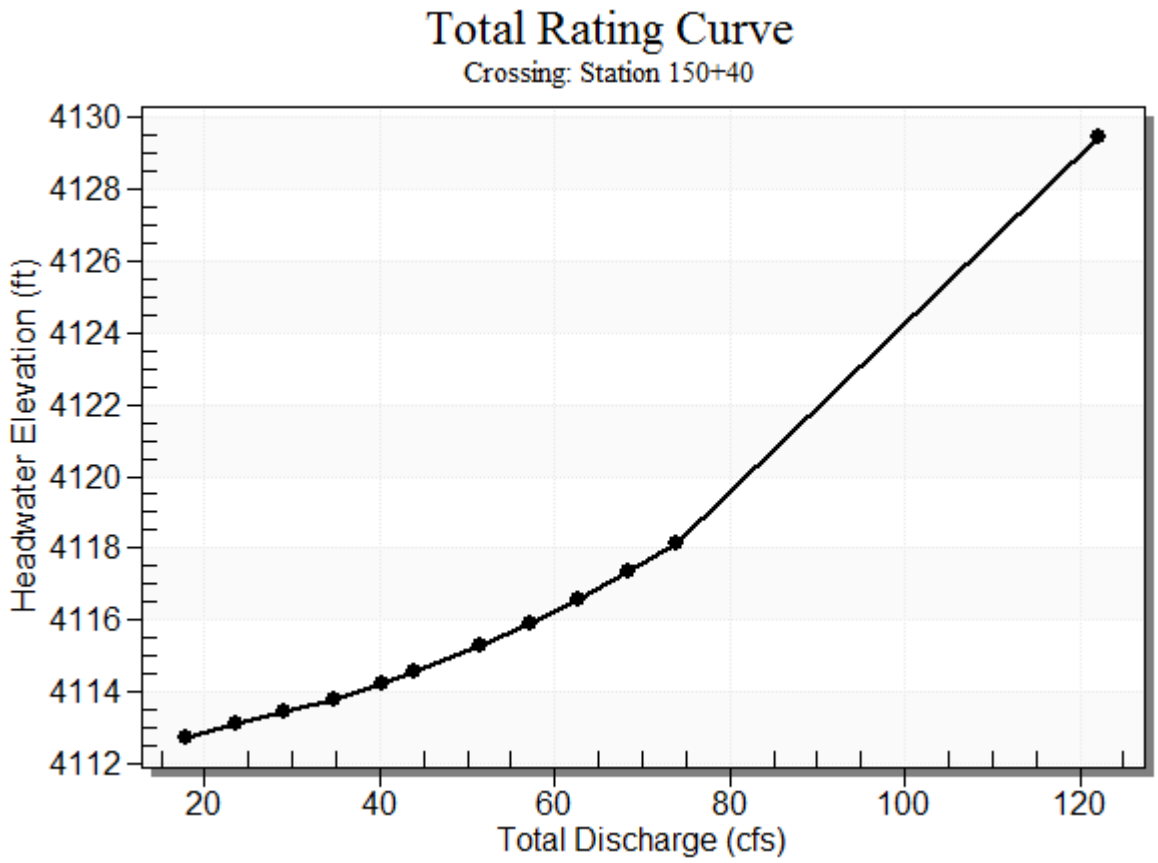


Table 32 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	17.90	17.90	4112.75	2.193	0.0*	1-S2n	0.800	1.354	0.800	0.469	11.814
	23.50	23.50	4113.09	2.531	0.0*	1-S2n	0.916	1.560	0.916	0.536	12.819
	29.10	29.10	4113.43	2.871	0.0*	1-S2n	1.027	1.742	1.027	0.594	13.573
	34.70	34.70	4113.80	3.244	0.0*	5-S2n	1.131	1.910	1.131	0.645	14.254
	40.30	40.30	4114.23	3.670	0.0*	5-S2n	1.225	2.065	1.218	0.692	14.946
	44.00	44.00	4114.55	3.987	0.0*	5-S2n	1.288	2.158	1.288	0.721	15.160
	51.50	51.50	4115.28	4.719	0.0*	5-S2n	1.410	2.331	1.410	0.775	15.785
	57.10	57.10	4115.90	5.344	0.0*	5-S2n	1.497	2.446	1.497	0.813	16.199
	62.70	62.70	4116.59	6.030	0.0*	5-S2n	1.584	2.547	1.584	0.848	16.567
	68.30	68.30	4117.33	6.768	0.0*	5-S2n	1.670	2.634	1.670	0.882	16.892
	73.90	73.90	4118.11	7.549	0.0*	5-S2n	1.756	2.706	1.756	0.914	17.209

* Full Flow Headwater elevation is below inlet invert.

****

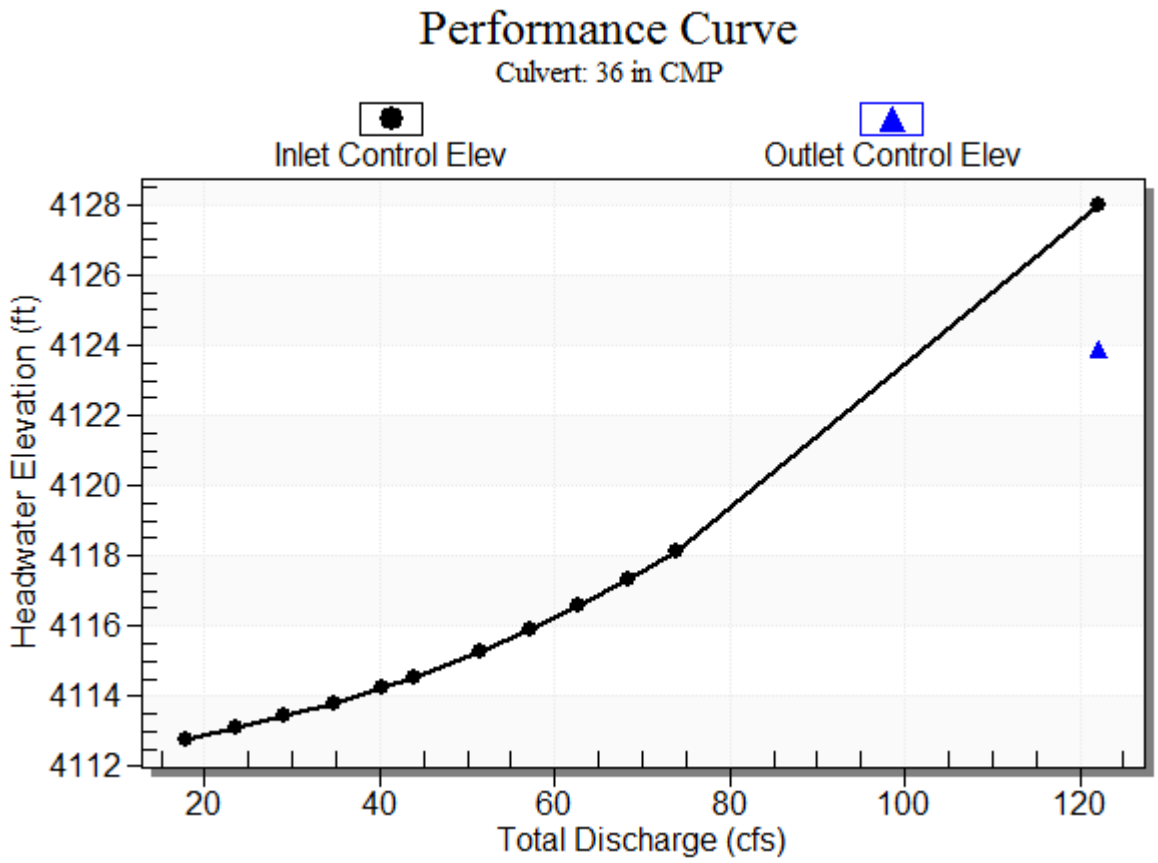
Straight Culvert

Inlet Elevation (invert): 4110.56 ft, Outlet Elevation (invert): 4093.34 ft

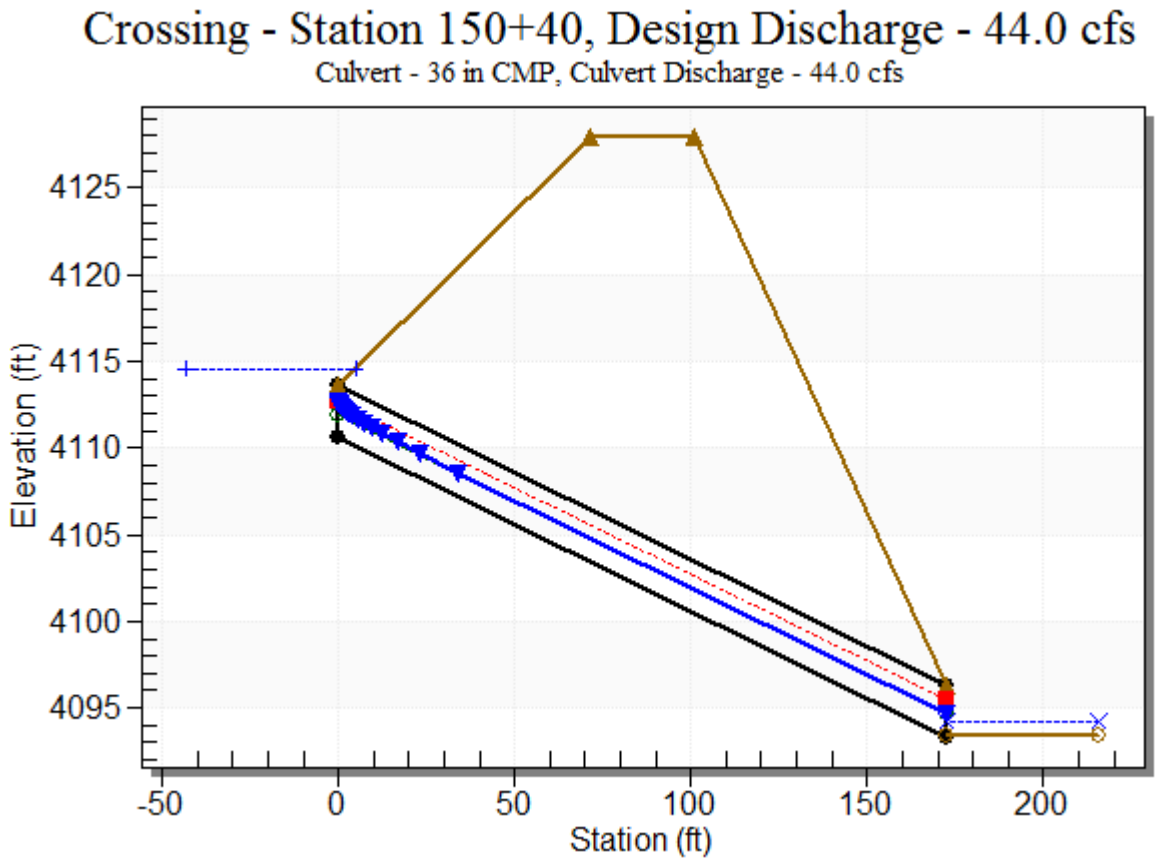
Culvert Length: 173.31 ft, Culvert Slope: 0.0999

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4110.56 ft

Outlet Station: 172.45 ft

Outlet Elevation: 4093.34 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 33 - Downstream Channel Rating Curve (Crossing: Station 150+40)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
17.90	4093.91	0.47	3.93	1.17	1.23
23.50	4093.98	0.54	4.23	1.34	1.26
29.10	4094.03	0.59	4.48	1.48	1.27
34.70	4094.09	0.65	4.70	1.61	1.29
40.30	4094.13	0.69	4.89	1.73	1.30
44.00	4094.16	0.72	5.00	1.80	1.31
51.50	4094.22	0.78	5.21	1.94	1.32
57.10	4094.25	0.81	5.35	2.03	1.33
62.70	4094.29	0.85	5.48	2.12	1.34
68.30	4094.32	0.88	5.60	2.20	1.35
73.90	4094.35	0.91	5.72	2.28	1.35

Tailwater Channel Data - Station 150+40

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4093.44 ft

Roadway Data for Crossing: Station 150+40

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4128.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

Crossing Discharge Data Sta 154+20

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 35.2 cfs

Design Flow: 95 cfs

Maximum Flow: 167.4 cfs

Table 34 - Summary of Culvert Flows at Crossing: Station 154+20

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4131.46	35.20	35.20	0.00	1
4132.59	48.42	48.42	0.00	1
4134.08	61.64	61.64	0.00	1
4135.87	74.86	74.86	0.00	1
4136.06	88.08	76.19	11.62	11
4136.08	95.00	76.33	18.15	4
4136.13	114.52	76.68	37.32	4
4136.16	127.74	76.88	50.69	4
4136.19	140.96	77.06	63.46	3
4136.21	154.18	77.22	76.62	3
4136.24	167.40	77.38	89.80	3
4136.00	75.76	75.76	0.00	Overtopping

Rating Curve Plot for Crossing: Station 154+20

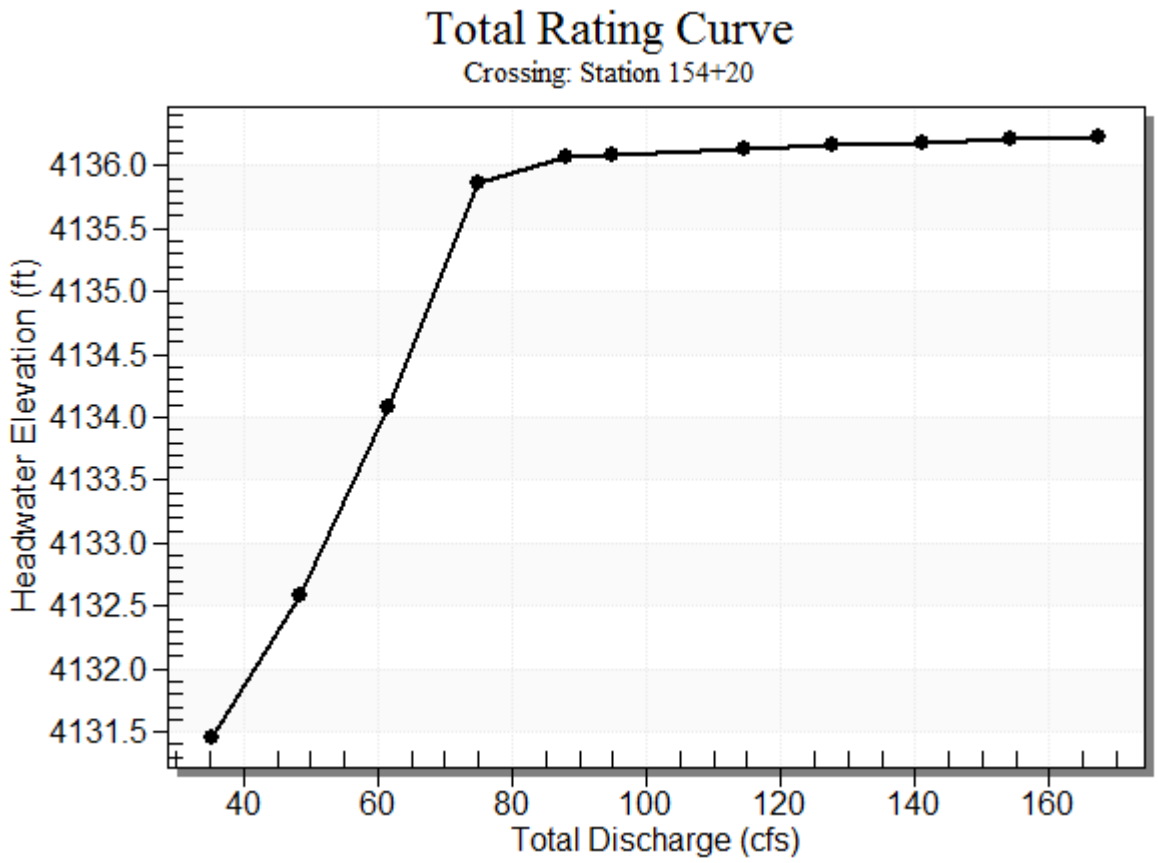


Table 35 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	35.20	35.20	4131.46	3.403	0.0*	5-S2n	1.004	1.924	1.004	0.650	16.922
	48.42	48.42	4132.59	4.526	0.0*	5-S2n	1.194	2.263	1.194	0.754	18.434
	61.64	61.64	4134.08	6.019	0.0*	5-S2n	1.370	2.529	1.396	0.842	19.143
	74.86	74.86	4135.87	7.809	0.0*	5-S2n	1.533	2.717	1.567	0.919	20.049
	88.08	76.19	4136.06	8.001	0.0*	5-S2n	1.549	2.733	1.582	0.989	20.151
	95.00	76.33	4136.08	8.022	0.0*	5-S2n	1.551	2.734	1.584	1.022	20.163
	114.52	76.68	4136.13	8.073	0.0*	5-S2n	1.555	2.738	1.588	1.111	20.194
	127.74	76.88	4136.16	8.102	0.0*	5-S2n	1.558	2.740	1.590	1.165	20.213
	140.96	77.06	4136.19	8.128	0.0*	5-S2n	1.560	2.742	1.592	1.216	20.229
	154.18	77.22	4136.21	8.152	0.0*	5-S2n	1.562	2.744	1.593	1.265	20.246
	167.40	77.38	4136.24	8.175	0.0*	5-S2n	1.564	2.745	1.595	1.311	20.260

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 4128.06 ft, Outlet Elevation (invert): 4116.34 ft

Culvert Length: 74.92 ft, Culvert Slope: 0.1584

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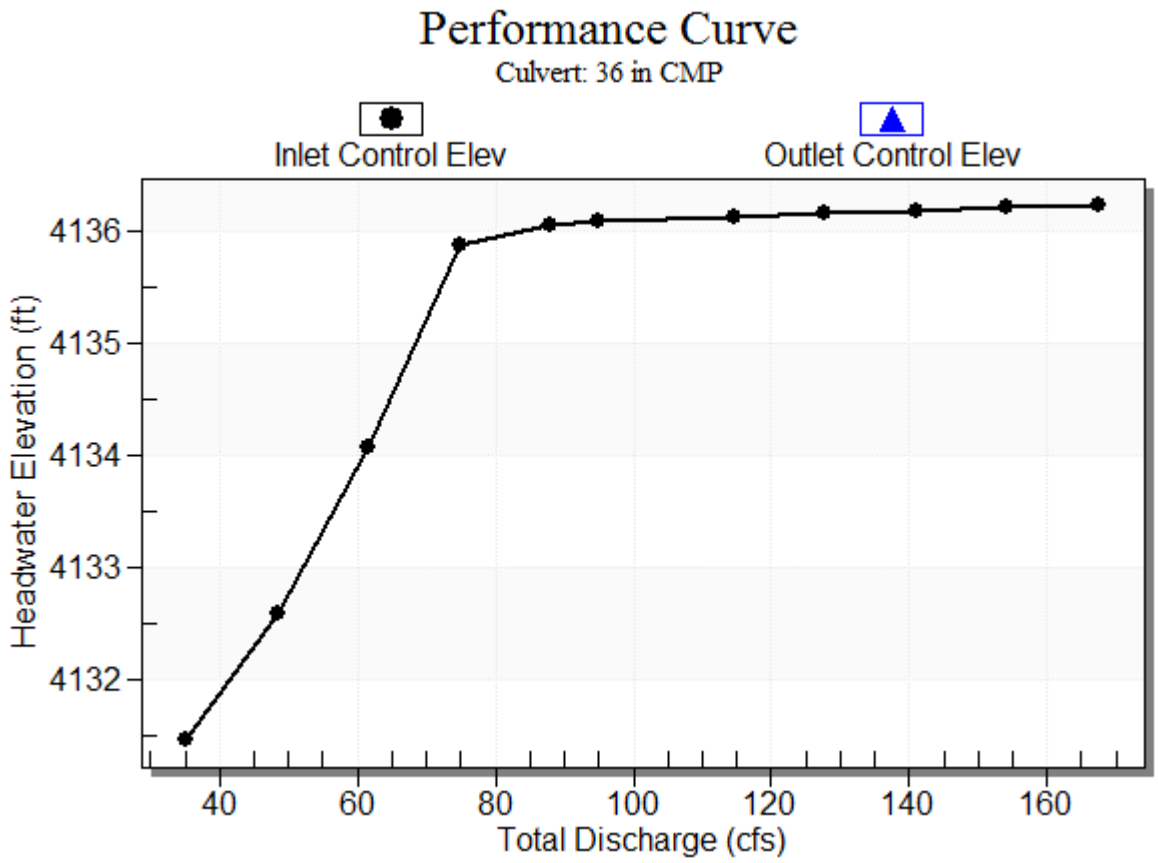
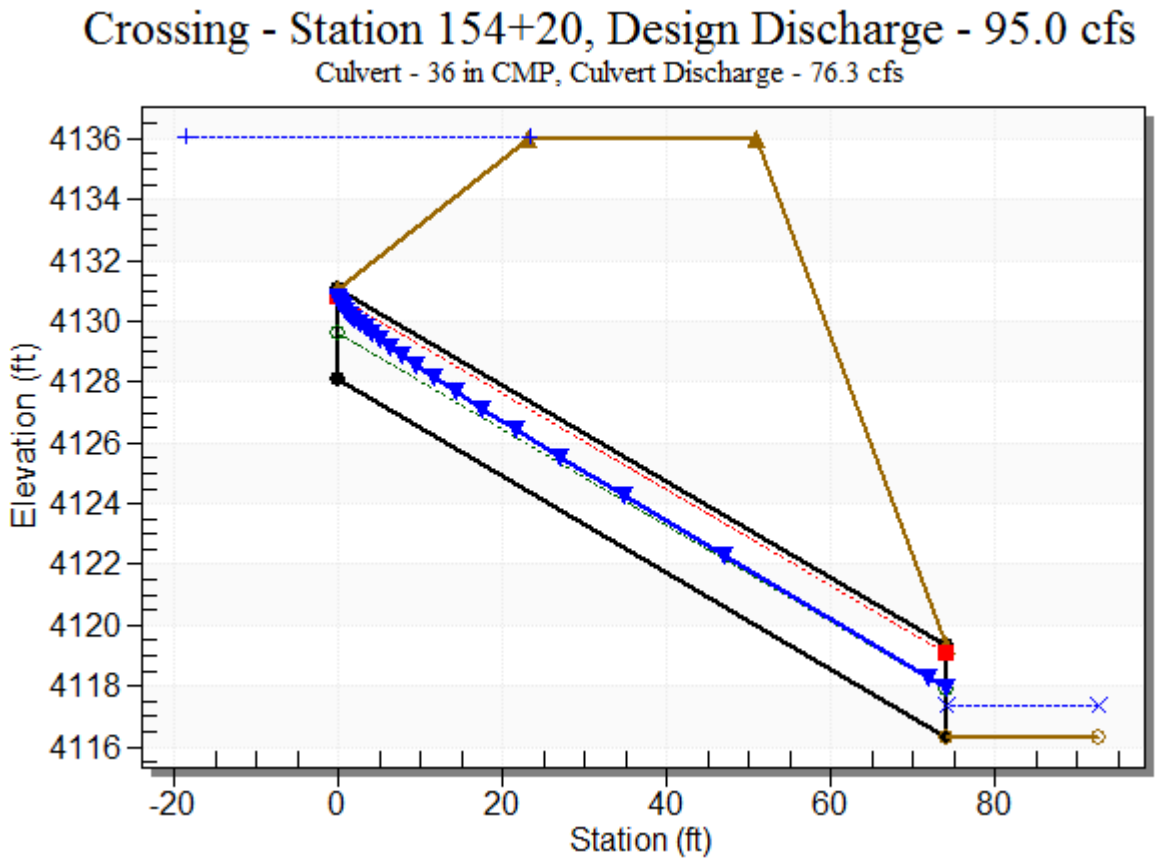
Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4128.06 ft

Outlet Station: 74.00 ft

Outlet Elevation: 4116.34 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 36 - Downstream Channel Rating Curve (Crossing: Station 154+20)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
35.20	4116.99	0.65	4.71	1.62	1.29
48.42	4117.09	0.75	5.12	1.88	1.32
61.64	4117.18	0.84	5.46	2.10	1.34
74.86	4117.26	0.92	5.74	2.29	1.35
88.08	4117.33	0.99	5.99	2.47	1.37
95.00	4117.36	1.02	6.10	2.55	1.38
114.52	4117.45	1.11	6.40	2.77	1.39
127.74	4117.51	1.17	6.58	2.91	1.40
140.96	4117.56	1.22	6.75	3.04	1.41
154.18	4117.60	1.26	6.91	3.16	1.42
167.40	4117.65	1.31	7.05	3.27	1.43

Tailwater Channel Data - Station 154+20

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4116.34 ft

Roadway Data for Crossing: Station 154+20

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4136.00 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Crossing Discharge Data Sta 170+50

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 28.9 cfs

Design Flow: 79 cfs

Maximum Flow: 139.2 cfs

Table 37 - Summary of Culvert Flows at Crossing: Station 170+50

Headwater Elevation (ft)	Total Discharge (cfs)	36 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4288.90	28.90	28.90	0.00	1
4289.68	39.93	39.93	0.00	1
4290.70	50.96	50.96	0.00	1
4291.98	61.99	61.99	0.00	1
4293.46	73.02	73.02	0.00	1
4294.33	79.00	79.00	0.00	1
4297.23	95.08	95.08	0.00	1
4298.04	106.11	98.96	6.82	20
4298.08	117.14	99.14	17.71	5
4298.11	128.17	99.28	28.57	4
4298.14	139.20	99.41	39.63	4
4298.00	98.76	98.76	0.00	Overtopping

Rating Curve Plot for Crossing: Station 170+50

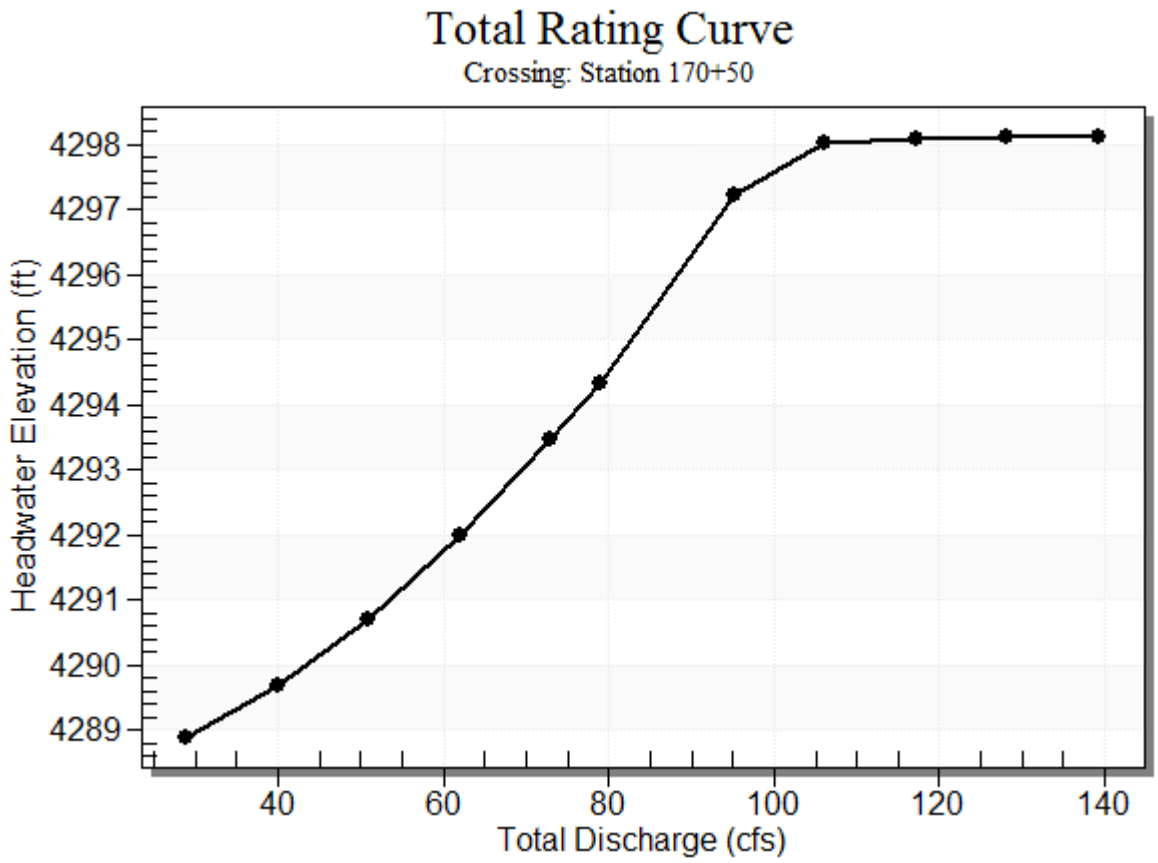


Table 38 - Culvert Summary Table: 36 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	28.90	28.90	4288.90	2.909	0.0*	1-S2n	0.964	1.736	0.964	0.592	14.674
	39.93	39.93	4289.68	3.690	0.0*	5-S2n	1.151	2.055	1.151	0.689	15.982
	50.96	50.96	4290.70	4.713	0.0*	5-S2n	1.318	2.319	1.318	0.772	17.043
	61.99	61.99	4291.98	5.990	0.0*	5-S2n	1.475	2.535	1.475	0.844	17.923
	73.02	73.02	4293.46	7.474	0.0*	5-S2n	1.628	2.696	1.628	0.909	18.635
	79.00	79.00	4294.33	8.341	0.0*	5-S2n	1.711	2.761	1.711	0.942	18.984
	95.08	95.08	4297.23	11.241	0.456	5-S2n	1.933	2.808	1.933	1.023	19.737
	106.11	98.96	4298.04	12.053	1.575	5-S2n	1.990	2.713	1.990	1.074	19.900
	117.14	99.14	4298.08	12.091	1.628	5-S2n	1.993	2.710	1.993	1.122	19.906
	128.17	99.28	4298.11	12.122	1.670	5-S2n	1.995	2.707	1.995	1.167	19.911
	139.20	99.41	4298.14	12.148	1.706	5-S2n	1.997	2.703	1.997	1.210	19.916

* Full Flow Headwater elevation is below inlet invert.

****

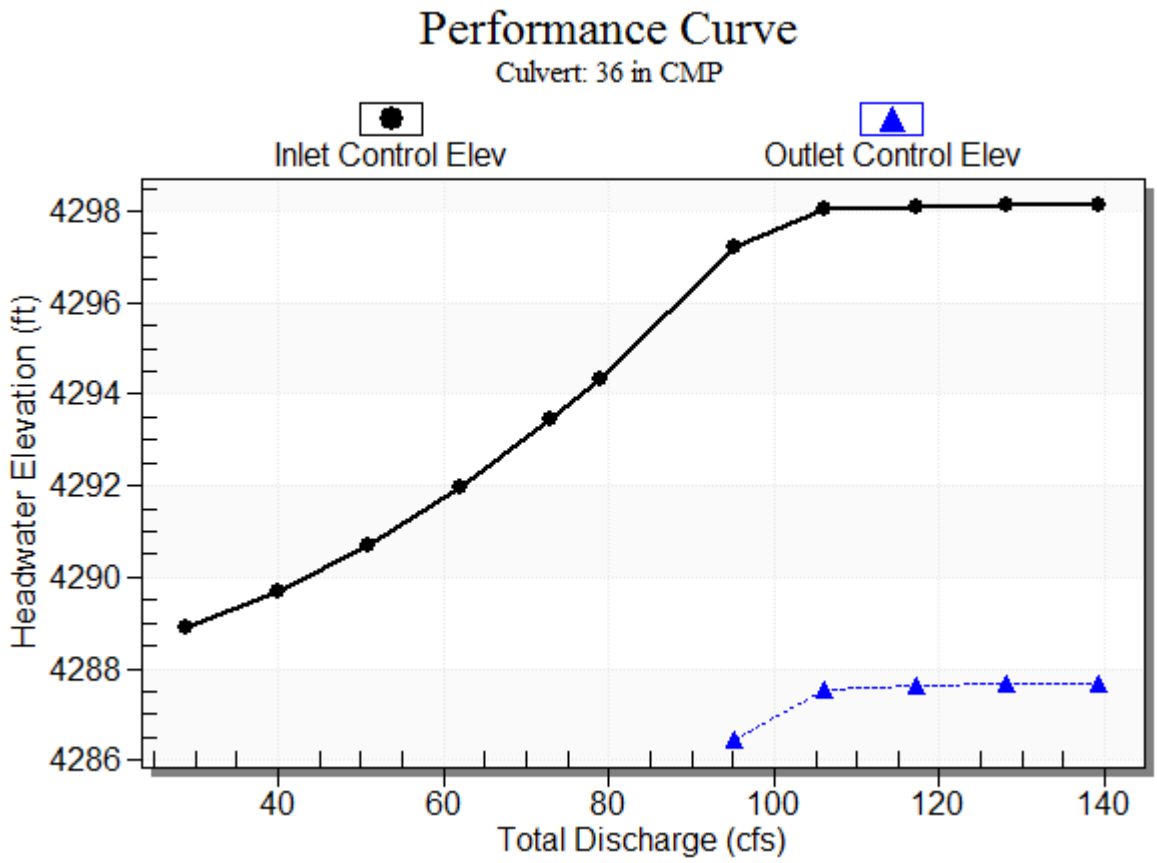
Straight Culvert

Inlet Elevation (invert): 4285.99 ft, Outlet Elevation (invert): 4269.55 ft

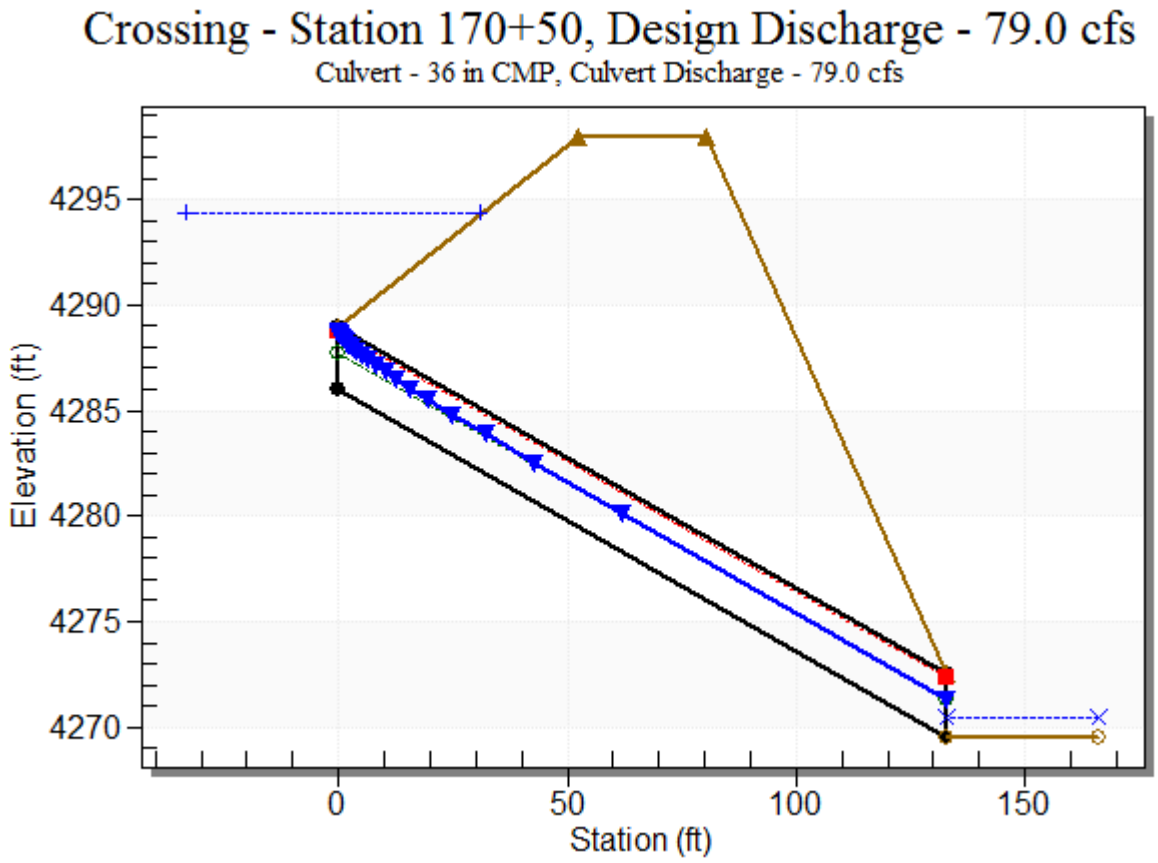
Culvert Length: 133.81 ft, Culvert Slope: 0.1238

****

Culvert Performance Curve Plot: 36 in CMP



Water Surface Profile Plot for Culvert: 36 in CMP



Site Data - 36 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4285.99 ft

Outlet Station: 132.80 ft

Outlet Elevation: 4269.55 ft

Number of Barrels: 1

Culvert Data Summary - 36 in CMP

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 39 - Downstream Channel Rating Curve (Crossing: Station 170+50)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
28.90	4270.14	0.59	4.47	1.48	1.27
39.93	4270.24	0.69	4.87	1.72	1.30
50.96	4270.32	0.77	5.19	1.93	1.32
61.99	4270.39	0.84	5.47	2.11	1.34
73.02	4270.46	0.91	5.70	2.27	1.35
79.00	4270.49	0.94	5.82	2.35	1.36
95.08	4270.57	1.02	6.10	2.55	1.38
106.11	4270.62	1.07	6.28	2.68	1.38
117.14	4270.67	1.12	6.44	2.80	1.39
128.17	4270.72	1.17	6.59	2.91	1.40
139.20	4270.76	1.21	6.73	3.02	1.41

Tailwater Channel Data - Station 170+50

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4269.55 ft

Roadway Data for Crossing: Station 170+50

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4298.00 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Crossing Discharge Data Sta 182+00

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 128 cfs

Design Flow: 326 cfs

Maximum Flow: 559.8 cfs

Table 40 - Summary of Culvert Flows at Crossing: Station 182+00

Headwater Elevation (ft)	Total Discharge (cfs)	84 in CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4324.09	128.00	128.00	0.00	1
4324.85	171.18	171.18	0.00	1
4325.57	214.36	214.36	0.00	1
4326.32	257.54	257.54	0.00	1
4327.16	300.72	300.72	0.00	1
4327.70	326.00	326.00	0.00	1
4329.20	387.08	387.08	0.00	1
4330.42	430.26	430.26	0.00	1
4331.77	473.44	473.44	0.00	1
4333.24	516.62	516.62	0.00	1
4334.83	559.80	559.80	0.00	1
4344.00	764.40	764.40	0.00	Overtopping

Rating Curve Plot for Crossing: Station 182+00

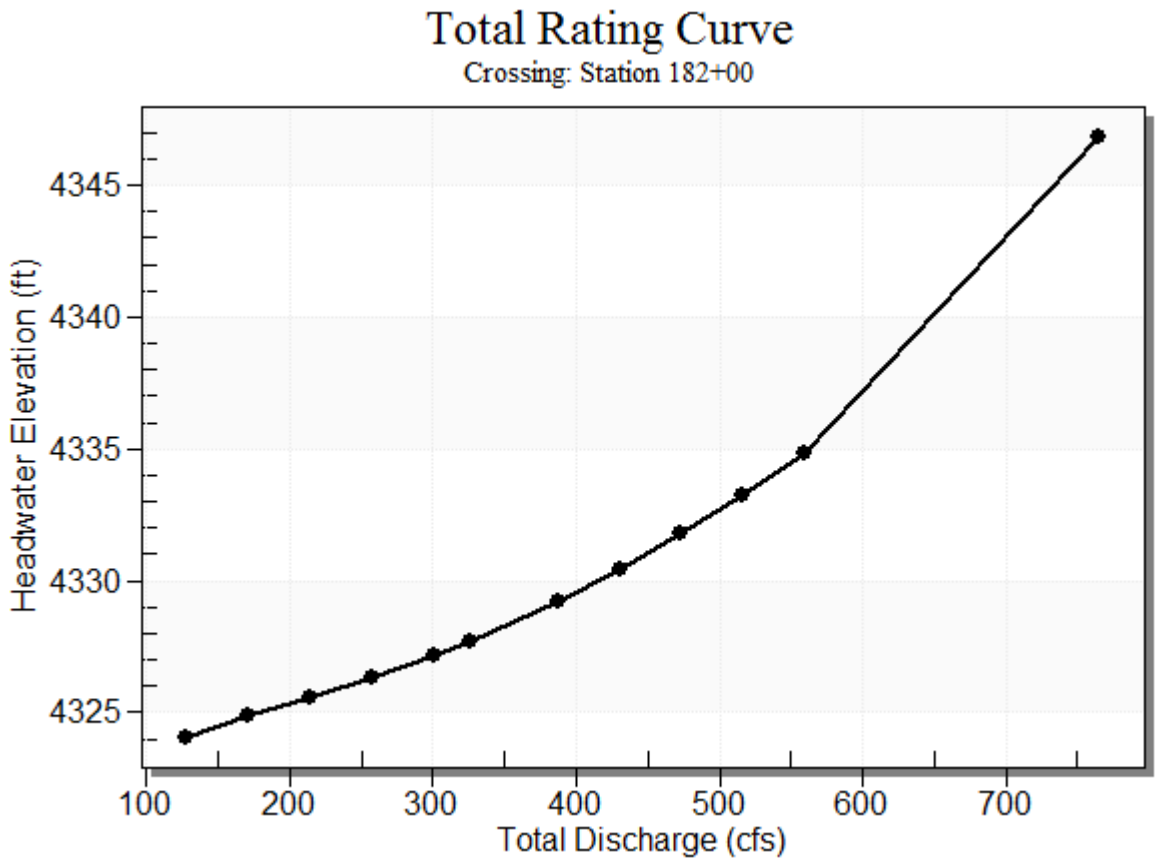


Table 41 - Culvert Summary Table: 84 in CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
	128.00	128.00	4324.09	4.926	0.0*	1-S2n	1.465	2.917	1.465	1.166	21.689
	171.18	171.18	4324.85	5.686	0.0*	1-S2n	1.700	3.400	1.700	1.323	23.508
	214.36	214.36	4325.57	6.409	0.0*	1-S2n	1.930	3.820	1.933	1.458	24.809
	257.54	257.54	4326.32	7.164	0.0*	5-S2n	2.108	4.204	2.146	1.576	25.635
	300.72	300.72	4327.16	8.001	0.0*	5-S2n	2.286	4.558	2.286	1.683	27.453
	326.00	326.00	4327.70	8.543	0.0*	5-S2n	2.390	4.751	2.402	1.741	27.846
	387.08	387.08	4329.20	10.036	0.0*	5-S2n	2.627	5.183	2.642	1.871	29.086
	430.26	430.26	4330.42	11.256	0.0*	5-S2n	2.778	5.456	2.778	1.956	30.209
	473.44	473.44	4331.77	12.609	0.0*	5-S2n	2.929	5.702	2.929	2.035	30.985
	516.62	516.62	4333.24	14.084	0.0*	5-S2n	3.080	5.922	3.116	2.110	31.182
	559.80	559.80	4334.83	15.666	0.0*	5-S2n	3.227	6.112	3.260	2.181	31.866

* Full Flow Headwater elevation is below inlet invert.

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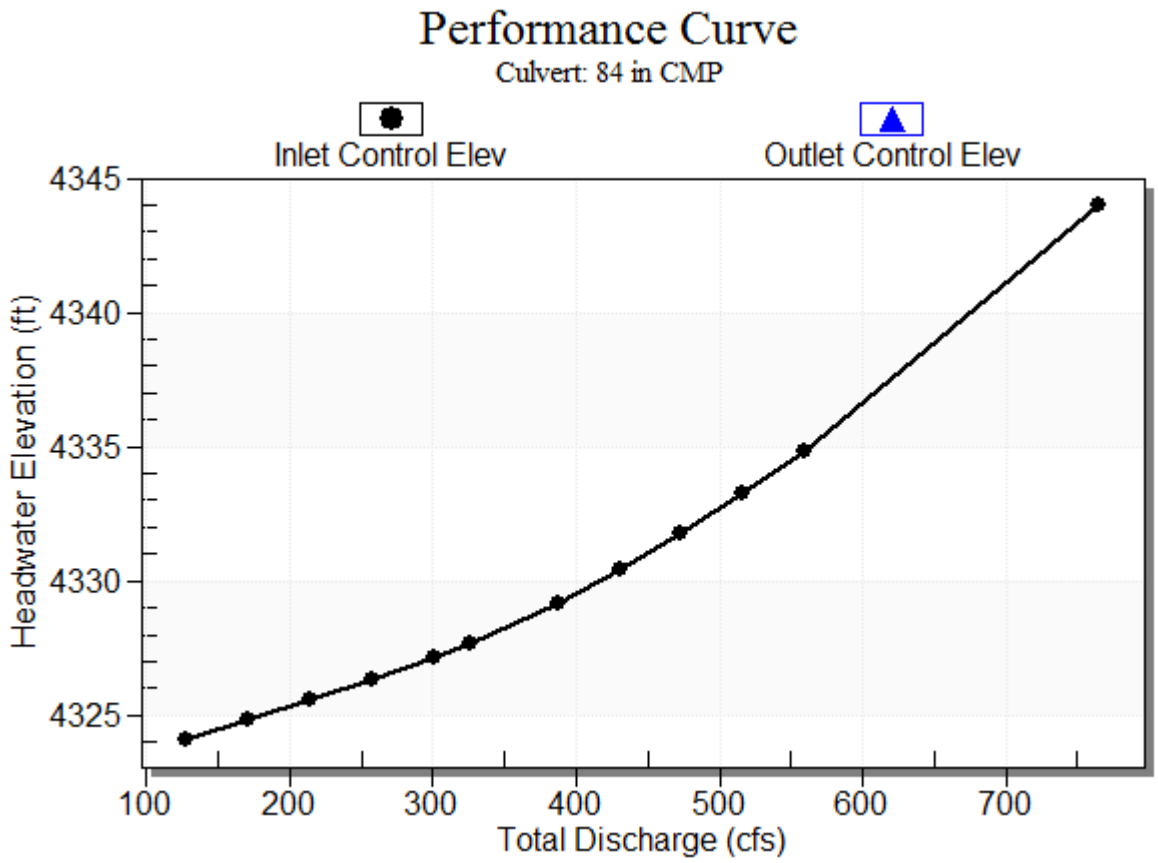
Straight Culvert

Inlet Elevation (invert): 4319.16 ft, Outlet Elevation (invert): 4278.92 ft

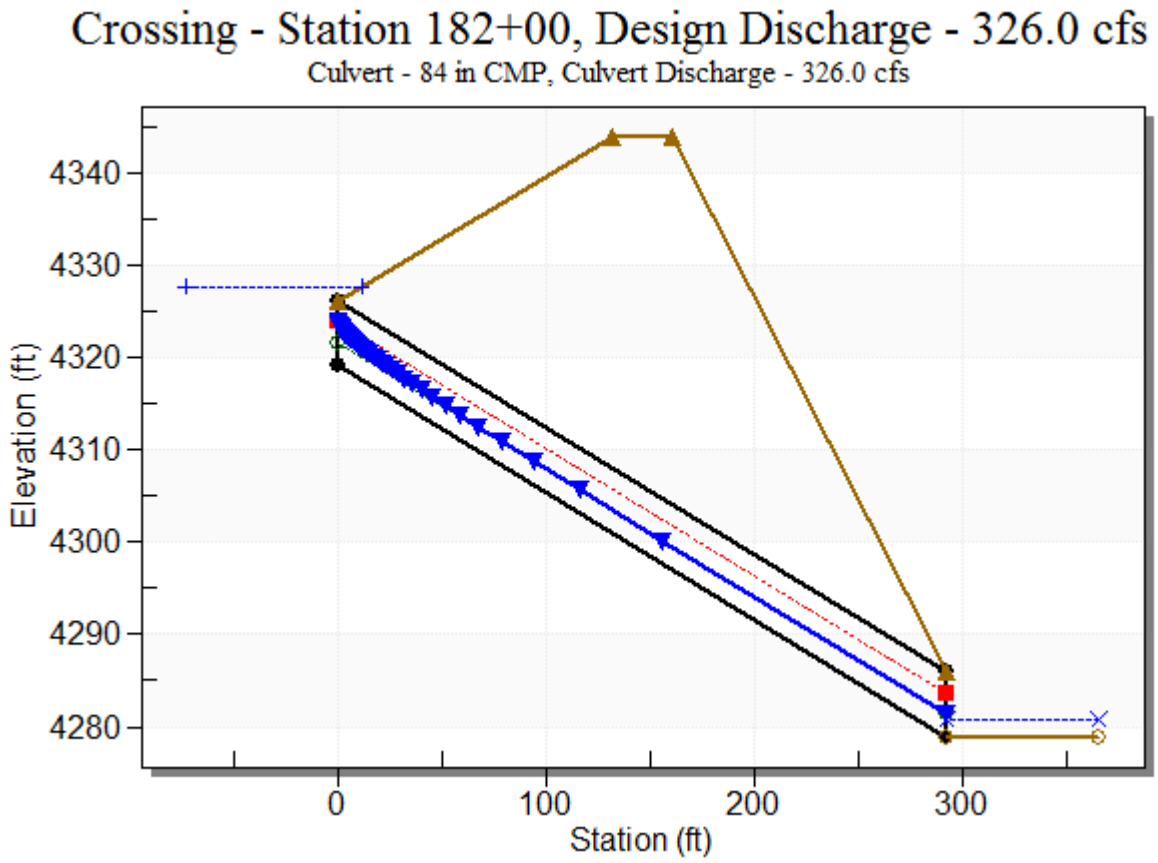
Culvert Length: 294.66 ft, Culvert Slope: 0.1379

****

Culvert Performance Curve Plot: 84 in CMP



Water Surface Profile Plot for Culvert: 84 in CMP



Site Data - 84 in CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 4319.16 ft

Outlet Station: 291.90 ft

Outlet Elevation: 4278.92 ft

Number of Barrels: 1

Culvert Data Summary - 84 in CMP

Barrel Shape: Circular

Barrel Diameter: 7.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: NONE

Table 42 - Downstream Channel Rating Curve (Crossing: Station 182+00)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
128.00	4280.09	1.17	6.59	2.91	1.40
171.18	4280.24	1.32	7.09	3.30	1.43
214.36	4280.38	1.46	7.51	3.64	1.45
257.54	4280.50	1.58	7.87	3.93	1.47
300.72	4280.60	1.68	8.18	4.20	1.48
326.00	4280.66	1.74	8.35	4.35	1.49
387.08	4280.79	1.87	8.72	4.67	1.50
430.26	4280.88	1.96	8.96	4.88	1.51
473.44	4280.95	2.03	9.18	5.08	1.52
516.62	4281.03	2.11	9.38	5.27	1.53
559.80	4281.10	2.18	9.57	5.44	1.54

Tailwater Channel Data - Station 182+00

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 5.00 ft

Side Slope (H:V): 10.00 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0350

Channel Invert Elevation: 4278.92 ft

Roadway Data for Crossing: Station 182+00

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 4344.00 ft

Roadway Surface: Gravel

Roadway Top Width: 28.00 ft

Appendix B – Culvert Riprap Calculations

Several relationships have been proposed for riprap sizing for culvert aprons and several of these are discussed in greater detail in Appendix D. The independent variables in these relationships include one or more of the following variables: outlet velocity, rock specific gravity, pipe dimension (e.g. diameter), outlet Froude number, and tailwater. The following equation (Fletcher and Grace, 1972) is recommended for circular culverts:

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right) \tag{10.4}$$

where,

D_{50}	=	riprap size, m (ft)
Q	=	design discharge, m^3/s (ft^3/s)
D	=	culvert diameter (circular), m (ft)
TW	=	tailwater depth, m (ft)
g	=	acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

Tailwater depth for Equation 10.4 should be limited to between 0.4D and 1.0D. If tailwater is unknown, use 0.4D.

Whenever the flow is supercritical in the culvert, the culvert diameter is adjusted as follows:

$$D' = \frac{D + y_n}{2} \tag{10.5}$$

where,

D'	=	adjusted culvert rise, m (ft)
y_n	=	normal (supercritical) depth in the culvert, m (ft)

Equation 10.4 assumes that the rock specific gravity is 2.65. If the actual specific gravity differs significantly from this value, the D_{50} should be adjusted inversely to specific gravity.

White Knob Haul Road
Riprap Apron Design
Method from HEC 14 by FHWA

Station 17+70

Q	25	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.19	
Yn	1.68	Ft
D'	1.84	
D_{50}	0.80	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 19+00

Q	112	cfs
D	4	Ft
TW	1.6	Ft
Froude	1.95	
Yn	1.92	Ft
D'	2.96	
D_{50}	1.57	

Use Class 5 Apron.
Apron Length = 7D = 28 Ft.

Station 43+50

Q	25	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.13	
Yn	1.6	Ft
D'	1.8	
D_{50}	0.82	

Use Class 3 Apron.
Apron Length = 5D = 10 Ft.

Station 49+35

Q	62	cfs
D	3	Ft
TW	1.2	Ft
Froude	1.75	
Yn	1.84	Ft
D'	2.42	
D_{50}	1.24	

Use Class 5 Apron.
Apron Length = 7D = 21 Ft.

Station 54+35

Q	62	cfs
D	3	Ft
TW	1.2	Ft
Froude	1.71	
Yn	1.4	Ft
D'	2.2	
D_{50}	1.41	

Use Class 5 Apron.
Apron Length = 7D = 21 Ft.

Station 57+75

Q	112	cfs
D	4	Ft
TW	1.6	Ft
Froude	1.03	
Yn	3.19	Ft
D'	3.595	
D_{50}	1.21	

Use Class 5 Apron.
Apron Length = 7D = 28 Ft.

White Knob Haul Road
Riprap Apron Design
Method from HEC 14 by FHWA

Station 62+30

Q	25	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.32	
Yn	1.55	Ft
D'	1.775	
D_{50}	0.84	

Use Class 4 Apron.
Apron Length = 6D = 12 Ft.

Station 88+15

Q	25	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.64	
Yn	1.37	Ft
D'	1.685	
D_{50}	0.90	

Use Class 4 Apron.
Apron Length = 6D = 12 Ft.

Station 90+00

Q	25	cfs
D	2	Ft
TW	0.8	Ft
Froude	1.57	
Yn	1.36	Ft
D'	1.68	
D_{50}	0.90	

Use Class 4 Apron.
Apron Length = 6D = 12 Ft.

Station 144+70

Q	35	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.72	
Yn	1.05	Ft
D'	2.025	
D_{50}	0.74	

Use Class 3 Apron.
Apron Length = 5D = 15 Ft.

White Knob Haul Road
Riprap Apron Design
Method from HEC 14 by FHWA

Station 150+40

Q	44	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.35	
Yn	1.29	Ft
D'	2.145	
D_{50}	0.92	

Use Class 4 Apron.
Apron Length = 6D = 18 Ft.

Station 154+20

Q	95	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.82	
Yn	1.58	Ft
D'	2.29	
D_{50}	2.36	

Use Class 6 Apron.
Apron Length = 8D = 24 Ft.

Station 170+50

Q	79	cfs
D	3	Ft
TW	1.2	Ft
Froude	2.56	
Yn	1.71	Ft
D'	2.355	
D_{50}	1.78	

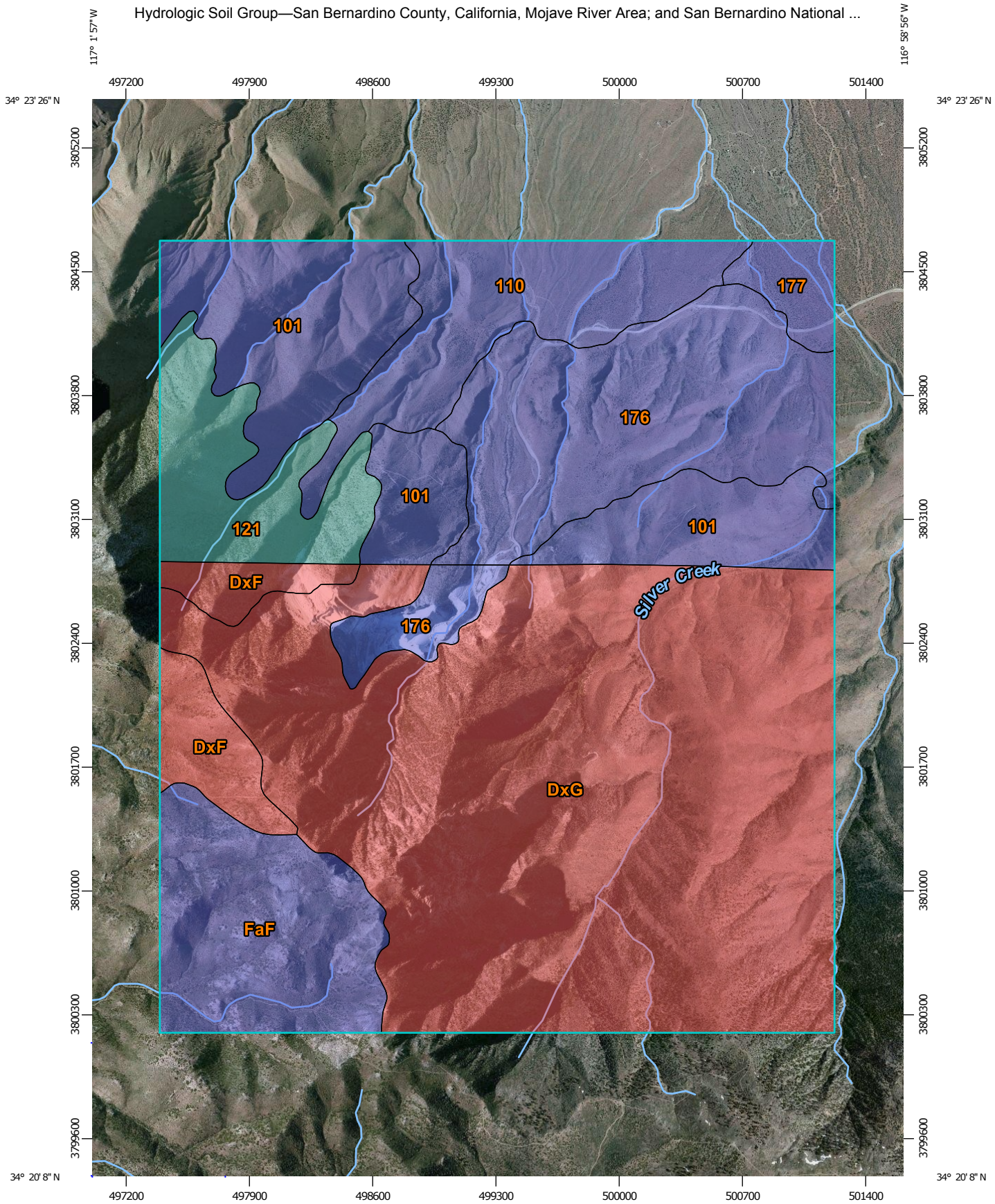
Use Class 6 Apron.
Apron Length = 8D = 24 Ft.

Station 182+00

Q	326	cfs
D	7	Ft
TW	2.8	Ft
Froude	3.17	
Yn	2.4	Ft
D'	4.7	
D_{50}	2.01	

Use Class 6 Apron.
Apron Length = 8D = 56 Ft.

Appendix C – NRCS Web Soil Survey



Map Scale: 1:29,700 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 5, Sep 26, 2008

Soil Survey Area: San Bernardino National Forest Area, California
Survey Area Data: Version 5, Sep 1, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2001—Jul 3, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Bernardino County, California, Mojave River Area (CA671)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
101	ARRASTRE-ROCK OUTCROP COMPLEX, 30 TO 50 PERCENT SLOPES*	B	580.9	13.7%
110	BRYMAN-CAJON ASSOCIATION, ROLLING*	B	313.1	7.4%
121	CRAFTON-SHEEPHEAD-ROCK OUTCROP ASSOCIATION, STEEP*	C	243.9	5.7%
176	YERMO GRAVELLY SANDY LOAM, 30 TO 50 PERCENT SLOPES	B	539.2	12.7%
177	YERMO-KIMBERLINA, COOL, ASSOCIATION, SLOPING*	B	64.0	1.5%
Subtotals for Soil Survey Area			**1,741.2**	**40.9%**
Totals for Area of Interest			**4,255.1**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — San Bernardino National Forest Area, California (CA777)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
176	Yermo gravelly sandy loam, 30 to 50 percent slopes	B	75.3	1.8%
DxF	Wapi-Pacifico families, dry-Rock outcrop complex, 30 to 50 percent slopes	D	155.3	3.7%
DxG	Wapi-Pacifico families, dry-Rock outcrop complex, 50 to 75 percent slopes	D	1,926.9	45.3%
FaF	Olete-Goulding families. association, 30 to 50 percent slopes	B	356.3	8.4%
Subtotals for Soil Survey Area			**2,513.9**	**59.1%**
Totals for Area of Interest			**4,255.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher