Appendix 7-4
Lila Canyon Mine
Sedimentation and Drainage Control Plan

Revised
January 2001
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SEDIMENTATION AND DRAINAGE CONTROL PLAN

TABLE OF CONTENTS

Section **Page Number**

1- Introduction: . . . . . Page -1-

2- Design of Drainage Control Structures: . . . . . Page -3-

3- Design of Sediment Control Structures: . . . . . Page -24-

4- Design of Drainage Control Structures for Reclamation: . . . . . Page -34-

5- Alternate Sediment Control for Fan Site . . . . . Page -39-

SEDIMENTATION AND DRAINAGE CONTROL PLAN

1- Introduction

The Sedimentation and Drainage Control Plan for the Lila Canyon Mine has been designed according to the State of Utah R645- Coal Mining Rules, November 1, 1996. All design criteria and construction will be certified by a Utah Registered Professional Engineer.

This plan has been divided into the following three sections:

1) Design of Drainage Control Structures for the Proposed Construction

2) Design of Sediment Control Structures

3) Design of Drainage Control Structures for Reclamation

The general surface water control plan for this project will consist of the following:

(a) This is a new site construction. All areas proposed for disturbance will be sloped to drain to surface ditches and/or culverts where runoff will be carried to the sediment pond. All minesite drainage controls and watersheds are shown on Plate 7-5 “Proposed Sediment Control Map”.

(b) The majority of undisturbed runoff will be diverted around the minesite and beneath the pond by properly sized culverts. Undisturbed diversion culvert UC-1, is located on the northwest end of the site. This diversion will allow the majority of undisturbed runoff from the Right Fork of Lila Canyon to bypass the mine area beneath the sediment pond. All undisturbed diversions are designed to carry runoff from a 100 year - 6 hour precipitation event. UC-1 is oversized at 60" diameter.

(c) A single, adequately sized sediment pond will be constructed at the lower end of the site. This pond is sized to contain and treat the runoff from all of the disturbed area and any contributing undisturbed areas for a 10 year - 24 hour precipitation event. The pond will be equipped with a C.M.P. culvert principle spillway and decant, and a second CMP culvert emergency spillway sized to safely pass runoff from a 25 year - 6 hour precipitation event. Spillways will discharge into a 60" CMP culvert running beneath the pond. This culvert will discharge onto an engineered discharge structure and into the main Grassy Trail channel below the minesite.

DESIGN OF DRAINAGE CONTROL STRUCTURES

Design Parameters:

2.1 Precipitation
2.2 Flow
2.3 Velocity
2.4 Drainage Areas
2.5 Slope Lengths
2.6 Runoff
2.7 Runoff Curve Numbers
2.8 Culvert Sizing
2.9 Culverts
2.10 Main Canyon Culvert - Outlet Structure
2.11 Ditches

Tables:

Table 1 Undisturbed Watershed Summary
Table 2 Disturbed Watershed Summary
Table 3 Watershed Parameters
Table 4 Runoff Summary - Undisturbed Watershed (Not Draining to Pond)
Table 5 Runoff Summary - Watersheds Draining to Sediment Pond
Table 6 Runoff Control Structure - Watershed Summary
Table 7 Runoff Control Structure - Flow Summary
Table 8 Disturbed Ditch Design Summary
Table 9 Disturbed Culvert Design Summary
Table 10 Undisturbed Culvert Design Summary

Figures:

Figure 1 Culvert Nomograph
Figure 2 Rip-Rap Chart
Figure 3 Disturbed Ditch Typical Section
Figure 4 Trash Rack - Culvert Inlet - Typical Section
Figure 4A UC-1 Culvert Outlet

Design Parameters

2.1 Precipitation

The precipitation-frequency values for the area were taken from the approved Mining and Reclamation Plan, Horse Canyon Mine, Emery County, Utah, Volume III, submitted by I.P.A.

Frequency - Duration	Precipitation
10 year - 6 hour	1.30"
10 year - 24 hour	1.90"
25 year - 6 hour	1.50"
100 year - 6 hour	1.90"

2.2 Flow

Peak flows, flow depths, areas and velocities were calculated using the computer program "Office of Surface Mining Watershed Model", Storm Version 6.20 by Gary E. McIntosh. All flow is based on the SCS - TR55 Method for Type II storms.

Time of concentration of storm events was calculated for each drainage area using the following formula:

$$t_L = \frac{L^{0.8}\,(S+1)^{0.7}}{1900\,Y^{0.5}}$$

where:

	t_C	=	*Time of Concentration (hrs.)*
	t_L	=	*Lag Time (hrs.) = 0.6* $_{tC}$
	L	=	*Hydraulic Length of Watershed (ft.)*
	Y	=	*Average Land Slope (%)*
	S	=	$\frac{1000}{CN} - 10$

2.3 Velocity

Flow velocities for each ditch structure were calculated using the Storm computer program with Manning's Formula:

$$V = \frac{1.49}{n} R^{2/3} S^{1/3}$$

where:	V	=	Velocity (fps)
	R	=	Hydraulic Radius (ft.)
	S	=	Slope (ft. per ft.)
	n	=	Manning's n; Table 3.1, p. 159,

"Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner & Haan, 1983.

Note: The following Manning's n were used in the calculations:

Structure	Manning's n
Culverts (cmp)	0.025
Unlined Disturbed Area Ditches	0.035

2.4 Drainage Areas

All drainage areas were planimetered directly from Plate 7-1, “Permit Area Hydrology Map”, and Plate 7-2, “Disturbed Area Hydrology/Watershed”.

2.5 Slopes, Lengths

All slopes and lengths were measured directly from the topography on Plates 7-1 and 7-2.

2.6 Runoff

Runoff was calculated using the SCS Formula for Type II Storms; using the Storm Version 6.21 computer program:

$$Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S}$$

where:

CN	=	Runoff Curve Number
Q	=	Runoff in inches
P	=	Precipitation in inches
S	=	$\frac{1000}{CN} - 10$

2.7 Runoff Curve Numbers

Two curve numbers were utilized for the undisturbed areas. Areas with milder slopes (less than 30%) were given a runoff curve number of 75. All other undisturbed areas (30% slope or greater) were given a runoff curve number of 83. These numbers were taken directly from the approved "Mining and Reclamation Plan, Horse Canyon Mine, Emery County, Utah, Volume III", submitted by I.P.A. The numbers in that plan were based on vegetation and soils data from on-site.

Two other runoff curve numbers have been used in the calculations. A runoff CN of 90 is used for all disturbed areas (including the areas designated as undisturbed which lie within the disturbed area boundary (See Plate 7-2), and a runoff CN of 95 is used for paved areas. These numbers are based on commonly used and approved values and from Table 2.20, (p. 82, Barfield, et al, 1983).

The following is a summary of runoff curve numbers used in these calculations:

Watershed	Runoff CN
Undisturbed (<30% slopes):	75
Undisturbed (>30% slopes):	83
Disturbed:	90
Paved:	95

2.8 Culvert Sizing

Minimum culvert sizing is based on the following Manning's Equation; using the Haestad Methods, Flowmaster I, Version 3.42 computer program:

$$D = \left(\frac{2.16\ Q\ n}{\sqrt{s}}\right)^{0.35}$$

where:	D	=	Required Diameter (feet)
	Q	=	QP = Peak Discharge (cfs)
	n	=	Roughness Factor (0.025 for cmp)
	S	=	Slope (ft. Per ft.)

Using the above formula, minimum required culvert sizes were calculated for each applicable area. Culverts were then selected above the required minimum, and these sizes were checked for adequacy against the Culvert Nomograph included as Figure 1 of this report.

2.9 Culverts

Culverts have been sized according to the calculations previously described, and are shown on Plate 7-5, “Proposed Sediment Control Map”. Culverts carrying undisturbed drainages are designated with UC- Letters (i.e. UC-1). All undisturbed area drainage culverts will be fitted with trash racks to minimize plugging by rocks or other debris.

Trash racks will be provided at the inlet for all undisturbed drainage culverts. These will consist of 3/4" steel bars welded on 6" centers across the flared inlet structures of each culvert. Bars will be sloped from the front of the inlet structure up to the top of the culvert. This ramp configuration will allow trash, branches and other potential obstructions to be swept up and away from the inlet rather than being impinged against the grates during a flow event. Rip rap will be placed around the flared inlet structure and above it to a height of at least 6" above the required headwall for each culvert. (See Figure 4 for details). Trash racks will be checked on a routine schedule and following precipitation events and all trash, branches and other obstructions will be removed.

It should be noted that all undisturbed area culverts are adequately sized to handle the expected runoff from a 100 year - 6 hour event for maximum protection of the mine area, sediment pond and undisturbed drainage. This is well in excess of the 10 year - 6 hour event required by the regulations and is proposed as an extra measure of safety.

Disturbed area culverts and ditches are shown on the “Sediment Control Map”, Plate 7-5. Culverts carrying disturbed drainage are designated with a DC-number (i.e. DC-1). Calculations for all disturbed area culverts and ditches are also included with this report, along with design criteria. Disturbed drainage areas draining to culverts and ditches are marked with a DA-number (i.e. DA-1). Undisturbed drainage areas are marked with a UA-number (i.e. UA-1).

Culverts will be inspected regularly, and cleaned as necessary to provide for passage of drainage flows. Inlets and outlets shall also be maintained so as to prevent plugging or undue restriction of water flow.

All disturbed area culverts are temporary, and will be removed upon final reclamation.

2.10 Main Canyon Culvert - Outlet Structure

The outlet of the 5' diameter culvert UC-1 has been designed to flow into a rip-rap apron to protect against souring and for energy dissipation. The rip-rap apron is designed to fit the natural channel configuration as closely as possible, and will allow runoff to re-enter the natural channel at a reduced velocity which is no greater than natural flow conditions. Runoff from the 100 year - 6 hour precipitation event in the canyon below the minesite has been calculated at 50.47 cfs, including sediment pond overflow.

The rip-rap apron design is based on Figure 7-26, Design of Outlet Protection - Maximum Tailwater Condition, “Applied Hydrology and Sedimentology for Disturbed Areas”, Barfield, Warner and Haan, 1983. Based on the figure, the apron should be a minimum of 15' in length, widening from 5' to 9', with a 0% slope. The proposed length has been increased to 20', to ensure adequate time for velocity reduction. The slope is kept at 0%. Rip-rap size is conservatively placed at 12" D_{50}. Rip-rap will be placed to a depth of 1.5 D_{50} and will be embedded in a 6" layer of 2" drain rock filter. Rip-rap will also be placed on 2:1 side slopes to the height of the culvert (4') at the culvert outlet tapering to 2' at the outlet of the apron. This rip-rap apron has been sized and designed to adequately dissipate energy from flow velocities of a 100 year - 6 hour precipitation event and resist dislodgement. The drain rock filter bed will also serve to secure the rip-rap boulders firmly in place, to add an additional element of stability, and prevent scouring underneath the boulder bed. (See Figure 4A for construction details). The channel is on a gradient of approximately 7.76%. When the flow is routed from the culvert across the apron to the natural channel, the velocity is reduced from 10.25 fps at the culvert outlet to 4.14 fps at the outlet of the apron. (See Culvert Outlet Rip-Rap Apron Flow Velocity Calculations in Appendix 1.)

It should be noted that these calculations are based on a <u>100 year - 6 hour event</u>.

2.11 Ditches

All ditches will carry disturbed area drainage to the pond. Ditches are shown on the Proposed Sediment Control Map, Map 7-5, and are designated with a DD-number (i.e. DD-1 for Disturbed Area Ditches) or UD-number (i.e. UD-1 for Undisturbed Area Ditches).

All ditches are designed to carry the expected runoff from a 10 year - 6 hour event with a minimum freeboard of 0.5' (See Table 8 and Figure 3).

Ditches which exhibit expected flow velocities of 5 fps or greater will be lined with rip-rap. Typical cross-sections, flow depths and areas for all lined and unlined ditches are shown on Figure 3 of this report.

Ditch slopes have been determined from Plate 7-2.

All ditches will be inspected regularly, and maintained to the minimum dimensions to provide adequate capacity for the design flow. All ditches are temporary and will be removed as described under the reclamation hydrology section. (Section 4)

TABLE 1

Table 1 Undisturbed Watershed Summary				
Watershed	CN	Acres	Drains To	Final
UA-1	75	248.41	UC-1	Lila Canyon
UA-2	83	11.74	DD-2	Sediment Pond
UA-3	83	5.98	DD-6	Sediment Pond
UA-4	83	7.20	Sediment Pond	Sediment Pond
UA-5	90	12.27	UC-1	Lila Canyon
UA-6	90	6.76	DD-13	Sediment Pond

Area south of coal stockpile DA-1 was changed to UA-5 and DA-9 to UA-6.

TABLE 2

Table 2 Disturbed Watershed Summary				
Watershed	CN	Acres	Drains To	Final
DA-2	90	2.45	DD-2	Sediment Pond
DA-3	90	2.92	DD-3	Sediment Pond
DA-4	90	2.63	DD-4	Sediment Pond
DA-5	90	0.56	DD-5	Sediment Pond
DA-6	95	5.10	DD-9	Sediment Pond
DA-7	95	6.86	DD-10	Sediment Pond
DA-8	90	0.58	DD-11	Sediment Pond
Total		40.13		

Area south of coal stock pile DA-1 was changed to UA-5 and DA-9 to UA-6.

TABLE 3

Table 3 Watershed Parameters					
Watershed	Area (Acre)	Hydraulic Length (ft.)	Elevation Change (ft.)	% Slope	CN
Undisturbed Watersheds					
UA-1	248.41	5200	1480	28.46	75
UA-2	11.74	1500	1000	66.67	83
UA-3	5.98	650	165	25.39	83
UA-4	7.20	1250	595	47.76	83
UA-5	12.27	1400	600	42.86	90
UA-6	6.76	625	50	8.00	90
Disturbed Watersheds					
DA-2	2.45	1520	190	12.50	90
DA-3	2.92	650	100	15.39	90
DA-4	2.63	330	25	7.58	90
DA-5	0.56	240	30	12.50	90
DA-6	5.10	550	50	9.09	95
DA-7	6.86	700	50	7.14	95
DA-8	0.58	350	25	7.14	90

Area south of coal stockpile DA-1 was changed to UA-5 and DA-9 to UA-6.

TABLE 4

Table 4
Runoff Summary
Undisturbed Watersheds (Not Draining to Pond)

Watershed	10 yr. / 6 hr. Peak Flow - cfs	25 yr. / 6 hr. Peak Flow - cfs	100 yr. / 6 hr. Peak Flow - cfs	10 yr. / 24 hr. Peak Flow - cfs	10 yr. / 24 hr. Volume - ac.ft.
UA-1	7.02	10.31	20.48	25.53	6.90
UA-5	5.94	7.65	11.24	12.14	1.03
Totals	12.96	17.96	31.72	37.67	7.93

TABLE 5

Table 5 Runoff Summary Watersheds Draining to Sediment Pond				
Watershed	10 yr. / 6 hr. Peak Flow - cfs	25 yr. / 6 hr. Peak Flow - cfs	10 yr. / 24 hr. Peak Flow - cfs	10 yr. / 24 hr. Volume - ac.ft.
DA-2	1.11	1.45	2.34	0.21
DA-3	1.36	1.75	2.77	0.25
DA-4	1.12	1.44	2.28	0.22
DA-5	0.20	0.26	0.41	0.05
DA-6	3.05	3.69	5.17	0.59
DA-7	4.55	5.49	7.70	0.79
DA-8	0.25	0.33	0.52	0.05
UA-2	1.49	2.30	5.02	0.61
UA-3	0.77	1.19	2.58	0.31
UA-4	0.91	1.41	3.08	0.38
UA-6	3.28	4.23	6.71	0.57
Totals	18.09	23.54	38.58	4.03

Area south of coal stockpile DA-1 was changed to UA-5 and DA-9 to UA-6.

TABLE 6

Table 6 Runoff Control Structure Watershed Summary		
Structure	Type	Contributing Watersheds/Structures
UC-1	Culvert	UA-1, UA-5, Sediment Pond Overflow
DD-2	Ditch	DA-2, UA-2
DD-3	Ditch	DA-3
DD-4	Ditch	UA-3
DD-5	Ditch	DA-5
DD-6	Ditch	DD-2, DD-4, DD-5
DD-7	Ditch	DD-3, DD-6, DA-4
DD-8	Ditch	DA-6
DD-9	Ditch	DD-8, DA-7
DD-10	Ditch	DA-8
DD-11	Ditch	DD-9, DD-10, DA-9
DD-12	Ditch	DD-1, DD-7
DC-5	Culvert	DD-5, DD-2
DC-6	Culvert	DD-3, DD-6
DC-7	Culvert	DD-7
DC-8	Culvert	DD-8
DC-9	Culvert	DA-8

DD-1 does not exist.

TABLE 7

Table 7 Runoff Control Structure Flow Summary					
Structure	Type	10 yr. / 6 hr. Peak Flow - cfs	10 yr. / 24 hr. Peak Flow - cfs	25 yr. / 6 hr. Peak Flow - cfs	100 yr. / 6 hr. Peak Flow - cfs
UC-1	Culvert	38.21	56.72	41.50	51.67
DD-2	Ditch	2.60	7.36	3.75	-
DD-3	Ditch	1.36	2.77	1.75	-
DD-4	Ditch	0.77	2.58	1.19	-
DD-5	Ditch	0.20	0.41	0.26	-
DD-6	Ditch	3.57	10.35	5.20	-
DD-7	Ditch	6.05	15.40	8.39	-
DD-8	Ditch	3.05	5.17	3.69	-
DD-9	Ditch	7.60	12.87	9.18	-
DD-10	Ditch	0.25	0.52	0.33	-
DD-11	Ditch	11.13	20.01	13.74	-
DD-12	Ditch	11.99	27.54	16.04	-
DC-5	Culvert	2.80	7.77	4.01	-
DC-6	Culvert	4.93	13.12	6.95	-
DC-7	Culvert	6.05	15.40	8.39	-
DC-8	Culvert	3.05	5.17	3.69	-
DC-9	Culvert	0.25	0.52	0.33	-

DD-1 does not exist.

TABLE 8

Table 8
Disturbed Ditch Design Summary

Ditch	DD-2	DD-3	DD-4	DD-5	DD-6
Slope (%)	12.50	14.60	20.70	15.30	5.00
Length (ft.)	1291	788	675	326	205
Manning's No.	0.035	0.035	0.035	0.035	0.035
Side Slope (H:V)	2:1	2:1	2:1	2:1	2:1
*Bottom Width (ft.)	2.00	2.00	1.00	1.00	2.00
Peak Flow 10/6 (cfs)	2.60	1.36	0.77	0.20	3.57
Peak Flow 10/24 (cfs)	7.36	2.77	2.58	0.41	10.35
Flow Depth (ft.) 10/6	0.22	0.15	0.14	0.07	0.34
Flow Depth (ft.) 10/24	0.40	0.22	0.27	0.10	0.61
Flow Area ($ft.^2$) 10/6	0.54	0.33	0.17	0.08	0.92
Flow Area ($ft.^2$) 10/24	1.11	0.54	0.41	0.13	1.96
Velocity (fps) 10/6	4.81	4.08	4.40	2.55	3.88
Velocity (fps) 10/24	6.65	5.18	6.32	3.24	5.29
Rip-Rap Req'd (Y/N)	N	N	N	N	N
Rip-Rap D_{50}	-	-	-	-	-

Note: Slope/Lengths from Plate 7-2.

DD-1 does not exsit.

TABLE 8 (Continued)

Table 8 (Continued) Disturbed Ditch Design Summary						
Ditch	DD-7	DD-8	DD-9	DD-10	DD-11	DD-12
Slope (%)	7.40	6.90	3.00	4.00	5.90	6.80
Length (ft.)	337	360	380	500	425	440
Manning's No.	0.035	0.035	0.035	0.035	0.035	0.035
Side Slope (H:V)	2:1	2:1	2:1	2:1	2:1	2:1
*Bottom Width (ft.)	2.50	2.00	2.50	1.00	3.00	3.00
Peak Flow 10/6 (cfs)	6.05	3.05	7.60	0.25	11.13	11.99
Peak Flow 10/24 (cfs)	15.40	5.17	12.87	0.52	20.01	27.54
Flow Depth (ft.) 10/6	0.37	0.29	0.54	0.12	0.51	0.51
Flow Depth (ft.) 10/24	0.62	0.38	0.71	0.17	0.70	0.80
Flow Area ($ft.^2$) 10/6	1.20	0.74	1.92	0.14	2.03	2.04
Flow Area ($ft.^2$) 10/24	2.30	1.06	2.80	0.24	3.07	3.66
Velocity (fps) 10/6	5.05	4.13	3.95	1.76	5.48	5.89
Velocity (fps) 10/24	6.68	4.86	4.60	2.21	6.52	7.52
Rip-Rap Req'd (Y/N)	Y	N	N	N	Y	Y
Rip-Rap D_{50}	6"	-	-	-	6"	6"
Note: Slope/Lengths from Plate 7-2.						

TABLE 9

Table 9
Disturbed Culvert Design Summary

Culvert	DC-5	DC-6	DC-7	DC-8	DC-9
Slope (%)	5.00	5.00	8.00	3.00	3.00
Length (ft.)	40	60	40	40	40
Manning's No.	0.025	0.025	0.025	0.025	0.025
Peak Flow 10/6 (cfs)	2.80	4.93	6.05	3.05	0.25
Peak Flow 10/24 (cfs)	7.77	13.12	15.40	5.17	0.52
Min. Diam. Req'd (ft.) 10/6	0.86	1.07	1.06	0.98	0.38
Min. Diam. Req'd (ft.) 10/24	1.27	1.54	1.50	1.20	0.51
Diam. Proposed (ft.)	1.50	2.00	2.00	1.50	1.50
Velocity (fps) 10/6	4.78	5.51	6.92	4.03	2.16
Velocity (fps) 10/24	6.17	7.04	8.74	4.60	2.59
Rip-Rap D_{50}	N/A	6"	6"	N/A	N/A

Note: Slope/Lengths from Plate 7-5.
Source: (Haestad Methods, Flowmaster I, Version 3.42)

TABLE 10

Table 10 Undisturbed Culvert Design Summary		
Culvert	UC-1	
Slope (%)	5.56	
Length (ft.)	535	
Manning's No.	0.025	
Peak Flow 10/6 (cfs)	38.21	
Peak Flow 100/6 (cfs)	51.67	
Min. Diam. Req'd (ft.) 10/6	2.26	
Min. Diam. Req'd (ft) 100/6	2.53	
Diam. Proposed (ft.)	5.00	
Velocity (fps) 10/6	9.57	
Velocity (fps) 100/6	10.32	
* Note: Peak Flows include 25 year - 6 hour design overflow from sediment pond.		

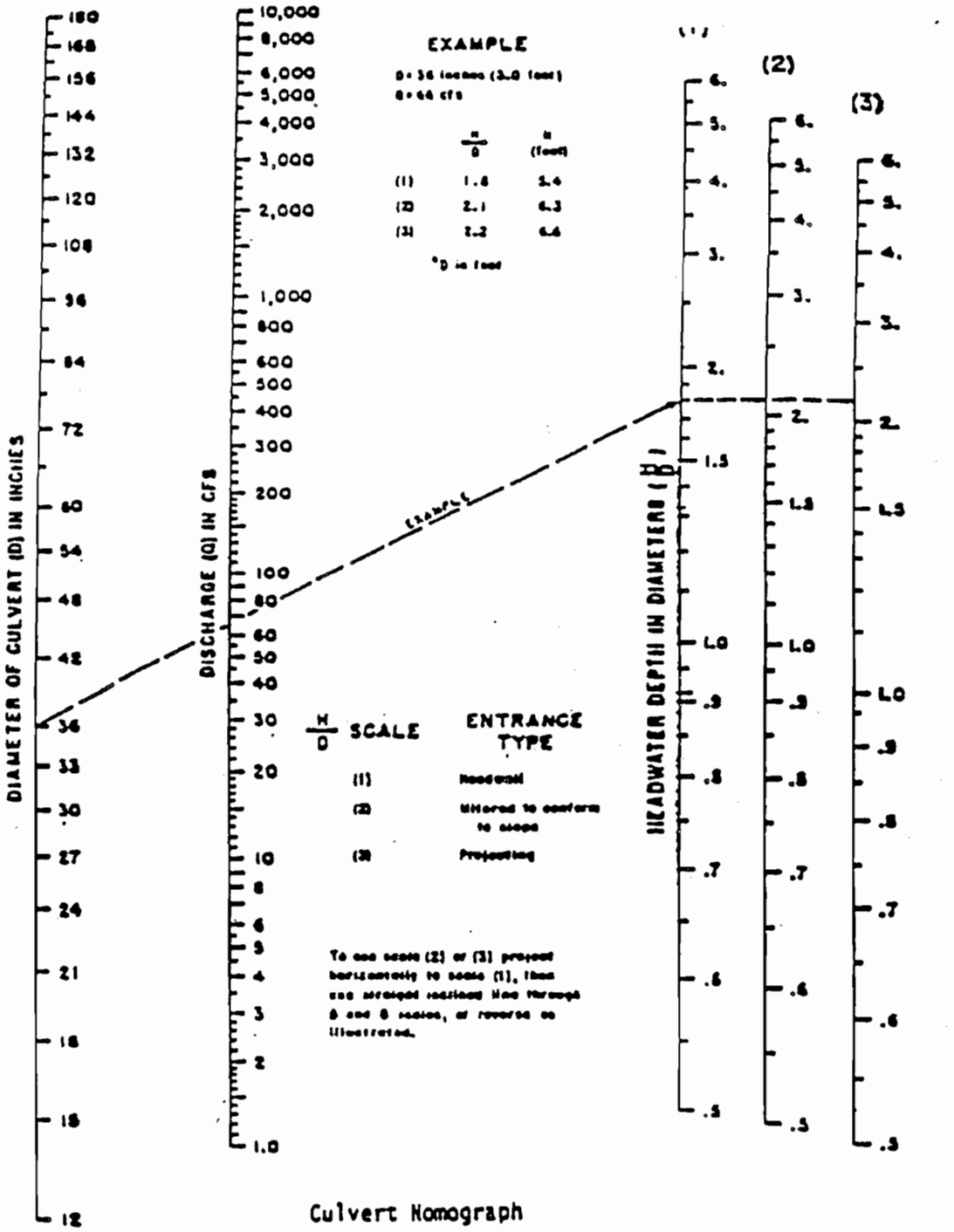
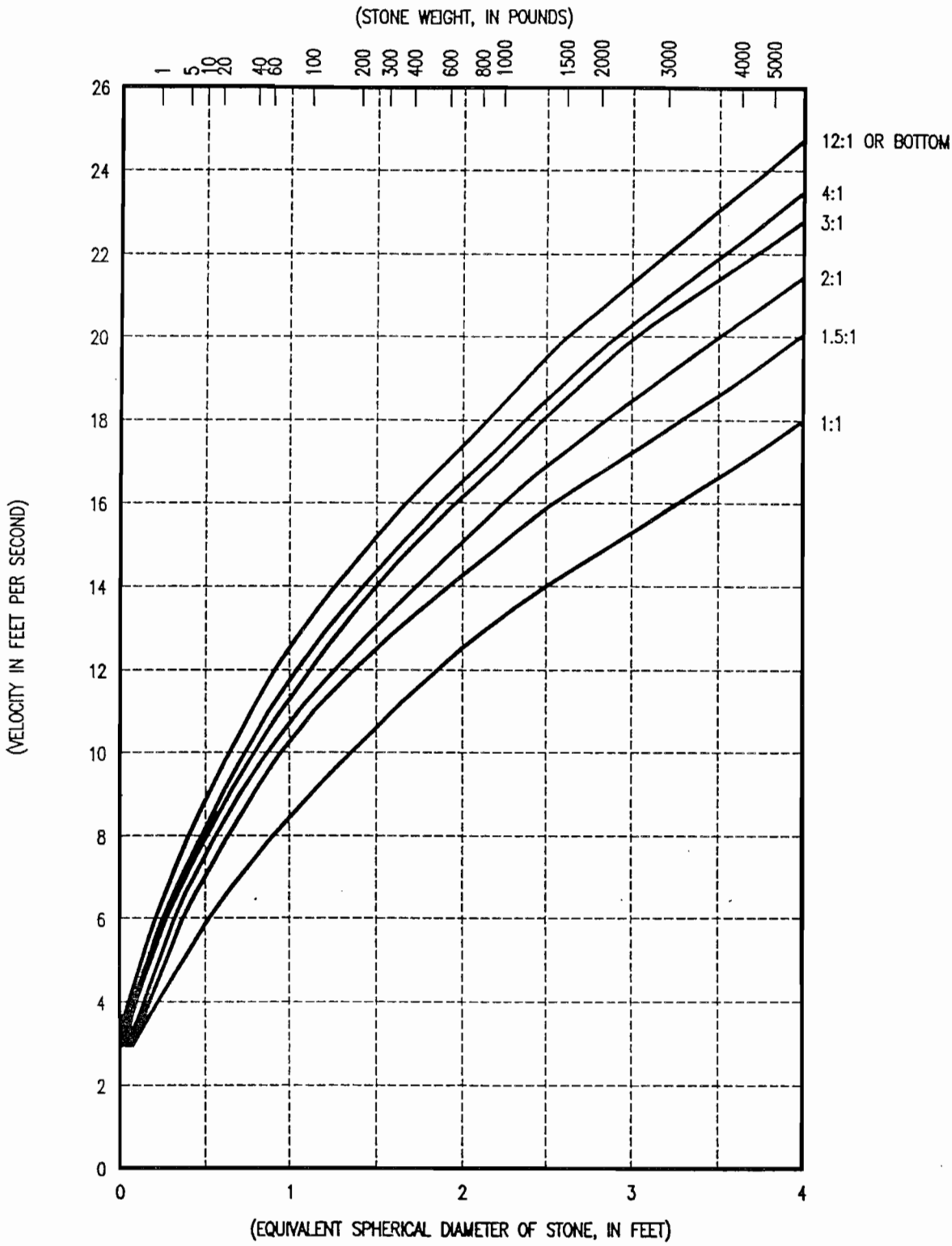

DIAMETER OF CULVERT (D) IN INCHES
DISCHARGE (Q) IN CFS
HEADWATER DEPTH IN DIAMETERS (H/D)
EXAMPLE
(1)
(2)
(3)
H/D SCALE
ENTRANCE TYPE
Culvert Nomograph

FIGURE 1

RIP-RAP CHART



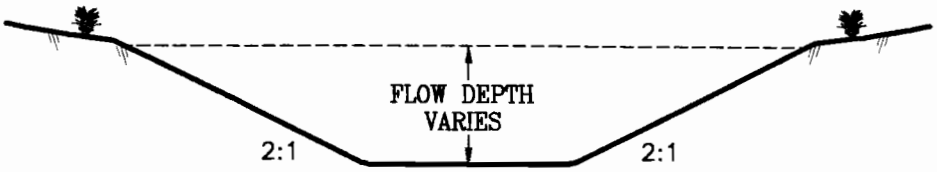
SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

NOTE:

ADAPTED FROM REPORT OF SUBCOMMITTE ON SLOPE PROTECTION, AM. SOC. CIVIL ENGINEERS PROC. JUNE 1948.
FOR STONE WEIGHING 165 LBS. PER CUBIC FEET.

Figure 2

DISTURBED DITCH TYPICAL SECTION



DITCH				
DITCH	FLOW DEPTH	FLOW AREA (FT.^{2})	BOTTOM WIDTH (FT.)	RIP-RAP D^{50}
DD-1	0.27	0.95	3.00	6"
DD-2	0.22	0.54	2.00	–
DD-3	0.15	0.33	2.00	–
DD-4	0.14	0.17	1.00	–
DD-5	0.07	0.08	1.00	–
DD-6	0.34	0.92	2.00	–
DD-7	0.37	1.20	2.50	6"
DD-8	0.29	0.74	2.00	–
DD-9	0.54	1.92	2.50	–
DD-10	0.12	0.14	1.00	–
DD-11	0.51	2.03	3.00	6"
DD-12	0.51	2.04	3.00	6"

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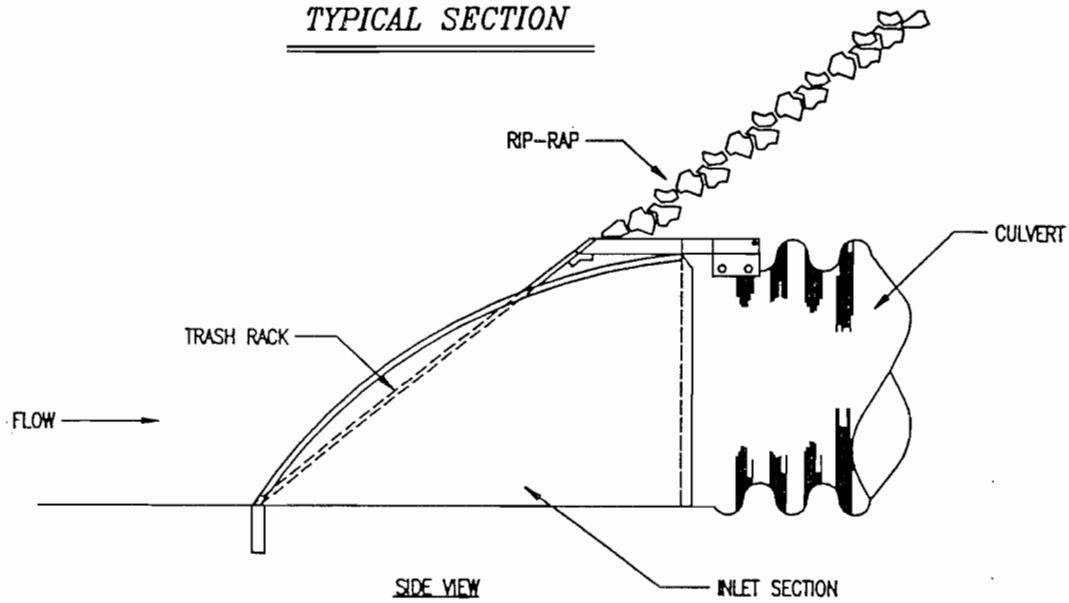
#154168
DAN W. GUY
1/15/01
PROFESSIONAL ENGINEER

NOTE: FLOW DEPTH AND AREA BASED ON RUNOFF FROM A 10 YEAR – 6 HOUR EVENT.

Figure 3

UNDISTURBED CULVERT INLET
TYPICAL SECTION



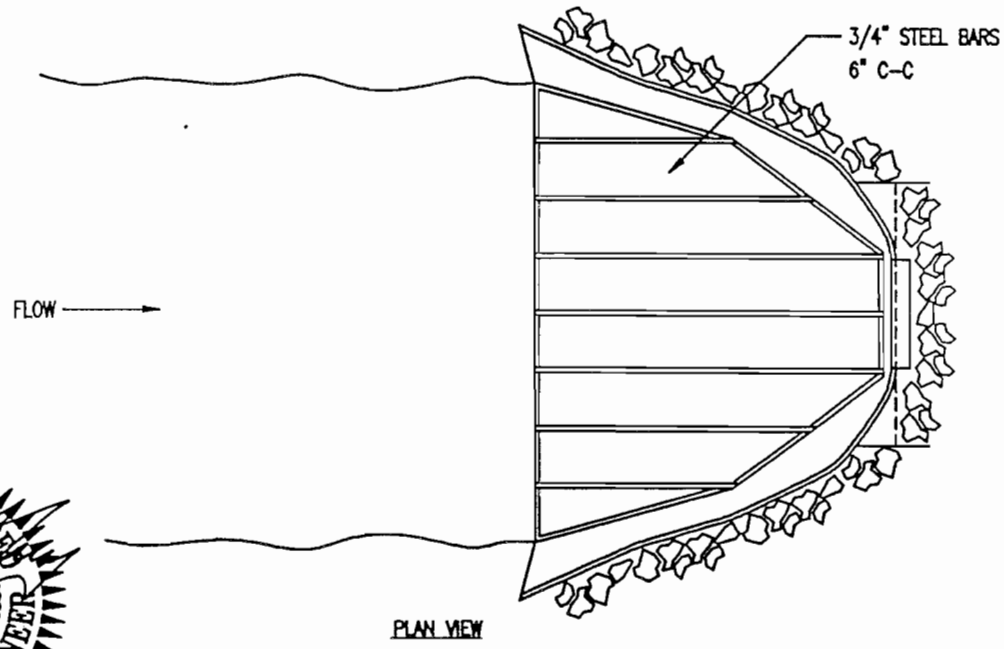
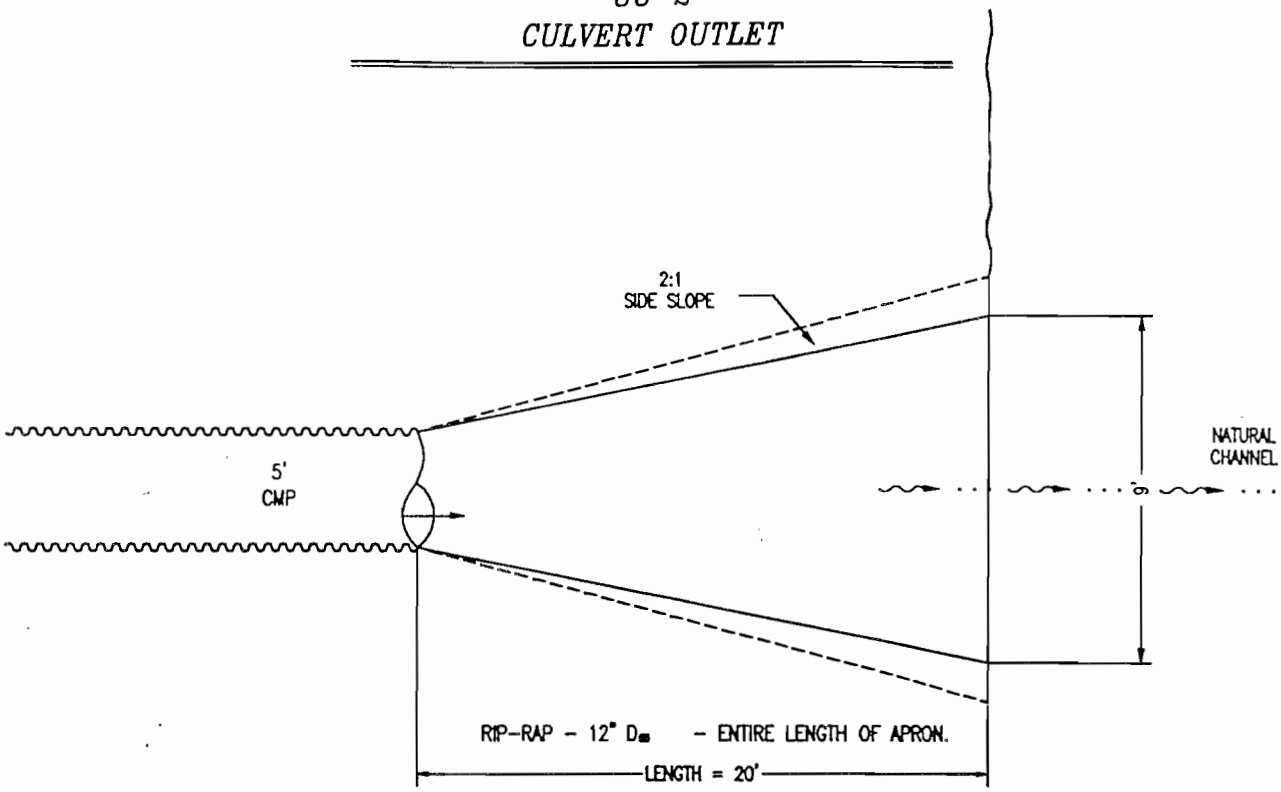
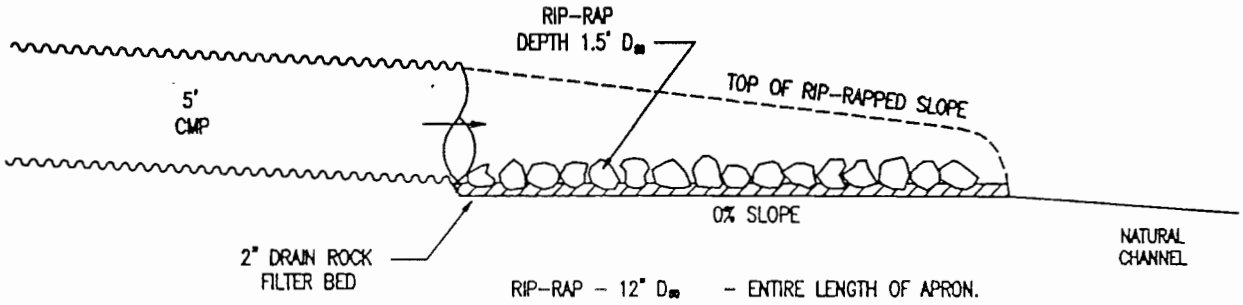


Figure 4

UC-2
CULVERT OUTLET





* DESIGN BASED ON FIGURE 7-26, DESIGN OF OUTLET PROTECTION - MAXIMUM TAILWATER CONDITION, "APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS", BARFIELD, WARNER & HAAN, 1983.

UTAH REGISTERED
#154168
DAN W. GUY
9/11/00
PROFESSIONAL ENGINEER

Figure 4A

DESIGN OF SEDIMENT CONTROL STRUCTURES

Design Specifications:

3.1 Design and Construction Specifications for Sedimentation Pond
3.2 Sediment Yield
3.3 Sediment Pond Volume

Tables:

Table 11 Sediment Pond Design
Table 12 Sediment Pond - Stage Volume Data
Table 13 Sediment Pond - Stage Discharge Data

3.4 Sediment Pond Summary

Figures:

Figure 5 Sediment Pond Stage-Volume Curve
Figure 6 Sediment Pond Stage-Discharge Curve
Figure 7 Removal of Culvert UD-2 for Final Reclamation

3.1 Design and Construction Specifications for Sedimentation Pond

a) All construction of sedimentation ponds will be performed under the direction of a qualified, registered professional engineer.

b) The sediment pond will be located in an existing low area where the Right Fork of Lila Canyon passes beneath the existing road. The existing road fill and culvert will be removed, and the pond embankment (road fill) will be reconstructed and compacted. The existing culvert will be replaced and extended approximately 300' up the Right Fork of Lila Canyon. This culvert will be equipped with a headwall, and will allow undisturbed runoff and treated access road drainage to pass beneath the sediment pond. The majority of the pond will be in an existing channel area, and is therefore considered incised. The embankment will be reconstructed to a maximum of 2h:1v slopes, with the total of inside and outside slopes not less than 5h:1v. The pond will be equipped with a culvert riser principal spillway with an oil skimmer, a decant, and a second culvert riser emergency spillway with an oil skimmer. Both spillways will discharge to the oversized (60") CMP culvert running beneath the pond.

c) The area of pond constructed shall be examined for topsoil, and where present in removable quantities, such soil shall be removed separately and stored in an approved topsoil storage location.

d) In areas where fill is to be placed for the pond impoundment structures, natural ground shall be removed for at least 12" below the base of the structure.

e) Native materials shall be used where practical. Fill will be placed in lifts not to exceed 6" and compacted prior to placement of next left. Compaction of all fill materials shall be at least 95%.

f) Rip-rap or other protection (culverts, concrete, etc.) will be placed at all inlets and outlets to prevent scouring. Rip-rap will consist of substantial (non-slaking) rock material of adequate size.

g) Decanting of the pond, as required, will be accomplished by use of a decant pipe with an inverted inlet as shown on Plate 7-6. Samples will be

collected prior to decanting of the pond. If the quality of the water meets the requirements of the U.P.D.E.S. Permit, decanting will proceed. Discharge samples will be collected as per the approved U.P.D.E.S. Discharge Permit.

h) Slopes of the embankments shall not be steeper than 2h:1v, inside or outside, with a total of the inslope and outslope not less than 5h:1v, except where areas of the pond are incised.

i) External slopes of the impoundment will be planted with an approved seed mix to help prevent erosion and promote stability.

j) Top width of the embankment shall be not less than (H+35)/5, where H = Height of Dam in feet.

3.2 Sediment Yield

The Universal Soil Equation (USLE) was used to estimate sediment yield from disturbed areas. All soil loss from this area was assumed to be delivered to, and deposited in the sedimentation pond.

Erosion rate (A) in tons-per-acre-per-year is determined using the USLE as follows:

$$A = (R)\ (K)\ (LS)\ (CP)$$

Where the variables R, K, LS, and CP are defined as follows:

Variable "R" is the rainfall factor which can be estimated from $R = 27P^{2.2}$; where P is the 2-year, 6-hour precipitation value. P for the Lila Canyon area is 0.75" as shown in Figure 5.4, page 315, Barfield, et.al. 1983. Therefore, the estimated value of "R" for this area is 14.34.

Variable "K" is the soil erodibility factor. For disturbed areas, the "K" value is conservatively estimated to be 0.5. For disturbed runoff, but uncompacted and ungraded areas, "K" is estimated at 0.320. "K" is estimated to be 0.035 for undisturbed areas.

Variable "LS" is the length-slope factor. This figure was determined by applying the slope length and percentage for each sub-drainage area to the chart in Figure 5.15, p. 334, "Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983.

Variable "CP" is the control practice factor, which can be divided into a cover and practice factor. Values were determined from Appendix 5A, Barfield, et.al., 1983.

Site	CP Factor
Compacted Areas	1.20
Disturbed/Uncompacted Areas	0.20
Undisturbed Areas	0.15

The sediment volume is based on a density of 100 pounds per cubic foot of sediment.

SEDIMENT YIELD CALCULATIONS - USLE

Drainage	R	K	Acres	Slope Length Feet	Slope (%)	LS	CP	A	Yield
DA-2	14.34	0.500	2.45	1520	12.50	7.45	1.20	64.10	0.072
DA-3	14.34	0.500	2.92	650	15.39	6.50	1.20	55.93	0.075
DA-4	14.34	0.500	2.63	330	7.58	1.60	1.20	13.77	0.017
DA-5	14.34	0.500	0.56	240	12.50	3.00	1.20	25.81	0.007
DA-6**	14.34	0.001	5.10	550	9.09	2.70	0.01	0.0004	-
DA-7**	14.34	0.001	6.86	700	7.14	2.20	0.01	0.0003	-
DA-8	14.34	0.500	0.58	350	7.14	1.50	1.20	12.91	0.003
UA-2	14.34	0.035	11.74	1500	66.67	102.68	0.15	7.73	0.042
UA-3	14.34	0.035	5.98	650	25.39	27.55	0.15	2.07	0.006
UA-4	14.34	0.035	7.20	12.50	47.76	58.50	0.15	4.40	0.015
UA-5	14.34	0.320	12.27	600	42.86	34.33	0.20	31.51	0.178
UA-6	14.34	0.500	6.76	625	8.00	2.45	0.20	3.51	0.011

Total Sediment 1 year (ac.ft.) 0.426

Total Sediment 3 years (ac. ft.) 1.278

* Disturbed Runoff / Uncompacted Area

** Paved Areas

3.3 Sediment Pond Volume

The volumes shown in Table 11 are from the volumes calculated from the precipitation, runoff and sediment yield for a 10 year-24 hour precipitation event. The volumes were calculated based on the disturbed areas (and contributing undisturbed areas) runoff values, developed using the design parameters described in this section.

TABLE 11

Table 11 Sediment Pond Design	
1. Use 1.90" for 10 year - 24 hour event.	
2. Runoff Volume (from Table 5, 10 yr/24 hr) =	5.06 ac. ft. (1)
3. Sediment Storage Volume USLE 1.289 ac.ft./yr. x 3 yrs. =	1.278 ac. ft.
4. Direct Precipitation into Pond 1.076 acres x 1.90" / 12 in./ft. =	0.184 ac. ft.
5. Total Required Pond Volume 5.060 + 1.278 + 0.184 =	6.522 ac. ft.
6. * Peak Flow (25 yr. - 6 hr. event) =	31.19 cfs
7. Pond Design Volume @ Principle Spillway = (See Table 12)	8.537 ac. ft.
* Peak Flow values from Table 5.	

(1) Capacity is 1.03 ac. Ft. higher than Table 5. This is to allow for the flow from UA-5. There is a possibility that UA-5 may be needed if the surface facilities were to be expanded.

TABLE 12

Table 12 Sediment Pond Stage/Volume Data				
Elevation	Area (ac.)	Volume (ac. ft.)	Acc. Volume (ac. ft.)	Remarks
5830	.6477	0.000	0.000	Bottom of Pond
5831	.6862	0.667	0.667	
5832	.7254	0.706	1.373	
5833	.7657	0.746	2.119	Sediment Cleanout Level
5834	.8070	0.786	2.905	Decant
5835	.8493	0.828	3.733	
5836	.8927	0.871	4.604	
5837	.9370	0.915	5.519	
5838	.9824	0.960	6.479	
5839	1.0287	1.006	7.485	
5840	1.0759	1.052	8.537	Principal Spillway
5841	1.1230	1.100	9.637	Emergency Spillway
5842	1.1708	1.147	10.784	
5843	1.2587	1.215	11.999	Top of Embankment

TABLE 13

Table 13 Sediment Pond Stage/Discharge Data			
Head (ft.)	Q (cfs) Weir Controlled	Q (cfs) Orfice Controlled	Q (cfs) Pipe Flow Controlled
0.0	-	-	-
0.2	2.53	15.22	74.10
0.4	7.15	21.53	74.89
0.6	13.14	26.36	75.67
0.8	20.23	30.44	76.43
1.0	28.27	34.04	77.19
1.2	37.17	37.28	77.95
1.4	46.84	40.27	78.69
1.6	57.22	43.05	79.43
1.8	68.28	45.66	80.16
2.0	79.97	48.13	80.89

Note: 1- 25 year - 6 hour flow = 31.19 cfs.
2- Flow will be weir controlled at a head of 1.07' over riser inlet.

Weir Controlled
$Q = CLH^{1.5}$; where: C= 3.0, L= Circumference of Riser = 9.4248'

Orfice Controlled
$Q = C'a\,(2gH)^{0.5}$; where: C= 0.6, a= Area of Riser = 7.0686 ft^2, g= 32.2 ft/sec^2

Pipe Flow Controlled
$Q = \frac{a\,(2gH')^{0.5}}{(1+Ke+Kb+KcL)^{0.5}}$; where a = Area of Pipe = 7.07 ft^2
H' = Head = H + 9.2 (At outlet of Riser)
Ke = 1.0
Kb = 0.5
Kc = 0.043
L = 70'

3.4 Sediment Pond Summary

a) The sedimentation pond has been designed to contain the disturbed area (and contributing undisturbed area) runoff from a 10 year-24 hour precipitation event, along with 3 years of sediment storage capacity. Runoff to the pond will be directed by various ditches and culverts as described in the plan.

b) The required volume for the sediment pond is calculated at 6.522 acre feet, including 3 years of sediment storage. The existing sediment pond size will be a volume of approximately 8.537 acre feet (at the principal spillway), which is more than adequate.

c) The pond will meet a theoretical detention time of 24 hours. It is equipped with a decant, a culvert principal spillway and a culvert emergency spillway. Any discharge from the pond will be in accordance with the approved UPDES Permit.

d) The pond inlets will be protected from erosion, and the spillway will discharge into the main drainage.

e) The pond is temporary, and will be removed upon final reclamation of the property.

f) The pond will be constructed according to the regulations and under supervision of a Registered, Professional Engineer.

STAGE VOLUME

SEDIMENT POND

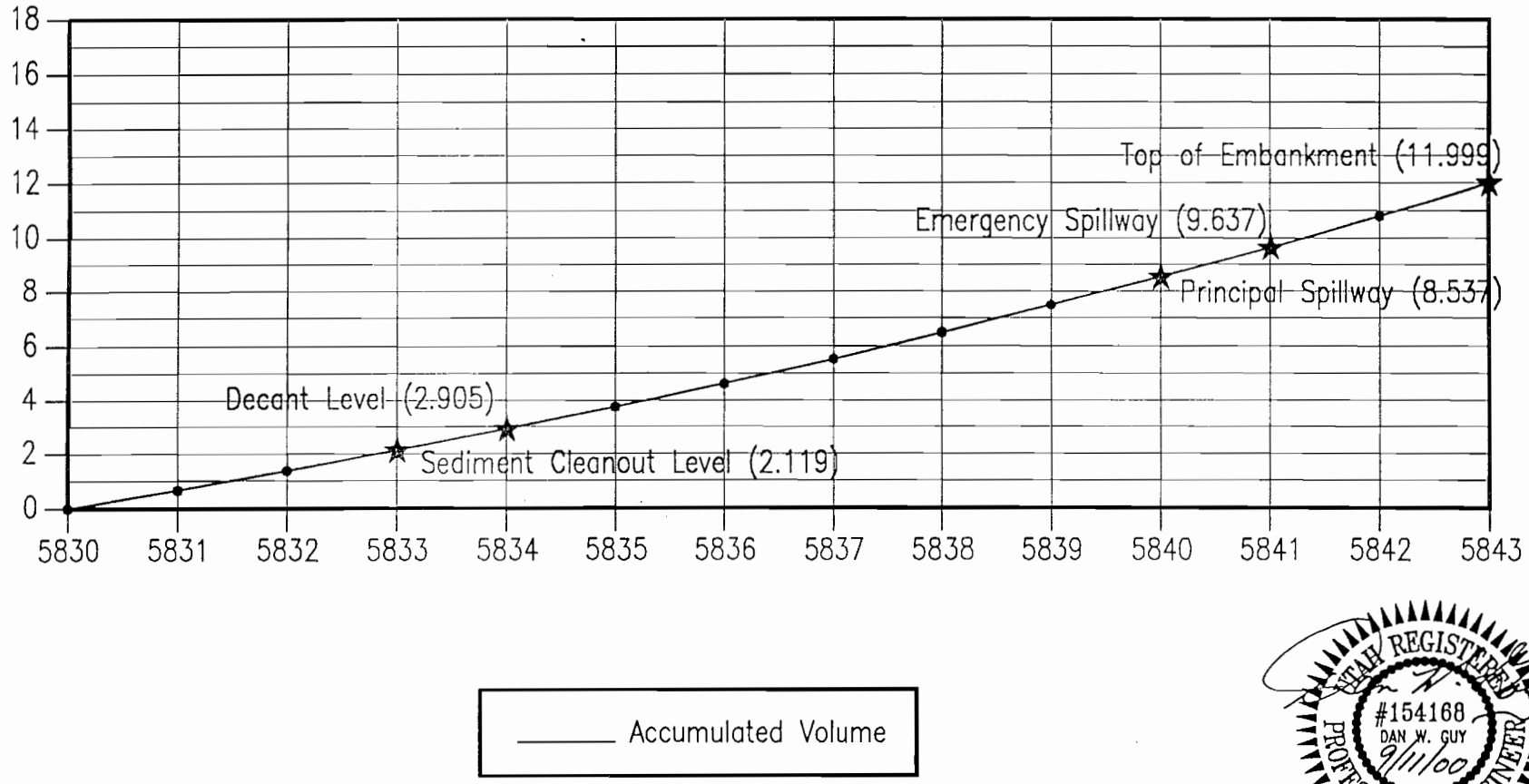
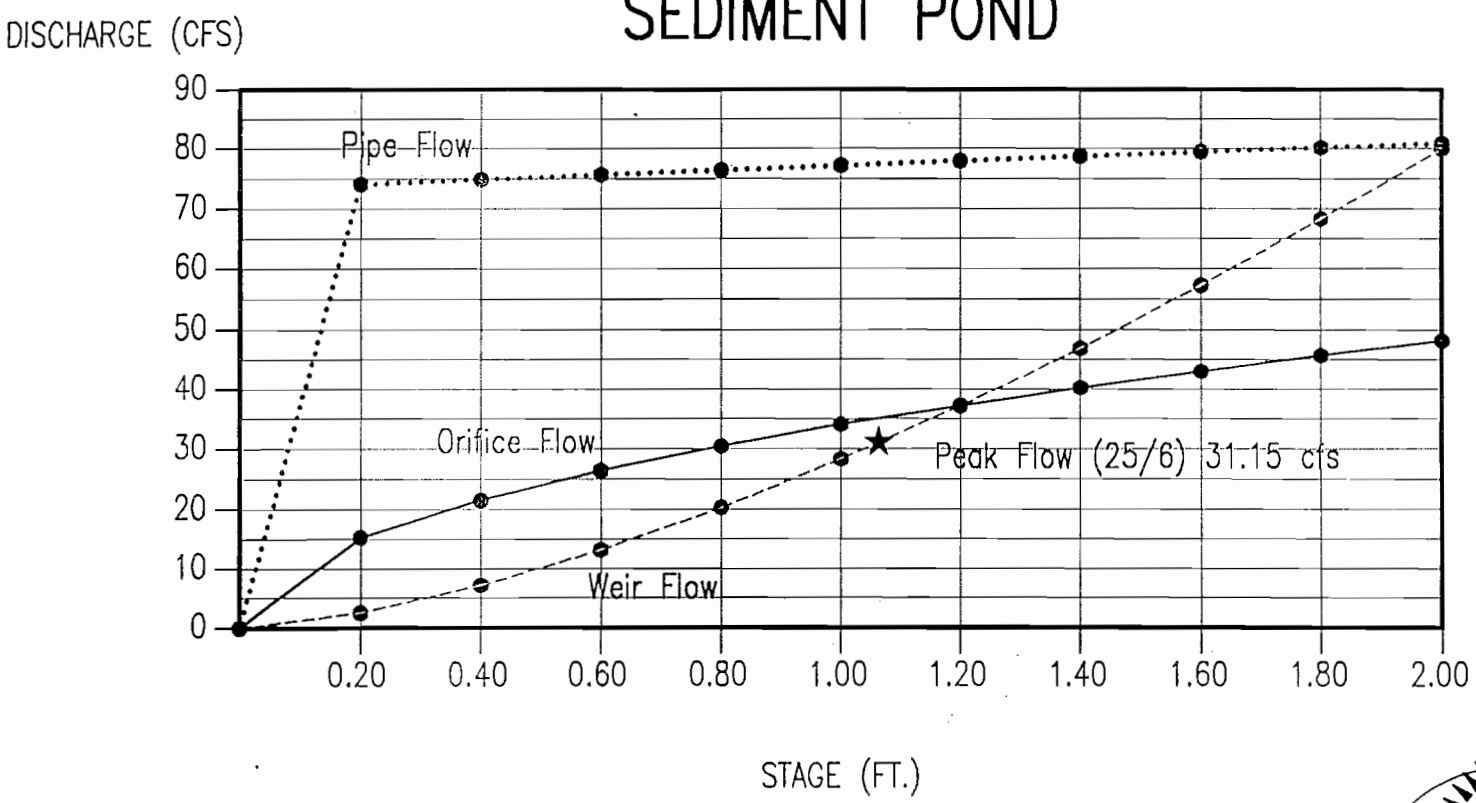


FIGURE 5

STAGE - DISCHARGE CURVE

SEDIMENT POND



------- Weir Flow	——— Orifice Flow	..... Pipe Flow

Note: Weir Controlled at H = 1.07'.

UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY 9/11/00

FIGURE 6

DESIGN OF DRAINAGE CONTROL STRUCTURES FOR RECLAMATION

Reclamation Hydrology:

4.1 General
4.2 Reclamation Area Drainage Control

Tables:

Table 14 Final Reclamation - Drainage Areas Contributing to Structures
Table 15 Final Reclamation - Drainage Structure Flow Summary
Table 16 Final Reclamation - Reclamation Structure Design Parameters
Table 17 Final Reclamation - Reclamation Structure Flow Calculations

Reclamation Hydrology

4.1 General

Upon completion of operations at the Lila Canyon Minesite, the portals will be sealed and backfilled and all structures will be removed except for the sediment pond, bypass culvert UC-1, reclamation ditches and temporary sediment controls such as silt fences or straw bales.

Any refuse or mine development waste previously deposited under the approved plan will also be left in place. Concrete will be buried beneath at least 2' of non-toxic, non-acid material. Any potentially toxic or acid-forming material buried on site will be covered with a minimum of 4' of material.

The sediment pond, and all remaining drainage controls will be removed upon completion of Phase II Bond Release.

4.2 Reclamation Area Drainage Control

During the initial phase of reclamation, all drainage controls will be removed with the exception of the sediment pond, bypass culvert UC-1, reclaimed ditches RD-1 and RD-2 and temporary sediment controls such as straw bales or silt fences installed in the undisturbed drainages.

As undisturbed drainage culverts are removed, a minimum of 2 each straw bale or silt fence barriers will be installed downstream for sediment control purposes.

Disturbed area ditches DD-11 and DD-12 will be cleaned and enlarged as necessary, and redesignated as reclaimed ditches RD-1 and RD-2, respectively.

When the vegetation and sediment contribution levels meet requirements for Phase II Bond Release, a series of at least 3 straw bale or silt fence barriers will be placed downstream of the sediment pond outlet. All upper sediment controls will be removed. Reclaimed ditches RD-1 and RD-2 will also be removed, regraded and reseeded. Culvert UC-1 will be cut off at the location of the principal pond spillway.

The portion of culvert UC-1 remaining beneath the road will be left as a

permanent drainage control. The culvert will be equipped with an inlet section and rip-rapped headwall. The culvert is adequately sized to safely pass runoff from a 100 year - 6 hour event, as shown in Table 10. To ensure that state of the art technology is incorporated, the final reclamation plans for the sedimentation pond area will be submitted prior to commencement of final reclamation of this area.

The remainder of culvert UC-1 will be removed, and the natural channel restored through the sediment pond area. The sediment pond structures will also be removed, the pond area regraded as necessary and reseeded. The pond embankment will remain as a permanent feature, since the existing (and proposed future) road through the area passes over the embankment.

Following the successful establishment of vegetation and when affluent standards are met, the sediment pond will be removed. The same methodologies relative to recontouring, top soil application and seeding will be utilized as outlined in Chapters 2, 5, and Appendix 5-8.

The pond embankment will be narrowed to facilitate the even character of the Lila Canyon Road. The existing 60 inch bypass culvert will be removed to within six feet of the road embankment. A newly formed channel will be constructed at an approximate four percent grade to intercept the inlet of the culvert at its intersection of the road. The road embankment and associated new channel will be armored by the Operator with an underlayment of filter gravel, with D_{50} -30 inch rip-rap. The new area of disturbance including the newly formed channel will have top soil spread in and around the rip-rap. The Operator will use the same seeding and mulching methods described in Appendix 5-8 will be used on this area as well. See Figures 4 and 7 for a detailed design.

TABLE 14

Table 14
Final Reclamation
Drainage Areas Contributing to Structures

Channel	*Contributing Watershed/Structure
RD-1	DD-11
RD-2	DD-12
UC-1	UA-1

* Taken from Table 6.

TABLE 15

Table 15 Final Reclamation Drainage Structure Flow Summary	
Channel	*10/6 Flow (cfs)
RD-1	11.91
RD-2	12.83
UC-1	**55.29

* Antecedent Moisture Condition III.
** 100/6 Flow.

TABLE 16

Table 16 Final Reclamation Reclamation Structure Design Parameters					
Channel	Bottom Width (ft.)	Side Slope H:V	Slope %	Reclaimed Depth (ft.)	Manning's No.
RD-1	3	2:1	5.00	1.5	0.035
RD-2	3	2:1	10.00	1.5	0.035
UC-1	60" Diam.	-	5.56	60" Diam.	0.025

TABLE 17

Table 17 Final Reclamation Reclamation Structure Flow Calculations			
Channel	RD-1	RD-2	UC-1
100 year - 6 hour event (in.)	-	-	1.90
10 year - 6 hour event (in.)	1.30	1.30	-
Peak Flow (cfs)	11.91	12.83	55.29
Velocity (fps)	5.28	6.87	10.49
Required Area ($ft.^2$)	2.26	1.87	5.27
Flow Depth (ft.)	0.55	0.47	2.59

Alternate Sediment Control for Fan Site

Sediment Control at the fan site will be accomplished with a combination of one or more of the following: berms, silt fences, and straw bales. The topsoil collected from the fan site will be located down dip from the fan house and will be used in the construction of the berm. The berm will be constructed a minimum of two feet high and have 2:1 side slopes. The berm will control the flow from a 10 year-24 hour precipitation event. Silt fence will be selectively placed to help control run-off. The berm will be stabilized with vegetation to prevent erosion. As much as practical, the vegetation techniques used on the main topsoil pile will be utilized on the fan topsoil berm.

The outside of the berm will be protected with a silt fence or gravel. The gravel, if used, would help augment the revegetation. Construction details of the silt fence/filter fence are shown if Figure 8.

Due to lack of final engineering details, the exact location of the berm and subsequent erosion techniques will be determined in field with the approval of UDOGM. The final determination will be made prior to the start of topsoil removal.

Run-off Calculations

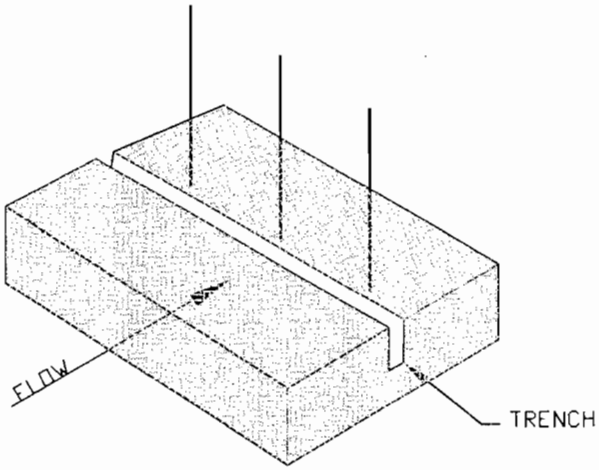
Acreage:	.716 acres
Design Storm:10 year/24 hour:	1.90"
CN:	90
S:	1.111

$$Q = \frac{(P-0.25S)^2}{P+0.8S} = 1.01''$$

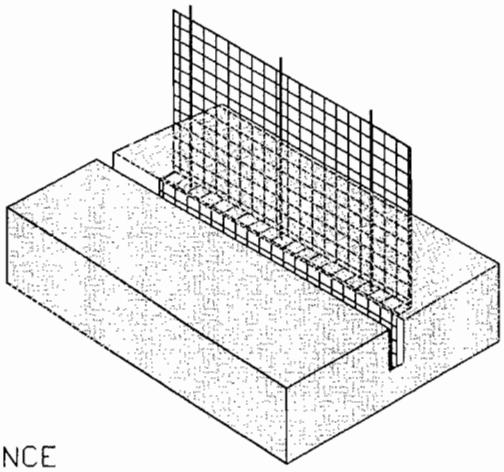
Total run-off = .06 acre feet

FILTER FENCE CONSTRUCTION

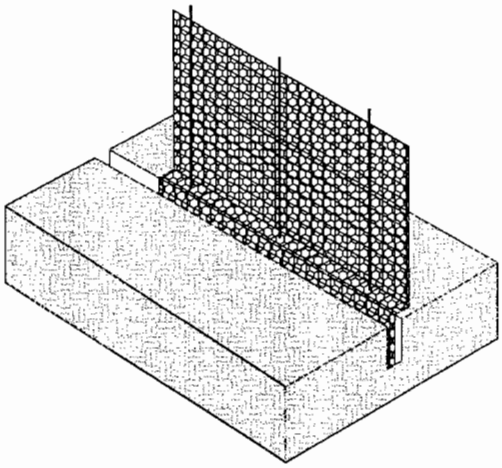
1. SET POSTS, EXCAVATE TRENCH



2. TIE WIRE FENCING TO POST



3. ATTACH FILTER FABRIC TO WIRE FENCE
WIRE AND FABRIC EXTENDS INTO TRENCH



4. BACKFILL AND COMPACT SOIL

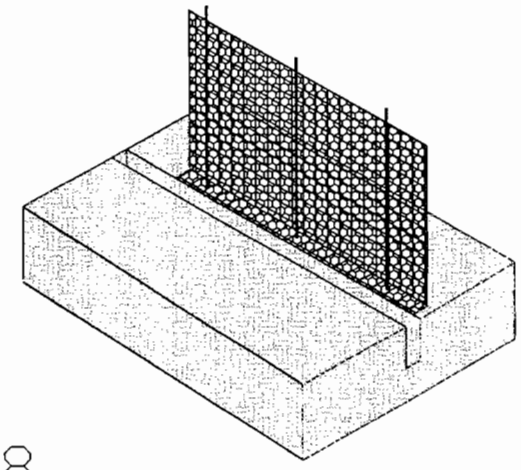


FIGURE 8

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Kathleen Clarke
Executive Director
Robert L. Morgan
State Engineer

1594 West North Temple, Suite 220
PO Box 146300
Salt Lake City, Utah 84114-6300
801-538-7240
801-538-7467 (Fax)

RECEIVED SEP 21

September 16, 1999

Utah American Energy
P.O. Box 986
Price, UT 84501

Re: Regulating Reservoir Application Number 99-91-73MD/UT21742

We have approved your "Application for a Dam not Requiring Submission of Formal Plans Under Section 73-5A-202". Conditions on the approval are as follows:

1. Any storage of water in the reservoir created is subject to all vested water rights.

2. All design and construction activities undertaken shall be commensurate with state-of-the-art standards.

3. Notification of the inspector and contractor for the project shall be submitted to this office prior to the beginning of any construction.

4. All inspectors' journals and results of material testing performed during construction should be submitted to this office.

This Decision is subject to the provisions of Rule R655-6 of the Division of Water Rights and to Sections 63-46b-13 and 73-3-14 of the Utah Code Annotated, 1953 as amended, which provide for filing either a Request for Reconsideration with the State Engineer, or an appeal with the appropriate District Court. A Request for Reconsideration must be filed with the State Engineer within 20 days of the date of this Decision. However, a Request for Reconsideration is not a prerequisite for a court appeal. A court appeal must be filed within 30 days after the date of this Request, or if a Request for Reconsideration has been filed, within 30 days after the date the Request for Reconsideration is denied. A Request for Reconsideration is considered denied when no action is taken 20 days after the Request is filed.

If you have any questions or need further clarification, please feel free to contact me or Mark Page in our Price Regional Office.

Sincerely,

Richard B. Hall P.E.
Assistant State Engineer

RBH/jm

Enclosure

pc: Mark Page - Regional Engineer

Form R-69
3/92

UT 21742

APPLICATION FOR A DAM NOT REQUIRING SUBMISSION OF FORMAL PLANS UNDER SECTION 73-5A-202

Application No 99-91-73 DIE
Received
Entered

STATE OF UTAH

The following application is submitted pursuant to Section 73-5a-204 for a dam meeting the exclusion under Section 73-5a-202(1) (dam under 20 acre-feet not constituting a threat to human life) or the waiver under Section 73-5a-202(3) (dams over 20 acre-feet not constituting a threat to human life or property not held by the owner of the dam).

1. **APPLICANT INFORMATION**
Name(s): Utah American Energy
Address: P.O. Box 986
City: Price State: Utah Zip Code: 84501

2. **PURPOSE OF DAM**
Stock Pond ____ Regulating Res. ____ Diversion Dam ____
Irrigation ____ Debris Basin ____ Flood Control ____
Sedimentation X Tailings Pond ____ Recreation ____
Other (describe) ____

3. **LOCATION OF DAM**
County Emery Quarter/Quarter (i.e. NESW) SESW Section 15
Township 16 S. Range 14 E Base & Meridian S.L.B.&M.

4. **PROPOSED DAM**
Dam Height (vertical distance) 13.0 feet
Crest Length (length of top of dam) 160 feet
Crest Width (width of top of dam) 24 feet
Upstream slope 1 vertical on 3 horizontal
Downstream slope 1 vertical on 3 horizontal
Water surface area at spillway crest 1.076 acres
Reservoir capacity at spillway crest 8.537 ac-ft.
Type of dam (i.e. earthfill, concrete, etc.) Earthfill

5. **PROPOSED OUTLET**
Inside diameter 24 inches Length 14 feet
Type of pipe (i.e. concrete, steel, etc.) C.M.P.
Type of gate or valve N/A - Open Vertical Riser with Oil Skimmer.
Location of gate (upstream, downstream, center, etc.) N/A - Flows to ~~36~~" C.M.P. Below 60" Pipe

6. **PROPOSED SPILLWAY**
Crest Length (width of bottom of spillway) 5 feet
Depth (from bottom of spillway to top of dam) 2 feet
Type (i.e. earth channel, pipe, etc.) Rip-rapped Earth Channel.
Control (i.e. gates, flashboards, etc.) N/A - Open-Channel

7. **WATER RIGHTS**
Describe (see instructions) N/A - Sediment Control Only.

8. COMMENTS

This is a sedimentation pond, designed to contain and treat runoff from the proposed minesite disturbed area for the Lila Canyon Mine. The majority of the pond will be incised within the existing channel. Undisturbed runoff from above will be diverted beneath the pond and road through a ~~36"~~ 60" R/A C.M.P. culvert. The road and portion of culvert are existing.

9. PLANS

Attach plans sketches or diagrams to clarify the information given on this application.

(Attached)

The undersigned acknowledge they have read the instructions included with this application, and are aware no construction is to begin until this application has been approved by the Utah State Engineer.

7/11/99 — Date

R. Jay Marshall — Signature of Applicant

Water Rights in Order By MP Date 9-1-99

Area Engineer's Hazard Rating (low)

Reviewed by Dam Safety By RD Date 9/3/99

Comments

Date of Approval September 3, 1999

For Robert L. Morgan, P.E.
State Engineer

Lila Canyon Mine
Watershed Calculations

```
Project Title          = LILA CANYON UA-3 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     6.0 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   165.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     6.0 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    0.77 cfs
    Discharge volume     =    0.13 acre ft
```

```
Project Title          = LILA CANYON UA-3 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     6.0 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   165.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     6.0 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    2.58 cfs
    Discharge volume     =    0.31 acre ft
```

```
Project Title          = LILA CANYON UA-3 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     6.0 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   165.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     6.0 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.19 cfs
    Discharge volume     =    0.19 acre ft
```

```
Project Title          = LILA CANYON UA-3 (100/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     6.0 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   165.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Forested

-- Total Area            =     6.0 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    2.17 cfs
    Discharge volume     =    0.31 acre ft
```

```
Project Title          = LILA CANYON UA-4 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     7.2 acres
    Hydraulic length          = 1250.00 Feet
    Elevation change          =   595.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type   = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     7.2 acres

-- Storm data
    Total precipitation   =     1.3 inches
    Storm type            = SCS 6 hour design storm
    Peak Discharge        =    0.91 cfs
    Discharge volume      =    0.16 acre ft
```

```
Project Title          = LILA CANYON UA-4 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     7.2 acres
    Hydraulic length          = 1250.00 Feet
    Elevation change          =   595.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     7.2 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    3.08 cfs
    Discharge volume     =    0.38 acre ft
```

```
Project Title          = LILA CANYON UA-4 (100/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     7.2 acres
    Hydraulic length          = 1250.00 Feet
    Elevation change          =   595.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     7.2 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    2.58 cfs
    Discharge volume     =    0.38 acre ft
```

```
Project Title          = LILA CANYON UA-4 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    83.0
    Area                      =     7.2 acres
    Hydraulic length          = 1250.00 Feet
    Elevation change          =   595.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Forested

-- Total Area            =     7.2 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.41 cfs
    Discharge volume     =    0.23 acre ft
```

App 7-4

```
Project Title          = LILA CANYON UA-5 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =    12.3 acres
    Hydraulic length          = 1400.00 Feet
    Elevation change          =   600.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =    12.3 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    5.94 cfs
    Discharge volume     =    0.54 acre ft
```

```
?roject Title          = LILA CANYON UA-5 (10/24)
VATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =    12.3 acres
    Hydraulic length          = 1400.00 Feet
    Elevation change          =   600.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =    12.3 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =   12.14 cfs
    Discharge volume     =    1.03 acre ft
```

```
?roject Title          = LILA CANYON UA-5 (25/6)
VATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =    12.3 acres
    Hydraulic length          = 1400.00 Feet
    Elevation change          =   600.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =    12.3 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    7.65 cfs
    Discharge volume     =    0.70 acre ft
```

```
'roject Title          = LILA CANYON UA-5 (100/6)
/ATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =    12.3 acres
    Hydraulic length          = 1400.00 Feet
    Elevation change          =   600.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =    12.3 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =   11.24 cfs
    Discharge volume     =    1.03 acre ft
```

```
Project Title          = LILA CANYON UA-6 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     6.8 acres
    Hydraulic length          =  625.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     6.8 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    3.28 cfs
    Discharge volume     =    0.30 acre ft
```

```
Project Title          = LILA CANYON UA-6 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     6.8 acres
    Hydraulic length          =  625.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     6.8 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    6.71 cfs
    Discharge volume     =    0.57 acre ft
```

```
?roject Title          = LILA CANYON UA-6 (25/6)
VATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     6.8 acres
    Hydraulic length          =  625.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     6.8 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    4.23 cfs
    Discharge volume     =    0.39 acre ft
```

```
'roject Title          = LILA CANYON UA-6 (100/6)
/ATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     6.8 acres
    Hydraulic length          =  625.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.06 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     6.8 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    6.21 cfs
    Discharge volume     =    0.57 acre ft
```

```
Project Title          = LILA CANYON DA-2 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.5 acres
    Hydraulic length          = 1520.00 Feet
    Elevation change          =   190.0 feet.
    Concentration time        =    0.12 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.5 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.11 cfs
    Discharge volume     =    0.11 acre ft
```

```
Project Title          = LILA CANYON DA-2 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.5 acres
    Hydraulic length          = 1520.00 Feet
    Elevation change          =   190.0 feet.
    Concentration time        =    0.12 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.5 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    2.34 cfs
    Discharge volume     =    0.21 acre ft
```

```
Project Title          = LILA CANYON DA-2 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.5 acres
    Hydraulic length          = 1520.00 Feet
    Elevation change          =   190.0 feet.
    Concentration time        =    0.12 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.5 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.45 cfs
    Discharge volume     =    0.14 acre ft
```

```
Project Title          = LILA CANYON DA-3 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.9 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   100.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.9 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.36 cfs
    Discharge volume     =    0.13 acre ft
```

```
Project Title          = LILA CANYON DA-3 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.9 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   100.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     2.9 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    2.77 cfs
    Discharge volume     =    0.25 acre ft
```

```
Project Title          = LILA CANYON DA-3 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.9 acres
    Hydraulic length          =  650.00 Feet
    Elevation change          =   100.0 feet.
    Concentration time        =    0.05 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.9 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.75 cfs
    Discharge volume     =    0.17 acre ft
```

```
Project Title          = LILA CANYON DA-4 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.6 acres
    Hydraulic length          =  330.00 Feet
    Elevation change          =    25.0 feet.
    Concentration time        =    0.03 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.6 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.12 cfs
    Discharge volume     =    0.12 acre ft
```

```
Project Title          = LILA CANYON DA-4 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.6 acres
    Hydraulic length          =  330.00 Feet
    Elevation change          =    25.0 feet.
    Concentration time        =    0.03 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.6 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    2.28 cfs
    Discharge volume     =    0.22 acre ft
```

```
Project Title          = LILA CANYON DA-4 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     2.6 acres
    Hydraulic length          =  330.00 Feet
    Elevation change          =    25.0 feet.
    Concentration time        =    0.03 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     2.6 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    1.44 cfs
    Discharge volume     =    0.15 acre ft
```

```
Project Title          = LILA CANYON DA-5 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     0.6 acres
    Hydraulic length          =  240.00 Feet
    Elevation change          =    30.0 feet.
    Concentration time        =    0.02 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     0.6 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    0.20 cfs
    Discharge volume     =    0.02 acre ft
```

```
Project Title          = LILA CANYON DA-5 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     0.6 acres
    Hydraulic length          =  240.00 Feet
    Elevation change          =    30.0 feet.
    Concentration time        =    0.02 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     0.6 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    0.41 cfs
    Discharge volume     =    0.05 acre ft
```

```
Project Title          = LILA CANYON DA-5 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     0.6 acres
    Hydraulic length          =  240.00 Feet
    Elevation change          =    30.0 feet.
    Concentration time        =    0.02 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     0.6 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    0.26 cfs
    Discharge volume     =    0.03 acre ft
```

```
Project Title          = LILA CANYON DA-6 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    95.0
    Area                      =     5.1 acres
    Hydraulic length          =  550.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.03 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     5.1 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    3.05 cfs
    Discharge volume     =    0.35 acre ft
```

```
Project Title          = LILA CANYON DA-6 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    95.0
    Area                      =     5.1 acres
    Hydraulic length          =  550.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.03 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     5.1 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    5.17 cfs
    Discharge volume     =    0.59 acre ft
```

```
Project Title          = LILA CANYON DA-6 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    95.0
    Area                      =     5.1 acres
    Hydraulic length          =  550.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.03 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     5.1 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    3.69 cfs
    Discharge volume     =    0.43 acre ft
```

```
Project Title          = LILA CANYON DA-7 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number            =    95.0
    Area                    =     6.9 acres
    Hydraulic length        =  700.00 Feet
    Elevation change        =    50.0 feet.
    Concentration time      =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area           =     6.9 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    4.55 cfs
    Discharge volume     =    0.47 acre ft
```

```
Project Title          = LILA CANYON DA-7 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number              =    95.0
    Area                      =     6.9 acres
    Hydraulic length          =  700.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     6.9 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    7.70 cfs
    Discharge volume     =    0.79 acre ft
```

```
Project Title          = LILA CANYON DA-7 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    95.0
    Area                      =     6.9 acres
    Hydraulic length          =  700.00 Feet
    Elevation change          =    50.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     6.9 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    5.49 cfs
    Discharge volume     =    0.58 acre ft
```

```
Project Title          = LILA CANYON DA-8 (10/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     0.6 acres
    Hydraulic length          =  350.00 Feet
    Elevation change          =    25.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     0.6 acres

-- Storm data
    Total precipitation  =     1.3 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    0.25 cfs
    Discharge volume     =    0.03 acre ft
```

```
Project Title          = LILA CANYON DA-8 (10/24)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     0.6 acres
    Hydraulic length          =  350.00 Feet
    Elevation change          =    25.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type    = Disturbed

-- Total Area            =     0.6 acres

-- Storm data
    Total precipitation  =     1.9 inches
    Storm type           = SCS Type 2 storm, 24 hour storm
    Peak Discharge       =    0.52 cfs
    Discharge volume     =    0.05 acre ft
```

```
Project Title          = LILA CANYON DA-8 (25/6)
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:         Null


-- Watershed data for watershed # 1
    Curve number              =    90.0
    Area                      =     0.6 acres
    Hydraulic length          =  350.00 Feet
    Elevation change          =    25.0 feet.
    Concentration time        =    0.04 hours
    Concentration time type = SCS Upland Curves
    Unit hydrograph type      = Disturbed

-- Total Area            =     0.6 acres

-- Storm data
    Total precipitation  =     1.5 inches
    Storm type           = SCS 6 hour design storm
    Peak Discharge       =    0.33 cfs
    Discharge volume     =    0.03 acre ft
```

Lila Canyon Mine
Ditch Calculations

```
Title of run: DITCH DD-1 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.27
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    3.00
   Slope of diversion.........=  0.1560
   Manning"s n................=   0.035
   CFS........................=    5.94
   Cross section area (sqft)..=    0.95
   Hydrualic radius...........=    0.23
   fps........................=    6.24
   Froude number..............=    2.31
```

Title of run: DITCH DD-1 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.40
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	3.00
Slope of diversion.....=	0.1560
Manning"s n.....=	0.035
CFS.....=	12.14
Cross section area (sqft)..=	1.54
Hydrualic radius.....=	0.32
fps.....=	7.87
Froude number.....=	2.45

```
Title of run: DITCH DD-2 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.22
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    2.00
   Slope of diversion.........=  0.1250
   Manning"s n................=   0.035
   CFS........................=    2.60
   Cross section area (sqft)..=    0.54
   Hydrualic radius...........=    0.18
   fps........................=    4.81
   Froude number..............=    1.99
```

```
Title of run: DITCH DD-2 (10/24)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.40
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    2.00
   Slope of diversion.........=  0.1250
   Manning"s n................=   0.035
   CFS........................=    7.36
   Cross section area (sqft)..=    1.11
   Hydrualic radius...........=    0.29
   fps........................=    6.65
   Froude number..............=    2.16
```

```
Title of run: DITCH DD-3 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.15
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    2.00
   Slope of diversion.........=  0.1460
   Manning"s n................=   0.035
   CFS........................=    1.36
   Cross section area (sqft)..=    0.33
   Hydrualic radius...........=    0.13
   fps........................=    4.08
   Froude number..............=    2.03
```

Title of run: DITCH DD-3 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.22
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	2.00
Slope of diversion.....=	0.1460
Manning"s n.....=	0.035
CFS.....=	2.77
Cross section area (sqft)..=	0.54
Hydrualic radius.....=	0.18
fps.....=	5.18
Froude number.....=	2.15

```
Title of run: DITCH DD-4 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.14
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    1.00
   Slope of diversion.........=  0.2070
   Manning"s n................=   0.035
   CFS........................=    0.77
   Cross section area (sqft)..=    0.17
   Hydrualic radius...........=    0.11
   fps........................=    4.40
   Froude number..............=    2.36
```

```
Title of run: DITCH DD-4 (10/24)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.27
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    1.00
   Slope of diversion.........=  0.2070
   Manning"s n................=   0.035
   CFS........................=    2.58
   Cross section area (sqft)..=    0.41
   Hydrualic radius...........=    0.19
   fps........................=    6.32
   Froude number..............=    2.58
```

```
Title of run: DITCH DD-5 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.07
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    1.00
   Slope of diversion.........=  0.1530
   Manning"s n................=   0.035
   CFS........................=    0.20
   Cross section area (sqft)..=    0.08
   Hydrualic radius...........=    0.06
   fps........................=    2.55
   Froude number..............=    1.84
```

```
Title of run: DITCH DD-5 (10/24)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.10
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    1.00
   Slope of diversion.........=  0.1530
   Manning"s n................=   0.035
   CFS........................=    0.41
   Cross section area (sqft)..=    0.13
   Hydrualic radius...........=    0.09
   fps........................=    3.24
   Froude number..............=    1.95
```

```
Title of run: DITCH DD-6 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.34
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    2.00
   Slope of diversion.........=  0.0500
   Manning"s n................=   0.035
   CFS........................=    3.57
   Cross section area (sqft)..=    0.92
   Hydrualic radius...........=    0.26
   fps........................=    3.88
   Froude number..............=    1.34
```

Title of run: DITCH DD-6 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.61
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	2.00
Slope of diversion.....=	0.0500
Manning"s n.....=	0.035
CFS.....=	10.35
Cross section area (sqft)..=	1.96
Hydrualic radius.....=	0.41
fps.....=	5.29
Froude number.....=	1.45

```
Title of run: DITCH DD-7 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.37
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    2.50
   Slope of diversion.........=  0.0740
   Manning"s n................=   0.035
   CFS........................=    6.05
   Cross section area (sqft)..=    1.20
   Hydrualic radius...........=    0.29
   fps........................=    5.05
   Froude number..............=    1.66
```

Title of run: DITCH DD-7 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.62
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	2.50
Slope of diversion.....=	0.0740
Manning"s n.....=	0.035
CFS.....=	15.40
Cross section area (sqft)..=	2.30
Hydrualic radius.....=	0.44
fps.....=	6.68
Froude number.....=	1.78

Title of run: DITCH DD-8 (10/6)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.29
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	2.00
Slope of diversion.....=	0.0690
Manning"s n.....=	0.035
CFS.....=	3.05
Cross section area (sqft)..=	0.74
Hydrualic radius.....=	0.22
fps.....=	4.13
Froude number.....=	1.54

Title of run: DITCH DD-8 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.38
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	2.00
Slope of diversion.....=	0.0690
Manning"s n.....=	0.035
CFS.....=	5.17
Cross section area (sqft)..=	1.06
Hydrualic radius.....=	0.29
fps.....=	4.86
Froude number.....=	1.60

```
Title of run: DITCH DD-9 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.54
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    2.50
   Slope of diversion.........=  0.0300
   Manning"s n................=   0.035
   CFS........................=    7.60
   Cross section area (sqft)..=    1.92
   Hydrualic radius...........=    0.39
   fps........................=    3.95
   Froude number..............=    1.11
```

Title of run: DITCH DD-9 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.71
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	2.50
Slope of diversion.....=	0.0300
Manning"s n.....=	0.035
CFS.....=	12.87
Cross section area (sqft)..=	2.80
Hydrualic radius.....=	0.49
fps.....=	4.60
Froude number.....=	1.15

```
Title of run: DITCH DD-10 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.12
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    1.00
   Slope of diversion.........=  0.0400
   Manning"s n................=   0.035
   CFS........................=    0.25
   Cross section area (sqft)..=    0.14
   Hydrualic radius...........=    0.09
   fps........................=    1.76
   Froude number..............=    1.01
```

Title of run: DITCH DD-10 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.17
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	1.00
Slope of diversion.....=	0.0400
Manning"s n.....=	0.035
CFS.....=	0.52
Cross section area (sqft)..=	0.24
Hydrualic radius.....=	0.13
fps.....=	2.21
Froude number.....=	1.07

```
Title of run: DITCH DD-11 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.51
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    3.00
   Slope of diversion.........=  0.0590
   Manning"s n................=   0.035
   CFS........................=   11.13
   Cross section area (sqft)..=    2.03
   Hydrualic radius...........=    0.39
   fps........................=    5.48
   Froude number..............=    1.55
```

```
Title of run: DITCH DD-11 (10/24)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.70
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    3.00
   Slope of diversion.........=  0.0590
   Manning"s n................=   0.035
   CFS........................=   20.01
   Cross section area (sqft)..=    3.07
   Hydrualic radius...........=    0.50
   fps........................=    6.52
   Froude number..............=    1.62
```

Title of run: DITCH DD-12 (10/6)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.51
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	3.00
Slope of diversion.....=	0.0680
Manning"s n.....=	0.035
CFS.....=	11.99
Cross section area (sqft)..=	2.04
Hydrualic radius.....=	0.39
fps.....=	5.89
Froude number.....=	1.67

Title of run: DITCH DD-12 (10/24)

Solving for.....= Depth Normal

Trapedeziod

Flow depth (ft).....=	0.80
First Side slope.....=	2.0
Second Side slope.....=	2.0
Bottom width (ft).....=	3.00
Slope of diversion.....=	0.0680
Manning"s n.....=	0.035
CFS.....=	27.54
Cross section area (sqft)..=	3.66
Hydrualic radius.....=	0.56
fps.....=	7.52
Froude number.....=	1.77

```
Title of run: DITCH RD-1 (10/6)
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.55
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    3.00
   Slope of diversion.........=  0.0500
   Manning"s n................=   0.035
   CFS........................=   11.91
   Cross section area (sqft)..=    2.26
   Hydrualic radius...........=    0.41
   fps........................=    5.28
   Froude number..............=    1.45
```

```
   Solving for................= Depth Normal
Trapedeziod
   Flow depth (ft)............=    0.47
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Bottom width (ft)..........=    3.00
   Slope of diversion.........=  0.1000
   Manning"s n................=   0.035
   CFS........................=   12.83
   Cross section area (sqft)..=    1.87
   Hydrualic radius...........=    0.36
   fps........................=    6.87
   Froude number..............=    2.01
```

Lila Canyon Mine
Culvert Calculations

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: UNDISTURBED CULVERT UC-1 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.1000 ft/ft
Manning's n.....	0.025
Discharge.....	7.02 cfs

Computed Results:

Full Flow Diameter.....	1.07 ft
Full Flow Depth.....	1.07 ft
Velocity.....	7.80 fps
Flow Area.....	0.90 sf
Critical Depth....	1.02 ft
Critical Slope....	0.0867 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	7.02 cfs
QMAX @.94D.....	7.55 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: UNDISTURBED CULVERT UC-1 (100/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.1000 ft/ft
Manning's n.....	0.025
Discharge.....	20.48 cfs

Computed Results:

Full Flow Diameter.....	1.60 ft
Full Flow Depth.....	1.60 ft
Velocity.....	10.20 fps
Flow Area.....	2.01 sf
Critical Depth....	1.54 ft
Critical Slope....	0.0874 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	20.48 cfs
QMAX @.94D.....	22.03 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: UNDISTURBED CULVERT UC-2 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0556 ft/ft
Manning's n.....	0.025
Discharge.....	38.21 cfs

Computed Results:

Full Flow Diameter.....	2.26 ft
Full Flow Depth.....	2.26 ft
Velocity.....	9.57 fps
Flow Area.....	3.99 sf
Critical Depth....	2.07 ft
Critical Slope....	0.0483 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	38.21 cfs
QMAX @.94D.....	41.10 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: UNDISTURBED CULVERT UC-2 (100/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0556 ft/ft
Manning's n.....	0.025
Discharge.....	51.67 cfs

Computed Results:

Full Flow Diameter.....	2.53 ft
Full Flow Depth.....	2.53 ft
Velocity.....	10.32 fps
Flow Area.....	5.01 sf
Critical Depth....	2.33 ft
Critical Slope....	0.0482 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	51.67 cfs
QMAX @.94D.....	55.58 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: UNDISTURBED CULVERT UC-2 (100/6) COND.III

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0556 ft/ft
Manning's n.....	0.025
Discharge.....	55.29 cfs

Computed Results:

Full Flow Diameter.....	2.59 ft
Full Flow Depth.....	2.59 ft
Velocity.....	10.49 fps
Flow Area.....	5.27 sf
Critical Depth....	2.39 ft
Critical Slope....	0.0482 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	55.29 cfs
QMAX @.94D.....	59.48 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-5 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0500 ft/ft
Manning's n.....	0.025
Discharge.....	2.80 cfs

Computed Results:

Full Flow Diameter.....	0.86 ft
Full Flow Depth.....	0.86 ft
Velocity.....	4.78 fps
Flow Area.....	0.59 sf
Critical Depth....	0.73 ft
Critical Slope....	0.0470 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	2.80 cfs
QMAX @.94D.....	3.01 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-5 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0500 ft/ft
Manning's n.....	0.025
Discharge.....	7.77 cfs

Computed Results:

Full Flow Diameter.....	1.27 ft
Full Flow Depth.....	1.27 ft
Velocity.....	6.17 fps
Flow Area.....	1.26 sf
Critical Depth....	1.10 ft
Critical Slope....	0.0454 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	7.77 cfs
QMAX @.94D.....	8.36 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-6 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0500 ft/ft
Manning's n.....	0.025
Discharge.....	4.93 cfs

Computed Results:

Full Flow Diameter.....	1.07 ft
Full Flow Depth.....	1.07 ft
Velocity.....	5.51 fps
Flow Area.....	0.89 sf
Critical Depth....	0.92 ft
Critical Slope....	0.0461 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	4.93 cfs
QMAX @.94D.....	5.30 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-6 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0500 ft/ft
Manning's n.....	0.025
Discharge.....	13.12 cfs

Computed Results:

Full Flow Diameter.....	1.54 ft
Full Flow Depth.....	1.54 ft
Velocity.....	7.04 fps
Flow Area.....	1.86 sf
Critical Depth....	1.36 ft
Critical Slope....	0.0448 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	13.12 cfs
QMAX @.94D.....	14.11 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-7 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0800 ft/ft
Manning's n.....	0.025
Discharge.....	6.05 cfs

Computed Results:

Full Flow Diameter.....	1.06 ft
Full Flow Depth.....	1.06 ft
Velocity.....	6.92 fps
Flow Area.....	0.87 sf
Critical Depth....	0.98 ft
Critical Slope....	0.0692 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	6.05 cfs
QMAX @.94D.....	6.51 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-7 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0800 ft/ft
Manning's n.....	0.025
Discharge.....	15.40 cfs

Computed Results:

Full Flow Diameter.....	1.50 ft
Full Flow Depth.....	1.50 ft
Velocity.....	8.74 fps
Flow Area.....	1.76 sf
Critical Depth....	1.41 ft
Critical Slope....	0.0692 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	15.40 cfs
QMAX @.94D.....	16.57 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-8 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0300 ft/ft
Manning's n.....	0.025
Discharge.....	3.05 cfs

Computed Results:

Full Flow Diameter.....	0.98 ft
Full Flow Depth.....	0.98 ft
Velocity.....	4.03 fps
Flow Area.....	0.76 sf
Critical Depth....	0.75 ft
Critical Slope....	0.0344 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	3.05 cfs
QMAX @.94D.....	3.28 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-8 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0300 ft/ft
Manning's n.....	0.025
Discharge.....	5.17 cfs

Computed Results:

Full Flow Diameter.....	1.20 ft
Full Flow Depth.....	1.20 ft
Velocity.....	4.60 fps
Flow Area.....	1.12 sf
Critical Depth....	0.93 ft
Critical Slope....	0.0332 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	5.17 cfs
QMAX @.94D.....	5.56 cfs
Froude Number.....	FULL

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-9 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0300 ft/ft
Manning's n.....	0.025
Discharge.....	0.25 cfs

Computed Results:

Full Flow Diameter.....	0.38 ft
Full Flow Depth.....	0.38 ft
Velocity.....	2.16 fps
Flow Area.....	0.12 sf
Critical Depth....	0.27 ft
Critical Slope....	0.0414 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	0.25 cfs
QMAX @.94D.....	0.27 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LILA CANYON

Comment: DISTURBED CULVERT DC-9 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.....	0.0300 ft/ft
Manning's n.....	0.025
Discharge.....	0.52 cfs

Computed Results:

Full Flow Diameter.....	0.51 ft
Full Flow Depth.....	0.51 ft
Velocity.....	2.59 fps
Flow Area.....	0.20 sf
Critical Depth....	0.37 ft
Critical Slope....	0.0390 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	0.52 cfs
QMAX @.94D.....	0.56 cfs
Froude Number.....	FULL

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