APPENDIX 7-4

WEST RIDGE MINE
SEDIMENTATION AND DRAINAGE CONTROL PLAN
(AS CONSTRUCTED)

STATE OF UTAH REGISTERED PROFESSIONAL ENGINEER
#154168
DAN W. GUY
12/18/02

PREPARED BY: **DAN W. GUY, P.E.**
BLACKHAWK ENGINEERING, INC.
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APPENDICES

WEST RIDGE MINE
SEDIMENTATION AND DRAINAGE CONTROL PLAN

1. Introduction

The Sedimentation and Drainage Control Plan for the West Ridge Mine has been designed according to the State of Utah R645 - Coal Mining Rules, September 1996. The mine was constructed in 1999. This plan represents the as-constructed drainage control plan. All design criteria and construction has been certified by a Utah Registered Professional Engineer.

The plan has been divided into the following three sections:

1) Design of Drainage Control Structures
2) Design of Sediment Control Structures
3) Design of Drainage Control Structures for Reclamation

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

a) Undisturbed drainage from the canyon above the minesite is diverted beneath the site via a properly sized culvert and be discharged below the disturbed area;

b) The right and left forks and major side drainages into the mine area are also diverted beneath the disturbed area via properly sized culverts. The culverts tie into the main canyon culvert and undisturbed runoff discharges below the disturbed area as described previously;

c) The entire disturbed area (except 4 small, Alternate Sediment Control Areas), and portions of the undisturbed area not diverted, are drained to the lower end of the property via properly sized ditches and culverts, where runoff is captured in a sedimentation pond.

d) Four small areas are treated as Alternate Sediment Control Areas (A.S.C.A.).

These areas consist of a test plot/topsoil storage area in the Right Fork, a rip-rapped culvert inlet area in the Left Fork, the office/pad area and a portion of the west side of the county road below the sediment ponds. These areas are described in detail under Section 2.11.

e) **At the present time, some water is being discharged from the mine. Since the mine is not sufficiently developed to provide large settling sumps at this time, the mine water is pumped into the upper cell of the sediment pond, where it is evaporated or sufficiently cleaned and discharged. Mine water will be pumped from the pond and discharged in accordance with the UPDES Permit, when it reaches a level at (or below) the 100% sediment level shown on the sediment markers. The mine water will utilize only the "dead" or sediment storage volume of the pond; therefore, adequate volume will be available in the pond for a 10 year - 24 hour design storm. Design details for the sediment pond are provided in Section 3.1.**

Water is pumped from the mine at a maximum rate of 230 gpm or 0.51 cfs. Mine water will discharged from a pipe into ditch DD-4A, to culvert DC-4A, to ditch DD-5, to culvert DC-6, to ditch DD-6, to culvert DD-7, to ditch DD-8A, to culvert DC-8A, to ditch DD-11, to culvert DC-11, to culvert DC-13 and into the upper cell (A) of the sediment pond.

All affected culverts and ditches have been sized to adequately carry the required 10 year- 24 hour runoff, plus the mine water and maintain 0.5' of freeboard.

The mine water may be discharged directly to the bypass culvert at UPDES 002, as shown on Plate 7-2. Existing mine sumps handle the current mine water volume and the anticipated volume for several years; however, occasionally, total suspended solids have been a concern on a visual basis (samples have shown no exceedences). Initial mine water volumes were in the order of 10 gpm or less on a 24 hour basis. Currently, the volume has increased to 80 gpm on a 24 hour basis. Until longwall panels 1 thru 5 are mined out (approximately late 2004 - early 2005) the mine water will pass thru the existing sumps. The mined out area of panels 1 thru 5 will provide a very large sump with the inflow and outtake points a considerable distance apart, which will greatly reduce the suspended solids. Until the larger sump is available, the mine water discharge will pass into the upper cell of the sediment pond, thru a filtering system and to the UPDES 001 discharge point or directly to the UPDES 002 discharge point.

f) 3 - nominal 9" pipes have been installed just upstream from the inlet to culvert DC-8A within the freeboard area of Ditch DD-8A. These pipes are intended to be used as relief culverts for culvert DC-8A, in the event of a storm exceeding the 10 year - 24 hour design. This relief would allow approximately 5.19 cfs to flow to ditch DD-12 and culvert DC-12. Although this would be expected to occur only during a storm event exceeding the 10 year - 24 hour event, both ditch DD-12 and culvert DC-12 are adequately sized to carry the 10 year - 24 hour event, plus the 5.19 cfs from the relief culverts. This will help prevent a potential overflow and subsequent erosion of the road in the event of storm runoff exceeding the required 10 year - 24 hour design.

DESIGN OF DRAINAGE CONTROL STRUCTURES

Design Parameters

2.1 Precipitation

The precipitation-frequency values for the area were taken from "NOAA, Precipitation-Frequency Atlas of the Western U.S., Atlas 2, Volume VI.

Frequency - Duration	Precipitation
2 year - 6 hour	0.82"
10 year - 6 hour	1.30"
10 year - 24 hour	2.00"
25 year - 6 hour	1.60"
25 year - 24 hour	2.40
100 year - 6 hour	2.00"
50 year - 24 hour	2.60"

Disturbed ditch and culvert designs for runoff control are based on the 10 year - 24 hour event of 2.00" and the 25 year - 6 hour event of 1.60", where required. Undisturbed culvert designs are based on the 10 year - 24 hour event of 2.00".

The sedimentation pond is designed to contain the runoff from a 10 year - 24 hour event of 2.00" as required by the Division. Reclamation designs are based on the 100 year - 6 hour event of 2.00", where applicable for permanent structures.

ASCA areas are sized to contain or treat runoff from a 10 year - 24 hour precipitation event.

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. (Trapezoidal Channel Flow). 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 t_c**
	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:

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

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)	0.020
Rip-rapped or Natural Drainage Channels	0.035 - 0.040
Unlined Disturbed Area Ditches	0.035 - 0.040
Bedrock Channels with Rubble	0.030
Concrete Lined Channels	0.015

2.4 Drainage Areas

All drainage areas were planimetered directly from As-Constructed Maps 7-1 (Drainage Area Map) and 7-2 (Minesite Drainage Plan).

2.5 Slopes, Lengths

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

2.6 Runoff

Runoff was calculated using the SCS Formula for Type II Storm:

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

where:

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

2.7 Runoff Curve Numbers

Due to the variability of soil types and resulting runoff potential of the drainage areas, a runoff curve number was calculated for each drainage area using a weighted average. The respective area for each soil type occurring in the drainages were planimetered directly from Map 7-1.

Curve numbers for the various soil types have been discussed with the Division, and are based on the SCS determination for Runoff Curve Numbers for Antecedent Moisture Condition II. Soil types and areas were taken from the SCS Soils Report and the August 1997 Soils Report for the area (see Appendix 1). The following will show the soils type and resulting runoff curve number for each (unit numbers are taken from the Soils Report):

Unit	Description	Hydrologic Soils Group	Runoff Curve Number
5	Beje Complex - Mountain Ridgetops	C	70
7	Beje - Trag Complex - Plateaus	C	70
21	Croydon Loam - Foot Slopes	B	59
62	Mid fork - Comodore Complex - Mountain Slopes	B	64
96	Rubbleland - Travessilla Complex - Rock Outcrop	D	80
Disturbed	Disturbed Area	-	90

The weighted average runoff curve numbers for each drainage area are summarized in Table 1 - "Undisturbed Drainage Areas - Runoff Curve Number Summary".

2.8 Culvert Sizing

All culverts were sized using the "Haestad Methods, Flowmaster I, Version 3.43" Computer Program.

Minimum culvert sizing is based on the following Manning's Equation:

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

where:	**D**	**=**	**Required Diameter (ft.)**
	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 Map 7-2, Minesite Hydrology. Culverts carrying undisturbed drainages are designated with UC-Letters (i.e. UC-AA). All undisturbed area drainage culverts will be fitted with trash racks to minimize plugging by rocks or other debris.

Trash racks are provided at the inlet for all undisturbed drainage culverts. These consist of 3/4" steel bars welded on 6" centers across the flared inlet structures of each culvert. Bars are 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 has been placed around the flared inlet structure and above it to a height of at least 6" above the required headwall for each culvert. Trash racks will be checked on a routine schedule and following

precipitation events and all trash, branches and other obstructions will be removed.

The outlet of the main canyon bypass culvert (UC-OO) has been equipped with an adequately sized rip-rap apron to slow the outlet velocity sufficiently to prevent erosional damage to the natural downstream channel. (See Figure 6).

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 Minesite Drainage Plan, Map 7-2. 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).

A series of 3 - 0.64' diameter pipes have been added above culvert DC-8A. These pipes are designated DC-8AR and are intended to provide relief for culvert DC-8A in the event of a storm event exceeding the 10 year - 24 hour design. This will help prevent potential overflow and erosion of the road in this area, should such an event occur. The overflow water would flow to ditch DD-12 and culvert DC-12 and to the lower cell of the sediment pond. The ditch and culvert are both adequately sized to carry the additional runoff from these pipes.

Undisturbed drainage areas report to undisturbed area drainage culverts with corresponding subscripted letters; for example undisturbed drainage area UA-FF reports to undisturbed area drainage culvert UC-FF. Other undisturbed drainage areas, subscripted with numbers, report to disturbed drainage area ditches with corresponding subscripted numbers; for example undisturbed drainage area UA-3 reports to disturbed area drainage ditch DD-3.

Design detail for all undisturbed drainage culverts is shown on the Undisturbed Drainage Culvert Profile, Map 5-8.

Culverts will be inspected regularly, and cleaned as necessary to provide for

entire ditch. The dissipaters will be allowed to fill with sediment, which will effectively reduce the ditch slope from 6.30% to 5.70% and the velocity from 6.88 fps to 5.99 fps between dissipaters. The energy dissipaters are placed in such a manner as to provide minimum ditch area requirements above the flow line of the structure. Typical installation is shown on Figure 4A of this section.

Ditches that are required to carry mine water have been sized to carry the required runoff from a 10 year- 24 hour precipitation event in addition to the mine water, and maintain a 0.5' of freeboard at all times. (See Table 13)

Ditch slopes have been determined from Map 7-2.

All ditches will be inspected regularly, and maintained to the minimum dimensions for the required 10 year - 24 hour runoff 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)

2.11 Alternate Sediment Control Areas (ASCA)

There are 4 Alternate Sediment Control Areas on this site. These areas are labeled ASCA-W, ASCA-X, ASCA-Y and ASCA-Z on the Minesite Drainage Plan.

ASCA -W is the portion of the west side of the county road from Culvert DC-12 to the County Culvert below the Office Pad. The total ASCA area is 1.33 acres. The area is drained by ditch UD-15. Sediment treatment is accomplished by straw bales or silt fences in the ditch, as well as side slope revegetation. The area below ASCA-W to the gate is County Road and not included in the mine plan drainage control.

ASCA-X is the test plot area and upper portion of the topsoil storage area in the upper right fork of the minesite. The total area is 1.19 acres. Approximately 0.14 acres is the test plot area. The upper end of the topsoil pile within the ASCA is approximately 0.16 acres. This area utilizes a containment. The containment has been measured and found to have a volume of 0.04 acre feet as shown on Figure 7. The calculation of runoff from the area draining to the containment from a 10 year - 24 hour event is 0.01 acre feet; therefore, the containment is more than adequate to hold the runoff from the design event. The containment is presently 3' in depth. When sediment accumulates to one half that depth, or 1.5', the containment will be cleaned. A marker will be placed to designate the cleaning level. All treatment methods utilized within ASCA-X are shown within the ASCA legend on Map 7-2. The balance of the ASCA is considered undisturbed.

ASCA-Y is a rip-rapped area from the pad to the culvert inlet in the upper end of the left fork of the minesite. This is an area of approximately 0.04 acres. The area is treated by a complete covering of large rock to prevent erosion.

ASCA-Z is the office pad area. This is an area of approximately 1.62 acres. The area is sloped to drain to the northeast where runoff is primarily retained and evaporated. Also installed at the retention area are a small drain and gravel field to provide some percolation of runoff from small events. Larger, design events, are primarily treated by containment and evaporation with minor treatment by absorption or percolation. The entire pad area is covered with a durable rock (slag). The ASCA also includes the outslope of the lower pad down to the main channel. This area is treated by a rock armor, vegetation and a silt fence below.

It should be noted that these calculations are based on a 100 year - 6 hour event, even though the culvert is temporary and will be removed upon reclamation.

2.13 Rip-Rap Design

Wherever rip-rap is designated to be used, i.e. Culvert Outlets or Unlined Ditches, the following procedure shall be used:

(1) Rip-rap will consist of hard, non-slaking angular, material;

(2) Rip-rap shall meet the following size criteria:

Rip-Rap Sizing	Percent (+ or - 10%)
0.1 D_{50} - 0.5 D_{50}	20
0.5 D_{50} - 1.0 D_{50}	30
1.0 D_{50} - 2.0 D_{50}	50

(3) Rip-rap shall be placed over a filter bedding consisting of -3/4" gravel and placed to a depth of at least the D_{50} of the rip-rap;

(4) Rip-rap depth shall be at least 1.5 times the D_{50} of the material;

(5) Concrete lining or grouting of rip-rap may be used in lieu of the above procedures.

TABLE 1
UNDISTURBED DRAINAGE AREAS - RUNOFF CURVE NUMBER SUMMARY

	CN	59	70	64	80	70	
Drainage Area ID	**Total Acres**	**Unit 21**	**Unit 5**	**Unit 62**	**Unit 96**	**Unit 7**	**Weighted CN**
UA-AA	**732.00**	**90.51**	**12.97**	**218.82**	**375.63**	**34.07**	**71.98**
%		**12.5%**	**1.8%**	**29.9%**	**51.3%**	**4.5%**	**Use 72**
UA-DD	**22.46**		**3.39**	**19.07**			**64.91**
%		**0.0%**	**15.1%**	**84.9%**	**0.0%**	**0.0%**	**Use 65**
UA-FF	**23.32**		**2.61**	**20.71**			**64.67**
%		**0.0%**	**11.2%**	**88.8%**	**0.0%**	**0.0%**	**Use 65**
UA-HH	**236.80**	**43.21**			**181.91**	**11.68**	**75.67**
%		**18.2%**	**0.0%**	**0.0%**	**76.8%**	**5.0%**	**Use 76**
UA-JJ	**7.21**				**7.21**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-MM	**13.78**		**0.62**	**13.16**			**64.27**
%		**0.0%**	**4.5%**	**95.5%**	**0.0%**	**0.0%**	**Use 64**
UA-PP	**16.90**		**0.19**	**15.97**	**0.74**		**64.77**
%		**0.0%**	**1.1%**	**94.5%**	**4.4%**	**0.0%**	**Use 65**

TABLE 1 (Continued)
UNDISTURBED DRAINAGE AREAS - RUNOFF CURVE NUMBER SUMMARY

	CN=	59	70	64	80	70	
Drainage Area ID	**Total Acres**	**Unit 21**	**Unit 5**	**Unit 62**	**Unit 96**	**Unit 7**	**Weighted CN**
UA-1a	**10.27**		**0.17**	**10.10**			**64.10**
%		**0.0%**	**1.7%**	**98.3%**	**0.0%**	**0.0%**	**Use 64**
UA-1b	**14.53**			**0.46**	**14.07**		**79.49**
%		**0.0%**	**0.0%**	**3.2%**	**96.8%**	**0.0%**	**Use 80**
UA-2a	**3.55**			**3.55**			**64.00**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**
UA-2b	**10.25**			**0.04**	**10.21**		**79.93**
%		**0.0%**	**0.0%**	**0.4%**	**99.6%**	**0.0%**	**Use 80**
UA-3	**7.77**				**7.77**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-4	**3.57**			**3.57**			**64.00**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**
UA-5	**1.28**			**1.28**			**64.00**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**
UA-7	**2.97**			**2.97**			**64.00**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**
UA-8	**0.81**				**0.81**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-9	**3.43**			**3.43**			**64.00**

TABLE 1 (Continued)
UNDISTURBED DRAINAGE AREAS - RUNOFF CURVE NUMBER SUMMARY

	CN=	59	70	64	80	70	
Drainage Area ID	**Total Acres**	**Unit 21**	**Unit 5**	**Unit 62**	**Unit 96**	**Unit 7**	**Weighted CN**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**
UA-10a	**3.71**	**1.00**			**2.71**		**74.34**
%		**27.0%**	**0.0%**	**0.0%**	**73.0%**	**0.0%**	**Use 74**
UA-10b	**3.85**				**3.85**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-10c	**1.50**				**1.50**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-12	**12.59**				**12.59**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-14	**4.30**			**4.30**			**64.00**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**
UA-15	**5.10**				**5.10**		**80.00**
%		**0.0%**	**0.0%**	**0.0%**	**100.0%**	**0.0%**	**Use 80**
UA-16	**0.51**			**0.51**			**64.00**
%		**0.0%**	**0.0%**	**100.0%**	**0.0%**	**0.0%**	**Use 64**

TABLE 2
HYDROLOGIC SUMMARY

Drainage	Area (acres)	Type	Drains To:	Runoff CN
UA-AA	732.00	UNDISTURBED	CULVERT UC-AA	72
UA-DD	22.46	UNDISTURBED	CULVERT UC-DD	65
UA-FF	23.32	UNDISTURBED	CULVERT UC-FF	65
UA-HH	236.80	UNDISTURBED	CULVERT UC-HH	76
UA-JJ	7.21	UNDISTURBED	CULVERT UC-JJ	80
UA-MM	13.78	UNDISTURBED	CULVERT UC-MM	64
UA-PP	16.90	UNDISTURBED	CULVERT UC-PP	65
UA-1a	10.27	UNDISTURBED	SEDIMENT POND	64
UA-1b	14.53	UNDISTURBED	SEDIMENT POND	80
UA-2a	3.55	UNDISTURBED	SEDIMENT POND	64
UA-2b	10.25	UNDISTURBED	SEDIMENT POND	80
UA-3	7.77	UNDISTURBED	SEDIMENT POND	80
UA-4	3.57	UNDISTURBED	SEDIMENT POND	64
UA-5	1.28	UNDISTURBED	SEDIMENT POND	64
UA-7	2.97	UNDISTURBED	SEDIMENT POND	64
UA-8	0.81	UNDISTURBED	SEDIMENT POND	80
UA-9	3.43	UNDISTURBED	SEDIMENT POND	64
UA-10a	3.71	UNDISTURBED	SEDIMENT POND	74
UA-10b	3.85	UNDISTURBED	SEDIMENT POND	80
UA-10c	1.50	UNDISTURBED	SEDIMENT POND	80
UA-12	12.59	UNDISTURBED	SEDIMENT POND	80
UA-14	4.30	UNDISTURBED	SEDIMENT POND	64
UA-15	5.10	UNDISTURBED	COUNTY ROAD	80
UA-16	0.51	UNDISTURBED	SILT FENCE	64
DA-W	1.33	DISTURBED (ASCA)	COUNTY CULVERT	90
DA-X	1.19	DISTURBED (ASCA)	CULVERT UC-AA	90
DA-Y	0.04	DISTURBED (ASCA)	CULVERT UC-HH	90
DA-Z	1.62	DISTURBED (ASCA)	CULVERT DC-16	83

TABLE 3
UNDISTURBED DRAINAGE AREA DATA

Area ID	Hydraulic Length	High Elevation	Low Elevation	Change Elevation	Slope %	Runoff CN
UA-AA	6400	8866	7128	1738	27.16	72
UA-DD	1650	8040	7100	940	56.97	65
UA-FF	1579	8080	7080	1000	63.33	65
UA-HH	4262	8680	7064	1616	37.92	76
UA-JJ	1285	7980	7094	886	68.95	80
UA-MM	1722	8115	7002	1113	64.63	64
UA-PP	1723	8115	6932	1183	68.66	65
UA-1a	1556	8038	7108	930	59.77	64
UA-1b	1427	7920	7120	800	56.06	80
UA-2a	917	7720	7110	610	66.52	64
UA-2b	972	7880	7112	768	79.01	80
UA-3	780	7700	7122	578	74.10	80
UA-4	850	7720	7092	628	73.88	64
UA-5	400	7420	7122	298	74.50	64
UA-7	880	7620	7052	568	64.55	64
UA-8	403	7480	7132	348	86.35	80
UA-9	850	7620	7036	584	68.71	64
UA-10a	605	7640	7112	528	87.27	74
UA-10b	1282	7980	7106	874	68.17	80
UA-10c	571	7440	7070	370	64.80	80
UA-12	1250	7890	6996	894	71.52	80
UA-14	630	7400	6982	418	66.35	64
UA-15	580	7440	6968	472	81.38	80
UA-16	340	7220	6948	272	80.00	64

TABLE 4
UNDISTURBED DRAINAGE SUMMARY

Drainage Area	10 yr - 6 hr 1.30"	10 yr - 24 hr 2.00"		25 yr- 6 hr 1.60"	100 yr - 6 hr 2.00"
	Peak Flow (Cfs)	Peak Flow (Cfs)	Runoff (ac.ft)	Peak Flow (Cfs)	Peak Flow (Cfs)
UA-AA	12.48	44.04	17.83	24.94	45.45
UA-DD	0.15	0.64	0.25	0.44	0.92
UA-FF	0.16	0.67	0.26	0.46	0.95
UA-HH	7.37	32.78	8.16	13.05	25.44
UA-JJ	0.50	2.65	0.34	1.12	2.16
UA-MM	0.07	0.32	0.14	0.24	0.52
UA-PP	0.11	0.49	0.19	0.33	0.69
UA-1a*	0.05	0.24	0.1	0.18	0.38
UA-1b*	0.97	5.20	0.68	2.19	4.22
UA-2a*	0.02	0.09	0.03	0.06	0.13
UA-2b*	0.75	3.84	0.48	1.64	3.13
UA-3*	0.58	2.93	0.36	1.26	2.39
UA-4*	0.02	0.09	0.04	0.06	0.13
UA-5*	0.01	0.03	0.01	0.02	0.04
UA-7*	0.01	0.07	0.03	0.05	0.11
UA-8*	0.06	0.32	0.04	0.14	0.26
UA-9*	0.02	0.08	0.03	0.06	0.12
UA-10a*	0.10	0.78	0.11	0.21	0.58
UA-10b*	0.27	1.42	0.18	0.6	1.15
UA-10c*	0.11	0.58	0.07	0.25	0.47
UA-12*	0.88	4.65	0.59	1.97	3.78
UA-14*	0.02	0.11	0.04	0.07	0.15
UA-15	0.39	1.97	0.24	0.85	1.61
UA-16	0.00	0.01	0.01	0.01	0.02
*Undisturbed Drainage to Pond			2.79	8.76	

TABLE 5
UNDISTURBED DITCH DESIGN SUMMARY

Ditch	UD-Z	UD-15
Ditch Slope (%)	16.0	7.6
Ditch Length (ft.)	80.0	864.8
10 yr - 6 hr Event (in.)	1.30	1.30
Peak Flow - 10/6 (cfs)	0.11	1.05
Velocity - 10/6 (fps)	2.71	3.61
Min. Ditch Area (ft^2)	0.04	0.29
Min. Flow Depth (ft.)	0.14	0.38
10 yr - 24 hr Event (in.)	2.00	2.00
Peak Flow - 10/24 (cfs)	0.49	3.43
Velocity - 10/24 (fps)	3.94	4.85
Min. Ditch Area (ft^2)	0.12	0.71
Min. Flow Depth (ft.)	0.25	0.59

TABLE 6
UNDISTURBED CULVERT DATA
(BYPASS CULVERTS)

Segment ID	Length	Slope %	Manning's No.
UC-AA	413.0	7.0%	0.020
UC-DD	128.8	28.0%	0.020
UC-EE	1022.2	6.4%	0.020
UC-FF	221.0	20.0%	0.020
UC-GG	841.8	6.4%	0.020
UC-HH	416.7	10.2%	0.020
UC-JJ	191.3	27.2%	0.020
UC-KK	613.8	10.0%	0.020
UC-LL	36.6	6.7%	0.020
UC-MM	138.6	36.0%	0.020
UC-NN	592.8	6.7%	0.020
UC-OO	392.6	4.8%	0.020
*UC-PP	240.0	16.0%	0.020
**UC-RR	3.0	5.0%	0.020

* 2 Inlets.

** Carries lower 1/3 of UA-PP Drainage.

TABLE 7
UNDISTURBED CULVERT DESIGN SUMMARY

Culvert	10 yr - 6 hr Event 1.30"			10 yr - 24 hr Event 2.00"			25 yr - 6 hr Event 1.60"		
	Peak Flow Cfs	Velocity fps	Min. Diam. Req'd - Ft	Peak Flow Cfs	Velocity fps	Min. Diam. Req'd - Ft	Peak Flow Cfs	Velocity fps	Min. Diam. Req'd - Ft
UC-AA	12.97	9.41	1.32	45.12	12.85	2.11	25.65	11.16	1.71
UC-DD	0.15	5.19	0.19	0.64	7.46	0.33	0.44	6.79	0.29
UC-EE	13.12	9.13	1.35	45.76	12.47	2.16	26.09	10.84	1.75
UC-FF	0.16	4.65	0.21	0.67	6.65	0.36	0.46	6.05	0.31
UC-GG	13.28	9.15	1.36	46.43	12.52	2.17	26.55	10.88	1.76
UC-HH	7.39	9.42	1.00	32.82	13.67	1.75	13.08	10.86	1.24
UC-JJ	0.50	6.94	0.30	2.65	10.52	0.57	1.12	8.49	0.41
UC-KK	7.89	9.50	1.03	35.47	13.83	1.81	14.20	11.00	1.28
UC-LL	21.17	10.46	1.61	81.90	14.67	2.67	40.75	12.32	2.05
UC-MM	0.07	4.71	0.14	0.32	6.89	0.24	0.24	6.41	0.22
UC-NN	21.24	10.47	1.61	82.22	14.69	2.67	40.99	12.34	2.06
UC-OO	44.97	11.15	2.27	105.95	13.81	3.13	64.72	12.21	2.60
UC-PP	0.11	3.89	0.19	0.49	5.66	0.33	0.33	5.12	0.29
*UC-RR	0.04	1.95	0.16	0.16	2.76	0.27	0.11	2.52	0.24

*** Carries 1/3 of drainage from UA-PP.**

TABLE 7 (Continued)

UNDISTURBED CULVERT DESIGN SUMMARY

Culvert	100 yr - 6 hr Event 2.00"			As-Constructed (Diameter) (Ft.)	Flow Capacity (Cfs)	Headwater Req'd (ft.)
	Peak Flow Cfs	Velocity fps	Min. Diam. Req'd - Ft			
UC-AA	46.45	12.94	2.14	3.5	173.02	-
UC-DD	0.92	8.17	0.38	1.5	36.13	-
UC-EE	47.37	12.58	2.19	3.5	165.44	-
UC-FF	0.95	7.26	0.41	1.5	30.53	-
UC-GG	48.32	12.64	2.21	3.5	165.44	-
UC-HH	25.48	12.83	1.59	2.0	46.96	-
UC-JJ	2.16	10.00	0.52	1.5	35.61	-
UC-KK	27.64	13.00	1.65	3.0	137.10	-
UC-LL	75.96	14.40	2.59	4.0	241.68	-
UC-MM	0.52	7.78	0.29	1.5	40.97	-
UC-NN	76.48	14.42	2.60	4.0	241.68	-
UC-OO	100.21	13.62	3.06	4.0	204.56	-
UC-PP	0.69	6.16	0.38	1.5	27.31	-
*UC-RR	0.23	3.03	0.31	3 x 0.75	3 x 2.40	-

* **Carries 1/3 of drainage from UA-PP.**

TABLE 10 (Continued)
DRAINAGE STRUCTURES

DC-2	DD-2 + DD-3	
DC-4a	DD-4a	
DC-5	DA-5, UA-5	
DC-6	DD-5	
DC-7	DD-6, DD-8	
DC-8	DA-8	
DC-8a	DD-8a	
DC-8AR	DD-8A Freeboard	To Lower Pond
DC-9	DD-9	To Upper Pond
DC-10	DA-10	
DC-10A	DD-10	
DC-11	DD-11	
DC-12	DD-12	To Lower Pond
DC-13	DD-11, DD-13	To Upper Pond

TABLE 11
DRAINAGE STRUCTURE FLOW SUMMARY

Structure	10/6 Cfs	10/24 Cfs	25/6 Cfs	100/6 Cfs	Flows To:
UC-AA	12.97	45.12	25.65	46.45	Undisturbed Bypass
UC-DD	0.15	0.64	0.44	0.92	Undisturbed Bypass
UC-EE	13.12	45.76	26.09	47.37	Undisturbed Bypass
UC-FF	0.16	0.67	0.46	0.95	Undisturbed Bypass
UC-GG	13.28	46.43	26.55	48.32	Undisturbed Bypass
UC-HH	7.39	32.82	13.08	25.48	Undisturbed Bypass
UC-JJ	0.50	2.65	1.12	2.16	Undisturbed Bypass
UC-KK	7.89	35.47	14.20	27.64	Undisturbed Bypass
UC-LL	21.17	81.90	40.75	75.96	Undisturbed Bypass
UC-MM	0.07	0.32	0.24	0.52	Undisturbed Bypass
UC-NN	21.24	82.22	40.99	76.48	Undisturbed Bypass
UC-OO	44.97	105.95	64.72	100.21	Undisturbed Bypass
UC-PP	0.11	0.49	0.33	0.69	Undisturbed Bypass
*UC-RR	0.04	0.16	0.11	0.23	Undisturbed Bypass
UD-Z	0.11	0.49	0.33	0.69	Main Canyon
UD-15	1.05	3.43	1.80	2.96	County Road
DD-1	1.79	7.13	3.48	6.17	Sediment Pond
DD-2	3.22	12.52	6.13	10.79	Sediment Pond
DD-3	1.18	4.30	2.13	3.65	Sediment Pond
DD-4	5.08	18.32	9.24	15.83	Sediment Pond
DD-4a	0.69	1.56	1.02	1.50	Sediment Pond
DD-5	1.26	2.81	1.84	2.68	Sediment Pond
DD-6	6.62	21.74	11.48	19.07	Sediment Pond
DD-8	0.68	1.69	1.03	1.53	Sediment Pond
DD-8a	7.30	23.43	12.51	20.60	Sediment Pond
DD-9	1.26	2.86	1.88	2.75	Sediment Pond
DD-10	2.58	7.44	4.09	6.52	Sediment Pond
DD-11	7.58	24.05	12.92	21.18	Sediment Pond
DD-12	4.11	13.51	6.99	11.62	Sediment Pond
DD-13	0.28	0.61	0.40	0.56	Sediment Pond

*** Carries 1/3 of drainage from UA-PP.**

TABLE 11 (Continued)
DRAINAGE STRUCTURE FLOW SUMMARY

Structure	10/6 Cfs	10/24 Cfs	25/6 Cfs	100/6 Cfs	Flows To:
DC-2	5.01	19.65	9.61	16.96	Sediment Pond
DC-4a	5.08	18.32	9.24	15.83	Sediment Pond
DC-5	0.57	1.25	0.82	1.18	Sediment Pond
DC-6	1.26	2.81	1.84	2.68	Sediment Pond
DC-7	7.88	24.55	13.32	21.75	Sediment Pond
DC-8	0.62	1.37	0.89	1.27	Sediment Pond
DC-8a	7.3	23.43	12.51	20.6	Sediment Pond
DC-8AR	1.73	1.73	1.73	1.73	To Lower Pond
DC-9	1.26	2.86	1.88	2.75	To Upper Pond
DC-10	2.58	7.44	4.09	6.52	Sediment Pond
DC-11	7.58	24.05	12.92	21.18	Sediment Pond
DC-12	4.11	13.51	6.99	11.62	To Lower Pond
DC-13	7.86	24.66	13.32	21.74	To Upper Pond

TABLE 13
DISTURBED DITCH DESIGN SUMMARY

Ditch Structure	DD-1	DD-2	DD-3	DD-4	DD-4A
10 yr - 6 hr event (in.)	1.30	1.30	1.30	1.30	1.30
Peak Flow (cfs)	1.79	3.22	1.18	5.08	**1.20
Velocity (fps)	4.26	3.24	3.05	4.99	2.60
Required Area (ft^2)	0.42	0.99	0.39	1.02	0.46
Flow Depth (ft.)	0.46	0.70	0.44	0.71	0.48
10 yr - 24 hr event (in.)	2.00	2.00	2.00	2.00	2.00
Peak Flow (cfs)	7.13	12.52	4.30	18.32	**2.07
Velocity (fps)	6.02	4.55	4.22	*** 5.99	2.98
Required Area (ft^2)	1.18	2.75	1.02	3.06	0.69
Flow Depth (ft.)	0.77	1.17	0.71	1.24	0.59
Construction					
Minimum Area (ft^2)	3.22	5.58	2.93	6.06	2.38
Minimum Depth (ft.)	1.27	1.67	1.21	1.74	1.09
*Erosion Protection	N	N	N	Y	N
Energy Dissipater Intervals	-	-	-	100' Max.	-

* Based on 10 year - 24 hour flow.

**Includes 0.51 cfs Mine Water.

*** Based on installation of energy dissipaters.

TABLE 13 (Continued)
DISTURBED DITCH DESIGN SUMMARY

Ditch Structure	DD-5	DD-6	DD-8	DD-8A	DD-9
10 yr - 6 hr event (in.)	1.30	1.30	1.30	1.30	1.30
Peak Flow (cfs)	**1.77	**7.13	0.68	**7.81	1.26
Velocity (fps)	2.29	10.25	3.74	6.27	3.52
Required Area (ft^2)	0.77	0.70	0.18	1.25	0.36
Flow Depth (ft.)	0.62	0.59	0.30	0.79	0.42
10 yr - 24 hr event (in.)	2.00	2.00	2.00	2.00	2.00
Peak Flow (cfs)	**3.32	**22.25	1.69	**23.94	2.86
Velocity (fps)	2.68	8.10	4.70	8.30	4.32
Required Area (ft^2)	1.24	2.75	0.36	2.89	0.66
Flow Depth (ft.)	0.79	1.17	0.42	1.20	0.58
Construction					
Minimum Area (ft^2)	3.33	5.58	1.69	5.78	2.33
Minimum Depth (ft.)	1.29	1.67	0.92	1.70	1.08
*Lining/Bedrock Y/N	N	***Y	N	Y	N
Rip-Rap D_{50}	-	-	-	7"	-

*** Based on 10 year - 24 hour flow.**

**** Includes 0.51 cfs Mine Water.**

***** On Bedrock.**

TABLE 13 (Continued)
DISTURBED DITCH DESIGN SUMMARY

Ditch Structure	DD-10	DD-11	DD-12	DD-13
10 yr - 6 hr event (in.)	1.30	1.30	1.30	1.30
Peak Flow (cfs)	2.58	**8.09	4.11	0.28
Velocity (fps)	2.74	3.35	4.07	1.48
Required Area (ft^2)	0.94	2.41	1.01	0.19
Flow Depth (ft.)	0.69	1.10	0.71	0.31
10 yr - 24 hr event (in.)	2.00	2.00	2.00	2.00
Peak Flow (cfs)	7.44	**24.56	13.51	0.61
Velocity (fps)	3.57	4.43	5.47	1.80
Required Area (ft^2)	2.08	5.55	2.47	0.34
Flow Depth (ft.)	1.02	1.67	1.11	0.41
Construction				
Minimum Area (ft^2)	4.62	9.42	5.18	1.66
Minimum Depth (ft.)	1.52	2.17	1.61	0.91
*Lining/Bedrock Y/N	N	N	N	N

*** Based on 10 year - 24 hour flow.**

**** Includes 0.51 cfs Mine Water.**

TABLE 14
DISTURBED CULVERT DATA

Culvert ID	Length	Slope %	Manning's No.
DC-2	45	2.0%	0.020
DC-4A	170	6.0%	0.020
DC-5	25	2.0%	0.020
DC-6	80	2.0%	0.020
DC-7	50	2.0%	0.020
DC-8	50	10.0%	0.020
DC-8A	150	16.0%	0.020
DC-9	120	25.0%	0.020
DC-10	85	25.0%	0.020
DC-10A	60	20.0%	0.020
DC-11	60	5.0%	0.020
DC-12	75	10.0%	0.020
DC-13	65	5.0%	0.020
*DC-8AR	3@40'	6.0%	0.020

*** Relief Culverts for DC-8A.**

TABLE 15
DISTURBED CULVERT DESIGN SUMMARY

Culvert	10 yr - 6 hr Event 1.30"			10 yr - 24 hr Event 2.00"			As-Constructed Diameter (ft.)	Flow Capacity (cfs)	Rip-Rap Req'd Y/N	Rip-Rap D_{50}
	Peak Flow Cfs	Velocity fps	Min. Diam. Req'd ft.	Peak Flow Cfs	Velocity fps	Min. Diam. Req'd ft.				
DC-2	4.40	4.49	1.12	16.82	6.28	1.85	2.0	20.80	N	-
DC-4A*	1.20	4.90	0.56	2.07	5.61	0.69	1.5	16.72	N	-
DC-5	0.57	2.69	0.52	1.25	3.28	0.70	1.5	9.66	N	-
DC-6*	1.77	3.58	0.79	3.32	4.18	1.01	1.5	9.66	N	-
DC-7*	7.81	5.18	1.39	23.94	6.86	2.11	2.0	20.80	Y	0.50
DC-8	0.62	5.03	0.40	1.37	6.13	0.53	1.5	21.59	Y	0.50
DC-8A*	7.81	11.30	0.94	23.94	14.95	1.43	1.5	27.31	Y	1.20
DC-9	1.26	8.47	0.44	2.86	10.39	0.59	1.5	34.14	Y	0.75
DC-10	2.58	10.13	0.57	7.44	13.20	0.85	1.5	34.14	Y	1.00
DC-10A	2.58	9.32	0.59	7.44	12.14	0.88	1.5	30.53	Y	1.00
DC-11*	8.09	7.37	1.18	24.56	9.73	1.79	2.0	32.88	Y	0.50
DC-12*	4.62	8.31	0.84	14.02	10.97	1.28	1.5	21.59	Y	0.75
DC-13*	8.37	7.43	1.20	25.17	9.79	1.81	2.0	32.88	Y	0.50
**DC-8AR	1.73	5.37	0.64	1.73	5.37	0.64	3@0.64	5.19	Y	0.50

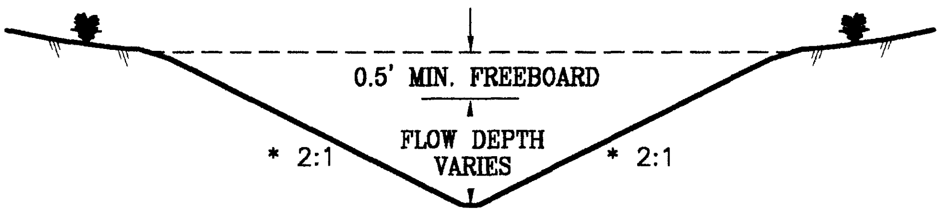
*** Includes 0.51 cfs Mine Water.**

**** Relief Culverts for DC-8A.**

FIGURES

UNDISTURBED AND DISTURBED DITCH
TYPICAL SECTION

(UNLINED DITCH)



UNLINED DITCH		
DITCH	FLOW DEPTH	FLOW AREA (FT.²)
UD-Z	0.42	0.35
UD-15	0.59	0.71
DD-1	0.77	1.18
DD-2	1.17	2.75
DD-3	0.71	1.02
**DD-4A	0.59	0.69
**DD-5	0.79	1.24
DD-8	0.42	0.36
DD-9	0.58	0.66
DD-10	1.02	2.08
**DD-11	1.67	5.55
DD-12	1.11	2.47
DD-13	0.41	0.34

Note: Flows based on a 10 year – 24 hour event.

* Used for calculation only. Side slopes may vary; however, minimum flow area will be maintained.

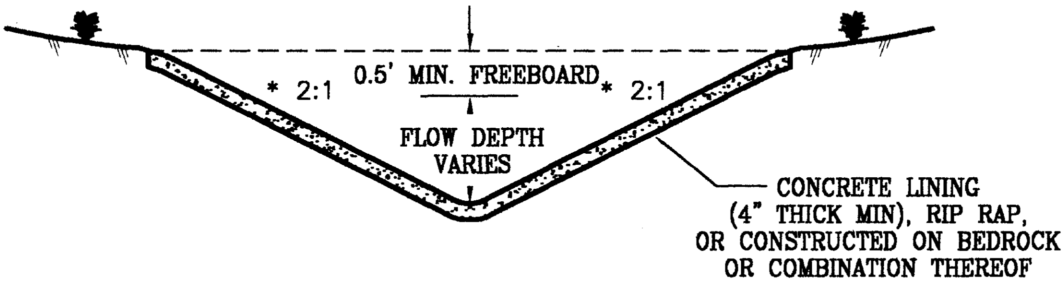
** 10 year – 24 hour flow + 0.51 cfs Mine Water.

UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY 2/14/03

FIGURE 3

UNDISTURBED AND DISTURBED DITCH
TYPICAL SECTION

(LINED DITCH)



LINED DITCH		
DITCH	*FLOW DEPTH*	*FLOW AREA (FT.^{2})*
DD-6	*1.17*	*2.75*
DD-8A	*1.20*	*2.89*

Note: Flows based on a 10 year – 24 hour event.
+ 0.51 cfs Mine Water.

* *Used for calculation only. Side slopes may vary; however, minimum flow area will be maintained.*

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FIGURE 4

DESIGN OF SEDIMENT CONTROL STRUCTURES

Figures

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 upper cell (cell A) of the sediment pond will be constructed with an open channel spillway with a minimum depth of 1.5' below the top of the dam. The lower cell (cell B) will be constructed with a combination of 2 spillways. The principal spillway will be a 36" C.M.P. culvert riser and oil skimmer. This spillway will overflow at an elevation at least 3' below the top of the dam. This spillway will discharge directly into the bypass culvert (UC-OO) which is located beneath the pond. In the unlikely event of failure of the principal spillway, the lower pond cell will also be equipped with a second (emergency) culvert spillway, consisting of a 36" C.M.P. culvert riser and oil skimmer, with a minimum depth of 2.0' below the top of the dam. This spillway will also flow directly into the undisturbed bypass culvert (UC-OO). The open-channel spillway will be constructed of grouted rip-rap or concrete, and will have a minimum 5' bottom width with 2h :1v side slopes.**

c) **The area of pond construction 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 15" 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) **Mine water will be pumped into the upper cell of the pond, as necessary, to provide for evaporation or cleaning prior to discharge. Mine water may also be pumped from the upper cell to the lower cell as needed, via the open-channel spillway. To ensure proper operation of the pond, mine water will not be allowed to accumulate beyond the maximum sediment level in each cell. If it reaches this point, it will be sampled and discharged according to the UPDES Discharge Permit.**

Sediment level markers will be installed in each cell. Sediment will be cleaned from the pond when it reaches the 60% volume level. Mine water will be removed from the pond at or below the 100% sediment level mark.

By utilizing only the "dead" or sediment storage volume of the pond for mine water, the remaining pond volume is still more than adequate to contain the runoff from a 10 year - 24 hour storm event, as required.

h) **Decanting of the ponds, as required, will be accomplished by use of a portable pump with an inverted inlet, and a pumping capacity of 100 gpm or greater. 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.**

i) **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.**

j) **Tops and external slopes of the impoundments will be planted with an approved seed mix to help prevent erosion and promote stability.**

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

3.2 Sediment Yield

The Universal Soil Loss 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 West Ridge area is 0.82" as shown in Section 2.1. Therefore, the estimated value of "R" for this area is 17.45.

Variable "K" is the soil erodibility factor. For disturbed areas, the "K" value is conservatively estimated to be 0.5. "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 a practice factor. For purposes of these calculations, the following "CP" values were used:

Site	CP Factor
Compacted Areas	1.20
Reseeded	0.38
Undisturbed Area	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***
Right Fork-Disturbed	17.45	0.5	12.97	150	15	3.10	1.20	32.46	0.193
Right Fork-Undisturbed	17.45	0.035	57.62	950	68	83.84	0.15	7.68	0.203
*Left Fork-Disturbed	17.45	0.5	5.75	680	9.5	3.20	1.20	33.50	0.089
*Left Fork-Undisturbed	17.45	0.035	21.65	830	78	92.82	0.15	8.50	0.081
Main Canyon-Disturbed	17.45	0.5	4.86	100	9.7	1.25	1.2	13.09	0.029
Main Canyon-Undisturbed	17.45	0.035	5.11	825	67.5	77.38	0.15	7.09	0.013

	Cell A	Cell B	Total
Total Sediment 1 year (ac.ft.)	0.438	0.170	0.608
Total Sediment 3 years (ac.ft.)	1.314	0.510	1.824

* Drains to Cell B
** A = tons/acre-year
*** Yield = acre-ft/year

3.3 Sediment Pond Volume

The volumes shown in Table 16 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 16
SEDIMENT POND DESIGN

1-	Use 2.00" for 10 year - 24 hour event.		
2-	Disturbed Area Draining to Pond = 23.58 acres.		
3-	Runoff Curve Number = CN = 90 (Disturbed)		
4-	Disturbed Area Runoff = (From Table 9, 10 yr./24 hr.)	=	2.160 ac.ft.
5-	Undisturbed Watershed = 84.38 Acres		
6-	Runoff Curve Number (See Table 3)		
7-	Undisturbed Area Runoff (From Table 4, 10 yr/24 hr)	=	2.790 ac.ft.
8-	Sediment Storage Volume USLE - 1.824	=	1.824 ac.ft.
9-	Direct Precipitation into Pond 1.66 acres x 2.00" / 12 in./ft.	=	0.277 ac.ft.
10-	Total Required Pond Volume 2.160 + 2.790 + 1.824+ 0.277	=	7.051 ac.ft.
11-	Pond Actual Volume at Principal Spillway	=	8.149 ac.ft.
12-	Peak Flow (25 year - 6 hour event)	=	23.73 cfs

Note: Refer to Appendix 1 for computer backup data.

TABLE 17
WEST RIDGE SEDIMENT POND
STAGE VOLUME DATA (AS-CONSTRUCTED)

Elevation	Area (ft²)	Volume (ac. ft.)	Acc. Volume (ac. ft.)	Remarks
6936	796.2	0	0	Bottom Cell A
6938	5,448.7	0.143	0.143	
6940	8,307.5	0.316	0.459	
6942	10,755.2	0.438	0.897	
6942.8		0.213	1.110	60% Sediment Cleanout Level
6944	12,527.2	0.534	1.431	
6945.4		0.419	1.850	Maximum Sediment Level***
6946	14,333.5	0.617	2.048	
6948	16,296.8	0.703	2.751	
6950	18,331.5	0.795	3.546	
6952	20,279.9	0.886	4.432	
6952.5	20,704.0	0.235	4.667	Spillway Cell A
6954.5	22,490.1	0.992	5.659*	Crest Cell A
6926	363.0	0.000	4.667	Bottom Cell B
6928	10,208.0	0.243	4.910	
6928.80	-	0.226	5.136	60% Sediment Cleanout Level
6930	13,282.9	0.313	5.449	Maximum Sediment Level***
6932	15,220.4	0.654	6.103	
6934	17,324.9	0.747	6.850	
6936	19,402.2	0.843	7.693	
6937	20,360.0	0.456	8.149	Principal Spillway
6938	21,407.8	0.479	8.628	Emergency Spillway
6940	23,731.5	1.036	(10.656)**	Crest Cell B

* Volume at Upper Dam Crest.

** Total Volume at Crest of Both Dams.

*** Also maximum level for storage of mine water.

Note: 0.29 ac. ft. surplus with sediment at maximum.

TABLE 17A
SEDIMENT POND
INTERCELL OPEN-CHANNEL SPILLWAY
STAGE DISCHARGE DATA

STAGE (ft.)	DISCHARGE (cfs)
0.00	0.00
0.20	1.49
0.40	4.53
0.60	8.90
0.80	14.58
0.83	*15.55
1.00	21.61

Note: *25 year - 6 hour Peak Flow to Upper Cell = 15.20 cfs.
Flow will pass through spillway at a depth of 0.83'.

<u>Calculations based on Broad Crested Weir Formula</u>

$$Q = 3.087\ bH^{1.5}; \text{ Where } b = \text{Average Width} = \frac{5 + (5 + 4d)}{2}$$

TABLE 18
SEDIMENT POND
PRINCIPAL SPILLWAY
STAGE - DISCHARGE DATA
36" C.M.P. RISER

Stage (ft.)	Discharge (cfs)		
	Weir Flow	Orifice Flow	Pipe Flow
0.00	0.00	0.00	44.81
0.20	2.53	15.17	46.80
0.40	7.15	21.45	48.71
0.52	10.60	24.45	49.82
0.60	13.13	26.27	50.55
0.80	20.22	30.33	52.33
0.89	*23.73	31.99	53.10
1.00	28.26	33.91	54.04
1.20	37.15	37.15	55.70
1.40	46.81	40.12	57.32
1.60	57.19	42.89	58.89
1.80	68.25	45.50	60.42
2.00	79.93	47.96	61.91
*25 year - 6 hour Peak Flow = 23.73 cfs; Flow is weir controlled at H = 0.89'.			

Weir Flow

$Q = CLH^{3/2}$; *Where* $C = 3.0,\ L = 9.42$

$Q = 28.26\ H^{3/2}$

Orifice **Flow**

$Q = C'a\sqrt{2gH}$; *Where* $C' = 0.6,\ a = 7.065,\ g = 32$

Q = *is* $33.91\sqrt{H}$

Pipe Flow

$$Q = \frac{a\,[\,2g\,(H')^{1/2}}{(1+\ Ke+\ Kb+\ KcL)};\ Where\ a = 7.065,\ g = 32,\ H' = H + 4 - [(0.6)(2.0)] = H + 2.2,\ Ke = 1.0,\ Kb = 0.5,\ Kc = 0.05,\ L = 20'$$

$Q = 30.21\ (H + 2.2)^{1/2}$

TABLE 19
SEDIMENT POND
EMERGENCY SPILLWAY
STAGE - DISCHARGE DATA
36" C.M.P. RISER

Stage (ft.)	Discharge (cfs)		
	Weir Flow	Orifice Flow	Pipe Flow
0.00	0.00	0.00	44.81
0.20	2.53	15.17	46.80
0.40	7.15	21.45	48.71
0.52	10.60	24.45	49.82
0.60	13.13	26.27	50.55
0.80	20.22	30.33	52.33
0.89	*23.73	31.99	53.10
1.00	28.26	33.91	54.04
1.20	37.15	37.15	55.70
1.40	46.81	40.12	57.32
1.60	57.19	42.89	58.89
1.80	68.25	45.50	60.42
2.00	79.93	47.96	61.91
*25 year - 6 hour Peak Flow = 23.73 cfs; Flow is weir controlled at H = 0.89'.			

Weir Flow

$Q = CLH^{3/2}$; *Where* $C = 3.0, L = 9.42$

$Q = 28.26\, H^{3/2}$

Orifice Flow

$Q = C'a\sqrt{2gH}$; *Where* $C' = 0.6,\ a = 7.065,\ g = 32$

$Q =$ is $33.91\sqrt{H}$

Pipe Flow

$\dfrac{Q = a\,[\,2g\,(H')^{1/2}}{(1 + Ke + Kb + KcL)}$; *Where* $a = 7.065,\ g = 32,\ H' = H + 4 - [(0.6)(2.0)] = H + 2.2,\ Ke = 1.0,\ Kb = 0.5,\ Kc = 0.05,\ L = 20'$

$Q = 30.21\,(H + 2.2)^{1/2}$

Note: Flow Data is based on no flow passing through Principal Spillway Riser.

3.4 Sediment Pond Summary

a) **The Sediment 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 7.051 acre feet, including 3 years of sediment storage. The sediment pond size is 2 cells with a total volume of approximately 8.149 acre feet at the Principal Spillway, which is more than adequate. Mine water is pumped to the pond; however, it is not allowed to exceed the maximum sediment storage level in both cells. If it should reach this level, it will be sampled and discharged according to the UPDES Permit. If sediment or mine water is allowed to reach the maximum volume in both the upper and lower cells, as determined by the markers, the ponds will still have 0.29 ac. ft. surplus storage capacity above the 10 year - 24 hour design.**

c) **The pond will meet a theoretical detention time of 24 hours. It is equipped with a 36" cmp culvert riser and oil skimmer for a principal spillway and a 36" cmp culvert riser emergency spillway. Any discharge from the pond will be in accordance with the approved UPDES Permit.**

d) **The pond inlets are protected from erosion. The principal spillway, and/or emergency spillway will discharge directly to the undisturbed bypass culvert (UC-OO), and to the main canyon drainage.**

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

f) **The pond has been constructed according to the design criteria listed under "Construction Specifications for Sedimentation Ponds".**

g) **The pond is equipped with an inter-cell open channel spillway constructed of grouted rip-rap or concrete. In addition, the lower cell (cell B) is equipped with a vertical 36" cmp culvert and oil skimmer as a principal spillway and a vertical 36" cmp culvert riser as an emergency spillway. Dimensions of the** inter-cell spillway are a minimum depth of 2.0', 5' bottom width and 2h : 1v sideslopes. Calculations in Table 17A show the spillway will pass the expected peak flow of 15.20 cfs from the upper cell at a depth of 0.83'.

h) The principal spillway in the lower cell (B) is sized to carry runoff from a 25 year - 6 hour precipitation event, which is shown on Table 11 as 23.73 cfs. This overflow is a 36" cmp culvert fitted with an oil skimmer as shown on Map 7-4. The discharge will go into by-pass culvert UC-OO, which is located beneath the ponds. In the event of failure of this overflow, the lower cell is also equipped with an additional 36" cmp emergency spillway as noted in g) above.

The 36" cmp principal spillway will carry the peak flow from a 25 year - 6 hour event at a depth of 0.89' over the pipe as shown on Table 18 and Figure 10. The emergency spillway is constructed 1' above the principal spillway elevation. This spillway is a minimum of 2.0' below the top of the dam, and will carry the entire flow of the 25 year - 6 hour event at a depth of 0.89', leaving more than a foot of freeboard to the top of the dam. See Table 19 and Figure 11 for Stage - Discharge details for the Emergency Spillway.

i) The runoff from the lower spillway will travel into by-pass culvert UC-OO, which will then discharge to the main channel below the minesite.

j) The main canyon culvert is adequately sized to carry the flow of the undisturbed by-pass drainage plus the pond overflow. It discharges into the Main Canyon drainage approximately 390' downstream of the pond outlet.

k) The culvert outlet is equipped with an adequately sized rip-rap apron to slow the combined flow sufficiently to prevent erosion of the downstream channel.

4.2 Reclaimed Area Drainage Control

During final reclamation, all previously installed drainage controls, including the sediment ponds, will be removed. The reclaimed area will be roughened by discontinuous tilling and/or "gouging" the area with a trackhoe bucket. The roughening will create furrows or depressions at approximately 18" deep throughout the reclaimed area. In addition, straw or wood mulch will be used in final seeding of the area. Roughening will continue to the existing channel banks, and the entire reclaimed area, including channels, will be reseeded according to the approved plan.

Prior to removal of the sediment ponds, a series of 4 silt fences will be installed across the main drainage channel below the pond area, as shown on Map 5-9. These silt fences will remain as final treatment for runoff from the reclaimed site until Phase II Bond Release requirements are met. These are, however, only secondary sediment controls. The primary sediment control from the reclaimed site will be extensive roughening/gouging, use of mulch and revegetation.

Calculations have been run to estimate the total sediment production from the reclaimed site, and to evaluate the effectiveness of the treatments.

The Universal Soil Loss 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 main channel.

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 West Ridge area is 0.82" as shown in Section 2.1. Therefore, the estimated value of "R" for this area is <u>17.45</u>.

Variable "K" is the soil erodibility factor. For disturbed areas, the "K" value is conservatively estimated to be 0.25. "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 a practice factor. For purposes fo these calculation, the following "CP" values were used:

Cover Factor - "C"

Reclaimed Area - Wood Fiber Mulch	**- ***	**0.01**
Undisturbed Area - Section 3.2	**-**	**0.15**
Disturbed Area - Section 3.2	**-**	**1.20**

Control Practice Factor - "P"

Assumed equal to 1.0, since the land is not used for crops.

The table on the following page is a summary comparing expected sediment contributions from the proposed disturbed area only, under all three phases of conditions - Undisturbed, Disturbed and Reclaimed.

Note: While this set of calculations assume all sediment production is delivered to the main channel, this is probably not the case. The deep surface gouging on both sides of the channel during reclamation will likely trap most, if not all, of the transported sediment prior to reaching the channel.

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

***Barfield, et.al., 1983, Appendix 5A.**

Undisturbed/Disturbed/Reclaimed
Sediment Yield Calculations - USLE
(Proposed Disturbed Area Only)

Drainage	R	K	Acres	Slope Length Feet	Slope (%)	LS	CP	A*	Yield**
Right Fork-Undisturbed	17.45	0.035	12.97	150	15	3.10	0.15	0.284	0.0017
Right Fork-Disturbed	17.45	0.5	12.97	150	15	3.10	1.20	32.46	0.1933
Right Fork-Reclaimed	17.45	0.25	12.97	150	15	3.10	0.01	0.1352	0.0009
Left Fork-Undisturbed	17.45	0.035	5.78	680	9.5	3.20	0.15	0.293	0.0008
Left Fork-Disturbed	17.45	0.5	5.78	680	9.5	3.20	1.20	33.51	0.0889
Left Fork-Reclaimed	17.45	0.25	5.78	680	9.5	3.20	0.01	0.1396	0.0004
Main Canyon-Undisturbed	17.45	0.035	4.83	100	9.7	1.25	0.15	0.115	0.0002
Main Canyon-Disturbed	17.45	0.5	4.83	100	9.7	1.25	1.20	13.09	0.0290
Main Canyon-Reclaimed	17.45	0.25	4.83	100	9.7	1.25	0.01	0.0545	0.0001

Total Sediment (Undisturbed State) 0.0027
Total Sediment (Disturbed State) 0.3112
Total Sediment (Reclaimed State) 0.0014

* A = tons/acre-year
** Yield = acre-ft/year

Summary

The above table indicates the sediment contribution from the reclaimed areas of the minesite will be approximately 0.0014 acre feet per year, as compared to 0.3112 acre feet per year for the disturbed area. When the reclaimed areas are calculated as undisturbed, the total minesite sediment contribution increases slightly to 0.0027 acre feet per year, verses the 0.0014 noted in the table above.

This indicates the proposed reclamation process will actually reduce the expected sediment contribution over natural, undisturbed conditions. This is primarily due to the extensive roughening and use of wood fiber mulch to reduce runoff.

4.3 Restored Channels

As mentioned in Section 4.1, existing channels will only be slightly altered prior to construction. The restored main channels will have a bottom width of approximately 12' with 2h : 1v side slopes, and the side channels are proposed to have a bottom width of approximately 4' with 2h : 1v side slopes. The overall channel slopes are not proposed to be altered during construction or reclamation. Since the existing channel bottoms are proposed to be only slightly regraded and widened, existing, natural rip-rap will be left in place; therefore, no additional rip-rapping is proposed for reclamation.

The restored channel sizes were for checked adequacy to carry runoff from a 100 year - 6 hour storm event. As shown on Table 23, all channels are adequately sized to carry the projected runoff with at least 1' of freeboard. See Figure 12 for a typical section of the reclaimed channels and summary of flow depths and velocities.

4.4 Sediment Pond

As discussed in Section 4.1, the sediment pond will be removed during final reclamation. Prior to removal of the pond, a series of 4 silt fences will be placed across the main canyon channel below the pond. Sediment control for the reclamation will be accomplished by extensive roughening/gouging and revegetation of the reclaimed area and installation of sediment traps in the restored channels. The silt fences will act as secondary, final sediment controls. These fences will be maintained until Phase II Bond Release. See Map 5-9 "Minesite Reclamation" for location and reclamation details.

TABLE 20
FINAL RECLAMATION
DRAINAGE AREAS CONTRIBUTING TO CHANNELS

RC-DD (Side Channel)	**UA-DD**
RC-FF (Side Channel)	**UA-FF**
RC-GG	**RC-DD, RC-FF, UA-AA, UA-1a,UA-1b, UA-2a, UA-2b, UA-3, UA-4, UA-5, UA-7, UA-9 DA-1, DA-2, DA-3, DA-4, DA-4A, DA-5, DA-6, DA-7, DA-9, DA-X**
RC-JJ (Side Channel)	**UA-JJ**
RC-KK	**UA-HH, UA-10a, UA-10b, UA-10c, UA-8, RC-JJ DA-Y, DA-8, DA-10**
RC-MM (Side Channel)	**UA-MM**
RC-PP (Side Channel)	**UA-PP**
RC-QQ	**RC-GG, RC-KK, RC-MM, RC-PP, UA-12, UA-14, UA-16 DA-11, DA-12, DA-13, DA-14, DA-Z**

Refer to Map 7-2 for drainage areas and Map 5-9 for reclamation channels.

TABLE 21
FINAL RECLAMATION
DRAINAGE STRUCTURE FLOW SUMMARY

Channel	10/6 cfs	100/6 cfs
RC-DD	0.15	0.92
RC-FF	0.16	0.95
RC-GG	21.08	69.98
RC-JJ	0.50	2.16
RC-KK	11.13	35.65
RC-MM	0.07	0.52
RC-PP	0.11	0.69
RC-QQ	35.88	116.35

Flows from Table 4, and Table 9.

TABLE 22
FINAL RECLAMATION
RESTORED CHANNEL DESIGN PARAMETERS

Channel	Bottom Width (ft.)	Side Slope H:V	Slope %	Reclaimed Depth (ft.)	Manning's No.
RC-DD	4	2:1	24.5	1.5	0.035
RC-FF	4	2:1	24.4	1.5	0.035
RC-GG	12	2:1	6.4	3.5	0.035
RC-JJ	4	2:1	24.6	1.5	0.035
RC-KK	12	2:1	10.0	3.0	0.035
RC-MM	4	2:1	40.7	1.5	0.035
RC-PP	4	2:1	40.5	1.5	0.035
RC-QQ	12	2:1	6.3	4.0	0.035

TABLE 23
FINAL RECLAMATION
RESTORED CHANNEL FLOW CALCULATIONS

Channel	RC-DD	RC-FF	RC-GG
10 yr - 6 hr event (in.)	1.30	1.30	1.30
Peak Flow (cfs)	0.15	0.16	21.08
Velocity (fps)	1.66	1.70	4.98
Req'd Area ($ft.^2$)	0.09	0.09	4.24
Flow Depth (ft.)	0.02	0.02	0.33
100 yr - 6 hr event (in.)	2.00	2.00	2.00
Peak Flow (cfs)	0.92	0.95	69.98
Velocity (fps)	3.36	3.40	7.70
Req'd Area ($ft.^2$)	0.27	0.28	9.09
Flow Depth (ft.)	0.07	0.07	0.68

APPENDIX 1

WEST RIDGE

COMPUTER BACKUP

DISTURBED CULVERT

CALCULATIONS

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-2 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	4.40 cfs

Computed Results:

Full Flow Diameter.....	1.12 ft
Full Flow Depth........	1.12 ft
Velocity..........	4.49 fps
Flow Area.........	0.98 sf
Critical Depth....	0.87 ft
Critical Slope....	0.0219 ft/ft
Percent Full......	100.00 %
Full Capacity.....	4.40 cfs
QMAX @.94D........	4.73 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-2 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	16.82 cfs

Computed Results:

Full Flow Diameter.....	1.85 ft
Full Flow Depth........	1.85 ft
Velocity..........	6.28 fps
Flow Area.........	2.68 sf
Critical Depth....	1.50 ft
Critical Slope....	0.0203 ft/ft
Percent Full......	100.00 %
Full Capacity.....	16.82 cfs
QMAX @.94D........	18.09 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-4A (10/6) MW

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0600 ft/ft
Manning's n.......	0.020
Discharge.........	1.20 cfs

Computed Results:

Full Flow Diameter.....	0.56 ft
Full Flow Depth........	0.56 ft
Velocity..........	4.90 fps
Flow Area.........	0.24 sf
Critical Depth....	0.52 ft
Critical Slope....	0.0520 ft/ft
Percent Full......	100.00 %
Full Capacity.....	1.20 cfs
QMAX @.94D........	1.29 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-4A (10/24) MW

Solve For Full Flow Diameter

Given Input Data:

Slope............	0.0600 ft/ft
Manning's n.......	0.020
Discharge.........	2.07 cfs

Computed Results:

Full Flow Diameter.....	0.69 ft
Full Flow Depth........	0.69 ft
Velocity..........	5.61 fps
Flow Area.........	0.37 sf
Critical Depth....	0.64 ft
Critical Slope....	0.0519 ft/ft
Percent Full......	100.00 %
Full Capacity.....	2.07 cfs
QMAX @.94D........	2.23 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-5 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n........	0.020
Discharge.........	0.57 cfs

Computed Results:

Full Flow Diameter.....	0.52 ft
Full Flow Depth........	0.52 ft
Velocity..........	2.69 fps
Flow Area.........	0.21 sf
Critical Depth....	0.38 ft
Critical Slope....	0.0253 ft/ft
Percent Full......	100.00 %
Full Capacity.....	0.57 cfs
QMAX @.94D........	0.61 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-5 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	1.25 cfs

Computed Results:

Full Flow Diameter.....	0.70 ft
Full Flow Depth........	0.70 ft
Velocity..........	3.28 fps
Flow Area.........	0.38 sf
Critical Depth....	0.52 ft
Critical Slope....	0.0238 ft/ft
Percent Full......	100.00 %
Full Capacity.....	1.25 cfs
QMAX @.94D........	1.34 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

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

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	1.77 cfs

Computed Results:

Full Flow Diameter.....	0.79 ft
Full Flow Depth........	0.79 ft
Velocity..........	3.58 fps
Flow Area.........	0.50 sf
Critical Depth....	0.60 ft
Critical Slope....	0.0233 ft/ft
Percent Full......	100.00 %
Full Capacity.....	1.77 cfs
QMAX @.94D........	1.90 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

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

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	3.32 cfs

Computed Results:

Full Flow Diameter.....	1.01 ft
Full Flow Depth........	1.01 ft
Velocity..........	4.18 fps
Flow Area.........	0.79 sf
Critical Depth....	0.78 ft
Critical Slope....	0.0223 ft/ft
Percent Full......	100.00 %
Full Capacity.....	3.32 cfs
QMAX @.94D........	3.57 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

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

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	7.81 cfs

Computed Results:

Full Flow Diameter.....	1.39 ft
Full Flow Depth........	1.39 ft
Velocity..........	5.18 fps
Flow Area.........	1.51 sf
Critical Depth....	1.10 ft
Critical Slope....	0.0212 ft/ft
Percent Full......	100.00 %
Full Capacity.....	7.81 cfs
QMAX @.94D........	8.40 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

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

Solve For Full Flow Diameter

Given Input Data:

Slope............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	23.94 cfs

Computed Results:

Full Flow Diameter.....	2.11 ft
Full Flow Depth........	2.11 ft
Velocity..........	6.86 fps
Flow Area.........	3.49 sf
Critical Depth....	1.73 ft
Critical Slope....	0.0200 ft/ft
Percent Full......	100.00 %
Full Capacity.....	23.94 cfs
QMAX @.94D........	25.75 cfs
Froude Number.....	FULL

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-8 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.1000 ft/ft
Manning's n.......	0.020
Discharge.........	0.62 cfs

Computed Results:

Full Flow Diameter.....	0.40 ft
Full Flow Depth........	0.40 ft
Velocity..........	5.03 fps
Flow Area.........	0.12 sf
Critical Depth....	0.38 ft
Critical Slope....	0.0873 ft/ft
Percent Full......	100.00 %
Full Capacity.....	0.62 cfs
QMAX @.94D........	0.67 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-8 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.1000 ft/ft
Manning's n.......	0.020
Discharge.........	1.37 cfs

Computed Results:

Full Flow Diameter.....	0.53 ft
Full Flow Depth........	0.53 ft
Velocity..........	6.13 fps
Flow Area.........	0.22 sf
Critical Depth....	0.52 ft
Critical Slope....	0.0879 ft/ft
Percent Full......	100.00 %
Full Capacity.....	1.37 cfs
QMAX @.94D........	1.47 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-8A (10/6) MW

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.1600 ft/ft
Manning's n.......	0.020
Discharge.........	7.81 cfs

Computed Results:

Full Flow Diameter.....	0.94 ft
Full Flow Depth........	0.94 ft
Velocity..........	11.30 fps
Flow Area.........	0.69 sf
Critical Depth....	0.93 ft
Critical Slope....	0.1482 ft/ft
Percent Full......	100.00 %
Full Capacity.....	7.81 cfs
QMAX @.94D........	8.40 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-8A (10/24) MW

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.1600 ft/ft
Manning's n.......	0.020
Discharge.........	23.94 cfs

Computed Results:

Full Flow Diameter.....	1.43 ft
Full Flow Depth........	1.43 ft
Velocity..........	14.95 fps
Flow Area.........	1.60 sf
Critical Depth....	1.42 ft
Critical Slope....	0.1496 ft/ft
Percent Full......	100.00 %
Full Capacity.....	23.94 cfs
QMAX @.94D........	25.75 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERTS DC-8AR (3) RELIEF

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0600 ft/ft
Manning's n........	0.020
Discharge.........	1.73 cfs

Computed Results:

Full Flow Diameter.....	0.64 ft
Full Flow Depth........	0.64 ft
Velocity..........	5.37 fps
Flow Area.........	0.32 sf
Critical Depth....	0.60 ft
Critical Slope....	0.0519 ft/ft
Percent Full......	100.00 %
Full Capacity.....	1.73 cfs
QMAX @.94D........	1.86 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERTS DC-8AR (3) RELIEF <EACH>

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	0.64 ft
Slope.............	0.0600 ft/ft
Manning's n.......	0.020
Discharge.........	1.73 cfs

Computed Results:

Full Flow Capacity.....	1.73 cfs
Full Flow Depth........	0.64 ft
Velocity..........	5.36 fps
Flow Area.........	0.32 sf
Critical Depth....	0.60 ft
Critical Slope....	0.0519 ft/ft
Percent Full......	100.00 %
Full Capacity.....	1.73 cfs
QMAX @.94D........	1.86 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-9 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	2.86 cfs

Computed Results:

Full Flow Diameter.....	0.59 ft
Full Flow Depth........	0.59 ft
Velocity..........	10.39 fps
Flow Area.........	0.28 sf
Critical Depth....	0.59 ft
Critical Slope....	0.2358 ft/ft
Percent Full......	100.00 %
Full Capacity.....	2.86 cfs
QMAX @.94D........	3.08 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-10 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	2.58 cfs

Computed Results:

Full Flow Diameter.....	0.57 ft
Full Flow Depth........	0.57 ft
Velocity..........	10.13 fps
Flow Area.........	0.25 sf
Critical Depth....	0.57 ft
Critical Slope....	0.2357 ft/ft
Percent Full......	100.00 %
Full Capacity.....	2.58 cfs
QMAX @.94D........	2.78 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-11 (10/6) MW

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0500 ft/ft
Manning's n.......	0.020
Discharge.........	8.09 cfs

Computed Results:

Full Flow Diameter.....	1.18 ft
Full Flow Depth........	1.18 ft
Velocity..........	7.37 fps
Flow Area.........	1.10 sf
Critical Depth....	1.10 ft
Critical Slope....	0.0432 ft/ft
Percent Full......	100.00 %
Full Capacity.....	8.09 cfs
QMAX @.94D........	8.70 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-11 (10/24) MW

Solve For Full Flow Diameter

Given Input Data:

Slope............	0.0500 ft/ft
Manning's n.......	0.020
Discharge.........	24.56 cfs

Computed Results:

Full Flow Diameter.....	1.79 ft
Full Flow Depth........	1.79 ft
Velocity..........	9.73 fps
Flow Area.........	2.52 sf
Critical Depth....	1.70 ft
Critical Slope....	0.0433 ft/ft
Percent Full......	100.00 %
Full Capacity.....	24.56 cfs
QMAX @.94D........	26.42 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-12 (10/6)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.1000 ft/ft
Manning's n........	0.020
Discharge.........	4.11 cfs

Computed Results:

Full Flow Diameter.....	0.81 ft
Full Flow Depth........	0.81 ft
Velocity..........	8.07 fps
Flow Area.........	0.51 sf
Critical Depth....	0.79 ft
Critical Slope....	0.0889 ft/ft
Percent Full......	100.00 %
Full Capacity.....	4.11 cfs
QMAX @.94D........	4.42 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-12 (10/24)

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.1000 ft/ft
Manning's n.......	0.020
Discharge.........	13.51 cfs

Computed Results:

Full Flow Diameter.....	1.26 ft
Full Flow Depth........	1.26 ft
Velocity..........	10.87 fps
Flow Area.........	1.24 sf
Critical Depth....	1.24 ft
Critical Slope....	0.0900 ft/ft
Percent Full......	100.00 %
Full Capacity.....	13.51 cfs
QMAX @.94D........	14.53 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-13 (10/6) MW

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0500 ft/ft
Manning's n.......	0.020
Discharge.........	8.37 cfs

Computed Results:

Full Flow Diameter.....	1.20 ft
Full Flow Depth........	1.20 ft
Velocity..........	7.43 fps
Flow Area.........	1.13 sf
Critical Depth....	1.12 ft
Critical Slope....	0.0432 ft/ft
Percent Full......	100.00 %
Full Capacity.....	8.37 cfs
QMAX @.94D........	9.00 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-13 (10/24) MW

Solve For Full Flow Diameter

Given Input Data:

Slope.............	0.0500 ft/ft
Manning's n.......	0.020
Discharge.........	25.17 cfs

Computed Results:

Full Flow Diameter.....	1.81 ft
Full Flow Depth........	1.81 ft
Velocity..........	9.79 fps
Flow Area.........	2.57 sf
Critical Depth....	1.71 ft
Critical Slope....	0.0433 ft/ft
Percent Full......	100.00 %
Full Capacity.....	25.17 cfs
QMAX @.94D........	27.08 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-2

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	2.00 ft
Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	20.80 cfs

Computed Results:

Full Flow Capacity.....	20.80 cfs
Full Flow Depth........	2.00 ft
Velocity..........	6.62 fps
Flow Area.........	3.14 sf
Critical Depth....	1.63 ft
Critical Slope....	0.0201 ft/ft
Percent Full......	100.00 %
Full Capacity.....	20.80 cfs
QMAX @.94D........	22.37 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-4A

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.0600 ft/ft
Manning's n.......	0.020
Discharge.........	16.72 cfs

Computed Results:

Full Flow Capacity.....	16.72 cfs
Full Flow Depth........	1.50 ft
Velocity..........	9.46 fps
Flow Area.........	1.77 sf
Critical Depth....	1.44 ft
Critical Slope....	0.0522 ft/ft
Percent Full......	100.00 %
Full Capacity.....	16.72 cfs
QMAX @.94D........	17.99 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-5

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	9.66 cfs

Computed Results:

Full Flow Capacity.....	9.66 cfs
Full Flow Depth........	1.50 ft
Velocity..........	5.46 fps
Flow Area.........	1.77 sf
Critical Depth....	1.20 ft
Critical Slope....	0.0209 ft/ft
Percent Full......	100.00 %
Full Capacity.....	9.66 cfs
QMAX @.94D........	10.39 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-6

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	9.66 cfs

Computed Results:

Full Flow Capacity.....	9.66 cfs
Full Flow Depth........	1.50 ft
Velocity..........	5.46 fps
Flow Area.........	1.77 sf
Critical Depth....	1.20 ft
Critical Slope....	0.0209 ft/ft
Percent Full......	100.00 %
Full Capacity.....	9.66 cfs
QMAX @.94D........	10.39 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-7

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	2.00 ft
Slope.............	0.0200 ft/ft
Manning's n.......	0.020
Discharge.........	20.80 cfs

Computed Results:

Full Flow Capacity.....	20.80 cfs
Full Flow Depth........	2.00 ft
Velocity..........	6.62 fps
Flow Area.........	3.14 sf
Critical Depth....	1.63 ft
Critical Slope....	0.0201 ft/ft
Percent Full......	100.00 %
Full Capacity.....	20.80 cfs
QMAX @.94D........	22.37 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-8

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.1000 ft/ft
Manning's n.......	0.020
Discharge.........	21.59 cfs

Computed Results:

Full Flow Capacity.....	21.59 cfs
Full Flow Depth........	1.50 ft
Velocity..........	12.22 fps
Flow Area.........	1.77 sf
Critical Depth....	1.48 ft
Critical Slope....	0.0904 ft/ft
Percent Full......	100.00 %
Full Capacity.....	21.59 cfs
QMAX @.94D........	23.23 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-9

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	34.14 cfs

Computed Results:

Full Flow Capacity.....	34.14 cfs
Full Flow Depth........	1.50 ft
Velocity..........	19.32 fps
Flow Area.........	1.77 sf
Critical Depth....	1.50 ft
Critical Slope....	0.2395 ft/ft
Percent Full......	100.00 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-10

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2500 ft/ft
Manning's n.......	0.020
Discharge.........	34.14 cfs

Computed Results:

Full Flow Capacity.....	34.14 cfs
Full Flow Depth........	1.50 ft
Velocity..........	19.32 fps
Flow Area.........	1.77 sf
Critical Depth....	1.50 ft
Critical Slope....	0.2395 ft/ft
Percent Full......	100.00 %
Full Capacity.....	34.14 cfs
QMAX @.94D........	36.72 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-10A

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.2000 ft/ft
Manning's n.......	0.020
Discharge.........	30.53 cfs

Computed Results:

Full Flow Capacity.....	30.53 cfs
Full Flow Depth........	1.50 ft
Velocity..........	17.28 fps
Flow Area.........	1.77 sf
Critical Depth....	1.49 ft
Critical Slope....	0.1896 ft/ft
Percent Full......	100.00 %
Full Capacity.....	30.53 cfs
QMAX @.94D........	32.85 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-11

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	2.00 ft
Slope.............	0.0500 ft/ft
Manning's n.......	0.020
Discharge.........	32.88 cfs

Computed Results:

Full Flow Capacity.....	32.88 cfs
Full Flow Depth........	2.00 ft
Velocity..........	10.47 fps
Flow Area.........	3.14 sf
Critical Depth....	1.90 ft
Critical Slope....	0.0433 ft/ft
Percent Full......	100.00 %
Full Capacity.....	32.88 cfs
QMAX @.94D........	35.37 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-12

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	1.50 ft
Slope.............	0.1000 ft/ft
Manning's n.......	0.020
Discharge.........	21.59 cfs

Computed Results:

Full Flow Capacity.....	21.59 cfs
Full Flow Depth........	1.50 ft
Velocity..........	12.22 fps
Flow Area.........	1.77 sf
Critical Depth....	1.48 ft
Critical Slope....	0.0904 ft/ft
Percent Full......	100.00 %
Full Capacity.....	21.59 cfs
QMAX @.94D........	23.23 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: WEST RIDGE

Comment: CULVERT DC-13

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	2.00 ft
Slope.............	0.0500 ft/ft
Manning's n.......	0.020
Discharge.........	32.88 cfs

Computed Results:

Full Flow Capacity.....	32.88 cfs
Full Flow Depth........	2.00 ft
Velocity..........	10.47 fps
Flow Area.........	3.14 sf
Critical Depth....	1.90 ft
Critical Slope....	0.0433 ft/ft
Percent Full......	100.00 %
Full Capacity.....	32.88 cfs
QMAX @.94D........	35.37 cfs
Froude Number.....	FULL

DISTURBED DITCH

CALCULATIONS

```
Title of run: DD-1 (10/6)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.46
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0830
   Manning"s n...............=   0.035
   CFS.......................=    1.79
   Cross section area (sqft)..=   0.42
   Hydrualic radius..........=    0.20
   fps.......................=    4.26
   Froude number.............=    1.66
```

```
Title of run: DD-1 (10/24)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)............=    0.77
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Slope of diversion.........=  0.0830
   Manning"s n................=   0.035
   CFS........................=    7.13
   Cross section area (sqft)..=    1.18
   Hydrualic radius...........=    0.34
   fps........................=    6.02
   Froude number..............=    1.81
```

```
Title of run: DD-2 (10/6)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)............=    0.70
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Slope of diversion.........=  0.0270
   Manning"s n................=   0.035
   CFS........................=    3.22
   Cross section area (sqft)..=    0.99
   Hydrualic radius...........=    0.32
   fps........................=    3.24
   Froude number..............=    1.02
```

```
Title of run: DD-2 (10/24)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    1.17
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0270
   Manning"s n...............=   0.035
   CFS.......................=   12.52
   Cross section area (sqft)..=   2.75
   Hydrualic radius..........=    0.52
   fps.......................=    4.55
   Froude number.............=    1.11
```

Title of run: DD-3 (10/6)

Solving for................=	Depth Normal
Triangle	
Flow depth (ft)............=	0.44
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0450
Manning"s n................=	0.035
CFS........................=	1.18
Cross section area (sqft)..=	0.39
Hydrualic radius...........=	0.20
fps........................=	3.05
Froude number..............=	1.21

```
Title of run: DD-3 (10/24)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.71
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0450
   Manning"s n...............=   0.035
   CFS.......................=    4.30
   Cross section area (sqft)..=    1.02
   Hydrualic radius..........=    0.32
   fps.......................=    4.22
   Froude number.............=    1.32
```

Title of run: DD-4 (10/6)

Solving for................=	Depth Normal
Triangle	
Flow depth (ft)............=	0.71
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0630
Manning"s n................=	0.035
CFS........................=	5.08
Cross section area (sqft)..=	1.02
Hydrualic radius...........=	0.32
fps........................=	4.99
Froude number..............=	1.56

Title of run: DD-4 (10/24) EN.DIS.

Solving for................= Depth Normal

Triangle

Flow depth (ft)............=	1.24
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0570
Manning"s n................=	0.040
CFS........................=	18.32
Cross section area (sqft)..=	3.06
Hydrualic radius...........=	0.55
fps........................=	5.99
Froude number..............=	1.42

```
Title of run: DD-4A (10/6) MW
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.48
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0290
   Manning"s n...............=   0.035
   CFS.......................=    1.20
   Cross section area (sqft)..=   0.46
   Hydrualic radius..........=    0.21
   fps.......................=    2.60
   Froude number.............=    0.99
```

```
Title of run: DD-4A (10/24) MW
   Solving for................= Depth Normal
Triangle
   Flow depth (ft)............=    0.59
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Slope of diversion.........=  0.0290
   Manning"s n................=   0.035
   CFS........................=    2.07
   Cross section area (sqft)..=    0.69
   Hydrualic radius...........=    0.26
   fps........................=    2.98
   Froude number..............=    1.02
```

```
Title of run: DD-5 (10/6) MW
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.62
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0160
   Manning"s n...............=   0.035
   CFS.......................=    1.77
   Cross section area (sqft)..=   0.77
   Hydrualic radius..........=    0.28
   fps.......................=    2.29
   Froude number.............=    0.77
```

Title of run: DD-5 (10/24) MW

Solving for................= Depth Normal

Triangle

Flow depth (ft)............=	0.79
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0160
Manning"s n................=	0.035
CFS........................=	3.32
Cross section area (sqft)..=	1.24
Hydrualic radius...........=	0.35
fps........................=	2.68
Froude number..............=	0.80

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

Solving for................=	Depth Normal
Triangle	
Flow depth (ft)............=	0.30
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.1120
Manning"s n................=	0.035
CFS........................=	0.68
Cross section area (sqft)..=	0.18
Hydrualic radius...........=	0.13
fps........................=	3.74
Froude number..............=	1.80

Title of run: DD-9 (10/6)

Solving for................= Depth Normal

Triangle

Flow depth (ft)............=	0.42
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0630
Manning"s n................=	0.035
CFS........................=	1.26
Cross section area (sqft)..=	0.36
Hydrualic radius...........=	0.19
fps........................=	3.52
Froude number..............=	1.43

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

Solving for................=	Depth Normal
Triangle	
Flow depth (ft)............=	0.58
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0630
Manning"s n................=	0.035
CFS ....=	2.86
Cross section area (sqft)..=	0.66
Hydrualic radius...........=	0.26
fps........................=	4.32
Froude number..............=	1.50

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

```
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.69
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0200
   Manning"s n...............=   0.035
   CFS.......................=    2.58
   Cross section area (sqft)..=    0.94
   Hydrualic radius..........=    0.31
   fps.......................=    2.74
   Froude number.............=    0.87
```

```
Title of run: DD-10 (10/24)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    1.02
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0200
   Manning"s n...............=   0.035
   CFS.......................=    7.44
   Cross section area (sqft)..=    2.08
   Hydrualic radius..........=    0.46
   fps.......................=    3.57
   Froude number.............=    0.93
```

```
Title of run: DD-11 (10/6) MW
   Solving for................= Depth Normal
Triangle
   Flow depth (ft)............=    1.10
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Slope of diversion.........=  0.0160
   Manning"s n................=   0.035
   CFS........................=    8.09
   Cross section area (sqft)..=    2.41
   Hydrualic radius...........=    0.49
   fps........................=    3.35
   Froude number..............=    0.84
```

```
Title of run: DD-11 (10/24) MW
   Solving for................= Depth Normal
Triangle
   Flow depth (ft)............=    1.67
   First Side slope...........=     2.0
   Second Side slope..........=     2.0
   Slope of diversion.........=  0.0160
   Manning"s n................=   0.035
   CFS........................=   24.56
   Cross section area (sqft)..=    5.55
   Hydrualic radius...........=    0.74
   fps........................=    4.43
   Froude number..............=    0.90
```

```
Title of run: DD-12 (10/6)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.71
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0420
   Manning"s n...............=   0.035
   CFS.......................=    4.11
   Cross section area (sqft)..=    1.01
   Hydrualic radius..........=    0.32
   fps.......................=    4.07
   Froude number.............=    1.27
```

```
Title of run: DD-12 (10/24)
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    1.11
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0420
   Manning"s n...............=   0.035
   CFS.......................=   13.51
   Cross section area (sqft)..=    2.47
   Hydrualic radius..........=    0.50
   fps.......................=    5.47
   Froude number.............=    1.37
```

Title of run: DD-13 (10/6)

```
   Solving for...............= Depth Normal
Triangle
   Flow depth (ft)...........=    0.31
   First Side slope..........=     2.0
   Second Side slope.........=     2.0
   Slope of diversion........=  0.0170
   Manning"s n...............=   0.035
   CFS.......................=    0.28
   Cross section area (sqft)..=   0.19
   Hydrualic radius..........=    0.14
   fps.......................=    1.48
   Froude number.............=    0.70
```

Title of run: DD-13 (10/24)

Solving for................=	Depth Normal

Triangle

Flow depth (ft)............=	0.41
First Side slope...........=	2.0
Second Side slope..........=	2.0
Slope of diversion.........=	0.0170
Manning"s n................=	0.035
CFS........................=	0.61
Cross section area (sqft)..=	0.34
Hydrualic radius...........=	0.18
fps........................=	1.80
Froude number..............=	0.74

Form DOGM - C1 (Last Revised March 19, 2003) File Folder # 3

APPLICATION FOR PERMIT PROCESSING

Permit Change ☐	New Permit ☐	Renewal ☐	Transfer ☐	Exploration ☐	Bond Release ☐	Permit Number: C/007/041

Title of Proposal: Mine Water NOV Clean Copies

Mine: WEST RIDGE

Permittee: **WEST RIDGE Resources, Inc.**

Description, include reason for application and timing required to implement:.

Instructions: *If you answer yes to any of the first 8 questions (gray), submit the application to the Salt Lake Office. Otherwise, you may submit it to your reclamation specialist.*

Yes	No	Question
☐ Yes	☒ No	1. Change in the size of the Permit Area? _____ acres Disturbed Area? _____ acres ☐ increase ☐ decrease.
☐ Yes	☒ No	2. Is the application submitted as a result of a Division Order?
☐ Yes	☒ No	3. Does application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes	☒ No	4. Does application include operations in hydrologic basins other than as currently approved?
☐ Yes	☒ No	5. Does application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes	☒ No	6. Does the application require or include public notice/publication?
☐ Yes	☒ No	7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes	☒ No	8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☒ Yes	☐ No	9. Is the application submitted as a result of a Violation?
☐ Yes	☒ No	10. Is the application submitted as a result of other laws or regulations or policies? Explain:
☐ Yes	☒ No	11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes	☒ No	12. Does the application require or include underground design or mine sequence and timing?
☐ Yes	☒ No	13. Does the application require or include collection and reporting of any baseline information?
☐ Yes	☒ No	14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes	☒ No	15. Does application require or include soil removal, storage or placement?
☐ Yes	☒ No	16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes	☒ No	17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes	☐ No	18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes	No	19. Does the application require or include certified designs, maps, or calculations?
☐ Yes	☒ No	20. Does the application require or include subsidence control or monitoring?
☐ Yes	☒ No	21. Have reclamation costs for bonding been provided for?
☒ Yes	No	22. Does application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes	☒ No	23. Does the application affect permits issued by other agencies or permits issued to other entities?

☐ **Attach _3_ complete copies of the application.**

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein. (R645-301-123)

Gary E Gray Engineer/Agent 3/19/03

Signed - Name - Position - Date

Subscribed and sworn to before me this 19 day of March, 2003

Notary Public

My Commission Expires:
Attest: STATE OF
COUNTY OF Carbon

RADA J. ROGERS
NOTARY PUBLIC • STATE of UTAH
LUNDY LANE
CLEVELAND, UT 84518
COMM. EXPIRES 10-2-2006

Received by Oil, Gas & Mining

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MAR 2 0 2003

DIV. OF OIL, GAS & MINING

ASSIGNED TRACKING NUMBER

Form DOGM - C2 (Last Revised 6/93) File Folder # 3

Application for Permit Processing
Detailed Schedule of Changes to the MRP

Title of Application: **Mine Water NOV Clean Copies**	Permit Number: C/007/041
	Mine: WEST RIDGE
	Permittee: WEST RIDGE Resources, Inc.

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit application. Individually list all maps and drawings which are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise the existing mining and reclamation plan. **Include page, section and drawing numbers as part of the description.**

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
☐ ADD	☒ REPLACE	☐ REMOVE	In Chapter 7, Appendix 7-4, all text and tables from cover page thru to page 59 except
☐ ADD	☐ REPLACE	☐ REMOVE	for Figures
☐ ADD	☒ REPLACE	☐ REMOVE	In Chapter 7, Appendix 7-4, after page 35, Figures 3 and 4, retain all other Figures
☐ ADD	☒ REPLACE	☐ REMOVE	In Chapter 7, Appendix 7-4, West Ridge Computer Backup, section containing
☐ ADD	☐ REPLACE	☐ REMOVE	Disturbed Ditch Calculations and
☐ ADD	☒ REPLACE	☐ REMOVE	In Chapter 7, Appendix 7-4, West Ridge Computer Backup, section containing
☐ ADD	☐ REPLACE	☐ REMOVE	Disturbed Culvert Calculations, retain all other sections.
☐ ADD	☒ REPLACE	☐ REMOVE	Map 7-2 in Chapter 7, Appendix 7-4
☐ ADD	☒ REPLACE	☐ REMOVE	Map 7-2 in Chapter 7, Volume C Maps
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
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☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	

Any other specific or special instructions required for insertion of this proposal into the Mining and Reclamation Plan?

RECEIVED
MAR 2 0 2003
DIV. OF OIL, GAS & MINING