PERMIT TRACKING FORM

☐ Permit Amendment ☐ Exploration Permit X NOV Abatement ☐ Division Order ☐ Permit Transfer ☐ Incidental Boundary Change
☐ Permit Midterm (MT) ☐ Permit Renewal (PR) ☐ New Permit ☐ Significant Revision ☐ Bond Release

Date Received: 2/09/98	By: TAT	PERMIT NUMBER	ACT/007/020
Title of Proposal: Abatements Plans for N97-45-1-1		PERMIT CHANGE #	97F-3
Description:		PERMITTEE	Horizon Coal Company
# Copies Required: 5	# Copies Received: 6	MINE NAME	Horizon Mine

☐ **PERMIT CHANGE APPLICATION SENT TO SLC**	Date:	Letter to Permittee:

☐ **15 DAY INITIAL RESPONSE TO PERMIT CHANGE APPLICATION OR INITIAL COMPLETENESS REVIEW**	Date Due:	Date Done:	Letter to Permittee:
☐ Notice of Affidavit of Publication. (If change is a Significant Revision, New Permit, or Permit Transfer.)	Date Due:	Date Done:	Public Comment Received:

PFO Review Tracking	Round 3		Round	
	Due	Done	Due	Done
☐ Lead ☐ Generalist				
☐ Administrative				
☐ Land Use/ AQ				
☐ Biology				
☐ Engineering				
☐ Geology				
☐ Soils				
☐ Hydrology				

SLC Review Tracking	Round 3		Round	
	Due	Done	Due	Done
☑ Lead ☐ Generalist PGD	2/23			
☐ Administrative				
☐ Land Use/ AQ				
☐ Biology				
☐ Engineering				
☐ Geology				
☐ Soils				
☑ Hydrology Sharon	2/23			

TA Review Due:	Date:	Permittee Response Due: ☐ Stipulation ☐ Condition ☐ No Requirements	Date:	Division Decision Letter: ☐ Approve ☐ Deny
TA Review Done	Date:	Response Received:	Date:	Date:

Coordinated Reviews:	Phone Cont.	Round		Round		Received:
		Sent	Due	Sent	Due	
☐ OSM- C						
☐ BLM- C						
☐ Water Rights-L						
☐ DEQ- L						
☐ DWR- L						

Comments:

Additional Tracking:	Date:
Public Hearing	
Letter from Comp. Super.	
AVS Completed	
Approval Effective Date	
Approved Copy to File	
Approve copy to Permittee	
Approve copy to PFO/SLC	
Approved copy to agencies	
CHIA Modified	
Update master TA Y/N	

RECEIVED
MAR 24 1998
DIV. OF OIL, GAS & MINING

APPENDIX 4-1

LAND USE CLASSIFICATION

Add to the back of the existing data

SUPERSEDED
EFFECTIVE:
APR 07 1998
UTAH DIVISION OIL, GAS AND MINING

INCORPORATED
EFFECTIVE:
APR 07 1998
UTAH DIVISION OIL, GAS AND MINING

3.5.4 Backfilling and Grading Plans

The surface area was originally disturbed between 1928 and the 1950's by previous owners. The owners made no effort to save/store any topsoil or other soil material; therefore restoration to a contour that approximates pre-mining conditions (Plate 3-6) is neither practical nor required by the regulations. However, it is the intent of Horizon to restore the area to a topography that is compatible with the post-mining land use, using materials that are available at the site (Plates 3-7 and 3-7A). Cut and fill calculations are provided in Table 3-1, for the for the operational to post-mining (i.e., reclamation) phase.

In general, the backfilling and regrading will proceed as follows:

(a) After sealing of the portals and removal of all structures, a backhoe (Cat 235 or larger) will be brought to the upper portal terrace (Portal Canyon). The roads on both side of Portal Canyon will be backfilled, regraded, recontoured, fertilized, seeded and mulched (See Sections 3.5.5 for additional method details).

(b) The backhoe will begin by reaching down over the fill bank and retrieving as much material as can be reached to be placed on the terrace. A dozer (Cat D-7 or larger) will work with the backhoe, taking the retrieved material and spreading and compacting it from the faceup outward.

(c) The mine yard will then be recontoured using backhoes and dozers to drain to the center of the canyons. The reclamation slopes will be achieved during this backfilling and grading operation. Reclamation channels (described in Chapter 7) will be constructed to convey runoff through the reclaimed area. Operational culverts will be removed as the construction of the reclamation channel move down each canyon.

(d) During backfilling and regrading operations, the surface will be scarified to prevent slippage of topsoil and promote root penetration.

(e) A loader will be used to load topsoil into haul trucks at the topsoil stockpiles. The haul trucks will be used to deliver the topsoil from the topsoil stockpile to the area where the dozer and backhoe will be working. The dozer will be used to evenly distribute the topsoil over the area.

TABLE 3-1

RECLAMATION CUT AND FILL CALCULATIONS

Total inclusion area: 398698.68 sq ft, 9.153 acres
Cut to Fill ratio: 0.99
Cut (C.Y)/Area (acres): 1769.51
Fill (C.Y)/Area (acres): 1780.67
Cut volume is 437293.26 cubic ft, 16196.05 cubic yards
Fill volume is 440052.40 cubic ft, 16298.24 cubic yards

Cut and fill data based on Survcadd software, version 13.1 and AutoCad 13 software.

calculations for the peak flows for these drainages. As indicated in Appendix 7-4, the design capacities of the reclamation channels exceed the capacities of the natural stream channels up- and downstream from the proposed reclamation channels. ~~Specifically~~, as indicated in Appendix 7-4, the natural and reclaimed capacities of Portal Canyon Creek and Jewkes Creek are as follows:

Creek	Upstream Capacity (cfs)	Downstream Capacity (cfs)	Reclamation Capacity (cfs)
Portal Canyon (RD-1)	13.1	—	56.7
Jewkes (RD-2)	27.6	38.7	143.5
Jewkes (RD-3)	27.6	38.7	150.6

Drainage from the 181.2-acre Portal Canyon watershed will flow through the reclaimed stream channel RD-1. As indicated in Appendix 7-4, the peak flow for the 100-year, 6-hour event for this drainage is 9.95 cfs. The reclaimed channel will be trapezoidal in shape and will be constructed with an 8-foot bottom width, 2H:1V sideslopes, and a channel slope ranging from 0.02 to 0.08 foot/foot (see Figure 7-12 and Plate 3-7). The channel will be constructed in regraded materials and will be riprapped to provide a stable stream section. To handle this event, the channel will have a maximum flow depth of 0.36 feet and a maximum velocity of 4.92 fps. The channel depth is planned to be a minimum of 1 foot, resulting in a freeboard of 0.64 feet. Although the velocity is less than 5 fps, indicating that riprap is not required, riprap with a median diameter of 0.5 foot will be installed to enhance long-term erosion protection. Material gradation for this riprap is presented in Table 7-6. A sand filter blanket will be installed beneath the riprap as indicated in Appendix 7-4 and Figure 7-12.

Reclamation channel RD-2 will receive flow from the 358.2 acre Upper Jewkes Creek drainage. The reclaimed channel will be a compound channel to provide channel stability and assist in establishment of the riparian/wet meadow vegetative community which currently exists along portions of Jewkes Creek. The base channel will be trapezoidal in shape and will be constructed with an 8-foot bottom width, 2H:1V sideslopes, and a channel slope of approximately 0.03 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this low flow channel, based on the 100-year, 6-hour event, is 19.75 cfs. The channel will be constructed in regraded materials and will be riprapped to provide a stable stream section. To handle this event, the channel will have a maximum flow depth of 0.51 foot and a maximum velocity of 4.25 fps. The channel depth is planned to be 2.0 feet deep, resulting in a freeboard of 1.49 feet. According to Appendix 7-4, the channel will be lined with riprap which will have a median diameter of 0.5 foot, with a material gradation as presented in Table 7-6. A sand filter blanket will be installed beneath the riprap as indicated in Appendix 7-4 and Figure 7-12.

Two procedures will be implemented during reclamation to assist in the re-establishment of riparian/wet meadow vegetation along Jewkes Creek. First, following installation of the filter blanket and the riprap, soil will be worked into the voids of the riprap using the bucket of a backhoe. The purpose of this soil will be to provide a growth medium for the seeds and seedlings that are planted in the channel during revegetation.

FIG7-12.DWG UC572-02 6-12-97

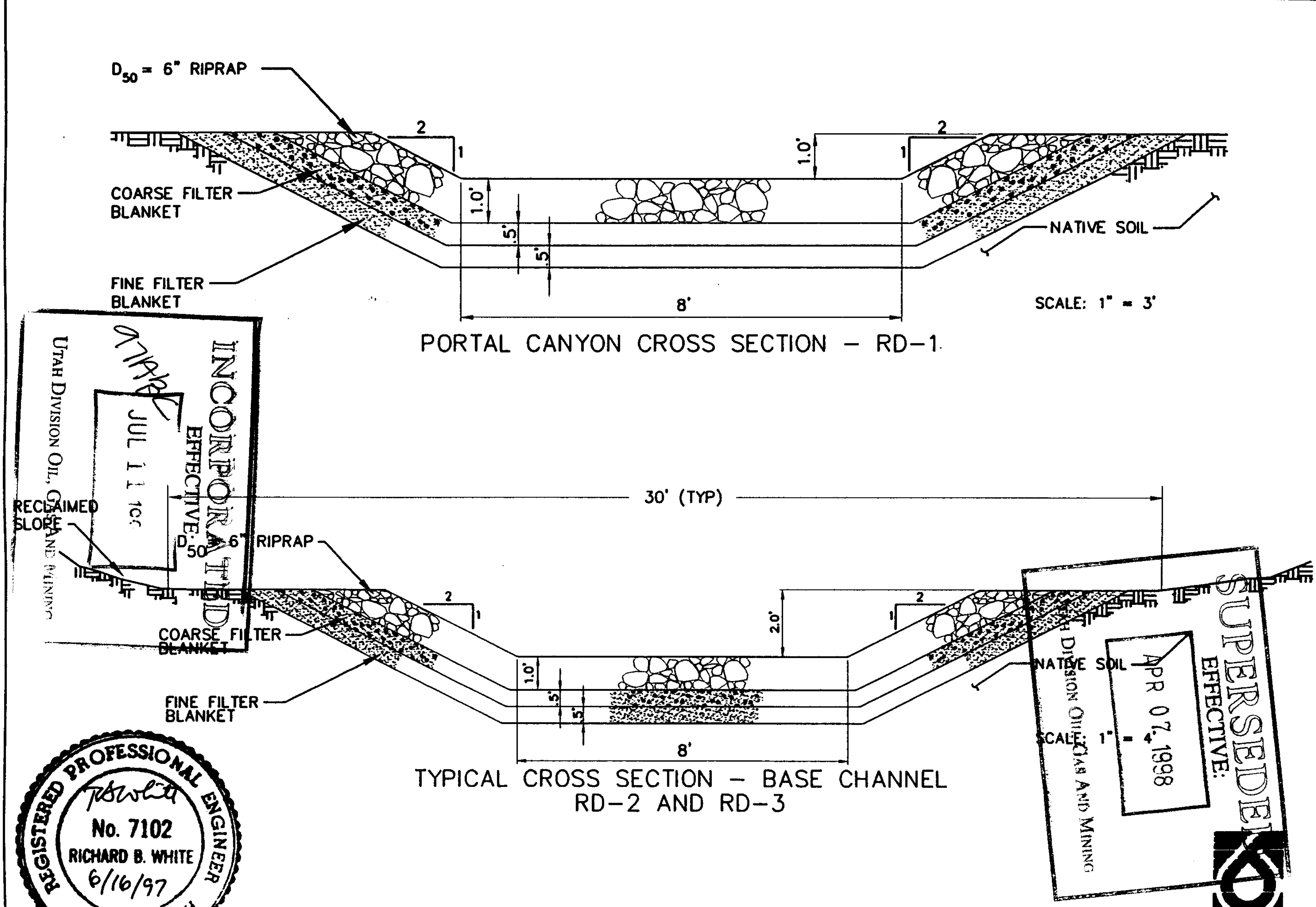

FIGURE 7-12. TYPICAL CROSS SECTIONS FOR RECLAIMED CHANNELS

EarthFax

Second, loose-rock check dams will be installed at the locations indicated on Plate 3-7 in accordance with Figure 7-12a. These check dams have been designed in accordance with the procedures outlined by Heede (1976) as indicated in Appendix 7-4 and will cause naturally-occurring sediment in the stream to be deposited in the reclaimed channel. This deposited sediment will provide an additional soil base for re-establishment of the riparian/wet meadow vegetation and will also provide a cross section which is more typical of that which currently exists. Nonetheless, should a major storm event occur, the underlying base channel will provide long-term protection against excessive erosion.

The check dams have been designed with a spillway that is capable of passing the peak flow resulting from the 10-year, 6-hour precipitation event. Discharge in excess of that event will flow onto the adjacent flood plain. By spreading this flow, moisture will be provided to the riparian/wet meadow vegetation to assist in its re-establishment. Data included in Appendix 7-4 indicate that the soil in the flood plain will be erosionally stable during runoff resulting from the 100-year, 6-hour rainfall event.

The width of the reclaimed flood plain will be at least equal to that of the current riparian/wet meadow vegetation community, as defined on Figure 2 of Appendix 9-2. The planned width of the reclamation flood plain is indicated on Plate 3-7. Check dams will be installed within the flood-plain sections as indicated on Plate 3-7. Even though the calculations provided in Appendix 7-4 indicate that the flood plain soils will be erosionally stable, a temporary jute matting will be installed in these flood plain areas to provide additional protection for the seeds until vegetation is established.

The flood plain of channel RD-2 will also be trapezoidal in shape and will be constructed with a typical bottom width of 30 feet, 2H:1V sideslopes, and a channel slope ranging from approximately 0.02 to 0.03 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this flood plain channel, based on the 100-year, 6-hour event, is 19.75 cfs. Allowing for the capacity of the low flow channel, the flood plain will only be required to handle 10.29 cfs. The channel will be constructed in regraded materials and will be stabilized using a temporary jute mesh erosion control blanket. This blanket will be in place only until the vegetation planting for the flood plain mature and provide natural protection. To handle this event, the flood plain channel will have a maximum flow depth of 0.16 foot and a maximum velocity of 2.32 fps. The velocity is less than the 5.5 fps allowed for jute mesh.

Reclamation channel RD-3 will receive flow from the 551.0 acre Lower Jewkes Creek drainage, below the confluence of Jewkes Creek and Portal Canyon. The reclaimed channel will also be a compound channel. It will consist of a base channel and a flood plain, with loose-rock check dams. The base channel will be trapezoidal in shape and will be constructed with an 8-foot bottom width, 2H:1V sideslopes, and a channel slope ranging from approximately 0.03 to 0.07 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this base channel, based on the 100-year, 6-hour event, is 30.21 cfs. The channel will be constructed in regraded materials and will be riprapped to provide a stable stream section. To handle this event, the base channel will have a maximum flow depth of 0.64 foot and a maximum velocity of 6.60 fps. The channel depth is planned to be 2.0 feet, resulting in a freeboard of

FIG7-12A.DWG UC372-02 8-13-97

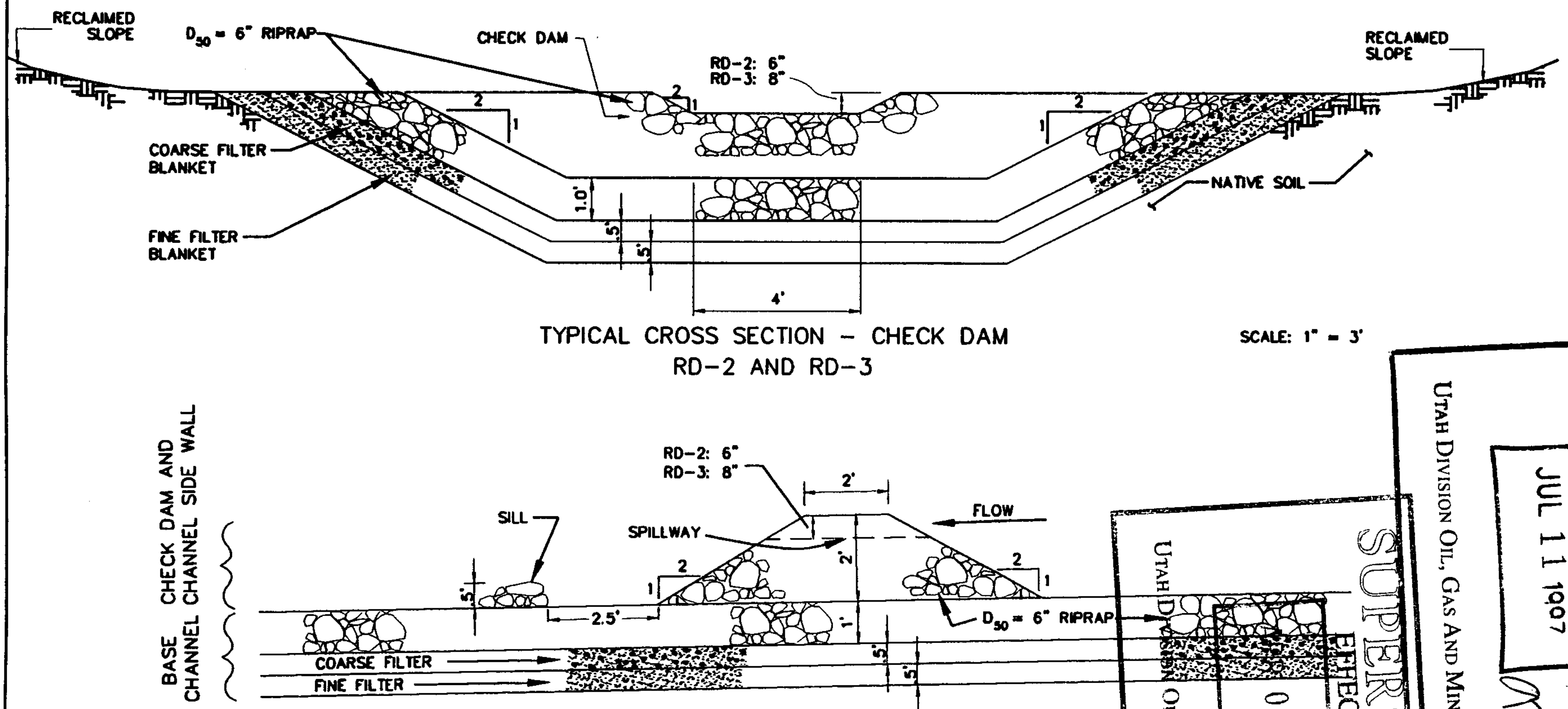

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FIGURE 7-12A. TYPICAL CHECK DAM CROSS SECTIONS

1.36 feet. The velocity is greater than 5 fps, requiring riprap protection. According to Appendix 7-4, this riprap will have a median diameter of 0.5 foot, with a material gradation as presented in Table 7-6. A sand filter blanket will be installed beneath the riprap as indicated in Appendix 7-4 and Figure 7-12.

Soil will be worked into the channel riprap and loose-rock check dams will be installed in channel RD-3 as indicated above. The flood plain will also be trapezoidal in shape and will be constructed with a typical bottom width of 30 feet (but at least equal to the extent of the pre-mining riparian/wet meadow vegetation community as defined on Figure 2 of Appendix 9-2), 2H:1V sideslopes, and a channel slope ranging from approximately 0.02 to 0.07 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this flood plain channel, based on the 100-year, 6-hour event, is 30.21 cfs. Allowing for the capacity of the low flow channel, the flood plain will only be required to handle 15.66 cfs. The channel will be constructed in regraded materials and will be stabilized using a temporary jute mesh erosion control blanket. This blanket will be in place only until the vegetation planting for the flood plain mature and provide natural protection. To handle this event, the flood plain channel will have a maximum flow depth of 0.20 foot and a maximum velocity of 3.59 fps. The velocity is less than the 5.5 fps allowed for jute mesh.

As indicated on Plate 3-7, no check dams will be installed in the middle portion of the channel RD-3. This section is currently narrow and the reclamation plan seeks to re-establish the riparian/wet meadow vegetation in this area at a width which is indicative of current conditions. Only the base channel will exist in this section, wherein the establishment of riparian/wet meadow vegetation will be enhanced by working soil into the riprap as indicated above.

<u>Sediment Control</u>. To minimize the hydrologic impacts of the reclamation work, Horizon commits to construct the reclaimed stream channels commencing at the upstream end of each channel. Horizon Coal Corporation proposes to employ the following alternative methods during reclamation to control sediment:

1. Silt fences
2. Surface ripping, pocking, and deep gouging
3. Mulching
4. Straw-bale dikes
5. Seeding
6. Reseeding areas that do not exhibit successful germination

The approximate locations of silt fences to be installed during the reclamation period are indicated on Plate 7-7a. The fences will be installed parallel to the contours with the ends of the fences turned up perpendicular to the contours to contain the sediment. Silt fences will be installed in accordance with Figure 7-5. The filter fabric will be installed against a supportive backing. To prevent sediment runoff from passing under the fence, the fabric will be secured by burying the bottom edge in a small trench along the length of the fence. In addition silt fences or straw-bale dikes will be installed in roadside ditches immediately downstream from the disturbed area.

APPENDIX 7-4

DESIGN CALCULATIONS

UPPER JEWKES CREEK

6 7/11/96

AREA

Map Area	Actual Area	
15.51 sq. in.	15510000 sq. ft.	356.1 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 8900 Min. Elev. 7595 Difference 1305

	Elevation	Length (ft.)
0.25	7921.25	7950
0.5	8247.5	8100
0.75	8573.75	6600

Ave Watershed Slope= 47.6 %

Hydraulic Length

Map Length	Actual Length
5.8 inches	5800 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.25 hrs

Time of Concentration = 0.42 hrs

97A?BC

7
8/12/96

SEDIMENT POND

AREA

Map Area	Actual Area	
1.53 sq. in.	1530000 sq. ft.	35.1 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 8170 Min. Elev. 7575 Difference 595

	Elevation	Length (ft.)
0.25	7723.75	2200
0.5	7872.5	1900
0.75	8021.25	500

Ave Watershed Slope= 44.7 %

Hydraulic Length

Map Length	Actual Length
2.14 inches	2140 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.12 hrs

Time of Concentration = 0.19 hrs

97A BC

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8/12/96

DIVERSION D-1

AREA

Map Area	Actual Area	
549.5 sq. in.	1373750 sq. ft.	31.5 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 8170 Min. Elev. 7585 Difference 585

	Elevation	Length (ft.)
0.25	7731.25	2100
0.5	7877.5	1800
0.75	8023.75	500

Ave Watershed Slope= 46.8%

SUPERSEDED
EFFECTIVE:
APR 07 1998
UTAH DIVISION OIL, GAS AND MINING

Hydraulic Length

Map Length	Actual Length
1.96 inches	1960 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.11 hrs

Time of Concentration = 0.18 hrs

INCORPORATED
EFFECTIVE:
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UTAH DIVISION OIL, GAS AND MINING

97 14 BC

CULVERT D-1

9 7/11/96

AREA

Map Area		Actual Area	
273.6 sq. in.	684000 sq. ft.		15.7 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 8170 Min. Elev. 7630 Difference 540

	Elevation	Length (ft.)
0.25	7765	1035
0.5	7900	800
0.75	8035	450

Ave Watershed Slope= 45.1 %

Hydraulic Length

Map Length	Actual Length
inches	1800 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.10 hrs

Time of Concentration = 0.17 hrs

97143C

10
2/7/97

CULVERT D-2

AREA

Map Area		Actual Area
14 sq. in.	35000 sq. ft.	0.8 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 7600 Min. Elev. 7590 Difference 10

	Elevation	Length (ft.)
0.25	7592.5	200
0.5	7595	250
0.75	7597.5	300

Ave Watershed Slope= 5.4 %

Hydraulic Length

Map Length	Actual Length
inches	300 feet

TIME OF CONCENTRATION

Curve Number = 90 S = 1.111 Lag 0.04 hrs

Time of Concentration = 0.06 hrs

CULVERT D-3

AREA

Map Area		Actual Area
16 sq. in.	40000 sq. ft.	0.9 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 7790 Min. Elev. 7600 Difference 190

	Elevation	Length (ft.)
0.25	7647.5	150
0.5	7695	120
0.75	7742.5	80

Ave Watershed Slope= 41.6 %

Hydraulic Length

Map Length	Actual Length
inches	500 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.04 hrs

Time of Concentration = 0.06 hrs

97143C

PRECIPTATION DEPTHS FOR VARIOUS RETURN PERIODS @ HORIZON MINE SITE AREA

RETURN PERIOD	PRECIP. DEPTH * (IN)
10 yr - 24 hr	1.8
10 yr - 6 hr	1.5
25 yr - 6 hr	1.6
100 yr - 6 hr	1.8

* DEPTH VALUES DETERMINED FROM NOAA, "PRECIPITATION FREQUENCY ATLAS OF WESTERN UNITED STATES", VOLUME II - UTAH (1973).

971A BC

12
7/11/96

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Horizon No. 1 Mine - Portal Canyon - 100 yr-6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 148.30 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.340 hrs

OUTPUT SUMMARY

Runoff depth	0.17002	inches	
Initial abstr	0.85714	inches	
Peak flow =	8.27	cfs	(0.05529 iph)
at time	3.627	hrs	

INPUT FOR:
Horizon No. 1 Mine - Upper Jewkes Creek - 100 yr-6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 356.10 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.420 hrs

OUTPUT SUMMARY

Runoff depth	0.17002	inches	
Initial abstr	0.85714	inches	
Peak flow =	19.60	cfs	(0.05459 iph)
at time	3.640	hrs	

971143C

DETERMINE CULVERT SIZE FOR BYPASS OF UNDISTURBED AREA RUNOFF:

CULVERT I.D.	BYPASSED WATERSHED	PEAK FLOW (CFS)	MINIMUM CULVERT (FT)	RECOMMENDED CULVERT SIZE (FT)
UC-1	JENKES	19.60		
	PORTAL	8.27		
	TOTAL	27.87	2.25**	3.0
UC-2	PORTAL	8.27	1.75*	2.0
UC-3	JENKES	19.60	2.5*	2.5

* BASED ON INLET CONTROL FOR PROJECTING INLET CMP CULVERT.

** BASED ON MINIMUM SLOPE SECTION FLOW IN CULVERT CALCULATIONS DETERMINED USING FLOWMASTER PROGRAM FROM HAESTAD METHODS (1990). OUTPUT ATTACHED.

UC-1 SIZING

PEAK FLOW = 27.87 CFS

SLOPE = (7585 - 7575)/370 FT = 0.027 FT/FT

MANNING'S n = 0.024 (CMP PIPE)

ASSUME: 2.0 FT DIAMETER

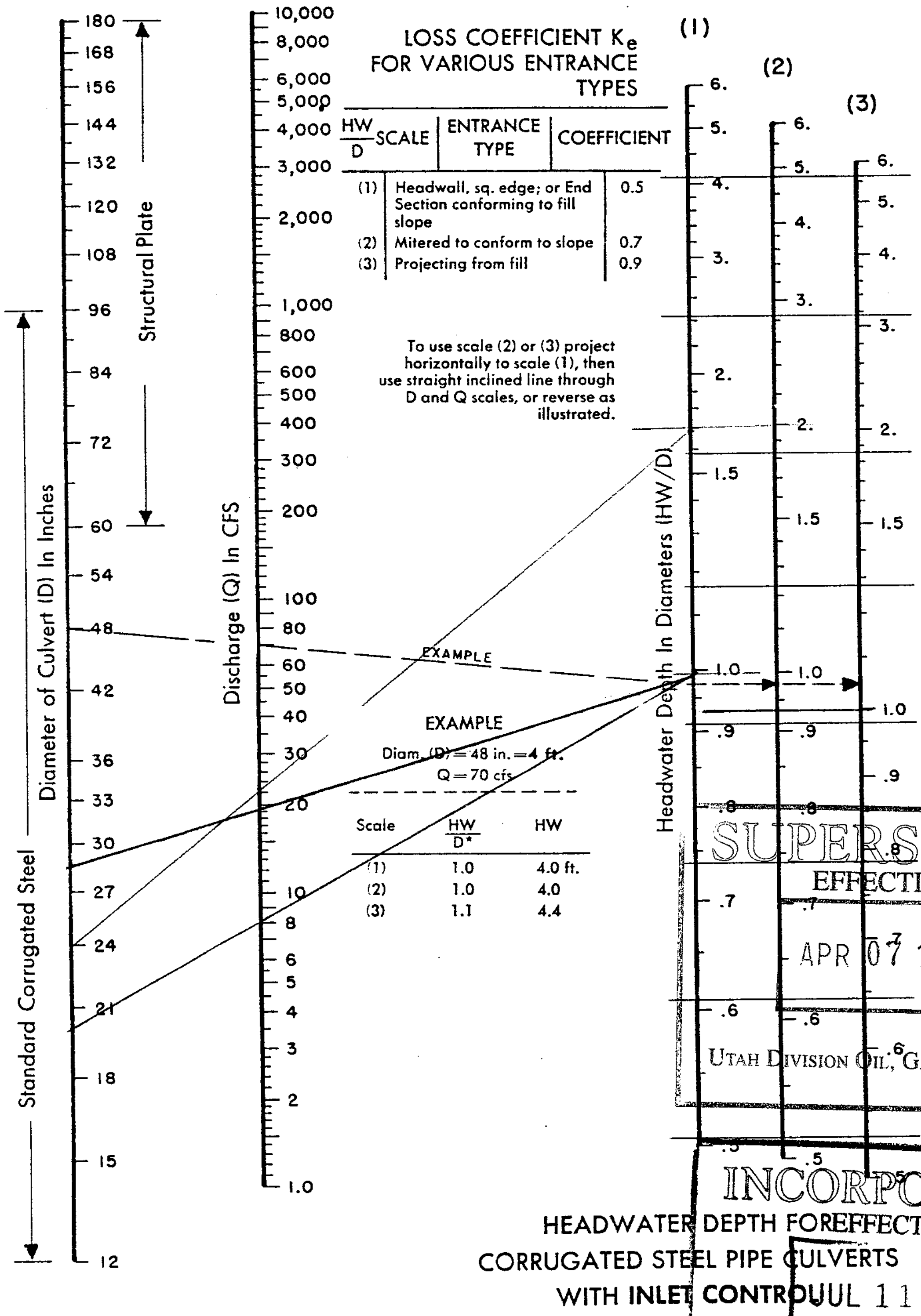
DEPTH GREATER THAN PIPE DIAMETER

ASSUME: 2.25 FT DIAMETER

DEPTH = 1.87 FT

VELOCITY = 7.9 FPS

14 7/11/96



97A&C

Fig. 4-18. *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommend keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

15 7/11/96

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: UD-1 Culvert (UC-1)

Comment: Minimum Slope Section

Solve For Actual Depth

Given Input Data:

Diameter..........	2.25 ft
Slope.............	0.0270 ft/ft
Manning's n.......	0.024
Discharge.........	27.87 cfs

Computed Results:

Depth.............	1.87 ft
Velocity..........	7.90 fps
Flow Area.........	3.53 sf
Critical Depth....	1.84 ft
Critical Slope....	0.0278 ft/ft
Percent Full......	83.00 %
Full Capacity.....	27.57 cfs
QMAX @.94D........	29.65 cfs
Froude Number.....	0.96 (flow is Subcritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, CT 06708

97A3C

DETERMINE RIPRAP OUTLET PROTECTION REQUIRED AT UC-1 CULVERT OUTLET.

BASED ON A 3.0 FT DIAMETER CULVERT + A 5% OUTLET SLOPE:

OUTLET VELOCITY = 10.38 FPS

TO ASSURE PROTECTION OF THE RIPARIAN AREA BELOW THE SEDIMENT POND AND UC-1 CULVERT OUTLET IT IS PROPOSED THAT A SERIES OF CHANNELS BE CONSTRUCTED. THE FIRST IS AN IMPACT POOL/OUTLET CHANNEL FROM CULVERT UC-1 + THE EMERGENCY SPILLWAY OF THE SEDIMENT POND. THIS CHANNEL WILL BE TRAPEZOIDAL IN SHAPE, RIPRAPPED W/ 0.5 FT D_{50} RIPRAP, + 2 FT DEEP. THE OUTLET CHANNEL WILL TRANSITION TO THE LOW FLOW CHANNEL + FLOOD PLAIN CONFIGURATION PROPOSED FOR FINAL RECLAMATION OF JEWKES CREEK. THIS TRANSITION WILL CREATE THE IMPACT POOL BECAUSE THE LOW FLOW CHANNEL IS NOT AS DEEP BELOW THE FLOOD PLAIN AS THE OUTLET CHANNEL.

THE LOW FLOW CHANNEL* WILL BE TRAPEZOIDAL IN SHAPE WITH A BOTTOM WIDTH OF 4 FT, RIPRAPPED W/ 0.5 FT D_{50} RIPRAP, + A DEPTH OF 0.5 FT. THIS WILL ENSURE THAT LOW FLOWS CAN SAFELY BE CONVEYED THRU THE AREA, HOWEVER THE HIGH FLOWS WILL SPREAD OVER THE FLOOD PLAIN. ADDITIONALLY, THE VERY SHALLOW DEPTH OF THE LOW FLOW CHANNEL WILL INSURE THE CAPABILITY OF SUB-IRRIGATION + SEEPAGE INTO THE SURROUNDING FLOOD PLAIN.

BY CONSTRUCTING THESE CHANNELS IT WILL NOT BE NECESSARY TO RE-DISTURB THE AREA WHEN THE SITE IS RECLAIMED. THE RIPARIAN AREA WILL ALREADY BE ESTABLISHED AROUND THE RECLAIMED CHANNEL AND ANY NEW DISTURBANCE WOULD JUST CONNECT TO IT.

* SEE PAGE 10 OF RECLAMATION CALC'S.

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Culvert UC-1

Comment: Outlet Protection Determination

Solve For Actual Depth

Given Input Data:

Diameter..........	3.00 ft
Slope.............	0.0500 ft/ft
Manning's n.......	0.024
Discharge.........	27.87 cfs

Computed Results:

Depth.............	1.22 ft
Velocity..........	10.38 fps
Flow Area.........	2.69 sf
Critical Depth....	1.71 ft
Critical Slope....	0.0155 ft/ft
Percent Full......	40.52 %
Full Capacity.....	80.79 cfs
QMAX @.94D........	86.90 cfs
Froude Number.....	1.91 (flow is Supercritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

97/A 3C

OUTLET CHANNEL

CHANNEL SHAPE: TRAPEZOIDAL

BOTTOM WIDTH: 10 FT

SIDESLOPES: 2H:1V

MANNING'S n: 0.035 (D_{50} = 0.5 FT)

CHANNEL SLOPE: 0.03 FT/FT

DISCHARGE: 27.37 CFS

FLOW DEPTH = 0.55 FT

FLOW VELOCITY = 4.57 FPS

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Culvert UC-1

Comment: Outlet Channel

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.035 — D_{50} = 0.5 FT
Channel Slope....	0.0300 ft/ft
Discharge........	27.87 cfs

Computed Results:

Depth............	0.55 ft
Velocity.........	4.57 fps
Flow Area........	6.10 sf
Flow Top Width...	12.20 ft
Wetted Perimeter.	12.46 ft
Critical Depth...	0.60 ft
Critical Slope...	0.0226 ft/ft
Froude Number....	1.14 (flow is Supercritical)

19
2/7/97

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Horizon No. 1 Mine - Div. DD-1 - 25 yr-6 hr event

STORM :	WATERSHED :
Dist.=SCS Type `b' - 6 Hr	Area = 33.40 acres
Depth = 1.60 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.190 hrs

OUTPUT SUMMARY

Runoff depth 0.10974 inches
Initial abstr 0.85714 inches
Peak flow = 1.28 cfs (0.03786 iph)
at time 3.547 hrs

INPUT FOR: Horizon No. 1 Mine - Culvert DC-1 - 25 yr-6 hr event

STORM :	WATERSHED :
Dist.=SCS Type `b' - 6 Hr	Area = 15.70 acres
Depth = 1.60 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.170 hrs

OUTPUT SUMMARY

Runoff depth 0.10974 inches
Initial abstr 0.85714 inches
Peak flow = 0.60 cfs (0.03813 iph)
at time 3.536 hrs

97A BC

ZO
2/7/97

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Horizon No. 1 Mine - Culvert DC-2 - 25 yr-6 hr event

STORM :	WATERSHED :
Dist.=SCS Type `b' - 6 Hr	Area = 0.80 acres
Depth = 1.60 inches	CN = 90.00
Duration = 6.00 hrs	Time conc.= 0.060 hrs

OUTPUT SUMMARY

Runoff depth	0.76270	inches	
Initial abstr	0.22222	inches	
Peak flow =	0.59	cfs	(0.72932 iph)
at time	2.504	hrs	

INPUT FOR: Horizon No. 1 Mine - Culvert DC-3 - 25 yr-6 hr event

STORM :	WATERSHED :
Dist.=SCS Type `b' - 6 Hr	Area = 0.90 acres
Depth = 1.60 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.060 hrs

OUTPUT SUMMARY

Runoff depth	0.10974	inches	
Initial abstr	0.85714	inches	
Peak flow =	0.04	cfs	(0.03993 iph)
at time	3.504	hrs	

97A/BC

DETERMINATION OF DIVERSION SIZING

DD-1 - UPPER SECTION (JUST DD-1 WATERSHED)

CHANNEL SHAPE: TRIANGULAR

SIDE SLOPES: 2H:1V

MIN. SLOPE: 0.033 FT/FT

MAX. SLOPE: 0.143 FT/FT

CHANNEL DEPTH: 1 FT

DISCHARGE = 1.28 CFS (25yr-6hr)

MAX. FLOW DEPTH = 0.45 FT

MAX. FLOW VELOCITY = 4.80 FPS

DD-1 LOWER SECTION (DD-1 PLUS DC-3)

CHANNEL SHAPE: TRIANGULAR

SIDESLOPES: 2H: 1V

MIN. SLOPE: 0.033 FT/FT

MAX. SLOPE: 0.143 FT/FT

CHANNEL DEPTH: 1 FT

DISCHARGE = 1.32 CFS (25yr-6hr)

MAX. FLOW DEPTH = 0.46 FT

MAX. FLOW VELOCITY = 4.83 FPS

ZZ
2/7/97

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Diversion DD-1 Upper

Comment: Minimum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0330 ft/ft
Discharge........	1.28 cfs

Computed Results:

Depth............	0.45 ft
Velocity.........	3.11 fps
Flow Area........	0.41 sf
Flow Top Width...	1.82 ft
Wetted Perimeter.	2.03 ft
Critical Depth...	0.48 ft
Critical Slope...	0.0245 ft/ft
Froude Number....	FULL

— MAX FLOW DEPTH < 0.7 FT
OK

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23
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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Diversion DD-1 Upper

Comment: Maximum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.030 — NATURAL MATERIAL
Channel Slope....	0.1430 ft/ft
Discharge........	1.28 cfs

Computed Results:

Depth............	0.34 ft
Velocity.........	5.39 fps — GREATER THAN 5 FPS NO GOOD NEED RIPRAP
Flow Area........	0.24 sf
Flow Top Width...	1.38 ft
Wetted Perimeter.	1.54 ft
Critical Depth...	0.48 ft
Critical Slope...	0.0245 ft/ft
Froude Number....	FULL

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97A
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24
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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Diversion DD-1 Upper

Comment: Maximum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.035 — 0.5FT D50
Channel Slope....	0.1430 ft/ft
Discharge........	1.28 cfs

Computed Results:

Depth............	0.37 ft
Velocity.........	4.80 fps — OK, LESS THAN 6.5FPS BASED ON PLATE 29 (ATTACHED).
Flow Area........	0.27 sf
Flow Top Width...	1.46 ft
Wetted Perimeter.	1.63 ft
Critical Depth...	0.48 ft
Critical Slope...	0.0334 ft/ft
Froude Number....	FULL

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PROJECT 4C0458-07 PAGE 25 OF
COMPUTED DJS DATE 7/11/96
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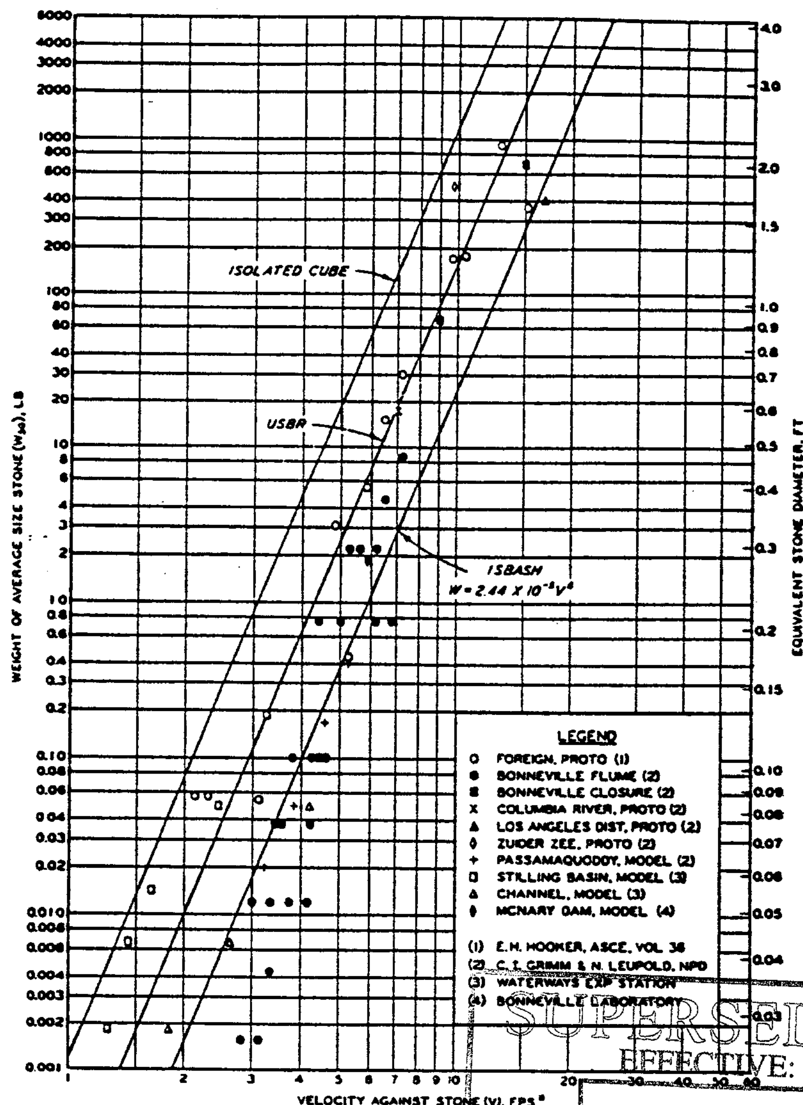

NOTE: SPECIFIC WEIGHT OF ROCK = 165 LB/CU FT.
*FOR STONE PROTECTION BELOW ENERGY DISSIPATORS USE AS AVERAGE VELOCITY ACROSS END SILL.

SEE TEXT PAGE 36

VELOCITY VS STONE WEIGHT

Plate 29

97A

FROM: U.S. ARMY CORPS OF ENGINEERS 1970.
HYDRAULIC DESIGN OF FLOOD CONTROL CHANNELS
EM 1110-2-1601. WASHINGTON, D.C.

25a
2/7/97

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Diversion DD-1 Lower

Comment: Minimum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V) – NATURAL MATERIAL
Manning's n......	0.030
Channel Slope....	0.0330 ft/ft
Discharge........	1.32 cfs

Computed Results:

Depth............	0.46 ft – OK, LESS THAN 0.7 FT
Velocity.........	3.13 fps
Flow Area........	0.42 sf
Flow Top Width...	1.84 ft
Wetted Perimeter.	2.05 ft
Critical Depth...	0.49 ft
Critical Slope...	0.0244 ft/ft
Froude Number....	FULL

25b
2/7/97

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Diversion DD-1 Lower

Comment: Maximum Slope Section

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.035 — 0.5 FT D50
Channel Slope....	0.1430 ft/ft
Discharge........	1.32 cfs

Computed Results:

Depth............	0.37 ft
Velocity.........	4.83 fps - OK, LESS THAN 6.5 FPS BASED ON PLATE 29.
Flow Area........	0.27 sf
Flow Top Width...	1.48 ft
Wetted Perimeter.	1.65 ft
Critical Depth...	0.49 ft
Critical Slope...	0.0332 ft/ft
Froude Number....	FULL

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Ancillary Road Crossing of DD-1
Worksheet for Triangular Channel

Project Description	
Project File	untitled.fm2
Worksheet	Design Configuration
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.050000 ft/ft	
Left Side Slope	5.000000 H : V	
Right Side Slope	5.000000 H : V	
Discharge	1.28	cfs

Results		
Depth	0.29	ft
Flow Area	0.42	ft²
Wetted Perimeter	2.97	ft
Top Width	2.91	ft
Critical Depth	0.33	ft
Critical Slope	0.024477 ft/ft	
Velocity	3.02	ft/s
Velocity Head	0.14	ft
Specific Energy	0.43	ft
Froude Number	1.40	
Flow is supercritical.		

— LESS THAN 0.7 FT DEEP.

— OK, LESS THAN 5.0 FPS, NO RIPRAP NEEDED.

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PROJECT UC0458-07 PAGE 26 OF
COMPUTED DS DATE 7/11/96
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DETERMINE DISTURBED AREA CULVERT SIZING

CULVERT I.D.	PEAK* FLOW (CFS)	MINIMUM** CULVERT (FT)	RECOMMENDED CULVERT SIZE (FT)
DC-1	0.60	1	1.5
DC-2	0.59	1	1.5
DC-3	0.04	1	1.5

* 25yr-6hr PEAK FLOW
** BASED ON INLET CONTROL NOMEGRAPH (pg. 14)

97193C

SEDIMENTATION POND DESIGN

RUNOFF VOLUME:

TOTAL DRAINAGE AREA = 35.1 AC *

Wt. Avg. CURVE NUMBER = 70 (SEE PG. 4)

PRECIP. DEPTH = 1.8 in (10yr-24hr)

* INCLUDES DISTURBED + UNDISTURBED AREAS.

$$Q = \frac{(P-0.2S)^2}{P+0.8S} = \frac{(1.8-0.2(4.28))^2}{1.8+0.8(4.28)} = 0.19 \text{ in}$$

$$S = \left(\frac{1000}{CN}\right) - 10 = \left(\frac{1000}{70}\right) - 10 = 4.28$$

$$VOL = \frac{Q * A}{12 \text{ in/ft}} = \frac{0.19 * 35.1}{12} = 0.56 \text{ AC-FT}$$

SEDIMENT VOLUME:

DISTURBED DRAINAGE AREA = 9.2 AC

SEDIMENT FACTOR = 0.1 AC-FT/AC DIST.

$$VOL = 9.2_{AC} * 0.1 \text{ ACFT/AC} = 0.92 \text{ AC-FT}$$

TOTAL POND VOLUME:

97A-5C

$$T_{VOL} = \text{SED. VOL.} + \text{RUNOFF VOL.}$$

$$= 0.56 \text{ AC-FT} + 0.92 \text{ AC-FT}$$

$$= 1.48 \text{ AC-FT}$$

28
8/12/96

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENRATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Horizon No. 1 Mine - Sediment Pond - 10 yr-24 hr event

---

STORM :	WATERSHED :
Dist.=SCS Type II - 24 Hr	Area = 35.10 acres
Depth = 1.80 inches	CN = 70.00
Duration = 24.00 hrs	Time conc.= 0.190 hrs

OUTPUT SUMMARY

Runoff depth	0.17002	inches	
Initial abstr	0.85714	inches	
Peak flow =	3.91	cfs	(0.11037 iph)
at time	12.109	hrs	

INPUT FOR: Horizon No. 1 Mine - Sediment Pond - 25 yr-6 hr event

---

STORM :	WATERSHED :
Dist.=SCS Type `b' - 6 Hr	Area = 35.10 acres
Depth = 1.60 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.190 hrs

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OUTPUT SUMMARY

Runoff depth	0.10974	inches	
Initial abstr	0.85714	inches	
Peak flow =	1.34	cfs	(0.03786 iph)
at time	3.547	hrs	

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HORIZON SEDIMENTATION POND

Stage-Capacity Table

Elevation (ft)	Area* (ft^2)	Average Area (ft^2)	Contour Interval (ft)	Incremental Volume (ft^3)	Cummulative Volume (ft^3)	Cummulative Volume (ac-ft)
7578	10340					
		11245	2	22490	22490	0.52
7580	12150					
		13120	2	26240	48730	1.12
7582	14090					
		15125	2	30250	78980	1.81
7584	16160					
		17260	2	34520	113500	2.61
7586	18360					

* Determined from the topography of the proposed pond (attached).

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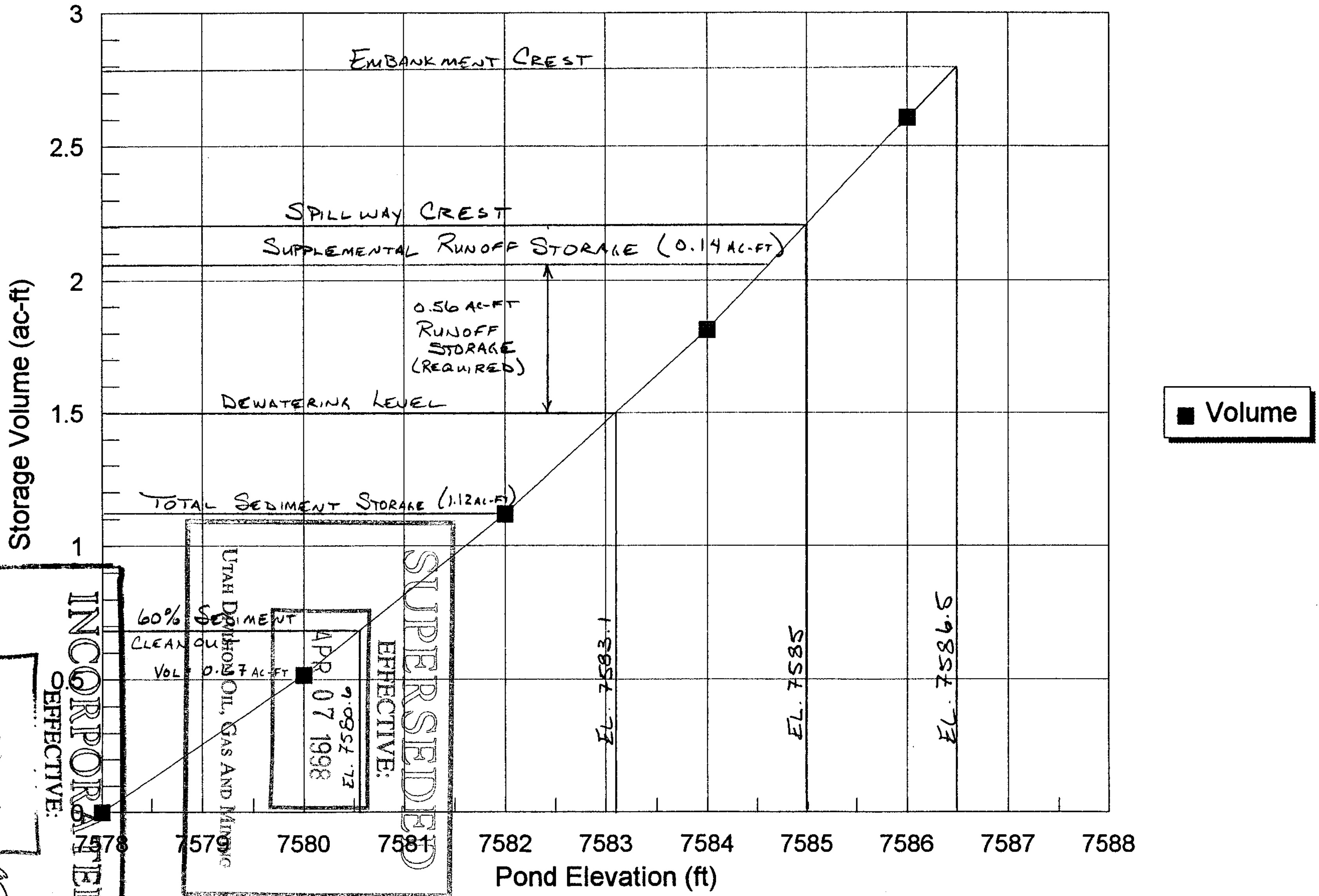
Stage-Capacity Curve

Horizon Sed. Pond



30
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SEDIMENT POND

REQUIRED RUNOFF VOLUME = 0.56 AC-FT
REQUIRED SEDIMENT VOLUME = 0.92 AC-FT

TOTAL 1.48 AC-FT

AVAILABLE VOLUME IN POND = ~~2.6~~ 2.20 AC-FT

USING RUNOFF STORAGE = 0.7 AC-FT

ALLOWS SEDIMENT STORAGE = 1.9 AC-FT

DEWATERING INVERT = 7583.1 FT
SPILLWAY CREST = 7585.0 FT

60% SEDIMENT CLEAN-OUT ELEVATION = 7580.6 FT

EMBANKMENT CREST = 7586.5 FT

SPILLWAY FLOWING @ DESIGN DEPTH = 7585.08 FT

FREE BOARD = 1.42 FT

9714 BC

DD-1 DIVERSION INLET TO SEDIMENT POND

- TRIANGULAR SHAPE
- SIDESLOPE : 2H:1V
- CHANNEL SLOPE = 0.5 FT/FT
- CHANNEL DEPTH = 1 FT
- MANNING'S n = 0.041
- DISCHARGE = 3.91 CFS (10yr-24hr PEAK - USED WORST CASE OF 10yr-24hr + 25yr-6hr. SEE PG 27)
- FLOW DEPTH = 0.47 FT < 0.7 FT OK
- FLOW VELOCITY = 9.01 FPS < 10 FPS, OK (SEE PLATE 29 PG 23)

D_{50} = 1.25 FT

RIPRAP THICKNESS = 2.5 FT

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33
8/12/96

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Sed. Pond Inlet

Comment: D-1 Diversion Inlet - Max. Slope (DD-1)

Solve For Depth

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.041 — RIPRAP - D_{50} = 1.25 FT
Channel Slope....	0.5000 ft/ft
Discharge........	3.91 cfs

Computed Results:

Depth............	0.47 ft
Velocity.........	9.01 fps
Flow Area........	0.43 sf
Flow Top Width...	1.86 ft
Wetted Perimeter.	2.08 ft
Critical Depth...	0.75 ft
Critical Slope...	0.0394 ft/ft
Froude Number....	FULL

97A BC

EMERGENCY SPILLWAY DESIGN

A SINGLE, OPEN-CHANNEL SPILLWAY WILL BE USED. THIS CHANNEL WILL BE RIPRAPPED TO PROTECT THE INTEGRATY OF THE STRUCTURE. EMBANKMENT.

OUTSLOPE SECTION

TRAPEZOIDAL CHANNEL

BOTTOM WIDTH = 10 FT

SIDE SLOPES = 2H:1V

CHANNEL SLOPE = 0.5 FT/FT (2H:1V)

CHANNEL DEPTH = 1 FT

DISCHARGE = 1.34 CFS (25yr-6hr PEAK, SEE PG 27)

MANNING'S n = 0.035

FLOW DEPTH = 0.04 FT OK

FLOW VELOCITY = 3.42 FPS OK

CREST SECTION

ALL THE SAME, EXCEPT:

CHANNEL SLOPE = 0.05 FT/FT

FLOW DEPTH = 0.08 FT OK

FLOW VELOCITY = 1.70 FPS OK

35
8/12/96

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Sed. Pond Spillway

Comment: Crest Section

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0500 ft/ft
Discharge........	1.34 cfs

Computed Results:

Depth............	0.08 ft
Velocity.........	1.70 fps
Flow Area........	0.79 sf
Flow Top Width...	10.31 ft
Wetted Perimeter.	10.35 ft
Critical Depth...	0.08 ft
Critical Slope...	0.0416 ft/ft
Froude Number....	1.09 (flow is Supercritical)

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36
8/12/96

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Sed. Pond Spillway

Comment: Outslope Section

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.5000 ft/ft
Discharge........	1.34 cfs

Computed Results:

Depth............	0.04 ft
Velocity.........	3.42 fps
Flow Area........	0.39 sf
Flow Top Width...	10.16 ft
Wetted Perimeter.	10.17 ft
Critical Depth...	0.08 ft
Critical Slope...	0.0416 ft/ft
Froude Number....	3.07 (flow is Supercritical)

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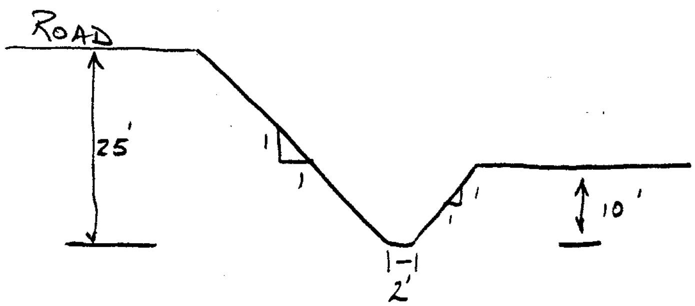
EVALUATION OF JEWKES CREEK ABOVE + BELOW DISTURBED AREA + PORTAL CANYON ABOVE DISTURBANCE.

JEWKES CREEK

ABOVE DISTURBANCE (APPROXIMATELY 200 FT ABOVE DISTURBED AREA BOUNDARY)



- INCISED CHANNEL
- HIGH WATER MARK 1 FT ABOVE CHANNEL BOTTOM

CHANNEL SLOPE $= \frac{\Delta 13.3}{\Delta 150} = 0.0889$ FT/FT

MANNING'S n = 0.035 (NATURAL CHANNEL)

USING FLOW MASTER I:

DISCHARGE FOR NATURAL DRAINAGE:

Q = 27.65 CFS

38
7/11/96

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Jewkes Creek

Comment: Natural Channel Above Disturbed Area

Solve For Discharge

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.0889 ft/ft
Depth............	1.00 ft

Computed Results:

Discharge........	27.65 cfs
Velocity.........	9.22 fps
Flow Area........	3.00 sf
Flow Top Width...	4.00 ft
Wetted Perimeter.	4.83 ft
Critical Depth...	1.42 ft
Critical Slope...	0.0238 ft/ft
Froude Number....	1.88 (flow is Supercritical)

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PROJECT UC0458-07 PAGE 39 OF
COMPUTED TJS DATE 7/11/96
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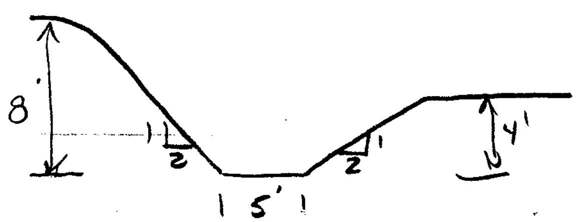
JEWKES CREEK

BELOW DISTURBANCE (APPROXIMATELY 350' BELOW DISTURBED AREA BOUNDARY @ SED. POND + 200 FT ABOVE COUNTY ROAD)



- INCISED CHANNEL
- HIGH WATER MARK 0.75 FT ABOVE CHANNEL BOTTOM

CHANNEL SLOPE = $\frac{\Delta\ 20\ FT}{\Delta\ 250\ FT}$ = 0.080 FT/FT

MANNING'S n = 0.037 (NATURAL CHANNEL W/ SOME WILLOWS)

USING FLOW MASTER I:

DISCHARGE FOR NATURAL DRAINAGE:

Q = 38.67 CFS

97A3C

40
7/11/96

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Jewkes Creek 2

Comment: Natural Channel Flow Below Disturbed Area

Solve For Discharge

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.037
Channel Slope....	0.0800 ft/ft
Depth............	0.75 ft

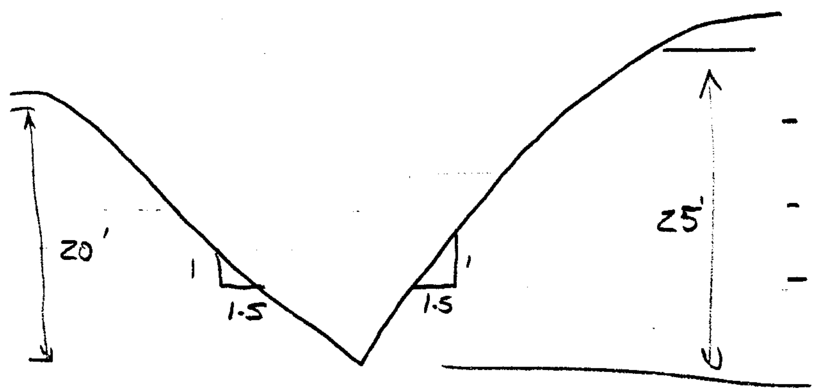
Computed Results:

Discharge........	38.67 cfs
Velocity.........	7.93 fps
Flow Area........	4.88 sf
Flow Top Width...	8.00 ft
Wetted Perimeter.	8.35 ft
Critical Depth...	1.06 ft
Critical Slope...	0.0229 ft/ft
Froude Number....	1.79 (flow is Supercritical)

971A BC

PORTAL CANYON

ABOVE DISTURBANCE (APPROXIMATELY 400 FT ABOVE DISTURBED AREA BOUNDARY)



- CHANNEL FORMED IN VALLEY "V".
- BRUSH IN CHANNEL BOTTOM
- NO IDENTIFIABLE HIGH WATER MARK (ASSUME 1.0 FT)

$$\text{CHANNEL SLOPE} = \frac{\Delta\ 22.3\ \text{FT}}{\Delta\ 125\ \text{FT}} = 0.179\ \text{FT/FT}$$

MANNING'S n = 0.04 (BRUSH IN NATURAL CHANNEL W/ SOME COBBLES)

USING FLOW MASTER I:

DISCHARGE FOR NATURAL DRAINAGE:

Q = 13.14 CFS

42
7/11/96

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Portal Canyon

Comment: Natural Channel Above Disturbed Area

Solve For Discharge

Given Input Data:

Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n......	0.040
Channel Slope....	0.1790 ft/ft
Depth............	1.00 ft

Computed Results:

Discharge........	13.14 cfs
Velocity.........	8.76 fps
Flow Area........	1.50 sf
Flow Top Width...	3.00 ft
Wetted Perimeter.	3.61 ft
Critical Depth...	1.37 ft
Critical Slope...	0.0338 ft/ft
Froude Number....	2.18 (flow is Supercritical)

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CAPACITY OF UC-3 CULVERT

DIAMETER = 2.5 FT

HEADWALL/DIAMETER RATIO = 2.0
(minimum anticipated head at culvert inlet)

BASED ON INLET CONTROL NOMAGRAPH ON PAGE 14 OF CALC'S

MAX. Q = 40 CFS

CAPACITY OF UC-1 CULVERT:

DIAMETER = 3.0 FT

MIN. SLOPE = $\frac{10 \text{ FT}}{370 \text{ FT}}$ = 0.027 FT/FT

MANNING'S n = 0.024

Q = 59.4 CFS (SEE FLOW MASTER I RESULTS FOR FULL PIPE)

Capacity of UC-2 Culvert

Diameter = 2.0 ft

Probable HW/D = 2.0

Capacity based on nomograph on pg 14

97143C

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Culvert UC-1 - Max

Comment: Max. Capacity of Culvert UC-1 at Min. Slope

Solve For Full Flow Capacity

Given Input Data:

Diameter..........	3.00 ft
Slope.............	0.0270 ft/ft
Manning's n.......	0.024
Discharge.........	59.36 cfs

Computed Results:

Full Flow Capacity.....	59.36 cfs
Full Flow Depth........	3.00 ft
Velocity..........	8.40 fps
Flow Area.........	7.07 sf
Critical Depth....	2.49 ft
Critical Slope....	0.0264 ft/ft
Percent Full......	100.00 %
Full Capacity.....	59.36 cfs
QMAX @.94D........	63.86 cfs
Froude Number.....	FULL

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PROJECT UC0458-07 PAGE 45 OF
COMPUTED DS DATE 8/13/96
CHECKED DATE

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WATER BAR SIZING

DETERMINE PEAK FLOW CONTRIBUTING TO WIDEST SPACING OF WATER BARS.

WORST CASE IS FROM FAN PORTAL ROAD (SEE FIG ATTACHED)

AREA ≈ 8.0 AC

Tc = 0.12 hr

P = 1.5 in

CN = 70

DURATION = 6 hr

DIST. = SCS TYPE "B" - 6 hr

PEAKFLOW = 0.24 CFS

DETERMINE MINIMUM SIZE OF WATER BAR STRUCTURE.

CHANNEL SHAPE: TRIANGULAR

SIDE SLOPES: 4:1

CHANNEL SLOPE: 0.02 FT/FT

MANNING'S n = 0.030 - NATIVE MATERIAL

DISCHARGE: 0.24 CFS

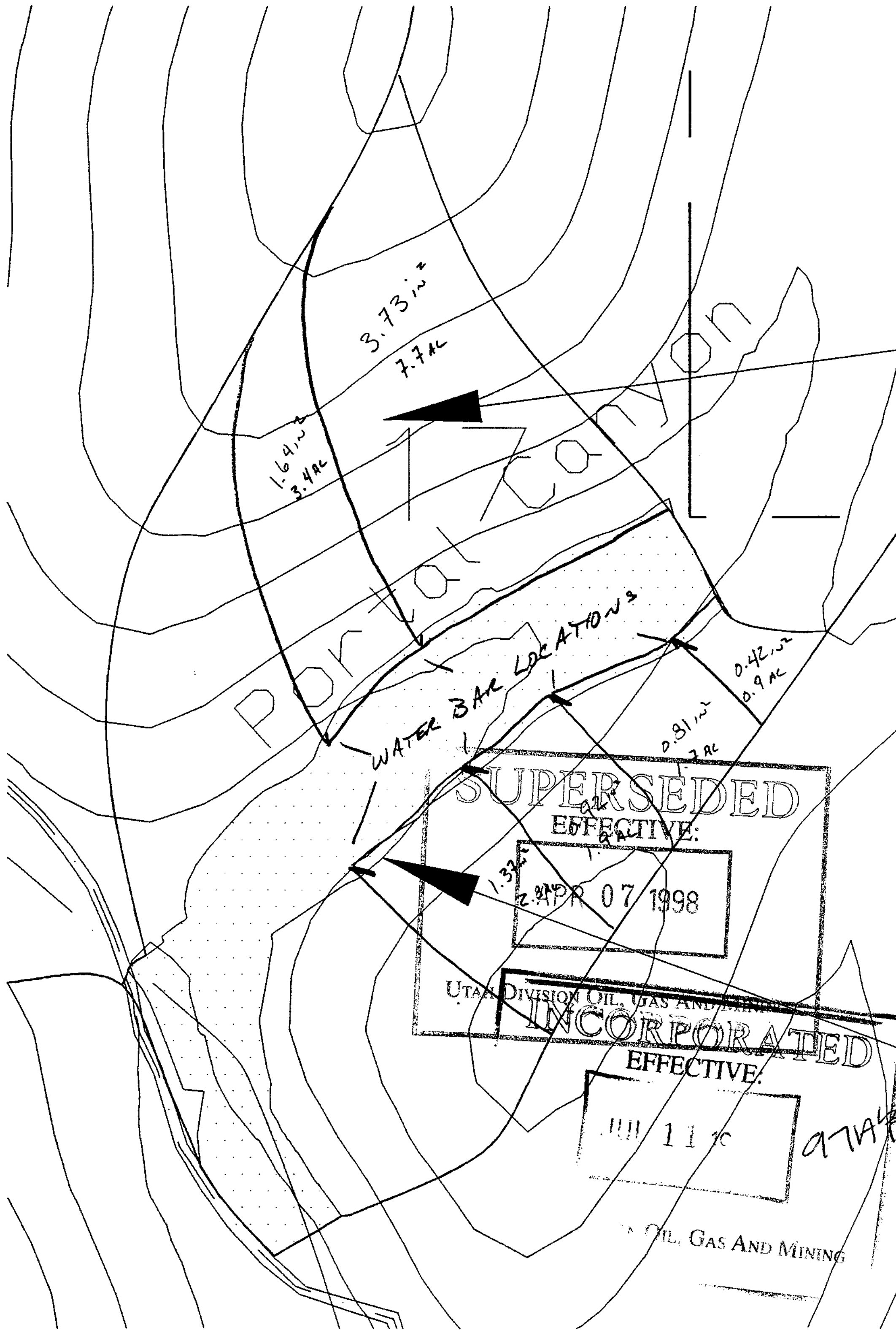
97A?

FLOW DEPTH = 0.2 FT ~~OK, LESS THAN 12"~~

FLOW VELOCITY = 1.48 OK, LESS THAN 5 FPS

1" = 300'

AREAS DRAINING TO PROPOSED WATER BARS



EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Waterbar - Worst Case - 10 yr-6 hr

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 8.00 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.120 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	0.24	cfs	(0.02964 iph)
at time	3.520	hrs	

47

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: WaterBar Sizing

Comment: Worst Case - 10 year-6 hour event

Solve For Depth

Given Input Data:

Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0200 ft/ft
Discharge........	0.24 cfs

Computed Results:

Depth............	0.20 ft
Velocity.........	1.48 fps
Flow Area........	0.16 sf
Flow Top Width...	1.61 ft
Wetted Perimeter.	1.66 ft
Critical Depth...	0.19 ft
Critical Slope...	0.0302 ft/ft
Froude Number....	FULL

Open Channel Flow Module, Version 3.2 (c) 1990
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97A RC

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PROJECT UC0458-07 PAGE 1 OF
COMPUTED RS DATE 7/11/96
CHECKED DATE

DETERMINATION OF PEAKFLOWS
FOR RECLAIMED DRAINAGES

97A&C

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PROJECT UC0458-07 PAGE 2 OF
COMPUTED TJS DATE 7/11/96
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DETERMINATION OF DRAINAGE AREA FOR RECLAIMED WATERSHEDS.

WATERSHED I.D.	DRAINAGE AREA (IN²)	(AC)
PORTAL CANYON	7.89	181.2
UPPER JEWKES CREEK (above confluence w/ Portal Canyon)	15.60	358.2
LOWER JEWKES CREEK (includes the above two watersheds plus additional area to base of disturbed area).	24.00	551.0

DETERMINATION OF HYDRAULIC LENGTH FOR RECLAIMED WATERSHEDS

WATERSHED I.D.	HYDRAULIC LENGTH (IN)	(FT)
PORTAL CANYON	5.65	5,650
UPPER JEWKES CREEK	5.40	5,400
LOWER JEWKES CREEK	6.10	6,100

97A3C

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PROJECT UCO458-07 PAGE 3 OF
COMPUTED TJS DATE 7/11/96
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DETERMINATION OF CURVE NUMBERS FOR RECLAIMED WATERSHEDS

WATERSHED I.D.	CURVE * NUMBER
PORTAL CANYON	70
UPPER JEWKES CREEK	70
LOWER JEWKES CREEK	70

* DETERMINED BASED ON AREA WEIGHTED VALUES

DETERMINATION OF AVERAGE WATERSHED SLOPE.

WATERSHED I.D.	MAX. ELEV.	MIN. ELEV.	CL 25	CL 50	CL 75	AREA (AC)	Y (%)
PORTAL CANYON	8905	7600	5050	3375	1450	181.2	40.8
UPPER JEWKES CREEK	8900	7600	7900	8100	5300	358.2	44.4
LOWER JEWKES CREEK	8905	7560	12150	12550	7500	551.0	45.1

DETERMINATION OF TIME OF CONCENTRATION

WATERSHED I.D.	HYDRAULIC LENGTH	CURVE NUMBER	AVE. W.S. SLOPE	TIME OF CONCENTRATION
PORTAL CANYON	5650	70	40.8	0.44 HR
UPPER JEWKES CREEK	5400	70	44.4	0.41 HR
LOWER JEWKES CREEK	6100	70	45.1	0.45 HR

SUPERSEDED
EFFECTIVE:
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INCORPORATED
EFFECTIVE:
JUL 11 199[illegible]
UTAH DIVISION OIL, GAS AND MINING

97A [illegible]

4
7/11/96

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Portal Canyon - 100 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 181.20 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.440 hrs

OUTPUT SUMMARY

Runoff depth 0.17002 inches
Initial abstr 0.85714 inches
Peak flow = 9.95 cfs (0.05447 iph)
at time 3.637 hrs

INPUT FOR: Upper Jewkes Creek - 100 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 358.20 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.410 hrs

OUTPUT SUMMARY

Runoff depth 0.17002 inches
Initial abstr 0.85714 inches
Peak flow = 19.75 cfs (0.05468 iph)
at time 3.608 hrs

97A[illegible]

5
8/12/96

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Lower Jewkes Creek - 100 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 551.00 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.450 hrs

OUTPUT SUMMARY

Runoff depth	0.17002	inches	
Initial abstr	0.85714	inches	
Peak flow =	30.21	cfs	(0.05438 iph)
at time	3.660	hrs	

SUPERSEDED
EFFECTIVE:
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INPUT FOR: Upper Jewkes Creek - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 358.20 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.450 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	9.46	cfs	(0.02620 iph)
at time	3.780	hrs	

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5a
8/12/96

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Lower Jewkes Creek - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 551.00 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.450 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	14.55	cfs	(0.02620 iph)
at time	3.780	hrs	

DETERMINATION OF RECLAIMED CHANNEL SIZING

PORTAL CANYON - RD-1

CHANNEL SHAPE: TRAPEZOIDAL

BOTTOM WIDTH = 8.0

SIDESLOPE = 2H:1V

MANNING'S n = 0.032 (NATIVE SOIL W/SOME GRAVEL)

MIN. CHANNEL SLOPE = 0.02 FT/FT

MAX. CHANNEL SLOPE = 0.08 FT/FT

DISCHARGE = 9.95 CFS

MAX. DEPTH SECTION

FLOW DEPTH = 0.36 FT < 0.7 FT OK

FLOW AREA = 3.17 FT^2

VELOCITY = 3.13 FPS

MAX. VELOCITY SECTION

FLOW DEPTH = 0.24 FT

FLOW AREA = 2.02 FT^2

VELOCITY = 4.92 FPS < 5.0 FPS OK

7
7/11/96

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Horizon No. 1

Comment: Portal Canyon - Min. Slope Section

Solve For Depth

Given Input Data:

Bottom Width.....	8.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.032
Channel Slope....	0.0200 ft/ft
Discharge........	9.95 cfs

Computed Results:

Depth............	0.36 ft
Velocity.........	3.13 fps
Flow Area........	3.17 sf
Flow Top Width...	9.45 ft
Wetted Perimeter.	9.63 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0222 ft/ft
Froude Number....	0.95 (flow is Subcritical)

8 7/11/96

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Horizon No. 1

Comment: Portal Canyon - Max. Slope Section

Solve For Depth

Given Input Data:

Bottom Width.....	8.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n......	0.032
Channel Slope....	0.0830 ft/ft
Discharge........	9.95 cfs

Computed Results:

Depth............	0.24 ft
Velocity.........	4.92 fps
Flow Area........	2.02 sf
Flow Top Width...	8.95 ft
Wetted Perimeter.	9.07 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0222 ft/ft
Froude Number....	1.82 (flow is Supercritical)

Open Channel Flow Module, Version 3.2 (c) 1990
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Jewkes Creek

The reclamation channel in Jewkes Creek has been divided into two sections:

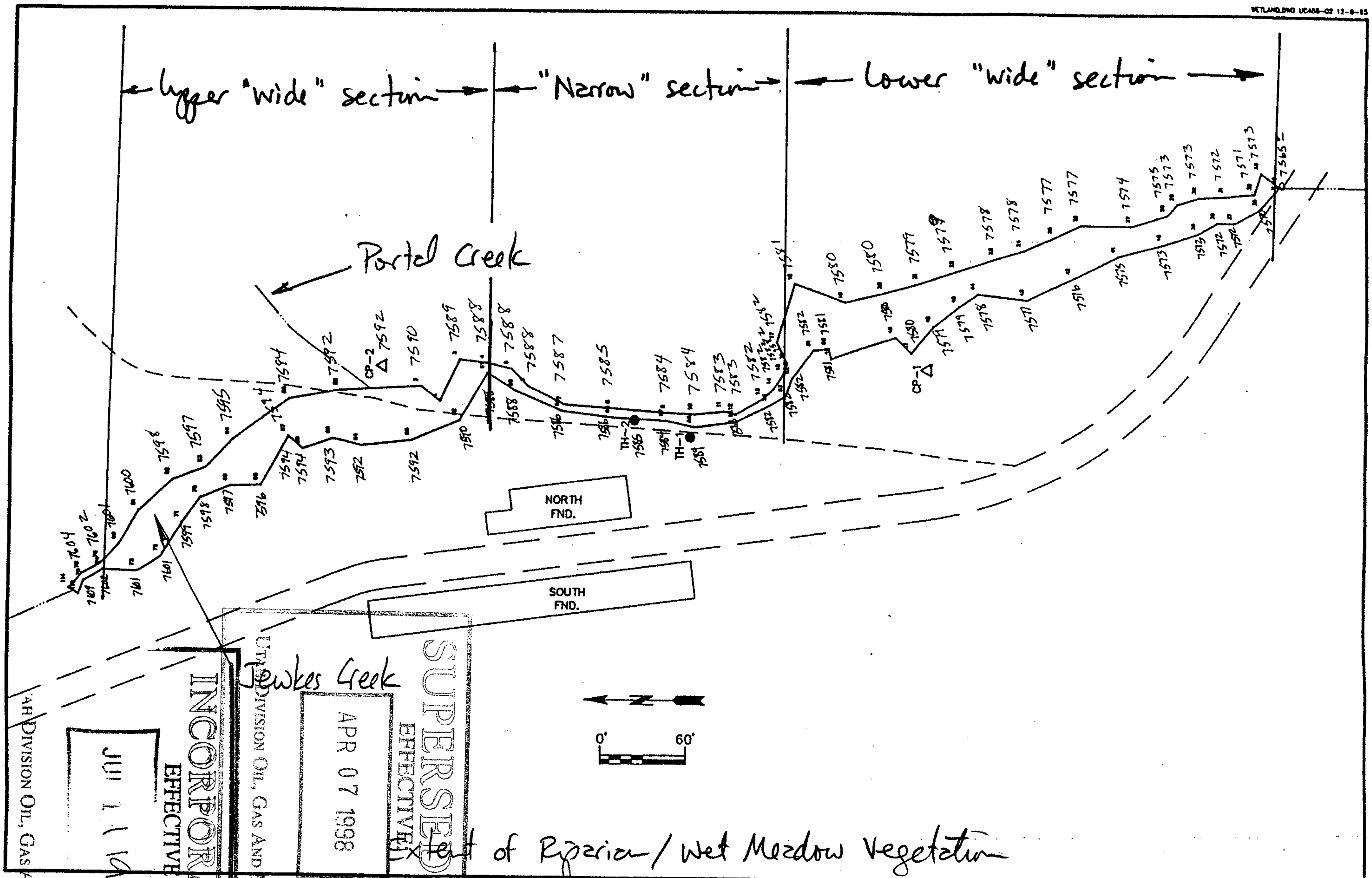
RD-2 → upstream from Portal Creek

RD-3 → downstream from Portal Creek

One of the goals of reclamation is to re-establish the riparian vegetation which currently exists along Jewkes Creek (see Figure 2 of Appendix 9-2 - also see pg 10 of this calc.). As indicated, the riparian vegetation extends for a width of 20 to 40 feet from a point starting approximately 90 ft downstream from the confluence of Portal Creek to a point approximately 250 ft above the confluence of Portal Creek (i.e., upstream from the disturbed-area boundary). Another area of widened riparian vegetation begins at a point approximately 300 ft downstream from the confluence of Portal Creek to the edge of the County Road (i.e., extending approximately 130 ft downstream from the disturbed-area boundary). The riparian vegetation community is generally less than 10 ft wide through the remainder of the disturbed area.

To assist in re-establishment of the riparian community, the design of RD-2 and RD-3 will incorporate the following features:

- Work soil into the riprap after placement to allow a base for establishment of vegetation within riprapped sections.
- Place loose-rock check dams in sections where the riparian community is wider, thereby spreading the streamflow onto the flood plain.
- Place erosion-control matting on overflow areas to protect against erosion.
- Design channels to safely convey the peak flow resulting from the 100-yr, 6-hr precipitation event. In those sections where check dams will be placed, design the notch in the check dam to convey the peak from the 10-yr, 6-hr event, with the flood plain area conveying the difference between the 100-yr, 6-hr peak and the 10-yr, 6-hr peak.
- In sections where check dams will be installed, design the underlying channel to convey the 100-yr, 6-hr peak, thus providing protection in case of a major event.


Upper "wide" section
"Narrow" section
Lower "wide" section
Portal Creek
Jewkes Creek
NORTH FND.
SOUTH FND.
CP-1
CP-2
TH-1
TH-2
0'
60'
Extent of Riparian / Wet Meadow Vegetation

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PROJECT UC-572-02 PAGE 11 OF
COMPUTED RAW DATE 12 Jun 1997
CHECKED DATE

RD-2

Base channel:

Design Q = 19.75 cfs (100-yr, 6-hr)
Bottom width = 8 ft (2:1 side slopes)
Max slope = min slope = 0.029 ft/ft
D_{50} = 6" (n = 0.035)
Max velocity = 4.25 ft/s
Max flow depth = 0.51 ft
} See pg 12 of this calc. Acceptable. Design depth = 1.0 ft (min). Increase to 2.0 ft for constructability.

Check dam:

Design Q = 9.46 cfs (10-yr, 6-hr)
Bottom width = 4 ft (2:1 side slopes)
Max slope = min slope = 0.020 ft/ft
(Slope of upstream deposits = (0.7)(channel slope) — see Heede, 1976).
D_{50} = 6" (n = 0.035)
Max velocity = 3.42 ft/s
Max flow depth = 0.54 ft
} See pg 12a of this calc. Acceptable. With notch depth of 0.5 ft, a small amt of water will flow onto flood plain during this event.

Flood plain:

Design Q = 19.75 cfs − 9.46 cfs = 10.29 cfs
Bottom width = 30 ft (typical of current riparian zone)
Max slope = 0.029 ft/ft (along sides of channel)
Min slope = 0.020 ft/ft (in channel)
No riprap (soil along banks, sediment behind check dams) (n = 0.030)
Max velocity = 2.32 ft/s < 5.0 ft/s — No riprap req'd
Max flow depth = 0.16 ft
→ See pg 12b and 12c of this calc.

See pg 23 of this calc. for typical design

RD-2, Base channel (100-yr, 6-hr event)
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.029000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	19.75	cfs

Results		
Depth	0.51	ft
Flow Area	4.65	ft²
Wetted Perimeter	10.30	ft
Top Width	10.06	ft
Critical Depth	0.55	ft
Critical Slope	0.023432	ft/ft
Velocity	4.25	ft/s
Velocity Head	0.28	ft
Specific Energy	0.80	ft
Froude Number	1.10	
Flow is supercritical.		

RD-2, Check dam (10-yr, 6-hr event)
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.020000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	4.00	ft
Discharge	9.46	cfs

Results		
Depth	0.54	ft
Flow Area	2.77	ft²
Wetted Perimeter	6.43	ft
Top Width	6.17	ft
Critical Depth	0.51	ft
Critical Slope	0.025032 ft/ft	
Velocity	3.42	ft/s
Velocity Head	0.18	ft
Specific Energy	0.73	ft
Froude Number	0.90	
Flow is subcritical.		

12b/

RD-2, Flood plain, Maximum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.029000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	30.00	ft
Discharge	10.29	cfs

Results		
Depth	0.15	ft
Flow Area	4.43	ft^2
Wetted Perimeter	30.65	ft
Top Width	30.58	ft
Critical Depth	0.15	ft
Critical Slope	0.024649 ft/ft	
Velocity	2.32	ft/s
Velocity Head	0.08	ft
Specific Energy	0.23	ft
Froude Number	1.08	
Flow is supercritical.		

SUPERSEDED
EFFECTIVE:
APR 07 1998
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EFFECTIVE:
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12c/

RD-2, Flood plain, Minimum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.020000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	30.00	ft
Discharge	10.29	cfs

Results		
Depth	0.16	ft
Flow Area	4.96	ft²
Wetted Perimeter	30.73	ft
Top Width	30.65	ft
Critical Depth	0.15	ft
Critical Slope	0.024649 ft/ft	
Velocity	2.08	ft/s
Velocity Head	0.07	ft
Specific Energy	0.23	ft
Froude Number	0.91	
Flow is subcritical.		

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RD-3

Base channel:

Design Q = 30.21 cfs (100-yr, 6-hr)
Bottom width = 8 ft (2:1 side slopes)
Max slope = 0.071 ft/ft
Min slope = 0.032 ft/ft
D_{50} = 6" (n = 0.035)
Max velocity = 6.60 ft/s } See pp 14 and 14a of this calc. Acceptable.
Max flow depth = 0.64 ft } Min design depth = 1.0 ft. Increase to 2.0' for constructability

Check dam:

Design Q = 14.55 cfs (10-yr, 6-hr)
Bottom width = 4 ft (2:1 side slopes)
Max slope = (0.7)(0.071) = 0.050 ft/ft
Min slope = (0.7)(0.032) = 0.022 ft/ft
D_{50} = 6" (n = 0.035)
Max velocity = 5.36 ft/s } See pp 14b & 14c of this calc. Acceptable.
Max flow depth = 0.67 ft } Design w/ notch depth of 8" (no freeboard)

Flood plain:

Design Q = 30.21 cfs − 14.55 cfs = 15.66 cfs
Bottom width = 30 ft (typical of current channel)
Max slope = 0.071 ft/ft } see above
Min slope = 0.022 ft/ft }
No riprap → n = 0.030
Max velocity = 3.59 ft/s < 5 ft/s, No riprap req'd
Max flow depth = 0.20 ft
→ See pp 14d and 14e of this calc.

See pg 23 of this calc. for typical design.

RD-3, Base channel, Maximum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.071000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	8.00	ft
Discharge	30.21	cfs

Results		
Depth	0.51	ft
Flow Area	4.58	ft²
Wetted Perimeter	10.27	ft
Top Width	10.03	ft
Critical Depth	0.72	ft
Critical Slope	0.021787 ft/ft	
Velocity	6.60	ft/s
Velocity Head	0.68	ft
Specific Energy	1.18	ft
Froude Number	1.72	
Flow is supercritical.		

14a/

RD-3, Base channel, Minimum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.032000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	30.21	cfs

Results		
Depth	0.64	ft
Flow Area	5.95	ft²
Wetted Perimeter	10.86	ft
Top Width	10.56	ft
Critical Depth	0.72	ft
Critical Slope	0.021788	ft/ft
Velocity	5.08	ft/s
Velocity Head	0.40	ft
Specific Energy	1.04	ft
Froude Number	1.19	
Flow is supercritical.		

RD-3, Check dam, Maximum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.050000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	4.00	ft
Discharge	14.55	cfs

Results		
Depth	0.54	ft
Flow Area	2.71	ft^2
Wetted Perimeter	6.39	ft
Top Width	6.14	ft
Critical Depth	0.66	ft
Critical Slope	0.023450 ft/ft	
Velocity	5.36	ft/s
Velocity Head	0.45	ft
Specific Energy	0.98	ft
Froude Number	1.42	
Flow is supercritical.		

14c/

RD-3, Check dam, Minimum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.022000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	14.55	cfs

Results		
Depth	0.67	ft
Flow Area	3.60	ft^2
Wetted Perimeter	7.01	ft
Top Width	6.69	ft
Critical Depth	0.66	ft
Critical Slope	0.023450	ft/ft
Velocity	4.04	ft/s
Velocity Head	0.25	ft
Specific Energy	0.93	ft
Froude Number	0.97	
Flow is subcritical.		

SUPERSEDED
EFFECTIVE:
APR 07 1998
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EFFECTIVE:
JUL 11 1997
97A3C
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RD-3, Flood plain, Maximum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.071000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	30.00	ft
Discharge	15.66	cfs

Results		
Depth	0.14	ft
Flow Area	4.36	ft²
Wetted Perimeter	30.64	ft
Top Width	30.58	ft
Critical Depth	0.20	ft
Critical Slope	0.022508 ft/ft	
Velocity	3.59	ft/s
Velocity Head	0.20	ft
Specific Energy	0.34	ft
Froude Number	1.68	
Flow is supercritical.		

14e/

RD-3, Flood plain, Minimum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.022000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	15.66	cfs

Results		
Depth	0.20	ft
Flow Area	6.21	ft^2
Wetted Perimeter	30.91	ft
Top Width	30.82	ft
Critical Depth	0.20	ft
Critical Slope	0.022508	ft/ft
Velocity	2.52	ft/s
Velocity Head	0.10	ft
Specific Energy	0.30	ft
Froude Number	0.99	
Flow is subcritical.		

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PROJECT UC-572-02 PAGE 14f OF ____
COMPUTED RBW DATE 12 Jun 1997
CHECKED ____ DATE ____

Check dam design

- Design spillway cross sections as indicated on pp 11-14e. See standard design on pg 15a of this calc.
- Use D_{50} = 6" riprap for dam construction
- Source of design equations → Heede (1976)
- Check dam spacing:

According to Heede (1976), check dams in channels w/ a gradient of less than 20% should be spaced to place each upstream check dam at the upstream extent of the sediment deposited behind the downstream check dam, assuming a sediment gradient of 0.7 times the channel gradient. Based on this, check dam spacing should be as follows:

RD-2 → Sediment gradient = (0.7)(0.029 ft/ft)
= 0.020 ft/ft

With a 2.0' channel depth and a 0.5' notch depth, the sediment will fill 1.5' at the check dam. Based on this fill depth:

Spacing = 1.5 ft / 0.020 ft/ft
= 75 ft

RD-3 → Sediment gradient = (0.7)(0.071 ft/ft) max
= 0.050 ft/ft max
= (0.7)(0.032 ft/ft) min
= 0.022 ft/ft min

With a channel depth of 2.0' and a notch depth of 0.67', the sediment will accumulate to a depth of 1.33'. This gives a spacing of:

Max slope spacing = 1.33 ft / 0.050 ft/ft
= 27 ft

Min slope spacing = 1.33 ft / 0.022 ft/ft
= 60 ft

- Check dam keys → not required since the entire channel will be lined with a dual filter blanket.

- Check dam aprons:

Apron length = (1.5)(Dam crest height) — See Heede (1976)

RD-2 → Apron length = (1.5)(1.5 ft)
= 2.25 ft

RD-3 → Apron length = (1.5)(1.33 ft)
= 2.0 ft

Design both w/ an apron length of 2.5 ft.

Since the entire downstream section will be a riprap-lined channel, there is no need to install a special apron. However, the sill needs to be placed at the indicated distance downstream from the toe of the check dam. According to Heede (1976), this sill should have a height of approx. 6 inches. Hence, after installation of the riprap channel and the check dam, a 6-inch high layer of riprap should be placed across the channel bottom at a distance of 2.5 ft downstream from the toe of the check dam.

- Check dam bank protection → provided by riprap in channel.

See typical design cross sections on pp 23-24 of this calc.

Reference

Heede, B.H. 1976. Gully Development and Control: The Status of Our Knowledge. USDA Forest Service Research Paper RM-169. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service. Fort Collins, CO.

RIPRAP GRADATIONS

D_{50} = 0.5 FT

D_{100}	=	$D_{50} * 2.0^*$	=	12"
D_{50}	=	$D_{50} * 1.0$	=	6"
D_{20}	=	$D_{50} * 0.5$	=	3"
D_0	=	$D_{50} * 0.2$	=	1.2"

* MULTIPLIERS BASED ON DISTRIBUTION PROPOSED IN FIG. 3.17 FROM BARFIELD, WARNER, + HAAN (1980).

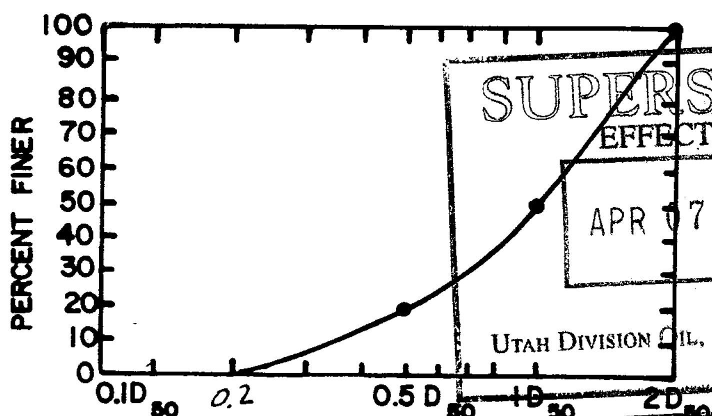


Figure 3.17. Suggested size distribution of riprap. (After Simons and Senturk, 1977).

Filter blanket requirement for reclamation channels:

According to the SCS soil survey for the area, the native soils which will comprise the base soil in the Portal Canyon reclaimed channel are comprised of the Pathead - Curecanti family association. The finer grained (conservative) portion of these soils average the following gradation:

Sieve No.	Percent Passing
4 (0.19")	90
10 (0.079")	85
40 (0.017")	70
200 (0.0030")	55

The soils in the Jewkes Creek channel bottom consist of Shupert - Winetti complex. The finer grained (conservative) portion of these soils average the following gradation:

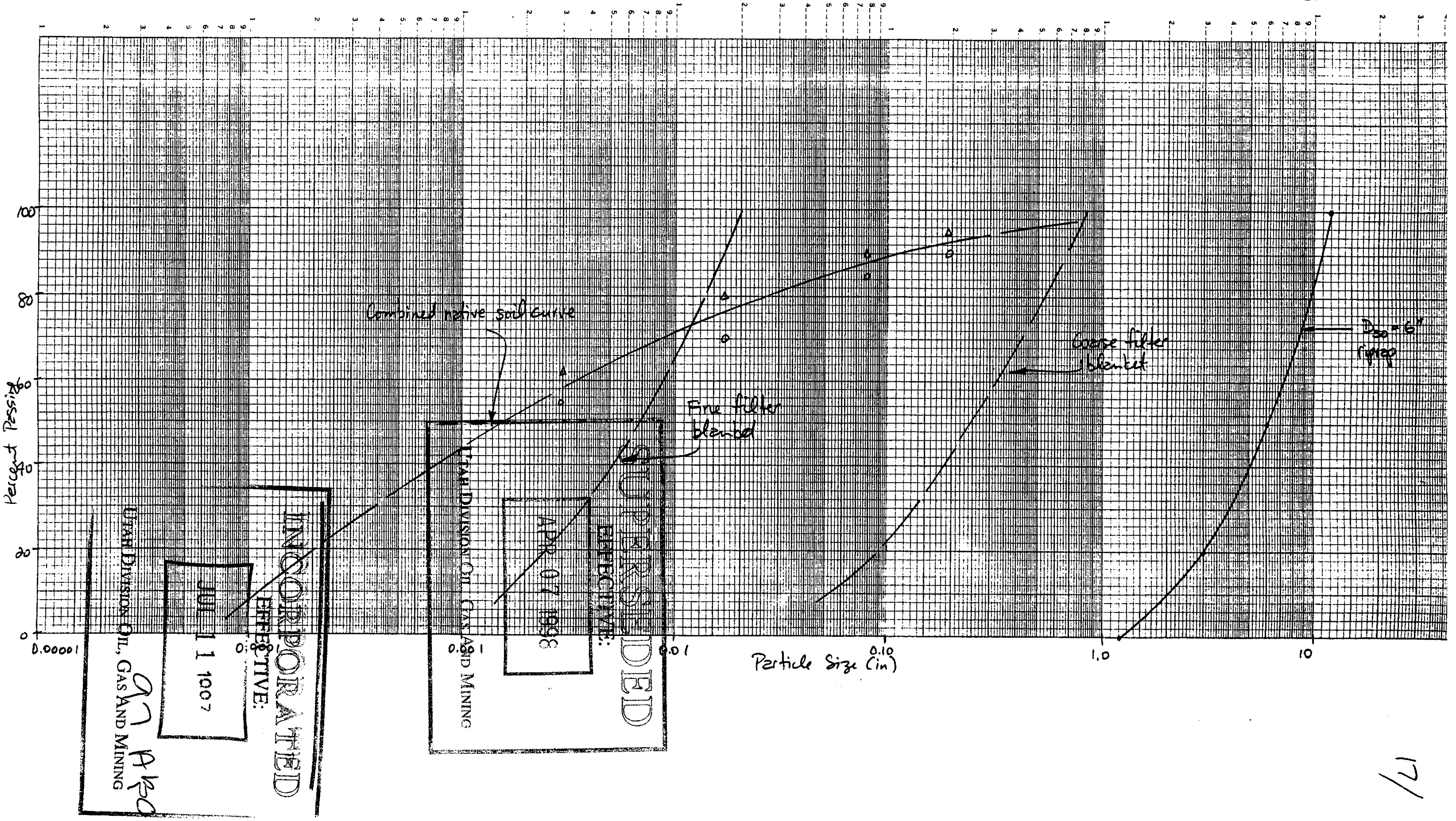
Sieve No.	Percent Passing
4	95
10	90
40	80
200	62

See the combined native soil curve on pg 17 of this calc.

Stability criteria

$$\frac{D_{15}\,(\text{riprap})}{D_{85}\,(\text{base})} < 5 < \frac{D_{15}\,(\text{riprap})}{D_{15}\,(\text{base})} < 40 \quad (\text{HEC-11, Federal Hwy Admin})$$

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A. 46 6010 K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.



17

Two filter blanket layers required (see pg 17).

$$\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (coarse)}} = \frac{2.50\text{ in}}{0.60\text{ in}} = 4.2 < 5 \quad \text{OK}$$

$$\frac{D_{15}\text{ (riprap)}}{D_{15}\text{ (coarse)}} = \frac{2.50\text{ in}}{0.07\text{ in}} = 35.7 < 40 \quad \text{OK}$$

— // —

$$\frac{D_{15}\text{ (coarse)}}{D_{85}\text{ (fine)}} = \frac{0.07\text{ in}}{0.015\text{ in}} = 4.7 < 5 \quad \text{OK}$$

$$\frac{D_{15}\text{ (coarse)}}{D_{15}\text{ (fine)}} = \frac{0.07\text{ in}}{0.002\text{ in}} = 35.0 < 40 \quad \text{OK}$$

— // —

$$\frac{D_{15}\text{ (fine)}}{D_{85}\text{ (native)}} = \frac{0.002\text{ in}}{0.052\text{ in}} = 0.04 < 5 \quad \text{OK}$$

$$\frac{D_{15}\text{ (fine)}}{D_{15}\text{ (native)}} = \frac{0.002\text{ in}}{0.00015\text{ in}} = 13.3 < 40 \quad \text{OK}$$

Adequate as designed.

In accordance with the recommendations of HEC-11:

Riprap layer thickness → 12"
Filter blanket layer thickness → 6" (each layer)

Comparison with Natural Channel Capacity

Capacity of Portal Canyon Creek:

q = 13.1 cfs (see pg 41 of prev. calc.) — Represents upstream capacity. Downstream end of creek will have been altered during mining

Capacity of Jewkes Creek:

Above disturbance → q = 27.6 cfs (see pg 37 of prev. calc.)

Below disturbance → q = 38.7 cfs (see pg 39 of prev. calc.)

Under conditions of minimum slope (max. flow depth):

Bankful capacity of RD-1 → 56.7 cfs (see pg 20 of this calc.)

Flood plain capacity of RD-2 → 143.5 cfs (see pg 21 of this calc.)

Flood plain capacity of RD-3 → 150.6 cfs (see pg 22 of this calc.)

→ Based on minimum floodplain with of 20 ft and flow depth of 1.0 ft.

In all cases, the design capacity exceeds the natural capacity. Hence, the requirements of R645-301-742.322 are met.

RD-1, Minimum slope, Bankful capacity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels - Capacity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.020000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft

Results		
Discharge	56.68	cfs
Flow Area	10.00	ft^2
Wetted Perimeter	12.47	ft
Top Width	12.00	ft
Critical Depth	1.06	ft
Critical Slope	0.016461	ft/ft
Velocity	5.67	ft/s
Velocity Head	0.50	ft
Specific Energy	1.50	ft
Froude Number	1.09	
Flow is supercritical.		

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RD-2, Minimum slope, Bankful capacity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels - Capacity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.020000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	20.00	ft

Results		
Discharge	143.54	cfs
Flow Area	22.00	ft²
Wetted Perimeter	24.47	ft
Top Width	24.00	ft
Critical Depth	1.13	ft
Critical Slope	0.013399	ft/ft
Velocity	6.52	ft/s
Velocity Head	0.66	ft
Specific Energy	1.66	ft
Froude Number	1.20	
Flow is supercritical.		

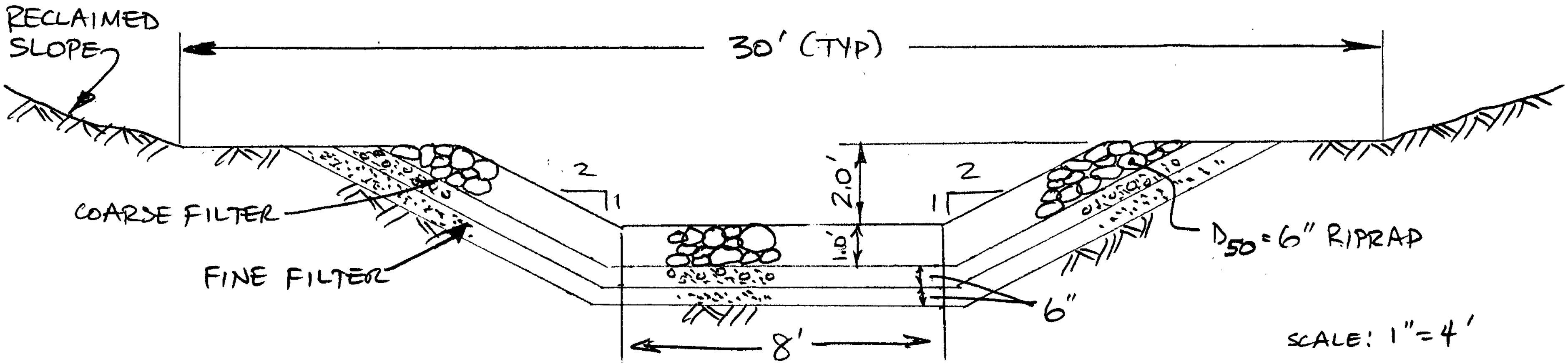
22/

RD-3, Minimum slope, Bankful capacity
Worksheet for Trapezoidal Channel

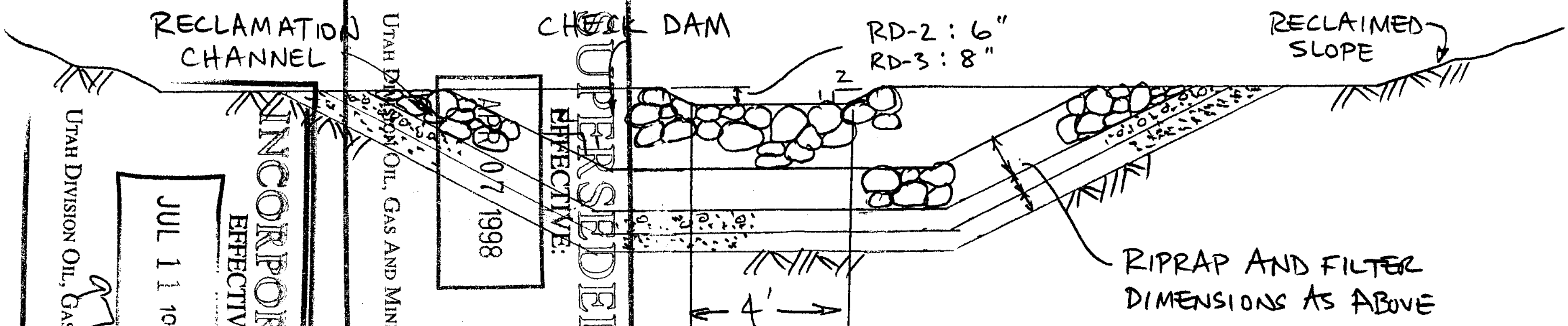
Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels - Capacity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.022000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	20.00	ft

Results		
Discharge	150.55	cfs
Flow Area	22.00	ft²
Wetted Perimeter	24.47	ft
Top Width	24.00	ft
Critical Depth	1.16	ft
Critical Slope	0.013284	ft/ft
Velocity	6.84	ft/s
Velocity Head	0.73	ft
Specific Energy	1.73	ft
Froude Number	1.26	
Flow is supercritical.		

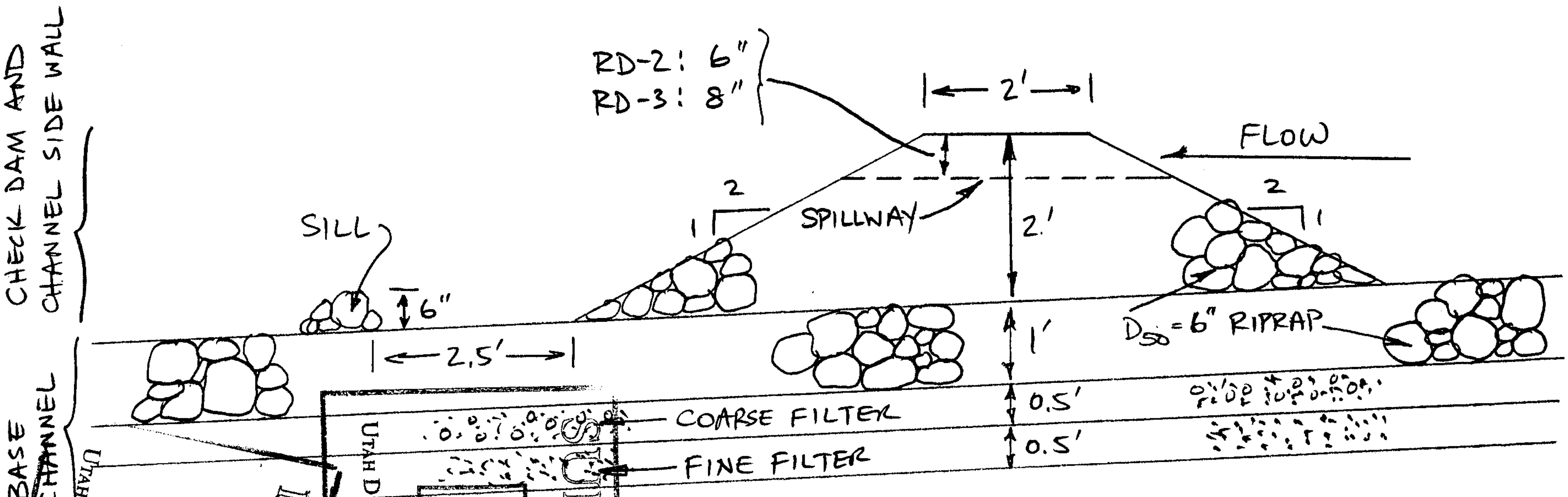


TYPICAL CROSS SECTION - BASE CHANNEL
RD-2 AND RD-3



TYPICAL CROSS SECTION - CHECK DAM
RD-2 AND RD-3

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS



SCALE: 1" = 2'

LONGITUDINAL CROSS SECTION
CHECK DAM
RD-2 AND RD-3

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT UC0458-07 PAGE 1 OF
COMPUTED TJS DATE 7/11/96
CHECKED DATE

EVALUATION OF SEDIMENT YIELD
FROM RECLAIMED SURFACE

COMPARISON OF TREATMENTS

EVALUATION OF SEDIMENT YIELD FROM RECLAIMED SITE.

DETERMINATION BASED ON UNIVERSAL SOIL LOSS EQUATION

- CALCULATE EXPECTED EROSION FROM:
  - DISTURBED SURFACE (BARE GROUND)
  - RIPPED SURFACE
  - MULCHED & RIPPED SURFACE
  - MULCHED + RIPPED SURFACE W/ SILT FENCE
  - UNDISTURBED SURFACE W/ SHRUB-GRASS VEG. TYPE FOR COVER + DENSITY REQUIRED FOR BOND RELEASE

EQUATION:

$$A = R\ LS\ K\ C\ P$$

WHERE:

A = COMPUTED SOIL LOSS PER UNIT AREA (TONS/AC/YR)

R = RAIN FALL FACTOR (ANNUAL)

LS = LAND SLOPE FACTOR

K = SOIL ERODIBILITY FACTOR

C = COVER FACTOR

P = PRACTICE FACTOR

RAIN FALL FACTOR = 15 (FROM ISRAELSEN, ET. AL., 1984)
(FIG. ATTACHED)

LS FACTOR BASED ON

$$LS = \left(\frac{\lambda}{72.6}\right)^{m} \left(\frac{430X^2 + 30X + 0.43}{6.613}\right)$$

WHERE:

λ = SLOPE LENGTH (FT)

X = SIN Θ

Θ = SLOPE ANGLE (DEG) = ATAN $\left(\frac{RISE}{RUN}\right)$

m = SLOPE EXPONENT

SLOPE ≤ 3% m = 0.3

SLOPE ≥ 5% m = 0.5

SLOPE > 3% & < 5% m = 0.4

K FACTOR = 0.31 (FROM ISRAELSEN, ET. AL., 1984)

C FACTOR:

FOR BARE SOIL:

FOR RIPPED SOIL: ~~0.8~~

FOR MULCHED + RIPPED SOIL (2 TONS/ACRE): ~~0.06~~

FOR EROSION MATTING: 0.10

FOR UNDISTURBED WATERSHED W/ 50% COVER
NO APPRECIABLE CANOPY

* VALUES DETERMINED FROM: BARFIELD, ET. AL. (1981)

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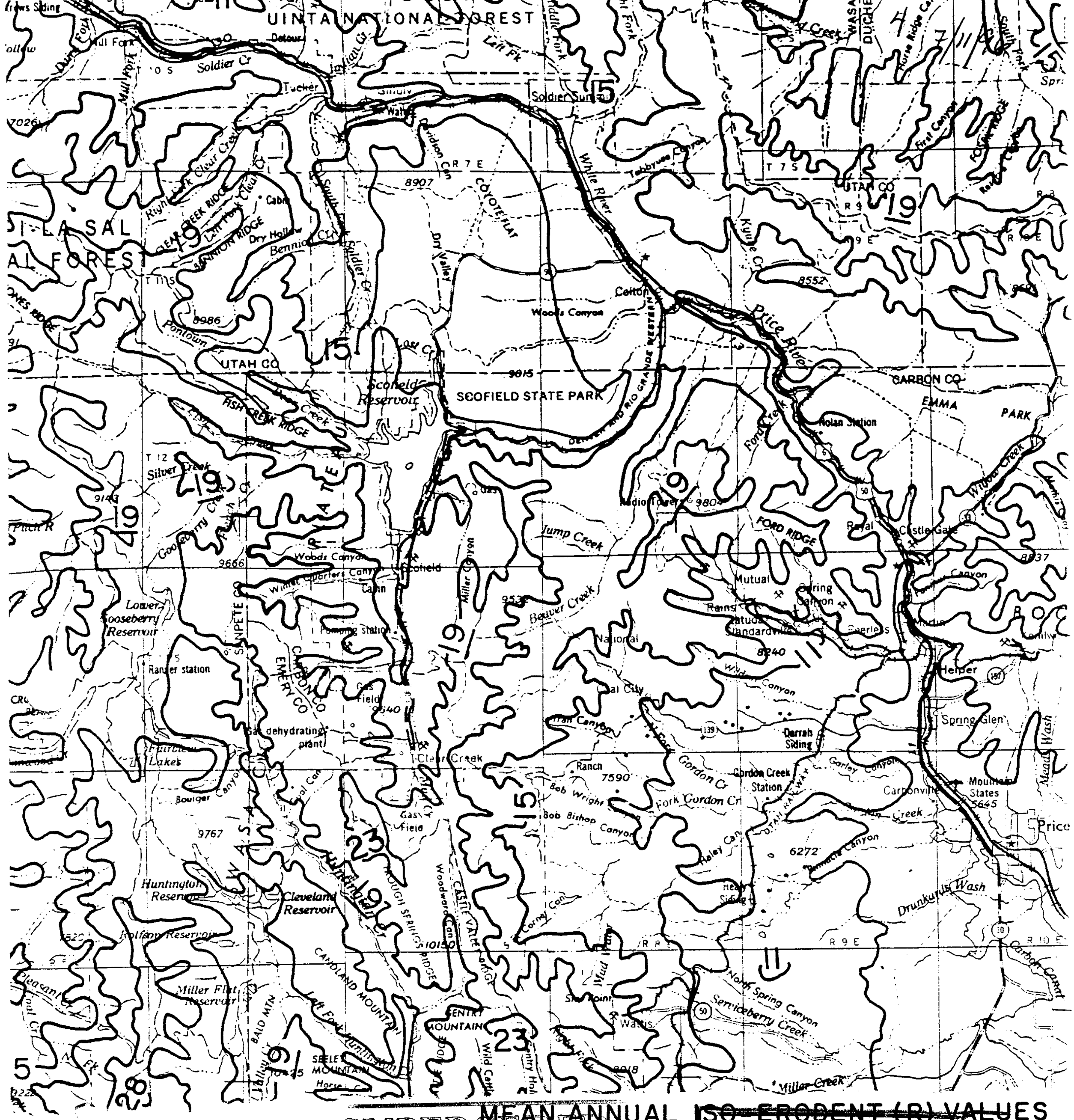

MEAN ANNUAL ISO-ERODENT (R) VALUES

Note:
R values shown are for rain and snowmelt together. R value for snowmelt alone = $R_s = 0.23881 R$ 4328.

Units of R
English R = foot tons/acre/hour
Metric Rm = meter tonnes/hectare/hour
$Rm = 1.735 \times R$

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EROSION FROM MULCHED + RIPPED SURFACE W/ SILT FENCE:

- AS LONG AS INSTALLED ACCORDING TO MANUFACTURES SPECIFICATION, SILT FENCES HAVE A 75% RETENTION EFFICIENCY.

BASED ON MIRAFI TECHNICAL NOTE, R.G. CARROLL, JR. "SILT FENCES FOR SEDIMENTATION CONTROL IN MINING" PUB NO. 81-17.
+
WYANT, D.C. 1980. EVALUATION OF FILTER FABRIC FOR USE AS SILT FENCES. VHTRC 80-R49. VIRGINIA HIGHWAY AND TRANSPORTATION RESEARCH COUNCIL. CHARLOTTESVILLE, VIRGINIA.

SILT FENCES RETAIN APPROXIMATELY 75% OF SEDIMENT.

THEREFORE:

SED. PRODUCTION = (MULCHED + RIPPED PROD. X 0.25)

97 IA BC

ALTERNATIVE SEDIMENT CONTROL SUMMARY - Horizon No. 1 Mine

WATERSHED	Area (Ac)	Rainfall Factor	Height of Rise	Field Slope Length (ft)	Slope Angle (%)	Slope Angl (deg)	Slope Factor m	LS Factor	K Factor	Undisturbed Sed. Prod. w/no Mining (Tons)	Sediment to Stream with Reclaimed Area Treated With Following Options: Bare ground (Tons)	Ripped (Tons)	Mulched (Tons)	Silt fence (Tons)	Silt trapped by silt fence (Tons)	Silt trapped by silt fence (Cu Ft)
10 YR - 6 HR STORM EVENT																
PORTAL CANYON																
NORTH SIDE																
RECLAIMED AREA	3.3	18.0	42.0	145.0	29.0	16.2	0.5	9.0	0.31	18.2	155.6	132.4	9.9	2.0	7.0	155.6
UNDISTURBED AREA	15.5	18.0	560.0	850.0	65.9	33.4	0.5	76.1	0.31	724.0	724.0	724.0	724.0	181.0	543.0	12066.7
SUBTOTAL:										742.3	879.6	856.5	734.0	183.0	550.0	12222.2
SOUTH SIDE																
RECLAIMED AREA	4.4	18.0	42.0	70.0	60.0	31.0	0.5	19.3	0.31	52.0	444.4	378.2	28.4	7.0	21.0	466.7
UNDISTURBED AREA	7.9	18.0	600.0	850.0	70.6	35.2	0.5	83.2	0.31	403.3	403.3	403.3	403.3	101.0	302.0	6711.1
SUBTOTAL:										455.3	847.7	781.5	431.6	108.0	323.0	7177.8
TOTAL SEDMENT TO STREAM										1197.5	1727.3	1638.0	1165.6	291.0		
JEWKES CREEK																
NORTH SIDE																
RECLAIMED AREA	0.5	18.0	36.0	150.0	24.0	13.5	0.5	6.7	0.31	2.1	17.6	15.0	1.1	0.0	1.0	22.2
UNDISTURBED AREA	3.2	18.0	140.0	150.0	93.3	43.0	0.5	48.1	0.31	94.4	94.4	94.4	94.4	24.0	71.0	1577.8
SUBTOTAL:										96.4	112.0	109.4	95.5	24.0	72.0	1600.0
SOUTH SIDE																
RECLAIMED AREA	1.8	18.0	80.0	180.0	44.4	24.0	0.5	19.9	0.31	22.0	187.8	159.8	12.0	3.0	9.0	200.0
UNDISTURBED AREA	9.0	18.0	160.0	250.0	64.0	32.6	0.5	39.7	0.31	219.4	219.4	219.4	219.4	55.0	165.0	3666.7
SUBTOTAL:										241.4	407.2	379.3	231.4	58.0	174.0	3866.7
TOTAL SEDMENT TO STREAM										337.8	519.2	488.6	326.9	82.0		
ANNUAL EROSION											(Tons)	(Tons)	(Tons)	(Tons)	(Tons)	(Cu Ft)
PORTAL CANYON																
NORTH SIDE																
RECLAIMED AREA	3.3	15.0	42.0	145.0	29.0	16.2	0.5	9.0	0.31	15.2	129.7	110.3	8.3	2.0	6.0	133.3
UNDISTURBED AREA	15.5	15.0	560.0	850.0	65.9	33.4	0.5	76.1	0.31	603.4	603.4	603.4	603.4	151.0	453.0	10066.7
SUBTOTAL:										618.5	733.0	713.7	611.6	153.0	459.0	10200.0
SOUTH SIDE																
RECLAIMED AREA	4.4	15.0	42.0	70.0	60.0	31.0	0.5	19.3	0.31	43.3	370.4	315.2	23.6	6.0	18.0	400.0
UNDISTURBED AREA	7.9	15.0	600.0	850.0	70.6	35.2	0.5	83.2	0.31	336.1	336.1	336.1	336.1	84.0	252.0	5600.0
SUBTOTAL:										379.4	706.4	651.3	359.7	90.0	270.0	6000.0
TOTAL SEDMENT TO STREAM										997.9	1439.4	1365.0	971.4	243.0		
JEWKES CREEK																
NORTH SIDE																
RECLAIMED AREA	0.5	15.0	36.0	150.0	24.0	13.5	0.5	6.7	0.31	1.7	14.7	12.5	0.9	0.0	1.0	22.2
UNDISTURBED AREA	3.2	15.0	140.0	150.0	93.3	43.0	0.5	48.1	0.31	78.7	78.7	78.7	78.7	20.0	59.0	1311.1
SUBTOTAL:										80.4	93.3	91.1	79.6	20.0	60.0	1333.3
SOUTH SIDE																
RECLAIMED AREA	1.8	15.0	80.0	180.0	44.4	24.0	0.5	19.9	0.31	18.3	156.5	133.2	10.0	2.0	7.0	155.6
UNDISTURBED AREA	9.0	15.0	160.0	250.0	64.0	32.6	0.5	39.7	0.31	182.9	182.9	182.9	182.9	46.0	137.0	3044.4
SUBTOTAL:										201.2	339.4	316.0	192.8	48.0	144.0	3200.0
TOTAL SEDMENT TO STREAM										281.5	432.7	407.2	272.4	68.0		

INPUTS

SOIL CONDITION	C FACTORS
Bare ground and seed	0.94
Ripped and seeded	0.8
Mulched, ripped, & seeded	0.06
Silt Fence w/mulch, ripped, and seed	0.015
Undisturbed	0.11

P Factor = 1

ERODIBILITY FACTOR, K 0.31

RAINFALL FACTORS

10-yr 6-hr storm	18
Annual	15

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6 7/11/96

REFERENCES:

ISRAELSEN, C.E, J.E. FLETCHER, F.W. HAWS, E.K. ISRAELSEN, 1984. EROSION & SEDIMENTATION IN UTAH: A GUIDE FOR CONTROL. UTAH WATER RESEARCH LABORATORY, USU. UWRL/H-84/03. LOGAN, UTAH.

BARFIELD, B.J., R.C. WARNER, & C.T. HAAN. 1981. APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS. OKLAHOMA TECHNICAL PRESS. STILLWATER, OKLAHOMA.

BASED ON PREVIOUS CALCULATIONS, THE MULCHED, RIPPED, & SEEDED WATERSHEDS PRODUCE LESS SEDIMENT THAN AN UNDISTURBED WATERSHED AT THE SAME SITE.

FOR ADDITIONAL PROTECTION, A SILT FENCE WILL BE INSTALLED ALONG THE RECLAIMED CHANNELS AS INDICATED ON ATTACHED FIGURE.

8
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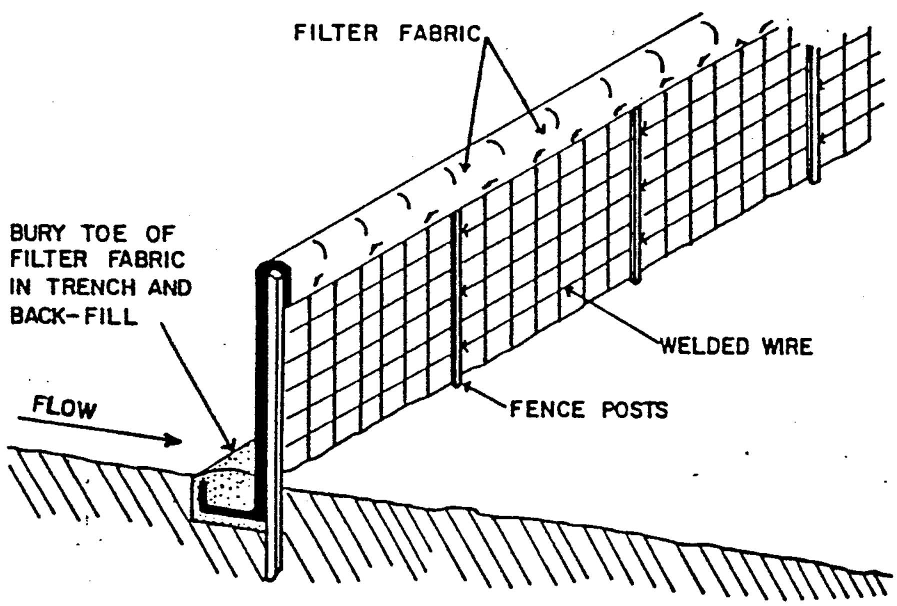
APPENDIX 6E



CHAPTER 8

SOIL RESOURCES

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

CHAPTER 8

SOIL RESOURCES

8.1 Scope

A soil inventory of the Horizon Mine area was conducted to provide soil resource information to meet the requirements of UDOGM and OSM. The soil survey was performed by Richard A. Foster, Soil Scientist, (USDA Soil Conservation Service) in February 13, 1990 (Section 8.3.1). This is in addition to the soil survey which was performed by George Cook (Range Conservationist), Earl Jensen (Soil Scientist) and Gary Moreau (District Conservationist) of the SCS in May 1980 (Appendix 8-1).

8.2 Methodology

Soil mapping of the area (Plate 8-1) is a refinement of USDA Soil Conservation Service manuscript mapping. The soils mapping was done by Patrick D. Collins (Botanist/Reclamation Specialist) using the information supplied by George Cook of the SCS as to the locations, types and depths of soils.

George Cook (SCS) and Richard A. Foster used the pit method to estimate depths and quality of the soil. Detailed pedon are described to depths of 60 inches, or until bedrock, whichever was shallowest. These pits were dug below the mine area, up the canyon where new disturbance will occur, and at previously disturbed areas.

The soils to be saved for reclamation were tested at a approved laboratory using the UDOGM guidelines. The parameters tested were pH, electrical conductivity, saturation percent, particle size, soluble Ca, Mg & Na, Total N, Nitrate-N, Organic carbon, available water capacity, rock fragments above 2mm size, and soil color. Where a high pH was indicated, tests were preformed for Selenium and Boron.

Present and potential uses of the soils of the site have been evaluated based on Soil Conservation Service Soil Survey Interpretation information. The soils have no potential as cropland or pasture land. The soils have also been evaluated for the potential production as rangeland and their capability groups are given.

The soils have been correlated by the SCS. Classifications are based on morphology as described in the field, and to a lesser degree on the analytical data. Where analytical data do not support the field description the soils are classified according to the field description.

8.3 Soil Resource Information for the Mine Plan Area

8.3.1 Soils Identification

The soils at Horizon were initially identified on site. This allowed the consultant to determine slopes, land forms, and vegetation patterns (see Section 8.2). The soil descriptions were compared with recorded characteristics of the soils in adjacent areas and in the official SCS series descriptions. Map units are comprised of soil series and inclusions found within an area to make them site specific. The differences in symbols between the SCS report located in Appendix 8-1 and the new SCS guidelines dated June 1988 used on Plate 8-1, are as follows:

FIA	=	Shupert-Winetti Complex
GIG	=	Curecanti
HIG	=	Senchert
JIB	=	Brycan Loam
DM	=	Mine Dumps (Previous Disturbed Area)
No symbol		Rabbitex

Shupert-Winetti Complex

The Shupert - Winetti complex consists of very deep, well drained, moderately permeable soils on narrow valley and canyon floors. These soils formed in alluvium derived from sandstone and shale. Slope is 1 to 8 percent. Elevation ranges from 4,600 to 7,200 feet but commonly is 5,200 to 6,400 feet. Average annual precipitation is 12 to 16 inches, and average annual air temperature is 43 to 45 degrees F.

These soils are fine-loamy, mixed (calcareous), frigid Typic Ustifluvents.

Brycan

The Brycan Series consists of very deep, well drained, moderately slowly permeable soils on alluvium derived from shale and sandstone. Slope is 3 to 8 percent. Elevation is 7,700 to 8,600 feet. Average annual precipitation is 16 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are fine-loamy, mixed Cumulic Haploborolls.

Curecanti

The Curecanti family consists of very deep, well drained, moderately permeable soils on mountain slopes. These soils formed in colluvium derived dominantly from sandstone and shale. Slope is 50 to 70 percent. Elevation is 6,800 to 9,000 feet. Average annual precipitation ranges from 16 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are loamy-skeletal, mixed Typic Argiborolls.

Rabbitex

The Rabbitex series consists of very deep, well drained, moderately permeable soils on mountain slopes and ridgetops. These soils formed in residuum and colluvium derived dominantly from sandstone, shale, limestone, and siltstone. Slope is 15 to 70 percent. Elevation is 7,000 to 9,200 feet. Average annual precipitation range from 16 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are fine-loamy, mixed Typic Calciborolls.

Senchert

The Senchert family consists of moderately deep, well drained, moderately permeable soils on mountain slopes, plateaus, and ridges. These soils formed in residuum and alluvium derived dominantly from sandstone and shale. Slope is 1 to 50 percent. Elevation is 8,000 to 10,100 feet. Average annual precipitation is 20 to 30 inches. An average annual air temperature is 36 to 38 degrees F. These soils are fine loamy, mixed Argic Pachic Cryoborolls.

A description of the soil sampled in Pits 1 through 7 follow.

Pit #1 - (TP-1) Shupert-Winetti Complex

Fine-loamy, mixed (calcareous), frigid Typic Ustifluvents. Colors are for dry soil unless otherwise noted.

A -- 0 to 6 inches (0 to 15.2 cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate thin platey structure paring to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine, many very fine roots; many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C1 -- 6 to 12 inches (15.2 to 30.5 cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard, firm; sticky and plastic; few dine, common very fine roots; common fine, many very fine random tubular pore; moderately calcareous, lime is disseminate; strongly alkaline (pH 8.5); clear smooth boundary.

C2 -- 12 to 26 inches (30.5 to 66 cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; hard, firm sticky and plastic; few dine and very fine roots; common fine, many very fine random tubular pore; moderately calcareous, lime is disseminate; strongly alkaline (pH 8.5); clear smooth boundary.

C3 -- 26 to 40 inches (66 to 101.6 cm); pale brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine, common very fine random tubular pores; moderately calcareous, lime is disseminate; strongly alkaline (pH 8.5); clear smooth boundary.

C4 -- 40 to 57 inches (101.6 to 144.8 cm); pale brown (10YR 6/3) loam, very dark grayish brown (10YR 3/2) moist; may fine distinct (10YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine and very fine random tubular pores; moderately calcareous lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

2C -- 57 to 65 inches (144.8 to 165.1 cm); very pale brown (10YR 7/4) loamy fine sand, brown (10YR 5/3) moist; common fine distinct (10YR 5/8) mottles; massive; soft, very friable, nonsticky and non plastic; few very fine random tubular pores; moderately calcareous, lime is disseminate; strongly alkaline (pH 8.5).

The C2 horizon has thin strata of material like the C# horizon. The C# horizon has thin strata of material like the C4 horizon.

Pit #2 - (TP-2) Shupert-Winetti Complex

Loamy-skeletal, mixed (calcareous), frigid Typic Ustifluvents. Colors are for dry soil unless otherwise noted. Moist colors are darker in the upper three horizons due to the presence of coal. This is a disturbed site.

C1 -- 0 to 6 inches (0 to 15.2 cm); pale brown (10YR 6/3) sandy lam, very dark gray (10YR 3/1) moist; moderate thin platey structure parting to weak fine and very fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few coarse and medium, many fine and very fine roots; few medium and fine, many very fine random tubular pore; moderately calcareous, lime is disseminate; moderately alkaline (pH) 8.4); clear smooth boundary.

C2 -- 6 to 19 inches (15.2 to 48.3 cm); pale brown (10YR 6/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and fine, many very fine roots; few medium and fine, many very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear wavy boundary.

C3 -- 19 to 34 inches (48.3 to 86.4 cm); light yellowish brown (10YR 6/4) extremely gravelly andy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few medium, fine, and very fine roots; few fine, common very fine random tubular pores; 10 percent cobble, 50 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.3); gradual wavy boundary.

C4 -- 34 to 47 inches (86.4 to 119.4 cm); pale brown (10YR 6/3) extremely gravelly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine and very interstitial pores; 20 percent cobble, 50 percent gravel; moderately calcareous, lime is disseminate; moderately alkaline (pH 8.3); gradual wavy boundary.

C5 -- 47 to 60 inches (119.4 to 152.4 cm); light yellowish brown (10YR 6/4) extremely cobbly sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; many fine and very fine interstitial pore; 10 percent stone, 55 percent cobble, 10 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4).

<u>Pit #3 - (TP-3) Rabbitex</u>

Fine-loamy, mixed Typic Calciboroll. Colors are for dry soil unless otherwise noted.

A -- 0 to 5 inches (0 to 12.7 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to moderate fine and very fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few coarse, common medium, many fine and very fine roots; common medium and fine, many very fine random tubular pores; 25 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4); clear wavy boundary.

Bk1 -- 5 to 20 inches (12.7 to 50.8); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard,friable, slightly sticky and slightly plastic; few coarse, medium, common fine, many very fine roots; common fine, many very fine random tubular pores; 20 percent gravel; moderately calcareous, lime is disseminated and in thin coatings on rock fragments; moderately alkaline (pH 8.4); gradual wavy boundary.

Bk2 -- 20 to 45 inches (50.8 to 114.3 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, common fine and very fine roots; few fine, many very fine random tubular pore; 5 percent cobble, 20 percent gravel; moderately calcareous, lime is disseminated and in thin coatings on rock fragments; strongly alkaline (pH 8.5); clear wavy boundary.

Bk3 -- 45 to 51 inches (114.3 to 129.5 cm); yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 4.3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium and fine, common very fine roots; few fine, common very fine random tubular pores; 5 percent cobble, 40 percent thin coatings on rock fragments; strongly alkaline (pH 8.5); clear wavy boundary.

Bk4 -- 51 to 70 inches (129.5 to 177.8 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; moderately medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, fine, and very fine roots; few fine and very fine random tubular pore; 25 percent gravel; moderately calcareous, lime is disseminated and in few fine veins and thin coatings on rock fragments; strongly alkaline (pH 8.5).

This soil is an inclusion in the Rabbitex mapping unit and is found predominantly at the base of steeper slopes.

Pit #4 - (TP-4) Shupert-Winetti Complex

Loamy-skeletal, mixed (calcareous), frigid Typic Ustifluvent. Colors are for dry soil unless otherwise noted. Moist colors are darker due to the presence of coal.

A -- 0 to 10 inches (0 to 25.4 cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and fine, many very fine roots; common medium, many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C1 -- 10 to 17 inches (25.4 to 43.2 cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium, common fine and very fine roots; few medium, common fine and very fine random tubular pore; 10 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C2 -- 17 to 35 inches (43.2 to 88.9 cm); pale brown (10YR 6/3) very cobbly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 10 per cent stone, 15 percent cobble, 15 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C3 -- 35 to 60 inches (88.9 to 152.4 cm); light yellowish brown (10YR 6/4) extremely cobbly sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine and very fine random tubular pores; 10 percent stone, 20 percent cobble, 30 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5)

Pit #5 - (TP-5) Brycan

Fine-loamy, mixed Cumulic Haploborolls. Colors are for dry soil unless otherwise noted. Less than 5 percent stone and cobbles on the surface.

A1 -- 0 to 8 inches (0 to 20.3 cm); dark brown (10YR 4/3) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium, common fine, many very fine roots; few medium, common fine, many very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear smooth boundary.

A2 -- 8 to 18 inches (20.3 to 45.7 cm); dark brown (10YR 4/3) gravelly loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and fine, common very fine roots; common medium and fine, many very fine random tubular pores; 20 percent gravel; noncalcareous; moderately alkaline (pH 8,2); gradual wavy boundary.

A3 -- 18 to 43 inches (45.7 to 109.2 cm); dark brown (10YR 4/3) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and lightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C -- 43 to 60 inches (109.2 to 152.4 cm); pale brown (10YR 6/3) very cobbly lam, brown (10YR 4/3) moist; massive slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots few fine and very fine random tubular pores; 20 percent cobble, 30 percent gravel; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.2).

Pit #6 - (TP-6) Shupert-Winetti Complex

Fine-loamy, mixed (calcareous), frigid Typic Ustifluvent. Colors are for dry soil unless otherwise noted.

A -- 0 to 5 inches (0 to 12.7 cm); pale brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common coarse, medium, fine and very fine roots; common medium, many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.2); clear wavy boundary

C1 -- 5 to 14 inches (12.7 to 35.6 cm); pale brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots few medium, common fine, many very fine random tubular pores; 5 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.2); clear wavy boundary.

C2 -- 14 to 18 inches (35.6 to 45.7 cm); pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard friable slightly sticky and slightly plastic; few medium and fine, common very fine roots; few medium and fine, many very fine random tubular pores; 5 percent gravel; slightly calcareous, lime is disseminated; strongly alkaline (pH 8.6): clear wavy boundary.

C3 -- 18 to 28 inches (45.7 to 71.1 cm); pale brown (10YR 6/3) very gravelly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine, common very fine roots; few fine, common very fine random tubular pore; 40 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C4 -- 28 to 48 inches (71.1 to 121.9 cm); pale brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 10 percent gravel with thin lenses of 50 percent gravel: moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C5 -- 48 to 60 inches (121.9 to 152.4 cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.4).

Pit #7 - (TP-7) Brycan

Fine-loamy, mixed Cumulic Haploborolls. Colors are for dry soil unless otherwise noted.

A1 -- 0 to 10 inches (0 to 25.4 cm); brown (10YR 5/3) loam, very dark brown (10YR 2/2) moist moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse and medium, common fine and very fine roots; few medium, common fine, many very fine random tubular pores; 5 percent gravel; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.2); clear wavy boundary.

A2 -- 10 to 17 inches (25.4 to 43.2 cm); brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear wavy boundary.

A3 -- 17 to 34 inches (43.2 to 86.4 cm); pale brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium sub angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C1 -- 34 to 52 inches (86.4 to 132.1 cm); pale brown (10YR 6/3) clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, firm, sticky and plastic; few fine and very fine roots; few fine, common very fine random tubular pores; noncalcareous; moderately alkaline (pH 8.2); abrupt wavy boundary.

C2 -- 52 to 60 inches (132.1 to 152.4 cm); light yellowish brown (10YR 6/4) clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; few fine and very fine random tubular pores; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.2).

Three soil test pits, TP-40 through TP-42, were excavated in the embankment located southwest of the portals. These test pits were dug to obtain samples of the material contained within the embankment to determine the suitability of the material to be used as backfill. A composite sample was obtained from each of the test pits by first excavating to total depth then obtaining a channel sample from one wall of the pit (if the material was similar throughout the excavation). If distinct units or horizons were observed to be unique to a wall of the excavation, a sample from each unique horizon was obtained and then composited with samples from all horizons observed. The composite samples were sent to Intermountain Laboratories, Inc. of Sheridan, Wyoming for analysis for the parameters listed in the Division's "Guidelines for Management of Topsoil and Overburden", (Leatherwood, 1988). Selected results of the analysis are presented in Table 8-1 and the laboratory analyses data reporting sheets are contained in Appendix 8-1.

Test pit TP-40 was excavated on the east (upstream) face of the south end of the embankment (Plate 8-1). The pit was excavated to eight feet below ground surface. Vegetative cover is very sparse and the area is well-drained. The surface and subsurface is comprised of coal waste and rock fragments. The profile consists of predominantly layered coal debris from previous mining operations.

Profile

0-8' Coal and waste rock (100%); very fine to very coarse fragments of angular to sub-angular coal debris and waste rock, coal waste is very dark brown (10YR 2/2) to black (10YR

2/1), waste rock is very dark brown (10YR 2/2), some wood fragments, trace of pyrite on some of the rock, material is dry to damp, loose.

Test pit TP-41 was excavated on the east (downstream) face of the south end of the embankment (Plate 8-1). The pit was excavated to 16 feet below ground surface. Vegetative is thin and the area is well-drained. The surface and subsurface is comprised of coal waste, rock fragments, and disturbed soil.

Profile

0-1' Coal, dark gray (10YR 4/1) to very dark brown (10YR 2/2), coarse coal fragments with some waste rock, angular to sub-angular coal debris and waste rock, some wood fragments, material is damp, loose.

1-4' Mixed Coal and Soil, Coal as above, Soil is a loam, brown (10YR 4/3), sandy with coal fines, occasional coarse rock fragments, damp, loose.

4-6' Mixed Coal and Waste Rock, Coal as above, Waste rock is sandstone and siltstone, angular, gravel to boulder size, some coal fines and soil are present as a matrix, damp, loose.

6-16' Sandy Loam, yellowish brown (10YR 5/4), mixed with some coal fines and coal waste, approximately 20 percent and greater coarse fragments, coarse fragments increase with depth, slightly sticky, slightly plastic, friable, soft to slightly hard, moist, loose.

Test pit TP-42 was excavated on the west (upstream) face of the north end of the embankment (Plate 8-1). The pit was excavated to 12 feet below ground surface. Vegetative cover is moderate and the area is well-drained. The surface is a loam and coal waste mixture and subsurface is comprised of coal waste and rock fragments. The profile consists of predominantly layered coal debris from previous mining operations.

Profile

0-5' Loam with coal fines, very dark gray (10YR 2/2) to black (10YR 3/1), sand to cobble size fragments, coarse fragments are angular and comprised of sandstone and siltstone, material is damp, loose.

5-12' Coal Waste, very dark gray (10YR 2/2) to black (10YR 3/1), includes large fragments of coal, waste rock, wood timbers, and metal pipe, fragment size is sand to cobble, damp, loose.

As described previously, the composite samples obtained from these test pits were analyzed for the parameters listed in Table 6 (Leatherwood, 1988) with the selected results listed in Table 8-1. The results of the analyses indicate that the soil and coal waste characteristics fall within the Division's acceptable range for overburden for the vegetative root zone as listed in Table 2 of the "Guidelines for Management of Topsoil and Overburden" (Leatherwood, 1988). Though the results indicate that the material is acceptable for vegetative growth, the concentration of coal eliminates most of this material from being used as topsoil. This material will be used as backfill in the facilities area. Coal and coal waste material from the embankment will be used as backfill and covered with at least four feet of acceptable backfill material as described in Section 3.3.2.5.

In addition to the soil test pits excavated in the embankment, one soil test pit (TP-43) was excavated in the bottom of the channel formed by Jewkes Creek while another (TP-44) was excavated across from the ruins of the concrete garages (Plate 8-1). These excavations were made to determine the type of soils present in these areas and their suitability as substitute topsoil. In both locations, the soils have been disturbed in the past and covered with materials imported from another location.

A composite sample of the material found in test pit TP-43 was obtained in a similar manner as described for test pits TP-40, 41, and 42. The pit was excavated to a depth of 12 feet below ground surface. The surface was covered with grasses and shrubs.

The material found in TP-43 was not predominantly coal waste, as in the case of the embankment, but was apparently deposited as a the result of mining operations. The material encountered below ground surface appeared to have been deposited by moving water on a slope of at least 10 degrees. The current ground surface is near horizontal. This suggests that the material was deposited on the face of a prograding "delta", perhaps forming in a pond. Following is a description of the soil profile observed in the excavation.

Profile

0-5" Loam with some very fine sands and clay, dark yellowish brown (10YR 4/4), some coal fines mixed with loam, abundant roots, less than 10% rock fragment, slightly sticky and plastic, friable, soft to slightly hard, blocky structure, dry to slightly damp.

5"-7' Sandy loam, dark yellowish brown (10YR 4/4) to very dark gray (10YR 3/1), interbedded with beds up to 12 inches thick of coal fines mixed with loam, occasional roots, less than 10% rock fragments, slightly sticky and plastic, friable, soft, blocky structure, occasional cobble size fragment, slightly moist. (Unit is approximately 30% coal fines and appears to have been deposited below a coal washing operation).

7-12' Sandy loam, some gravel, dark brown (10YR 3/3), trace of roots, approximately 15% sandstone and siltstone rock fragments, occasional cobble and boulder size fragments, non-sticky and non-plastic, friable, loose, crumb structure, laminated to thin bedded, sands and gravel are fine to coarse, subangular to subrounded, wet. (Unit appears to be fluvial in origin. Test pit terminated at or near bed rock.)

It is interesting to note that this excavation was located within a few feet of the stream bottom, left open for more than one-half an hour, and did not have significant water in the bottom of the pit prior to back filling.

Test pit TP-44 was excavated near the ruins of a building on the top of the west bank of the drainage formed by Jewkes Creek. It was excavated to a depth of 12 feet below ground surface. It appeared that at least the upper 5 feet of material encountered in this excavation had been disturbed or transported into this area. Soil samples were obtained from 0 to 3 feet, 3 to 5 feet, and 5 to 10 feet below ground surface for analyses. These samples were analyzed for the same parameters as TP-40 through TP-43. The results of the analyses are included in Table 8-1. Following is a description of the soil profile observed in this test pit.

Profile

0-3′ Loam, very dark brown (10YR 2/2), some sand and gravel with brick and wood fragments, occasional cobble size rock fragments, rock fragments are less than 10% of total material, abundant roots, slightly sticky and slightly plastic, friable, slightly hard, blocky structure, trace of coal, slightly damp, obviously disturbed.

3-5′ Loam, dark yellowish brown (10YR 4/4), some sand and gravel, approximately 15% rock fragments, fragments are sandstone, sand is very fine to fine, subangular, gravels are fine, subangular to subrounded, soil is slightly damp.

5-10′ Sandy loam, brown (7.5YR 4/4), interbedded with loam as above, trace of roots, approximately 15 to 20% rock fragments, non-sticky and non-plastic, very friable, loose, crumb structure, sand is very fine to fine, subangular, occasional fine gravel, slightly damp. (Appears to be undisturbed).

10-12′ Gravel, coarse to very coarse, a fine to very coarse sand matrix, some cobbles and boulders of sandstone and siltstone, loose, slightly damp.

The results of the analyses of the samples obtained from test pits TP-43 and TP-44 indicate that the soils sampled would be acceptable for use as substitute topsoil/growth medium or backfill. The exception to this would be the layers of coal fines located in TP-43.

At the request to Leland D. Sasser of the Natural Resources Conservation Service from Robert A. Davidson of UDOGM a small area of soils in Jewkes Canyon were sampled. The samples were reviewed for their development as hydric soils by Mr. Sasser. Mr. Sasser's letter report and log are found in Appendix 8-1. The location of the test pit sampled on October 23, 1996 is labeled as TP-45 on Plate 8-1.

TABLE 8-1

Horizon Coal Soil Analytical Data

Parameter	Units	Division's Acceptable Range[a]	Sample Number (Depth Interval, feet)			
			TP-40 (0-7)	TP-41 (0-16)	TP-42 (0-12)	TP-43 (0.5-7)
pH	-	4.5 - 9.0	6.4	7.4	7.2	7.1
EC	mmhos/cm	0 - 15	2.37	0.37	0.83	0.43
Saturation %	-	25 - 80%	36.6	31.2	32.0	35.7
Calcium	mg/kg	-	25.1	1.78	4.33	2.10
Magnesium	mg/kg	-	8.41	1.08	4.50	1.36
Sodium	mg/kg	-	0.58	0.51	0.41	0.58
SAR	-	0 - 12,15	0.14	0.42	0.20	0.44
Nitrate-N	mg/kg	-	1.74	1.18	1.18	1.16
Organic-C	%	-	28.8	16.3	17.2	27.6
Na (exchangeable)	meq/100g	-	0.26	0.25	0.26	0.20
Available Water Capacity[b]	%	5 - >10%	6.2	10.3	9.9	6.6
Boron	mg/kg	<5	1.35	1.46	1.31	0.29
Selenium	mg/kg	<0.1	0.02	<0.02	<0.02	<0.02
Acid/Base Potential	tons CaCO3/ 1,000 tons material	> -5	-1.16	55.6	88.0	27.4
Sample Type	-	-	Coal Waste	Coal Waste	Coal Waste	Over-burden
Texture[c]	-	-	CL	L	L	SL

TABLE 8-1

Horizon Coal Soil Analytical Data (Continued)

Parameter	Units	Division's Acceptable Range[a]	Sample Number (Depth Interval, feet)		
			TP-44 (0-3)	TP-44 (3-5)	TP-44 (5-10)
pH	-	4.5 - 9.0	6.9	7.3	7.5
EC	mmhos/cm	0 - 15	0.35	0.31	0.41
Saturation %	-	25 - 80%	33.4	32.3	27.1
Calcium	mg/kg	-	1.87	1.51	2.24
Magnesium	mg/kg	-	0.57	0.47	0.55
Sodium	mg/kg	-	0.56	0.68	0.95
SAR	-	0 - 12,15	0.51	0.68	0.80
Nitrate-N	mg/kg	-	1.04	0.46	0.76
Organic-C	%	-	4.8	1.8	1.2
Na (exchangeable)	meq/100g	-	0.21	0.25	0.29
Available Water Capacity[b]	%	5 - >10%	11.8	11.4	11.6
Boron	mg/kg	<5	0.80	0.92	0.39
Selenium	mg/kg	<0.1	<0.02	<0.02	<0.02
Acid/Base Potential	tons CaCO3/ 1,000 tons material	> -5	2.20	112.0	93.3
Sample Type	-	-	Over-burden	Over-burden	Over-burden
Texture [c]	-	-	L	L	L

(a) Leatherwood and Duce, 1988.
(b) USDA, 1953.
(c) Texture: LS - loamy sand, SL - sandy loam, L - loam

8.3.2 Soil Series Descriptions

Disturbed Land

The disturbed area consists of generally deep, nearly level to nearly vertical, moderately well-drained materials. The fill materials are derived from sandstone, shale, and coal from previous mining operations. The fill material comprise most of the proposed disturbed area. The native vegetation has been previously disturbed in the mine area.

The available water capacity is moderate to low and permeability is moderate. The mean annual air temperature ranges from 36 degrees to 45 degrees F. and the frost free period is 60 to 120 days.

Soils are identified by four categories (FIA, GIG, HIG, JIB) and are identified on Plate 8-1 and in the text as such. Depths and types of soil were identified by SCS. The topsoil/growth medium to be saved for reclamation is also identified by category (see Section 8.2). A complete survey of the soil area was completed on November 3, 1990 and the results were incorporated into this chapter. The majority of the proposed disturbed area was previously used as a mine yard, making it difficult to determine the amount of salvageable topsoil or substitute topsoil.

Mapping Legend

The following is a list of the soil symbols and mapping units which appear in the legend on the soils maps and elsewhere in this permit.

Soil Symbol	Soil Mapping Unit Name
FIA	Shupert-Winetti Complex - 0 to 2% slopes
GIG	Curecanti - Very bouldery loam, 55-65% slopes
HIG	Senchert - Silt loam, 50-70% slopes
JIB	Brycan - 4-6% slopes
DM	Mine Dumps - Previous Disturbed Areas
No symbol	Rabbitex - Fine loamy, mixed Typic Calciborolls

The additional surface soil sampling points on Plate 8-1 are from a survey done by George Cook, Earl Jensen and Gary Moreau for the C & W Coal Producers (Appendix 8-1).

8.3.3 Present and Potential Uses - Crops and Pasture Lands

The SCS has determined that there are no prime farmlands of statewide importance, or unique in the permit area (see Figure 8-1). None of the soils mapped at the site have potential for the growth of crops or pasture land.

Rangelands

The soils of the area have been used as rangeland in the past. Data on predicted forage production for rangeland soils for various sites are available from the SCS (Section 9-9). The principle limitations are erosion and shallowness, according to the SCS the soils cannot support cultivated crops. The soils incapability have very severe limitations thus restricting the use of the land largely to grazing, woodland or wildlife.

8.4 Prime Farmland Investigation and Determination

On August 14, 1990, Blue Blaze Coal Company requested the SCS (Price, Utah office) review the soils within the mine area to determine if any soils qualified as prime farmland. The State Soil Scientist determined there were no soils classified as prime farmlands in the permit area (see Figure 8-1).

8.5 Physical and Chemical Properties of Soils and Results of Analysis

The criteria for evaluating soil as a plant growth media are given in Table 8-2. The criteria include sodium absorption ration (SAR), electrical conductivity or salinity (EC), toxic materials, soil reaction (pH), available water hold capacity (AWMC), erosion factor (K), wind erosion group, texture and percent coarse fragments.

Criteria are given for good, fair or poor sources of reconstruction material (Table 8-2). A good rating means vegetation is relatively easy to establish and maintain, the surface is stable and resists erosion, and the reconstructed soil has good potential productivity. Material rated fair can be vegetated and stabilized by modifying one or more properties. Top dressing with better material or application of soil amendments may be necessary for satisfactory performance. Material rated poor has such severe problems that revegetation and stabilization is very difficult and costly. Top dressing with better material may be necessary to establish and maintain vegetation (USDA, 1978).

Soil Chemistry and Physical Properties

Chemical and physical data for project area soils were collected to evaluate the soils as reconstruction material for disturbed areas. Soil chemical and physical data from analysis by Commercial Testing & Engineering Company and Inter-Mountain Laboratories, Inc. are reported

United States Department of Agriculture

Soil Conservation Service

PO Box 11350
Salt Lake City, UT 84147

September 12, 1990

William R. Skaggs
Blue Blaze Coal Company
PO Box 784
Price, UT 84501

Dear Mr. Skaggs:

In response to your request August 14, 1990, we have made a review of Sections 7, 8, 17, 18, and 20, T. 13S., R8E., SLM for Important Farmlands determination.

None of these areas qualified as Important Farmland soils: steep slopes, stoney, or bouldry surfaces and soil disturbance from previous construction work are factors that eliminate these sects from categories of Important Farmlands.

Sincerely,

FERRIS P. ALLGOOD
State Soil Scientist

cc:
Price Field Office/Jan Anderson

FIGURE 8-1

SUPERSEDED
EFFECTIVE:
APR 07 1998
UTAH DIVISION OIL, GAS AND MINING

11/25/90

TABLE 8-2

Soil Reconstruction Material for Disturbed Areas

Property	Limits Good	Fair	Poor	Restrictive Feature
Sodium Adsorption Ratio (SAR)	<5	5 - 12	>12	Excess Sodium
Salinity (mmhos/cm)	<8	8 - 16	>16	Excess Salt
Toxic Materials	Low	Medium	High	Toxicity
Soil Reaction (pH)[a]	5.6 - 7.8	4.5 - 5.5	<4.5[b]	Too Acid
Soil Reaction (pH)	7.9	7.9 - 8.4	>8.4	Excess Lime
Available Water Capacity (IN/IN)^2	>.10	.05 - .10	<.05	Drought
Erosion Factor (K)	<.37	>.37	---	Erodes Easily
Wind Erod. Group	3	3	1, 2	Soil Blowing
USDA Texture	---	SCL,CL, SICL	C[c], SIC[c], SC	Too Clayey
USDA Texture	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	Too Sandy
Coarse Frag. (WTPCT) 3-10 in. (7.6-25.4 cm) 10 in. (25.4 cm)	<15 <3	15 - 35 3 - 10	>35 >10	Large Stones Large Stones

[a] Layers with high potential acidity should be rated "Poor - Too Acid"
[b] Rate "Fair - Too Acid" if found deeper than 40 inches.
[c] If in kaolinitic family, rate one class better if experience confirms.

From National Soil Handbook, NSH - Part II [403.6(2)], 1978 and Part 603 (603.03-3(e)(3)], 1983.

in Appendix 8-1. The parameters tested were under the UDOGM guidelines; pH, electrical conductivity, saturation percentage, particle size, soluble Ca, Mg & Na, sodium absorption ratio, Total N, Nitrate-N, Organic carbon, available water capacity, rock fragments, and soil color. If the pH ran high the samples were tested for Selenium and Boron.

Suitability as a Source Material for Reclamation of Disturbed Lands

Appendix 8-1 contains a chemical evaluation of the soils in both the undisturbed area and the area to be redisturbed. The soils are rated as good, fair or poor sources for reconstruction material. The overall rating given for each horizon is the rating for the most limiting criteria, and no horizon can be rated better than an overlying horizon. Vegetation is difficult to establish on soils with high SAR which indicates potential instability of water transmission problems (USDA, 1978). All of the soils of the site were rated good for SAR.

Electrical conductivity is a measure of soil salinity. Excessive salts restrict plant growth, create problems in establishing vegetation and therefore also influence erosion and the stability of the surface (USDA, 1978). All of the soils of the site were rated good for EC.

Excessively high or low pH causes problems in establishing vegetation and as a result influences erosion and stability of the surface (USDA, 1978). The substratum of the soils are rated good for pH.

The AWHC also is important in establishing vegetation. Soils with low available water capacity may require irrigation for establishment of vegetation (USDA, 1978). AWHC was estimated based on field texture and percent coarse fragments (U.S. Forest Service, 1974). The soils are rated fair to good for AWHC.

The stability of the soil depends upon its erodibility by water and wind and its strength. Water erodibility is indicated by the K factor; wind erodibility is rated according to the wind erodibility group. K values for soils of the project area are from the best data available in the SCS Soil Survey Interpretation Records (USDA, 1978). Soils of the site are rated good for erodibility. Wind erodibility is based on SCS Soil Survey Interpretation Records for the surface horizons.

Wind erodibility data is available for only the surface soils of the site (USDA, 1978). The surface layers of the Pathead and Curecanti soils are rated good for wind erodibility.

USDA texture also influences available water capacity and erodibility by wind or water. Texture influences soil structure, consistence, water intake rate, runoff, fertility, workability, and trafficability. Potential slippage hazard is related to soil texture, and although other factors also contribute, the ratings of soil texture represent one important factor (USDA, 1978). Soil texture for soils of the site are rated fair to poor, but are generally not considered the limiting factors. The fill textures for soils of the site were described in the field and the evaluations are based on the field determinations.

Coarse fragments influence the ease of excavation, stockpiling and respreading, and suitability for the final use of the land. A certain amount of coarse fragments can be tolerated depending upon the size and intended use of the reclaimed area.

Test pit 1 was determined by SCS to be unsuitable for salvage. A summary of TP-1 characteristics are summarized in a table in Appendix 8-1.

Salvageable topsoil/growth medium will be placed in a stockpile. The soil will be spread over a large area so that the application of soil nutrients can be carefully controlled. The stockpile will be surveyed to verify that the quantity of soils contained are sufficient for reclamation.

Topsoil/growth medium which meets the UDOGM suitability criteria will be salvaged from all areas within the permit area. The applicant will submit as-built surveys of the completed topsoil stockpile. The surveys will include: volume of material, maximum and minimum elevations and slopes, cross sections, and all other pertinent dimensions. Based on the survey information topsoil mass balance tables will be amended.

All topsoil/growth medium to be used for reclamation will be tested according to the UDOGM soil guidelines. The requirements of regulation R645-301-233 will be meet in the event the mass balance calculations indicate a topsoil\subsoil deficiency.

Depths of Suitable Topsoil Available for Reclamation

Table 8-3 presents the topsoil/growth medium recovery calculations, soil types, as well as the recommended depth of stripping. Volumes of soil available for storage are also indicated. Figure 8-2 shows the location of each recovery area.

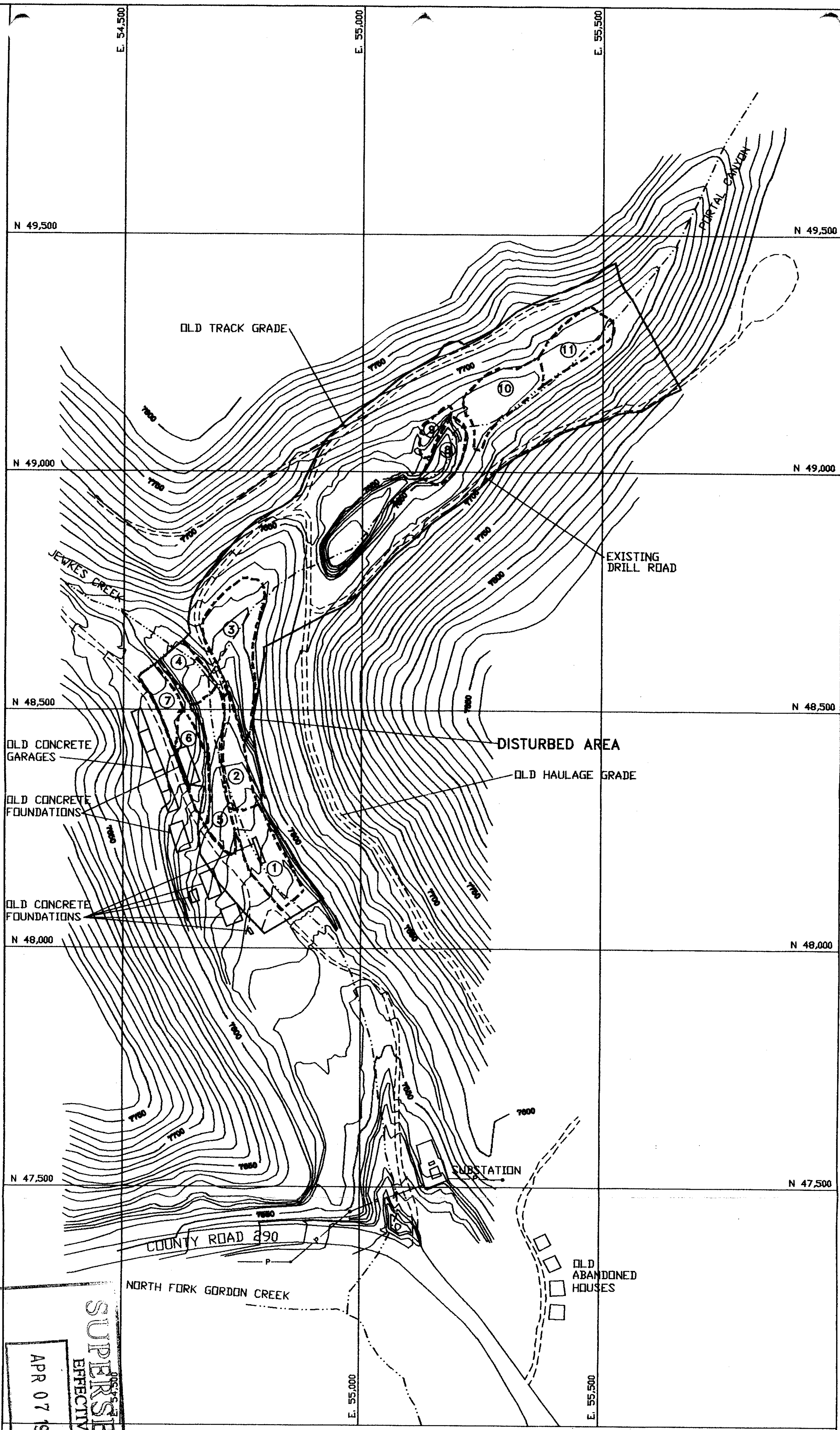
Much of the site is mapped as disturbed land. The fill material has variable properties, but the main restrictive features are coarse fragments and slope. The chemistry of the fine earth fraction is fair. The fill material is the only readily available reconstruction material in the mapped area. Included in the map unit DM (Mine Dumps) are areas of excessive large stones, rock outcrops, coal and rock dumps from previous mining. The coal and coal waste material from this areas (specifically the embankment at the mouth of Portal Canyon) will be handled as outlined in Section 3.3.2.5.

TABLE 8-3

Topsoil/Growth Medium Calculations

Recovery Area No.	Soil Type	Depth To Be Removed (Feet)	Volume (CY)[A]
1	DM	1.0	513
2	GIG	2.0	704
3	JIB	3.0	3000
4	DM	3.0	1173
5	DM	1.5	773
6	DM	3.0	1280
7	GIG	4.5	1600
8	FIA	2.5	667
9	DM	3.0	227
10	FIA/JIB	4.0	2133
11	JIB	3.0	1600
		Total	13,670 CY

[A] All topsoil/growth medium to be stored at the top of Portal Canyon.



LEGEND

(11) Growth Medium Removal Locations

Unimproved Road

Improved Gravel Road

Streams

—— P —— Power Line

N

0' 100' 200'
APPROXIMATE SCALE

REVISION	
DATE	BY
7-2-96	VS

FIGURE 8-2

GROWTH MEDIUM REMOVAL LOCATIONS

HORIZON No. 1 MINE

HORIZON COAL CORPORATION
P.O. BOX 2560
WISE, VIRGINIA 24273

BOURQUIN MINERAL ENGINEERING
EARTH FAX ENGINEERING, INC.

All disturbance was conducted prior to enactment of regulations requiring salvaging of topsoil. Due to the already disturbed area a limited amount of the original topsoil/growth medium can be salvaged for storage.

Sampling of soil test pits prior to disturbance within the proposed disturbed area have provided positive indications that the soils in the area are capable of sustaining vegetation. Soils which lack the ability to sustain vegetation will be covered with topsoil/growth medium in sufficient depth to sustain and support vegetation. Horizon commits to cover any toxic-or acid-forming material with four feet of topsoil/growth medium prior to reclamation revegetation.

8.6 Use of Selected Overburden Materials or Substitutes

It is anticipated that there will be enough topsoil/growth medium stockpiled to re-distribute over the disturbed area (see Section 8.3.2). Contaminated material will be removed from the site and disposed of properly before topsoil/growth medium is replaced.

8.7 Soil Plan for Removal, Storage, and Protection

It is proposed to remove the topsoil/growth medium using the island method to insure that the proper thickness of the soil is removed. At the time of soil removal a professional soil scientist or equivalently qualified individual will be on site to insure proper salvage depths.

In areas of disturbance, available topsoil/growth medium will be salvaged and stored. The exception will be the riparian area where only topsoil (A horizon) will be salvaged due to the inplace soil's value for reestablishment of riparian vegetation during reclamation. Topsoil/growth medium salvaged from the riparian area will be dried (when necessary) prior to inclusion in the topsoil stockpile.

The excavation of the sediment pond will likely occur where remnants of a building's foundation exists. The size of this foundation is unknown. Therefore, the quantity of topsoil/growth medium available for salvage is unknown. All available topsoil/growth medium will be salvaged during the excavation of the sediment pond and stored in the stockpile.

The vegetative cover will be removed with and incorporated into the topsoil prior to placement of the topsoil in the stockpile. Leaving the vegetation in the stockpiled topsoil should allow natural degradation of the plant material to occur, thus enhancing the organic content of the stored topsoil.

The soil will be transported to the topsoil storage area shown on Plate 3-1. The soil will then be contoured at a rate of not more than 2:1 (see Section 8.8). Mulch will be applied as outlined in Section 3.5.5.3. The topsoil stockpile will be seeded using the seed mix listed in Table 3-2. Signs will be placed in this area indicating "Topsoil Storage". If necessary, the area will be fenced to prevent livestock from entering the area. A berm will be placed around the stockpile.

Trash, concrete, and debris will be hauled to a properly licensed disposal facility as it is removed from the mine site during topsoil/growth medium removal. The majority of the debris will be loaded directly into trucks and hauled from the site. On occasion debris will be stored until a truckload is collected, there will be not permanent storage on site for the debris collected during topsoil/growth medium removal.

8.8 Plans for Redistribution of Soils

Deep scarification of overburden and compacted areas (of no less than 12" depth), will be accomplished to ensure good overburden and redistributed topsoil contact to prevent slippage. The regraded material will be topographically conformed to the relative environmental conditions, which will be approximate to the premining topography with the highwalls being eliminated.

Topsoil/growth medium will be placed over the reclaimed areas at a thickness of approximately 11 inches. The thickness of the topsoil/growth medium is based on the total available medium divided by the total disturbed area. Soils will be placed to aid in the achievement of the reclamation groundcover success standards described in Section 9.8.

Soil will be redistributed using the wooden stake method, where a stake is marked to the depth of fill, then the soils will be added to accomplish that depth. The soil will then be harrowed to break up the cloddy surface and scarify to a depth of 18 inches (see Section 3.5.5.1). The regraded soils surface roughness will be maximized by pocking, pitting and gouging. Particular care will be taken not to compact soils placed in the riparian area.

The soil will then be sampled as stated in Section 8.9 to determine needed fertilization levels. The area will then be fertilized as required and mulched (Section 3.5.5.3). Seeding will then commence using the seed mix listed in Table 3-3. Erosion control matting will be used where the slope grades are 2 1/2H:1V or steeper.

8.9 Nutrients and Soil Amendments

Tests will be taken of soils to be used for final reclamation in order to evaluate the need for soil amendments and nutrients. Soil testing will be performed by a qualified laboratory which uses accepted analytical procedures (UDOGM soil guidelines). The soils chosen for sampling will be based on previous analysis, affected soil series type, postmining land use, and the postmining vegetation ecosystem. Twenty sub-samples per acre will be taken at 12 inch depths then combined, 5 samples will be taken from the combined sub-samples and send to a qualified laboratory for testing. The tests to be performed will be pH, electrical conductivity, sodium absorption ratio, texture, nitrogen, organic content, phosphorus, potassium, available water capacity, and percent rock fragments, in order to determine needed fertilization levels. Commercial organic fertilizers will be added to replenish soil nutrients and to enhance successful revegetation. The soil nutrient and amendments plan will also follow the Divisions Guidelines for management of topsoil and overburden for underground and surface coal mines.

8.10 Effects of Mining Operations on Soils, Nutrients and Amendments

The previously disturbed land which has been impacted by mining operations has some inherit problems. These problems include large stones and compacted zones. The large stones will be removed by standard earth moving equipment and/or commercial rock-picker implements. Compacted zones will be eliminated by deep gouging, prior to final reclamation. See Section 8.9 for nutrients and soil amendments.

8.11 Mitigation and Control Plans

No additional surface disturbance involving soils will be required for the surface facilities. Therefore, the stripping and stockpiling of soils will be the soils saved from the previously disturbed areas.

APPENDIX 8-1

SOILS DATA

Add to the back of the existing data

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Lowell P. Braxton
Division Director

1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, Utah 84114-5801
801-538-5340
801-359-3940 (Fax)
801-538-7223 (TDD)

April 7, 1998

Denise Dragoo, Resident Agent
Van Cott, Bagley, Cornwall, & McCarthy
50 South Main Street, Suite 1600
Salt Lake City, Utah 84111-1495

Re: N97-45-1-1, Topsoil Placement, Horizon Mining, LLC, Horizon Mine, ACT/007/020-97F, File #3, Carbon County, Utah

Dear Ms. Dragoo:

A stamped approved incorporated copy of the referenced amendment is provided for insertion into your Mining and Reclamation Plan.

If you have any questions, please call.

Sincerely,

Joseph C. Helfrich
Permit Supervisor

tat
Enclosure
cc: Ranvir Singh, OSM
Richard Manus, BLM
Alan Rabinoff, BLM, w/o
Mark Page, Water Rights, w/o
Dave Ariotti, DEQ, w/o
Bill Bates, DWR, w/o
Vicky Bailey, EarthFax
Price Field Office
O:\007020.HZN\FINAL\APPROVAL.97F

Horizon Coal
P.O. Box 599
Helper, UT 84526

February 9, 1998

Pamela Grubaugh-Littig
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, UT 84114-5801

Subject: Abatement Plans for NOV N97-45-1-1

File #2

Copy Abatement file
Joe 97

Dear Pam,

Upon a request by Horizon Coal Corporation, please find enclosed 6 copies of changes to the Horizon Coal Corporation permit. These changes address soils issues associated with NOV N97-45-1-1.

If you have any questions please contact me at (801) 561-1555.

Sincerely yours,

Vicky

Vicky S. Bailey

cc: Bill Malensick

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

Application for Permit Change
Detailed Schedule of Changes to the Permit

Title of Change: Abatement Plans for NOV N97-45-1-1

Permit Number: ACT/007/020

Mine: Horizon Mine

Permittee: Horizon Coal

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit change. 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 exiting 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	X REPLACE	☐ REMOVE	X Chapter 3, Pages 3-29 and 3-30
☐ ADD	X REPLACE	☐ REMOVE	X Chapter 8, Pages 8-24 through 8-29
☐ ADD	X REPLACE	☐ REMOVE	X Appendix 8-1 - Topsoil Stockpile Table
☐ ADD	X REPLACE	☐ REMOVE	X Appendix 8-1, Plate B
☐ ADD	X REPLACE	☐ REMOVE	X Plates 3-1, 3-7, 3-7A
☐ ADD	X REPLACE	☐ REMOVE	X Appendix 7-4 , Reclamation Hydrology , Pages 6 - the end of appendix
☐ ADD	X REPLACE	☐ REMOVE	X Chapter 7, Pages 7-63 through 7-67

February 9, 1998

APPLICATION FOR PERMIT PROCESSING

Permit Change ☐	New Permit ☐	Renewal ☐	Transfer ☐	Exploration ☐	Bond Release ☐	Permit Number: ACT/007/020

Title of Proposal: Abatement Plans for NOV N97-45-1-1, ACT 007/020/-97F-2

Mine: HORIZON

Permittee: HORIZON COAL

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	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? DO #
☐ 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? NOV # N97-45-1-1
☐ 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? (Modification of R2P2?)
☐ 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 _6_ 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.

Larry G Jones 2/9/98

Signed - Name - Position - Date

Subscribed and sworn to before me this 9th day of Feb., 19 98

Julie G. McKenzie

Notary Public

JULIE G MCKENZIE
NOTARY PUBLIC • STATE of UTAH
80 SOUTH MAIN #1600
SALT LAKE CITY, UT 84144
COMM. EXP. 5-23-2001

My Commission Expires: ____________, 19__

Attest: STATE OF ____________ }
COUNTY OF ____________

Received by Oil, Gas & Mining

RECEIVED
FEB 09 1998
DIV. OF OIL, GAS & MINING

ASSIGNED TRACKING NUMBER