0013

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

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October 16, 1997

To: File

Thru: Joe Helfrich, Permit Supervisor, Compliance JK for Joe Helfrich

From: Wm. J Malencik, Reclamation Specialist

RE: NOV 97-26-7-1, Horizon Coal Mine, Horizon Mine, ACT/007/020, Folder #5, Carbon County, Utah

Attached is a plan prepared by the operator with the assistance from Earthfax.

Since this is predominately a hydrology matter, it is only appropriate that Sharon review the plan.

I believe the channel as constructed will provide for the following:

(1) The establishment of a riparian area in the stream channel.

(2) Will provide the necessary interface between a three foot culvert outlet, UC-1 reconstructed channel, and finally the intertie into the county reconstructed channel.

In my opinion, it does not appear reasonable, in light of what took place with the recent storms, to reconstruct the channel to it's pre-flood design.

sd

SLC COPY

(B)

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

RECEIVED
OCT 13 1997
DIV. OF OIL, GAS & MINING

October 13, 1997

Mr. Bill Malensick
Utah Division of Oil, Gas & Mining
451 East 400 North
Price, UT 84501

Subject: Notice of Violation No. N97-26-7-1

Dear Bill,

The information attached is to address Notice of Violation No. N97-26-7-1, which was issued on August 21, 1997 by the Utah Division of Oil, Gas & Mining to Horizon Coal Corporation. The stated nature of the violation was "failure to receive Division of Oil, Gas & Mining approval before modifying an undisturbed diversion". It is our understanding that the NOV was issued for the channel downstream from culvert UC-1 at the Horizon Mine.

Pages 7-54, 7-64, 7-65, 7-66, and the cover of Plate 7-4 from the approved permit have been included for ease of review.

Revisions to Chapter 9 have been included to clarify the methods used to restore the riparian vegetation downstream from culvert UC-1.

Horizon Coal Corporation requests that Notice of Violation No. N97-26-7-1 be vacated in accordance with the attached information.

Sincerely,

Vicky S. Bailey
Permitting Consultant, EarthFax Engineering, Inc.

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

September 19, 1997

Mr. Bill Malensick
Utah Division of Oil, Gas & Mining
451 East 400 North
Price, UT 84501

Subject: Notice of Violation No. N97-26-7-1

Dear Bill,

The purpose of this letter is to address Notice of Violation No. N97-26-7-1, which was issued on August 21, 1997 by the Utah Division of Oil, Gas & Mining to Horizon Coal Corporation. The stated nature of the violation was "failure to receive Division of Oil, Gas & Mining approval before modifying an undisturbed diversion" (spelling corrected for clarity). It is our understanding that the NOV was issued for the channel downstream from culvert UC-1 at the Horizon Mine.

As you may be aware, Carbon County intended to realign their road downstream from the Horizon Mine disturbed area during the time that the surface facilities were being constructed at the mine. As part of this alignment, the County was intending to also realign Jewkes Creek downstream from the disturbed area to the point where it flows beneath the Consumers road.

The approved design for the channel downstream from culvert UC-1 is presented on page 7-54 of the Mining and Reclamation Plan. According to this design, an impact pool will be constructed immediately downstream from the culvert, transitioning into the approved base reclamation channel. The impact pool was designed with a minimum bottom width of 10 feet (see Plate 7-4), while the base reclamation channel was designed with a minimum bottom width of 8 feet (see Figure 7-12). Loose-rock check dams (Figure 7-12A) would eventually also be placed in the reclamation channel for the reasons outlined on page 7-65 of the Mining and Reclamation Plan.

At the time culvert UC-1 was installed, the County had not yet completed realignment of either the road or the creek. Construction of the base reclamation channel downstream from culvert UC-1 would, therefore, have resulted in an abrupt change in channel conditions at the downstream end of the reclamation channel until such time as the realigned county channel was constructed. Given the significant precipitation events which were occurring in the area at the time, such an abrupt change would likely cause significant channel erosion and was not

considered appropriate. Therefore, a small amount of temporary riprap was placed downstream from the culvert outlet to provide interim protection until the county channel was completed.

As soon as the County had completed realignment of the road and channel, the approved outlet channel was constructed downstream from UC-1. This constructed channel has a bottom width of 10 feet immediately downstream from the culvert outlet (i.e., in the area of the approved impact pool) and 9 to 10 feet downstream from the impact pool, thereby meeting or exceeding the minimum requirements of the approved plan. Riprap sizing and channel side slopes also meet or exceed the minimum requirements of the approved plan.

Hence, Horizon Coal Corporation did not modify an undisturbed diversion without UDOGM approval. The activity which had occurred downstream from the culvert outlet at the time of the NOV was approved and was completed to connect with the County's completed stream channel realignment. As soon as the County completed their work, the base channel of the diversion was constructed to meet the minimum requirements of the approved plan.

Horizon Coal Corporation therefore requests that Notice of Violation No. N97-26-7-1 be vacated.

Sincerely,

Vicky S. Bailey
Permitting Consultant, EarthFax Engineering, Inc.

Michael A. Gipson
Mine Manager, Horizon Coal Corporation

Culvert UC-2 will receive runoff from Portal Canyon. The 100-year, 6-hour peak flow for this culvert is 8.3 cfs. A 24-inch diameter culvert is planned to be installed at this location. This size is based on inlet control and a headwater to depth ratio of one or less. A trash rack will be installed on the inlet to this culvert, as indicated in Figure 7-8.

Culvert UC-3 will receive runoff from Jewkes Creek. The 100-year, 6-hour peak flow to this culvert is 19.6 cfs. This flow can adequately be handled by a 30-inch diameter culvert, based on inlet control and a headwater to depth ration of one or less.

Discharge at the outlet of culvert UC-1 will have an exit velocity of approximately 10.4 fps (see Appendix 7-4). This will be controlled by installing an outlet channel and impact pool. The outlet channel will have graded riprap on the bottom and along the sides of the channel for an approximate distance of 30 feet downstream from the culvert outlet to a transition to a compound channel with a riprapped low flow channel and vegetated flood plain, as proposed for the final reclamation channel (see Plates 7-4 & 7-6). The riprap in the outlet channel and the low flow channel will have a median diameter of 0.5 foot and will be placed at a thickness of 12 inches. The gradation of the riprap is presented in Table 7-6. A geotextile material will be installed beneath the outlet channel riprap as a filter blanket. A sand filter will be installed beneath the low flow channel riprap.

The outlet channel will act as an impact pool for flows from the culvert or emergency spillway. The impact pool will be created by the transition to the compound channel, due to the shallower depth of the low flow channel versus outlet channel. Under flow conditions, the water will fill the outlet channel and spill to the low flow channel until its capacity is exceeded and then spread out into the flood plain. This will ensure that low flows can be conveyed through the area, while high flows will spread over the flood plain. Additionally, the shallow depth of the low flow channel will ensure the capability of sub-irrigation and seepage into the surrounding flood plain.

By constructing these channels during operations, the area will not need to be disturbed again during reclamation. The riparian area will already be established around the channels and the area will be stabilized. If these channels are not included in the initial disturbance, then the area will be redisturbed upon reclamation.

Calculations contained in Appendix 7-4 indicate that the flow capacity of the unaltered Jewkes Creek upstream from culvert UC-3 is 27.7 cfs. The flow capacity of the unaltered Jewkes Creek downstream from culvert UC-1 is 38.7 cfs. Culverts UC-1 and UC-3 have design capacities of 59 cfs and 40 cfs, respectively. Hence, the capacities of these culverts exceed the capacity of Jewkes Creek in its unaltered state.

As indicated in Appendix 7-4, the capacity of the unaltered Portal Canyon Creek upstream from culvert UC-2 is 13.1 cfs. All of the downstream portion of this creek will be subject to the culverted diversion. Culvert UC-2 has a capacity of 22 cfs. Hence, the capacity of this culvert exceeds that of Portal Canyon Creek in its unaltered state.

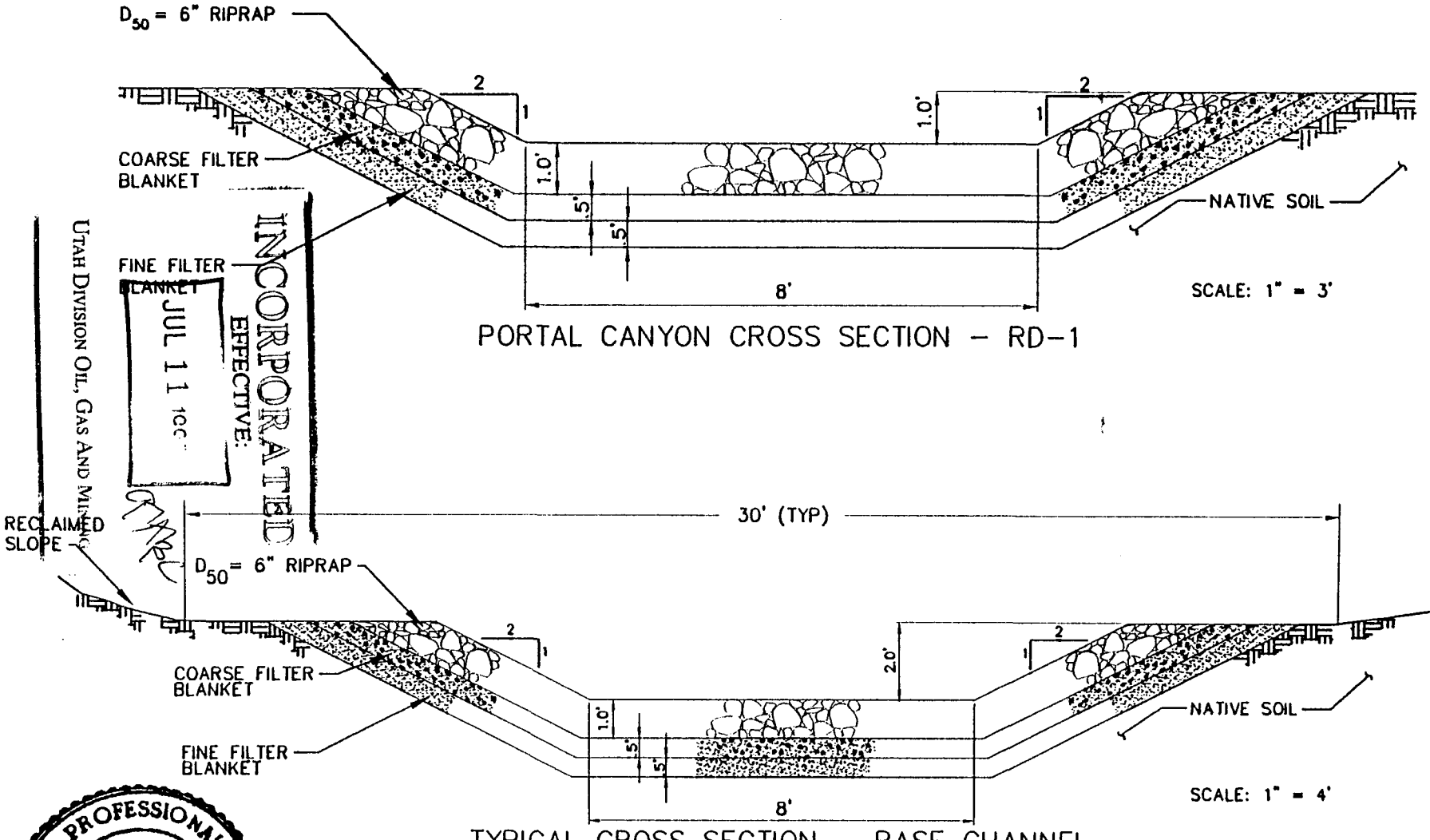

FIGURE 7-12. TYPICAL CROSS SECTIONS FOR RECLAIMED CHANNELS

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

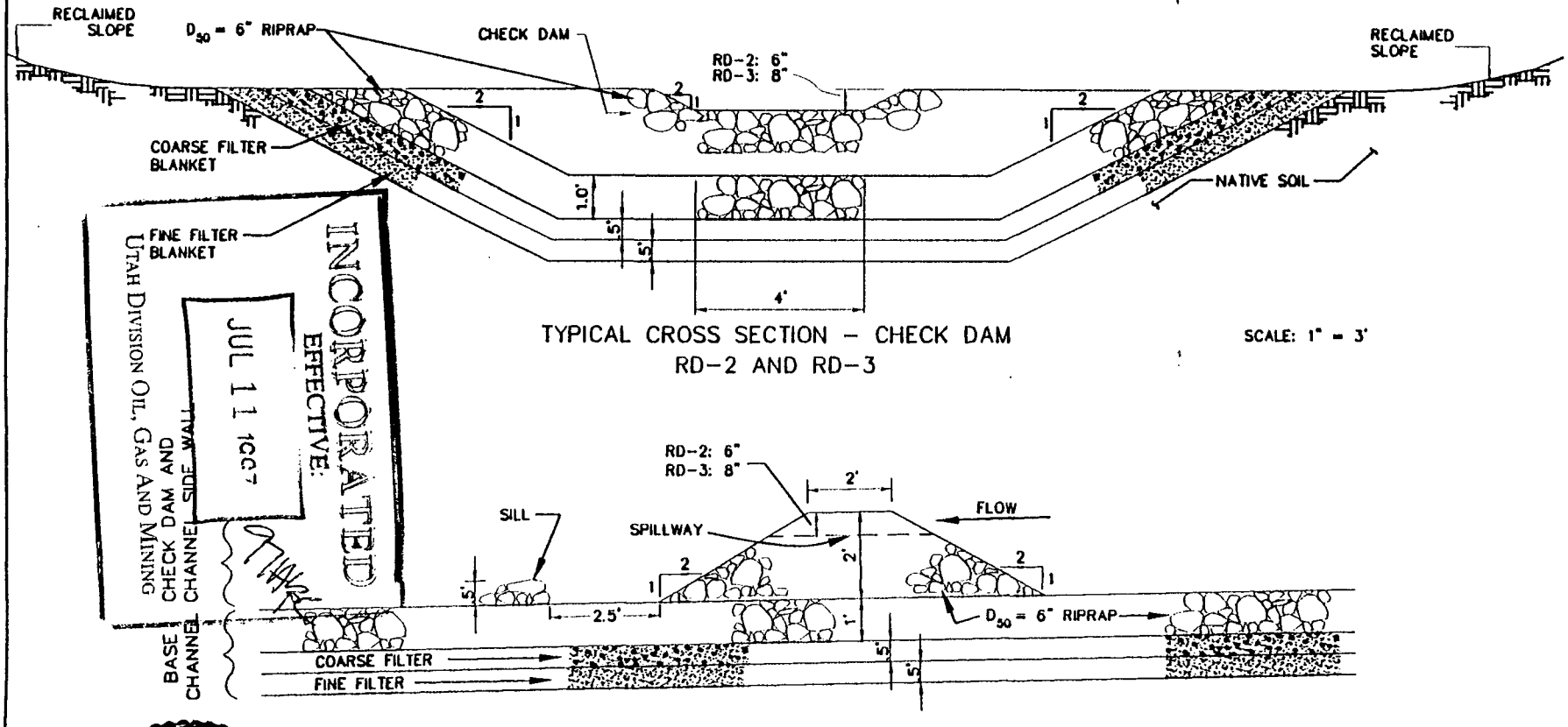

FIGURE 7-12A. TYPICAL CHECK DAM CROSS SECTIONS

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UTAH DIVISION OIL, GAS AND MINING

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JUL 28 1997
DIV. OF OIL, GAS & MINING

LICENSED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
7/23/97
STATE OF UTAH

0' 100' 200'
APPROXIMATE SCALE

REVISION	

PLATE 7-4

DRAINAGE DIVERSIONS

HORIZON No. 1 MINE

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

DRAWN BY: SWF	CHECKED BY: RBW DATE: 2-6-97
APPROVED BY: VSB	AUTOCAD FILE: PLT7-4.DWG

BOURQUIN MINERAL ENGINEERING
EarthFax Engineering, Inc.

During the summer of 1997 the Horizon Mine site received extensive precipitation, with several storm events testing the drainage capacity of the culverts within the disturbed area. Runoff from storms on August 4 and 5 blocked or bypassed culverts ranging in size from 18 - 48" within the disturbed and permit boundaries. During the storm events the riparian vegetation above and below the pad area was flattened by runoff and in some places uprooted and carried downstream. The damage to the area included extensive erosion, displacement of culverts, sediment control structures, and the cutting of new stream channels. To prevent additional erosion and damage to the area, a single channel (containing Jewkes Creek) was defined and constructed within the disturbed area boundary as described in Section 7.2.3.2.

The Jewkes Creek channel extends below the disturbed area boundary and joins the North Fork of Gordon Creek. The altered Jewkes Creek channel involves property owned by Hidden Splendor Resources and Carbon County and a commitment has been made to reestablish riparian vegetation in this area (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA). Horizon was requested by both parties to assist in the planting of riparian vegetation. Horizon agreed to provide labor, seed, and plants to complete the planting of the entire realigned channel (861 feet) both within (151 feet) and beyond (710 feet) the disturbed area boundary. The channel bottom width is 10 feet within the disturbed area boundary and varies between 6 and 10 feet below the disturbed area boundary. The channel area receiving riparian mitigation outside the disturbed area boundary is approximately 0.13 acre. The reseeded area within the disturbed boundary is 0.034 acre.

The channel was planted in 1997 with the Revegetation Seed Mix (Appendix 3-9) approved by the Division of Water Rights (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA). The reclamation riparian seed mix described in Section 3.5.5.2 will be planted in the reclamation channel during final reclamation within the disturbed area boundary.

An area approximately 40' x 60' (0.055 acre) of preconstruction riparian vegetation below the sediment pond on the east side of Jewkes Creek was left as a mitigation requirement of UDOGM. The area is fenced and receives the annual precipitation for the area. However, due to the alteration of Jewkes Creek, the area receives no water from the creek. The planting of riparian vegetation in the altered Jewkes Creek channel outside the disturbed area should compensate for this area in addition to the area (0.068 acre) planned for disturbance in the extension of Culvert UC-3. At the request of UDOGM and the Division of Wildlife Resources and to satisfy mitigation requirements a wetland (approximately 1.5 acres) owned by the Division of Wildlife Resources was fenced by Horizon in Coal Canyon one mile to the west of the mine site.

A threatened and endangered vegetation study of the permit area was done the week of August 21, 1995 by Patrick Collins of Mt. Nebo Scientific.

9.4.1.3 Moderately Disturbed Areas

Some of the areas have had considerable disturbance to the vegetation and the top few inches of soil, but have had relatively little deep, subsurface disturbance. These areas are presently

October 13, 1997

ABATEMENT PLAN

The channel at the outlet of UC-1 was impacted during two consecutive storm event in August of 1997. Due to these impacts a reconstruction of the channel was necessary. According to the Horizon approved permit two options were available to accomplish the reconstruction. For clarification purposes, the flow from the outlet of UC-1 is undisturbed drainage; UC-1 merely provides a bypass through the disturbed area for the flow of Jewkes Creek.

The first option was constructed and in place prior to the August storm events, however the flow was uncontrolled and caused damage and erosion to the properties below the outlet. Reconstruction of the identical channel (Appendix 7-4, page 16) would provide results which Horizon, the Division of Water Rights and Hidden Splendor Resources (landowner) consider inadvisable due to the experiences of 1997.

Description of Diversion after the Storm Events

- 36" culvert containing flow
- Area above culvert 100' wide
- Diversion below culvert 4' wide
- Culvert discharge resulted in an uncontrolled flooding verses a controlled flood that spread out the runoff in a controlled manner
- The diversion constructed by the county controlled the runoff except for the road culvert
- The operator constructed the current diversion to exceed the final reclamation diversion design.

The second option was constructed using the base channel as described in Appendix 7-4, Determination of Peak Flows for Reclaimed Drainages, page 13 and etc (attached). The construction provided a more controlled permanent channel for the flow of Jewkes Creek to the North Fork of Gordon Creek.

The Jewkes Creek channel lies both within (151 feet) and beyond (710 feet) the disturbed area boundary and joins the North Fork of Gordon Creek. The altered Jewkes Creek channel (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA) involves property owned by Hidden Splendor Resources and Carbon County. A commitment has been made to the Division of Water Rights to reestablish riparian vegetation in the channel. Horizon was requested by both parties to assist in the planting and eventual establishment of riparian vegetation. Horizon volunteered to provide labor, seed, and plants to complete the planting of the entire realigned channel (861 feet). The channel area receiving riparian mitigation outside the disturbed area boundary is approximately 0.16 acre and 0.034 acre within the disturbed area boundary. The second option furnished a better environment for the restoration of a riparian area, providing a confined area to catch stream flow and a defined area for planting. This option would provide the opportunity to plant riparian vegetation presently and allow the establishment of mature communities during the operation of the mine.

An area approximately 40' x 60' (0.055 acre) of preconstruction riparian vegetation below the sediment pond on the east side of Jewkes Creek was left as a mitigation requirement of UDOGM. The area is fenced and receives the annual precipitation for the area. However, due to the alteration of Jewkes Creek, the area receives no water from the creek. The operator does not have water rights to Jewkes Creek therefore water cannot be diverted from the creek to water this riparian vegetation. The planting of riparian vegetation in the altered Jewkes Creek channel outside the disturbed area should compensate for this bypassed area.

A summary of the advantages associated with the second option follow:

- Extended area for the deposit of sediment
- Less potential for erosion, thus less sediment load in the North Fork of Gordon Creek
- Establishment of riparian environment prior to reclamation
- Control of Jewkes Creek flow during spring runoff and storm events
- Prevention of damage to property not owned or controlled by the mine

Horizon has observed the sediment in Jewkes Creek is sufficient to constitute a soil base for the planting of willows and grasses along the edges and banks of the channel during 1997. These plantings would serve to stabilize the banks, to recreate a riparian environment in the channel, and provide additional opportunity for the restoration of riparian vegetation during the operational life of the mine. Horizon also commits to place supplemental riprap as needed for bank protection.

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, & 2FT 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 4FT, 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 NOW, 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

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} = 0.5FT
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)

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 pg 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 pg 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 condition)
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 pg 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	ft^2
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.		

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	ft^2
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.		