0023

CASTLE GATE
COAL COMPANY

RECEIVED
JUN 25 1986
DIVISION OF
OIL, GAS & MINING

June 24, 1986

Mr. Lowell Braxton
Administrator
Division of Oil, Gas and Mining
Three Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Dear Mr. Braxton:

Castle Gate Coal Company proposes to modify the drainage plan as submitted by Price River Coal Company and approved by your office on April 21, 1986. The location of the requested change is the conveyor loadout area in Hardscabble Canyon.

The revised Exhibit 3.3-4a and 3.3-10A shows the elimination of Culvert C-3, the 18" Dia C.M.P. split in half and diversion 3a. Castle Gate Coal Company will be reclaiming the truck load-out area earlier than expected because of increased production requests. Abandonment and reclamation of this area is expected to start in Spring of 1987. Therefore, long term solutions to the drainage in this area are not necessary.

Specific justification for elimination for each structure is as follows:

1. Culvert C-3: The existing culvert C-3 is approved and adequately handles existing runoff. Castle Gate Coal Comany will backfill, seed and mulch the existing Culvert C-3 as shown on the revised Figure 3.3-9(a). This will ensure the stablity of the pipe and make the proposed 36" C-3 relocation unnecessary.

2. Diversion 3A. Diversion 3A is unnecessary in that the small undisturbed area HC3A or drainage will flow into the coal loadout area. Table 3.3-5(D) shows that the total runoff from this small area is negligible. This small volume of water will be easily contained in the loadout area. The loadout area is low and does not drain out. In the event that some drainage from the loadout area would take place, the drainage would flow in to pond 007. Table 3.3-4 page 3-146 of the MRP shows that the ponds have a combined excess capacity of 6,200 cubic feet, which is more than enough

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P. O. Box 449 • Helper, Utah 84526 • 801/472-5523

capacity for this negligible amount. Page 3-139 of the MRP shows that current 24" cmp outlets at pond 007 will flow at 26 cfs. The current required amount is 17 cfs, therefore the extra peak discharge of 1 cfs can easily be handled.

All other drainage control as proposed by Price River Coal Company will be installed as shown on the Proposed Drainage Modification for Hardscabble Canyon dated March 12, 1986.

If you have any further questions about this request, please do not hesitate to call me at our Helper City office.

Sincerely,

Richard H. Allison Jr.

Richard H. Allison, Jr., P.E.
Project Supervisor

RHA:sk

Enclosures

cc: Dennis Bryant

cc4.015

PRICE RIVER COAL COMPANY
P.O. BOX 629 HELPER, UTAH 84526 (801) 472-3411

RECEIVED
MAR 18 1986
DIVISION OF
OIL, GAS & MINING

March 12, 1986

Dr. Dianne R. Nielson, Director
DIVISION OF OIL, GAS AND MINING
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Re: Proposed Drainage Control Modifications
Hardscrabble Canyon, Carbon County, Utah

Dear Dr. Nielson:

The following responses are submitted to address the comments contained in Mr. D. Wayne Hedberg's letter of February 19, 1986 pertaining to the proposed drainage control modifications at our facilities in Hardscrabble Canyon near Helper.

COMMENT 1: Comment #2 made by the Division in the December 30, 1985, deficiency letter required that the plan view of diversion D-6 on Exhibit 3.3-11 be correlated and referenced to a topographic map depicting all diversion structures. The applicant must delineate the locations of the cross-sections on Exhibit 3.3-11 on Exhibit 3.3-4a.

RESPONSE: Exhibit 3.3-4(A) has been revised to show the requested information.

COMMENT 2: Comment #5 made by the Division in the December 30, 1985 deficiency letter required that the proposal must contain designs for the channel to replace culvert C-3. The applicant has stated that a small diversion, D-3A, will replace culvert C-3. The proposal states that the diversion will be excavated into rock. An on site visit performed by the Division on January 15, 1986 indicated that the location for diversion D-3A is not in rock but rather on an unstable slope. Therefore, complete designs for stabilizing the fill prior to the excavation of diversion D-3A are required. Additionally, Table 3.3-5(D) includes a Mannings "n" value of 0.045. Since the diversion will have to be excavated in stabilized fill a Mannings "n" value that is representative of a riprapped lined channel must be used to compute the velocity during the design event.

RESPONSE: Due to the unstable nature of the existing slope, it is proposed to stabilize the slope by placing additional fill against the slope. The outslope of the new fill will be sloped at 2H:1V. The proposed diversion D-3A will be constructed on top of the fill. Diversion D-3A will be lined with a half round culvert consisting of an 18-inch diameter CMP split in half. Figure 3.3-9(A) and Exhibit 3.3-10(A) have been revised to show the proposed modifications. Table 3.3-5(D) has been revised and contains a rating of the proposed diversion lined with the half round culvert.

COMMENT 3: Comment #6 made by the Division in the December 30, 1985 deficiency letter requested channel stability measures for the reclaimed section of diversion D-5 in the vicinity of culvert C-2 after removal. Table 3.3-5(C) indicates that the design discharge will flow with a velocity of approximately 9.8 feet/second. Therefore, plans for a channel lining to minimize erosion at the design discharge must be submitted. Additionally, Table 3.3-5(C) includes a Mannings "n" value of 0.045. A Mannings "n" value that corresponds to the D50 rip rap size must be used for computation of velocity at the design event. Figure 3.3-11(A) must be revised to incorporate the channel lining design to be used.

RESPONSE: Due to the inter-relationship of Manning's "n", flow velocity and riprap size, the design of riprap linings is an iterative process. The process consists of computing a flow velocity based upon an assumed "n" value, determine the riprap size necessary to protect the channel at the computed flow velocity, calculate a new "n" value based on the riprap size selected, and if the new "n" value is appreciably different from the assumed value, recompute the velocity and riprap size. An empirical equation relating Manning's "n" and riprap size is presented in Applied Hydrology and Sedimentology of Disturbed Areas, Barfield, Warner and Haan, 1981. Equation 3.34 is n =0.0395xD50**0.1666, where D50 is the median riprap size. The above method and equation in conjunction with Figure 7-9(A), contained in the January 16, 1986 submittal, were used to design the riprap lining. Table 3.3-5(C) has been revised using an "n" value of 0.040. The computed flow velocity indicates a median riprap size of 1 foot is required. Figure 3.3-11(A) has been revised to show the proposed riprap lining. Section 3.3-3(1)B has been revised to reflect the above design modifications.

COMMENT 4: Comment #9 made by the Division in the December 30, 1985 deficiency letter required designs to demonstrate that each proposed channel will be stable at the design flows. The applicant must submit channel lining designs for diversions D-2, D-3, D-3A, D-5 and D-6. A Mannings "n" value that is representative of the riprap size to be used must be used for velocity computations. All figures of diversion cross-sections must be drawn to scale and revised to incorporate channel lining designs. Additionally, the applicant must commit to placing rip rap on all sections of diversion D-6 that are not excavated in bedrock.

RESPONSE: Since the purpose of this and previous submittals was to satisfy in part Condition #2 placed on the approved MRP, design information is being submitted for structures directly affected by modifications necessary to meet Condition #2. This information includes channel lining designs for diversion D-2 below the proposed culvert C-3 outlet and D-5 in the vicinity of culvert C-2. The other information requested was deemed unnecessary pursuant to a telephone conversation with Mr. David J. Cline on March 6, 1986.

Table 3.3-5(A) and Figure 3.3-8(A) have been revised to contain the requested information for diversion D-2 below the outlet of culvert C-3.

The requested information for diversions D-3A and D-5 have been presented in the responses to Comments 2 and 3 above, respectively.

Figure 3.3-12(A) has been revised to show the proposed riprap lining of diversion D-6. Section 3.3-3(1)B has been revised to commit to placing riprap on all sections of diversion D-6 that are not excavated in bedrock.

COMMENT 5: Exhibit 3.3-4a depicts diversion D-3 as extending only to within 300 feet of the Number 4 Mine Portal. The applicant must clarify how diversion D-3 collects runoff from the portion of sub-watershed HC-3 that is located upstream of the head of the diversion.

RESPONSE: Diversion D-3 actually extends to the head of the canyon near the No.4 mine portal and collects the runoff from all of sub-area HC-3. The actual extent of D-3 is show on Exhibit 3.3-2(A) in the approved MRP. Exhibit 3.3-4A has been revised to show the actual extent of diversion D-3.

COMMENT 6: Section 3.3-3(1)B states that diversion D-2 was constructed in rock. An on site visit performed by the Division on January 15, 1986 indicated that diversion D-2 is not constructed in rock but rather a valley fill material. The slope of diversion D-2, as determined from Exhibit 3.3-4a is 26% rather than the 10% which was used on Table 3.3-5(A). The design of diversion D-2 must be modified to reflect the unstable nature of the material, the correct slope, and a Manning's "n" value that corresponds to the size of rip rap to be used as a channel lining.

RESPONSE: As stated in the response to Comment 4 above, a channel lining design for D-2 is being submitted for the reach of channel downstream of the outlet from culvert C-3. Actual field survey data indicates that the slope of the D-2 channel below C-3 varies from 13% to 17%. The maximum slope of 17% was used in the channel lining design. A Manning's "n" value of 0.045 was used in the rating presented in Table 3.3-5(A). This resulted in a computed velocity of approximately 11.7 feet/second. Figure 7-9(A) indicates that 18-inch stone riprap will withstand that velocity. The "n" value computed using a D50 of 1.5 feet is 0.042 which was judged to be close enough to the assumed value for design purposes. As stated above, Table 3.3-5(A) and Figure 3.3-8(A) have been revised to contain the design information for the channel lining. Section 3.3-3(1)B has been revised to contain a description of the riprap lining.

In addition to the above comments, Mr. Hedberg's letter contained a copy of a letter from Mr. Allen D. Klein of the Office of Surface Mining. In a telephone conversation with Mr. David J. Cline on March 6, 1986, Mr. Cline stated that OSM's comments had been satisfied and no further response to their concerns was necessary.

We hope the above responses and attached information satisfy your agency's concerns regarding the proposed permit modifications. If there are any questions regarding the information being submitted, please contact me at 801-472-3411 or Richard Allison at 801-472-5523. Thank you for your prompt consideration of the proposed modifications.

Sincerely,
Price River Coal Company

Kenneth B. Hutchinson
Chief Engineer

KBH:jwb
Attachments

PRICE RIVER COAL COMPANY
P.O. BOX 629 HELPER, UTAH 84526 (801) 472-3411

RECEIVED
NOV 14 1985
DIVISION OF OIL
GAS & MINING

November 14, 1985

HAND DELIVERED

Dr. Dianne R. Nielson, Director
DIVISION OF OIL, GAS AND MINING
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Re: Special Conditions for Permit No. UT-0007

Dear Dr. Nielson:

Pursuant to Mr. L.P. Braxton's letter of November 6, 1985, the proposed modifications to the drainage control plan for our facilities in Hardscrabble Canyon have been reevaluated using an SCS Type II rainfall distribution. Since the hydraulic designs in the original permit were based upon the 10-year, 24-hour storm event, the reevaluation was conducted using this same frequency storm.

The attached revisions are intended to replace our submittal of October 31, 1985. The only items from the original submittal that must be incorporated into the revisions are Table 7-13(A) and Exhibit 3.3-12. The remainder of the text, figures, tables and exhibits have been revised and should be replaced with the corresponding attached item.

If there are any questions regarding the submittal, please contact me at (801) 472-3411. Your prompt attention to this matter is appreciated.

Sincerely,

PRICE RIVER COAL COMPANY

Kenneth B. Hutchinson
Chief Engineer

KBH:jb

Attachments

PRICE RIVER COAL COMPANY
P.O. BOX 629 HELPER, UTAH 84526 (801) 472-3411

RECEIVED
JAN 16 1986
DIVISION OF OIL
GAS & MINING

January 16,1986

HAND DELIVERED

Dr. Dianne R. Nielson, Director
DIVISION OF OIL, GAS AND MINING
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Re: Proposed Drainage Control Modifications
Hardscrabble Canyon, Carbon County, Utah

Dear Dr. Nielson:

The following responses are submitted to address the comments contained in Mr. David J. Cline's letter of December 30, 1985 pertaining to the proposed drainage control modifications at our facilities in Hardscrabble Canyon near Helper.

1 COMMENT: Price River Coal Company must also submit designs for culverts 3 and 10 in Sowbelly Gulch in order to meet the requirements of Condition #2.

RESPONSE: Information pertaining to culverts 3 and 10 in Sowbelly Gulch was previously presented in PRCC's letter dated February 25, 1985 to Mr. Mark Humphrey with the OSM. That letter was submitted to address, in part, Condition #2. The presently proposed modifications are confined to the facilities located in Hardscrabble Canyon. Pursuant to a telephone conversation with Mr. Rick Summers on January 7, 1986, the culverts in Sowbelly Gulch need not be addressed in this submittal.

2 COMMENT: The proposal must contain a map of all diversion structures being modified or being affected by the modifications of diversions. The map should clearly depict the topography of the area and all diversions should be labeled and referenced to in the text. Additionally, the plan view of diversion D-6 on Exhibit 3.3-11 must be correlated and referenced to this map. not on map not done

RESPONSE: The requested information is presented on attached Exhibit 3.3-4a. Section 3.3-3(1)B paragraph four has been revised to reference the exhibit and describe the segment of diversion D-6 which will be modified.

not done not done

3 COMMENT: The proposal must contain a watershed map that clearly delineates each sub-watershed in Hardscrabble Canyon. The map must depict each area draining to each diversion or structure, the controls (i.e.,topographic, berms, etc.) that delineate the area, disturbed and undisturbed areas, the location of each diversion, and be of sufficient topographic scale to determine elevation change and hydraulic length. verbal to submit

RESPONSE: The watershed boundaries and topographic information requested are presented on attached Exhibit 7.3(A). Revised Tables 3.3-5 and 3.3-6 show contributory watersheds draining to each diversion or structure.

4 COMMENT: The curve number for each sub-watershed must be justified. The November 14, 1985 submittal states that the curve numbers were developed using the methods outlined in the National Engineering Handbook, Section 4 - Hydrology (Soil Conservation Service 1972). However, the variation in curve numbers for each sub-watershed is unclear and the input parameters for each sub-watershed should be presented (i.e., soil type, ground cover type, and ground cover density).

RESPONSE: The requested information pertaining to soil type, ground cover type, and ground cover density were presented in the October 31, 1985 submittal. Pursuant to a telephone conversation with Mr. Rick Summers on January 7, 1986, the previously submitted information was determined to be adequate.

5 COMMENT: The proposal must contain designs for the channel proposed to replace culvert C-3. The design must demonstrate the capacity to convey the runoff from the contributing watershed for a 10-year, 24-hour precipitation event.

RESPONSE: Attached Table 3.3-5(D) contains a peak discharge determination for the contributing watershed as well as a rating of the proposed ditch channel. A typical cross-section of the proposed diversion channel is presented in Attached Figure 3.3-9(A). Section 3.3-3(1)B has been revised to contain a description of the proposed diversion.

6 COMMENT: The proposal must contain designs for the reclamation of the channel in the vicinity of culvert C-2 after removal. These designs must include expected peak flow values, velocities and designs for channel stability measures.

RESPONSE: At the present time, it is proposed to remove culvert C-2 and reshape the channel to conform to the existing stream channel geometry upstream and downstream of the culvert. Final reclamation of the channel is not proposed at this time since areas adjacant to the diversion channel will still be required for continuing operations in the area. Upon completion of mining activities in the area, final reclamation of the channel will be accomplished according to the approved reclamation plan in the original MRP. Section 3.3-3(1)B has been revised to contain a description of the proposed modification.

7 COMMENT: The proposal must contain exit velocities and designs for energy dissipators for culverts C-1, C-2, C-4, C-5, and the replacement culvert for C-3.

RESPONSE: Section 3.3-3(1)C has been revised to contain the requested information for culverts C-1, C-3 and C-4. Since culvert C-2 will be removed and not replaced, and no modifications are proposed to C-5 the comment does not apply to these two culverts.

8 COMMENT: The proposal must contain designs for the inlet conditions present at the replacement culvert for C-3. Because the inlet of this culvert is located at an approximate 90 degree angle from the direction of flow in diversion D-3, designs for the inlet conditions will be required to determine the potential for erosion in this area and the adequacy of the culvert to pass the design flow.

RESPONSE: The culvert inlet will be provided with a metal end section and the ditch channel will be enlarged around the inlet to form a stilling basin as noted on Exhibit 3.3-10(A). The berm which will form the stilling basin will be constructed of compacted rock material excavated during installation of the culvert.

The berm will tie into the hillside on the right side and be extended upstream along the diversion channel to provide a minimum of 5 feet of headwater depth. The upstream slope of the berm will be riprapped with 12 inch stone. Attached Figure 7-9(A) indicates that 12 inch stone riprap on a 2H:1V slope can resist displacement by a velocity of approximately 10.5 feet/second. The combination stilling basin and riprap armor is judged to be sufficient to prevent erosion and provide the required headwater at the culvert inlet.

COMMENT: The proposal must contain designs to demonstrate that each proposed channel will be stable at the design flow. Due to the large peak flow expected for diversion D-6 (368 cfs), a filter blanket will be required for the riprap design.

BULL SHIT

RESPONSE: Proposed diversion D-3A will be excavated into rock with a typical cross-section as shown in Fig. 3.3-9(A). The design rating indicates a peak velocity of about 3.4 feet/second. The design velocity is well below the permissible velocity for channels constructed in rock. Existing diversion D-6 was constructed in rock. The right side slope, bottom and varying heights of the left side slope are composed of intact rock material. The confining berm which composes the upper portion of the left side slope is constructed of compacted unconsolidated material. The proposed modifications to D-6 will be to place additional compacted fill material on the existing berm along a portion of the diversion channel. The HEC-2 computer run for D-6 indicates that channel velocities (parameter VCH in Summary Printout Table 150) in the reach to be modified are in the range of 8.6 to 10.5 feet/second. Attached Fig. 7-9(A) indicates that 12 inch stone riprap placed on a 2H:1V slope can withstand those velocities. The need for a filter blanket beneath the riprap is debatable. Within 15 days of the completion of the confining berm and prior to placement of the riprap, PRCC will contact the Division of Oil, Gas and Mining and after an on-site investigation and consultation with UDOGM the need for a filter blanket or filter fabric will be determined. Section 3.3-3(1)B has been revised to contain this information.

PROBABLY BULL SHIT

COMMENT: Discrepancies exist between Table 7-13A and Table 7-14A concerning the size of the sub-watersheds. These discrepancies must be clarified.

RESPONSE: The watershed areas contained in Table 7-13(A) are the areas determined for each of the individual watersheds. As discussed in Section 7.2-2(5)(A) a few of the watersheds were combined for computational expediency (Ex. sub-areas HC-6, HC-7 & HC-8). The watershed areas shown in Table 7-14(A) are the combined areas of the individual sub-watersheds. The confusion resulted from the output HYDGRAPH file naming convention used by the HYDRO program. A note has been added to Page 1 of Table 7-14(A) to clarify the data in the table. Identification of the watersheds are contained in the Watershed Analysis Table following the Project Summary Table in Table 7-14(A).

COMMENT: The HEC-2 computer output presented in the November 14, 1985 submittal must be clearly labelled and all computer code designations must be defined. A narrative of the conclusions drawn from the computer run must be included in the submittal.

RESPONSE: The attached cover sheet for the HEC-2 computer run contains the table number and identifies the contents of the table. The cover sheet should be inserted immediately preceeding the HEC-2 output. Definitions of the code designations used in the HEC-2 program are presented in Appendices VI and VII contained in HEC-2 Water Surface Profiles Users Manual, U.S. Army Corps of Engineers September 1982. A copy of the users manual will be provided for your reference, if requested. The narrative description of the conclusions drawn from the HEC-2 run contained in Section 3.3-3(1)B have been expanded.

12 COMMENT: Paragraph 1 Section 3.3-3(1) states that culvert C-1 has been evaluated and is adequate to pass the 10-year, 24-hour storm. However, paragraph 4 in the same section states that culvert C-1 is not adequate to pass the additional flow from the relocation of culvert C-3. This discrepancy must be clarified.

RESPONSE: Section 3.3-3(1)C has been revised by removing paragraph 1 and rewording paragraphs 2 and 3.

13 COMMENT: Upon final approval of the designs, the applicant will need to update the MRP (including all applicable maps of Hardscrabble Canyon) to reflect the changes in the drainage plan and site layout.

RESPONSE: The MRP will be updated after approval of the proposed minor modifications.

The text of the November 14, 1985 submittal has been revised. The original text should be replaced with the revised text attached. Also included are revised Tables 7-13(A) and 7-14(A)(Page 1). Tables 3.3-5 and 3.3-6 have been revised to reflect the changes in watersheds draining to the diversions and culverts. These tables replace the corresponding tables in the original MRP. New information to address comments in Mr. Cline's letter include: Tables 3.3-5(C) and 3.3-5(D); Figures 3.3-9(A), 3.3-11(A) and 7-9(A); and a cover sheet for Table 7-15(A). This information should be incorporated into the submittal in numerical order.

We hope the above responses and attached information satisfy your agency's concerns regarding the proposed permit modifications. If there are any questions regarding the information being submitted, please contact me at 801-472-3411 or James Buck at 317-266-2673. Thank you for your prompt consideration of the proposed modifications.

Sincerely,
Price River Coal Company

KBHutchinson

Kenneth B. Hutchinson
Chief Engineer

KBH:jwb
Attachments

3.3-3 (1) B DIVERSION DITCHES (ADDENDUM) (Revised 3/12/86)

Condition No. 2 to the MRP required the redesign of diversions D-1, D-4 and D-6. The reclamation of the Goose Island area was completed in November 1984. Diversion D-1 was eliminated by the reclamation and subsequent reconstruction of the main stream channel through the Goose Island area. The elimination of diversion D-1 also significantly reduced the watershed area contributing flow to D-4. The former watershed area was approximately 540 acres while the present area is about 3.5 acres. This information was previously presented in PRCC's letter dated February 25, 1985 to Mr. Mark Humphrey with the OSM. This letter was submitted to address, in part, Condition No. 2.

In this letter, PRCC also proposed to reconstruct D-6 from the warehouse storage yard to downstream of Pond 009 to the design specifications submitted for reclamation channel RC-5. Reclamation channel RC-5 was designed for the peak flow resulting from a 100-year, 24-hour storm event. Operational changes being considered for the Hardscrabble Canyon facilities would make the reconstruction of D-6 to the specifications of RC-5 unworkable. At the present time, it is being considered to continue to utilize the Hardscrabble Canyon facilities for approximately 15 to 20 years. With this operational change in mind, it is proposed to modify the existing diversion D-6 to convey the peak discharge resulting from a 10-year, 24-hour storm event.

The existing diversion D-6 was modeled using the U.S. Army Corps of Engineers HEC-2 Water Surface Profile computer program. The modeling was completed for a reach of approximately 2550 feet of the diversion commencing just upstream of pond 009 and terminating just downstream of culvert 5 near the upper bath house. See Exhibit 3.3-4a for the location of the referenced strutures. The peak discharge resulting from the 10-year, 24-hour storm is 368 cfs. The peak discharge determination is presented in the Addendum to Chapter VII contained in this submittal. The water surface profile for the design storm is presented in Exhibit 3.3-11 contained in this submittal. Stream channel cross-sections of the existing diversion used in the computer model are presented in Exhibit 3.3-12. The purpose of the HEC-2 modeling was to determine if the confining berm was adequate to contain the design discharge.

The results of the flood routing indicate that the confining berm along a portion of the diversion channel is too low to contain the design discharge. To contain the design discharge and provide the necessary 0.3 feet freeboard, the berm will need to be raised a minimum of 0.3 feet at cross-section 0+00 and a maximum of 2.45 feet at cross-section 4+00. The total length of berm that must be raised is approximately 1160 feet from near cross-section 0+00 to about cross-section 11+60. See exhibit 3.3-4a for the locations of the referenced cross-sections. The HEC-2 computer run indicates that the channel velocities in the reach to be modified are in the range of 8.6 to 10.5 feet/second.

A typical cross-section of the diversion channel and berm depicting the raising of the berm is presented in Figure 3.3-12(A). The additional fill material will be compacted and the left channel side slope protected with riprap. Existing diversion D-6 was constructed in rock. The right side slope, bottom and varying heights of the left side slope are composed of intact rock. Figure 7-9(A) indicates that 12-inch stone riprap placed on a 2H:1V slope can withstand the velocities predicted by the HEC-2 model. Within 15 days of the completion of the raising of the confining berm and prior to placement of the riprap, PRCC will contact the UDOGM and after an on-site investigation and consultation with the

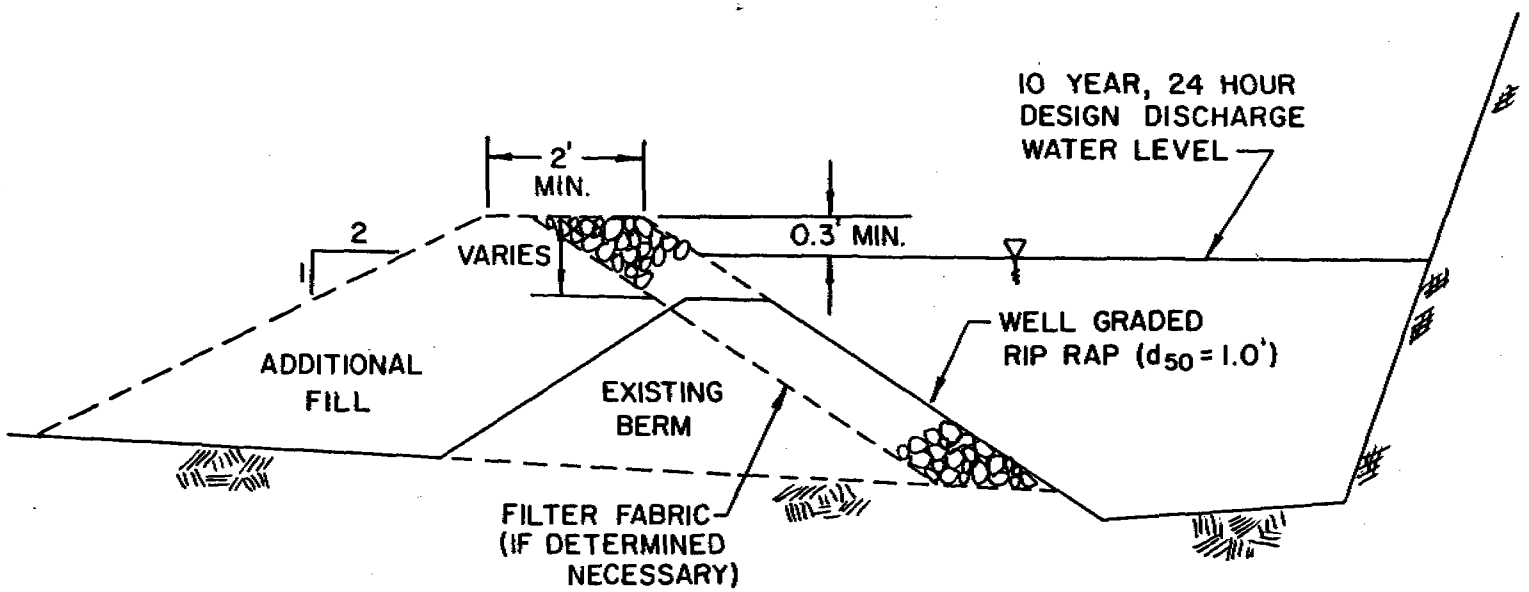
UDOGM the need for a filter blanket or filter fabric will be determined. PRCC will place riprap on all sections of D-6 that are not constructed in intact bedrock.

The proposed replacement of culvert C-3 discussed in Section 3.3-3 (1) C will increase the flow to diversion D-2. The adequacy of D-2 to convey the additional flow was evaluated. Attached Table 3.3-5(A) contains the results of the rating of a typical cross-section of D-2 downstream of the proposed culvert. The rating shows the design discharge will flow at a depth of approximately 1.1 ft. The existing channel has a minimum depth of 2.3 ft and is therefore adequate for the 10-year, 24-hour design discharge of 69 cfs. The rating of D-2 indicates a flo velocity of about 11.7 fps. Figure 7-9(A) indicates that 18-inch riprap will withstand the computed flow velocity. Figure 3.3-8(A) contains a typical cross-section of diversion D-2 below the outlet of C-3 showing the proposed riprap lining. Within 15 days prior to the placement of the riprap, PRCC will contact the UDOGM and after an on-site investigation and consultation with UDOGM, the need for a filter blanket or filter fabric under the riprap will be determined.

The replacement of C-3 will also require the installation of a small diversion, D-3A, to convey the runoff from undisturbed area HC-3A to the main diversion. The location of proposed diversion D-3A is shown on Exhibit 3.3-4a. A typical cross-section of the proposed D-3A diversion channel is presented in Figure 3.3-9(A). Table 3.3-5(D) contains a HYDRO peak discharge determination for the contributing watershed, HC-3A, as well as a rating of the proposed ditch channel. Due to the unstable nature of the existing slope, it is proposed to stabilize the slope by placing additional fill against the slope. The outslope of the new fill will be placed at a 2H:1V slope. The proposed diversion D-3A will be constructed on top of the fill. Diversion D-3A will be lined with a half round culvert consisting of an 18-inch diameter CMP split in half. The discharge rating indicates that the design discharge will flow at a depth of about 0.25 feet and at a velocity of approximately 5.0 fps.

The removal of culvert C-2 discussed in Section 3.3-3(1)C will require reshaping the channel in the vicinity of the removed culvert. It is proposed to reshape the channel to conform to the existing stream channel geometry upstream and downstream of the culvert. Final reclamation of the channel is not proposed at this time since areas adjacant to the diversion channel will still be required for continuing operations in the area. Upon completion of mining activities in the area, final reclamation of the channel will be accomplished according to the reclamation plan in 3.3-4. Table 3.3-5(C) contains a rating of the proposed channel configuration after removal of culvert C-2. The rating indicates the design discharge of 270 cfs will flow at a depth of about 2.1 feet and a velocity of about 10.7 feet/second. Figure 7-9(A) indicates that 1 foot stone riprap can withstand the computed velocity. A typical cross-section of the proposed channel geometry and riprap lining is shown in Figure 3.3-11(A). Within 15 days prior to the placement of the riprap, PRCC will contact the UDOGM and after an on-site investigation and consultation with UDOGM the need for a filter blanket or filter fabric under the riprap will be determined.

PRICE RIVER COAL COMPANY
AMERICAN ELECTRIC POWER
SERVICE CORPORATION
HELPER, UTAH



TYPICAL CROSS-SECTION
MODIFICATIONS
OF
DIVERSION D-6
1" = 2.5' HORZ. & VERT.

FIGURE 3.3-12(A)
(REVISED - 3-11-86)

TABLE 3.3-5 (REVISED 1/16/86)

DIVERSIONS

STRUCTURE NUMBER	CONTRIBUTORY WATERSHEDS	TOTAL DRAINAGE AREA	DESIGN DISCHARGE 10 YR.,24 HR STORM
D-1 (RECLAIMED)	-	-	-
D-2	HC-9 & HC-3	73.4 AC.	69 CFS
D-3	HC-3	60.7 AC.	51 CFS
D-3A	HC-3A	1.8 AC.	1.5 CFS
D-4	HC-9A	3.5 AC.	4.9 CFS
D-5	HC-2,3,4,5,6, 7,8,9,14	712.7 AC.	296 CFS
D-6	HC-1,2,3,4,5, 6,7,8,9,11, 14,16,17	911.7 AC.	368 CFS
D-7	HC-1 & 17	126.4 AC.	85 CFS

TABLE 3.3-5(A) (Revised 3/12/86)

```
* ************************************ *
*          +++  DITCH  +++             *
*          DYNAPLAN Worksheet          *
*     Ver. 1.0 - James W. Buck, P.E.   *
* ************************************ *
```

INPUT DATA

```
Project Title    : Diversion D-2 Rating D/S of C-3 Outlet
Location         : Hardscrabble Canyon near Helper, Utah
                   Price River Coal Company
Channel Slope    =   0.1740 feet/foot
Mannings 'n'     =   0.0450
Bottom Width     =     4.00 feet
Left Sideslope   =     1.50 H    1.00 V
Right Sideslope  =     1.50 H    1.00 V
Depth Increment  =     0.10
```

DESCRIPTION

DITCH is a DYNAPLAN worksheet which will calculate uniform flow information for trapezoidal or triangular channels. This information can assist a user in sizing a channel configuration to pass a given discharge or in determining if an existing channel configuration will adequately pass a certain diacharge.

The following formulas are used to calculate channel parameters and flow information:

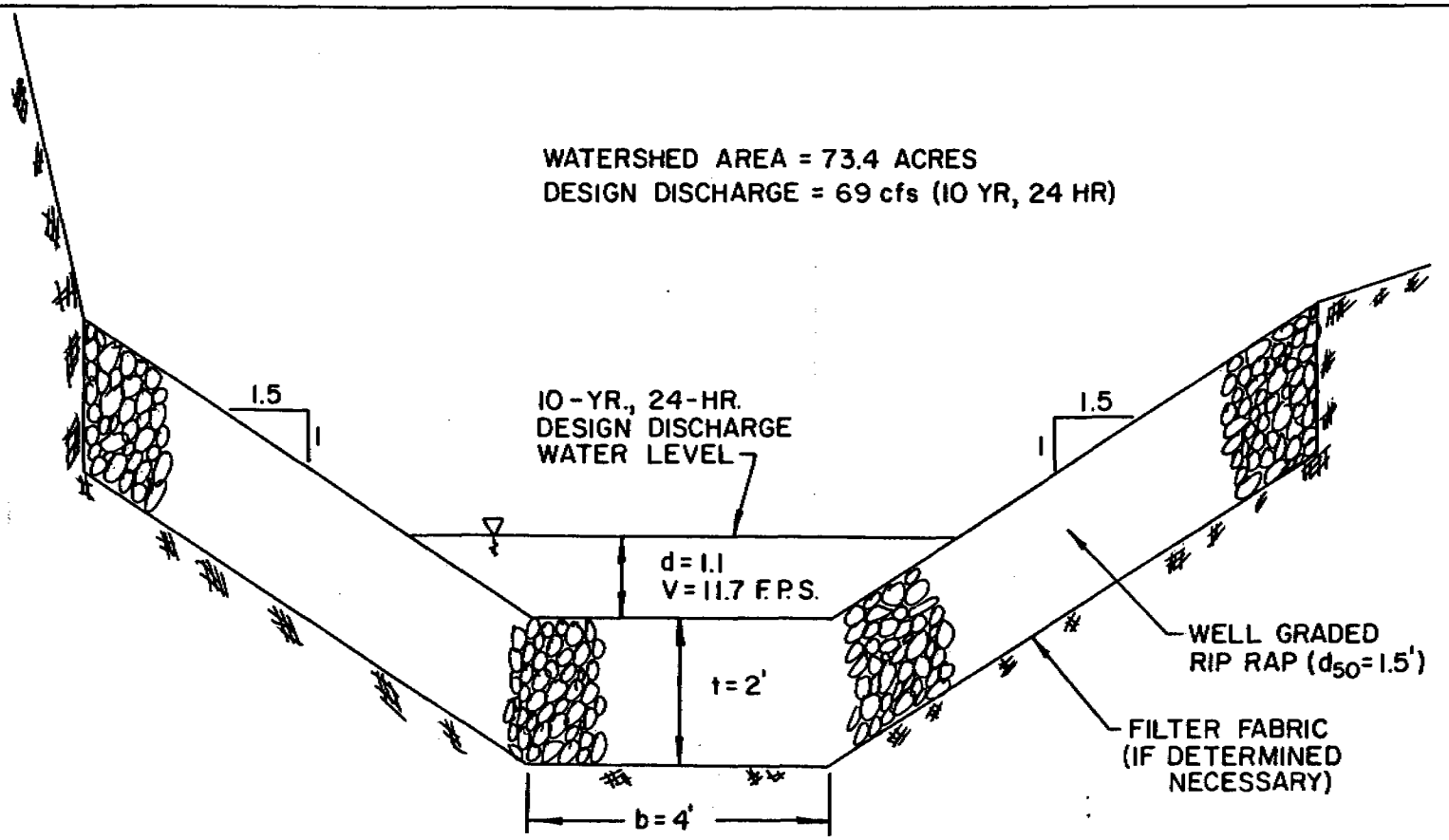
```
Area  =  ((0.50)*(Left Sideslope H/Left Sideslope V)*(Depth**2))+
---      (Depth*Bottom Width)+((0.50)*(Right Sideslope H/
         Right Sideslope V)*(Depth**2))

Wetted Perimeter  = ((Depth)*(1+(Left Sideslope H)/
-----------------     Left Sideslope V)**2)+(Bottom Width)+
                      ((Depth)*(1+(Right Sideslope H/
                      Right Sideslope V)**2)

Hydraulic Radius  = Area/Wetted Perimeter
-----------------

Topwidth  = ((Left Sideslope H/Left Sideslope V)*(Depth)+
--------    (Bottom Width)+((Right Sideslope H/Right Sideslope V)*
            (Depth))

Discharge (Q)  =((1.486)*(Area)*(Hydraulic Radius**0.667)*
-------------     (Slope**0.5))/(Manning's Roughness Coefficient)

Average Velocity  = Discharge(Q)/Area
----------------

Froude Number  = Average Velocity/((32.2)*(Area/Topwidth))**0.5)
-------------
```

The source for these equations was Open Channel Hydraulics (Chow, 1959).

TABLE 3.3-5(A) Cont. (Revised 3/12/86)

OUTPUT DATA

Depth (feet)	Q (cfs)	Velocity (ft/sec)	Froude Number	Area (sq ft)	Perimeter (feet)	Radius (feet)	Topwidth (feet)
0.00	0.00	0.00	0.000	0.00	4.00	0.00	4.00
0.10	1.19	2.87	1.628	0.42	4.36	0.10	4.30
0.20	3.80	4.42	1.803	0.86	4.72	0.18	4.60
0.30	7.54	5.65	1.907	1.34	5.08	0.26	4.90
0.40	12.30	6.68	1.980	1.84	5.44	0.34	5.20
0.50	18.03	7.59	2.036	2.38	5.80	0.41	5.50
0.60	24.72	8.41	2.081	2.94	6.16	0.48	5.80
0.70	32.36	9.15	2.119	3.54	6.52	0.54	6.10
0.80	40.95	9.84	2.152	4.16	6.88	0.60	6.40
0.90	50.50	10.49	2.180	4.82	7.24	0.66	6.70
1.00	61.03	11.10	2.206	5.50	7.61	0.72	7.00
1.10	72.55	11.67	2.229	6.21	7.97	0.78	7.30



TYPICAL CROSS-SECTION
DIVERSION D-2
BELOW PROPOSED CULVERT C-3

1" = 2.5' HORZ. & VERT.

PRICE RIVER COAL COMPANY
AMERICAN ELECTRIC POWER
SERVICE CORPORATION
HELPER, UTAH

FIGURE 3.3-8(A)
(REVISED - 3-11-86)

TABLE 3.3-6 (REVISED 1/16/86)

CULVERTS

STRUCTURE NUMBER	CONTRIBUTORY WATERSHEDS	TOTAL DRAINAGE AREA	DESIGN DISCHARGE 10 YR.,24 HR STORM
C-1	HC-3 & 9 9A?, 10?	73.4 AC.	69 CFS
C-2 (TO BE REMOVED)	HC-4,5,6,7,8, HC-19? ~~18?~~	584.1 AC.	269 CFS
C-3	HC-3 DOES Division D-3 extend all around top of conveyor area?	60.7 AC.	51 CFS
C-4	HC-3,4,5,6,7, 8,9 10?, 9A?, ~~18?~~, 19?	657.5 AC.	281 CFS
C-5	HC-3,4,5,6,7, 8,9,	657.5 AC.	281 CFS
C-6	HC-11	55.0 AC.	54 CFS
C-7	HC-2,3,4,5,6,7, 8,9,11,14,16	785.3 AC.	352 CFS

Drawing poorly →

what about

Divisions

D-2 = HC-9, HC-10

D-3 = HC-3

D-4 = HC-9A (If Goose Island channel was eliminated).

D-6 = HC-1-19

where does D-5 & D-6 start & end.

3.3-3 (1) C CULVERTS (ADDENDUM) (Revised 1/16/86)

To address Condition #2 of the MRP PRCC proposed to upgrade culverts C-3 and C-4 in accordance with Exhibit 3.3-10. The primary purpose of this proposed modification was to expand the No. 4 Mine loadout to accommodate tandum trucks. The pro-proposed plan was to be implemented in the event that reclamation was not completed in Hardscrabble Canyon by December 31, 1986. This information was previously presented in PRCC's letter dated February 25, 1985 to Mr. Mark Humphrey with the OSM.

Operational changes being considered for the Hardscrabble Canyon facilities would make the proposed modifications unnecessary. At the present time, it is being considered to continue to utilize the Hardscrabble Canyon facilities for approximately 15 to 20 years and, therefore, the reclamation of Hardscrabble Canyon will not be completed by December 31, 1986. The loading of tandum trucks is no longer being considered and the previously proposed modifications are unnecessary. However, to correct the stability problem associated with the existing installation of culvert C-3, it is proposed to remove C-3 and replace it with a buried culvert.

The proposed culvert C-3 installation will convey flow from diversion D-3 beneath the No.4 Mine conveyor and discharge into D-2. Exhibit 3.3-10(A) shows the location and installation details for the replacement of culvert C-3. Attached Figure 3.3-15(A) shows the hydraulic design data for sizing the replacement culvert. The drainage area contributing flow to the culvert is about 60.7 acres (Subarea HC-3) with a 10-year, 24-hour storm discharge of 51 cfs. The culvert inlet will be provided with a metal end section and the ditch channel will be enlarged around the inlet to form a stilling basn as shown on Exhibit 3.3-10(A). The berm which will form the stilling basin will be constructed of compacted rock material excavated during installation of the culvert. The berm will tie into the hillside on the right abutment and be extended upstream along the diversion channel to provide a minimum of 5 feet of headwater depth. The upstream slope of the berm will be riprapped with 12 inch stone. Figure 7-9(A) indicates that 12 inch stone on a 2H:1V slope can resist displacement by a velocity of approximately 10.5 feet/second. The outlet velocity from the culvert at the design flow is 9.8 feet/second. Figure 7-9(A) indicates the 12 inch stone riprap proposed for the outlet will withstand displacement by this velocity.

The proposed culvert installation will divert additional flow to culvert C-1. The adequacy of C-1 to convey the additional flow was evaluated. Attached Figure 3.3-13(A) shows the hydraulic data used to evaluate C-1. The combined drainage area to C-1 is about 73.4 acres (Subareas HC-3 and HC-9) with a 10-year, 24-hour storm discharge of 69 cfs. The existing culvert was determined to be inadequate for the combined flow. To provide sufficient discharge capacity, it is proposed to replace the existing culvert with a 42" CMP. The hydraulic data used for sizing the new culvert are presented in Figure 3.3-13(A). The discharge from culvert C-1 has free outfall. The flow drops approximately 5 feet to the D-5 channel. The channel below the outlet will be protected with 18 inch stone riprap.

The proposed replacement of culvert C-3 will increase the flow to culvert C-4 since the runoff from sub-area HC-3 will enter the main diversion upstream of C-4 instead of downstream as is now the case. The adequacy of C-4 to convey the additional flow was evaluated. Attached Figure 3.3-16(A) shows the hydraulic data used to evaluate C-4. The 10-year, 24-hour storm discharge to C-4 is approximately 280 cfs. The existing culvert was determined to be inadequate for the increased flow rate. To provide the required discharge capacity, it is proposed to replace the existing culvert with a 72" CMP. The hydraulic data used in sizing the new culvert are presented in Figure 3.3-16(A). The outlet velocity for the design discharge is 17.2 feet/second. Figure 7-9(A) indicates that 24 inch stone riprap placed on the channel bottom can withstand displacement by the design velocity. The outlet will be protected with 24 inch stone riprap.

The adequacy of existing culvert C-2 to convey the peak discharge from the 10-year, 24-hour storm was evaluated. The existing installation was determined to be inadequate for the design discharge. It is proposed to remove the existing culvert and not replace it. The road over the culvert provided access to the Goose Island area. Due to the reclamation of the Goose Island area, access to the area will be restricted for periodic maintenance of the area. Access to the Goose Island area can still be accomplished by the road from the No. 4 loadout. Attached Figure 3.3-15(A) shows the hydraulic data used to evaluate C-2.

The adequacy of existing culvert C-5 to convey the peak discharge from the 10-year, 24-hour storm was evaluated. The existing installation was determined to be adequate for the design discharge. The hydraulic data used in the evaluation are presented in Figure 3.3-17(A).

TABLE 3.3-5(C) (REVISED 3/12/86)

```
* ************************************ *
*          +++  DITCH  +++             *
*          DYNAPLAN Worksheet          *
*     Ver. 1.0 - James W. Buck, P.E.   *
* ************************************ *
```

INPUT DATA

```
Project Title    : Diversion D-5 Rating After C-2 Removal
Location         : Hardscrabble Canyon near Helper, Utah
                   Price River Coal Company
Channel Slope    =   0.0500 feet/foot
Mannings 'n'     =   0.0400
Bottom Width     =     8.00 feet
Left Sideslope   =     2.00 H    1.00 V
Right Sideslope  =     2.00 H    1.00 V
Depth Increment  =     0.30
```

DESCRIPTION

DITCH is a DYNAPLAN worksheet which will calculate uniform flow information for trapezoidal or triangular channels. This information can assist a user in sizing a channel configuration to pass a given discharge or in determining if an existing channel configuration will adequately pass a certain diacharge.

The following formulas are used to calculate channel parameters and flow information:

```
Area  =  ((0.50)*(Left Sideslope H/Left Sideslope V)*(Depth**2))+
---      (Depth*Bottom Width)+((0.50)*(Right Sideslope H/
         Right Sideslope V)*(Depth**2))

Wetted Perimeter  = ((Depth)*(1+(Left Sideslope H)/
-----------------     Left Sideslope V)**2)+(Bottom Width)+
                      ((Depth)*(1+(Right Sideslope H/
                      Right Sideslope V)**2)

Hydraulic Radius  = Area/Wetted Perimeter
----------------

Topwidth  = ((Left Sideslope H/Left Sideslope V)*(Depth)+
--------    (Bottom Width)+((Right Sideslope H/Right Sideslope V)*
            (Depth))

Discharge (Q)  =((1.486)*(Area)*(Hydraulic Radius**0.667)*
-------------     (Slope**0.5))/(Manning's Roughness Coefficient)

Average Velocity  = Discharge(Q)/Area
----------------

Froude Number  = Average Velocity/((32.2)*(Area/Topwidth))**0.5)
-------------
```

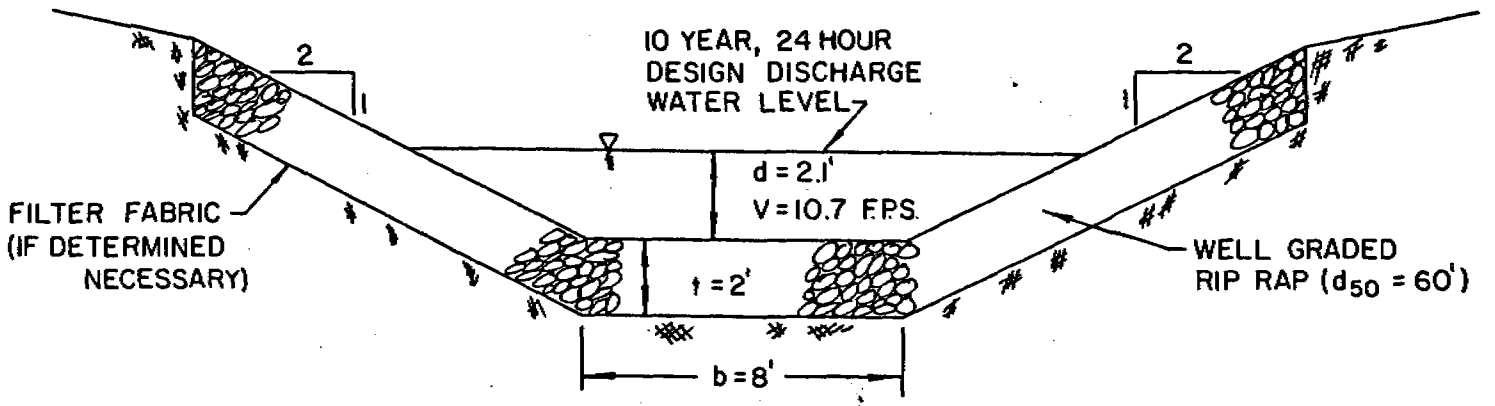
The source for these equations was Open Channel Hydraulics (Chow, 1959).

TABLE 3.3-5(C) Cont. (Revised 3/11/86)

OUTPUT DATA

Depth (feet)	Q (cfs)	Average Velocity (ft/sec)	Froude Number	Area (sq ft)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Topwidth (feet)
0.00	0.00	0.00	0.000	0.00	8.00	0.00	8.00
0.30	9.09	3.52	1.172	2.58	9.34	0.28	9.20
0.60	29.52	5.35	1.294	5.52	10.68	0.52	10.40
0.90	59.58	6.76	1.365	8.82	12.02	0.73	11.60
1.20	99.03	7.94	1.416	12.48	13.37	0.93	12.80
1.50	147.99	8.97	1.456	16.50	14.71	1.12	14.00
1.80	206.72	9.90	1.489	20.88	16.05	1.30	15.20
2.10	275.58	10.76	1.517	25.62	17.39	1.47	16.40
2.40	354.93	11.55	1.541	30.72	18.73	1.64	17.60
2.70	445.19	12.30	1.563	36.18	20.07	1.80	18.80
3.00	546.75	13.02	1.583	42.00	21.42	1.96	20.00
3.30	660.05	13.70	1.601	48.18	22.76	2.12	21.20
3.60	785.47	14.35	1.618	54.72	24.10	2.27	22.40
3.90	923.45	14.99	1.634	61.62	25.44	2.42	23.60
4.20	1,074.39	15.60	1.649	68.88	26.78	2.57	24.80
4.50	1,238.70	16.19	1.664	76.50	28.12	2.72	26.00
4.80	1,416.78	16.77	1.677	84.48	29.47	2.87	27.20
5.10	1,609.03	17.33	1.690	92.82	30.81	3.01	28.40
5.40	1,815.85	17.89	1.702	101.52	32.15	3.16	29.60
5.70	2,037.62	18.43	1.714	110.58	33.49	3.30	30.80
6.00	2,274.74	18.96	1.725	120.00	34.83	3.45	32.00

WATERSHED AREA = 584.1 ACRES
DESIGN DISCHARGE = 268.8 cfs (10 YR, 24 HR)



TYPICAL CROSS-SECTION
RECONSTRUCTION OF DIVERSION D-5
AT
LOCATION OF CULVERT C-2
AFTER REMOVAL OF CULVERT

1" = 5' HORZ. & VERT.

FIGURE 3.3-11(A)
(REVISED - 3-11-86)

PRICE RIVER COAL COMPANY
AMERICAN ELECTRIC POWER
SERVICE CORPORATION
HELPER, UTAH

TABLE 3.3-5(D)
(Revised 3/12/86)
Diversion D-3A Discharge Rating
Hardscrabble Canyon near Helper, Utah

Watershed Area = 1.8 acres
Design Discharge = 1.0 cfs (10-yr, 24-hr)

Proposed diversion lining is a 18-inch diameter CMP split in half, S=0.10'/' (2.67"x0.5" corrugations, unpaved; n=0.024)

Determine discharge rating using Manning's Equation:

$$Q = 1.486/n x A x R^{2/3} x S^{1/2}$$

Where: Q= Discharge; cfs
n= Manning Friction Factor
A= Cross-sectional Area; square feet
R= Hydraulic Radius; feet
S= Channel Slope; feet/foot

For an 18-inch pipe flowing full:

n= 0.024
A= 1.767 sq. feet
R= 0.375 feet
S= 0.10 ft/ft

$$Qfull = 1.486/0.024(1.767)(0.375)^{2/3}(0.10)^{1/2}$$
Qfull= 18.0 cfs

Vfull= Qfull/A = 18.0/1.767 = 10.2 fps

For part full pipe flow:
(from Fig. 36 Handbook of Concrete Culvert Pipe Hydraulics, Portland Cement Assoc. 1981)

d/D	Q/Qfull	V/Vfull
0.1	0.03	0.40
0.2	0.09	0.62
0.3	0.20	0.78
0.4	0.33	0.90
0.5	0.50	1.00

For an 18-inch CMP:

D= 1.5 feet
Qfull= 18.0 cfs
Vfull= 10.2 fps

d	Q	V
0.15'	0.54 cfs	4.1 fps
0.30'	1.62 cfs	6.3 fps
0.45'	3.60 cfs	7.9 fps
0.60'	5.90 cfs	9.2 fps
0.75'	9.00 cfs	10.2 fps

PRICE RIVER COAL COMPANY
AMERICAN ELECTRIC POWER
SERVICE CORPORATION
HELPER, UTAH

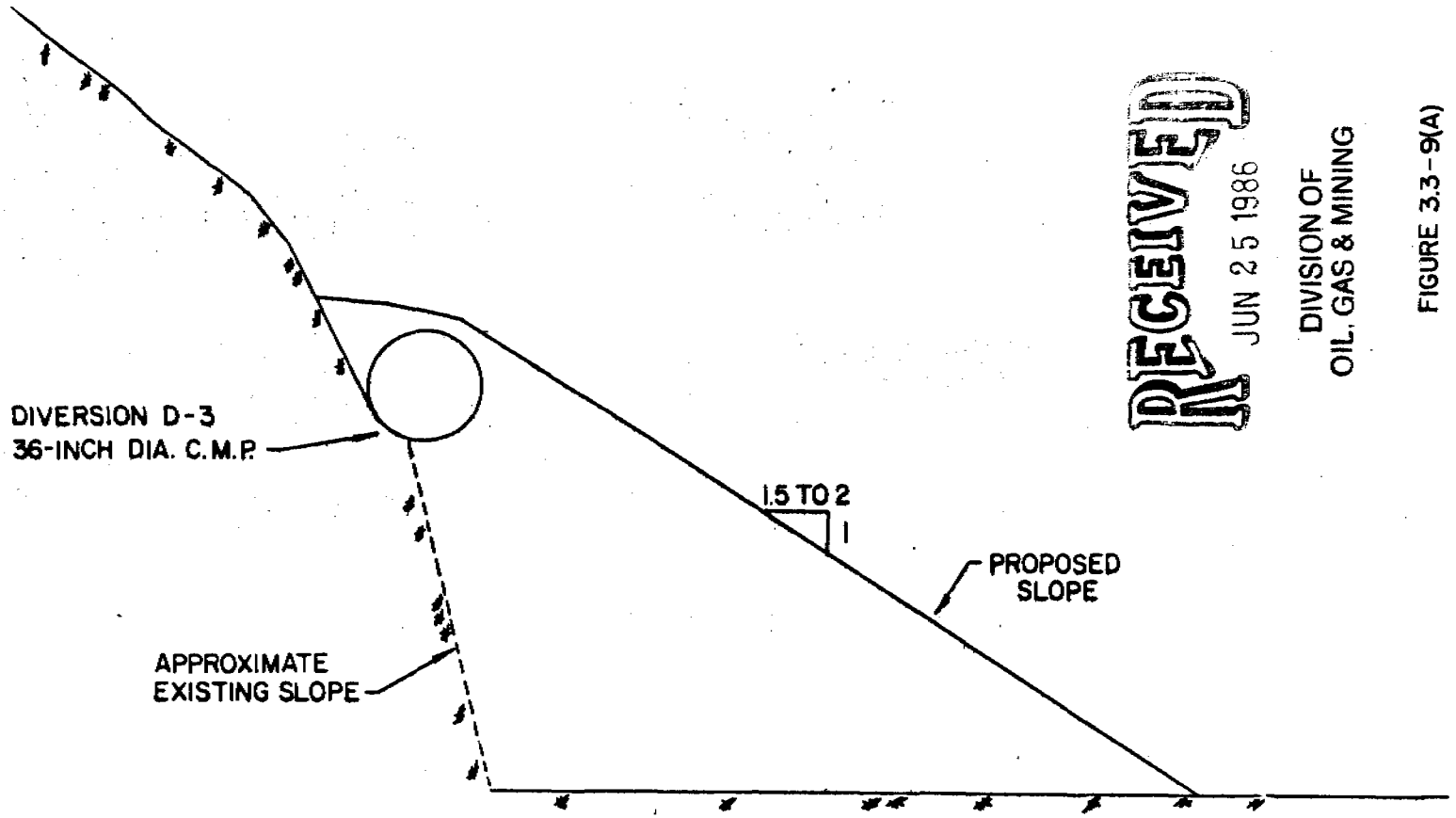


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FIGURE 3.3-9(A)
(REVISED -6-19-86)

TYPICAL CROSS-SECTION
PROPOSED
SLOPE STABILIZATION AT NO. 4 LOADOUT

1" = 5' HORZ. & VERT.

(Revised 1/16/86)

7.2-2(5) A HYDROLOGIC CALCULATIONS & ASSUMPTIONS/FORMULAS/REFERENCES (ADDENDUM)

AMAX Coal Company's HYDRO (HYDRograph Operations) software system was selected to model the hydrologic and hydraulic response of the watershed to rainfall amounts representing the the 10-year, 24-hour storm event.

The HYDRO system is comprised of six individual programs. Five of these programs perform an individual hydrograph operation and are as follows: HYGEN - Hydrograph Generation; HYSUM - Hydrograph Summation; HYLAG - Hydrograph Lagging; CHROUT - Channel Routing; and RSROUT - Reservoir Routing. The sixth program is the HYDRO executive program which accesses the five operation programs and also enables the submittal of batch runs.

The HYDRO system has the capability to develop storm-runoff hydrographs, lag hydrographs, combine hydrographs, and channel and reservoir route hydrographs for single or multiple watershed analysis. The HYDRO system provides a user the option of selecting which of several methods of hydrograph development is most applicable for a certain situation or location. The multiple watershed capability of HYDRO allows the user to analyze the effects on storm runoff for a complex watershed system with varying characteristics and configurations. The hydrograph routing capability allows analysis of the effects of various hydraulic structures on storm runoff.

The Bureau of Reclamation method, as outlined in Design of Small Dams (Bureau of Reclamation, 1973), was used to develop synthetic storm hyrographs for the sub-watersheds. The SCS Type II rainfall distribution was used for the 10-year, 24-hour storm event. The rainfall volume used for the 10-year, 24-hour storm event was 1.9 inches. The rainfall volume was determined from NOAA Atlas 2, Volume VI, Rainfall Frequency Maps of Utah (National Oceanic and Atmospheric Administration,1974).

The watershed areas for Hardscrabble Canyon are delineated on Exhibits 7.3 and 7.3(A). The total watershed was divided into 19 sub-areas (HC-1 to HC-19) at points where hydraulic structures were or planned to be located, at confluences of streams and/or tributaries and where runoff information was desired (i.e., runoff volume and peak discharge). The individual sub-areas were planimetered and the areas of each determined. The calculated areas are presented in attached Table 7-13(A).

Runoff curve numbers for each of the sub-watersheds were developed using the methods outlined in the National Engineering Handbook, Section 4 - Hydrology (SCS, 1972). The hydrologic soil classifications of the surface soils in the watershed were determined from the Preliminary Soil Survey of Carbon County, Utah (Unpublished Report obtained from Robert Fish, SCS, Price, Utah). The runoff curve numbers for the soil classifications present in the watershed were determined from Figure 9.5 (NEH-4) assuming an herbaceous ground cover with a ground cover density of 50 percent. The ground cover type and density are based upon information presented in Exhibit 9.1 in the original MRP and on-site observations. The majority of the drainage area is covered by a mixed brush ground cover with minor areas of oak-aspen brush and juniper-sage-grass mixes. The herbaceous ground cover assumption is conservative in that it yields the highest runoff curve number for a given ground cover density.

The minimum retention rates (MRR) selected for the hydrologic soil groups in the watershed were the recommended values presented in the table on Page 64 of Design of Small Dams (1973). The exception to this is the MRR for the B/C hydrologic soil group which was selected as the limit between the B and C soil groups (i.e. 0.15).

The time of concentration for the individual sub-areas was determined using Kirpich's formula. A few of the smaller areas were combined together and a combined time of concentration was calculated (Ex. Sub-areas HC-6,HC-7 & HC-8). The sub-areas combined had similar runoff characteristics and were combined for computational expediency.

The results of the runoff curve number, minimum retention rate and time of concentration calculations for the individual sub-watersheds in the Hardscrabble Canyon area are presented in attached Table 7-13(A).

The hydraulic design and evaluation of proposed and existing culverts are based upon the methods contained in Hydraulic Charts for the Selection of Highway Culverts, Hydraulic Engineering Circular No.5, (U.S. Bureau of Public Roads, 1965).

The HYDRO program uses a computational time increment of 0.1 hours. Runoff from sub-areas having a time of concentration less than this value is computed assuming instantaneous runoff. The results of the HYDRO run for the 10-year,24-hour storm event for the Hardscrabble Canyon watershed are presented in attached Table 7-14(A).

The HEC-2 Water Surface Profiles Program (U.S. Army Corps of Engineers, September, 1982 version) was used to develop a water surface profile for the 10-year, 24-hour storm discharge along diversion D-6 to evaluate the adequacy of the existing diversion. The flow rate used in the HEC-2 model was the value developed by the HYDRO hydrologic model. The results of the computer run are presented in Table 7-15(A).

TABLE 7-13(A)
(Revised 1/16/86)

AREA, CURVE NUMBER, TIME OF CONCENTRATION
AND
MINIMUM RETENTION RATES
FOR
UNDISTURBED AREAS IN
HARDSCRABBLE CANYON

WATERSHED NO.	AREA (ACRES)	RUNOFF CURVE NUMBER	MINIMUM RETENTION RATE	TIME OF CONCENTRATION
HC-1	124.2	78	0.13	0.09
HC-2	53.1	79	0.12	0.08
HC-3	60.7	84	0.08	0.08
HC-3A	1.8	76	0.15	0.02
HC-4	173.5	81	0.11	0.12
HC-5	356.8	78	0.14	0.23
HC-6	27.7	76	0.15	0.04
HC-7	4.2	76	0.15	SEE HC-6
HC-8	13.1	76	0.15	SEE HC-6
HC-9	12.7	89	0.04	0.07
HC-9A	3.5	89	0.04	0.03
HC-10	6.5	87	0.06	0.03
HC-11	55.0	83	0.09	0.07
HC-12	8.5	76	0.15	0.04
HC-13	1.3	76	0.15	0.03
HC-14	2.1	76	0.15	SEE HC-2
HC-15	19.3	79	0.13	0.03
HC-16	17.7	80	0.12	0.03
HC-17	2.3	79	0.13	SEE HC-1
HC-18	4.7	76	0.15	0.04
HC-19	1.0	76	0.15	SEE HC-18

```
*****  ***  *********  ****  *********
*                 HYDRAVE                  *
*              DRAINAGE Work[illegible]                *
* Ver[illegible] .0 [illegible] 88 W. B[illegible] P.E.          *
*****  ***  *******  ****  *********
```

10/1[illegible]

SCS [illegible] [illegible]E NRCS
[illegible] RETENT[illegible] [illegible]E [illegible] CULATIONS

[illegible] Tit[illegible] : River[illegible]
Loc[illegible] [illegible]

COVER CONDITION	A (ac)	CN	EPA (in/hr)	A x CN	A x MNR
L/C - FOREST/RANGE	[illegible]	71.5	0.150	8,021.60	15.83
~~L/C - FOREST/RANGE~~	~~[illegible]~~	~~[illegible]~~	~~0.120~~	~~0.00~~	~~0.00~~
L/C - FOREST/RANGE	[illegible]	89.25	0.0[illegible]0	[illegible]	[illegible]
TOTALS	124.18			[illegible]	[illegible]

Weighted [illegible] [illegible]

[illegible] [illegible] 0.13

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
*****************************************
```

10/18/85

SCS RUNOFF CURVE NUMBER AND MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-2

R.O. vol.

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR	
B/C - FOREST/RANGE	39.86	76	0.150	3,029.36	5.98	1.21
~~C - FOREST/RANGE ?~~	~~0.00~~	~~80~~	~~0.120~~	~~0.00~~	~~0.00~~	
D - FOREST/RANGE	13.28	89	0.040	1,181.92	0.53	1.05
						2.24
TOTALS	53.14			4,211.28	6.51	
	.....			.....	.....	
				Weighted CN =	79.25	2.10
					=======	
				Weighted MRR =	0.12	
					=======	

vs. incorrect

wtd CN =

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
****************************************
```

10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-3

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	24.27	76	0.150	1,844.52	3.64
C - FOREST/RANGE	0.00	80	0.120	0.00	0.00
D - FOREST/RANGE	36.40	89	0.040	3,239.60	1.46
TOTALS	60.67			5,084.12	5.10

Weighted CN = 83.80

Weighted MRR = 0.08

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-4

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	69.42	76	0.150	5,275.92	10.41
C - FOREST/RANGE	56.12	80	0.120	4,489.60	6.73
D - FOREST/RANGE	48.00	89	0.040	4,272.00	1.92
TOTALS	173.54			14,037.52	19.06

Weighted CN = 80.89

Weighted MRR = 0.11

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-5

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	285.40	76	0.150	21,690.40	42.81
C - FOREST/RANGE	34.30	80	0.120	2,744.00	4.12
D - FOREST/RANGE	37.10	89	0.040	3,301.90	1.48
TOTALS	356.80			27,736.30	48.41

Weighted CN = 77.74

Weighted MRR = 0.14

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-6

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	27.70	76	0.150	2,105.20	4.16
C - FOREST/RANGE	0.00	80	0.120	0.00	0.00
D - FOREST/RANGE	0.00	89	0.040	0.00	0.00
TOTALS	27.70			2,105.20	4.16

Weighted CN = 76.00

Weighted MRR = 0.15

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-7

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	4.17	76	0.150	316.92	0.63
C - FOREST/RANGE	0.00	80	0.120	0.00	0.00
D - FOREST/RANGE	0.00	89	0.040	0.00	0.00
TOTALS	4.17			316.92	0.63

Weighted CN = 76.00

Weighted MRR = 0.15

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-8

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	13.11	76	0.150	996.36	1.97
C - FOREST/RANGE	0.00	80	0.120	0.00	0.00
D - FOREST/RANGE	0.00	89	0.040	0.00	0.00
TOTALS	13.11			996.36	1.97

Weighted CN = 76.00

Weighted MRR = 0.15

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-9

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	0.00	76	0.150	0.00	0.00
C - FOREST/RANGE	0.00	80	0.120	0.00	0.00
D - FOREST/RANGE	12.67	89	0.040	1,127.63	0.51
TOTALS	12.67			1,127.63	0.51

Weighted CN = 89.00

Weighted MRR = 0.04

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-10

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	0.98	76	0.150	74.48	0.15
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	5.52	89	0.040	491.28	0.22
TOTALS	6.50			565.76	0.37
				Weighted CN =	87.04
				Weighted MRR =	0.06

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.
    *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-11

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	26.30	76	0.150	1,998.80	3.95
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	28.70	89	0.040	2,554.30	1.15
TOTALS	55.00			4,553.10	5.10

Weighted CN = 82.78

Weighted MRR = 0.09

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-12

SOIL - COVER CONDITION	AREA,A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	8.49	76	0.150	645.24	1.27
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	0.00	89	0.040		
TOTALS	8.49			645.24	1.27

Weighted CN = 76.00

Weighted MRR = 0.15

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-13

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	1.30	76	0.150	98.80	0.20
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	0.00	89	0.040		
TOTALS	1.30			98.80	0.20

Weighted CN = 76.00

Weighted MRR = 0.15

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF-CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-14

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	2.10	76	0.150	159.60	0.32
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	0.00	89	0.040		
TOTALS	2.10			159.60	0.32

Weighted CN = 76.00

Weighted MRR = 0.15

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-15

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	15.45	76	0.150	1,174.20	2.32
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	3.86	89	0.040	343.54	0.15
TOTALS	19.31			1,517.74	2.47

Weighted CN = 78.60

Weighted MRR = 0.13

```
*****************************************
*          +++  HYCURVE  +++            *
*          DYNAPLAN Worksheet           *
*  Ver. 1.0 - James W. Buck, P.E.       *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-16

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	12.36	76	0.150	939.36	1.85
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	5.30	89	0.040	471.70	0.21
TOTALS	17.66			1,411.06	2.06
				Weighted CN =	79.90
				Weighted MRR =	0.12

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-17

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	1.80	76	0.150	136.80	0.27
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	0.45	89	0.040	40.05	0.02
TOTALS	2.25			176.85	0.29

Weighted CN = 78.60

Weighted MRR = 0.13

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Subarea HC-18

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	4.65	76	0.150	353.40	0.70
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	0.00	89	0.040		
TOTALS	4.65			353.40	0.70

Weighted CN = 76.00

Weighted MRR = 0.15

```
****************************************
*          +++  HYCURVE  +++           *
*          DYNAPLAN Worksheet          *
*  Ver. 1.0 - James W. Buck, P.E.      *
****************************************
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10/18/85

SCS RUNOFF CURVE NUMBER AND
MINIMUM RETENTION RATE CALCULATIONS

Project Title : Price River Coal Company
Location : Hardscrabble Canyon Utah
Sub-area HC-19

SOIL - COVER CONDITION	AREA, A (acres)	CN	MRR (in/hr)	A x CN	A x MRR
B/C - FOREST/RANGE	1.01	76	0.150	76.76	0.15
C - FOREST/RANGE	0.00	80	0.120		
D - FOREST/RANGE	0.00	89	0.040		
TOTALS	1.01			76.76	0.15

Weighted CN = 76.00

Weighted MRR = 0.15

PROJECT: PRICE RIVER COAL COMPANY - HARDSCRABBLE CANYON
EVALUATION OF CULVERT C-1

DESIGNER: J. W. BUCK
DATE: 11-6-85

C-1 WILL CONVEY THE COMBINED FLOW FROM D-2 & D-3

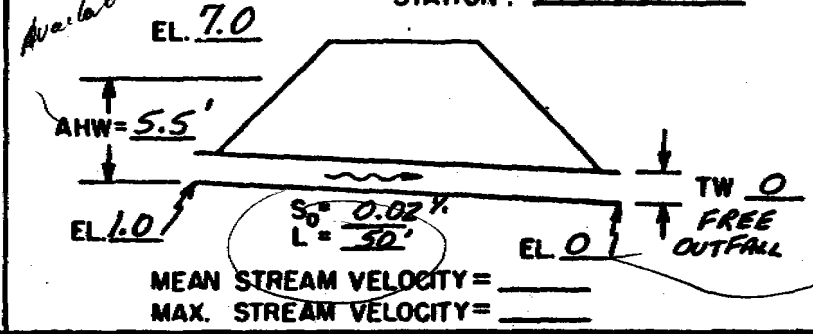
Q = 69 cfs (10-YR, 24-HR)

K_e = 0.9 (PROJECTING, FROM TABLE 1 HEC-5)

EXISTING C-1 IS A 24" CMP WITH FREE OUT FALL

SKETCH

STATION: CULVERT C-1



map inference

outlet control: or 2.2 ft HW

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs	SIZE IN.	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY		
EXISTING CMP (PROJECTING)	69	24	6.5	13.0												INADEQUATE ∴ REPLACE
PROPOSED CMP (PROJECTING)	69	36	2.4	7.2												HW TOO HIGH
or "	69	42	1.43	5.0	0.9	2.5	2.6	3.1	0	3.1	1.0	4.6	5.0			HW < AHW ∴ SELECT

NOTES: $\frac{HW}{D}$ FROM CHART 5; H FROM CHART 11; d_c FROM CHART 16 } ALL FROM BUREAU OF PUBLIC ROADS HEC-5 (1965)

FIG. 3.3-13(A)

PROJECT: PRICE RIVER COAL COMPANY - HARDSCRABBLE CANYON
EVALUATION OF CULVERT C-2

DESIGNER: J. W. BUCK
DATE: 11/7/85

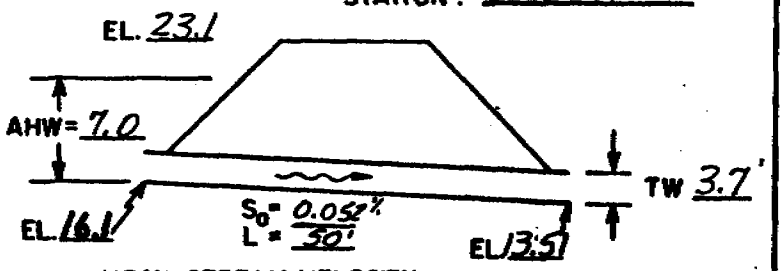
EXISTING C-2 IS A 54" CMP WITH PROJECTING ENTRANCE

Q = 270 cfs (10-YR, 24-HR)

K_e = 0.9 (TABLE 1, HEC-5)

SKETCH

STATION: CULVERT C-2



MEAN STREAM VELOCITY = ____
MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL HW=H+h_0−LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY		
CMP (PROJECTING)	270	54"	4.3	19.3	0.9	12.1	4.5	4.5	3.7	4.5	2.6	14.0	19.3			HW TOO HIGH
CMP (PROJECTING)	270	72"	1.45	8.7	0.9	3.4	4.5	5.2	3.7	5.2	2.6	6.0	8.7			HW TOO HIGH
"	"	78"	1.2	7.8	0.9	2.5	4.4	5.5	3.7	5.5	2.6	5.4	7.8			OK SELECT INCREASE AHW

NOTES: $\frac{HW}{D}$ FROM CHART 5
H FROM CHART 11
d_c FROM CHART 16
} ALL FROM BUREAU OF PUBLIC ROADS HEC-5 (1965)

FIG. 3.3-14(A)

PROJECT: PRICE RIVER COAL COMPANY - HARDSCRABBLE CANYON
REPLACEMENT FOR CULVERT C-3

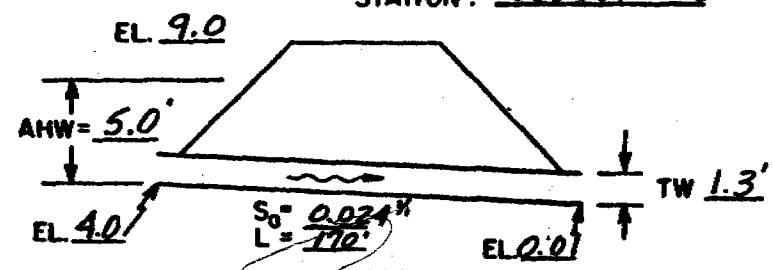
DESIGNER: J.W. BUCK
DATE: 11/6/85

C-3 WILL CONVEY FLOW FROM D-3 TO D-2

$Q = 51$ cfs (10-YR, 24-HR)

$K_e = 0.5$ (METAL END SECTION, FROM TABLE 1, HEC-5)
→ Headwall or mitered?

SKETCH
STATION: CULVERT C-3



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

outlet control:
$L = 170 \cdot 0.61$
$= 103.7$
$K_e = 0.5$
$HW = 3.8'$

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY		
CMP (METAL END SECTION)	51	33"	1.72	4.7	0.5	6.9	2.3	2.5	1.3	2.5	4.0	5.4	5.4			HW TOO HIGH
"	"	36"	1.35	4.0	0.5	4.6	2.3	2.6	1.3	2.6	4.0	3.2	4.0			HW < AHW ∴ SELECT

NOTES: $\frac{HW}{D}$ FROM CHART 5
H FROM CHART 11
d_c FROM CHART 16
} ALL FROM BUREAU OF PUBLIC ROADS HEC-5 (1965)

FIG. 3.3-15(A)

PROJECT: PRICE RIVER COAL COMPANY - HARDSCRABBLE CANYON
EVALUATION OF CULVERT C-4

DESIGNER: J.W. BUCK
DATE: 11/7/85

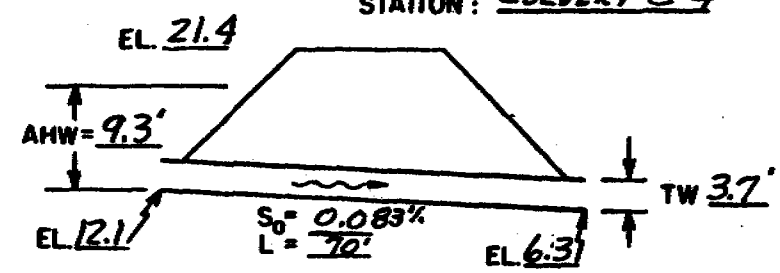
EXISTING C-4 IS A 60" CMP WITH PROJECTING ENTRANCE

$Q = 280$ cfs (10-YR, 24-HR)

$K_e = 0.9$ (TABLE 1, HEC-5)

SKETCH

STATION: CULVERT C-4



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_0 - LS_0$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY		
EXISTING CMP (PROJECTING)	280	60"	2.9	14.5	0.9	9.0	4.6	4.8	3.7	4.8	5.8	8.0	14.5			HW > AHW ∴ INADEQUATE
CMP (PROJECTING)	280	72"	1.5	9.0	0.9	4.0	4.6	5.3	3.7	5.3	5.8	3.5	9.0			HW < AHW ∴ SELECT

NOTES: $\frac{HW}{D}$ FROM CHART 5; H FROM CHART 11; d_c FROM CHART 16 } ALL FROM BUREAU OF PUBLIC ROADS HEC-5 (1965)

FIG. 3.3-16(A)

PROJECT: PRICE RIVER COAL COMPANY - HARDSCRABBLE CANYON
EVALUATION OF CULVERT C-5

DESIGNER: J. W. BUCK
DATE: 11/7/85

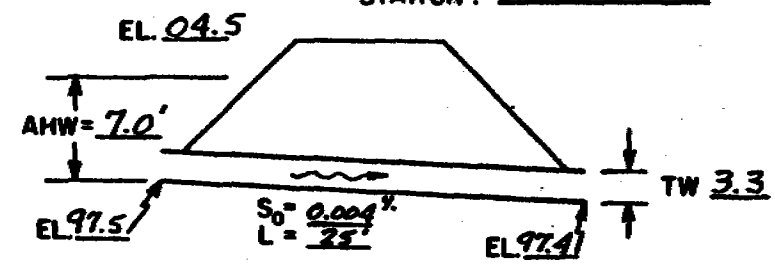
EXISTING C-5 ARE TWIN 60" CMP WITH PROJECTING ENTRANCE

$Q = 280$ cfs (10-YR, 24-HR)

$K_e = 0.9$ (TABLE 1, HEC-5)

SKETCH

STATION: CULVERT C-5



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY		
TWIN CMP (PROJECTING)	140	60"	1.18	5.9	0.9	2.0	3.4	4.2	3.3	4.2	0.1	6.1	6.1			HW < AHW ∴ ADEQUATE

NOTES: $\frac{HW}{D}$ FROM CHART 5; H FROM CHART 11; d_c FROM CHART 16 } FROM BUREAU OF PUBLIC ROADS HEC-5 (1965)

FIG. 3.3-17(A)

TABLE 7-13(A)

AREA, CURVE NUMBER, TIME OF CONCENTRATION
AND
MINIMUM RETENTION RATES
FOR
UNDISTURBED AREAS IN
HARDSCRABBLE CANYON

WATERSHED NO.	AREA (ACRES)	RUNOFF CURVE NUMBER	MINIMUM RETENTION RATE	TIME OF CONCENTRATION
HC-1	124.2	78	0.13	0.09
HC-2	53.1	79	0.12	0.08
HC-3	60.7	84	0.08	0.08
HC-4	173.5	81	0.11	0.12
HC-5	356.8	78	0.14	0.23
HC-6	27.7	76	0.15	0.04
HC-7	4.2	76	0.15	SEE HC-6
HC-8	13.1	76	0.15	SEE HC-6
HC-9	12.7	89	0.04	0.07
HC-10	6.5	87	0.06	0.03
HC-11	55.0	83	0.09	0.07
HC-12	8.5	76	0.15	0.04
HC-13	1.3	76	0.15	0.03
HC-14	2.1	76	0.15	SEE HC-2
HC-15	19.3	79	0.13	0.03
HC-16	17.7	80	0.12	0.03
HC-17	2.3	79	0.13	SEE HC-1
HC-18	4.7	76	0.15	0.04
HC-19	1.0	76	0.15	SEE HC-18

TABLE 7-14(A)
(Revised 1/16/86)

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************************************
*          AMAX COAL COMPANY       *
*  ENGINEERING SYSTEMS DEVELOPMENT *
*     ENVIRONMENTAL ENGINEERING    *
*       HYDROGRAPH OPERATIONS      *
************************************
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HYDRO VERSION 2.0I
FILE: PRICERIV PROJTAB * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

* * * PROJECT SUMMARY TABLE * * *

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	10.00 years
RAINFALL DURATION	24.00 hours
RAINFALL AMOUNT	1.90 inches
RAINFALL DISTIBUTION	SCS Type II
METHOD TO CALC ROF VOL	Bureau of Reclamation
TIME INTERVAL	0.10 hours

PROJECT OPERATIONS

* INPUT *					* OUTFLOW *				
OPER-ATION	METH Q	CURVE NO.	TIME CONC (HR)	MRR (IN/HR)	BASIN AREA (AC)	PEAK Q (CFS)	TIME PEAK (HR)	RUNOFF VOLUME (AC-FT)	HYDGRAPH FILE
DEV	SCS	81	0.12	0.11	173.5	137	12.10	4.2	0010HC4
DEV	SCS	78	0.23	0.14	365.7	152	12.20	5.9	0010HC5*
DEV	SCS	76	0.04	0.15	44.9	25	12.00	0.6	0010HC6*
DEV	SCS	81	0.08	0.08	60.7	51	12.00	1.6	0010HC3
DEV	SCS	89	0.07	0.04	12.7	18	12.00	0.7	0010HC9
DEV	SCS	78	0.09	0.13	126.4	85	12.00	2.1	0010HC1*
DEV	SCS	80	0.08	0.12	55.2	43	12.00	1.2	0010HC2*
DEV	SCS	80	0.03	0.12	17.6	14	12.00	0.4	0010HC16
DEV	SCS	83	0.07	0.09	55.0	54	12.00	1.7	0010HC11

* NOTE: The Basin Areas Shown for These Watersheds are Combined Areas. See the Following Watershed Analysis Tables for Area Descriptions.

HYDRO VERSION 2.0I
FILE: PRICERIV PROJTAB *

NOVEMBER 7, 1985

* * * PROJECT SUMMARY TABLE (CONT'D) * * *

* INPUT *			* OUTFLOW *				
OPER-ATION	HYDGRAPH FILE 1	HYDGRAPH FILE 2	BASIN AREA (AC)	PEAK Q (CFS)	TIME PEAK (HR)	RUNOFF VOLUME (AC-FT)	HYDGRAPH FILE
SUM	0010HC3	0010HC9	73.4	69	12.00	2.3	CULVERT1
SUM	0010HC4	0010HC5	539.2	264	12.10	10.1	SUM1
SUM	SUM1	0010HC6	584.1	269	12.10	10.7	CULVERT2
SUM	CULVERT2	0010HC9	596.8	272	12.10	11.4	SUM3
SUM	SUM3	0010HC3	657.5	281	12.10	13.0	CULVERT4
SUM	CULVERT4	0010HC2	712.7	296	12.00	14.2	SUM5
SUM	SUM5	0010HC11	767.7	350	12.00	15.8	POND008

OPER-ATION	HYDGRAPH FILE	FROM PT	TO PT	CHANNL LENGTH (FT)	LAG TIME (HR)	BASIN AREA (AC)	PEAK Q (CFS)	TIME PEAK (HR)	RUNOFF VOLUME (AC-FT)	HYDGRAPH FILE
LAG	POND008	P008	PARK	N/A	0.2	767.7	350	12.20	15.8	P008LAG

OPER-ATION	HYDGRAPH FILE 1	HYDGRAPH FILE 2	BASIN AREA (AC)	PEAK Q (CFS)	TIME PEAK (HR)	RUNOFF VOLUME (AC-FT)	HYDGRAPH FILE
SUM	P008LAG	0010HC16	785.3	352	12.20	16.2	NEWPARK
SUM	NEWPARK	0010HC1	911.7	368	12.20	18.3	POND009

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
*************************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREA 4

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= SCS Unit Hydrograph

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 173.5 ACRES (0.271 SQ MI)
SCS RUNOFF CURVE NUMBER	= 81
MINIMUM RETENTION RATE	= 0.11 INCHES/HOUR
TIME OF CONCENTRATION	= 0.12 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 136.5 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.1 HOURS
RUNOFF VOLUME	= 4.2 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREA 5
& RECLAIMED AREA

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= SCS Unit Hydrograph

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 365.7 ACRES (0.571 SQ MI)
SCS RUNOFF CURVE NUMBER	= 78
MINIMUM RETENTION RATE	= 0.14 INCHES/HOUR
TIME OF CONCENTRATION	= 0.23 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 151.7 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.2 HOURS
RUNOFF VOLUME	= 5.9 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREAS 6,7,& 8

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 44.9 ACRES (0.070 SQ MI)
SCS RUNOFF CURVE NUMBER	= 76
MINIMUM RETENTION RATE	= 0.15 INCHES/HOUR
TIME OF CONCENTRATION	= 0.04 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 25.1 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 0.6 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
*************************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREA 3

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 60.7 ACRES (0.095 SQ MI)
SCS RUNOFF CURVE NUMBER	= 81
MINIMUM RETENTION RATE	= 0.08 INCHES/HOUR
TIME OF CONCENTRATION	= 0.08 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 51.5 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 1.6 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
*************************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREA 9

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 12.7 ACRES (0.020 SQ MI)
SCS RUNOFF CURVE NUMBER	= 89
MINIMUM RETENTION RATE	= 0.04 INCHES/HOUR
TIME OF CONCENTRATION	= 0.07 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 17.9 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 0.7 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
*************************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREAS 1 & 17

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 126.4 ACRES (0.197 SQ MI)
SCS RUNOFF CURVE NUMBER	= 78
MINIMUM RETENTION RATE	= 0.13 INCHES/HOUR
TIME OF CONCENTRATION	= 0.09 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 84.5 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 2.1 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
*************************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREAS 2 & 14

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 55.2 ACRES (0.086 SQ MI)
SCS RUNOFF CURVE NUMBER	= 80
MINIMUM RETENTION RATE	= 0.12 INCHES/HOUR
TIME OF CONCENTRATION	= 0.08 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 43.4 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 1.2 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*       HYDROGRAPH GENERATION       *
*************************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREA 16

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 17.6 ACRES (0.028 SQ MI)
SCS RUNOFF CURVE NUMBER	= 80
MINIMUM RETENTION RATE	= 0.12 INCHES/HOUR
TIME OF CONCENTRATION	= 0.03 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 13.8 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 0.4 ACRE-FEET

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*********************************
*        AMAX COAL COMPANY      *
* ENGINEERING SYSTEMS DEVELOPMENT *
*    ENVIRONMENTAL ENGINEERING   *
*      HYDROGRAPH GENERATION     *
*********************************
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HYGEN - Version 3.2I
FILE: PRICERIV PRREPORT * NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: HARDSCRABBLE CANYON SUBAREA 11

WATERSHED ANALYSIS TABLE

METHOD OF COMPUTATION

RUNOFF VOLUME	= Bureau of Reclamation
PEAK DISCHARGE	= Instantaneous Runoff

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 55.0 ACRES (0.086 SQ MI)
SCS RUNOFF CURVE NUMBER	= 83
MINIMUM RETENTION RATE	= 0.09 INCHES/HOUR
TIME OF CONCENTRATION	= 0.07 HOURS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 53.8 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 1.7 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
*************************************
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HYSUM - Version 2.0
FILE: CULVERT1 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
0010HC3 HYDGRAPH and 0010HC9 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= 0010HC3 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC9 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 73.4 ACRES (0.115 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 69.4 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 2.3 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
*************************************
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HYSUM - Version 2.0
FILE: SUM1 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
0010HC4 HYDGRAPH and 0010HC5 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= 0010HC4 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC5 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA = 539.2 ACRES (0.842 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 263.9 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.1 HOURS
RUNOFF VOLUME	= 10.1 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
*************************************
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HYSUM - Version 2.0
FILE: CULVERT2 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
SUM1 HYDGRAPH A and 0010HC6 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= SUM1 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC6 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 584.1 ACRES (0.913 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 268.6 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.1 HOURS
RUNOFF VOLUME	= 10.7 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
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HYSUM - Version 2.0
FILE: SUM3 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
CULVERT2 HYDGRAPH and 0010HC9 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= CULVERT2 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC9 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA = 596.8 ACRES (0.932 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 271.6 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.1 HOURS
RUNOFF VOLUME	= 11.4 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
*************************************
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HYSUM - Version 2.0
FILE: CULVERT4 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
SUM3 HYDGRAPH A and 0010HC3 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= SUM3 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC3 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 657.5 ACRES (1.027 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 280.8 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.1 HOURS
RUNOFF VOLUME	= 13.0 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
*************************************
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HYSUM - Version 2.0
FILE: SUM5 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
CULVERT4 HYDGRAPH and 0010HC2 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= CULVERT4 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC2 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 712.7 ACRES (1.114 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 296.1 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 14.2 ACRE-FEET

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*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
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HYSUM - Version 2.0
FILE: POND008 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
SUM5 HYDGRAPH A and 0010HC11 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= SUM5 HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC11 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 767.7 ACRES (1.200 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 349.8 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.0 HOURS
RUNOFF VOLUME	= 15.8 ACRE-FEET

```
*********************************
*        AMAX COAL COMPANY      *
*  ENGINEERING SYSTEMS DEVELOPMENT *
*    ENVIRONMENTAL ENGINEERING    *
*        HYDROGRAPH LAGGING       *
*********************************
```

HYLAG - Version 2.0I
FILE: P008LAG HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Lagged from P008 to PARK
Inflow hydrograph - POND008 HYDGRAPH A

HYDROGRAPH LAG TABLE

INPUT HYDROGRAPH = POND008 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	=	10.0 YEARS
RAINFALL DURATION	=	24.00 HOURS
RAINFALL AMOUNT	=	1.90 INCHES
TIME INTERVAL	=	0.10 HOURS
RAINFALL DISTRIBUTION	=	SCS Type II

INFLOW PARAMETERS (AT UPSTREAM POINT OF REACH: P008)

WATERSHED AREA	=	767.7 ACRES (1.200 SQ MI)
PEAK INFLOW RATE	=	349.8 CFS
TIME TO PEAK (FROM START OF RAIN)	=	12.0 HOURS
INFLOW RUNOFF VOLUME	=	15.8 ACRE-FEET

HYDROGRAPH LAG PARAMETERS

LAG TIME	=	0.20 HOURS

LAG TIME WAS INPUT DIRECTLY

HYDROGRAPH LAG SUMMARY AT: PARK

PEAK DISCHARGE	=	349.8 CFS
TIME TO PEAK (FROM START OF RAIN)	=	12.2 HOURS
RUNOFF VOLUME	=	15.8 ACRE-FEET

```
*********************************
*        AMAX COAL COMPANY      *
* ENGINEERING SYSTEMS DEVELOPMENT *
*    ENVIRONMENTAL ENGINEERING   *
*       HYDROGRAPH SUMMATION     *
*********************************
```

HYSUM - Version 2.0
FILE: NEWPARK HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
P008LAG HYDGRAPH and 0010HC16 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= P008LAG HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC16 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 785.3 ACRES (1.227 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 352.4 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.2 HOURS
RUNOFF VOLUME	= 16.2 ACRE-FEET

```
*************************************
*          AMAX COAL COMPANY        *
*  ENGINEERING SYSTEMS DEVELOPMENT  *
*     ENVIRONMENTAL ENGINEERING     *
*        HYDROGRAPH SUMMATION       *
*************************************
```

HYSUM - Version 2.0
FILE: POND009 HYDGRAPH A4 NOVEMBER 7, 1985

PROJ TITLE: PRICE RIVER COAL COMPANY
HARDSCRABBLE CANYON HYDROLOGIC STUDY

LOCATION: HARDSCRABBLE CANYON NEAR HELPER
CARBON COUNTY UTAH

WATERSHED: Combined hydrographs
NEWPARK HYDGRAPH and 0010HC1 HYDGRAPH

HYDROGRAPH SUMMATION TABLE

INPUT HYDROGRAPHS

HYDROGRAPH NO. 1	= NEWPARK HYDGRAPH A
HYDROGRAPH NO. 2	= 0010HC1 HYDGRAPH A

RAINFALL PARAMETERS

RAINFALL RETURN PERIOD	= 10.0 YEARS
RAINFALL DURATION	= 24.00 HOURS
RAINFALL AMOUNT	= 1.90 INCHES
TIME INTERVAL	= 0.10 HOURS
RAINFALL DISTRIBUTION	= SCS Type II

WATERSHED PARAMETERS

TOTAL WATERSHED AREA	= 911.7 ACRES (1.425 SQ MI)

NOTE: REFER TO INDIVIDUAL WATERSHED REPORT FILES
FOR SPECIFIC WATERSHED PARAMETERS

RAINFALL - RUNOFF SUMMARY

PEAK DISCHARGE	= 368.4 CFS
TIME TO PEAK (FROM START OF RAIN)	= 12.2 HOURS
RUNOFF VOLUME	= 18.3 ACRE-FEET

TABLE 7-15(A)

HEC-2

WATER SURFACE PROFILE

10-YEAR, 24-HOUR STORM

DIVERSION D-6

THIS RUN EXECUTED 11/08/85 11:06:54

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*********************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAR. 1982
  ERROR CORR -  01,02,03,04,05
  MODIFICATION -  50,51,52,53,54,55
*********************************************
```

T1 PRICE RIVER COAL COMPANY HYDROLOGIC STUDY OF HARDSCRABBLE CANYON
T2 WATER SURFACE PROFILE FOR 10 YR/ 24 HR STORM EVENT ** J.W.BUCK **
T3 MAIN DIVERSION CHANNEL D-6

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	0.	0.068000	0.00	0.0	368.	6610.000	0.000

J2	NPROF	IFLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NC	0.045	0.045	0.045	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	0.000	4.000	0.000	13.000	0.000	0.000	0.000	0.000	0.000	0.000
GR	6610.699	0.000	6606.000	7.000	6606.699	11.000	6610.801	13.000	0.000	0.000
X1	50.000	5.000	0.000	16.000	50.000	50.000	50.000	0.000	0.000	0.000
GR	6614.102	0.000	6609.801	7.000	6609.898	10.000	6612.801	14.000	6615.500	16.000
X1	100.000	5.000	0.000	23.000	50.000	50.000	50.000	0.000	0.000	0.000
X2	352.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GR	6616.102	0.000	6612.801	5.000	6613.199	7.000	6615.398	13.000	6620.699	23.000
X1	200.000	5.000	0.000	15.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	6619.602	0.000	6617.398	5.000	6617.602	7.000	6619.301	13.000	6622.398	15.000
X1	300.000	5.000	0.000	12.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	6623.898	0.000	6621.301	4.000	6621.500	7.000	6623.398	9.000	6626.199	12.000
X1	400.000	5.000	0.000	10.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	6631.199	0.000	6628.102	5.000	6628.500	7.000	6631.500	8.000	6633.699	10.000
X1	500.000	3.000	0.000	11.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	6637.500	0.000	6634.398	5.000	6639.398	11.000	0.000	0.000	0.000	0.000
X1	600.000	4.000	0.000	21.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	6644.801	0.000	6641.301	5.000	6645.102	10.000	6649.602	21.000	0.000	0.000
X1	1160.000	3.000	0.000	17.000	560.000	560.000	560.000	0.000	0.000	0.000
GR	6696.898	0.000	6693.500	8.000	6697.301	17.000	0.000	0.000	0.000	0.000

X1	1710.000	5.000	0.000	20.000	550.000	550.000	550.000	0.000	0.000	0.000
GR	6736.000	0.000	6730.801	7.000	6730.699	11.000	6731.102	15.000	6734.801	20.000
X1	1940.000	5.000	0.000	34.000	230.000	230.000	230.000	0.000	0.000	0.000
GR	6749.000	0.000	6745.602	8.000	6744.500	17.000	6745.801	22.000	6751.301	34.000
X1	2235.000	5.000	0.000	21.000	295.000	295.000	295.000	0.000	0.000	0.000
GR	6786.000	0.000	6782.398	1.000	6781.801	3.000	6784.398	15.000	6792.500	21.000
X1	2555.000	5.000	0.000	24.000	320.000	320.000	320.000	0.000	0.000	0.000
GR	6801.898	0.000	6798.199	10.000	6797.602	15.000	6798.000	19.000	6804.102	24.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

12 [illegible] K COAL COMPANY [illegible]
[illegible] JOB PROFILE FO[illegible] YR. 24 HR STORM [illegible]
MAX [illegible]

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       ARQB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST

*PROF 1

CCHV=   0.100 CEHV=   0.300
*SECNO 0.000
3280 CROSS SECTION      0.00 EXTENDED      0.01 FEET

3720 CRITICAL DEPTH ASSUMED
     0.00      4.71  6610.71  6610.71  6610.00  6612.17     1.46      0.00      0.00  6610.70
     368.       0.     368.       0.       0.      38.       0.        0.        0.   6610.80
     0.00      0.00     9.70     0.00    0.045    0.045    0.045     0.000  6606.00     0.00
 0.029545       0.       0.       0.        0        8        0      0.00     12.96    12.96


*SECNO 50.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    50.00      4.29  6614.09  6614.09     0.00  6615.45     1.37      1.44      0.01  6614.10
     368.       0.     368.       0.       0.      39.       0.        0.        0.   6615.50
     0.00      0.00     9.38     0.00    0.045    0.045    0.045     0.000  6609.80     0.03
 0.027963      50.      50.      50.       20       11        0      0.00     14.93    14.95


*SECNO 100.000
3280 CROSS SECTION    100.00 EXTENDED      0.88 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   100.00      4.18  6616.98  6616.98     0.00  6618.24     1.26      1.39      0.01  6616.10
     352.       0.     352.       0.       0.      39.       0.        0.        0.   6620.70
     0.00      0.00     8.99     0.00    0.045    0.045    0.045     0.000  6612.80     0.00
 0.027677      50.      50.      50.       20        8        0      0.00     15.99    15.99


*SECNO 200.000
3280 CROSS SECTION    200.00 EXTENDED      1.55 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   200.00      3.75  6621.15  6621.15     0.00  6622.49     1.34      2.79      0.03  6619.60
     352.       0.     352.       0.       0.      38.       0.        0.        0.   6622.40
     0.01      0.00     9.29     0.00    0.045    0.045    0.045     0.000  6617.40     0.00
 0.028174     100.     100.     100.        6       13        0      0.00     14.20    14.20
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```
   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST

*SECNO 300.000
3280 CROSS SECTION    300.00 EXTENDED      1.85 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   300.00     4.45  6625.75  6625.75     0.00  6627.30     1.55     2.98     0.06  6623.90
     352.       0.     352.       0.       0.     35.       0.       0.       0.  6626.20
     0.01     0.00    10.00     0.00    0.045    0.045    0.045    0.000  6621.30     0.00
 0.031610     100.     100.     100.       20       11        0     0.00    11.51    11.51

*SECNO 400.000
3280 CROSS SECTION    400.00 EXTENDED      2.15 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   400.00     5.25  6633.35  6633.35     0.00  6635.06     1.72     3.41     0.05  6631.20
     352.       0.     352.       0.       0.     33.       0.       0.       0.  6633.70
     0.01     0.00    10.51     0.00    0.045    0.045    0.045    0.000  6628.10     0.00
 0.036972     100.     100.     100.       20       11        0     0.00     9.68     9.68

*SECNO 500.000
3280 CROSS SECTION    500.00 EXTENDED      2.10 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   500.00     5.20  6639.60  6639.60     0.00  6641.22     1.62     3.57     0.01  6637.50
     352.       0.     352.       0.       0.     34.       0.       0.       0.  6639.40
     0.01     0.00    10.22     0.00    0.045    0.045    0.045    0.000  6634.40     0.00
 0.034449     100.     100.     100.       20        5        0     0.00    11.00    11.00

*SECNO 600.000
3280 CROSS SECTION    600.00 EXTENDED      1.81 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   600.00     5.31  6646.61  6646.61     0.00  6647.96     1.36     3.23     0.03  6644.80
     352.       0.     352.       0.       0.     38.       0.       1.       0.  6649.60
     0.02     0.00     9.36     0.00    0.045    0.045    0.045    0.000  6641.30     0.00
 0.030426     100.     100.     100.       20        5        0     0.00    13.69    13.69
```

```
   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST

*SECNO 1160.000
3280 CROSS SECTION   1160.00 EXTENDED      0.80 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  1160.00      4.20  6697.70  6697.70      0.00  6698.86      1.16     15.68      0.02  6696.90
     352.        0.     352.        0.        0.      41.        0.        1.        0.  6697.30
     0.04      0.00      8.63      0.00     0.045     0.045     0.045     0.000  6693.50      0.00
 0.025856      560.     560.      560.        20        14         0      0.00     17.00     17.00

*SECNO 1710.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  1710.00      3.40  6734.10  6734.10      0.00  6735.32      1.22     14.36      0.02  6736.00
     352.        0.     352.        0.        0.      40.        0.        2.        1.  6734.80
     0.05      0.00      8.88      0.00     0.045     0.045     0.045     0.000  6730.70      2.56
 0.026358      550.     550.      550.        20        16         0      0.00     16.50     19.05

*SECNO 1940.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  1940.00      3.14  6747.64  6747.64      0.00  6748.62      0.98      5.93      0.02  6749.00
     352.        0.     352.        0.        0.      44.        0.        2.        1.  6751.30
     0.06      0.00      7.93      0.00     0.045     0.045     0.045     0.000  6744.50      3.20
 0.025256      230.     230.      230.        20        11         0      0.00     22.81     26.01

*SECNO 2235.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  2235.00      3.81  6785.61  6785.61      0.00  6786.86      1.25      7.92      0.08  6786.00
     352.        0.     352.        0.        0.      39.        0.        2.        1.  6792.50
     0.07      0.00      8.98      0.00     0.045     0.045     0.045     0.000  6781.80      0.11
 0.028565      295.     295.      295.        20        11         0      0.00     15.79     15.90
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

```
*SECNO 2555.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  2555.00      3.34  6800.95  6800.95      0.00  6802.05      1.11      8.73      0.01  6801.90
     352.        0.     352.       0.        0.     42.        0.        2.        1.  6804.10
     0.08      0.00     8.47     0.00     0.045    0.045     0.045     0.000   6797.60     2.58
 0.026073      320.     320.     320.        20       12         0      0.00     18.84    21.41
```

THIS RUN EXECUTED 11/08/85 11:06:55

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*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAR. 1982
  ERROR CORR -  01,02,03,04,05
  MODIFICATION -  50,51,52,53,54,55
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

MAIN DIVERSION CHANNEL D-6

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	0.000	0.00	0.00	0.00	6606.00	368.00	6610.71	6610.71	6612.17	295.45	9.70	37.92	21.41
*	50.000	50.00	0.00	0.00	6609.80	368.00	6614.09	6614.09	6615.45	279.63	9.38	39.24	22.01
*	100.000	50.00	0.00	0.00	6612.80	352.00	6616.98	6616.98	6618.24	276.77	8.99	39.14	21.16
*	200.000	100.00	0.00	0.00	6617.40	352.00	6621.15	6621.15	6622.49	281.74	9.29	37.89	20.97
*	300.000	100.00	0.00	0.00	6621.30	352.00	6625.75	6625.75	6627.30	316.10	10.00	35.19	19.80
*	400.000	100.00	0.00	0.00	6628.10	352.00	6633.35	6633.35	6635.06	369.72	10.51	33.49	18.31
*	500.000	100.00	0.00	0.00	6634.40	352.00	6639.60	6639.60	6641.22	344.49	10.22	34.44	18.97
*	600.000	100.00	0.00	0.00	6641.30	352.00	6646.61	6646.61	6647.96	304.26	9.36	37.62	20.18
*	1160.000	560.00	0.00	0.00	6693.50	352.00	6697.70	6697.70	6698.86	258.56	8.63	40.77	21.89
*	1710.000	550.00	0.00	0.00	6730.70	352.00	6734.10	6734.10	6735.32	263.58	8.88	39.64	21.68
*	1940.000	230.00	0.00	0.00	6744.50	352.00	6747.64	6747.64	6748.62	252.56	7.93	44.36	22.15
*	2235.000	295.00	0.00	0.00	6781.80	352.00	6785.61	6785.61	6786.86	285.65	8.98	39.20	20.83
*	2555.000	320.00	0.00	0.00	6797.60	352.00	6800.95	6800.95	6802.05	260.73	8.47	41.57	21.80

MAIN DIVERSION CHANNEL D-6

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	0.000	368.00	6610.71	0.00	0.00	0.71	12.96	0.00
*	50.000	368.00	6614.09	0.00	3.38	0.00	14.93	50.00
*	100.000	352.00	6616.98	0.00	2.90	0.00	15.99	50.00
*	200.000	352.00	6621.15	0.00	4.17	0.00	14.20	100.00
*	300.000	352.00	6625.75	0.00	4.59	0.00	11.51	100.00
*	400.000	352.00	6633.35	0.00	7.60	0.00	9.68	100.00
*	500.000	352.00	6639.60	0.00	6.25	0.00	11.00	100.00
*	600.000	352.00	6646.61	0.00	7.01	0.00	13.69	100.00
*	1160.000	352.00	6697.70	0.00	51.09	0.00	17.00	560.00
*	1710.000	352.00	6734.10	0.00	36.40	0.00	16.50	550.00
*	1940.000	352.00	6747.64	0.00	13.54	0.00	22.81	230.00
*	2235.000	352.00	6785.61	0.00	37.97	0.00	15.79	295.00
*	2555.000	352.00	6800.95	0.00	15.33	0.00	18.84	320.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION  SECNO=    0.000  PROFILE= 1  CRITICAL DEPTH ASSUMED

CAUTION  SECNO=   50.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=   50.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=   50.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  100.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  100.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  100.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  200.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  200.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=  300.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  300.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  300.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  400.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  400.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  400.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  500.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  500.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  500.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=  600.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=  600.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=  600.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO= 1160.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO= 1160.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO= 1160.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO= 1710.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO= 1710.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO= 1710.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO= 1940.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO= 1940.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO= 1940.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO= 2235.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO= 2235.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO= 2235.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO= 2555.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO= 2555.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO= 2555.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
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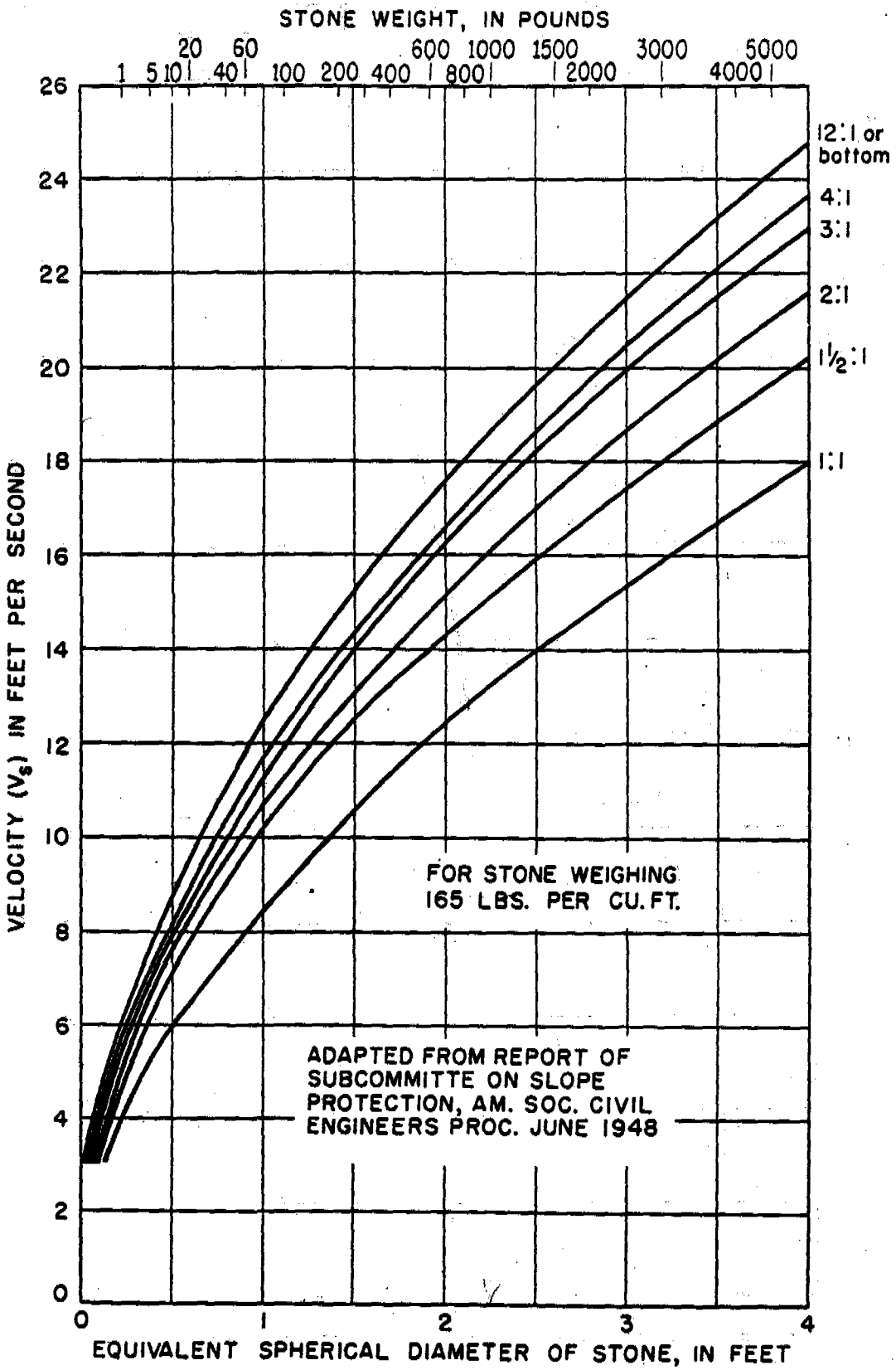

Figure 21.—Size of stone that will resist displacement for various velocities and side slopes.

(Source: Design of Roadside Drainage Channels
U.S.Bureau of Public Roads,1965)

FIGURE 7-9(A)
(Revised 1/16/86)

Document Information Form

Mine Number: C/007/0004

File Name: Incoming Castle Gate

To: Lowell Braxton

From:

Person Richard H. Allison, JR

Company Castle Gate

Date Received: 6-25-86

Explanation: Map - Proposed Drainage Control Modifications Hard Scrabble Canyon

cc:

Document Information Form

Mine Number: C/007/0004

File Name: Incoming Castle Gate

To: Lowell Braxton

From:

Person Richard H. Allison Jr.

Company Castle Gate

Date Received: 6-25-86

Explanation: Map - (Graph) Proposed Drainage Control Modifications Hard Scrabble Canyon Existing Cross-Sections Diversion D-6

cc: