William Paul Goranson, P.E.
Manager, Radiation Safety
Regulatory Compliance and Licensing

Quivira Mining Company
6305 Waterford Boulevard
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Rio Algom

October 10, 2001

CERTIFIED MAIL 7000 1670 0013 4034 8455
RETURN RECIEPT REQUESTED

Melvyn Leach
Chief, Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety and Safeguards
U.S. Nuclear Regulatory Commission
Mail Stop T-8A33
Washington, DC 20555

Subject: Pond #2 Run-on and Run-off Apron Design - License Condition 37M
Ambrosia Lake Facility
License No: SUA-1473 Docket No: 40-8905

Dear Mr. Leach:

As required in License Condition 37M, Quivira Mining Co. is submitting the Run-on and Run-off apron designs for Pond #2 at the Ambrosia Lake Facility. The design proposal can be found in Attachment A to this letter. The design follows the guidelines presented in NUREG-1623, *Design of Erosion Protection for Long-Term Stabilization*. Attachment B contains qualification data for the rock that is expected to be used for the construction. It is a Pennsylvanian limestone that is a substitution for the basalt that is has been previously approved and used at the site due to the closure of the basalt quarry. The qualification data is from 1991 testing, and the rock will be re-qualified before placement.

If you have any questions, please call me at (405) 858-4807.

Sincerely,

William Paul Goranson, P.E.
Manager, Radiation Safety, Regulatory Compliance and Licensing

Enclosures

CC: Jill Caverly, NRC
Marvin Freeman, QMC
Terry Fletcher, QMC w/o attachments
Peter Luthiger, QMC w/o attachments
Russell Jones, QMC

NMSS01 Public

ATTACHMENT A

DESIGN REPORT - POND 2 EROSION PROTECTION
AMBROSIA LAKE MILL, NEW MEXICO

DESIGN REPORT – POND 2 EROSION PROTECTION
AMBROSIA LAKE MILL, NEW MEXICO

DESIGN REPORT – POND 2 EROSION PROTECTION
AMBROSIA LAKE MILL, NEW MEXICO

Prepared for:

Quivira Mining Company
P.O. Box 218
Grants, New Mexico 87020

Prepared by:

Maxim Technologies, Inc.
10601 Lomas NE, Suite 106
Albuquerque, New Mexico 87112

August 29, 2001

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INTRODUCTION

This design report was prepared by Maxim Technologies, Inc. (Maxim) for Quivira Mining Company (Quivira) as part of their agreement for engineering services dated July 2001. Maxim has been retained to evaluate flood and long-term erosion conditions at the Ambrosia Lake Facility near Grants, New Mexico and to prepare designs for the long-term stability of tailings and evaporation ponds at this uranium mill tailings disposal site. This report provides the basis for the design required by the first of four tasks included in the agreement. Task One addresses erosion concerns at Pond 2, a reclaimed tailings pond, and consists of two sub-tasks: 1) Designing a run-on apron for the natural slope above the southwestern portion of the reclaimed pond; and 2) Designing the run-off apron for the southern toe of the reclaimed pond. Figure 1 is a schematic representation of the areas of concern in the current study.

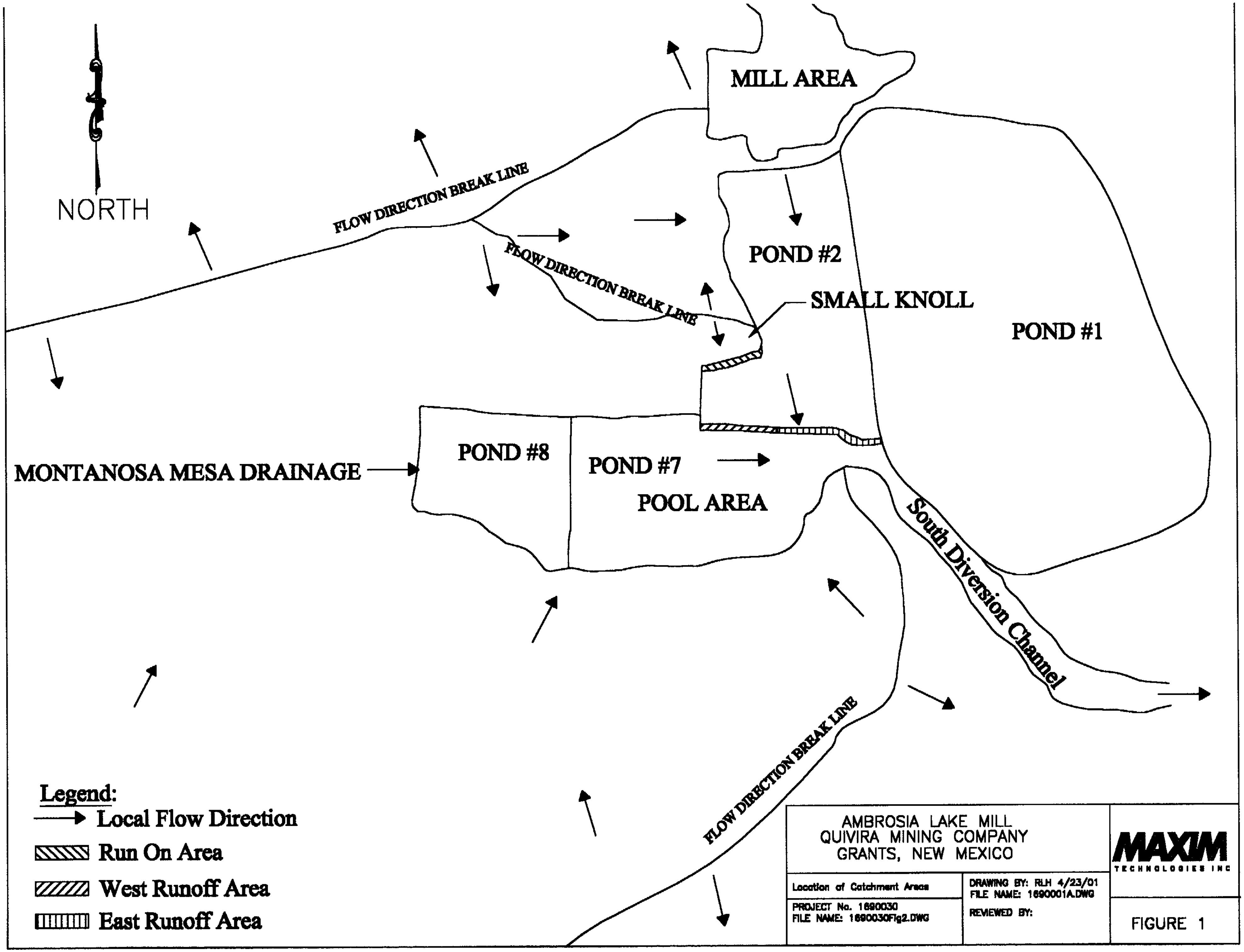
Pond 2 is partially reclaimed but the northern portion remains uncovered to allow for burial of byproduct material and the mill. The southern portion of the reclaimed pond has a radon barrier rock cover serving as erosion protection. For purposes of this design effort, it has been assumed that the entire pond is covered with the radon barrier and the rock erosion protection since this future condition will generate more run-off than the existing condition.

The analysis conducted for this design is consistent with Nuclear Regulatory Commission (NRC) guidance, particularly, *Design of Erosion Protection for Long-Term Stabilization* (Johnson 1999). This guidance, referred to as NUREG-1623 in this report, requires, in most cases, that erosion protection be designed for a 1,000-year life to minimize future maintenance issues. Because flood events with a 1,000 year recurrence interval are difficult to quantify, the guidance recommends use of the probable maximum precipitation event (PMP) for design purposes. PMPs can be derived for various parts of the United States using appropriate hydrometeorological reports. The report that addresses New Mexico east of the continental divide is *Hydrometeorological Report No. 55A, Probable Maximum Precipitation Estimates – United States between the Continental Divide and the 103rd Meridian* (Hansen *et al.* 1988). Appropriate PMPs are used to develop runoff hydrographs and determine the probable maximum flood (PMF) for an area of concern. The final step in the design process is to apply the PMF to the appropriate erosion control design method. Guidance for design of riprap erosion protection is found in Appendix D of NUREG-1623.

This design report is limited to those items affecting design of Pond 2 erosion protection, namely, the run-on and run-off issues mentioned previously. The report first addresses the run-on issue and then the run-off issue. Methods of analysis are described for both design issues including derivation of the PMP and calculation of the appropriate PMFs. The calculation of the riprap sizing is then described, and the report concludes with a discussion of other issues that affect the design.

1.0 PMP CALCULATION

Maxim verified the PMP calculation performed by others following the methods outlined in *Hydrometeorological Report No. 55A* (Hansen *et al.* 1988). The PMP rainfall depth calculated previously for the 1-hour local storm was 9.6 inches with no areal reduction. For the 3.7 square mile drainage that lies to the south of Pond 2 (called the Montanosa Mesa drainage in this report), the one-hour PMP rainfall depth was calculated to be 9.45 inches (Michaud 1990) presumably computed with an areal reduction factor. Maxim's calculation of the PMP depth arrived at a 9.5 inch value for the 1-hour, 1-square mile local storm, slightly less than the previously calculated value of 9.6 inches. Because the values are so similar, we used the slightly higher, previously determined values, in our calculations. Calculation sheets are attached in Appendix A.


NORTH
MILL AREA
FLOW DIRECTION BREAK LINE
FLOW DIRECTION BREAK LINE
POND #2
SMALL KNOLL
POND #1
POND #8
POND #7
POOL AREA
MONTANOSA MESA DRAINAGE
South Diversion Channel
FLOW DIRECTION BREAK LINE
Legend:
Local Flow Direction
Run On Area
West Runoff Area
East Runoff Area
AMBROSIA LAKE MILL
QUIVIRA MINING COMPANY
GRANTS, NEW MEXICO
MAXIM
TECHNOLOGIES INC
Location of Catchment Areas
DRAWING BY: RLH 4/23/01
FILE NAME: 1690001A.DWG
PROJECT No. 1690030
FILE NAME: 1690030Fig2.DWG
REVIEWED BY:
FIGURE 1

2.0 RUN-ON CALCULATIONS

A small, south-facing slope of natural ground lies immediately above the southwest portion of Pond 2 (Figure 2). Quivira and the NRC have expressed concern that the run-on from this slope could erode the radon cover of this portion of Pond 2. In order to perform peak run-off calculations on this slope, Maxim asked Quivira to survey two cross-sections on the slope (Figure 3). Using the 9.6 inch PMP determined previously, Maxim performed a PMF calculation for this area (see Appendix A). The first step in this calculation was the determination of the time of concentration (t_c), which is 1.5 minutes on this short (250 feet), steep (20 foot drop) slope. NUREG-1623 guidance suggests setting the incremental rainfall period equal to the time of concentration. Because the shortest incremental rainfall listed in *Methodologies for Evaluating Long-Term Stabilization Designs for Uranium Mill Tailings Impoundments* (Nelson *et al.* 1986) is 2.5 minutes, this incremental rainfall was used in the calculation instead of 1.5 minutes. The small size of the catchment suggested use of the Rational Method for calculation of the PMF rather than the more detailed Soil Conservation Service (SCS) Soil Cover Complex Method or other unit hydrograph methods. The resulting peak PMF for the 250 ft long slope segment is 0.13 cfs/ft.

Maxim followed the guidance provided in NUREG-1623, Appendix D, Section 6 to size a run-on apron. Although this guidance, based on the method developed by Abt *et al.* (1998), is intended for run-off aprons, the geometrical situation is the same in this run-on scenario where a steep slope is transitioning to a flatter slope. In this case the steep slope is natural ground and the flat slope is the reclaimed Pond 2 surface. Use of the equation developed by Abt *et al.* and the calculated discharge of 0.13 cfs/ft results in a rock d_{50} of 2.9 inches to prevent erosion. Because a d_{50} =3.2 inch rock gradation was previously approved by the NRC for work performed at the Quivira Mine and an on-site stockpile of the same rock gradation is available, the run-on design incorporated the d_{50} =3.2 inch for construction.

The width and depth of the apron were determined using guidance in NUREG-1623, Appendix D, Section 6 and a filter gravel with a rock d_{50} of 1.0 inches was designed to prevent scour beneath the apron. Sheet 4 in Appendix D shows the details of the design and specifies the rock and filter gradations.

3.0 RUN-OFF APRON

A run-off apron is needed along the south toe of the Pond 2 embankment to prevent scour from incising the tailings cap during extreme run-off events. The general approach for this analysis consisted of two tasks:

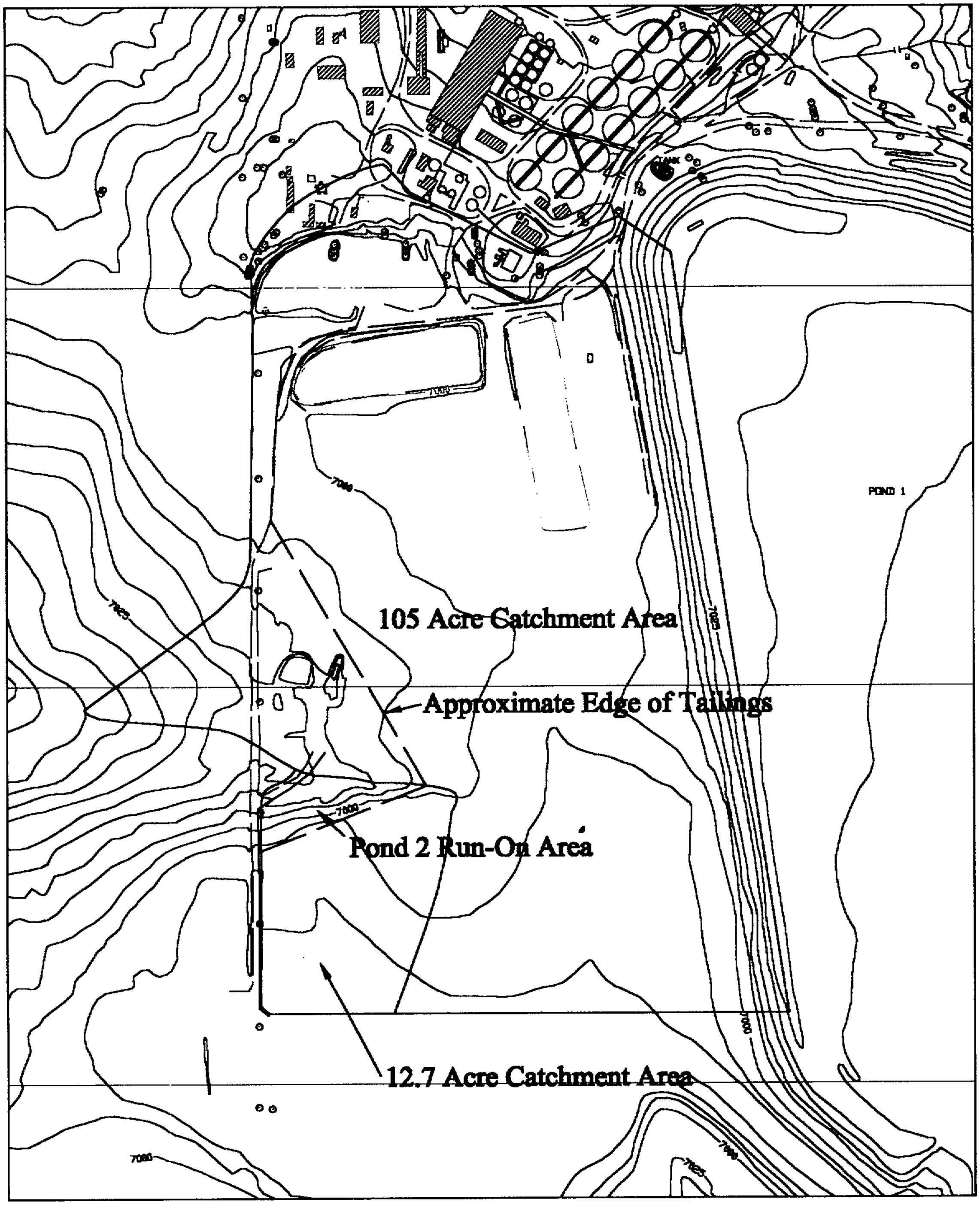
1) Determining the apron requirements based on run-off analysis for Pond 2 in accordance with NUREG-1623, Appendix D, Section 6; and

2) Determining rock protection requirements due to the PMF passing through the Montanosa Mesa drainage south of Pond 2 in accordance with NUREG-1623, Appendix D, Section 5.

Each of these analyses is described separately in this section of the report.

3.1 RUN-OFF FROM POND 2

The 1 hr. local PMP depth for Pond 2 is 9.6 inches. The Pond 2 catchment includes both essentially impervious covered tailings and natural ground to the west of the impoundment. In these calculations it is assumed that the entire tailings area is capped although the northern portion of this area is not yet capped and closed. There are two catchment areas on the pond, a 105 acre area that includes a portion of the natural slopes west of the pond and the northern and eastern portions of the pond itself. This catchment drains to the south and exits across the south embankment of Pond 2. A smaller catchment of 12.7 acres includes the natural slope analyzed in Section 2.0 of this report as well as the southwest corner of the pond. This catchment drains to the south, exiting over the south embankment of Pond 2. Catchment areas are shown on Figure 2.



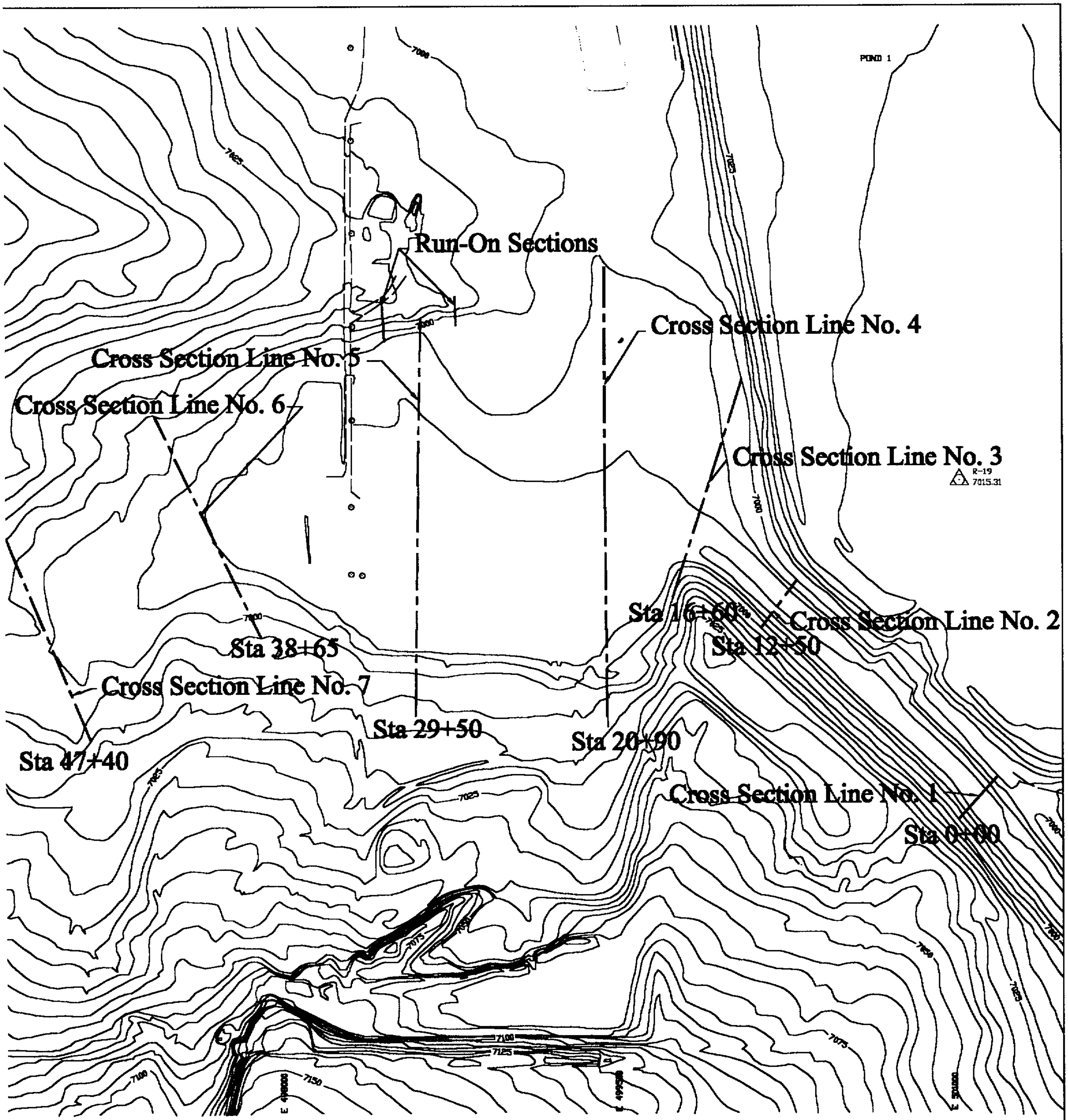
NORTH

1 in. = 600 ft

AMBROSIA LAKE MILL
QUIVIRA MINING COMPANY
GRANTS, NEW MEXICO
RUNOFF APRON DESIGN – Pond 2

MAXIM TECHNOLOGIES INC

Location of Catchment Areas	DRAWING BY: RLH 4/23/01 FILE NAME: 1690001A.DWG	
PROJECT No. 1690030 FILE NAME: 1690030Fig2.DWG	REVIEWED BY:	FIGURE 2



AMBROSIA LAKE MILL
QUIVIRA MINING COMPANY
GRANTS, NEW MEXICO
APRON DESIGN – Pond 2

MAXIM TECHNOLOGIES INC

Location of Cross Sections	DRAWING BY: RLH 4/23/01 FILE NAME: 1690001A.DWG	
PROJECT No. 1690030 FILE NAME: 1690030Fig2.DWG	REVIEWED BY:	FIGURE 3

The time of concentration for the 105 acre area is 14 minutes and the 15 minute incremental rainfall amount given in *Hydrometeorological Report No. 55A* (Hansen *et al.* 1988) was used to determine a 6.5 inch PMP depth. Using the Rational Method, a PMF peak discharge of 2,316 cfs was calculated for this drainage. These calculations are presented in Appendix B, Run-Off Calculations.

Riprap was sized according to the method of Abt *et al.* (1998). The length of the south embankment is 1,000 feet, resulting in a unit flow of 2.32 cfs/ft. Using the maximum measured embankment slope of 14.7 percent and a concentration factor of 2.5, a riprap size d_{50} of 12 inches results. Due to the placement requirements for larger rock, we have provided a slope flattening design at Quivira Mine's request. By flattening the current slope of 14.7 percent to 10.0 percent, rock sizing was reduced from the d_{50} of 12 inches to a d_{50} of 9.2 inches, therefore, reducing the quantity of rock requiring "hand-placing" techniques. A riprap size gradation based on Army Corps of Engineers guidance was developed (ASCE 1995), and filter blankets were designed in accordance with the findings of Sherard *et al.* (1984). This method requires that five times the d_{85} of the filter be no smaller than the d_{15} of the riprap, and that the d_{15} of the filter be no larger than five times the d_{85} of the subgrade material. Because of the large range in sizes between the fine-grained base material (sandy loams) and the riprap, two filter layers were required; a finer sand filter underneath a coarser gravel filter. The riprap design applies to the eastern 1,000 feet of the south embankment of Pond 2 as shown on Sheet 1 of Appendix D. The riprap designs, filter designs, and gradations are presented on Sheet 3 in Appendix D.

For the 12.7 acre catchment, a time of concentration of six minutes was calculated and a six-minute PMP depth of 4.6 inches was calculated using the incremental rainfall information in Nelson *et al.* (1986). The Rational Method gives a unit peak flow of 0.93 cfs/ft. for this catchment. Using a maximum embankment slope of 12.9 percent and a flow concentration factor of 2.0, the method of Abt *et al.* (1998) predicts a rock d_{50} of 6.1 inches. At the request of the Quivira mine, the rock d_{50} was increased to 9.2 inches to coincide with the rock specified for the east portion of south embankment. Dimensions of the apron were likewise increased as a result of the larger, more conservative riprap sizing. This change was made due to operational concerns based on rock availability Calculations are found in Appendix B. Riprap gradation and filter requirements were determined as for the 105 acre catchment. This riprap design applies to the western portion of the southern embankment of Pond 2 as shown on Sheet 1 in Appendix D.

3.2 MONTANOSA MESA DRAINAGE PMF

In addition to potential extreme flows which will run off the Pond 2 embankment, the tailings cover must be protected from the PMF that could flow from the Montanosa Mesa drainage to the south of Pond 2 (Figure 1). An investigation was undertaken to determine what erosional forces could result from such a flow on the Pond 2 embankment. This investigation consisted of developing the PMF for the drainage (previously determined by others) using HEC-1 (USACE 1990) and determining the PMF water-surface profile in the vicinity of Pond 2 using HEC-RAS (USACE 1998). The velocity and depth of flow determined from the hydraulic analysis was used to determine the need for riprap on the Pond 2 embankment and apron. Calculations for this analysis are found in Appendix C.

The Montanosa Mesa drainage PMP depth is calculated at 9.45 inches using the areal reduction factor for a 3.7 square mile basin. A composite curve number of 73.4 was determined by Quivira Mining in a 1986 application to the NRC and was employed in this calculation. A hydrograph was developed using the SCS method and HEC-1 that showed that the peak flow was 12,842 cfs, very close to the 13,000 cfs value previously determined by others for Quivira. This hydrograph was then routed through the pool south of Pond 2 using HEC-1. Outflow from this pool is controlled by the South Diversion Channel, which constricts flows downstream of the pool. The pool has the effect of reducing the outflow through the South Diversion Channel, resulting in a peak outflow of 9,800 cfs. Reducing the east portion of the south embankment slope from 14.7 percent to 10 percent results in placement of approximately 4630 cubic yards of material within the pool footprint. Maxim conducted an analysis to determine whether construction of this embankment would have any effect on pool draindown time. A HEC-1 modeling run determined that after four hours of draindown, residual water in the pool is reduced by 0.3 acre feet over the existing condition.

HEC-RAS was used to determine velocities and depths of flows in the vicinity of the Pond 2 embankment. Sections used for this model are shown in Figure 3. Sections 1 and 2 are based on the typical section of the engineering plans for the South Diversion Channel set at the elevations shown on the 2001 topographic map supplied by Quivira. Sections 3, 4 and 5 were surveyed in the field by Quivira. Sections 6 and 7, which are less critical to the analysis because they only determine the inflow water elevations and velocities, were developed from the 2001 topographic map.

A roughness coefficient (Manning's n) of 0.02 was used for graded areas surfaced with small diameter rock such as the south diversion channel and Pond 2 cover. A roughness coefficient of 0.03 was used for all other areas. Results of the hydraulic analysis shows that the inflow to the pool area is slightly supercritical and a hydraulic jump will occur at the upstream end of the pool. This hydraulic jump should occur at least 500 feet upstream of the Pond 2 embankment. Flow through the pool area is very slow with a left overbank velocity in the vicinity of the Pond 2 embankment of about 0.67 ft/sec. Depth of flow over the apron is about 10 feet. U.S. Army Corps of Engineers (ASCE 1995) guidance for riprap design does not consider velocities less than 8 ft/sec., at which velocity a d_{30} = 0.3 ft. stone is required. Because the expected velocity is much less than 8 ft./sec., no rock protection is required to prevent erosion from the PMF in the drainage south of Pond 2. Therefore, the runoff apron design has been based solely on run-off from Pond 2. Results from the HEC-1 and HEC-RAS analyses are found in Appendix C.

Because the HEC-RAS model was based on limited cross-section data and there are significant changes in hydraulic conditions through the modeled reach, the computer program generated warning messages. These messages are not considered detrimental to the general results obtained because the velocities calculated for the reach of interest are so low that further refinement of the model would be unlikely to increase the velocities enough to require riprap protection from the Montanosa Mesa drainage PMF.

4.0 OTHER DESIGN CONSIDERATIONS

The cross-sectional dimensions of the riprap aprons have been determined from the relations established by Abt *et al.* (1998) that the apron width should be at least 15 times d_{50} and the depth should be at least three times d_{50}. The aprons are generally wider than this criterion to permit construction of an erosion resistant transition at the junction of the existing rock cover with the apron. The edges of the apron excavations have also been sloped to 2V:1H to permit placement of filters to the surface of the ground. This should eliminate potential scour in the native material adjacent to the upstream and downstream edges of the aprons as well as below the aprons. Design drawings for the aprons are found in Appendix D.

The aprons should slope to the downstream edge with a minimum slope of two percent or at a slope that matches the slope of the natural ground, should it be steeper than two percent. This slope will help ensure that water exits from the outside edge of the apron. If the aprons need to be built on longitudinal slopes (slopes along the toe of the embankment) that are greater than 0.5 percent, measures will need to be taken to prevent flow along the apron causing channelized flow and potential scour of the apron. This is most likely to occur in the run-on apron shown on Sheet 4 in Appendix D. It is recommended that all portions of the apron with longitudinal slopes greater than 0.5 percent be constructed in the following manner:

1. Place rock in lifts no thicker than one foot.
2. Backfill the voids between rocks with a one to one mixture of native soil (taken from the trench excavation) and filter gravel.
3. Compact the backfilled riprap using vibratory methods to ensure material fills the voids.

4. Repeat steps 2 and 3 for additional lifts.

This procedure should eliminate the tendency for water to flow along the riprap apron. Specifications for riprap and filter materials are found on the construction drawings in Appendix D.

5.0 REFERENCES

Abt, S. R., T. L. Johnson, C. I. Thornton, and S. C. Trabant, 1998. *Riprap Sizing at Toe of Embankment Slopes.* Journal of Hydraulic Engineering, v. 124, No. 7.

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Hansen, E. M., D. D. Fenn, L. C. Schreiner, R. W. Stodt, and J. F. Miller, 1988. *Hydrometeorological Report No. 55A, Probable Maximum Precipitation Estimates – United States between the Continental Divide and the 103rd Meridian.* U. S. Department of Commerce, Silver Spring, Maryland.

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Michaud, P. W. 1990. Letter from U. S. Nuclear Regulatory Commission, Region IV to Quivira Mining company dated September 24, 1990.

Nelson, J. D., S. R. Abt, R. L. Volpe, D. van Zyl, N. E. Hinkle, W. R. Staub, 1986. *Methodologies for Evaluating Long-Term Stabilization Designs for Uranium Mill Tailings Impoundments.* NUREG/CR-4620, U. S. Nuclear Regulatory Commission, Washington, D.C.

Sherard, J. L., L. P. Dunnigan, and J. R. Talbot, 1984. *Filters for Silts and Clays.* Journal of Geotechnical Engineering, Vol. 110, No. 6.

United States Army Corps of Engineers, 1990. *HEC-1 Flood Hydrograph Package.* Version 4.0. Hydrologic Engineering Center, Davis, California.

United States Army Corps of Engineers, 1998. *HEC-RAS River Analysis System.* Version 2.2. Hydrologic Engineering Center, Davis, California.

APPENDIX A

CALCULATIONS FOR POND 2 RUN-ON

MAXIM TECHNOLOGIES INC

BY B Bucker DATE 7/11/01

JOB TITLE Quivira - Engineering JOB NUMBER 1690030

SUBJECT PMP Calculation - Local Storm SHEET -

Reference: Hydrometeorological Report No. 55A
U.S. Dept of Commerce, NOAA, June 1988

Calculate local storm PMP for mine site following method in Section 14.3.

1. 1-hr 1mi² PMP at 5000 ft el. from Plate IVc
   10.5 in.
2. Elevation adjustment - use 7,000 ft site elevation
   Maximum 12-hr persisting 1000 MB Dew Point 76.6°F from Figure 4.11
   From Figure 14.3 - Elevation adjustment = 0.90
3. 0.90 × 10.5 in = 9.5 in 1 mi² - 1 hr.
4. From Table 12.4, 6 hr. storm is 1.35 × 1 hr. storm

   9.5 × 1.35 = 12.8 in

5. Areal reduction factors will depend on basin.

For Arroyo del Puerto Basin

1. 1 hr - 1mi² PMP at 5000' El = 10.4" from Plate IVc
2. Assume average basin el of 7500'; max 12 hr persistent 1000 MB dew point - 76.6°F

   Elevation adjustment = 0.86

3. 0.86 × 10.4 = 8.9" 1 hr - 1 mi² PMP
5. For 1 hr storm areal reduction factor is .58
   Basin Area = 57 mi²
   0.58 × 8.9 = 5.2"

MAXIM TECHNOLOGIES INC

BY RLH - Bill Bucher DATE 3/27/01

JOB TITLE Quivira Engineering JOB NUMBER 1690030

SUBJECT Run-On to Pond 2 SHEET 1 of 2

Use Method in NUREG 1623 Appendix D

Slope Length = 250' (From Quivira Survey)

Maximum Slope 17% (From Quivira Survey)

Elev. Difference = 20'

$$t_c = (11.9\ L^3/H)^{0.385}$$

$$= \left(11.9\left(\frac{250}{5280}\right)^3/20\right)^{0.385}$$

$= 0.02$ hrs. or 1.5 min.

Use 2.5 min rainfall from Nelson et al (1986)

- the shortest increment available

2.5 min PMP = 0.275 X 9.6" = 2.64"

Use Rational Method Equation for Unit Slope (1' wide)

A = 1' x 250' = 250 Ft² or 0.006 Acres

i = 60 x 2.64 / 2.5 = 63 in/hr

Q = Cia = 0.35 X 63 X 0.006

Q = 0.132 cfs/ft Use $C_f = 3$ (Concentration Factor)

Using Equat. D-18 From NUREG-1623 App. D.

$$D_{50} = 10.46 \cdot S^{0.43}(C_f \times q_u)^{0.56}$$

$$D_{50} = 10.46(0.17)^{0.43}(3 \times 0.132)^{0.56}$$

D_{50} = <u>2.9 in</u>

MAXIM TECHNOLOGIES INC

BY RLH + Bill Bucher DATE 3/27/01

JOB TITLE Quivira Mining JOB NUMBER 1690030

SUBJECT Pond 2 Run-On (Continued) SHEET 2 of 2

Run-On Apron Rock Gradation:

$d_{50} = 2.9$ in → 1.22 lb Stone @ 165 lb/ft^3

Based on previously approved $D_{50} = 3.2$" rock gradation for work completed at the Quivira Mine by the NRC,

$D_{50} = 3.2$"

Sieve Size	% Passing (By Weight)
6 in	100 %
5 in	78-100
4 in	35-100
3 in	12-45
2 in	0-20

APPENDIX B

CALCULATIONS FOR POND 2 RUN-OFF

Method: Calculate Rock Size for Toe Apron for Pond 2 using method in NUREG-1623 Appendix D Section 6.

Location: West Portion of Apron (12.7 Acre Segment)

→ 1. PMP = 9.6" (1hr - 1mi²)

Calculate PMF from Rational Method Eqn.

$A = 1000' \times 1' = 1000\,ft^2 = 0.023$ acres

$T_c = (11.9\ L^3/H)^{0.385}$

$L = 1000'/5280 = 0.19$ mi

$H = 7015' - 6985' = 30'$

$T_c = (11.9\ (.19)^3/30)^{0.385}$

$= 0.10\ hr \times 60\ min/hr = 6\ min$

6 min PMP = 0.48 × 9.6" = 4.6"
(Based on Table 2.1 of Nelson et al (1986))

$i = \frac{4.6\ in}{6\ min} \times 60\ min/hr = 46\ in/hr$

C for 2.4 acres soil = 0.35

C for 10.3 acres Cover = 1.0

$C_{ave} = \frac{2.4 \times 0.35 + 10.3 \times 1.0}{12.7} = 0.88$

$Q = CiA = 0.88 \times 46 \times 0.023$

Q = 0.93 cfs/ft

(continued)

MAXIM TECHNOLOGIES INC

BY RLH - Bill Bucher DATE 2/23/01

JOB TITLE Quivira Engineering JOB NUMBER 1690030

SUBJECT Pond 2 Runoff (continued) SHEET 2 of 2

→ 2. Embankment side slopes

At Section R-11 (Section 5), Slope = 12.9% based on Quivira Field Survey.

→ 3. Flow Concentration Factor $C_f = 2.0$

→ 4. Rock Sizing from equation D-18

$$D_{50} = 10.46 \cdot S^{0.43} (C_f \times q_d)^{0.56}$$

$$= 10.46 (0.129)^{0.43} (2.0 \times 0.93)^{0.56}$$

$$D_{50} = 6.1'' \rightsquigarrow 6.7''$$ 15 lb Stone (165 lbs/ft³)

→ 5. Gradation

Based on ACE 12" Stone d_{50} = 21.5 lbs @ 165 lbs/ft³ - ACE Manual EM 1110-2-1601 Table 3-1 (1995).

Sieve Designation	% Passing
12"	100%
8"	60-90
6"	25-50
5"	10-30
4"	0-10

Maxim Technologies, Inc.

JOB NO. 1690030 JOB TITLE Quivira - Engineering DATE 8/27/01 BY RLH - BB

SUBJECT Run OFF From Pond 2 CHECKED ______ SHEET 1 OF 2

Method: Calculate Rock Size For Toe Apron For Pond 2 using method in NUREG-1623 Appendix D section 6.

Location: East Portion of Apron (105 Acre Segment)

→ 1. PMP = 9.6" (1 hr - 1 mi²)

Calculate PMF From Rational Equation

Area = 105 acre

$T_c = (11.9\ L^3/H)^{0.385}$

L = 2500/5280 = 0.47 mi

H = 7040' - 6985' = 55'

T_c = 0.23 hr x 60 min/hr = 14 min

USE PMP for 15 min duration

= 0.68 x 9.6" = 6.5 in. (HMR55A)

i = 6.5 in / .25 hr = 26.1 in/hr

For 25 acres of soil use C = 0.35 (heavy soil, steep - Chow, 1964)

For 80 acres of tailings cover assume C = 1.0 (Clay cap with no infiltration or adsorpt)

$$C_{AVE} = \frac{(25 \times .35 + 80 \times 1.0)}{105} = 0.85$$

Q = CiA = 0.85 x 26.1 x 105 = 2316 cfs

Length of Toe = 1,000 ft

(continued)

Maxim Technologies, Inc.

JOB NO. 1690030 JOB TITLE Quivira-Eng DATE 8/27/01 BY RLH-B-B

SUBJECT Run Off Pond 2 CHECKED ______ SHEET 2 OF 2

$Q = 2316$ cfs

Length = 1000 ft

Unit Run-Off $= q_d = \frac{2316}{1000} = 2.32$ cfs/ft

→ 2. Embankment Slope

Reconstruct 14.7% slope to 10% slope

(Approx 5,500 cuyd of Clay Fill)

→ 3. Use Flow Concentration Factor of $2.0 = C_f$

→ 4. Sizing of Rock Using Eq. D-18

$$D_{50} = 10.46 \cdot S^{0.43} (C_f \times q_d)^{0.56}$$

$$= 10.46 (0.10)^{0.43} (2.0 \times 2.32)^{0.56}$$

$D_{50} = 9.2''$ ≈ 9.2" Median Rock Size

Maxim Technologies, Inc.

JOB NO. 1690030 JOB TITLE Quivira - Engin. DATE 8/27/01 BY BLH - BB

SUBJECT Pond 2 - Run OFF Gradation CHECKED ________ SHEET 1 OF 1

East Apron d_{50} = 9.2" -> 38.9 lb stone @ 165 lb/ft³

Base on ACE

165 lb/ft³ - ACE Manual EM-1110-2-1601, 1995

Table 3.1 -> 15" Minus For The 165 lb/ft³

Sieve Designation	Percent Passing
15"	100%
12"	70 - 90%
9"	30 - 55%
6"	0 - 10%

Maxim Technologies, Inc.

JOB NO. 1690030 JOB TITLE Quivira - Engineering DATE 8/27/01 BY RLH - BB

SUBJECT Run-Off Pond 2 Slopes CHECKED ________ SHEET 1 OF 2

Method: Calculate Rock Size For Outside Slope For Pond 2 using method in NUREG-1623, Appendix D - Section 2 - Riprap For Side Slopes.

Location: East Portion of Slope @ 10%

→ 1.) PMP = 9.6" (1 hr - 1 mi²)

Calculate PMF From Rational Method Equation

Area = 105 acres

$T_c = (11.9\ L^3/H)^{0.385}$

L = 0.47 mi

H = 55'

T_c = 0.23 hr 60 min/hr = 14 min

USE PMP For 15 min duration

= .68 x 9.6" = 6.5 in (HMR55A, Table 12.4)

i = 6.5 in/.25 hr = 26.1 in/hr

$$C_{AVE} = \frac{25 \times .35 + 80 \times 1.0}{105} = 0.85$$

Q = CiA = 2316 cfs

$$q_d = \frac{2316}{1000\ ft} = 2.32\ cfs/ft$$ on 1,000 ft Apron

→ 2.) Embankment Slope:

Reconstruction of Outside Slope 14.7% → 10%

(continued)

Maxim Technologies, Inc.

JOB NO. 1690030 JOB TITLE Quivira Engin. DATE 8/21/01 BY RLA BB

SUBJECT Pond 2 East Slopes. (continued) CHECKED ______ SHEET 2 OF 2

→ 3.) Size Rock Using Abt. & Johnson Method

$$D_{50} = 5.23 \cdot S^{0.43} (gd)^{0.56}$$

$$D_{50} = 5.23 (10)^{0.43} \times (2.32)^{0.56}$$

D_{50} = <u>3.1"</u> in 8.0

⊛ Assuming Concentration Factor = 1.0

→ 4.) Based on a previously approved D_{50} = 3.2" rock gradation for work completed at the Quivira Mine by the NRC.

D_{50} = 3.2 inch

Sieve Size	Percent Passing (By Weight)
6 in	100 %
5 in	78 - 100
4 in	35 - 100
3 in	12 - 45
2 in	0 - 20

Maxim Technologies, Inc.

JOB NO. 1690030 JOB TITLE Quivira - Engineer DATE 3/23/01 BY RLH · BB

SUBJECT Pond 2 Run OFF - Slopes CHECKED ________ SHEET 1 OF 2

Location: West Portion of Slope (12.7 acre segment)

→ 1. PMP = 9.6" (1hr-1mi²)

Calculate PMF From Rational Method Equat.

Area = 1000' x 1' = 1000 ft² = 0.023 acres

Area = 12.7 acres

$T_c = (11.9\ L^3/H)^{0.385}$

L = 1000'/5280' = 0.19 mi

H = 7015' - 6985' = 30'

$T_c = (11.9\ (.19)^3/30)^{0.385}$ = 0.10 hr = 6 min

6 min PMP = 0.48 x 9.6" = 4.6"
* Table 2.1 of Nelson et al (1986)

i = 4.6/6 min x 60 min/hr = 46 in/hr

C for 2.4 acres Soil = 0.35

C for 10.3 acres Rock Cover = 1.0

$C_{Ave} = \frac{2.4(.35) + 10.3(1.0)}{12.7} = 0.877$

Q = Cia = 0.877 x 46 x 0.023 = 0.93 cfs/ft

→ 2. Embankment Side Slope - Slope = 12.9%

→ 3. Size Rock Using Abt & Johnson Method

$D_{50} = 5.23 \cdot S^{.43} \cdot (q_d)^{0.56}$

$D_{50} = 5.23(.129)^{0.43}(0.93)^{0.56}$

D_{50} = 2.1" (assuming concentration factor = 1.0)

MAXIM TECHNOLOGIES INC

BY RLH - Bill Bucher DATE

JOB TITLE Quivira Engineering JOB NUMBER 1690030

SUBJECT Pond 2 - Run OFF Gradation - Slope SHEET 2 of 2

West Slope d_{50} = 2.1" → 0.46 lb Stone @ 165 lbs/ft³

→ 4. Based on a previously approved D_{50} = 2" rock gradation for work completed at the Quivira Mine by the NRC.

D_{50} = 2.0 inch

Sieve Size	Percent Passing (By Weight)
4 in	100 %
3 in	66-100
2 in	13-50
1 in	0-10

```
HEC1 S/N: 1343001338        HMVersion: 6.33    Data File: n:\quivira\pond2\pond2pmf.txt

*****************************************
*****************************************
*                                       *
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*                                       *
*              MAY   1991               *
*                                       *
*            VERSION 4.0.1E             *
*                                       *
*                                       *
*                                       *
*  RUN DATE  07/25/2001  TIME  13:49:09 *
*                                       *
*                                       *
*                                       *
*****************************************
*****************************************

*                                          *
*   U.S. ARMY CORPS OF ENGINEERS            *
*   HYDROLOGIC ENGINEERING CENTER           *
*         609 SECOND STREET                 *
*      DAVIS, CALIFORNIA 95616              *
*         (916) 756-1104                    *
*                                          *

X      X  XXXXXXX   XXXXX           X
X      X  X        X     X         XX
X      X  X        X                X
XXXXXXX   XXXX     X         XXXXX  X
X      X  X        X                X
X      X  X        X     X          X
X      X  XXXXXXX   XXXXX          XXX

::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::
:::                                    :::
:::  Full Microcomputer Implementation :::
:::               by                   :::
```

```
:::         Haestad Methods, Inc.         :::
:::                                       :::
:::::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1           ID   QUIVIRA - POND 2 FLOOD HYDROLOGY  FILE:POND2PMF.TXT
   2           ID   1/4-HR. PMF, POINT DIST., MEDIAN DIST.
   3           ID   25 JULY 2001
   4           ID   B. BUCHER, MAXIM TECHNOLOGIES, HELENA, MT
*** FREE ***
               *
               * *** TIME SPECIFICATION
   5           IT       1 01JUL01    0000      50
               *
               * Rainfall time increment
   6           IN       5
               *
               * *** GLOBAL OUTPUT OPTIONS
   7           IO       2       0
               *
               * ***
               *
               *

   8           KK     IN1
   9           KM   HYDROGRAPH FOR POND 2
               * Basin area
  10           BA   0.164
               *
               * Rainfall data
  11           PB     6.4
  12           PI     .52     .30     .18
               *
               * Basin Losses
  13           LS       0      84       0
               *
               * Unit hydrograph
  14           UD    0.14
               *
               * ***
               *
               *
  15           ZZ
```

```
HEC1 S/N: 1343001338        HMVersion: 6.33     Data File: n:\quivira\pond2\pond2pmf.txt

*****************************************
****************************************
*                                       *
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*                                       *
*              MAY  1991                *
*                                       *
*           VERSION 4.0.1E              *
*                                       *
*                                       *
*                                       *
*  RUN DATE  07/25/2001  TIME  13:49:09 *
*                                       *
*                                       *
*                                       *
*****************************************
****************************************

                                                   *
                                                   *    U.S. ARMY CORPS OF ENGINEERS
                                                   *    HYDROLOGIC ENGINEERING CENTER
                                                   *          609 SECOND STREET
                                                   *       DAVIS, CALIFORNIA 95616
                                                   *           (916) 756-1104
                                                   *


                 QUIVIRA - POND 2 FLOOD HYDROLOGY  FILE:POND2PMF.TXT
                 1/4-HR. PMF, POINT DIST., MEDIAN DIST.
                 25 JULY 2001
                 B. BUCHER, MAXIM TECHNOLOGIES, HELENA, MT

   7 IO        OUTPUT CONTROL VARIABLES
                     IPRNT          2  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT        HYDROGRAPH TIME DATA
                      NMIN          1  MINUTES IN COMPUTATION INTERVAL
                     IDATE     1JUL 1  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ         50  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     1JUL 1  ENDING DATE
```

```
          NDTIME        0049  ENDING TIME
          ICENT           19  CENTURY MARK

      COMPUTATION INTERVAL     0.02 HOURS
           TOTAL TIME BASE     0.82 HOURS

 ENGLISH UNITS
      DRAINAGE AREA          SQUARE MILES
      PRECIPITATION DEPTH    INCHES
      LENGTH, ELEVATION      FEET
      FLOW                   CUBIC FEET PER SECOND
      STORAGE VOLUME         ACRE-FEET
      SURFACE AREA           ACRES
      TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
***


              **************
              *            *
  8 KK        *     IN1    *
              *            *
              **************

                          HYDROGRAPH FOR POND 2

  6 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN            5  TIME INTERVAL IN MINUTES
                     JXDATE       1JUL 1  STARTING DATE
                     JXTIME            0  STARTING TIME

               SUBBASIN RUNOFF DATA

 10 BA          SUBBASIN CHARACTERISTICS
                      TAREA         0.16  SUBBASIN AREA

                PRECIPITATION DATA

 11 PB                STORM         6.40  BASIN TOTAL PRECIPITATION
```

12 PI INCREMENTAL PRECIPITATION PATTERN

0.10	0.10	0.10	0.10	0.10	0.06	0.06	0.06	0.06	0.06
0.04	0.04	0.04	0.04	0.04					

13 LS SCS LOSS RATE

STRTL 0.38 INITIAL ABSTRACTION
CRVNBR 84.00 CURVE NUMBER
RTIMP 0.00 PERCENT IMPERVIOUS AREA

14 UD SCS DIMENSIONLESS UNITGRAPH

TLAG 0.14 LAG

***

UNIT HYDROGRAPH
44 END-OF-PERIOD ORDINATES

21.	65.	125.	208.	314.	416.	489.	528.	533.	521.
483.	439.	384.	316.	253.	209.	174.	145.	123.	103.
85.	71.	59.	49.	41.	34.	28.	24.	20.	16.
14.	11.	9.	8.	7.	6.	5.	4.	3.	3.
2.	1.	1.	0.						

****
****

HYDROGRAPH AT STATION IN1

****
****

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
								*								
1	JUL	0000	1	0.00	0.00	0.00	0.	*	1	JUL	0025	26	0.00	0.00	0.00	785.
1	JUL	0001	2	0.67	0.63	0.04	1.	*	1	JUL	0026	27	0.00	0.00	0.00	663.
1	JUL	0002	3	0.67	0.39	0.28	8.	*	1	JUL	0027	28	0.00	0.00	0.00	553.
1	JUL	0003	4	0.67	0.24	0.43	32.	*	1	JUL	0028	29	0.00	0.00	0.00	458.
1	JUL	0004	5	0.67	0.16	0.50	81.	*	1	JUL	0029	30	0.00	0.00	0.00	379.
1	JUL	0005	6	0.67	0.12	0.55	167.	*	1	JUL	0030	31	0.00	0.00	0.00	316.
1	JUL	0006	7	0.38	0.05	0.33	297.	*	1	JUL	0031	32	0.00	0.00	0.00	263.
1	JUL	0007	8	0.38	0.05	0.34	469.	*	1	JUL	0032	33	0.00	0.00	0.00	220.
1	JUL	0008	9	0.38	0.04	0.34	674.	*	1	JUL	0033	34	0.00	0.00	0.00	183.
1	JUL	0009	10	0.38	0.04	0.35	895.	*	1	JUL	0034	35	0.00	0.00	0.00	153.

1 JUL 0010	11	0.38	0.03	0.35	1112.	*	1 JUL 0035	36	0.00	0.00	0.00	127.
1 JUL 0011	12	0.23	0.02	0.21	1307.	*	1 JUL 0036	37	0.00	0.00	0.00	106.
1 JUL 0012	13	0.23	0.02	0.21	1472.	*	1 JUL 0037	38	0.00	0.00	0.00	88.
1 JUL 0013	14	0.23	0.02	0.21	1603.	*	1 JUL 0038	39	0.00	0.00	0.00	73.
1 JUL 0014	15	0.23	0.01	0.22	1698.	*	1 JUL 0039	40	0.00	0.00	0.00	61.
1 JUL 0015	16	0.23	0.01	0.22	1750.	*	1 JUL 0040	41	0.00	0.00	0.00	51.
1 JUL 0016	17	0.00	0.00	0.00	1760.	*	1 JUL 0041	42	0.00	0.00	0.00	43.
1 JUL 0017	18	0.00	0.00	0.00	1731.	*	1 JUL 0042	43	0.00	0.00	0.00	36.
1 JUL 0018	19	0.00	0.00	0.00	1670.	*	1 JUL 0043	44	0.00	0.00	0.00	30.
1 JUL 0019	20	0.00	0.00	0.00	1587.	*	1 JUL 0044	45	0.00	0.00	0.00	25.
1 JUL 0020	21	0.00	0.00	0.00	1479.	*	1 JUL 0045	46	0.00	0.00	0.00	20.
1 JUL 0021	22	0.00	0.00	0.00	1351.	*	1 JUL 0046	47	0.00	0.00	0.00	16.
1 JUL 0022	23	0.00	0.00	0.00	1209.	*	1 JUL 0047	48	0.00	0.00	0.00	13.
1 JUL 0023	24	0.00	0.00	0.00	1062.	*	1 JUL 0048	49	0.00	0.00	0.00	10.
1 JUL 0024	25	0.00	0.00	0.00	919.	*	1 JUL 0049	50	0.00	0.00	0.00	8.
						*						

****
****

TOTAL RAINFALL = 6.40, TOTAL LOSS = 1.83, TOTAL EXCESS = 4.57

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	0.82-HR
(CFS)	(HR)	(CFS)				
1760.	0.27		592.	592.	592.	592.
		(INCHES)	4.568	4.568	4.568	4.568
		(AC-FT)	40.	40.	40.	40.

CUMULATIVE AREA = 0.16 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	IN1	1760.	0.27	592.	592.	592.	0.16		

*** NORMAL END OF HEC-1 ***

APPENDIX C

CALCULATIONS FOR MONTANOSA MESA PMF

```
HEC1 S/N: 1343001338        HMVersion: 6.33     Data File: N:\QUIVIRA\MONTIN5.TXT

*****************************************                      ****************************************
*                                       *                      *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                      *   U.S. ARMY CORPS OF ENGINEERS       *
*              MAY  1991                *                      *   HYDROLOGIC ENGINEERING CENTER      *
*            VERSION 4.0.1E             *                      *         609 SECOND STREET            *
*                                       *                      *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE  10/01/2001  TIME  16:36:10 *                      *          (916) 756-1104              *
*                                       *                      *                                      *
*****************************************                      ****************************************


                         X     X  XXXXXXX   XXXXX          X
                         X     X  X        X     X        XX
                         X     X  X        X               X
                         XXXXXXX  XXXX     X       XXXXX   X
                         X     X  X        X               X
                         X     X  X        X     X         X
                         X     X  XXXXXXX   XXXXX         XXX


                     ::::::::::::::::::::::::::::::::::::::::::
                     ::::::::::::::::::::::::::::::::::::::::::
                     :::                                    :::
                     :::  Full Microcomputer Implementation :::
                     :::                by                  :::
                     :::        Haestad Methods, Inc.       :::
                     :::                                    :::
                     ::::::::::::::::::::::::::::::::::::::::::
                     ::::::::::::::::::::::::::::::::::::::::::

            37 Brookside Road * Waterbury, Connecticut  06708 * (203) 755-1666


      THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

      THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
```

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
      LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         1        ID   QUIVIRA - MESA MONTANOSA FLOOD HYDROLOGY  FILE:MONTIN5.TXT
         2        ID   1-HR. PMF, WITH ROUTING THROUGH POOL, RATING CURVE FROM HEC-RAS
         3        ID   1 OCTOBER 2001, REDUCED POOL VOLUME BY 4630 CU. YDS.
         4        ID   B. BUCHER, MAXIM TECHNOLOGIES, HELENA, MT
*** FREE ***
                  *
                  * *** TIME SPECIFICATION
         5        IT       5 01JUL01    0000      50
                  *
                  * Rainfall time increment
         6        IN      15
                  *
                  * *** GLOBAL OUTPUT OPTIONS
         7        IO       2       0
                  *
                  * ***
                  *
                  *

         8        KK     IN1
         9        KM   HYDROGRAPH FOR MESA MONTANOSA DRAINAGE
                  *
                  * Basin area
        10        BA     3.7
                  *
                  * Rainfall data
        11        PB    9.45
        12        PI     .68     .18     .08     .06
                  *
                  * Basin Losses
        13        LS       0    73.4       0
                  *
                  * Unit hydrograph
        14        UD    0.66
                  *
                  * ROUTE FLOOD THROUGH POOL

        15        KK    OUT1  OUTFLOW FROM POOL
        16        RS       1    ELEV  6983.0
        17        SQ       0    1000    2000    3000    4000    5000    6000    7000    8000    9000
        18        SQ   10000   11000   12000
        19        SE  6984.9  6987.7  6989.2  6990.3  6991.2  6992.0  6992.7  6993.4  6994.0  6994.6
        20        SE  6995.1  6995.6 6996.16
```

```
21          SA       0     11.0   36.21    65.0
22          SE    6983     6985    6990    6995
            *
            * ***
            *
            *
23          ZZ
```

```
HEC1 S/N: 1343001338        HMVersion: 6.33    Data File: N:\QUIVIRA\MONTIN5.TXT

****************************************                            ***************************************
*                                      *                            *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                            *    U.S. ARMY CORPS OF ENGINEERS     *
*              MAY   1991              *                            *    HYDROLOGIC ENGINEERING CENTER    *
*           VERSION 4.0.1E             *                            *          609 SECOND STREET          *
*                                      *                            *       DAVIS, CALIFORNIA 95616       *
*  RUN DATE  10/01/2001  TIME  16:36:10 *                           *           (916) 756-1104            *
*                                      *                            *                                     *
****************************************                            ***************************************


                              QUIVIRA - MESA MONTANOSA FLOOD HYDROLOGY  FILE:MONTIN5.TXT
                              1-HR. PMF, WITH ROUTING THROUGH POOL, RATING CURVE FROM HEC-RAS
                              1 OCTOBER 2001, REDUCED POOL VOLUME BY 4630 CU. YDS.
                              B. BUCHER, MAXIM TECHNOLOGIES, HELENA, MT

   7 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           2  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1JUL 1  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ          50  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      1JUL 1  ENDING DATE
                      NDTIME        0405  ENDING TIME
                       ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL    0.08 HOURS
                        TOTAL TIME BASE    4.08 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

        **************
        *            *
  8 KK  *      IN1   *
        *            *
        **************
                   HYDROGRAPH FOR MESA MONTANOSA DRAINAGE

  6 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN          15  TIME INTERVAL IN MINUTES
                     JXDATE      1JUL 1  STARTING DATE
                     JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

 10 BA          SUBBASIN CHARACTERISTICS
                      TAREA        3.70  SUBBASIN AREA

                PRECIPITATION DATA

 11 PB                STORM        9.45  BASIN TOTAL PRECIPITATION

 12 PI            INCREMENTAL PRECIPITATION PATTERN
                     0.23       0.23       0.23       0.06       0.06       0.06       0.03       0.03       0.03       0.02
                     0.02       0.02

 13 LS          SCS LOSS RATE
                      STRTL        0.72  INITIAL ABSTRACTION
                     CRVNBR       73.40  CURVE NUMBER
                      RTIMP        0.00  PERCENT IMPERVIOUS AREA

 14 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG        0.66  LAG

                                                                      ***

                                                               UNIT HYDROGRAPH
                                                          42 END-OF-PERIOD ORDINATES
            110.       341.       656.      1096.      1651.      2124.      2417.      2534.      2530.      2388.
           2178.      1923.      1598.      1267.      1026.       840.       696.       585.       484.       393.
            327.       268.       222.       182.       149.       123.       101.        84.        69.        57.
             47.        38.        32.        27.        23.        20.        16.        12.         9.         6.
```

3. 0.

****

HYDROGRAPH AT STATION IN1

****

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1	JUL	0000	1	0.00	0.00	0.00	0.	*	1	JUL	0205	26	0.00	0.00	0.00	2119.
1	JUL	0005	2	2.14	1.74	0.40	44.	*	1	JUL	0210	27	0.00	0.00	0.00	1743.
1	JUL	0010	3	2.14	0.78	1.37	286.	*	1	JUL	0215	28	0.00	0.00	0.00	1435.
1	JUL	0015	4	2.14	0.42	1.72	916.	*	1	JUL	0220	29	0.00	0.00	0.00	1185.
1	JUL	0020	5	0.57	0.08	0.49	1972.	*	1	JUL	0225	30	0.00	0.00	0.00	978.
1	JUL	0025	6	0.57	0.07	0.50	3503.	*	1	JUL	0230	31	0.00	0.00	0.00	807.
1	JUL	0030	7	0.57	0.06	0.50	5530.	*	1	JUL	0235	32	0.00	0.00	0.00	665.
1	JUL	0035	8	0.25	0.03	0.23	7759.	*	1	JUL	0240	33	0.00	0.00	0.00	548.
1	JUL	0040	9	0.25	0.03	0.23	9743.	*	1	JUL	0245	34	0.00	0.00	0.00	451.
1	JUL	0045	10	0.25	0.02	0.23	11280.	*	1	JUL	0250	35	0.00	0.00	0.00	372.
1	JUL	0050	11	0.19	0.02	0.17	12317.	*	1	JUL	0255	36	0.00	0.00	0.00	308.
1	JUL	0055	12	0.19	0.02	0.17	12826.	*	1	JUL	0300	37	0.00	0.00	0.00	256.
1	JUL	0100	13	0.19	0.02	0.17	12842.	*	1	JUL	0305	38	0.00	0.00	0.00	214.
1	JUL	0105	14	0.00	0.00	0.00	12459.	*	1	JUL	0310	39	0.00	0.00	0.00	177.
1	JUL	0110	15	0.00	0.00	0.00	11695.	*	1	JUL	0315	40	0.00	0.00	0.00	146.
1	JUL	0115	16	0.00	0.00	0.00	10634.	*	1	JUL	0320	41	0.00	0.00	0.00	118.
1	JUL	0120	17	0.00	0.00	0.00	9492.	*	1	JUL	0325	42	0.00	0.00	0.00	93.
1	JUL	0125	18	0.00	0.00	0.00	8389.	*	1	JUL	0330	43	0.00	0.00	0.00	70.
1	JUL	0130	19	0.00	0.00	0.00	7315.	*	1	JUL	0335	44	0.00	0.00	0.00	50.
1	JUL	0135	20	0.00	0.00	0.00	6315.	*	1	JUL	0340	45	0.00	0.00	0.00	35.
1	JUL	0140	21	0.00	0.00	0.00	5400.	*	1	JUL	0345	46	0.00	0.00	0.00	26.
1	JUL	0145	22	0.00	0.00	0.00	4549.	*	1	JUL	0350	47	0.00	0.00	0.00	18.
1	JUL	0150	23	0.00	0.00	0.00	3794.	*	1	JUL	0355	48	0.00	0.00	0.00	13.
1	JUL	0155	24	0.00	0.00	0.00	3145.	*	1	JUL	0400	49	0.00	0.00	0.00	9.
1	JUL	0200	25	0.00	0.00	0.00	2584.	*	1	JUL	0405	50	0.00	0.00	0.00	6.

****

TOTAL RAINFALL = 9.45, TOTAL LOSS = 3.29, TOTAL EXCESS = 6.16

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW					
		6-HR	24-HR	72-HR	4.08-HR	(CFS)	(HR)	
	(CFS)	12842.	1.00		3605.	3605.	3605.	3605.
	(INCHES)	6.164	6.164	6.164	6.164			
	(AC-FT)	1216.	1216.	1216.	1216.			

CUMULATIVE AREA = 3.70 SQ MI

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
 15 KK       *     OUT1   *       OUTFLOW FROM POOL
             *            *
             **************

                HYDROGRAPH ROUTING DATA

 16 RS            STORAGE ROUTING
                        NSTPS            1  NUMBER OF SUBREACHES
                         ITYP         ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC      6983.00  INITIAL CONDITION
                            X         0.00 WORKING R AND D COEFFICIENT

 21 SA                   AREA          0.0        11.0       36.2       65.0

 22 SE              ELEVATION      6983.00    6985.00    6990.00    6995.00

 17 SQ              DISCHARGE           0.       1000.      2000.      3000.      4000.      5000.      6000.      7000.      8000.      9000.
                                    10000.      11000.     12000.

 19 SE              ELEVATION      6984.90    6987.70    6989.20    6990.30    6991.20    6992.00    6992.70    6993.40    6994.00    6994.60
                                   6995.10    6995.60    6996.16

                                                                ***

                                                 COMPUTED STORAGE-ELEVATION DATA

              STORAGE        0.00       7.33     119.28     368.82
            ELEVATION     6983.00    6985.00    6990.00    6995.00

                                             COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

              STORAGE        0.00       6.29       7.33      52.01      92.35     119.28     130.36     166.38     201.99     236.09
              OUTFLOW        0.00       0.00      35.75    1000.00    2000.00    2727.35    3000.00    4000.00    5000.00    6000.00
            ELEVATION     6983.00    6984.90    6985.00    6987.70    6989.20    6990.00    6990.30    6991.20    6992.00    6992.70

              STORAGE      273.03     307.06     343.35     368.82     375.36     409.03     448.76
              OUTFLOW     7000.00    8000.00    9000.00    9799.80   10000.00   11000.00   12000.00
            ELEVATION     6993.40    6994.00    6994.60    6995.00    6995.10    6995.60    6996.16
```

HYDROGRAPH AT STATION OUT1

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	JUL	0000	1	0.	0.0	6983.0	1	JUL	0125	18	9649.	364.0	6994.9	1	JUL	0250	35	1634.	77.6	6988.7
1	JUL	0005	2	0.	0.2	6983.0	1	JUL	0130	19	9298.	352.8	6994.7	1	JUL	0255	36	1431.	69.4	6988.3
1	JUL	0010	3	0.	1.3	6983.4	1	JUL	0135	20	8834.	337.3	6994.5	1	JUL	0300	37	1250.	62.1	6988.1
1	JUL	0015	4	0.	5.4	6984.6	1	JUL	0140	21	8318.	318.6	6994.2	1	JUL	0305	38	1090.	55.7	6987.8
1	JUL	0020	5	195.	14.7	6985.4	1	JUL	0145	22	7723.	297.6	6993.8	1	JUL	0310	39	956.	50.0	6987.6
1	JUL	0025	6	547.	31.0	6986.4	1	JUL	0150	23	7071.	275.4	6993.4	1	JUL	0315	40	846.	44.9	6987.3
1	JUL	0030	7	1109.	56.4	6987.9	1	JUL	0155	24	6451.	252.8	6993.0	1	JUL	0320	41	747.	40.3	6987.0
1	JUL	0035	8	1980.	91.5	6989.2	1	JUL	0200	25	5827.	230.2	6992.6	1	JUL	0325	42	658.	36.2	6986.7
1	JUL	0040	9	3109.	134.3	6990.4	1	JUL	0205	26	5190.	208.5	6992.1	1	JUL	0330	43	578.	32.5	6986.5
1	JUL	0045	10	4405.	180.8	6991.5	1	JUL	0210	27	4608.	188.0	6991.7	1	JUL	0335	44	507.	29.2	6986.3
1	JUL	0050	11	5737.	227.1	6992.5	1	JUL	0215	28	4075.	169.1	6991.3	1	JUL	0340	45	443.	26.2	6986.1
1	JUL	0055	12	6921.	270.1	6993.3	1	JUL	0220	29	3592.	151.7	6990.8	1	JUL	0345	46	385.	23.5	6986.0
1	JUL	0100	13	8002.	307.1	6994.0	1	JUL	0225	30	3154.	135.9	6990.4	1	JUL	0350	47	335.	21.2	6985.8
1	JUL	0105	14	8807.	336.4	6994.5	1	JUL	0230	31	2785.	121.6	6990.1	1	JUL	0355	48	291.	19.2	6985.7
1	JUL	0110	15	9421.	356.8	6994.8	1	JUL	0235	32	2441.	108.7	6989.7	1	JUL	0400	49	252.	17.4	6985.6
1	JUL	0115	16	9762.	367.6	6995.0	1	JUL	0240	33	2129.	97.1	6989.3	1	JUL	0405	50	218.	15.8	6985.5
1	JUL	0120	17	9820.	369.5	6995.0	1	JUL	0245	34	1863.	86.8	6989.0							

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW						
			6-HR	24-HR	72-HR	4.08-HR	(CFS)	(HR)	
		(CFS)	9820.	1.33		3558.	3558.	3558.	3558.
		(INCHES)	6.084	6.084	6.084	6.084			
		(AC-FT)	1201.	1201.	1201.	1201.			

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE					
		6-HR	24-HR	72-HR	4.08-HR	(AC-FT)	(HR)
369.	1.33	144.	144.	144.	144.		

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE					
		6-HR	24-HR	72-HR	4.08-HR	(FEET)	(HR)
6995.01	1.33	6989.69	6989.69	6989.69	6989.69		

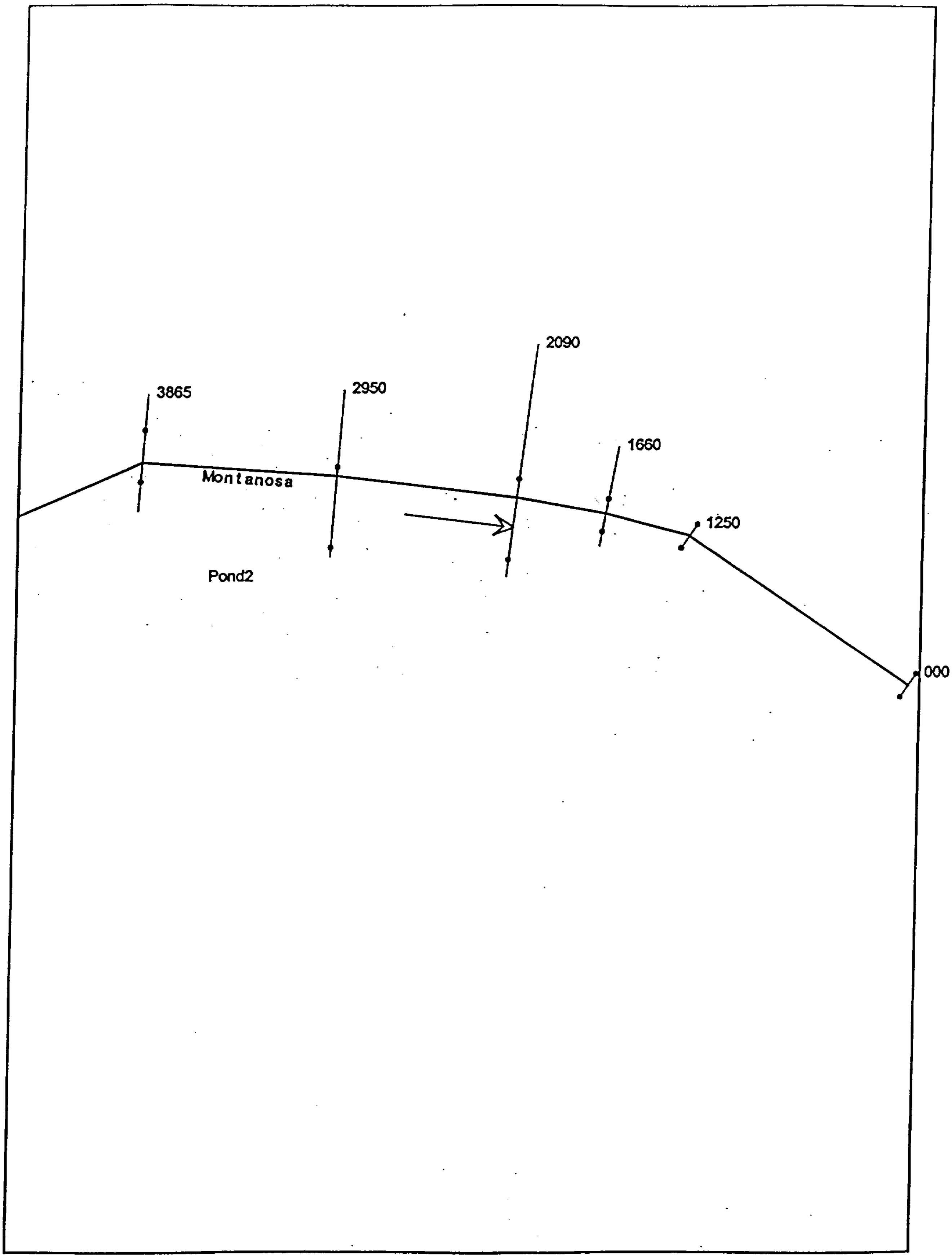
CUMULATIVE AREA = 3.70 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	IN1	12842.	1.00	3605.	3605.	3605.	3.70		
ROUTED TO	OUT1	9820.	1.33	3558.	3558.	3558.	3.70	6995.01	1.33

*** NORMAL END OF HEC-1 ***

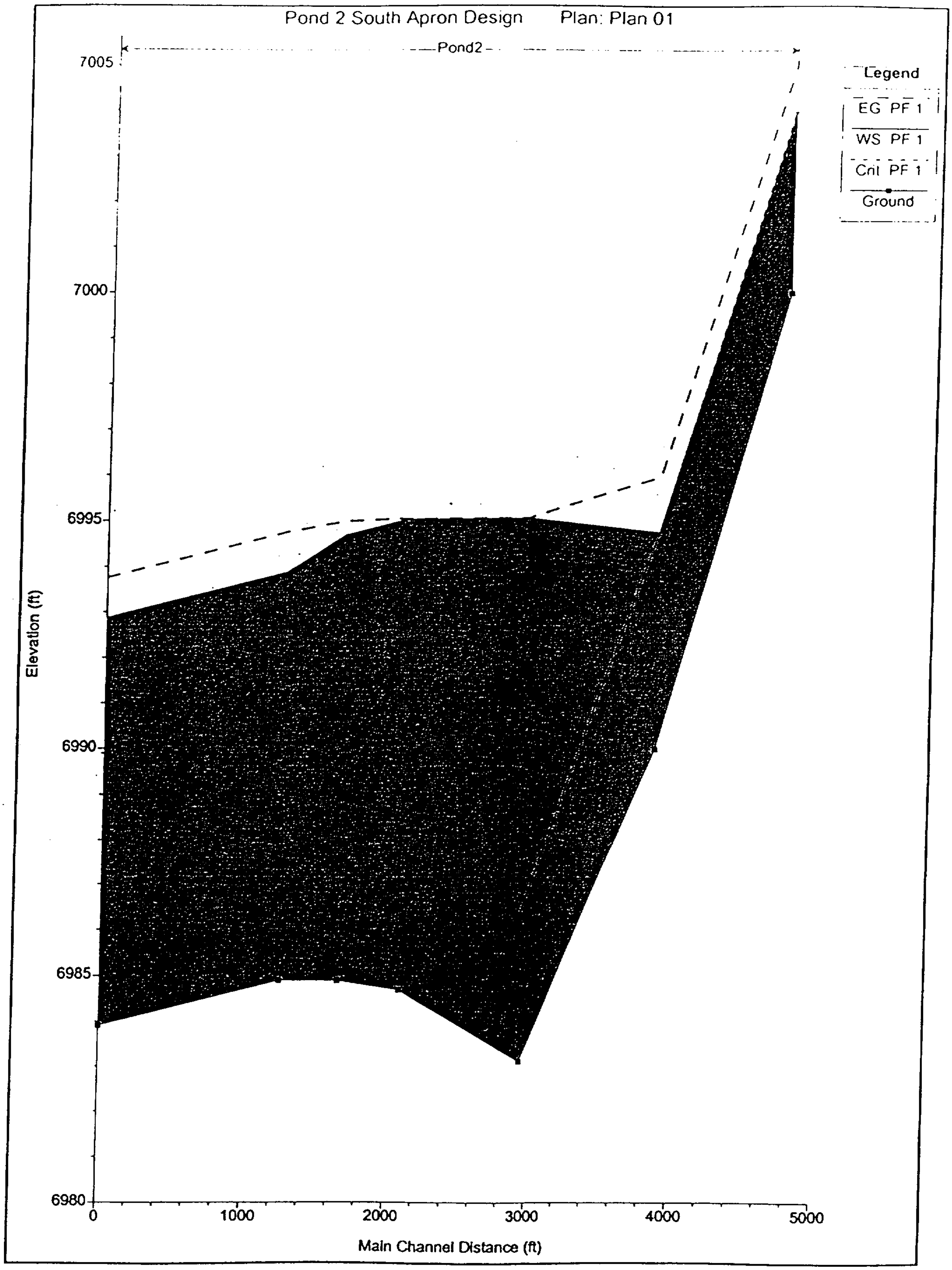
HEC-RAS RESULTS FOR MONTANOSA MESA DRAINAGE PMF



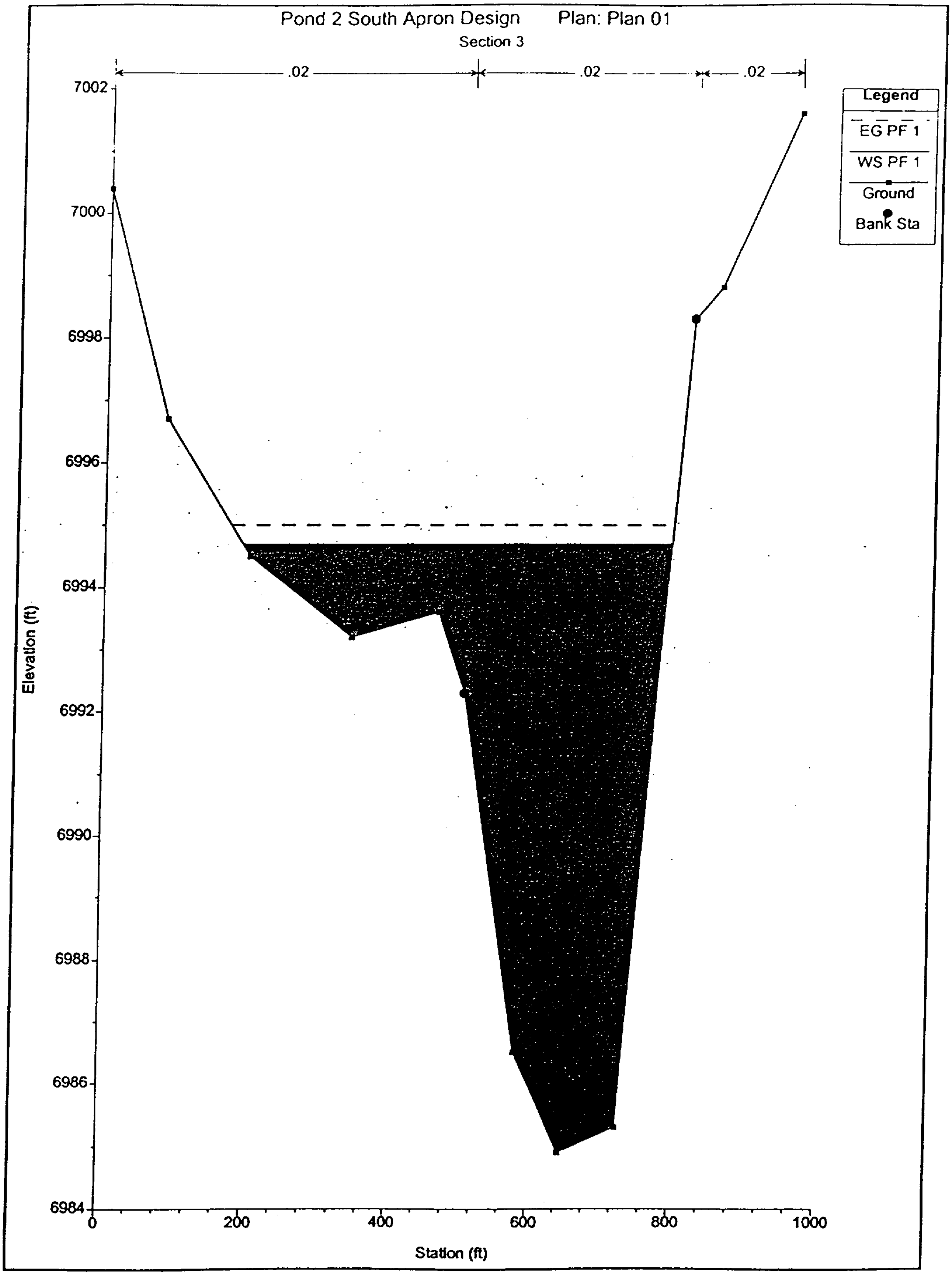
2090
3865
2950
1660
Montanosa
1250
Pond2
000

HEC-RAS Plan: PMF River: Montanosa Reach: Pond2 Profile: PF 1

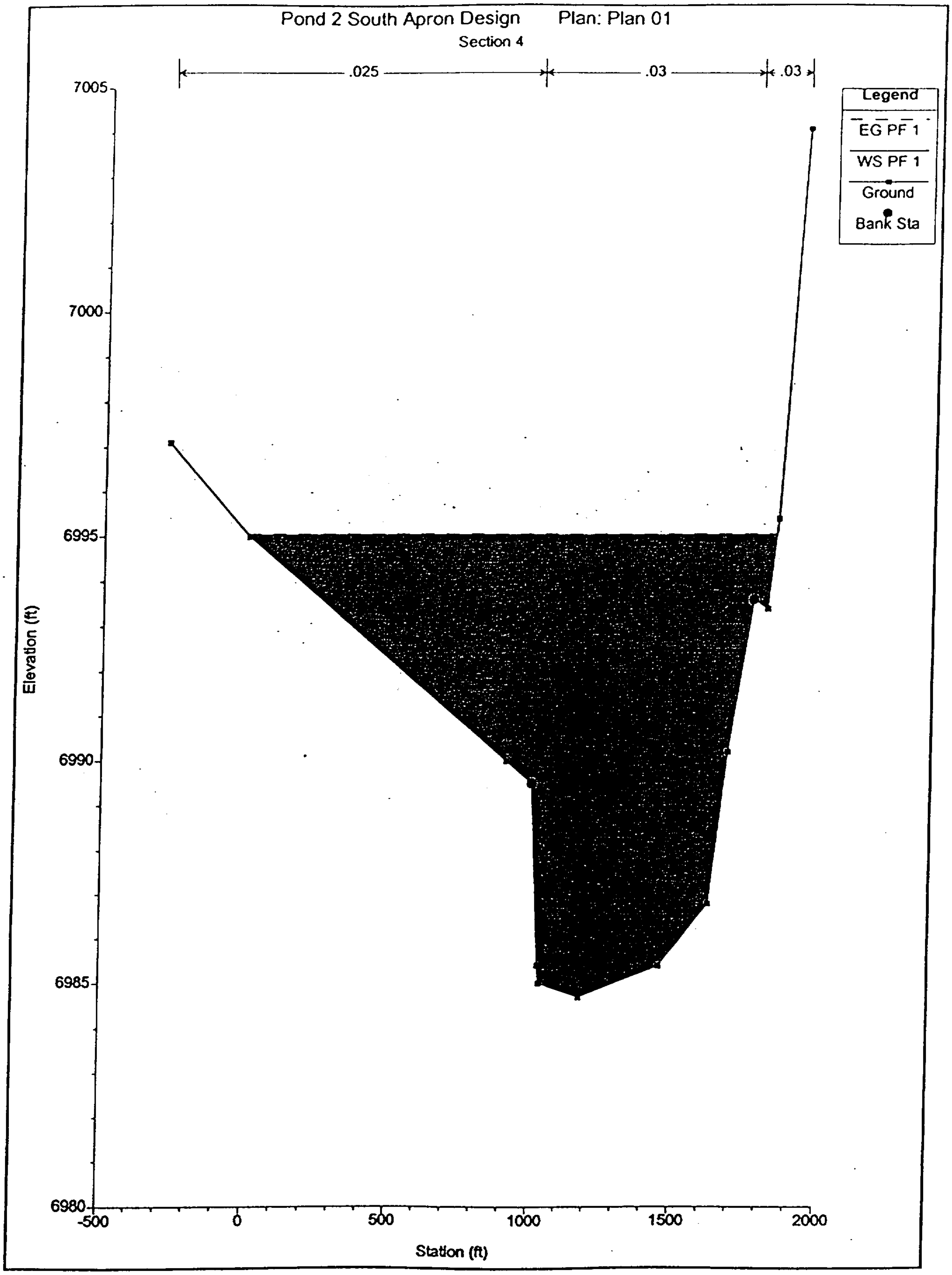
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Pond2	4740	9800.00	7000.00	7003.88	7003.98	7004.99	0.012004	8.44	1160.58	597.88	1.07
Pond2	3865	9800.00	6990.00	6994.76	6994.76	6995.97	0.009984	8.82	1110.80	466.60	1.01
Pond2	2950	9800.00	6983.10	6995.07	6986.44	6995.08	0.000019	1.00	10794.47	1504.23	0.06
Pond2	2090	9800.00	6984.70	6995.04		6995.06	0.000032	1.19	9557.65	1845.87	0.07
Pond2	1660	9800.00	6984.90	6994.70		6995.00	0.000265	4.50	2423.24	601.97	0.30
Pond2	1250	9800.00	6984.90	6993.88		6994.76	0.000799	7.53	1301.20	189.80	0.51
Pond2	000	9800.00	6983.90	6992.87	6989.89	6993.76	0.000802	7.54	1299.72	189.72	0.51



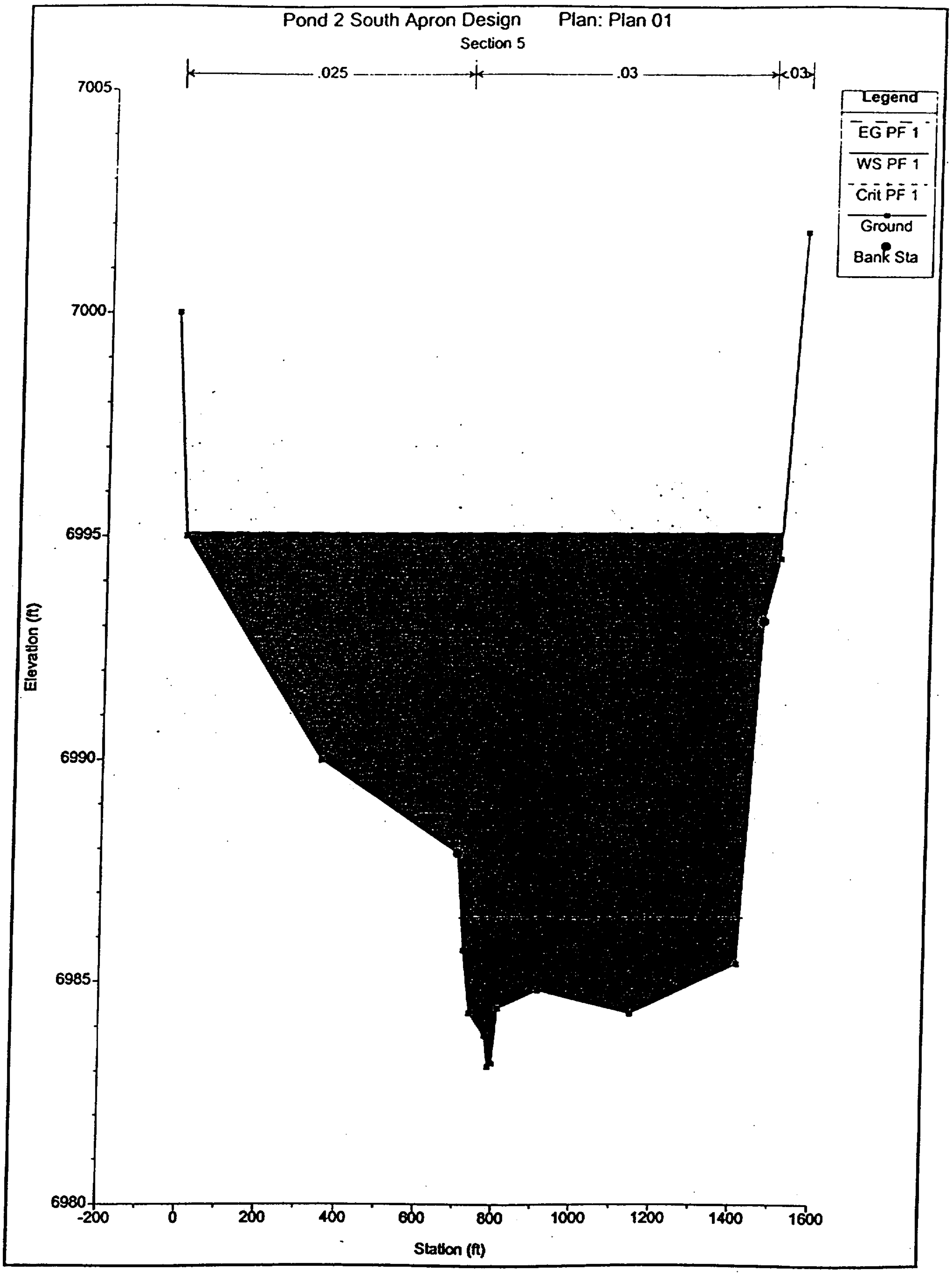
Pond 2 South Apron Design Plan: Plan 01
Pond2
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
7005
7000
6995
6990
6985
6980
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)



Pond 2 South Apron Design Plan: Plan 01
Section 3
.02
.02
.02
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
7002
7000
6998
6996
6994
6992
6990
6988
6986
6984
0
200
400
600
800
1000
Station (ft)



Pond 2 South Apron Design Plan: Plan 01
Section 4
.025
.03
.03
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
7005
7000
6995
6990
6985
6980
-500
0
500
1000
1500
2000
Station (ft)

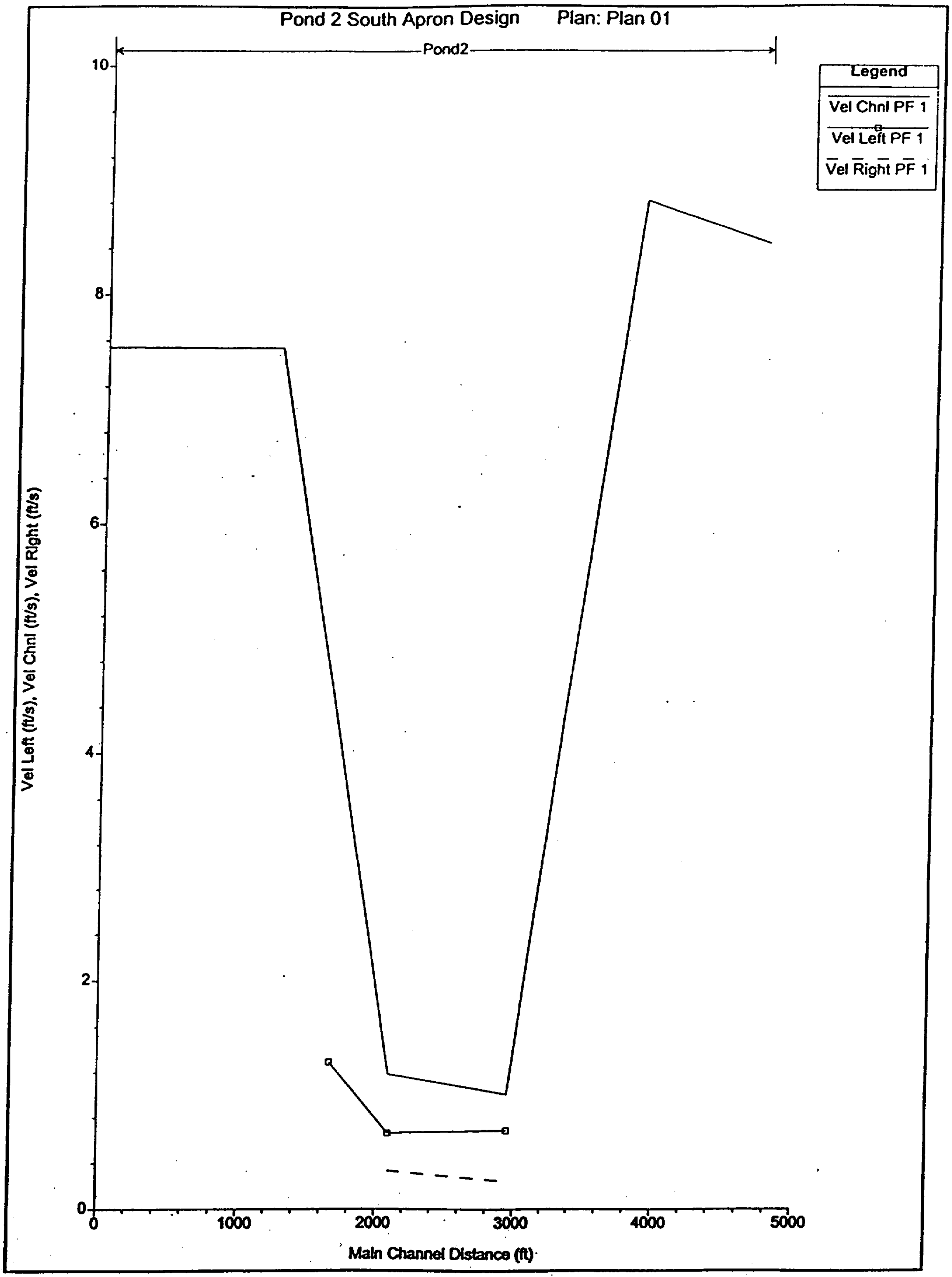

Pond 2 South Apron Design Plan: Plan 01
Section 5
.025
.03
.03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
7005
7000
6995
6990
6985
6980
Elevation (ft)
-200
0
200
400
600
800
1000
1200
1400
1600
Station (ft)

Plan: PMF Montanosa Pond2 RS: 2950 Profile: PF 1

E.G. Elev (ft)	6995.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.025	0.030	0.030
W.S. Elev (ft)	6995.07	Reach Len. (ft)	850.00	860.00	870.00
Crit W.S. (ft)	6986.44	Flow Area (sq ft)	3040.38	7704.81	49.28
E.G. Slope (ft/ft)	0.000019	Area (sq ft)	3040.38	7704.81	49.28
Q Total (cfs)	9800.00	Flow (cfs)	2078.99	7709.25	11.76
Top Width (ft)	1504.23	Top Width (ft)	700.41	762.00	41.82
Vel Total (ft/s)	0.91	Avg. Vel. (ft/s)	0.68	1.00	0.24
Max Chl Dpth (ft)	11.97	Hydr. Depth (ft)	4.34	10.11	1.18
Conv. Total (cfs)	2266672.0	Conv. (cfs)	480855.1	1783096.0	2720.4
Length Wtd. (ft)	858.02	Wetted Per. (ft)	700.46	762.88	41.88
Min Ch El (ft)	6983.10	Shear (lb/sq ft)	0.01	0.01	0.00
Alpha	1.08	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	90.01	238.32	2.10
C & E Loss (ft)	0.00	Cum SA (acres)	31.37	27.98	1.67

Plan: PMF Montanosa Pond2 RS: 2090 Profile: PF 1

E.G. Elev (ft)	6995.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.025	0.030	0.030
W.S. Elev (ft)	6995.04	Reach Len. (ft)	875.00	430.00	600.00
Crit W.S. (ft)		Flow Area (sq ft)	2789.61	6672.45	95.59
E.G. Slope (ft/ft)	0.000032	Area (sq ft)	2789.61	6672.45	95.59
Q Total (cfs)	9800.00	Flow (cfs)	1852.72	7915.59	31.69
Top Width (ft)	1845.87	Top Width (ft)	1005.60	766.00	74.27
Vel Total (ft/s)	1.03	Avg. Vel. (ft/s)	0.66	1.19	0.33
Max Chl Dpth (ft)	10.34	Hydr. Depth (ft)	2.77	8.71	1.29
Conv. Total (cfs)	1731503.0	Conv. (cfs)	327345.7	1398559.0	5599.1
Length Wtd. (ft)	482.53	Wetted Per. (ft)	1005.61	766.49	74.33
Min Ch El (ft)	6984.70	Shear (lb/sq ft)	0.01	0.02	0.00
Alpha	1.16	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	33.13	96.40	0.66
C & E Loss (ft)	0.03	Cum SA (acres)	14.72	12.90	0.51



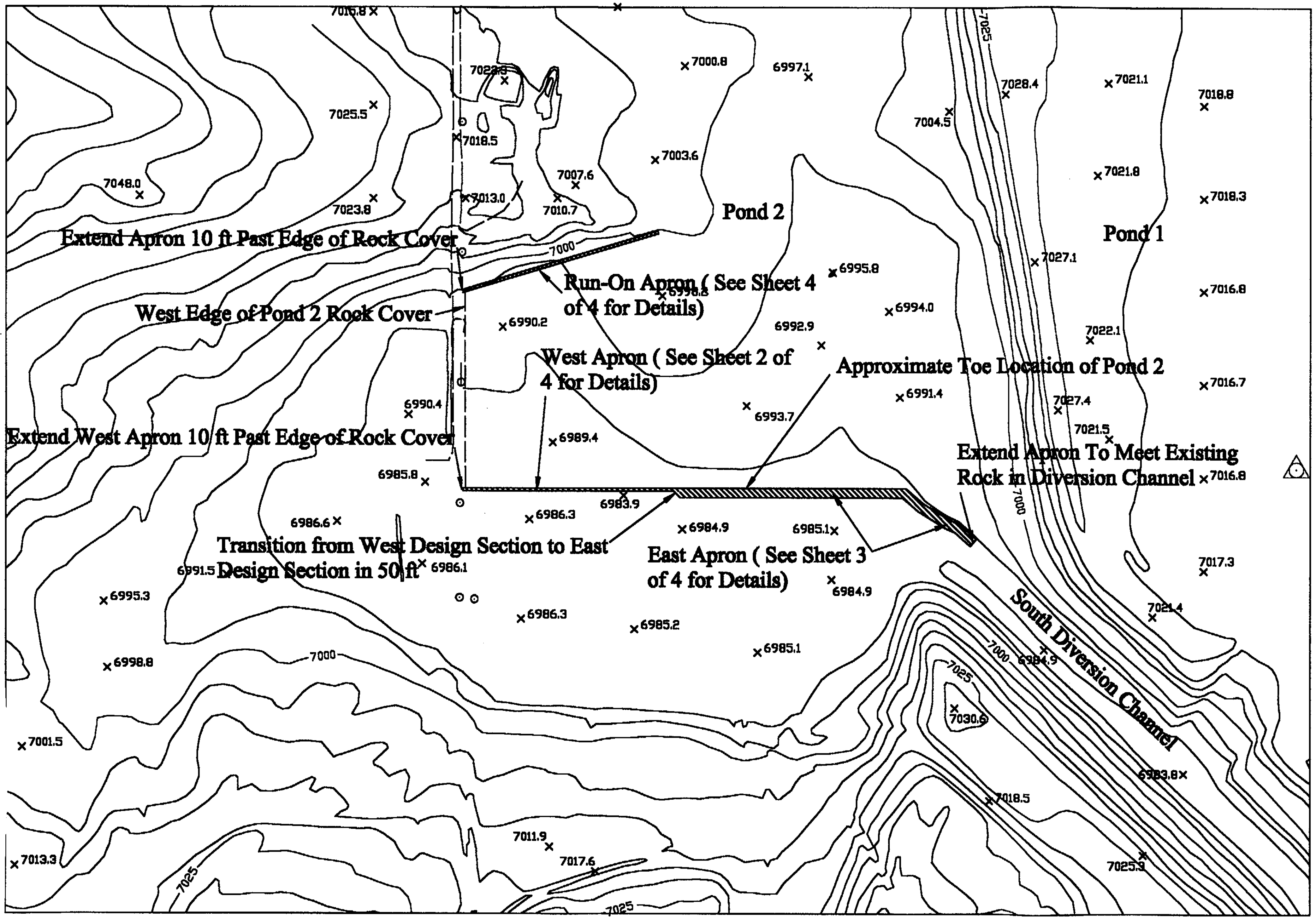
Pond 2 South Apron Design Plan: Plan 01
Pond2
Legend
Vel Chnl PF 1
Vel Left PF 1
Vel Right PF 1
Vel Left (ft/s), Vel Chnl (ft/s), Vel Right (ft/s)
0
2
4
6
8
10
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)

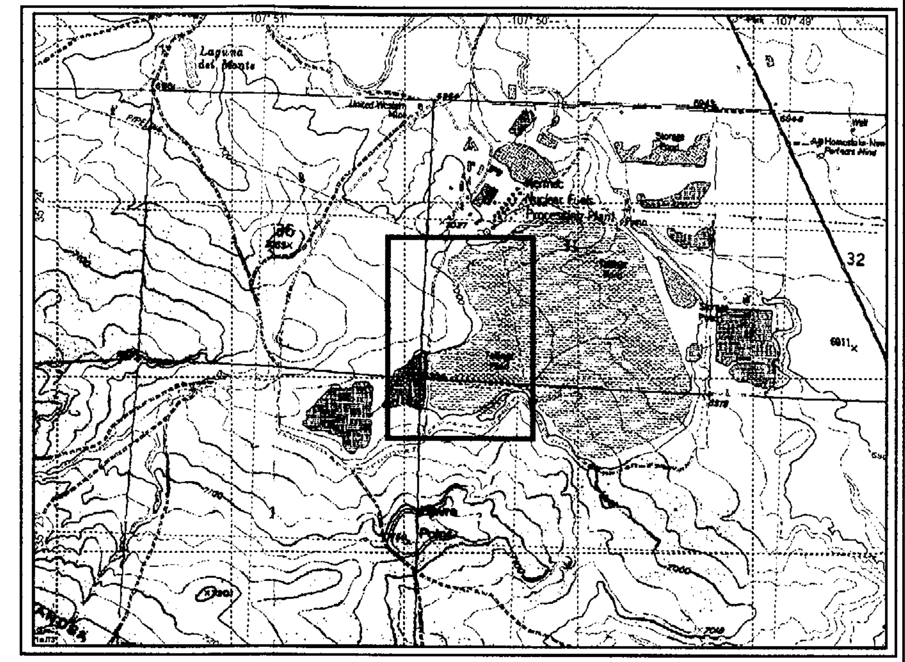
Errors Warnings and Notes for Plan : PMF

Location:	River: Montanosa Reach: Pond2 RS: 3865 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program
	used critical depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth,
	the calculated water surface came back below critical depth. This indicates that there is not a valid
	subcritical answer. The program defaulted to critical depth.
Location:	River: Montanosa Reach: Pond2 RS: 2950 Profile: PF 1
Note:	Hydraulic jump has occurred between this cross section and the previous upstream section.
Location:	River: Montanosa Reach: Pond2 RS: 2090 Profile: PF 1
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Montanosa Reach: Pond2 RS: 1660 Profile: PF 1
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Montanosa Reach: Pond2 RS: 1250 Profile: PF 1
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.

APPENDIX D

DESIGN DRAWINGS





1 in = 700 ft

Clifford E. Vaughan

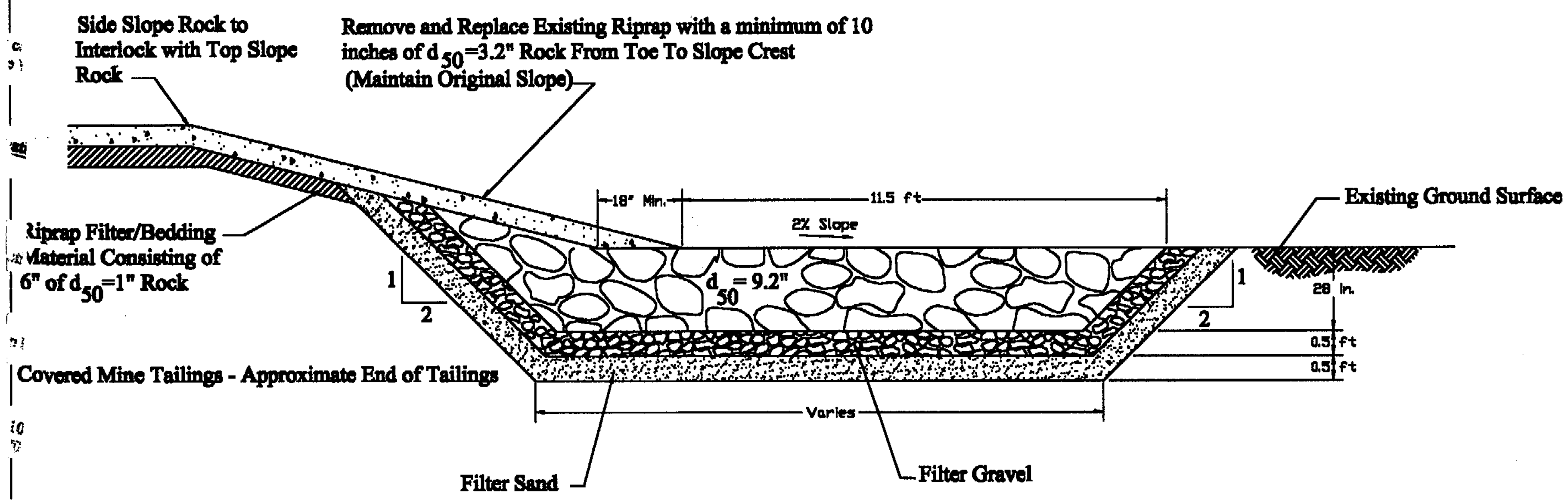
10/4/01
Date

[CONS]TRUCTION NOTES:

1. The west erosion protection apron shall be constructed along the south edge of Pond 2. The section is approximately 700 ft in length.
2. The run-on and west erosion protection aprons shall extend 10 ft west of the west end of the rock cover limits.
3. Transition between the west erostion protection apron and the east erosion protectoin apron designs shall be completed in 50 ft.
4. The east erosion protection apron shall be constsructed along the south edge of Pond 2. This section is approximately 1,000 ft in length.
5. The east end of the east erosion protection apron shall meet the existing rock in the south drainage channel.
6. The erosion protection apron ends shall be constructed with 2V:1H Slopes with bedding/filter materials extended to the ground surface.
7. The run-on erosion protection apron shall be constructed along the north edge of Pond 2 where the small knoll exists. The apron shall extend the full length of the knoll, approximately 700 ft.

AMBROSIA LAKE MILL QUIVIRA MINING COMPANY GRANTS, NEW MEXICO APRON DESIGN – Pond 2		MAXIM TECHNOLOGIES INC
PROJECT No. 1690030-100	DRAWING BY: RLH 9/23/01	SHEET 1 of 4
FILE NAME: 1690030S1.DWG	REVIEWED BY: WHB	

WEST APRON DESIGN - Typical Section
See Sheet 1 of 4 for Placement Location



Not To Scale

Clifford E. Vaughan 10/4/01

Date

CONSTRUCTION NOTES:

1. Rock Riprap for erosion protection aprons shall be placed and in conformance with Appendix F of *Design of Erosion Protection for Long-Term Stabilization*, U.S. Nuclear Regulatory Commission's NUREG - 1623 Draft Report unless otherwise specified in the Pond 2 Erosion Control Design Report or the Design Drawings.
2. Erosion protection aprons shall be sloped to the downstream edge with a minimum slope of two percent or at a slope that matches the slope of the natural ground, should it be steeper than two percent.
3. Erosion protection apron excavations shall be constructed with 2V:1H slopes to permit placement of the filter materials to the surface of the ground.
4. Excavations shall be constructed with flat bottoms free of loose debris, vegetation and muddy surfaces. The transition between the West Apron design and the East Apron design shall be completed in 50 ft.
5. The west portion of the erosion protection apron shall be constructed of a rock diameter d_{50} = 9.2" conforming to the following gradation:

Sieve Designation	Percent Passing
15"	100
12"	70 - 90
9"	30 - 55
6"	0 - 10

6. The west portion of the south slope of Pond 2 shall be covered using d_{50}=3.2". The slope shall be covered from the slope crest to the toe. The slope protection riprap rock shall conform to the following gradation:

Sieve Designation	Percent Passing
6"	100
5"	78 - 100
4"	35 - 100
3"	12 - 45
2"	0 - 20

7. Each erosion protection bedding/filter material shall be placed at a minimum thickness of 6" along the length of the apron. The bedding/filter material shall extend up the 2V:1H sides and end flush with the existing ground elevation. Bedding/filter material shall be spread and compacted in one layer.
8. Erosion protection rip-rap bedding/filter material shall meet the following gradation:

Filter Gravel		Filter Sand	
Sieve Designation	Percent Passing	Sieve Designation	Percent Passing
3"	100	No.4	100
2"	80 - 100	No. 10	80 - 100
3/4"	20 - 70	No. 20	36 - 76
3/8"	10 - 30	No. 40	10 - 20
No.4	0 - 10	No.100	0 - 10

9. The outside slope rock cover shall be placed on a minimum of 6" of filter/bedding material. The filter/bedding material shall consist of d_{50}=1" rock meeting the following gradation:

Sieve Designation	Percent Passing
3"	100
2"	80 - 100
3/4"	20 - 70
3/8"	10 - 30
No.4	0 - 10

10. Existing erosion protection disturbed during erosion protection aprons shall be replaced such as to maintain existing slopes and riprap conditions as approved previously by the U.S. Nuclear Regulatory Commission. Care shall be taken in removing and stockpiling the riprap such that the material is not degraded or otherwise damaged. Rock degraded or otherwise out of conformance with the NUREG 1623 due to removal and replacement methods shall be replaced with similar approved materials. Care should be taken so that existing tailings are not disturbed during erosion protection apron construction.

AMBROSIA LAKE MILL
QUIVIRA MINING COMPANY
GRANTS, NEW MEXICO
WEST APRON DESIGN – Pond 2

MAXIM TECHNOLOGIES INC

Rock Erosion Protection Sections

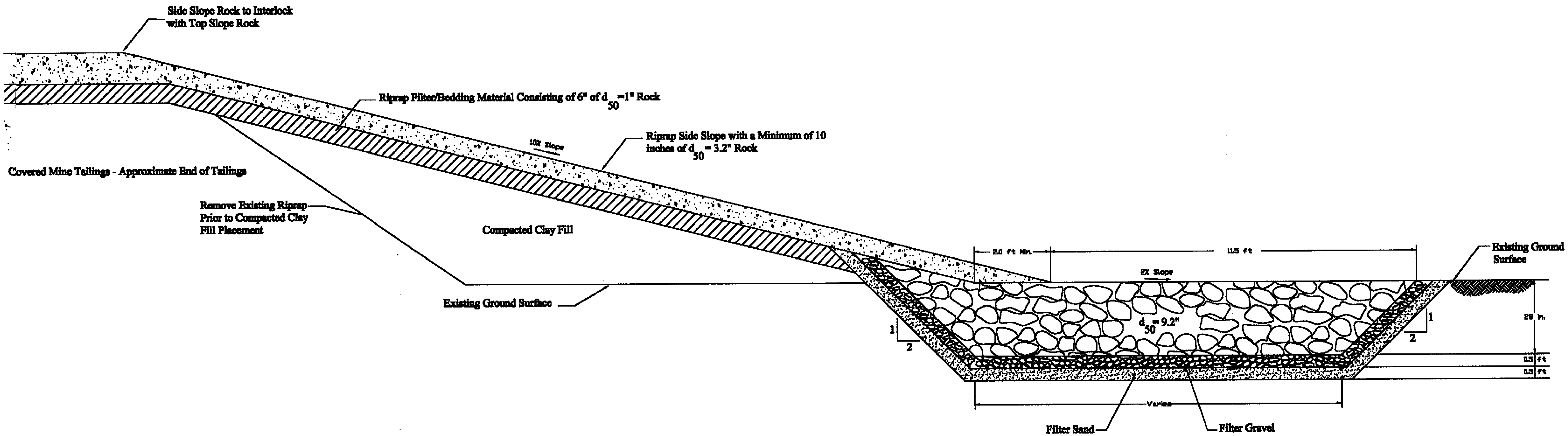
DRAWING BY: RLH 9/23/01

PROJECT No. 1690030
FILE NAME: 1690030S2.DWG

REVIEWED BY: WHB

SHEET 2 of 4

EAST APRON DESIGN - Typical Section
See Sheet 1 of 4 for Placement Location



Not To Scale

CONSTRUCTION NOTES:

1. Rock Riprap for erosion protection aprons shall be placed and in conformance with Appendix F of *Design of Erosion Protection for Long-Term Stabilization,* U.S. Nuclear Regulatory Commission's NUREG - 1623 Draft Report unless otherwise specified in the Pond 2 Erosion Control Design Report or the Design Drawings.
2. Erosion protection aprons shall be sloped to the downstream edge with a minimum slope of two percent or at a slope that matches the slope of the natural ground, should it be steeper than two percent.
3. Erosion protection apron excavations shall be constructed with 2V:1H slopes to permit placement of the filter materials to the surface of the ground.
4. Excavations shall be constructed with flat bottoms free of loose debris, vegetation and muddy surfaces. The transition between the West Apron design and the East Apron design shall be completed in 50 ft.
5. The east portion of the erosion protection apron shall be constructed of a rock diameter d_{50} = 9.2" conforming to the following gradation:

Sieve Designation	Percent Passing
15"	100
12"	70 - 90
9"	30 - 55
6"	0 - 10

6. Each layer of erosion protection bedding/filter material shall be placed at a minimum thickness of 6" along the length of the apron. The bedding/filter material shall extend up the 2V:1H sides and end flush with the existing ground elevation. Bedding/filter material shall be spread and compacted in one layer.
7. Erosion protection apron riprap bedding/filter material shall meet the following gradation:

Filter Gravel

Sieve Designation	Percent Passing
3"	100
2"	80 - 100
3/4"	20 - 70
3/8"	10 - 30
No.4	0 - 10

Filter Sand

Sieve Designation	Percent Passing
No.4	100
No. 10	80 - 100
No. 20	36 - 76
No. 40	10 - 20
No.100	0 - 10

8. Existing erosion protection disturbed during construction of the erosion protection aprons shall be replaced such as to maintain existing slopes and riprap conditions as approved previously by the U.S. Nuclear Regulatory Commission. Care shall be taken in removing and stockpiling the riprap such that the material is not degraded or otherwise damaged. Rock degraded or otherwise out of conformance with the NUREG 1623 due to removal and replacement methods shall be replaced with similar approved materials. Care should be taken so that existing tailings are not disturbed during erosion protection apron construction.
9. Fill required to construct the slope for the east apron shall consist of on-site soils free of vegetation, shall have greater than 50% passing the #4 sieve by weight, shall have greater than 10% passing the #200 sieve by weight, and free of particles larger than 6 inches. The clay fill shall be compacted at a minimum of 95% of maximum density as determined by ASTM D-698 and within +/- 2% of optimum moisture content. Each lift of clay fill shall not exceed a loose thickness of 10 inches.
10. The reconstructed slope shall be covered with a minimum thickness of 10 inches of d_{50}=3.2" rock conforming to the following gradation:

Sieve Designation	Percent Passing
6"	100
5"	78 - 100
4"	35 - 100
3"	12 - 45
2"	0 - 20

12. The outside slope rock cover shall be placed on a minimum of 6" of filter/bedding material. The filter/bedding material shall consist of d_{50}=1" rock meeting the following gradation:

Sieve Designation	Percent Passing
3"	100
2"	80 - 100
3/4"	20 - 70
3/8"	10 - 30
No.4	0 - 10

Clifford E. Vaughan — Date: 10/4/01

AMBROSIA LAKE MILL
QUIVIRA MINING COMPANY
GRANTS, NEW MEXICO
EAST APRON DESIGN – Pond 2

MAXIM TECHNOLOGIES INC

Rock Erosion Protection Sections

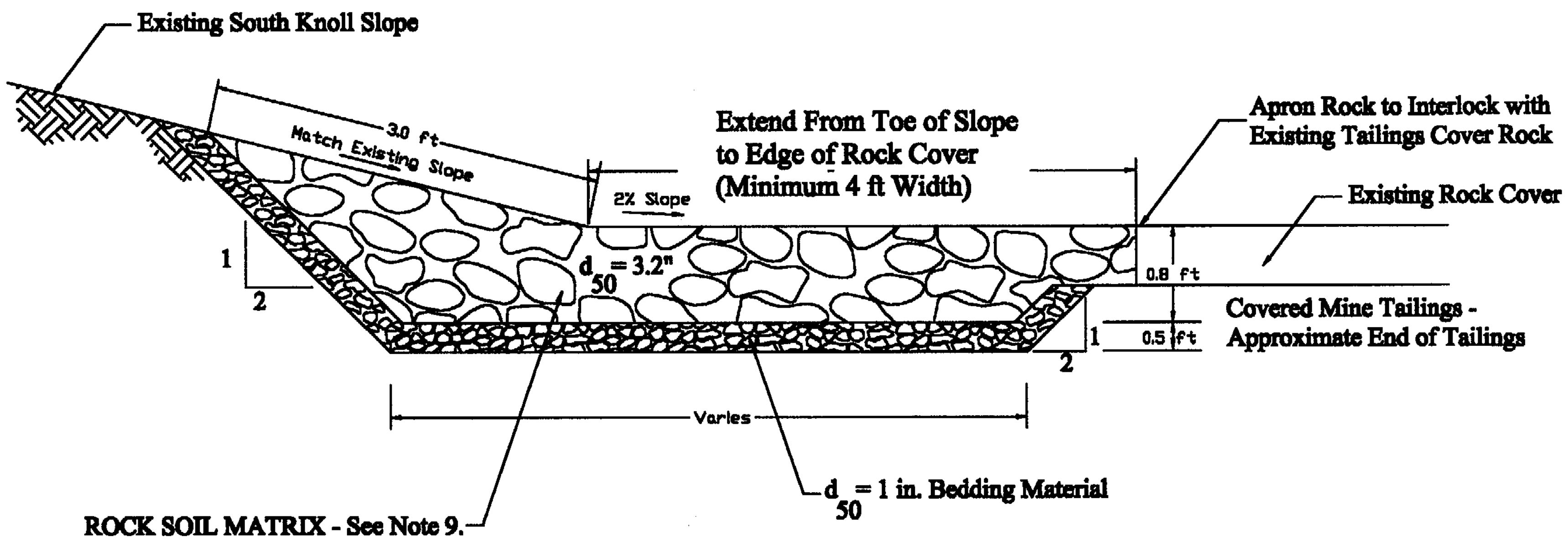
DRAWING BY: RLH 9/23/01

REVIEWED BY: WHB

PROJECT No. 1690030-100
FILE NAME: 1690030S3.DWG

SHEET 3 of 4

RUN-ON APRON DESIGN - Typical Section
See Sheet 1 of 4 for Placement Location



Not To Scale

CONSTRUCTION NOTES:

1. Rock Rip-Rap for erosion protection aprons shall be placed and in conformance with Appendix F of *Design of Erosion Protection for Long-Term Stabilization,* U.S. Nuclear Regulatory Commission's NUREG - 1623 Draft Report unless otherwise specified in the Pond 2 Erosion Control Design Report or the Design Drawings.
2. Erosion protection aprons shall be sloped to the downstream edge with a minimum slope of two percent or at a slope that matches the slope of the natural ground, should it be steeper than two percent.
3. Erosion protection apron excavations shall be constructed with 2V:1H slopes to permit placement of the filter materials to the surface of the ground.
4. Excavations shall be constructed with flat bottoms free of loose debris, vegetation and muddy surfaces and such that the existing rock cover will interlock with the run-on erosion protection apron rock.
5. The run-on portion of the erosion protection apron shall be constructed of a rock diameter d_{50} = 3.2" conforming to the following gradation:

Sieve Designation	Percent Passing
6"	100
5"	78 - 100
4"	35 - 100
3"	12 - 45
2"	0 - 20

6. Erosion protection bedding/filter material shall be placed at a minimum thickness of 6" along the length of the apron. The bedding/filter material shall extend up the 2V:1H sides and end flush with the existing ground elevation. Bedding/filter material shall be spread and compacted in one layer.
7. Run-on erosion protection riprap bedding/filter material shall meet the d_{50}= 1" gradation that follows:(Gradation supplied by Quivira - Gradation performed on available site stockpile remnents from previous reclamation work at the site - For use on Run-On Apron Only)

Filter Gravel

Sieve Designation	Percent Passing
3"	100
2"	70 - 100
3/4"	25 - 55
3/8"	15 - 40
No.4"	0 - 25

8. Existing erosion protection disturbed during erosion protection aprons shall be replaced such as to maintain existing slopes and riprap conditions as approved previously by the U.S. Nuclear Regulatory Commission. Care shall be taken in removing and stockpiling the rip-rap such that the material is not degraded or otherwise damaged. Rock degraded or otherwise out of conformance with the NUREG 1623 due to removal and replacement methods shall be replaced with similar approved materials. Care should be taken so that existing tailings are not disturbed during erosion protection apron construction.
9. See Section 4.0 OTHER DESIGN CONSIDERATIONS for placement of soil fill into the rock apron matrix to prevent flow along the apron causing channelized flow and potential scour of the apron.

Clifford E. Vaughan   10/4/01 Date

AMBROSIA LAKE MILL QUIVIRA MINING COMPANY GRANTS, NEW MEXICO RUN-ON APRON DESIGN - Pond 2		MAXIM TECHNOLOGIES INC
Rock Erosion Protection Sections	DRAWING BY: RLH 9/23/01	
PROJECT No. 1690030 FILE NAME: 1690030S4.DWG	REVIEWED BY: WHB	SHEET 4 of 4

ATTACHMENT B

ROCK QUALIFICATION DATA
MAY 3, 1991

AMBROSIA LAKE MILL, NEW MEXICO

Aug-16-2001 04:26am From-

TECHNOLOGIES INC.
Albuquerque, New Mexico 87113
(505) 823-4488 • fax 821-2963

LABORATORY REPORT

Client C & E CONCRETE
P. O. BOX 2547
MILAN, NM 87021

Job No. 32430215
Lab./Invoice No.
Date of Report May 3, 199[illegible]
Reviewed By

Project Proposed Aggregate Erosion Protection
Location Albuquerque Laboratory
Material/Specimen Rock Samples — Sampled By Hays, S./WT — Date 3-18-9[illegible]
Source Teneja Pit — Submitted By Hays, S./WT — Date 3-18-9[illegible]
Test Procedure See Below — Authorized By Walter Lee Meech — Date 3-18-9[illegible]

RESULTS

Test Description, designation	Result	Score
Specific Gravity, (ssd) ASTM C127	2.693	8.8
Absorption, ASTM C127	0.2	9.5
Sodium Sulfate Soundness, ASTM C88 *	2.1	9.5
Abrasion, ASTM C131 (100 Revolution)	4.5	8.2
Schmidt Hammer, ISRM Method **	52.0	6.8
Tensile Strenth, ISRM Method ***	1456.0	10.0

* 5 Cycles
** Average of 20 Readings
*** Average of 5 Specimens

ROCK QUALTIY SCORE
(Using Table 02278-A)

Weighting Factor - Limestone
Total Score = 400.1

Copies to:

287-2944
FAX 287-7364

Western Technologies Inc.
The Quality People
Since 1955

8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488 • fax 821-2963

LABORATORY REPORT

Client: C & E Concrete
PO Box 2547
Milan, NM 87021

Job No.
Lab/Invoice No. 32440605
Date of Report 10-11-94
Reviewed By D. Rush

Aggregate Test Data

Test Data Per AASHTO General Data	Coarse Results	NMSHTD Specifications
Bulk Specific Gravity (SSD), T-85	2.662	N/A
Absorption, T-85	1.10%	N/A
Dry Rodded Unit Weight, T-19	96.7 lbs/cf	N/A
Clay Lumps, T-112	0.06%	0.25% max
Coal & Lignite, T-113	0.10%	0.25% max
Material Passing #200 Sieve, T-11	0.3%	1.0% max
Organic Impurities, T-21	LTS*	1.00% max
Flat or Elongated Pieces	0.0%	15.0% max
Soundness Loss, T-105 5 Cycle Magnesium	0.9%	15.0% max
Fractured Faces, by count - 2 faces	100.0%	50.0% min
Percent Wear, T-96 500 Revolutions	20.0%	45.0% max

* Lighter Than Standard

Source of Sample: Coarse Aggregate
Tinaja Pit, 36 Miles South of Grants
off New Mexico Highway 53, Cibola County

Technologies Inc.
The Quality People
Since 1955
Albuquerque, New Mexico 87113
(505) 823-4488 • fax 821-2963

LABORATORY REPORT

Client: C & E Concrete
PO Box 2547
Milan, NM 87021

Job No.
Lab/Invoice No. 32440605
Date of Report 10-11-94
Reviewed By D. Rush

Aggregate Test Data

Test Data Per AASHTO General Data	Coarse Results	NMSHTD Specifications
Bulk Specific Gravity (SSD), T-85	2.662	N/A
Absorption, T-85	1.10%	N/A
Dry Rodded Unit Weight, T-19	96.7 lbs/cf	N/A
Clay Lumps, T-112	0.06%	0.25% max
Coal & Lignite, T-113	0.10%	0.25% max
Material Passing #200 Sieve, T-11	0.3%	1.0% max
Organic Impurities, T-21	LTS*	1.00% max
Flat or Elongated Pieces	0.0%	15.0% max
Soundness Loss, T-105 5 Cycle Magnesium	0.9%	15.0% max
Fractured Faces, by count - 2 faces	100.0%	50.0% min
Percent Wear, T-96 500 Revolutions	20.0%	45.0% max

* Lighter Than Standard

Source of Sample: Coarse Aggregate
Tinaja Pit, 36 Miles South of Grants
off New Mexico Highway 53, Cibola County