Rio Algom Mining LLC

October 17, 2006

ADDRESSEE ONLY
Mr. William Von Till, Chief
Uranium Processing Section
Fuel Cycle Facilities Branch, NMSS
Mail Stop T-8A33
U.S. Nuclear Regulatory Commission
Washington, DC 20850

Re: **License SUA-1473, Docket 40-8905**
Lateral Migration Channel Proposal

Dear Mr. Von Till,

By this letter, Rio Algom Mining LLC (RAML) submits for Nuclear Regulatory Commission (NRC) review and approval a proposed design for the construction of a drainage control channel as part of the site reclamation activities for the Ambrosia Lake facility. This submittal is in response to NRC's November 27, 2002 and October 5, 2004 Technical Evaluation Reports in which NRC requested RAML address the issue of potential lateral migration of the Arroyo del Puerto towards the disposal facility.

The attached engineering evaluation report, prepared by Mr. Curt Sealy, P.E., of Maxim Technologies, provides the technical basis for the construction of the re-aligned drainage channel, which will result in protecting the toe of Pond 3 from future encroachment thereby ensuring long term stability of the disposal area. This proposed design provides reasonable assurance to achieve the 1000 year design criteria specified in Criterion 6 of 10 CFR Part 40, Appendix A.

RAML is willing to meet with NRC staff to further discuss this submittal to facilitate a timely review and approval process. Please contact me if you have any questions or are in need of additional information related to this request.

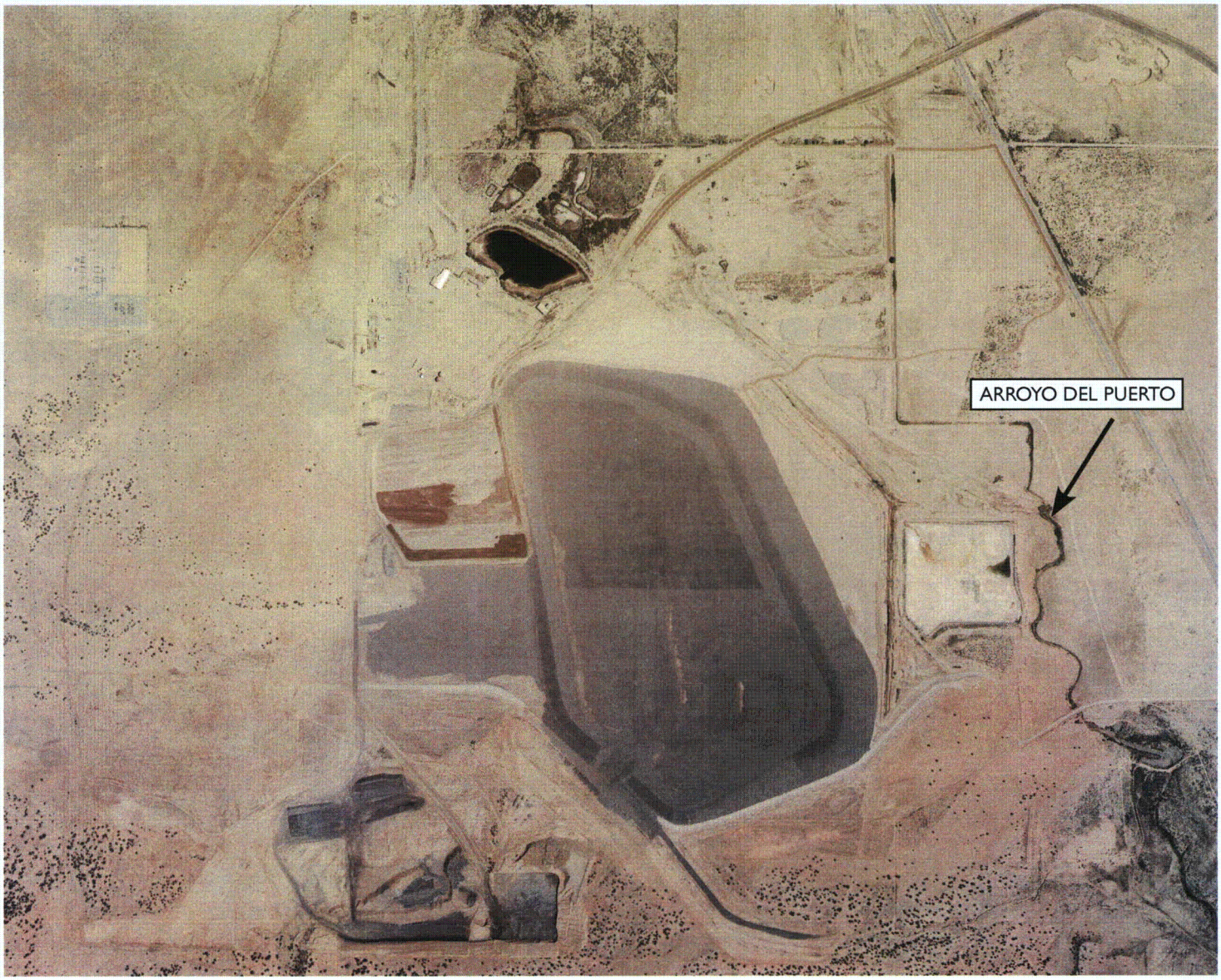
Regards,

Peter Luthiger
Manager, Radiation Safety
and Environmental Affairs

Attachment: As stated

xc: T. Fletcher
R. Jones (KM)
R. Lukes (NRC)
C. Sealy (Maxim – w/o attachment)
File

RE-ESTABLISHMENT OF THE ARROYO DEL PUERTO CHANNEL WITH PROTECTION MEASURES AGAINST POTENTIAL LATERAL MIGRATION AMBROSIA LAKE MILL AMBROSIA LAKE, NEW MEXICO



Prepared for:
Rio Algom Mining, LLC
P.O. Box 218
Grants, New Mexico 87020

OCTOBER 2006

MAXIM TECHNOLOGIES

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

10601 Lomas. NE, Suite 106
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Office 505.237.8440
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October 13, 2006

Terry Fletcher
Rio Algom Mining, LLC
P. O. Box 218
Grants, NM 87020

Reference: Transmittal of Report
"Re-Establishment of the Arroyo
del Puerto Channel with Protection
Measures against Potential Lateral Migration"

Dear Mr. Fletcher:

Maxim Technologies is transmitting 5 copies of the above referenced document for your review. This document fully addresses the Nuclear Regulatory Commission's concerns for protection of the toe of Tailings Pond No. 3 against potential lateral migration of the Arroyo del Puerto.

We would be pleased to meet with you and discuss this document at your convenience.

Sincerely,

Curtis O. Sealy, P.E.

RE-ESTABLISHMENT OF THE ARROYO DEL PUERTO CHANNEL WITH PROTECTION MEASURES AGAINST POTENTIAL LATERAL MIGRATION

AMBROSIA LAKE MILL
AMBROSIA LAKE, NEW MEXICO

Prepared for:

Rio Algom Mining, LLC
P.O. Box 218
Grants, New Mexico 87020

Prepared by:

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

Maxim Technologies
10601 Lomas NE, Suite 106
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October 13, 2006

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1.0 INTRODUCTION

The following design report was prepared by Maxim Technologies (Maxim) for Rio Algom Mining, LLC (RAM). Maxim was retained by RAM to design a channel that would return the Arroyo del Puerto to its historic general natural course and prevent future lateral migration of the re-established channel towards Tailings Pond No. 3. This report provides the basis for the design and construction of the channel, together with drawings and specifications for construction.

1.1 Historical Perspective

The Arroyo del Puerto historically has been a relatively narrow channel, in a broad alluvial flood plain. Historically, it was a dry wash and flowed only in response to significant rainfall events and periods of prolonged snow melt. In the late fifties, several mining companies began sinking mining shafts, with subsequent pumping from the Westwater Formation into the Arroyo del Puerto. The flows in the Arroyo del Puerto reached San Mateo Creek about 4 miles to the south. These flows eventually decreased with cessation of mining in the valley. The Creek then became dry until it reached the United Nuclear-Homestake IX plant in Section 25, northwest of the mill where the Homestake IX discharges were added to the arroyo.

In late 1976 the arroyo was realigned by Kerr McGee as part of their operations to flow north and east of Tailings Pond Nos. 4, 5 and 6 away from Ponds 1 and 3 (Figure 1.1). This new diversion channel rejoined the original arroyo near the northeast corner of Tailings Pond No. 9. Drainage from the channel reach of the abandoned creek was captured behind a small dam and pumped back into Tailings Pond No. 3.

The approved RAM reclamation plans call for restoring the arroyo to its original channel as nearly as achievable to the pre-1976 grade and alignment. The stream restoration will re-establish the general structure, function and self sustaining behavior of the arroyo to that which existed prior to the diversion channel construction. This re-establishment of the stream bed will place the arroyo alignment approximately 300 feet from the toe of the reclaimed Tailings Pond No. 3.

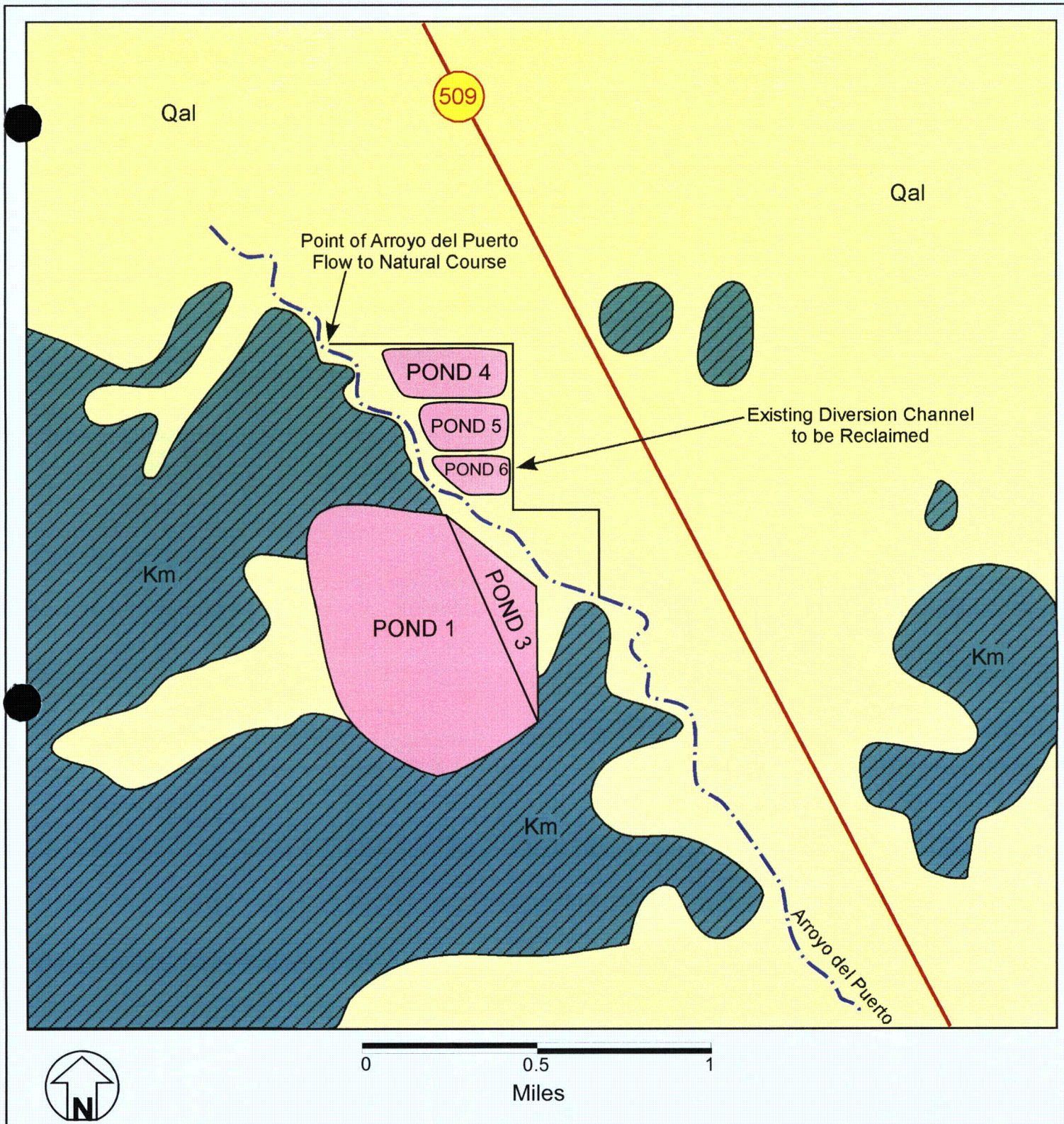


FIGURE 1.1

Simplified Geologic Map of the Site
Showing Outcrop of Bedrock Surface

MAXIM TECHNOLOGIES

1.2 Scope

Because of the proximity of the re-established channel to the Tailings Pond No. 3 the US Nuclear Regulatory Commission (NRC) has expressed concern that potential lateral migration of the Arroyo del Puerto could affect the integrity of the toe of the reclaimed Tailings Pond No. 3 over the long term.

The following design summary and associated drawings addresses the NRC's concerns and presents an erosion protection design for the arroyo to prevent the potential for long term lateral migration of the arroyo towards Tailings Pond No. 3.

RAM, formally Quivira Mining Company is conducting reclamation of its Uranium facility located in the Ambrosia Lake Valley northeast of Grants, New Mexico. This work is being performed under RAM's NRC license No SUA-1473.

As part of the reclamation program RAM has reclaimed Tailings Pond No. 1 and is in the process of reclaiming Tailings Pond No. 3. The tailings pile reclamation was designed and constructed to provide assurance of control of radiological hazards for 1,000 years to the extent reasonably achievable. Specifically, the plan meets Appendix A of 10 CFR Part 40 for decommissioning of the tailing ponds. Erosion protection designs for Tailings Pond Nos. 1 and 3 were an integral part of the reclamation plan. These designs were submitted to the NRC on May 16, 2005 and September 26, 2002. The NRC conducted a detailed technical evaluation report (TER), on the design, which was transmitted to RAM on November 27, 2002 (See Appendix A). The NRC staff concluded that the designs submitted appropriately addressed the long-term erosion protection of Tailings Pond Nos. 1 and 3, for a Probable Maximum Precipitation (PMP) event, and issued Amendment 51 to update License condition 37 of Source Materials License, SUA-1473.

However, the TER summary stated that the toe of Tailings Pond No. 3 (at Section 3) should be revisited (i.e. re-evaluated) to determine if the erosion protection adequately protects against lateral migration of the Arroyo del Puerto, thus potentially undercutting the toe of Tailings Pond No. 3. In response to this TER, RAM submitted a report assessing the potential for migration of the Arroyo del Puerto (Appendix B). The NRC issued another TER addressing this report on October 5, 2004 (Appendix A). This second TER by the NRC concluded that since the maximum differential distance between the toe of

Tailings Pond No. 3 and the re-established channel bed would be approximately 10 feet, that RAM should again address the potential for undercutting of the impoundment toe due to the potential migration of the arroyo. The TER suggested that methods of toe protection could include stabilizing the stream at its reconstructed location or providing additional protection against migration into the toe of Tailings Pond No. 3.

In response to the NRC requests, RAM is providing a revised channel design contained in this document that will protect Tailings Pond No. 3 against lateral migration of the arroyo. The following pages present the redesign of the Channel and incorporate the NRC's lateral migration protection concerns into the design.

2.0 CHANNEL DESIGN

2.1 Alignment

The reconstruction of the Arroyo del Puerto will begin upstream of the tailings ponds near the original point of diversion (approximate site coordinates E500583±, N1603190±) where the re-established alignment will tie into the existing channel bed of the arroyo. The site plan (Design Sheet 1) shows the general configuration and alignment of the re-established channel. Sheets 2 through 5 show the general plan and profile for the new construction. As shown by the drawings, the re-established channel generally follows the alignment of the historic channel but with more gentle curves in the alignment.

2.2 Channel Configuration and Grade

The channel will have a minimum bottom width of 100 feet and will be constructed with side slopes of 5 (horizontal) to 1 (vertical) with a minimum depth of 4 feet allowing for 1 foot of free-board. This channel design will accommodate a 100 year design storm event of 2,974 cfs (Appendix C).

The re-established arroyo channel is designed to have a gradient typical of the Arroyo del Puerto original slope and surrounding topography. The channel from stations 0+00 to 9+00 will have a 1.0% grade, while the remainder of the channel will have a 0.49% gradient. The maximum cut for construction of the arroyo channel is estimated to be 9 ft with an average cut of 5 ft. The fill depths required to provide positive drainage of surrounding areas into the constructed arroyo channel will range from 0 to 2 ft with some isolated areas requiring 4 ft of fill for positive drainage. Fill for the

channel will be compacted to a minimum of 95% Standard Proctor density (ASTM D-698) to help reduce erosion of surrounding areas and inner channel slopes.

3.0 EROSION PROTECTION

The toe of the reclaimed Tailings Pond No. 3 will be provided protection against lateral migration of the arroyo due to its natural setting and engineering controls that have been incorporated into the channel design. Figure 1.0 shows the re-established (historic) channel with respect to the local geology. As shown by this figure, the channel is bounded predominantly by Cretaceous Mancos Shale to the west and quaternary alluvium to the east. The Mancos Shale provides a resistant foundation material against erosive forces when compared to the weaker alluvial soils. This is evidenced by the historic flooding across the alluvium creating the board flood plain. While the geology is favorable against migration into the toe of Tailings Pond No. 3, engineering controls are believed necessary to provide additional assurance that the integrity of the pond 3 toe will not be jeopardized.

3.1 Engineering Designs

Several engineering controls have been incorporated into the erosion protection design to insure protection against lateral migration of the arroyo in the direction of the Tailings Pond No. 3 as follows.

3.2 Channel Bottom Configuration

Design sheet No. 6 shows the typical channel section details. As shown by the drawing, the channel bottom will be provided with a cross slope of 1.5% to "the outside" of the channel away from Tailings Pond No. 3. This will place the preferential flows on the weak side of the channel as discussed below. Low flows will be directed along the toe of the far side of the channel approximately 400 feet from the nearest point of Tailings Pond No. 3.

3.3 Erosion Protection Rock

Erosion protection rock will be provided between station 9+00 to station 57+00. The channel will be fully lined with erosion protection rock consisting of durable quarried rock having a D_{50} size of 9.2 inches from approximately station 9+00 to station 29+50. The rock will have a minimum thickness of 14 inches placed on 6 inches of filter/bedding material having a D_{50}=1.0". The gradation requirements for these materials are shown in Table 3.1. From station 29+50 to station 41+00, the channel will also

be fully lined with rock having a D_{50} size of 7.8 inches with the gradation requirements shown in Table 3.1. This rock will have a minimum thickness of 12 inches and also be placed on 6 inches of filter/bedding material having a D_{50}=1.0". From approximately station 41+00 to station 57+00 the channel will be lined on only the Tailings Pond No. 3 side with rock having a D_{50} size of 7.8" as shown in Design Sheet 6. As shown in the drawing detail, the rock will be placed on 6 inches of filter/bedding material having a D_{50}=1.0" and extend a minimum of 3 feet below the flow line of the channel. The rock will have the gradation requirements shown in Table 3.1. The objective of providing the erosion protection rock only on one side of the channel is to create a preferential flow to the weak side of the channel. The natural soils are fine silty sands to sandy silts and will erode at velocities approaching 2.0-2.5 feet per second. Consequently, the flow would be directed to the far side of the channel and would eventually breach the channel and flow into the historic flood plain during extreme precipitation events.

Additional erosion protection to provide further redundancy against lateral migration will be accomplished by placing launchable riprap on top of the channel embankment from station 29+50 to about station 57+00. The launchable riprap will be constructed 5 to 10 feet from the edge of the top of the channel. The riprap will have a D_{50} size of 9.2 inches and will be placed at the rate of 1.5 cubic yards of riprap per linear foot of embankment. This will provide a theoretical collapsed rock thickness of 18 inches over the embankment slope. A typical diagram showing the erosion protection concept in the critical area is shown in Figure 3.1.

Table 3.1 Arroyo del Puerto Channel Re-Establishment

Riprap Gradation Requirements

Filter/Bedding Rock and Erosion Protection Gravel (D_{50}=1.0")

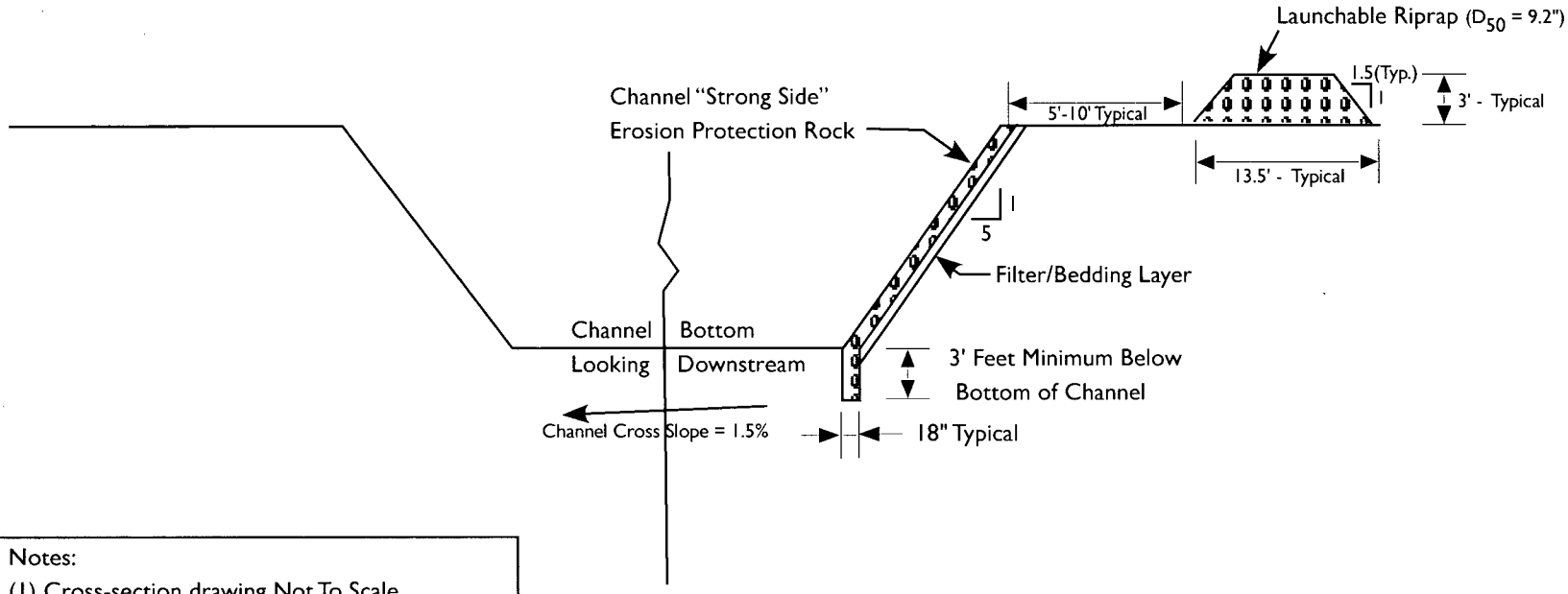
Sieve Designation	Percent Passing
3"	100
2"	80-100
¾"	20-70
3/8"	10-30
No. 4	0-10

Erosion Protection Rock (D_{50}=7.8")

Sieve Designation	Percent Passing
12"	100
9"	60-85
6"	5-30
4"	0-5

Erosion Protection Rock (D_{50}=9.2")

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



Notes:

(1) Cross-section drawing Not To Scale.

(2) Launchable riprap to have a D_{50} = 9.2" (see Table 3.1).

(3) Launchable riprap to be dumped continuously at the rate of 1.5 c.y./L.F.

FIGURE 3.1 CONCEPTUAL DIAGRAM FOR EROSION PROTECTION IN CRITICAL AREA

ARROYO DEL PUERTO CHANNEL RE-ESTABLISHMENT
RIO ALGOM MINING , LLC
AMBROSIA LAKE MILL
AMBROSIA LAKE, NEW MEXICO

COMPLETED BY: MB CHECKED BY: CS	DATE: 10/13/06	NOT TO SCALE
PROJECT NO.: 1155690067 FILE NAME: FIGURE 3-1 TYPICAL DIAGRAM EROSION PROTECTION	MAXIM TECHNOLOGIES	

4.0 SUMMARY

In conclusion, the revised design for the re-establishment of the Arroyo del Puerto fully addresses the concerns brought forth by the NRC in the technical evaluation reviews with respect to potential long-term lateral migration and undercutting by the arroyo.

The toe of Tailings Pond No. 3 is protected by incorporating several redundancies into the design. The Channel configuration generally follows the historic alignment and grade with no sharp bends or abrupt changes. The Channel bottom is cross-sloped 1.5 percent to the east to direct low flows to the outside of the channel. Erosion protection rock within the Channel at the critical area is designed to have a "weak side-strong side" in the re-established alignment. Furthermore, launchable riprap will be placed in the critical zone to add further erosion protection redundancy.

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.

American Society of Civil Engineers (ASCE), 1995. *Hydraulid Design of Flood Control Channels.* U. S. Army Corps of Engineers engineer manual EM 1110-2-1601.

Goranson, W. P., Rio Algom Mining, LLC, letter to NRC dated May 16, 2002, "Design Report for Pond 1 North Embankment Erosion Protection, Pond 3 Erosion Protection and Erosion Protection for the Area North of Pond 1" License No.: SUA-1473, Docket No.:40-8905

Goranson, W. P., Rio Algom Mining, LLC, letter to NRC dated September 26, 2002, "Responses to Staff Question on Erosion Protection Design for Pond #e and Additional Arroyo del Puerto Investigation" License No.: SUA-1473, Docket No.: 40-8905

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 0 United States between the Continental Divide and the 103rd Meridian. U. S. Department of Commerce, Silver Spring, Maryland.

Johnson, T. L., 2002, *Design of Erosion Protection for Long-Term Stabilization.* Final Report, NUREG-1623, U.S. Nuclear Regulatory Commission, Washington, DC.

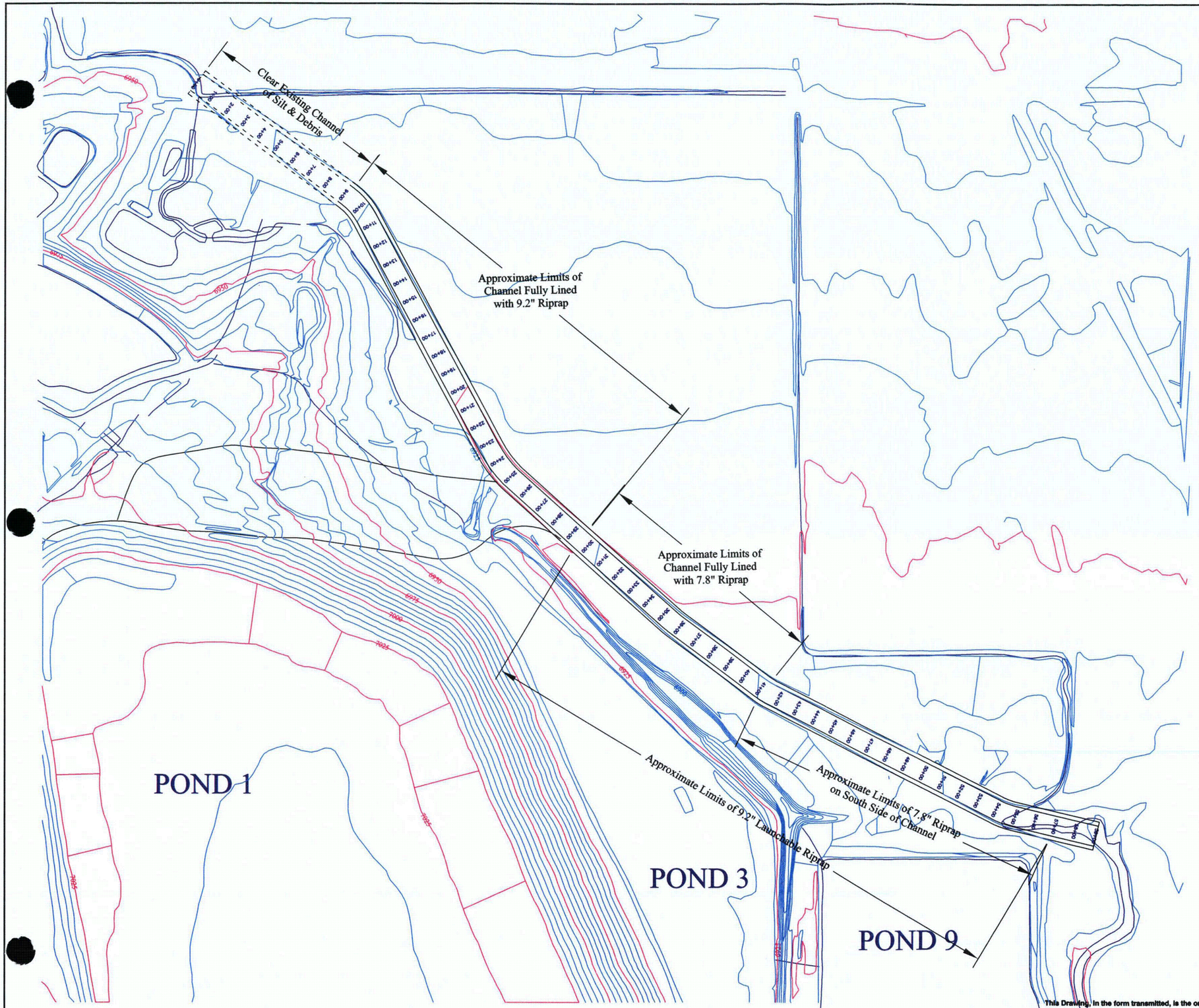
Nelson, J. D., S. R. Abt, R. L. Volpe, D. van Zyl, N. E. Hinkle, W. R. Staub, 1986. *Methodologies for Evaluating Long-Term Stabilization Designs for Uranium Mill Tailings Impoundments.* NUREG/CR-4620, U. S. Nuclear Regulatory Commission, Washington, DC

Quivira Mining Company, 1990. Enclosure to a letter from Bill Ferdinand, Manager for Radiation Safety, Licensing & Regulatory Compliance, to Edward Hawkins, Chief Licensing Branch 1, Uranium Field Recovery Office, U. S. Nuclear Regulatory Commission, Washington, DC

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

6.0 DESIGN DRAWINGS



1) Location of channel alignment and grade based on 2001 Aerial Survey provided by Rio Algom Mining, LLC.

2) Adjustments to the channel alignment and grade will be necessary to fit actual topography.

3) All fill areas adjacent to the reestablished channel shall be graded to have positive drainage. slopes shall be constructed such that uniform sheet flow occurs unobstructed into the channel.

4) Disturbances to the area shall be kept to a minimum during construction. Temporary erosion control measures shall be taken where necessary.

5) Topsoil shall be removed within existing vegetated areas and shall be stockpiled for later use where needed as directed by owner. Topsoil removal shall be limited to construction limits. Care should be taken to prevent damage to vegetated areas outside construction limits.

6) All existing drainages along and near the reestablished channel shall remain in place and undisturbed.

0 200 500
SCALE IN FEET

CURTIS O. SEALY
NEW MEXICO
10084
LICENSED PROFESSIONAL ENGINEER
10/13/06

SITE PLAN

ARROYO DEL PUERTO
CHANNEL REESTABLISHMENT
AMBROSIA LAKE MILL
RIO ALGOM MINING, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

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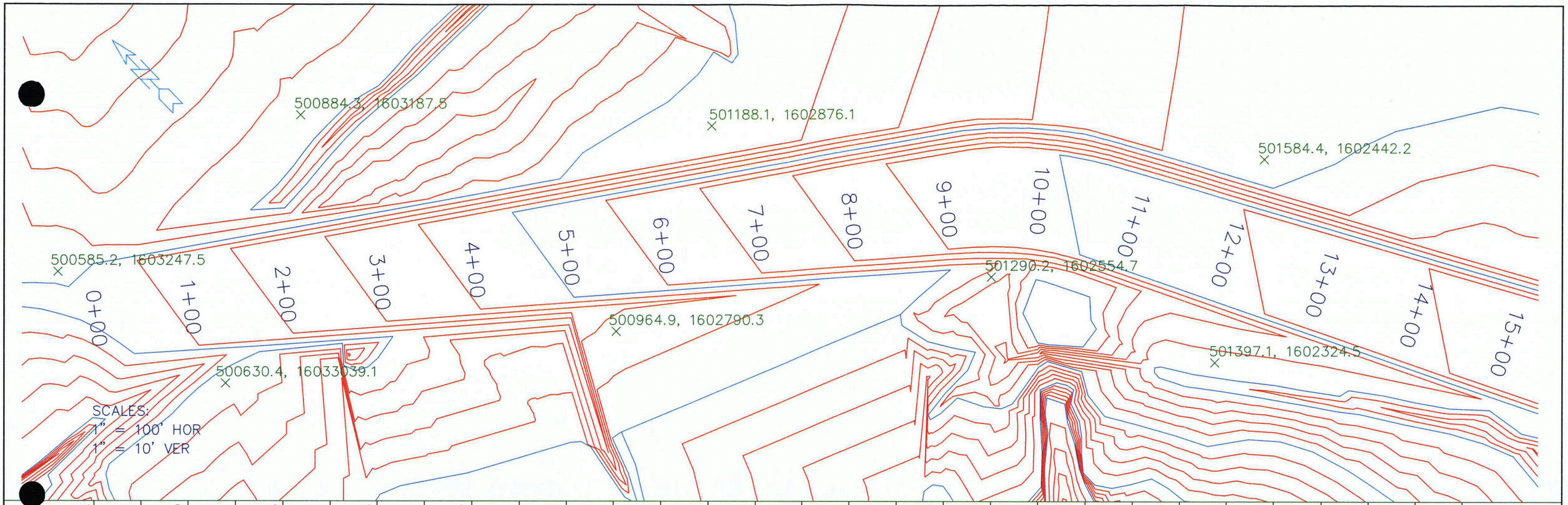

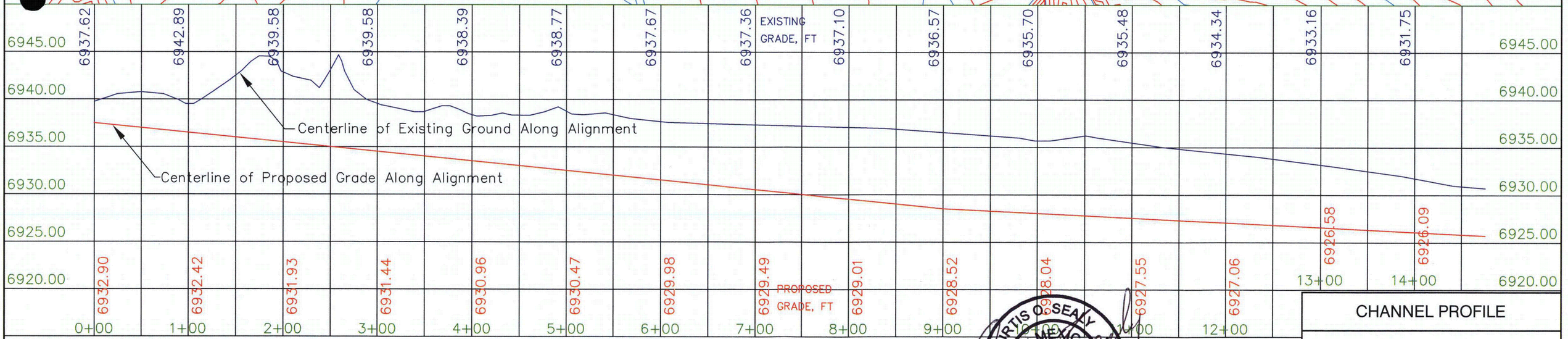

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2) Adjustments to the channel alignment and grade will be necessary to fit actual topography.

3) Erosion protection rock shall be placed in the entire channel cross section from Approximate Station 9+00 to Approximate Station 41+00.

4) Erosion protection rock shall be placed on the southwest side of the channel cross section from Approximate Station 41+00 to Approximate Station 57+00.

5) Launchable riprap will be placed on the southwest side of the channel from Approximate Station 29+50 to Approximate Station 57+00.

6) The channel shall have a minimum depth of 4 feet, with a bottom slope of 1.5% to the northeast side of the channel, and a minimum top width of 100 feet.

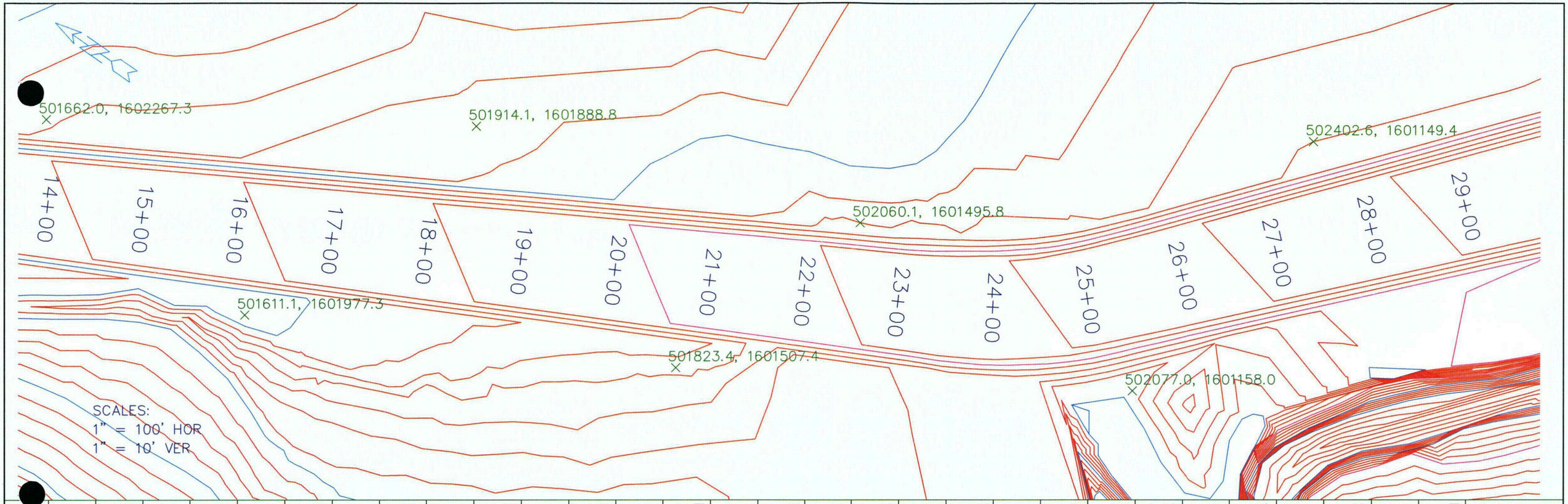
CURTIS O'SEALY NEW MEXICO 10084 10/13/06 LICENSED PROFESSIONAL ENGINEER

CHANNEL PROFILE

ARROYO DEL PUERTO
CHANNEL REESTABLISHMENT
AMBROSIA LAKE MILL
RIO ALGOM MINING, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

5690067 | SHEET 2



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LICENSED PROFESSIONAL ENGINEER

CHANNEL PROFILE

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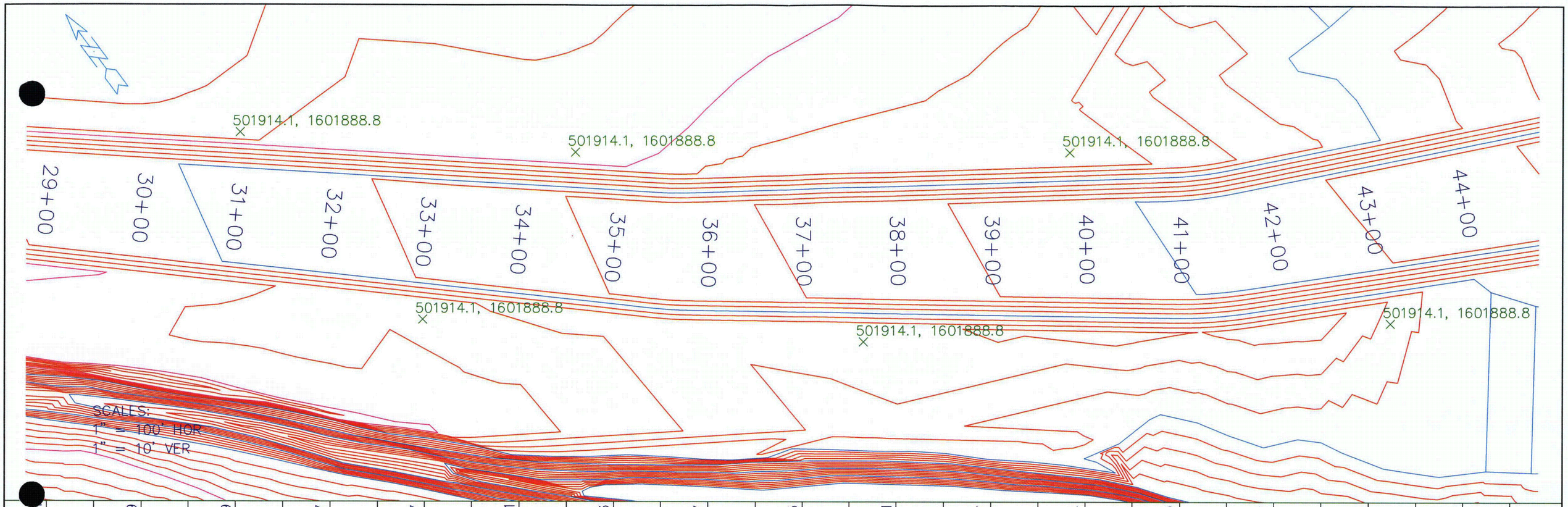
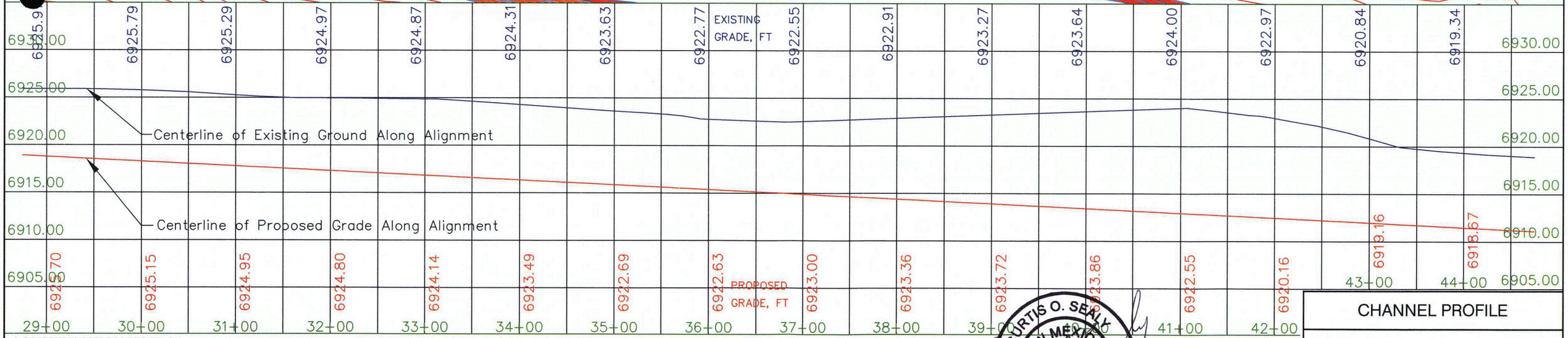
CHANNEL REESTABLISHMENT
AMBROSIA LAKE MILL
RIO ALGOM MINING, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

5690067 | SHEET 3





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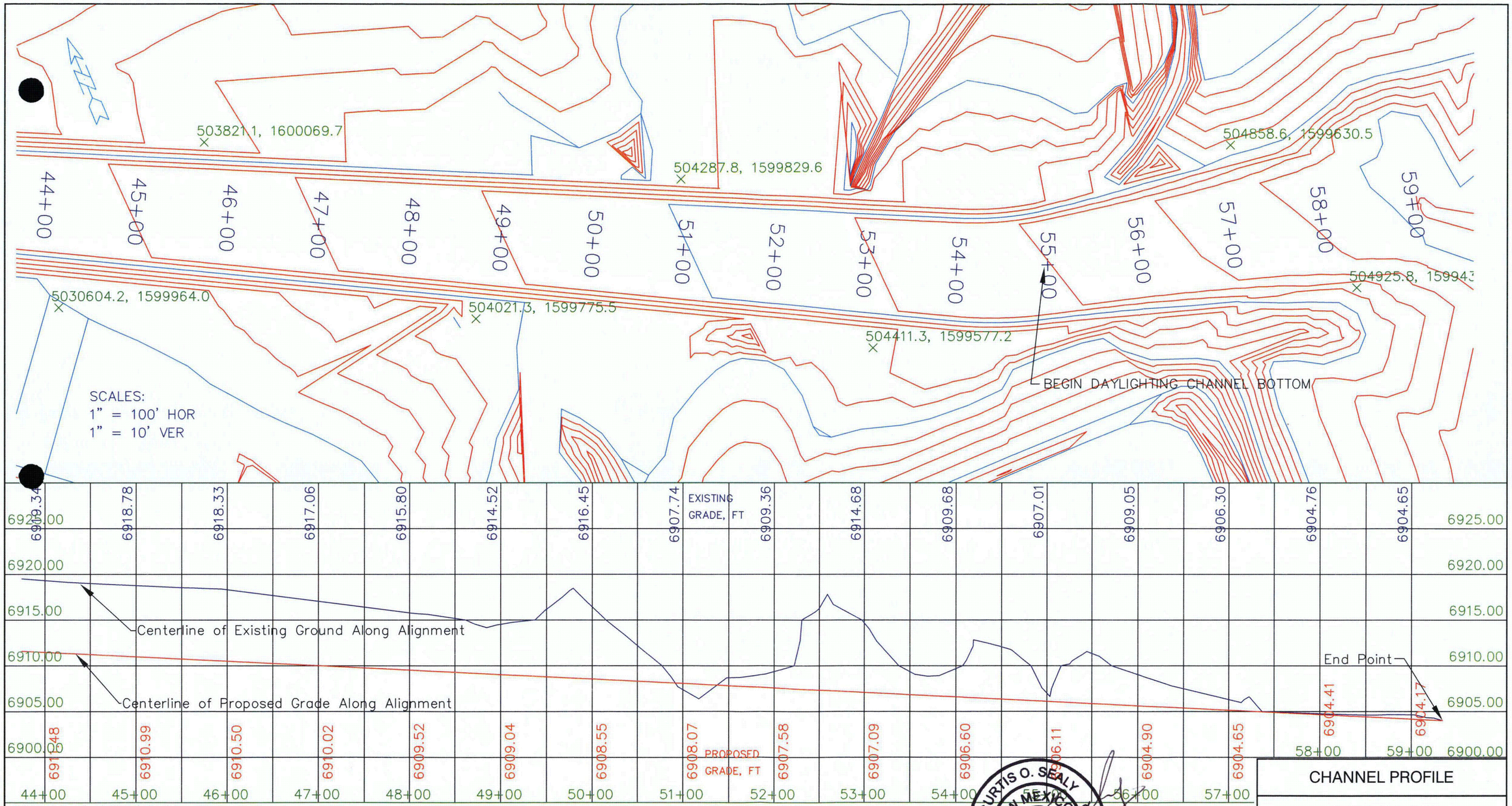
LICENSED PROFESSIONAL ENGINEER
11/13/06

CHANNEL PROFILE

ARROYO DEL PUERTO
CHANNEL REESTABLISHMENT
AMBROSIA LAKE MILL
RIO ALGOM MINING, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

5690067 | SHEET 4



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CHANNEL PROFILE

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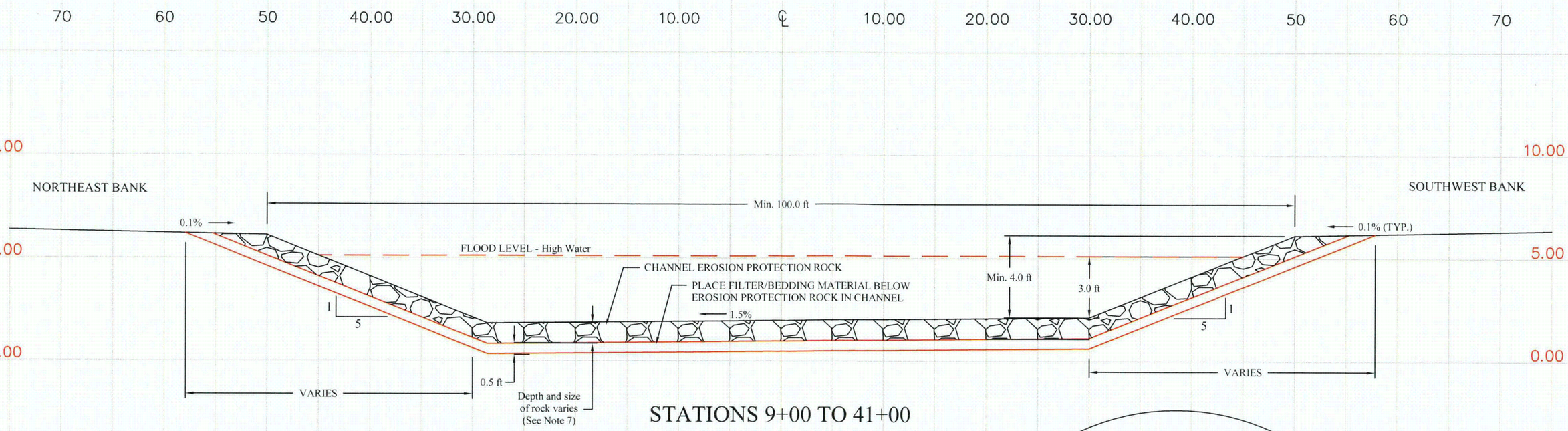
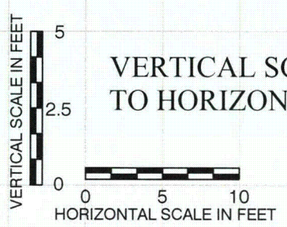
CHANNEL REESTABLISHMENT
AMBROSIA LAKE MILL
RIO ALGOM MINING, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

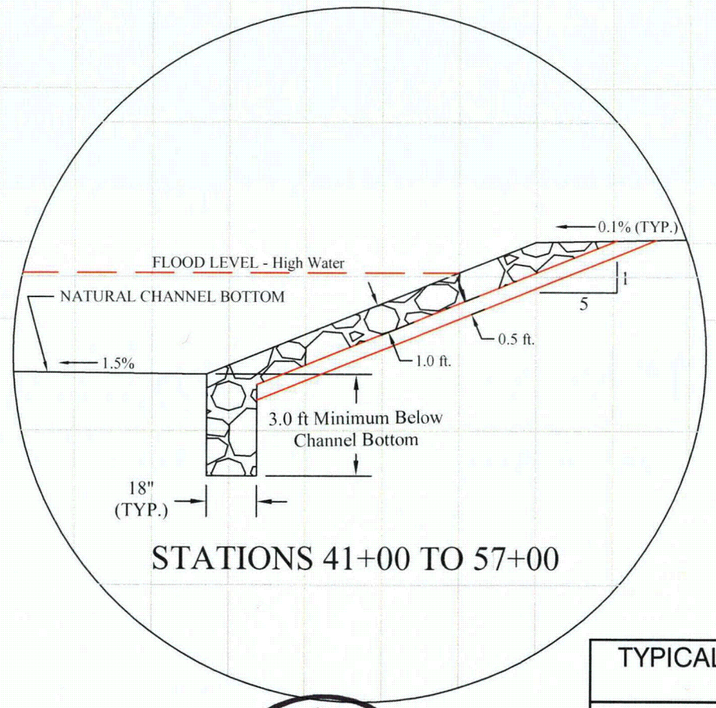
5690067 | SHEET 5



STATIONS 9+00 TO 41+00
(LOOKING DOWNSTREAM)



VERTICAL SCALE NOT EQUAL
TO HORIZONTAL SCALE



STATIONS 41+00 TO 57+00

CONSTRUCTION NOTES:

1) Rock Riprap for erosion protection shall be placed in conformance with Appendix F of *Design of Erosion Protection for Long-Term Stabilization,* U.S. Nuclear Regulatory Commission's NUREG -CR1623 Draft Report.

2) Constructed channel slopes shall not exceed 5H:1V.

3) The arroyo channel bottom shall be constructed with a slope of 1.5%, sloping to the northeast.

4) The channel excavation shall be constructed with bottoms free of loose debris, vegetation and muddy surfaces.

5) Where applicable, compacted fill may be placed on the exterior to construct an embankment that will provide the minimum channel depth. The fill required to construct the embankment shall consist of material excavated from within the channel/apron trench or on-site borrow areas. The fill shall be compacted to a minimum of 95% of maximum density as determined by ASTM D-698 and within +/- 3% of optimum moisture content. Each lift of fill shall not exceed a loose thickness of 10 inches.

6) The erosion protection filter/bedding layer shall be placed at a minimum thickness of 6" along the length of the channel. The filter/bedding material shall extend up the 5H:1V side slopes to the existing grade or berm crest, which ever is greater. Filter/bedding materials shall be spread and compacted in one layer.

7) The channel shall be constructed with a minimum thickness of 14" of D_{50}=9.2" rock from Station 9+00 to Station 29+50, and a minimum thickness of 12" of D_{50}=7.8" from Station 29+50 to 41+00. The rock shall be extended up the side slopes to the existing grade on the exterior.

8) The channel erosion protection rock shall be placed on a minimum 6" thick filter/bedding layer of D_{50}=1" conforming to the following gradation:

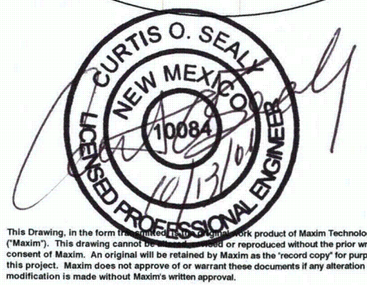
Sieve Designation	Percent Passing
3"	100
2"	80 - 100
3/4"	20 - 70
3/8"	10 - 30
No. 4	0 - 10

9) The channel erosion protection rock shall be constructed of a rock diameter D_{50}=7.8" conforming to the following gradation:

Sieve Designation	Percent Passing
12"	100
9"	60 - 85
6"	5 - 30
4"	0 - 5

10) The channel erosion protection rock 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



TYPICAL CHANNEL SECTION DETAILS

ARROYO DEL PUERTO
CHANNEL REESTABLISHMENT
AMBROSIA LAKE MILL
RIO ALGOM MINING, LLC
GRANTS, NEW MEXICO

MAXIM TECHNOLOGIES

5690067 | SHEET 6

Appendix A

United States Nuclear Regulatory Commission

Technical Evaluation Report
Evaluation of Erosion Protection for Ponds 1 and 3
At the Ambrosia Lake Mill site
Source Materials License, SUA-1473
Docket 40-8905
TAC No. L 52431
November 27, 2002

Technical Evaluation Report
Migration of the Arroyo del Puerto
At the Ambrosia Lake Uranium Mill Tailings Facility
Source Materials License, SUA-1473
Docket 40-8905
TAC No. LU 0056
October 5, 2004

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 27, 2002

Mr. William Paul Goranson, Manager
Radiation Safety, Licensing and
Regulatory Compliance
Rio Algom Mining LLC
6305 Waterford Blvd., Suite 400
Oklahoma City, OK 73118

SUBJECT: EROSION PROTECTION DESIGN FOR PONDS 1 AND 3 FOR THE AMBROSIA LAKE MILL TAILINGS SITE - LICENSE AMENDMENT 51, SUA -1473 (TAC NO. L52431)

Dear Mr. Goranson:

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the design of erosion protection for Ponds 1 and 3 at the Ambrosia Lake mill site. You submitted four separate designs and analysis under cover letters dated May 16, 2002, and September 26, 2002. Based on our review of the information submitted by you and on independent calculations, NRC staff concludes that the designs you have submitted have appropriately addressed the erosion protection along Ponds 1 and 3. Accordingly, Amendment 51 updates License Condition 37 of Source Materials License, SUA-1473 to reference these submittals. A detailed Technical Evaluation Report as well as the updated license is enclosed.

In many of the designs, especially for Pond 3, the design is dependent on an assumed final elevation and grade. Please be aware that the design is not valid if the final grade differs from that which you have assumed. In addition, you have not provided any information regarding the durability of the rock to be used in the erosion protection design. The rock should be good quality to meet the design which has been approved and rock durability information should be provided to NRC prior to placement. Finally, the design of the toe of Pond 3 (at Section 3) should be revisited to determine if the toe adequately protects against undercutting by the Arroyo del Puerto.

Other than the items stated above, the erosion protection design appears to be adequate to provide reasonable assurance of protection for 1000 years, as required in Criterion 6 of 10 CFR Part 40, Appendix A.

In accordance with 10 CFR 2.790 of NRC's "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders," a copy of this letter will be available electronically for

public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have questions regarding this matter, please contact the NRC project manager, Jill Caverly, at 301-415-6699 or by e-mail to JSC1@nrc.gov.

Sincerely,

Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No. 40-8905
SUA-1473

Enclosure: Technical Evaluation Report
Source Materials License, SUA-1473

cc: Art Kleinrath, DOE-GJ

TECHNICAL EVALUATION REPORT
EVALUATION OF EROSION PROTECTION FOR PONDS 1 AND 3
AT THE AMBROSIA LAKE MILL SITE
DOCKET 40-8905
NOVEMBER 2002

SUMMARY:

During a 2001 inspection of the Rio Algom Mining LLC (RAM) Ambrosia Lake facility, a U.S. Nuclear Regulatory Commission (NRC) inspector observed rilling of the soil along the southern toe trench of the Pond #1 tailings impoundment. A follow-up visit identified additional areas of concern, including excessive rilling along the northern Pond 1 toe trench and the potential for head-cutting along the drainage area north of Pond 1 and Pond 3. In a letter dated May 16, 2002, RAM submitted for NRC review, a report that provides the design of head-cutting control and toe protection facilities to be constructed along the northern edge of Pond 1. Staff reviewed this report and met with representatives of RAM on August 28, 2002. As a result of concerns raised at this meeting, RAM submitted a report entitled, "Responses to Staff Questions on Erosion Protection Design for Pond #3 and Additional Arroyo del Puerto Investigations." This report responded to staff concerns about the determination of the probable maximum flood and possible erosion for the nearby arroyo. The final aspect of the design, which addresses the erosion protection for Pond 3, was submitted under cover letter dated September 26, 2002, "Design Report: Pond 1 South Embankment Toe Erosion Protection, Ambrosia Lake New Mexico." This Technical Evaluation Report documents the staff's review of RAM's proposed designs and provides the technical basis for the acceptability of the licensee's design.

INTRODUCTION

The first proposed design addresses rilling along the northern embankment of Pond 1. An apron is provided to mitigate the effects of a hydraulic jump formed as flow transitions from the steeper embankment slope to the flat toe surface. Additionally, the channel is designed to withstand longitudinal flow forces that are anticipated along the embankment toe. The second design addresses potential erosion on approximately 20 acres north of the north embankment of Pond 1 and potential erosion for the surface of Pond 3. The third report is the response to staff questions regarding erosion protection for Pond 3, determination of the probable maximum flood (PMF) and the effects of a local stream, the Arroyo del Puerto. The final report addresses erosion protection for the south embankment of Pond 1.

In general, criterion 6 of 10 CFR 40, Appendix A, requires stability of the tailings for 1000 years to the extent reasonably achievable and in any case for 200 years. Because the design storm is difficult to quantify for 1000 year design period, NRC guidance suggests using the probable maximum precipitation (PMP) and PMF for the design basis of erosion control features at mill tailings sites. The licensee has proposed that the design storm for the entire site will be the probable maximum precipitation event.

REPORT 1: DESIGN REPORT: POND 1 NORTH EMBANKMENT TOE EROSION PROTECTION - AMBROSIA LAKE MILL, NEW MEXICO

Pond 1 is a reclaimed tailings disposal site and was previously used for burial of byproduct material produced at the mill. During a May 2001 inspection, NRC staff observed rilling along the northern embankment of Pond 1. In addition, the inspectors noted concerns with the current design of the apron and identified the potential for head-cutting along the toe from flow along the planned diversion channel. The embankment of Pond 1 includes a radon barrier and an overlying rock cover that provides erosion protection. The proposed erosion protection system for the north embankment toe of Pond 1 involves an apron, which is designed to withstand a hydraulic jump that occurs as flow transitions from the steeper embankment slope to the flat toe surface, and a channel design that will withstand the effects of longitudinal flow that is anticipated adjacent to the embankment toe.

Design parameters and assumptions

The PMP was determined using methodology outlined in the U.S. Department of Commerce's Hydrometeorological Report No. 55A (HMR-55A). The 1-hour 1 square mile event is estimated to be 10.5 inches but is adjusted for elevation and duration. The final value was determined to be 9.5 inches for the 1-hour, 1-square mile local storm. However, an earlier prediction of the PMP, based on calculations for this site's reclamation plan, estimates the precipitation to be 9.6 inches for the same storm. In order to maintain consistency, the licensee chose to use the 9.6 inch value for the remainder of the design.

Erosion Protection Design

The north toe of the Pond 1 embankment requires an erosion protection apron for runoff from the pile as well as erosion protection for the longitudinal flow along the toe due to the moderate slope. The licensee determined the apron characteristics based on methods recommended in NUREG-1623, Appendix D, Section 6. The open channel flow requirements to control the runoff and longitudinal flow were computed in accordance with NUREG-1623, Appendix D, Sections 2 and 3.

The north apron drains a 13.4 acre catchment on the top of Pond 1. A slope of 5H:1V exists along the entire Pond 1 embankment toe. The current apron has experienced minor erosion indicating that a redesign of the apron is appropriate. For the catchment area, a time of concentration was calculated for each of two slopes, with respective slope lengths of 350 feet and 575 feet. These are the longest and shortest slope length for the north toe of Pond 1. Times of concentration of 1.5 minutes and 2.5 minutes were calculated for the short and long slope, respectively. A shortest incremental rainfall duration of 2.5 minutes was used for both slope lengths. This assumption is in accordance with NRC guidance put forth in NUREG/CR-4630. The Rational Method was used to determine the runoff volume for both slopes. Given the computed flow rate and assuming a concentration factor of 2.5, the design calls for the placement of rock with a d_{50} of 6.0 inches on slopes shorter than 350 feet and a d_{50} of 7.8 inches is called for on slopes with lengths between 350 feet and 575feet.

The area along the toe at the northern end of Pond 1 is moderately sloped and could produce erosive longitudinal flows. The licensee proposes an open channel that will collect and convey

the precipitation that falls on the embankment slope. The design makes use of methods presented in NUREG-1623, Appendix D, Sections 2 and 3.

The design subdivides the channel into two sections. The first, consisting of the upper 5.1 acres, is segregated due to its location and slopes. The time of concentration, developed using the maximum calculated flow length of 1195 feet, was determined to be 7.0 minutes. The 7.0 minute PMP is 5.09 inches according to the method by Nelson et al in NUREG-1623. The resulting peak flow for the upper section is 221cfs.

The remaining 8.3 acres of the embankment are included in a second subdivision. The time of concentration for this area, which was based on a maximum flow length of 2100 feet and takes into account the flow length from the upper section, was determined to be 9.5 minutes. The 10 minute PMP according to Nelson et al in NUREG-1623 is 5.95 inches. The rational method yields a peak flow of 480cfs for the entire system.

The channel/apron configurations were developed using flow calculations and methods discussed in NUREG-1623. The more protective method between the apron and channel were chosen to maintain the channel integrity during both flow scenarios. A Manning's roughness coefficient was developed using the procedures of Section 3 of NUREG-1623 and entered into the hydraulic design software, Flow Pro 2.0. Estimated channel widths of 8 feet (upper channel) and 20 feet (lower channel) were included as program input data. The guidance recommends that channel widths be greater than 15 times the d_{50} diameter. The corresponding D_{50} diameters were also included in the program. The program calculates the depth of flow in the channel while the remaining channel cross-section can be determined based on a typical trapezoidal cross section with a 2H:1V side slope. For this case, a channel depth of 3 feet was determined.

The existing erosion control apron will be removed and the sub-grade properly re-graded to ensure that embankment run-off flows into the proposed channel/apron.

Conclusion

Given the assumptions stated in the referenced report, staff concludes that the proposed design for the northern embankment toe of Pond 1 and the channel/apron is appropriate.

REPORT 2: DESIGN REPORT - POND 3 EROSION PROTECTION AND EROSION PROTECTION FOR THE AREA NORTH OF POND 1- AMBROSIA LAKE MILL, NEW MEXICO

This design report address three areas of the site that include potential erosion on approximately 20 acres north of the north embankment, the extension of the Pond 1 channel/apron, and the runoff area for Pond 3. Seven specific areas for erosion protection have been identified.

1. Toe erosion protection apron at the interface of Pond 1 and Pond 3;
2. Surface erosion protection for Pond 3;
3. Erosion protection for the east embankment of Pond 3;
4. Toe erosion protection of the area north of Pond 1;
5. Surface run-off protection for the area north of Pond 1;

6. Diversion channel construction along the northern limit of the area north of Pond 1; and
7. Discharge channel construction from the end of the Pond 1 north embankment channel/apron to the Arroyo del Puerto basin.

Method of analysis

The analysis in this report determined that the erosion protection should be based on runoff analysis for sheet flow down slopes and across pond surfaces in accordance with NRC guidance in NUREG-1623. The longitudinal flow requirements for the open channel were used to calculate the toe requirements for the control of runoff during a PMF event.

In order to estimate the PMF for the Arroyo del Puerto, a natural channel, the basin area was first calculated to be 57.6 square miles at the Ambrosia Lake mill. Next, the Soil Conservation Service's curve number for the Montanosa Mesa drainage basin, 73.4, was chosen due to this basins similarities to the Arroyo del Puerto basin. A lag time of 1.83 hours was chosen corresponding to 60 percent of the time of concentration. Several storms were investigated, including the 1-hour and 6-hour local storms and the 6-hour, 24-hour and 72-hour general storms. Analysis of the results showed that the largest PMF was produced during the 6-hour local storm that produced a peak flow of 75,200 cfs. Since earlier designs used a peak flow of 78,000 cfs, the licensee opted to use the higher value.

Using the storm value of 78,000 cfs, the licensee constructed a hydraulic model of the Arroyo del Puerto in the vicinity of the Ambrosia Lake mill. The purpose of the model was to determine the flood water elevation in the vicinity of Pond 3. The following assumptions were used:

1. Arroyo del Puerto was rerouted to a new alignment east of its existing position in the vicinity of the mill. The new channel rejoins the original channel near the north-east corner of Pond 9.
2. The Pond 3 embankment will be constructed to a final elevation of 6935 feet.
3. The existing groundwater trench is backfilled.
4. Pond 9 is assumed to be removed and regarded to a final elevation of 6917 feet.

Using the assumptions stated above and the calculated PMP and PMF, the main aspects of the erosion protection were analyzed. A brief description of each follows.

Toe erosion protection apron at the interface of Pond 1 and Pond 3

For the 31 acre catchment with a slope length of 520 feet, a time of concentration was calculated to be 1.92 minutes. A corresponding incremental PMP distribution of 2.5 minutes was used to calculate the corresponding PMP depth of 2.64 inches. Based on this flow, the methods of NUREG-1623 yield a d_{50} of 7.5 inches. Because the licensee has stone of larger diameter available, the final d_{50} was increased to 9.4 inches. Consistent with NRC guidance established in NUREG-1623, apron width is set at 15 times d_{50}, while depth is set at six times d_{50}.

Surface erosion protection for Pond 3

Because Pond 3 is not yet complete, the design is based on several assumptions. The licensee anticipated that the 33 acre area will have a 12-inch thick rock cover resulting in a final elevation of 6938 feet. A surface grade of 0.3 percent will prevent ponding of water and the maximum surface length is assumed to be 7000 feet. The modeling of the PMF in the Arroyo del Puerto shows the flow elevation to be 1 foot less than the top of the embankment. A time of concentration of 11.6 minutes was determined. Pond 1 embankment flows will be discharged onto the Pond 3 surface, therefore, the time of concentration for Pond 3 was calculated to be 13.52 minutes. The incremental rainfall duration was used to determine the PMP depth of 6.72 inches. The method of Abt et al from NUREG-1623 predicts a rock d_{50} of 0.4 inches and the licensee proposed a rock size d_{50} of 1.0 inches since it is easier to obtain.

Erosion protection for the east embankment toe of Pond 3

Assumptions were made about the location of the east embankment toe of Pond 3 because of the ongoing reclamation work at Pond 3. The elevation was assumed to be 6923 feet. The apron will dissipate energy from the 65 feet slope. Two precipitation events were analyzed to determine which event would produce the largest run-off at the site. The controlling forces came from the PMF in the Arroyo del Puerto. Because the flow was greater in the open channel, the Army Corps of Engineers method was used to determine the d_{50} of 12 inches. This method is consistent with NRC guidance.

Surface run-off protection of the area north of Pond 1

The 20 acres of undeveloped land adjacent to the north embankment of Pond 1 was investigated for the need of an erosion protection layer. Analysis of the PMP determined that an erosion protection rock layer was necessary to prevent head-cutting due to local rain events. The licensee proposes to re-contour the area to prevent erosion and provide effective rock cover. To achieve this, slopes of greater than 7.5 percent will be regraded to slopes equal to or less than 7.5%. A rock size of d_{50} equal to 2.2 inches was based on flow volume calculated from the rational method of 1.6 cfs/ft, incremental rainfall duration of 7.82 minutes and a PMP depth of 5.2 inches.

Diversion channel construction along the northern limit of the area north of Pond 1

Rainfall that falls on the area north of Pond 1 flows toward the Arroyo Del Puerto producing head-cut erosion that is directed west toward the mill site. The licensee proposes an engineered diversion channel be placed at the erosion location to prevent further degradation. The design segmented the channel into three sections to account for flows, slopes and terrains. The following is a summary channel segment characteristics.

Channel Segment	Time of Concentration (minutes)	Local Incremental Rainfall (in)	Basin Size (acres)	Segment Flow Rate (cfs)	Rock Size, d_{50} (in)	Bottom Width of Channel (ft)
0+00-9+00	6.6	4.8	2.2	97	9.2	3
9+00-17+00	8.3	5.4	7.4	288	9.2	20
17+00-27+01	13.2	6.7	16.3	497	9.2	28

The hydraulic model developed for the channel indicated that a hydraulic jump develops between the steep second segment and the flatter third segment. It was then concluded that the channel would require additional height to contain the jump for a distance of 25 feet at the jump location. Additionally, the apron requires that rock with a d_{50} = 17 inches be placed to a depth of 4.3 feet to accommodate forces associated with the hydraulic jump.

Discharge channel construction from the end of Pond 1 north embankment channel/apron to the Arroyo del Puerto basin.

Runoff from the north embankment of Pond 1 collects in an apron/channel that runs east toward the Arroyo del Puerto. The discharge channel transitions back to the arroyo with a transition section 25 feet long to convert the apron/channel to a normal channel with 2:1 side slopes. The next 25 feet, the channel rock size is increased to accommodate an expected hydraulic jump. The time of concentration was calculated to be 12.2 minutes and the incremental PMP depth is 6.5 inches. The catchment area is 15.7 acres, resulting in a discharge (using the rational equation) of 498 cfs. A rock d_{50}=9.2 provides adequate protection for the channel under the design conditions.

The purpose of the apron will be to slow the flow of the water before it reaches the native vegetation of the Arroyo del Puerto, thereby preventing scour of the native silty clays. The apron also handles discharges from the arroyo. Accordingly, the design flow is a sum of the discharge channel and that from the arroyo basin (995 cfs). A slope of 0.5 percent and width of 80 feet should adequately slow the flow to less than 4ft/sec. The scour depth of 6 feet has been included in the toe design as well as 25 foot wing walls.

Conclusion

The staff concludes that the designs proposed for the apron along Pond 1 and Pond 3 interface and the Pond 3 embankment, toe and surface and the north erosion protection areas are appropriate given the assumptions stated in the referenced report. Staff notes that the assumptions of final grade should be reviewed at the time of construction and that changes may require re-evaluation of the proposed design.

REPORT 3: RESPONSES TO STAFF QUESTIONS ON EROSION PROTECTION DESIGN FOR POND #3 AND ADDITIONAL ARROYO DEL PUERTO INVESTIGATIONS

In August of 2002, NRC staff raised their concern to the licensee that the estimated PMF of 78,000 cfs for the Ambrosia Lake mill site may be too low. Additionally, the staff noted that the Arroyo del Puerto may be subject to migration over the design period and its flows should be accounted for when sizing rock. In response to the first concern, that the PMF was underestimated, the licensee performed a sensitivity analysis in order to determine which variable may have a dramatic effect on the calculation of the PMF.

The calculation of the PMF from the PMP requires many parameters including type of storm, the geometry of the basin, the infiltration properties of the basin, as well as assumptions about the behavior of the flood peak as it travels through the basin. A sensitivity analysis was performed using the hydrologic model HEC-1. The three variables that would affect the peak flow significantly were reviewed. The variables included curve number, lag time and rainfall sequence. The licensee applied the most conservative bounds on the parameters and the results showed that the PMF could be as high as 126,000 cfs. However, the circumstances for this to occur were so unlikely that the value simply provided a high bound for the PMF.

The one variable which appeared to have an influence within a reasonable range was the lag time calculation. The lag time was adjusted based on a New Mexico method developed by the U.S. Geological Survey (USGS) which increased the calculated PMF. However, the methodology for USGS which lowered the lag time does not directly transfer to the current situation. The methodology was based on floods in smaller basins. Therefore, the licensee's conclusion was that the current estimate for the PMF is reasonable.

In addition to considering the PMF calculation, the licensee was also asked to review the possibility for lateral migration of the Arroyo del Puerto. The concern of staff was that the arroyo would migrate over time and eventually be located at the toe of the tailings impoundment. If that occurred, the erosive forces of the arroyo could undermine the toe of the tailings impoundment causing a failure. The licensee performed an analysis which determined that the maximum lateral migration of the outside banks would be approximately 3 feet per year.

Conclusion

Staff concludes that the PMF is within a reasonable range and has been appropriately used in the design of Ponds 1 and 3 erosion protection. However, the lateral migration of the Arroyo del Puerto at Section 3 should be re-evaluated for the possibility of undercutting of the Pond 3 toe. The toe may be sufficient to resist any erosion to the migrating stream but the licensee should revisit this matter prior to construction and should verify this with staff.

REPORT 4: DESIGN REPORT; POND 1 SOUTH EMBANKMENT TOE EROSION PROTECTION, AMBROSIA LAKE, NEW MEXICO.

The report was written in response to an NRC inspection in 2000 where concerns were raised about erosion and rock displacement on the south side of Pond 1. The assumption of the PMP as discussed in Reports 1 and 2 is the same for this report and design. This report analyzes the apron requirements based on run-off analysis for the south embankment of Pond 1 and determined the open channel requirements to control the run-off and longitudinal flow from the south embankment.

A 19-acre catchment that discharges along the southern end of Pond 2 had a corresponding time of concentration of 1.64 minutes and a PMP depth for a local storm of 2.64 inches. The Rational Method calculated the unit discharge to be 0.63cfs/ft for the 452 feet slope length. Assuming a maximum embankment slope of 20 percent and a concentration factor or 2.5, the rock d_{50} requirement is 6.7 inches.

The slope at the toe of the south embankment of Pond 1 may induce moderate flows along the toe. This condition was evaluated by placing an open channel/apron at the base of the slope that will catch the precipitation that falls on the embankment slope and runs off. Methods from NUREG-1623 were used to develop the characteristics of the channel. The channel configuration is based on a time of concentration of 11.4 minutes, the incremental storm depth of 6.3 inches, a peak flow of 579 cfs and a bottom width of 12 feet. The average existing slope of 2.3 percent requires a rock d_{50} of 7.5 inches and a depth of 4.5 feet.

A discharge apron is required where the flow runs onto native ground downstream from the pond. A toe will be constructed at the edge of the discharge apron to prevent scour. Wingwalls will extend for an additional 25 feet beyond the apron and are constructed with a rock toe keyed into bedrock. A filter rock should also be placed. The existing erosion control apron must be removed and the subgrade properly re-graded such that run-off from the embankment flow into the proposed channel/apron and toe apron.

Conclusion

The staff concludes that the design proposed for the south embankment of Pond 1 is appropriate given the assumptions stated in the referenced report.

CONCLUSION

Based on the review of the information submitted by the licensee and on independent calculations, the NRC staff concludes that the licensee has identified the appropriate floods for the design of erosion protection features at the site. However, staff notes that the assumptions, especially final grade assumptions, should be closely monitored during construction and if any changes occur then the design should be revisited for potential impacts to the initial designs. In addition, these designs are based on durable rock that should be verified prior to placement. If suitable rock is not available and oversizing is requested, it may be possible that the revised rock size will affect the performance of the design. The licensee will be responsible for providing updated calculations and redesigns accounting for the new rock size. Finally, the toe of Pond 3 (at Section 3) should be reviewed for the possibility of undercutting by the Arroyo del Puerto in the event the arroyo migrates to the toe of the pond.

Other than the items stated above, the erosion protection design appears to be adequate and to provide reasonable assurance of protection for 1000 years, as required in Criterion 6 of 10 CFR Part 40, Appendix A.

Source Material License, SUA-1473, has been updated in Amendment 51 to reference the submittals dated May 16, 2002 and September 26, 2002. The designs included in these submittals for specific areas of Ponds 1 and 3 supercede any other designs previously approved.

ENVIRONMENTAL IMPACT EVALUATION

An environmental assessment for this action is not required, since this action is categorically excluded under 10 CFR 51.22(c)(3)(i), and an environmental report from the licensee is not required by 10 CFR 51.60(b)(2).

REFERENCES

Goranson, W.P., Rio Algom Mining LLC, letter to NRC dated May 16, 2002, "Design Report for Pond 1 North Embankment Erosion Protection, Pond 3 Erosion Protection and Erosion Protection for the Area North of Pond 1" License No.: SUA-1473, Docket No.: 40-8905.

Goranson, W.P., Rio Algom Mining LLC, letter to NRC dated September 26, 2002, "Responses to Staff Question On Erosion Protection Design for Pond #3 and Additional Arroyo del Puerto Investigation" License No.: SUA-1473, Docket No.: 40-8905.

Goranson, W.P., Rio Algom Mining LLC, letter to NRC dated September 26, 2002, "Design Report; Pond 1 South Embankment Toe Erosion Protection" License No.: SUA-1473, Docket No.: 40-8905.

Johnson, T.L., 2002, Design of Erosion Protection for Long-Term Stabilization. Final Report, NUREG-1623, U.S. Nuclear Regulatory Commission, Washington, DC.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 5, 2004

Mr. Peter Luthiger
Manager, Radiation Safety
and Environmental Affairs
Rio Algom Mining LLC
P.O. Box 218
Grants, NM 87020

SUBJECT: REVIEW OF RIO ALGOM MINING LLC's LATERAL MIGRATION EVALUATION FOR ARROYO DEL PUERTO (TAC NO. LU0056)

Dear Mr. Luthiger:

In a letter dated June 22, 2004, Mr. Paul Goranson of Rio Algom Mining LLC (Rio Algom) submitted to the U.S. Nuclear Regulatory Commission (NRC) a report assessing the potential for migration of the Arroyo del Puerto at the Ambrosia Lake uranium mill tailing site. This analysis was requested by the NRC during its review of erosion control facility design for Amendment 51 of Source Materials License SUA-1473.

An evaluation of Rio Algom's analysis is included in NRC's Technical Evaluation Report and has been enclosed for your information. Based on the conclusion that the maximum differential between the toe of the impoundment (Pond 3) and the channel bed is approximately 10 feet, we request Rio Algom address the potential undercutting of the impoundment due to the vertical down-cutting by the Arroyo in its design of erosion protection at the toe of Pond 3.

Should you have any questions regarding this letter, please feel free to contact me or Ms. Jill Caverly, the NRC project manager, at (301) 415-6699 or via email to jsc1@nrc.gov.

In accordance with 10 CFR 2.390 of the NRC's Rules of Practice, a copy of this letter will be available electronically from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

Gary S. Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No.: 40-8905
License No.: SUA-1473

Enclosure: Technical Evaluation Report

cc: B. Law, Rio Algom

Technical Evaluation Report
Migration of the
Arroyo del Puerto at the
Ambrosia Lake Uranium Mill Tailings Facility

BACKGROUND:

In 2002, Rio Algom Mining LLC (Rio Algom) submitted to the U.S. Nuclear Regulatory Commission (NRC) updated designs for erosion control at the uranium mill tailings impoundments at the Ambrosia, New Mexico facility. The designs were intended to update an earlier reclamation design that was approved by the NRC but with the requirements that additional analysis be performed. The erosion control designs were approved in an amendment (Amendment No. 51) to Source Materials License, SUA-1473. However, the NRC noted that geomorphic stability of the stream adjacent to the tailings impoundment should be verified.

The Arroyo del Puerto is a small meandering stream that crosses the Ambrosia Lake site at the northeast corner. The stream was realigned after the construction of the mill and other facilities. The revised alignment diverted the stream from its natural southeasterly course to one that goes directly east then turns approximately 90 degrees to the south eventually returning to the original channel. Included in the reclamation of the site was the re-establishment of the natural channel that will bring it within 300 feet of the toe of the tailings impoundment.

EVALUATION:

In NRC's review of Amendment No. 51, the staff noted its concern that the stream would migrate toward the toe of the Pond 3 impoundment and stated this in its Technical Evaluation Report dated November 27, 2002. Rio Algom discussed the migration of the Arroyo del Puerto in its original Ponds 1 and 3 erosion protection design submittal, stating that considering the most conservative assumptions the stream would migrate approximately 3 feet a year. Given the 300 feet distance between the pond and the stream, there is a possibility that the stream could migrate toward the tailings within the 1000 year design criteria. The NRC asked that further analysis be performed to evaluate the possibility of undercutting the Pond 3 toe and to assure that the impoundment would not be compromised. Rio Algom submitted an analysis for review by letter dated June 22, 2004.

Rio Algom evaluated the potential migration of the Arroyo del Puerto by considering the geologic characteristic of the site and the historical migration of the stream. The geologic analysis used information from mapping in an earlier submittal dealing with groundwater alternate concentration limits. The second method of evaluating the stream migration was based on arial photographs.

The geologic information shows that an outcropping of the Mancos Formation is at the surface in the vicinity of the tailings impoundment. The Mancos formation is comprised of cretaceous age shales interbedded with sandstone. The formation brackets the tailings impoundment on the north and south. The tailings impoundment is essentially located in a drainage between the two areas where Mancos outcrops. The channel of the stream abuts the outcrop of the Mancos at the north end and the southeast segment of the channel. Rio Algom stated that because Mancos is a competent rock and brackets the tailings impoundment that it is a limiting factor for the migration of the Arroyo del Puerto.

In addition to the geologic analysis, Rio Algom studied arial photographs of the Ambrosia Lake site dating 1935, 1952 and 1996 that viewed the area of Ambrosia Lake both pre- and post-milling activities. Migration of the Arroyo has been minimal based on the analysis of the photographs. Rio Algom concluded that the Arroyo has not significantly migrated over the past 70 years. However, Rio Algom noted that the bed elevation for the reconstructed Arroyo channel will be approximately 6 to 10 feet below the toe of the impoundment.

SUMMARY AND CONCLUSION:

The staff has reviewed the information submitted by Rio Algom and concludes that the geologic and historic information does provide a level of assurance that migration of the Arroyo del Puerto will not be significant. However, the east side of the impoundment (along Pond 3) will not be protected by the Mancos shale outcropping. Therefore, a possibility exists that migration of the Arroyo could affect the tailings impoundment by undercutting the toe of the impoundment by 6 to 10 feet.

Because parts of the Pond 3 impoundment can be compromised by undercutting from the Arroyo, Rio Algom should update the Ambrosia Lake erosion protection design to account for the migration of the Arroyo. Some suggested methods include stabilizing the stream at its reconstructed location or providing additional protection against undercutting at the Pond 3 toe.

REFERENCES:

U.S. Nuclear Regulatory Commission, November 27, 2002, "Erosion Protection Design for Ponds 1 and 3 for the Ambrosia Lake Mill Tailings Site - License Amendment 51" [ADAMS Accession No. ML023370493]

Rio Algom Mining LLC, May 16, 2002, "Design Report for Pond 1 North Embankment Erosion Protection, Pond 3 Erosion Protection and Erosion Protection for Area North of Pond 1" [ADAMS Accession No. ML021480047]

Rio Algom Mining LLC, June 22, 2004, "Lateral Migration for Arroyo del Puerto" [ADAMS Accession No. ML041970652]

October 5, 2004

In accordance with 10 CFR 2.390 of the NRC's Rules of Practice, a copy of this letter will be available electronically from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

Gary S. Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No.: 40-8905
License No.: SUA-1473

Enclosure: Technical Evaluation Report

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NAME	J. Caverly	B. Garrett	B. von Till,Acting SC	G. Janosko
DATE	10/04/04	10/01/04	10/5/04 Via e-m 10/5	10/5/04

OFFICIAL RECORD COPY September 30, 2004 # 1

Appendix B

Lateral Migration Evaluation for
Arroyo del Puerto

Memorandum by Maxim Technologies
November 5, 2003

MAXIM

10601 Lomas NE, Suite 106
Albuquerque, NM 87112
(505) 237-8440

MEMORANDUM

DATE: **November 5, 2003**

TO: **Paul Goranson, Rio Algom Mining Corporation**

FROM: **John M. McBee, P.E.**

SUBJECT: **Lateral Migration Evaluation for Arroyo del Puerto**

PURPOSE AND SCOPE OF STUDY

This memorandum presents the results of a study to assess the potential migration of Arroyo del Puerto in the vicinity of the Ambrosia Lake Mill. Specifically, this study was in response to concerns presented in a letter from the Nuclear Regulatory Commission (NRC) dated November 27, 2002, which was a review of design submittal "Erosion Protection Design for Ponds 1 and 3 for the Ambrosia Lake Mill Tailings Site – License Amendment 51, SUA – 1473 (TAC no. L51431). On pages 7 and 8 of the letter, the NRC states in the conclusions that "the toe of Pond 3 (at Section 3) should be reviewed for the possibility of undercutting by the Arroyo del Puerto in the event the arroyo migrates to the toe of the pond". Section 3 of Pond 3 is through the northeast portion of the pond embankment closest to the arroyo.

PREVIOUS EVALUATION

A memorandum dated September 6, 2002, "Ambrosia Lake Mill – Arroyo del Puerto Investigations" by Maxim Technologies focused on issues raised in discussions with the NRC concerning calculation of the probable maximum flood (PMF). However, the memo also included a potential lateral migration rate of the arroyo to provide an assessment that the location of the channel (300 feet from the toe of Pond 3) used in the PMF calculations was adequate for the PMF erosion protection design. As stated in the memorandum, conservative assumptions were used in the calculation and were based on studies completed in western Canada. No historical site area records were available.

SITE ASSESSMENT

Two different lines of information were used to assess the potential migration of the arroyo. First, a bedrock outcrop map of the site area which had been compiled previously and included as Figure 2.3 in "Application for Alternate Concentration Limits (ACLs) in the Alluvial Materials at the Quivira Mill Facility Ambrosia Lake, New Mexico." Grants, New Mexico: Quivira Mining Company. 2001 was reviewed. Also, aerial photographs from as wide a time span as possible were collected and evaluated. Photographs of the site vicinity dated from 1935, 1952, and 1996; the first two photographs pre-dated mining and milling operations.

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This report presents the results of a study to assess the potential migration of Arroyo del Puerto in the vicinity of the Ambrosia Lake Mill. Specifically, this study was in response to concerns presented in a letter from the Nuclear Regulatory Commission (NRC) dated November 27, 2002, which was a review of design submittal "Erosion Protection Design for Ponds 1 and 3 for the Ambrosia Lake Mill Tailings Site – License Amendment 51, SUA – 1473 (TAC no. L51431). On pages 7 and 8 of the letter, the NRC states in the conclusions that "the toe of Pond 3 (at Section 3) should be reviewed for the possibility of undercutting by the Arroyo del Puerto in the event the arroyo migrates to the toe of the pond". Section 3 of Pond 3 is through the northeast portion of the pond embankment closest to the arroyo.

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SITE ASSESSMENT

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Implications of the outcropping of the Mancos Formation at the ground surface in the vicinity of the site reveal that it in part controls the location of the channel of Arroyo del Puerto. Figure 1 shows the surface geologic map of the site vicinity with two units exposed at the surface, Quaternary Alluvium and the Mancos Formation, which is comprised of Cretaceous age shales interbedded with some sandstone. North of the tailings impoundment (primarily Ponds 1and 3) the channel of the arroyo abuts the outcrop of the Mancos Formation. Also, southeast of the impoundment the channel of the arroyo is adjacent to the Mancos in certain areas or has migrated to the east away from the Mancos Formation at the surface. As can be seen from the figure, the tailings impoundment was primarily located on an un-named drainage between the two outcroppings of the Mancos Formation. Since the Mancos is a competent rock unit and it essentially "brackets" the disposal cell, it will be a limiting factor of the migration of Arroyo del Puerto to the west for the two hundred to 1,000 design life of the disposal cell. Therefore, if migration of the arroyo both north and southeast of the disposal is limited by the bedrock outcrop, then the potential for migration of the arroyo immediately east of the cell will be limited.

Aerial photographs of the site vicinity, which covered a 61 year period of time, were reviewed to determine whether there were measureable changes in the location of the arroyo. Figures 2 through 5 show the overall location of the arroyo at the three time periods (1935, 1952, and 1996). Insets in the photographs were an attempt to highlight the same portion of the arroyo channel at a higher scale. But because of limitations of the resolution of the photographs and differences do the slight distortion of altitude and flight path of the aircraft, measurements to quantify migration distances could not be made. However, it can be seen from reviewing the photographs that migration of the channel of Arroyo del Puerto has been minimal, if any, since 1935.

The impacts of the mining operations can be seen in the 1996 photograph. The area of the arroyo southeast to north of the final disposal cell shows evidence of manmade changes, i.e., reworked, regraded, construction of ponds, etc. The natural, pre-mining conditions have been disturbed and will be remediated before site closure. However, there will be only about 6 feet difference in elevation of the reconstructed arroyo channel and the base of the disposal cell apron on the north end of the Pond 3 area to about 10 feet where the channel will discharge to the east of Pond 3. The potential of the arroyo under-cutting backfilled areas on the northeast section of Pond 3 will be limited to these depths.

No data from historical storm events in the vicinity of the site could be obtained. However, only since mining dewatering of underground operations has there been continuous discharge to the arroyo. All but one mine dewatering operation has stopped (Quivira Mining Company), which will also be stopped once approved. Therefore, flows in the arroyo will revert to only large natural storm events.

In summary, based on observation of aerial photographs, migration of the channel of Arroyo del Puerto has been minimal, if any, since 1935. Also, the bedrock outcrop of the Mancos Formation north and southeast of the tailings impoundment will limit potential westward migration of Arroyo del Puerto. Vertical down-cutting of the arroyo in the vicinity of Pond 3 will be limited to approximately 6 to 10 feet below the toe of the Pond 3 Apron.

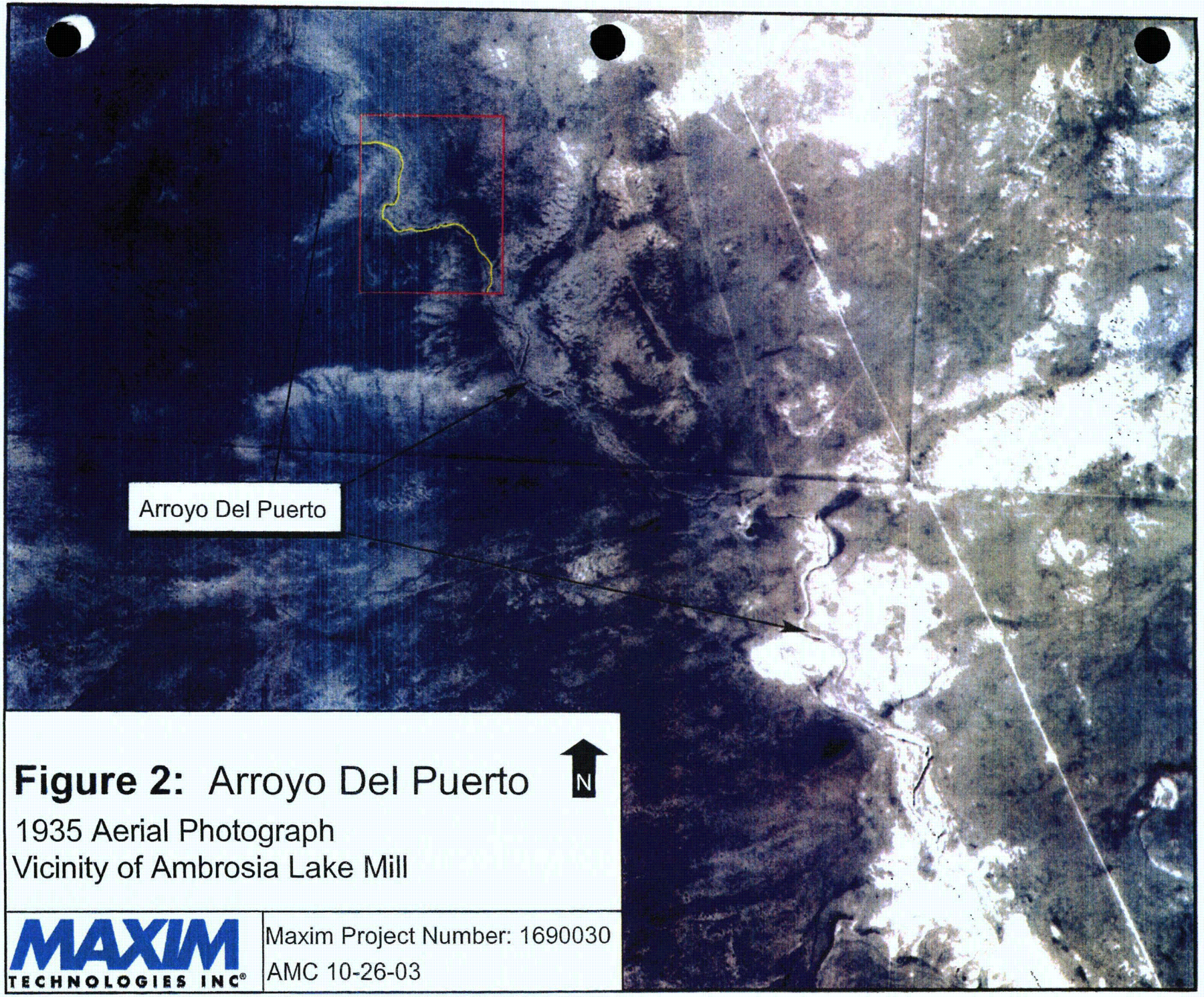

Figure 2: Arroyo Del Puerto

1935 Aerial Photograph
Vicinity of Ambrosia Lake Mill

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AMC 10-26-03

Figure 3: Arroyo Del Puerto

1952 Aerial Photograph
Vicinity of Ambrosia Lake Mill

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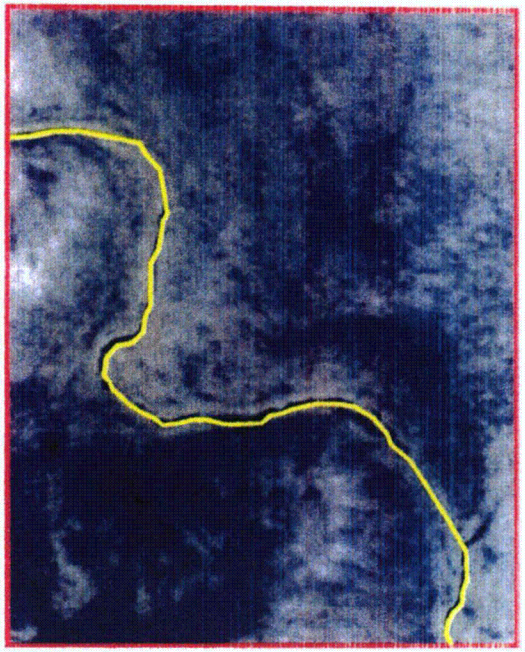
Figure 4: Arroyo Del Puerto

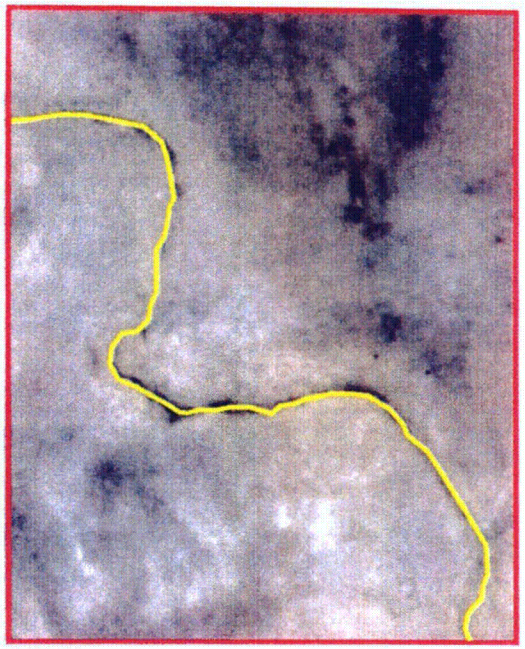
1996 Aerial Photograph
Vicinity of Ambrosia Lake Mill

MAXIM TECHNOLOGIES INC®

Maxim Project Number: 1690030
AMC 10-26-03



1935



1952

1996

Figure 5: Detail of Arroyo Del Puerto

N

1935, 1952, and 1996 Aerial Photographs
Vicinity of Ambrosia Lake Mill

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AMC 10-26-03

Appendix C

Arroyo del Puerto 100 year flow Calculations

MAXIM® TECHNOLOGIES INC

BY B. Bucher DATE 4/5/04

JOB TITLE Rio Algom JOB NUMBER 4690034

SUBJECT Arroyo del Puerto 100yr flow SHEET

Calculate 100yr recurrence for Arroyo del Puerto using basin characteristic method from Waltemeyer 1996 (USGS WRI 96-4112)

For Central Mountain Valley region,

$$Q_{100} = 4.18 \times 10^{+} A^{0.42} (E_c/1{,}000)^{-3.08} I_{24,10}^{2.74}$$

Q_{100} = 100yr recurrence flow, cfs

E_c = ave of channel elevations, feet a.m.s.l

$I_{24,10}$ = maximum precipitation intensity of a 24 hr. storm with 10-yr recurrence interval, in inches. I9 is from U.S. Precipitation Frequency Atlas

A = Basin area, sq. mi.

$$Q_{100} = 4.18 \times 10^{4} (5.76)^{0.42} \left(\frac{7210}{1000}\right)^{-3.08} (1.9)^{2.74}$$

$$= \underline{2974 \text{ cfs}}$$

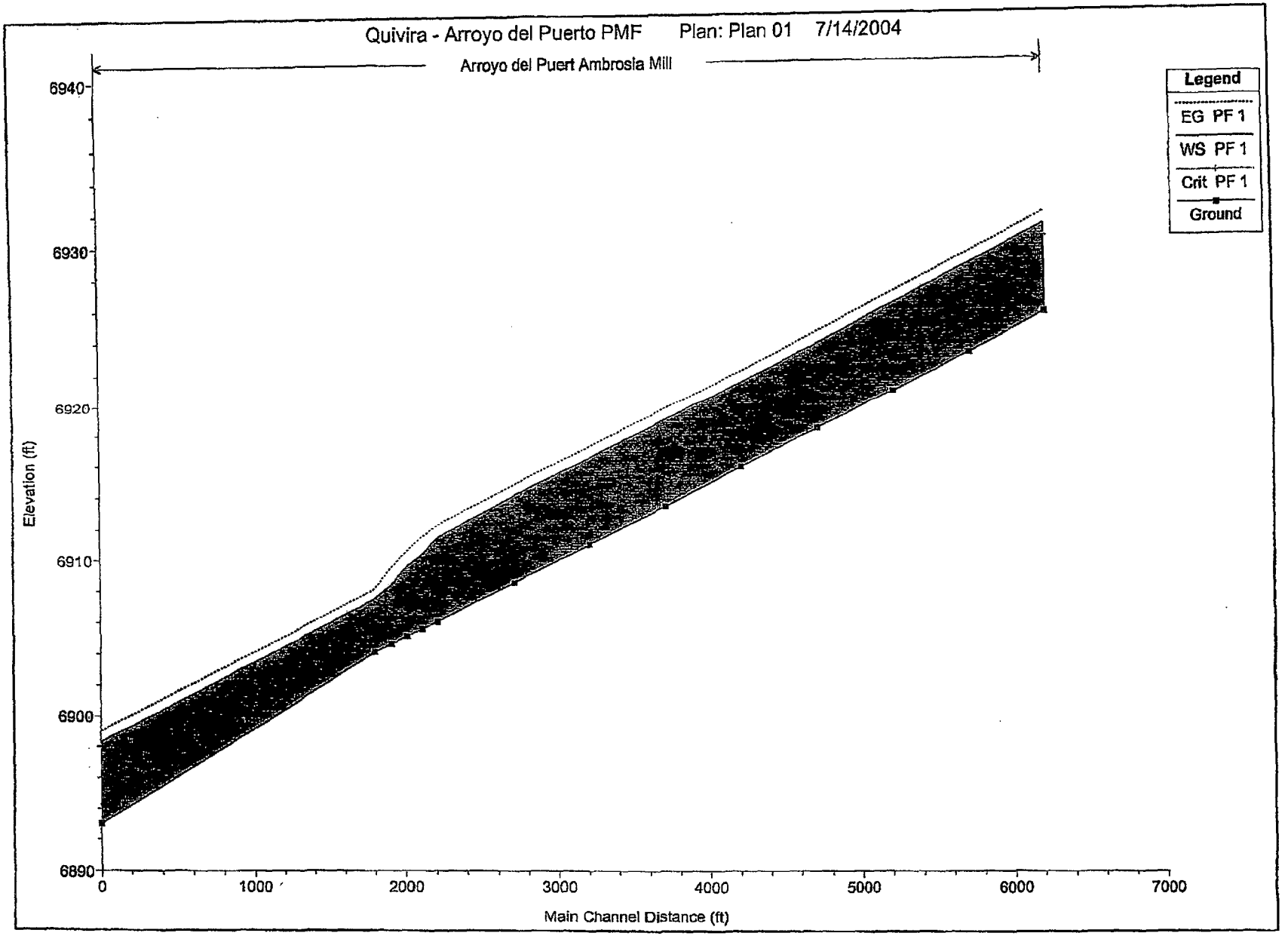
Calculate 2-yr flow for natural channel design of Arroyo del Puerto using Waltemeyer 1995

For Central Mountain Valley region

$$Q_2 = 7.47 \times 10^{5} A^{0.50} \frac{E_c}{1000}^{-5.28} I_{24,10}^{1.18}$$

$$= 7.47 \times 10^{5} (5.76)^{0.50} \left(\frac{7210}{1000}\right)^{-5.28} (1.9)^{2.74}$$

Q_2 = 971 cfs.


Quivira - Arroyo del Puerto PMF Plan: Plan 01 7/14/2004
Arroyo del Puert Ambrosia Mill
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
6940
6930
6920
6910
6900
6890
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)

HEC-RAS Plan: ADP 100 yr River: Arroyo del Puert Reach: Ambrosia Mill Profile: PF 1

Reach	River Sta	Profile	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)	
Ambrosia Mill	5761	PF 1	2974.00	6925.49	6931.03	6930.25	6931.76	0.004909	8.58	448.02	137.25	0.66
Ambrosia Mill	5361	PF 1	2974.00	6923.04	6928.58		6929.32	0.004870	8.55	449.22	137.34	0.65
Ambrosia Mill	4861	PF 1	2974.00	6920.60	6926.14		6926.87	0.004909	8.58	448.02	137.25	0.66
Ambrosia Mill	4361	PF 1	2974.00	6918.15	6923.69		6924.43	0.004870	8.55	449.22	137.34	0.65
Ambrosia Mill	3861	PF 1	2974.00	6915.71	6921.25		6921.98	0.004911	8.58	447.95	137.25	0.66
Ambrosia Mill	3361	PF 1	2974.00	6913.26	6918.81		6919.54	0.004851	8.54	449.79	137.38	0.65
Ambrosia Mill	2861	PF 1	2974.00	6910.82	6916.35		6917.09	0.004955	8.61	446.61	137.15	0.66
Ambrosia Mill	2361	PF 1	2974.00	6908.38	6913.99		6914.69	0.004598	8.38	458.03	137.98	0.64
Ambrosia Mill	1861	PF 1	2974.00	6905.94	6911.32		6912.14	0.005661	9.03	426.96	135.71	0.70
Ambrosia Mill	1761	PF 1	2974.00	6905.47	6910.24	6910.14	6911.39	0.009381	10.93	365.08	136.15	0.89
Ambrosia Mill	1661	PF 1	2974.00	6905.00	6909.48	6909.22	6910.45	0.008406	10.16	393.56	150.44	0.85
Ambrosia Mill	1561	PF 1	2974.00	6904.52	6908.29	6908.29	6909.44	0.011942	11.04	360.61	157.35	1.00
Ambrosia Mill	1450	PF 1	2974.00	6904.00	6907.38	6906.87	6908.02	0.006885	7.94	470.64	199.31	0.76
Ambrosia Mill	0	PF 1	2974.00	6893.00	6898.31	6897.98	6899.05	0.005003	8.50	510.71	232.13	0.68

Plan: ADP 100 yr Arroyo del Puert Ambrosia Mill RS: 1561 Profile: PF 1

E.G. Elev (ft)	6909.44	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.14	Wt. n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	6908.29	Reach Len. (ft)	111.00	111.00	111.00
Crit W.S. (ft)	6908.29	Flow Area (sq ft)	183.27	60.14	117.20
E.G. Slope (ft/ft)	0.011942	Area (sq ft)	183.27	60.14	117.20
Q Total (cfs)	2974.00	Flow (cfs)	1466.39	663.93	843.68
Top Width (ft)	157.35	Top Width (ft)	80.81	16.00	60.54
Vel Total (ft/s)	8.25	Avg. Vel. (ft/s)	8.00	11.04	7.20
Max Chl Dpth (ft)	3.77	Hydr. Depth (ft)	2.27	3.76	1.94
Conv. Total (cfs)	27214.3	Conv. (cfs)	13418.5	6075.5	7720.3
Length Wtd. (ft)	111.00	Wetted Per. (ft)	80.92	16.39	60.64
Min Ch El (ft)	6904.52	Shear (lb/sq ft)	1.69	2.74	1.44
Alpha	1.08	Stream Power (lb/ft s)	13.51	30.21	10.37
Frctn Loss (ft)	0.99	Cum Volume (acre-ft)	10.17	4.80	2.68
C & E Loss (ft)	0.15	Cum SA (acres)	4.79	1.07	1.47

Plan: ADP 100 yr Arroyo del Puert Ambrosia Mill RS: 3861 Profile: PF 1

E.G. Elev (ft)	6921.98	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.74	Wt.n-Val.	0.035	0.035	0.035
W.S. Elev (ft)	6921.24	Reach Len. (ft)	500.00	500.00	500.00
Crit W.S. (ft)		Flow Area (sq ft)	173.05	101.05	173.05
E.G. Slope (ft/ft)	0.004937	Area (sq ft)	173.05	101.05	173.05
Q Total (cfs)	2974.00	Flow (cfs)	1052.70	868.61	1052.70
Top Width (ft)	137.19	Top Width (ft)	59.09	19.00	59.09
Vel Total (ft/s)	6.65	Avg. Vel. (ft/s)	6.08	8.60	6.08
Max Chl Dpth (ft)	5.53	Hydr. Depth (ft)	2.93	5.32	2.93
Conv. Total (cfs)	42326.3	Conv. (cfs)	14982.1	12362.1	14982.1
Length Wtd. (ft)	500.00	Wetted Per. (ft)	59.42	20.66	59.42
Min Ch El (ft)	6915.71	Shear (lb/sq ft)	0.90	1.51	0.90
Alpha	1.08	Stream Power (lb/ft s)	5.46	12.96	5.46
Frctn Loss (ft)	2.42	Cum Volume (acre-ft)	19.49	9.88	11.61
C & E Loss (ft)	0.01	Cum SA (acres)	8.05	2.04	4.63

4.0 REFERENCES

1. US Army Corps of Engineers, 2001. *HEC-RAS River Analysis System.* Version 3.1.1. Hydrologic Engineering Center, Davis, California.

2. US Nuclear Regulatory Commission, 1999. Design of Erosion Protection for Long-Term Stabilization. NUREG-1623. Office of Nuclear Materials Safety and Safeguards, Washington, DC.

3. Waltermeyer, S. D., 1996. *Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico.* US Geological Survey Water-Resources Investigations Report 96-4112.