Rio Algom Mining LLC

July 15, 2005

ADDRESSEE ONLY
Mr. Gary Janosko, Chief
Fuel Cycle Facilities Branch, NMSS
Mail Stop T-8A33
U.S. Nuclear Regulatory Commission
Washington, DC 20850

Re: **License SUA-1473, Docket 40-8905**
Response to Request for Additional Information Items 6, 9, and 13 for the Soil Decommissioning Plan and The Closure Plan – Lined Evaporation Ponds For Ambrosia Lake Facility (TAC No. LU0077)

Dear Mr.Janosko,

Please find attached to this letter Rio Algom Mining LLC's responses to Comments 6, 9 and 13 as outlined within NRC's May 5, 2005 Request for Additional Information.

Upon NRC acceptance of RAM's responses, the Soil Decommissioning Plan will be revised to incorporate necessary changes to the document and a final soil plan document will be forwarded to NRC.

Please contact me if you have any questions or are in need of additional information related Rio Algom's responses to the RAI.

Regards,

Peter Luthiger
Manager, Radiation Safety
and Environmental Affairs

Attachment: As stated

xc: T. Fletcher
B. Law
B. Lewis (Komex)
R. Nelson (NRC)
File

P.O. Box 218, Grants, NM USA 87020 - Tel: 505.287.8851 - Fax: 505.285.5550

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) – COMMENTS 6, 9 AND 13

SOIL DECOMMISSIONING PLAN
LINED EVAPORATION PONDS CLOSURE PLAN

RIO ALGOM MINING LLC
AMBROSIA LAKE FACILITY
GRANTS, NEW MEXICO

SOURCE MATERIAL LICENSE SUA-1473
DOCKET NUMBER 40-8905

Prepared For:

Rio Algom Mining LLC

6305 Waterford Boulevard

Suite 400

Oklahoma City, OK 73118

Prepared By:

KOMEX

1300 Jackson Street

Suite 200

Golden, CO 80401

July 15, 2005

TABLE OF CONTENTS

COMMENT 6 1

COMMENT 9 2

COMMENT 13 3

RESPONSE TO LINED POND CLOSURE PLAN COMMENT 21 5

ATTACHMENT A – PREDICTION OF EROSIONAL SOIL LOSS 6

SOIL DECOMMISSIONING PLAN
RESPONSE TO COMMENTS 6, 9, AND 13

COMMENT 6. Page 65 states that no further clean-up will be done in the ponds because of the application of alternate release criteria. Dose modeling for Ponds 4-8 is provided but assumes that all contamination is 2 meters (6.5 ft) thick and radionuclide concentrations are the maximum measured value. Around the perimeter of Ponds 4, 5, and 6, the values for both Ra-226 and Th-230 drop to below 20 pCi/g at the 2-foot level except for pit 6A which had 966 pCi/g Th-230 (page 27).

REQUEST: Explain why it is not reasonable to clean-up Pond 6; around the perimeter of Ponds 4, 5, and 6; and other areas where only 1-2 ft of removal is needed to meet or approximate clean-up criteria.

RESPONSE TO COMMENT 6: The top few feet of contaminated soil has previously been removed from the footprint of each of ponds 4, 5, and 6. Analytical results from soil samples collected in trenches excavated within the unlined ponds indicate that more than six feet of material may still require excavation from the footprints of these ponds in order to eliminate the remaining residual radioactive materials. The presence of this material at depth provides a significant challenge to closing these ponds in a safe, efficient, and cost effective manner.

Following discussions with NRC staff regarding possible options for these areas, which centered around alternate release criteria approach, the footprints were subsequently covered with clean soil. Section 5.2 and Appendix C and D of the Soil Decommissioning Plan demonstrate that the remediation strategy completed in these areas is appropriate and no further investigation or soil remediation is planned within pond footprints. As discussed in RAM Response to NRC RAI #9 below, RAM intends to place a non-engineered rock mulch over these areas to provide for additional assurance that the long stabilization of the area will be maintained.

The pond perimeters present a distinct situation in that near surface soils may contain residual radioactive materials dispersed by surface actions and activities, while the deeper areas may contain impacts associated with pond seepage similar to those impacts present within the pond footprints and is an indication that contamination is expected to continue to greater depths.

RAM will sample the pond perimeters as described in Section 8.1 of the Soil Decommissioning Plan, which applies to surface soils. Up to 2 feet of soil will be removed in areas that are found to be above soil clean-up levels. In the event that impacts indicative of seepage are encountered, soil removal will discontinue as the contamination is likely to persist to greater depths. These areas will be treated in a similar fashion as the pond footprints in that the excavations will be backfilled to grade and the total area (footprints and perimeter) will be evaluated against the Alternate Release Criteria for deeper contamination described in Section 5.2 of the Soil Decommissioning Plan. This approach will ensure that any deeper impacts will receive similar assurance of long term stability.

The perimeter of ponds 4, 5, and 6 will be contoured to reduce erosion. RAM will then place a gravel mulch over the total area to further stabilize the cover as described in the response to RAI Comment 9.

COMMENT 9. RAM plans to cover Ponds 7 and 8 with at least 1 foot of clean soil (page 51), and has placed a similar thickness on Ponds 4-6 (page 66). The half-life of Th-230 is 77,000 years and its decay product, Ra-226, has a half-life of 16,000 years. Because of these half-lives, the expected longevity of the soil cover must be considered.

REQUEST: Describe if the cover soil will be compacted and why the cover on each of these evaporation ponds is likely to last for the design life of 1000 years. Also, since the thin cover soil on Pond 8 has apparently mixed with underlying contamination or eroded in spots (high surface Ra-226 values), clarify that one foot of additional fill will be added and that this fill will be adequate.

RESPONSE TO COMMENT 9: Ponds 7 and 8 have been stabilized in place by excavating and grading the remaining contaminated soils within the ponds to create a consistent base, followed by placement of no less than one foot of clean soil cover onto the ponds. Section 5.2 and Appendix D of the Soil Decommissioning Plan demonstrate that the remediation strategy completed in these areas is appropriate. Moderate native vegetation has been established over the whole area. No further remediation is planned within pond footprints other than placement of a rock mulch layer over the area as described below.

An evaluation of the long-term erosion potential at the Rio Algom site is provided in Attachment A. The purpose of the evaluation was to predict soil loss in reclaimed areas beyond the existing reclaimed tailing ponds that could be affected by runoff and run-on from periodic and long term storm events. In addition, the erosion potential of the land surface of reclaimed evaporation ponds 4, 5, and 6 were evaluated both for short term periodic storm events and from a PMP event. In general, the evaluation found that slopes less than one percent would experience an acceptable erosion rate over a 1000 year period.

The report recommends that a gravel mulch be placed over the reclaimed surface of Ponds 4, 5 and 6, and over slopes at Ponds 7 and 8 that exceed one percent. RAM will also apply the gravel mulch to the perimeter surrounding Ponds 4, 5 and 6 as an additional protective measure if deep impacts due to pond seepage are encountered in these areas.

The rock to be used for these areas will consist of a minimum D_{50} 0.5 inch rock and will be placed in a minimum of 1 inch thickness. It is anticipated that belly dump trucks will be used to place the rock and a grader will spread the rock to the desired thickness.

COMMENT 13. RAM states (page 63) that 2 percent of remediated grids in the windblown area will be soil sampled.

REQUEST: Describe what sampling will be done in other areas such as pipe trenches and the Section 4 Ponds.

RESPONSE TO COMMENT 13: There is approximately 15,000 feet of buried pipeline at the site. Approximately 13,000 feet runs from Pond 9 to the Section 4 ponds. The other 2000 feet is in the mill area. The buried pipeline ranges from four to eight feet below surface. The spoils from the pipeline excavation will be removed to the disposal cell. The excavation will be backfilled with clean material.

The survey techniques for excavated pipelines will include scanning and soil sampling. The scanning will be performed as described in Section 8.1.2 of the Soil Decommissioning Plan. The scanning will be completed along the length of the pipeline as access permits; e.g. if the trench is too deep or the sidewalls unstable, a scan will not be attempted. The scanning results will be evaluated qualitatively, and locations of significant increase in count rate will be identified for biased sampling described below.

The soil sampling will contain both systematic and biased components. The systematic soil samples will be collected as follows:

- The length of the excavation will be divided into 100 meter segments.
- A composite sample will be collected from every other 100 meter segment.
- The composite sample will be comprised of five-plugs evenly-spaced across the bottom of the excavation for the respective 100 meter segment.

Biased soil samples will be collected from soils where the scanning result and/or visual observation of the soils beneath the pipeline are indicative of elevated levels. Biased soil samples will consist of discrete single plugs. Other aspects of soil sampling (e.g. methods, QA/QC) will be consistent with Section 8.1 of the Soil Decommissioning Plan.

All pipeline trenches outside of the mill yard area will be cleaned to meet soil concentration limits appropriate for subsurface soils below 6 inches (15cm). The soil concentration limits applicable for subsurface soils will be provided with the revised Soil Decommissioning Plan (included in Table 5-1) to be submitted upon approval of RAI responses.

In the mill yard area, pipelines may be located on shallow bedrock. In areas where pipelines are in bedrock, impacted material will remain and Alternate Release Criteria will be applied as described in Section 5.2 of the Soil Decommissioning Plan.

The soil sampling of the Section 4 ponds will be conducted as described in Section 8.1 of the Soil Decommissioning Plan.

RESPONSE TO LINED POND CLOSURE PLAN COMMENT 21

LINED POND CLOSURE PLAN, COMMENT 21 (December 22, 2004):

REQUEST: Provide a summary of the gamma survey and soil sampling plan for trenches that meet Criterion 6(6).

RESPONSE TO LINED POND CLOSURE PLAN, COMMENT 21: See Response to Comment 13 (above), Soil Decommissioning Plan.

ATTACHMENT A

PREDICTION OF EROSIONAL SOIL LOSS AND LAND SURFACE PROTECTION MEASURES

PREDICTION
OF
EROSIONAL SOIL LOSS
AND
LAND SURFACE PROTECTION MEASURES

Ambrosia Lake Facility
Rio Algom Mining Company, LLC
Grants, New Mexico

Prepared by:

Maxim Technologies
Albuquerque, NM
July 2005

Introduction

This engineering report has been prepared by Maxim Technologies (Maxim) for Rio Algom Mining Company, LLC., to evaluate the long term erosion potential for general areas at the Ambrosia Lake facility near Grants, New Mexico. The purpose was to use standard methodologies to predict soil loss potential in reclaimed areas beyond the existing reclaimed tailing ponds that could be affected by runoff and run-on from periodic and long term storm events. In addition, the erosion potential of the land surface of reclaimed holding ponds 4, 5 and 6 were evaluated both for short term periodic storm events and from a PMP event.

The following paragraphs present the accepted methodologies for predicting soil loss and present recommendations for achieving stable reclamation covers and land surfaces at the facility.

Soil Loss Prediction Methodologies

Several methodologies exist that are useful to predict erosion potential of reclamation covers and surrounding land surfaces. Agricultural erosion has been studied for many years resulting in the development of prediction algorithms and control procedures. Because soil erosion and sedimentation from construction and mining activities are similar, the procedures and algorithms developed are useful in predicting soil erosion from these activities.

Maxim utilized two industry accepted methods for predicting soil erosion loss at the Ambrosia Lake Facility which are presented in NUREG Documents CR-3199, CR-4620 and 1623. The methods are described as follows:

Universal Soil Loss Equation

The principal controlling factors affecting the erosional processes in the Universal Soil Loss Equation model are:

- Soil particle size, density and moisture control
- Surface roughness
- Slope angle and slope length
- Vegetation/surface protection
- Climatic Variables

Both the short and long term erosional stability of slopes at this facility can be evaluated with respect to the aforementioned variables by use of the Universal Soil Loss Equation model.

The USLE was primarily developed for agricultural purposes but has been modified to accommodate mining and construction activities in the Western United States by the Utah Water Research Laboratory. The resulting modified method (MUSLE) is a mathematical model based on coefficients determined in the field and provides the most rational approach to evaluating the potential for long term erosion on bare or vegetated land surfaces.

The modified Universal Soil Loss Equation (MUSLE) is defined as follows:

$$A=R*K*(LS)*(VM) \qquad \text{Equation 1.1}$$

Where,

A = the computed loss per unit area in tons per calculated area units per year with the units selected for K and R properly selected:

R = the rainfall factor which is the number for rainfall erosion index units plus a factor for snowmelt, if applicable:

K = the soil erodibility factor, which is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot that is defined as a 72.6 ft length of uniform 9% slope continuously maintained as clean tilled fallow:

LS = the topographic factor, which is the ratio of soil loss from the field slope length to that from a 72.6 ft length under otherwise identical conditions:

VM = the dimensionless erosion control factor relating to vegetative and mechanical factors. This factor replaces the cover management factor (C) and the support factor (P) of the original USLE.

The Rainfall and Runoff Factor (R)

The R factor is described in terms of a rainfall storm energy (E) and the maximum 30-minute rainfall intensity (I_{30}). Generalized R factors applicable to the interior western United States are given in Table 1.1.

Table 1.1 Generalized Rainfall and Runoff (R) Values

State	Eastern Third	Central Third	Western Third
N. Dakota	50-75	40-50	40
S. Dakota	75-100	50	40
Montana	30-40	20	20-50
Wyoming	30-50	15-30	15-25
Colorado	75-100	40-50	20-40
Utah	20-30	20-50	15-40
New Mexico	75-100	40-50	20-40
Arizona	20-50	20-50	25-40

Source: NUREG CR-4620

The Soil Erodibility Factor (K)

The soil erodibility factor (K) recognized the fact that the erodibility potential of a given soil is dependent on its compositional makeup, which in turn reflects the grain size distribution of the soil. To predict soil erodibility, five soil characteristics that include the percent silt and fine sand, percent sand greater that 0.2 mm, percent organic material, general soil structure and general permeability are determined. The K factor is then found by using the Wischmeier nomograph presented in Figure 1.1.

The Topographic Factor (LS)

Although the effects of both length and steepness of slope have been investigated separately in different research efforts, it is more convenient for analytical purposes to combine the two into one topographic factor, LS. Wischmeier and Smith (1978) developed plots correlating the topographic factor for slopes up to 500 meters in length at slope inclinations from 0.5% to 50%.

The equation to determine the LS factor is as follows:

$$LS = \frac{650+450+65s2}{10,000+s2} \quad \frac{L}{72.6} \quad M \qquad \text{Equation 1.2}$$

where LS = topographic factor

L = slope length in feet

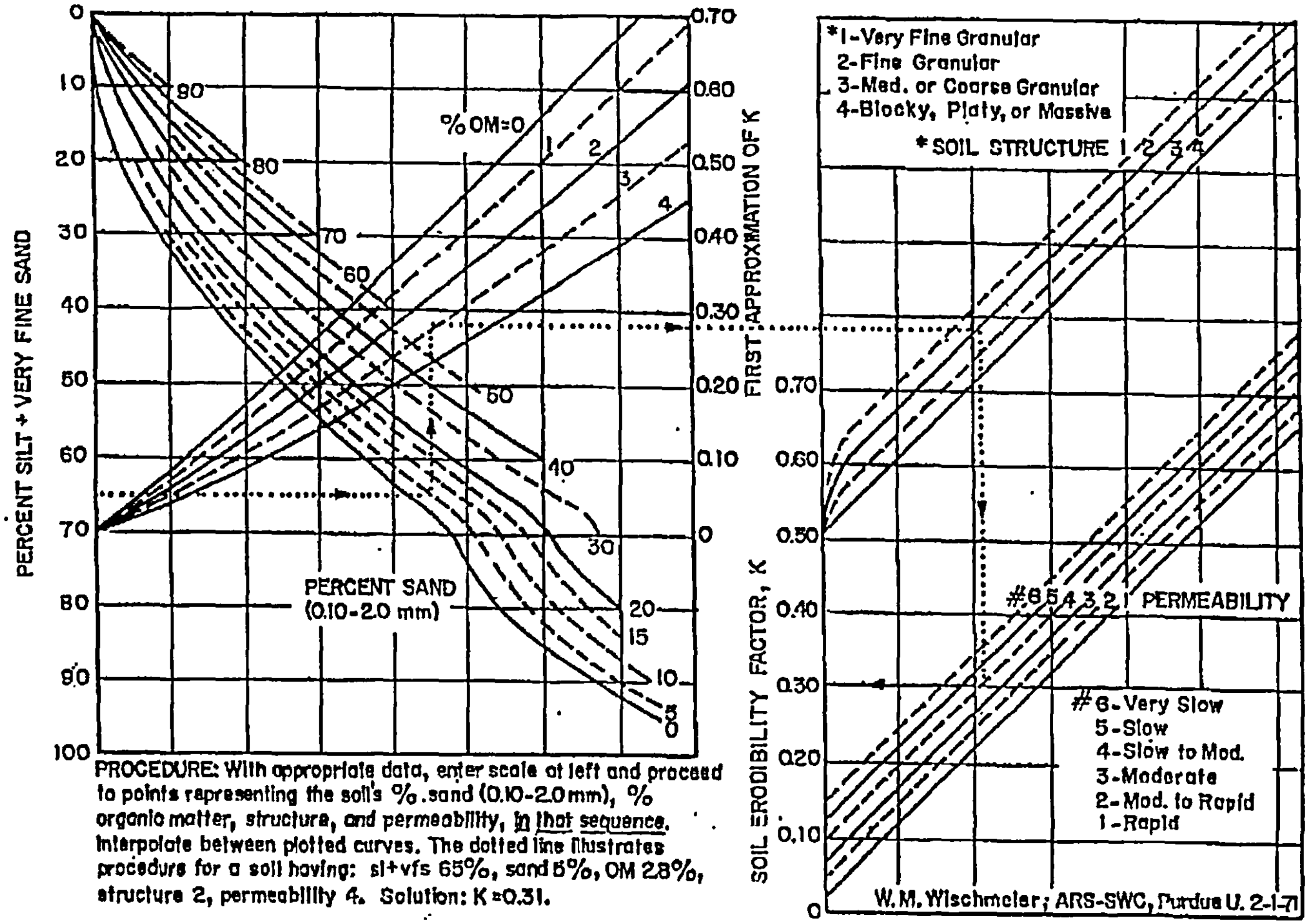

Fig. 1.1 Nomograph for determining soil erodibility factor *K*. *Source:* after Wischmeier et al., 1971.

S = slope steepness in percent

M = exponent dependent upon slope steepness

The slope dependent exponent m is presented in Table 1.2

Table 1.2 Slope Dependent Exponent

Slope	m
$s \leq 1.0$	0.2
$1.0 < s \leq 3.0$	0.3
$3.0 < s \leq 5.0$	0.4
$5.0 < s \leq 10.0$	0.5
$s > 10.0$	0.6

The VM Factor

The VM factor is the erosion control factor applied in place of the cover and erosion control factors found in the USLE. The erosion control factor accounts for measures implemented at the construction site to include vegetation, mulching, chemical treatments and sprayed emulsions to impede or reduce erosion due to the overland flow of water. Values of the VM factor relative to site-specific conditions are presented in Table 1.3 The VM factor is perhaps the most sensitive factor to effect the computed erosion loss for a given site. As shown by the values presented on Table 1.3, the development of a permanent vegetative cover can have a significant impact in reducing the computed erosion loss.

Permissible Velocity Approach

The erosion potential of a soil cover or land surface can be evaluated by determining the properties of the soils and specifying a velocity criterion that will not erode the cover or land surface and will prevent scour. Studies by the U.S. Army Corps of Engineers, Universities and other organizations have developed permissible velocities for various soil types obtained from experimental studies which provide a conservative estimate for evaluating erosion potential of soil for the long term. These permissible velocity values are summarized in NUREG CR-4620 and are presented in Tables 1.4 through 1.6.

Table 4.3 Typical VM Factor Values Reported in the Literature.[a]

Condition	VM Factor
1. Bare soil conditions	
freshly disked to 6-8 inches	1.00
after one rain	0.89
loose to 12 inches smooth	0.90
loose to 12 inches rough	0.80
compacted bulldozer scraped up and down	1.30
same except root raked	1.20
compacted bulldozer scraped across slope	1.20
same except root raked across	0.90
rough irregular tracked all directions	0.90
seed and fertilizer, fresh	0.64
same after six months	0.54
seed, fertilizer, and 12 months chemical	0.38
not tilled algae crusted	0.01
tilled algae crusted	0.02
compacted fill	1.24 - 1.71
undisturbed except scraped	0.66 - 1.30
scarified only	0.76 - 1.31
sawdust 2 inches deep, disked in	0.61
2. Asphalt emulsion on bare soil	
1250 gallons/acre	0.02
1210 gallons/acre	0.01 - 0.019
605 gallons/acre	0.14 - 0.57
302 gallons/acre	0.28 - 0.60
151 gallons/acre	0.65 - 0.70
3. Dust binder	
605 gallons/acre	1.05
1210 gallons/acre	0.29 - 0.78
4. Other chemicals	
1000 lb. fiber Glass Roving with 60-150 gallons asphalt emulsion/acre	0.01 - 0.05
Aquatain	0.68
Aerospray 70, 10 percent cover	0.94
Curasol AE	0.30 - 0.48
Petroset SB	0.40 - 0.66
PVA	0.71 - 0.90
Terra-Tack	0.66
Wood fiber slurry, 1000 lb/acre fresh[b]	0.05
Wood fiber slurry, 1400 lb/acre fresh[b]	0.01 - 0.02
Wood fiber slurry, 3500 lb/acre fresh[b]	0.10
5. Seedings	
temporary, 0 to 60 days	0.40
temporary, after 60 days	0.05
permanent, 0 to 60 days	0.40
permanent, 2 to 12 months	0.05
permanent, after 12 months	0.01
6. Brush	
7. Excelsior blanket with plastic net	0.04 - 0.10

[a]Note the variation in values of VM factors reported by different researchers for the same measures. References containing details of research which produced these VM values are included in NCHRP Project 16-3 report, "Erosion Control During Highway Construction. Vol. III. Bibliography of Water and Wind Erosion Control References," Transportation Research Board, 2101 Constitution Avenue, Washington, DC 20418.

[b]This material is commonly referred to as hydromulch.

Table 1.4 Maximum permissible velocities in erodible channels

Channel Material	Water Transporting Colloidal Silts Velocity v (ft/sec)
Fine sand, colloidal	2.50
Sandy loam, non-colloidal	2.50
Silty loam, non-colloidal	3.00
Alluvial silts, non-colloidal	3.50
Firm loam	3.50
Volcanic ash	3.50
Stiff clay, colloidal	5.00
Alluvial silts, colloidal	5.00
Shales and hardpans	6.00
Fine Gravel	5.00
Graded loam to cobbles, non-colloidal	5.00
Graded Silts to cobble, colloidal	5.50
Coarse gravel, non-colloidal	6.00
Cobbles and shingles	5.50

Source: NUREG CR-4620

Table 1.5 Maximum allowable velocities in sand-based material

	Velocity (ft/sec)
Very light sand of quicksand character	0.75 to 1.00
Very light loose sand	1.00 to 1.50
Coarse sand to light sandy soil	1.50 to 2.00
Sandy soil	2.00 to 2.50
Sandy loam	2.50 to 2.75
Average loam, alluvial soil, volcanic ash	2.75 to 3.00
Firm loam, clay loam	3.00 to 3.75
Stiff clay soil, gravel soil	4.00 to 5.00
Coarse gravel, cobbles and shingles	5.00 to 6.00
Conglomerate, cemented gravel, soft slate, Tough hardpan, soft sedimentary rock	6.00 to 8.00

Source: NUREG CR-4620

Table 1.6 Limiting velocities in cohesive materials

	Compactness of Bed			
	Loose	Fairly Compact	Compact	Very Compact
Principle Cohesive Material	Velocity (ft/sec)	Velocity (ft/sec)	Velocity (ft/sec)	Velocity (ft/sec)
Sandy clay	1.48	2.95	4.26	5.90
Heavy clayey soils	1.31	2.79	4.10	5.58
Clays	1.15	2.62	3.94	5.41
Lean clayey soils	1.05	2.30	3.44	4.43

Source: NUREG CR-4620

Recommendations

General

The surface soils at the Ambrosia Lake facility consist of alluvium/colluvium which classify primarily as very silty sands to sandy silts in the Unified Soil Classification system. The types of soils are easily erodible under storm runoff events.

Prediction of soil loss by the Modified Universal Soil Loss equation shows that unvegetated soils at this site will be relatively stable for slopes generally less than one percent and not exceeding 200 feet. Predicted soil loss for this gradient and length is on the order of one foot per 1000 years. Unvegetated slopes steeper than one percent even for short distances will experience an unacceptable erosion rate. (See Results of MUSLE Analysis in Tables A-1 and A-2 in the appendix.)

Soil surfaces that are sparingly to moderately vegetated will be stable at slopes up to 3 percent. Vegetated slopes at 3 percent will generally be stable up to a distance approaching 1000 feet.

Using the "Allowable Velocity Approach" the surface soils at this facility will erode at runoff velocities approaching or exceeding 2.5 ft/sec. This criterion is more conservative than the MUSLE model and is recommended to evaluate surface stability in sensitive areas and from significant storm events.

Stability of Land Surface (Reclaimed Ponds 4, 5 & 6)

Ponds 4,5 & 6 are considered to be in a sensitive area because of the proximity to the Arroyo del Puerto, and the need to apply alternative release criteria to this area. The MUSLE model shows that a moderately vegetated surface will under go about 1/3 foot of soil loss over a 1000 year period. Calculations of runoff from a PMP event (see appendix) show that the runoff velocity will be on the order of 2.6 feet/sec and the flow depth will be on the order of 0.4 foot. Considering the above, it is recommended that a rock mulch be placed over the existing reclaimed surface of Ponds 4, 5 & 6. The rock should have a median stone diameter D_{50} of 0.5 inch or larger. The stone should have a minimum thickness of 1.0 inch. This will more than adequately protect the land surface in this area from the runoff originating from a PMP event.

Stability of Land Surface (Ponds 7 & 8)

The area of encompassing Ponds 7 and 8 and surrounding land is sparsely to moderately vegetated. For this area it is recommended that a gravel mulch be placed on slopes exceeding one percent. The gravel should have a median stone diameter (D_{50}) of 0.5 inch. The gravel may be placed in a thin layer as practicably achievable. The stone may be placed directly on the established grasses and around shrubs. The placement of this gravel mulch will enhance soil moisture retention, further promote re-establishment of the vegetative cover and enhance infiltration. Runoff velocities from storm events will also be reduced, further enhancing the stability of the land surface.

Selected References

Johnson, T. L., 1998, Design of Erosion Protection for Long-Term Stabilization. Draft Report for Comment, NUREG-1623. U.S. Nuclear Regulatory Commission, Washington, D.C.

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.

Voorhees, L. D., M. J. Sale, J. W. Webb, P. J. Mulholland, 1983, Guidance for Disposal of Uranium Mill Tailings: Long-Term Stabilization of Earthen Cover materials, NUREG/CR-3199, U. S. Nuclear Regulatory Commission, Washington, D. C.

Appendix

Calculations

Figure A-1

MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE)

INPUT		COMPUTED RESULTS	
SLOPE LENGTH (FEET)	200	TOPOGRAPHIC FACTOR	0.35
SLOPE (%)	3.00		
RAIN FALL EROSIVITY FACTOR-R	30	AVERAGE ANNUAL SOIL L (TONS/ACRE/YEAR)	1.44
SOIL ERODIBILITY FACTOR-K	0.55		
VEG MANAGEMENT FACTOR-(VM)	0.25		
SOIL DENSITY (PCF)	105	LOSS IN DEPTH (FT/1000 YEARS)	0.63

REFERENCE NUREG/CR-4620

Table A-1
Results of MUSLE Analysis
Predicted Soil Loss Measured in Feet/1000 years
On
Bare Land Surfaces
Ambrosia Lake Facility
Rio Algom Company, LLC

Slope Length (feet)

Slope Percent	50	100	200	500	1000	2000
3	1.67	2.05	2.52	3.32	4.09	5.04
2	1.17	1.44	1.77	2.33	2.87	3.53
1	0.78	0.90	1.03	1.24	1.42	1.53

Note: All values reported in chart are in feet/1000 years

Table A-2
Results of MUSLE Analysis
Predicted Soil Loss Measured in Feet/1000 Years
On
Vegetated Land Surfaces
Ambrosia Lake Facility
Rio Algom Company, LLC

Slope Length (feet)

Slope Percent	50	100	200	500	1000	2000
3	0.42	0.51	0.63	0.83	1.02	1.26
2	0.29	0.36	0.44	0.58	0.72	0.88
1	0.19	0.22	0.26	0.31	0.35	0.41

MAXIM TECHNOLOGIES BY C SEALY DATE 7-5-05

A DIVISION OF TETRA TECH, INC.

JOB TITLE Rio Algom JOB NUMBER

SUBJECT PMP Hydrology - Ponds 4, 5 & 6 SHEET 1/2

FOR Drainage AREA

MAX Length = 1780

Avg Slope = 0.66% OR 0.0066

Determine T_c (Time of Conc)

$$T_c = 0.0013 \frac{L^{0.77}}{S^{0.385}}$$

$$T_c = 0.0013 \frac{(1780)^{0.77}}{(0.0066)^{0.385}} = 0.286 \text{ HRS OR } 17.15 \text{ min.}$$

Calculate % of 1-HR pmp

Table 2.1 NUREG 4620

DURATION (MIN)	% 1-HR pmp
15	74
17.15	? → 77.4%
20	82

PMP RAINFALL Depth = (0.774)(9.4) = 7.3 inches

Rainfall Intensity

$$i = \frac{(7.3)(60)}{17.15} = 25.5 \text{ inches/HR}$$

FIG A-2

MAXIM TECHNOLOGIES
A DIVISION OF TETRA TECH, INC.

BY C. SEALY DATE 7-5-05

JOB TITLE Rio Algom JOB NUMBER

SUBJECT PMP Hydrology SHEET 2/2

Peak Sheet Flow Unit Discharge

Rational Formula $Q = CIA$

$q_{soil} = Q/ft = (1.0)(25.5)\left(\frac{1780}{43,560}\right) = 1.04$ cfs/ft

Calc Sheet Flow Velocity

y = Flow Depth $= \left[\frac{(1.04)(.025)}{(1.486)(0.0066)^{1/2}}\right]^{3/5} = 0.4$ foot

V_{design} (soil surface) $= Q/A = \frac{1.04}{0.4} = 2.6$ ft/sec > 2.5 ft/sec

∴ Surface Protection from Runoff Req'd

Safety Factors Method - See Attached Spread Sheet = Fig A-4

$D_{50} \approx 1/2$ inch S.F. = 1.16 ∴ OK

NUREG 1623 Sec D-8

Abt & Johnson Method

$q_{Rock} = Q_{soil} \times 0.8 = 1.04 \times 0.8 = 0.83$ cfs

$D_{50} = (5.23)(0.0066)^{0.43}(0.83)^{.56}$

$D_{50} = (5.23)(.1155)(0.90) = 0.54$ inch

Use $D_{50} \approx 0.5$

Fig A-3

Figure A-2

Project: Rio Algom-Ambrosia Lake		Date	7/5/05
Location: Ponds 4,5,& 6			

RIPRAP DESIGN-SAFETY FACTORS METHOD
FLOW OVER A PLANE SLOPING BED

INPUT		COMPUTED RESULTS	
Median Rock Diameter-(D-50)-ft	0.04		
Flow Depth-Ft	0.40	Design Shear-Psf	0.16
Bed Slope- Ft/Ft	0.007		
Angle of repose-Rock-Degrees	40.00	Safety Factor	1.16
Unit Weight-Rock-Pcf	160.00		