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WESTERN STATES MINERALS CORPORATION

#2 of 2

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September 15, 1992

Dr. Dianne R. Nielson
Director
UTAH DIVISION OF OIL, GAS & MINING
3 Triad Center
355 West North Temple
Suite 350
Salt Lake City, Utah 84180

Re: Western States Minerals Corporation, J.B. King Mine
ACT/015/002, Folder No. 2, Emery County, Utah
(NOV N91-35-6-1, N91-35-7-1, N91-32-6-1;
Stipulation Response R614-301-742.113)

Dear Dr. Nielson:

Earlier this year Western States Minerals Corp. (WSMC) received violations from the Division concerning the J.B. King mine site and Stipulation R614-301-742.113 Response. In order to resolve the outstanding violations and to prevent future violations, several meetings have been held between WSMC and the Division, including an onsite meeting August 11, 1992. After thorough consideration of these matters, WSMC has done all that it deems practicable to reclaim the J.B. King site. Any additional effort onsite would destroy the progress which has been made to date, unnecessarily prolong the reclamation process, and not significantly enhance successful reclamation of the site. This response has been prepared to reconcile the J.B. King permit, with the site conditions, and the regulations.

Violations N91-35-6-1 and N91-35-7-1

Both of these violations concern erosion. N91-35-6-1 is for erosion on reclaimed areas and N91-35-7-1 is for erosion on the refuse pile. Both violations refer to R614-301-742.113 of the regulations which states, "Minimize erosion to the extent possible."

R614-301-742.113 cross references to 817.45 in the permit. This section of the permit is copied and attached for convenience as Appendix 1. Recent meetings between WSMC and DOGM, including the August 11 site meeting, have established that erosion on the site is inevitable and that all reasonable measures have been taken to minimize erosion to the extent possible. The erosion prevention measures which have been implemented are those described in 817.45 of the permit so the permit and the site are consistent with each other. The permit accurately reflects site conditions. Erosion has been minimized to the extent possible, the site and this section of the permit are in compliance with the regulatory standards for erosion. It is, therefore, respectfully requested that these two violations be vacated.

To assess the environmental impact of erosion of the J.B. King site, a study was performed by Hansen, Allen & Luce, and the resulting report, Effects and Timing of Erosion at the J.B. King Mine Site, is enclosed in Appendix 2. The following is a summary of the findings resulting from this study.

- It will take at least 20 years and maybe as long as 2,000 years for erosion to expose the coal refuse pile on the J.B. King site.
- When the refuse material is exposed there will be between 2% and 63% of the amount of coal exposed in the J.B. King basin as is naturally exposed in the undisturbed basin adjacent to J.B. King.
- The refuse material will not sustain combustion.
- It will take 65 to 100 years for the sediment pond at J.B. King to fill.

Samples of the refuse material, soils, and sediment were analyzed to determine environmental impact if coal refuse sediment were to leave the site. The results of analyses of the samples are reported in a WSMC internal memo from Larry Berg to Buzz Gerick which is attached as Appendix 3. The following is a summary:

- The soils in the area have the capacity to neutralize any acidic runoff which may result from the coal refuse.
- The lowest pH solution generated by leaching the refuse material with meteoric water was 6.43. The highest pH value obtained was 7.54. This is in the "Good" range according to the Division's Guidelines (James Leatherwood and Dan Duce, April, 1988).
- The SAR for the refuse material ranged from 1.5 to 6.6 which is in the "Good" to "Fair" range according to the Guidelines.
- Solutions generated by leaching the refuse material meet Primary Drinking Water Standards for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and fluoride.

Independently, Dr. Samuel Bamberg reported his observations and recommendations in a letter dated August 28, 1992, to Buzz Gerick. This letter is attached as Appendix 4. Dr. Bamberg's observations are that:

- Vegetation should continue to stabilize on site over the next 35 years.
- The reclaimed site will not present a hazard or risk from sediment and exposed coal on and off site greater than the other basins along the sandstone bluffs around Dog Valley because erosion and exposed coal seams are a natural part of this part of the Colorado Plateau.

- Erosion of the site is continually decreasing because of natural armoring of the surfaces and because the soil is beginning to develop structure.

Based on the above observations Dr. Bamberg recommends the following:

- Allow vegetation and soils to continue to mature.

- Prevent any man-made redisturbance of the soil.

- Remove silt fencing and other sediment control structures to allow the site to adjust to natural erosion rates given the configuration of the site.

The above analyses show that WSMC is meeting its reclamation obligation on the site. The regulations require that coal and refuse be covered to "control the impact on surface and ground water...to prevent sustained combustion, and to minimize effects on plant growth and the approved postmining land use." (R645-301-553.300). The Meteoric Water Mobility Test shows that water leaching through the refuse material will meet Primary Drinking Water Standards so there will not be degradation of surface or ground water. The Hansen, Allen & Luce analysis shows that by MSHA standards the refuse material will not sustain combustion. Further, the pH, SAR and overall average acid/base potential classify the products of erosion from the refuse pile as "Fair" to "Good" for vegetation according to Division Guidelines.

In sum, there will be insignificant impact resulting from the reclaimed J.B. King site. Even if coal sediment leaves the reclaimed site the impact will be negligible because of the benign nature of the coal and refuse material as shown by the sample analyses summarized above. Therefore, it is WSMC's position that there will be no further construction or other disturbance on the site.

Violation 91-32-6-1

This violation was written because the current condition of the "feeder ditches" is not as prescribed in section 817.44 of the permit, which contains designs for the ditches. Over time the condition of the feeder ditches has evolved until the feeder ditches are no longer as designed. After thorough analysis we believe that section 817.44 of the permit should be replaced. The designs of these ditches and the implementation of the designs are not compatible with long-term reclamation of the site.

The designs presented in the permit are not consistent with the surrounding terrain as required by the regulations and in keeping with the overall goal of reclamation. The "main feeder ditch" requires runoff to flow down a steep ramp of fill material and to make two sharp 90 degree turns. The "feeder ditch" requires runoff to meander back and forth across a relatively steep slope. Both of these channels are very unnatural in appearance and function.

Mining has not disturbed the channels above the sandstone cliffs which form the eastern boundary of the site. This means that runoff from above the site discharged over the cliff at the current locations and that the surfaces below these discharge locations were subject to more concentrated erosion prior to any disturbance of the site. Since the coal seam is above the bottom of the basin it is certain that below these discharge locations the coal seam was exposed prior to disturbance. Channels in basins adjacent to the J.B. King site tend to be straight and relatively deep from the base of the cliff to the bottoms of the basins. The ditches on the J.B. King site should be allowed to form similar configurations. The main feeder ditch and the feeder ditch at J.B. King should both be allowed to seek direct flow paths to the main channel at the bottom of the basin. This will result in a more natural appearance of the J.B. King site. Also it will eliminate the on going maintenance problems associated with these ditches. As long as the ditches do not conform to natural drainage patterns, the ditches will require maintenance.

The ditches should be allowed to naturally evolve from the present forced configurations to the natural configurations, rather than attempting to construct the changes. There are three reasons for this approach: First, the feeder ditches as presently designed fail to minimize erosion to the extent possible. Second, to project final configurations would be attempting to outguess nature. It would be more efficient and effective to allow nature to reconfigure the ditches. Third, reconstruction of the ditches would destroy much of the established vegetation. Allowing the ditches to evolve to the natural configuration will take place over time, allowing the vegetation to adapt and minimize erosion.

The naturalized ditches will ultimately expose the natural coal seam. This is more a function of the natural location of the seam than the result of unsuccessful reclamation. Since exposure of the coal seam was a predisturbance condition it should be allowed as a postmining condition.

To abate Violation N91-32-6-1, WSMC herein submits revised Section 817.44 for replacement in the permit. The change to 817.44 of the permit also requires the revision of other parts of the permit. The first page of section 817.56 should be removed, the addendum page should remain in the permit. Page 3 of section 817.101 should be replaced with the attached page. Section 817.103 should be replaced with the attached revised section. And section 817.106 should be replaced with the revised section enclosed.

These changes are consistent with the regulations and with the observations and recommendations summarized above. The environmental impacts of these changes are negligible.

In conclusion, WSMC requests that Violations N91-35-6-1 and N91-35-7-1 be vacated and the enclosed permit revision be accepted by the Division to abate Violation N91-32-6-1 and address Stipulation Response R614-301-742.113.

WSMC also requests that the reclamation bond period not be restarted, but be allowed to continue from the original date of reclamation. Two reasons for this are:

1) The vegetation reclamation standard has already been achieved.

2) From an erosional standpoint the site is rapidly stabilizing.

These facts suggest that the reclamation effort at J.B. King has resulted in continual progress toward meeting the reclamation performance standards. We see no compelling reason for restarting the reclamation bond period and do not feel that it will serve any productive purpose relative to the reclamation success at J.B. King.

Very truly yours,

E.M. Gerick by kpl

Edward M. Gerick
Vice President of Operations

APPENDIX 1

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UMC 817.45 HYDROLOGIC BALANCE: SEDIMENT CONTROL MEASURES

(a)

While the mine was in operation, the smallest practical area was disturbed at any one time. For the most part, this consisted of the 28 acres comprising the disturbed area. See Dwg. No. 4050-5-19-R, UMC 817.46 (DOC Text). The disturbed area includes all surface facilities.

Backfilling and grading in preparation for planting is projected to require about 30 working days; it is hoped that timing of this preparation work will merge well with the recommended fall planting period thus enabling "prompt" re-vegetation. See UMC 784.13 for details.

(b)

The backfill and topsoil material will be stabilized through reshaping, grading and prompt compaction in order to enhance sediment control during the reclamation period.

(c)

Sediment will be retained within the disturbed area during reclamation by the use of a sediment pond to be constructed in the lower northwest portion of the borrow pit. This pond will allow any sediment transported by overland flow during the recla-

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mation process to settle out. The sediment can then be redistributed on the reclaimed area. Design details regarding the sediment pond are described in 817.42 and 817.56.

(d)(e)

During the reclamation process some of the area runoff will be diverted away from the disturbed area by means of the refuse pile intercept ditch and the southwest drainage ditch. The latter ditch will be temporarily left in place to that point where it intercepts the borrow pit. This will help protect the borrow pit and adjacent south disturbed areas from excessive erosion during reclamation activities.

After the reclamation is completed, the area runoff will be channeled through the reclaimed area by means of a borrow pit diversion ditch.

(f)

Overland flow velocities will be controlled by strategically placing straw bales, boulders and riprap where high velocities are expected. The straw bales will be securely fastened in place with roof bolts or metal fence posts driven through the center of the bales. Two supports will be used to anchor each bale.

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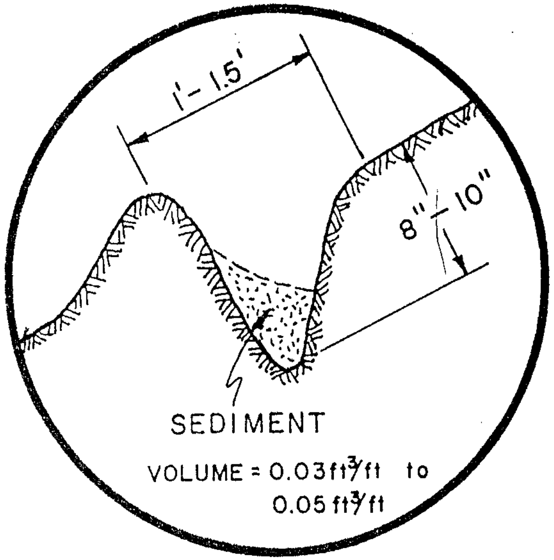
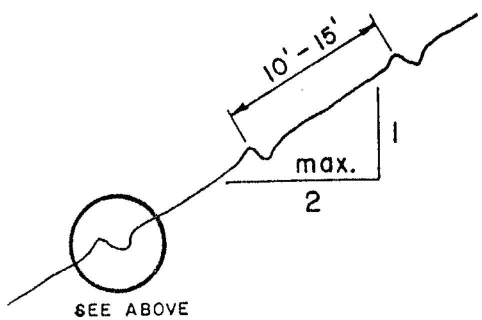
Contour furrowing is planned for the steeper slopes within the reclaimed area. The furrows will reduce the overland flow velocities and prevent, to a large degree, the transport of sediment. Sediment that is displaced by overland flow will be trapped in the furrows. The furrows will be allowed to gradually fill with sediment. As the furrows fill and become less efficient, the slope will have stabilized with the maturation of the vegetation. Therefore, when the furrows are no longer needed, they will have been filled with sediment. The result is a fairly smooth and stable slope.

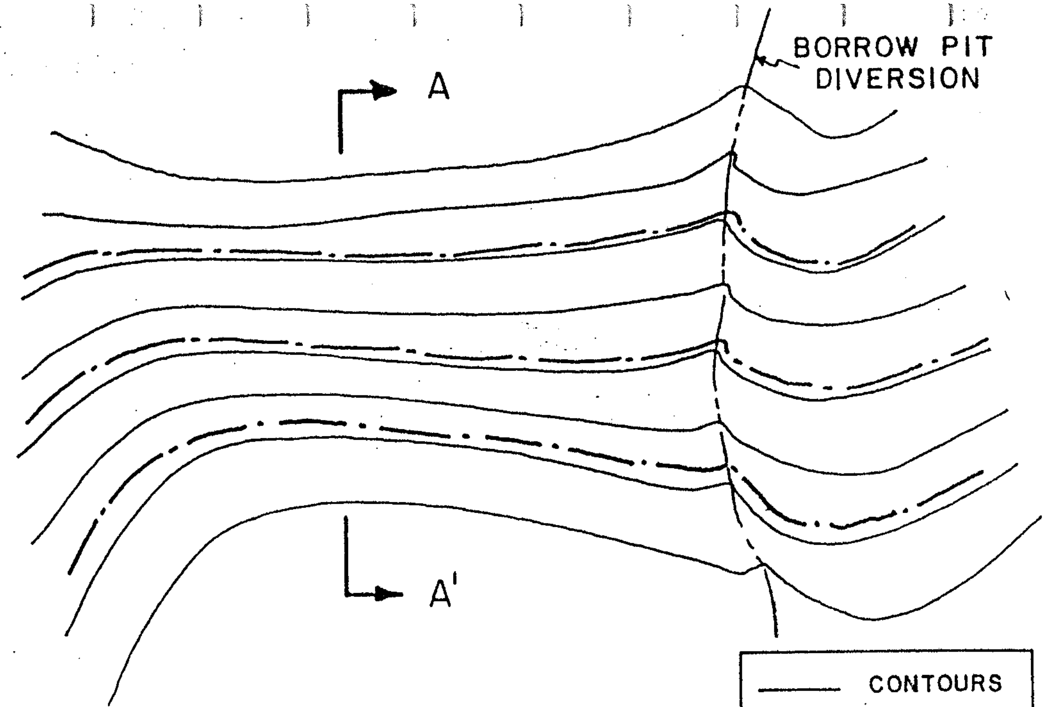
Furrows will be installed using a small blade, tilted and pulled behind a tractor. The blade will be lifted about every 10-15 ft. for about a foot to provide a small dam along the furrows. This dam will prevent sediment from being transported along the furrows themselves. Furrowing will take place after the disking but before the planting and mulching. See Figure 1 for details on furrow spacing and size.



ENLARGED VIEW



CROSS-SECTION
A—A'



PLAN VIEW

CONTOUR FURROW DESIGN

WESTERN STATES MINERALS CORP.

SCALE: None	APPROVED BY: L.G. MANWARING	DRAWN BY B.D.H.
DATE: 7/15/85		REVISED

CONTOUR FURROWING

COAL SYSTEMS, INC.	DRAWING NUMBER FIGURE 1

APPENDIX 2

EFFECTS AND TIMING OF EROSION AT THE J.B. KING MINE SITE

INTRODUCTION

The purpose of this report is to provide a comparison of the potential for off site coal contamination caused by erosion of the **reclaimed** J.B. King basin, to the potential for coal contamination caused by erosion of the hypothetically **undisturbed** J.B. King basin, and of an undisturbed basin adjacent to J.B. King. During a site visit on August 11, 1992, it was suggested by Division personnel that if it can be shown that erosion on the reclaimed J.B. King site will cause no more coal contamination off site that would be expected naturally, then the reclaimed condition may be acceptable, because the environment in this area has adapted to certain amounts of coal contamination which occur naturally because of coal out crops in the area. As the reclaimed site matures it will go through stages and it was suggested that estimates be developed of the timing of each of these stages. This report is in response to these suggestions from the Division.

It should be noted that methods available for the estimation of erosional processes are not highly accurate. The variations in calculation methodology as well as assumptions made related to changing environmental conditions seldom yield highly precise results. Conservative assumptions have been used herein whenever possible in an attempt to minimize the effects of this inherent lack of precision and provide a higher factor of safety to the results presented.

The first issue addressed in this report is the basis for comparing one drainage basin to another. After that, the data necessary to make the comparison will be developed. Finally the comparison will be made and the resulting conclusions will be summarized.

EQUIVALENT COAL SEAM AREA

In order to make comparisons, a concept of equivalent coal seam area is introduced. This concept is based on the fact that in any basin, the amount of coal which will be eroded is roughly proportional to the exposed surface area of the coal, other factors being equal. By determining the area of exposed coal in a basin and dividing the area by the width of the basin a **surface area per unit width** can be estimated. Areas per unit width for two basins can then be used for comparing the **relative** coal erosion within the basins. If the areas per unit width for two basins are the same then it would be expected that the impact of erosion of the coal seams would be relatively equivalent for the two basins. If the area of coal per unit width of one basin is one half that of another basin, then it is expected that the impact of coal erosion of the first basin will be about one half the impact from the second basin, other factors being similar. In order to meet the requirement of environmental similarity the reclaimed J.B. King basin will be compared to the hypothetically undisturbed J.B. King basin and the undisturbed basin adjacent to the north of J.B. King. This ensures that the characteristics of materials and the climatic conditions will be similar for all comparisons.

Unless otherwise indicated, whenever "coal seam" is used in this report it will refer to the "I" Coal Seam in which the J.B. King Mine was developed.

ADJACENT BASIN

The undisturbed basin to be used for comparitive purposes herein is located adjacent to and just north of the J.B. King basin. On August 21, 1992, the coal seam in this basin was mapped. The "I" seam is exposed and extends the full width of this basin. The seam thickness was measured in two places one of which was 12 feet thick and the other was 13 feet thick. The J.B. King permit states that the "I" seam is 12 feet thick with a 9 inch to 18 inch parting. It will be assumed that the coal seam is uniformly 12 feet thick with an 18 inch parting which results in an area per unit width of 10.5 square feet.

10.5 *feet high* x 1 *foot wide* = 10.5 *square feet*

The area of coal identified at this location, therefore, is 10.5 cubic feet per foot or 10.5 square feet per unit width. This assumption is conservative because the seam has been measured with thicknesses greater than 12 feet and with a parting less than 18 inches in thickness.

UNDISTURBED J.B. KING BASIN

From the location of the coal seam in the adjacent basin and from the locations of two exposures of the "I" seam within the J.B. King basin it is determined that the seam would have cropped out across the entire width of the J.B. King basin (See Appendix 1). Field observations indicate that the lowest elevation of the seam is around 6300 feet at the south west boundary of the basin. A typical low elevation of the basins both north and south of the J.B. King basin is 6280 feet. It is expected that the low elevation of the J.B. King basin was historically similar to the low elevations of the adjacent basins. This means that the lowest elevation of the coal seam is higher than the low elevation of the basin, therefore, would have been exposed naturally.

The coal seam was covered with fill material during reclamation from the northern edge of the basin to just west of the "feeder ditch" ramp. Just west of the ramp there is a small exposure of the top of the coal seam. There is also a small exposure of the top of the seam in the drainage just north of the feeder ditch. The elevation of the seam west of the ramp indicates that the seam should be exposed from the feeder ditch ramp to the southwest edge of the basin, however, no coal was found. There are two possible explanations for this. One is that the seam may have become so thin in this area that the seam is no longer identifiable. The Monograph Series No. 3, Central Utah Coal Fields, by H.H. Doelling, states that "The Dog Valley area is characterized by many lenticular coal beds...". The other possibility is that the coal seam burned historically at this location. The point which forms the southwest boundary of the J.B. King basin shows evidence of burning. It is relatively easy to determine where the coal seam should have been because of a gray clay marker bed which is very distinctive and which underlies the coal seam. This marker bed is clearly evident along the southern edge of the basin.

Since the coal seam is covered by reclamation material where the coal exists, thickness measurements were not possible. However, the permit states that the I seam is 12 feet thick and has a 9 inch to 18 parting, and the Monograph Series No. 3 states that the I seam is 13 feet thick at the Dog Valley Mine (J.B. King Mine). As with the adjacent basin, it will be assumed that the seam is 10.5 feet thick where it crops out in the J.B. King basin. The total width of the J.B. King basin is approximately 2850 feet and it is estimated from the field observations that there is a 1925 foot coal out crop in the basin.

The equivalent area per unit width for the J.B. King basin is:

$$\frac{1925\ feet\ x\ 10.5\ square\ feet}{2850\ feet} = 7.1\ square\ feet$$

Since this area per unit width (7.1 square feet) is less than the area per unit width of the adjacent basin (10.5 square feet) it is expected that in its natural state, either before disturbance, or after the effects of reclamation have been eroded away and the site returns to its natural state, the J.B. King basin would have less impact because of coal erosion than the adjacent basin. It can be estimated that the impact of coal erosion from the J.B. King basin compared to the adjacent basin will be:

$$\frac{7.1\ square\ feet}{10.5\ square\ feet} = 68\%$$

This type of comparison will be made for various cases to determine the relative impact of the reclaimed J.B. King basin compared to the natural J.B. King basin and to the adjacent basin.

RATE OF EROSION OF REFUSE PILE

The method used to calculate the rate of erosion of the refuse pile is the Universal Soil Loss Equation which was derived empirically by the Soil Conservation Service. Since this is an empirical method it is understood that the calculated results are estimates of the rates of soil loss and are not represented in this report as being absolute values. Because the results are estimates and not highly precise absolute values, conservative assumptions have been used whenever possible.

The Universal Soil Loss Equation takes into account the erosional characteristics of the material, the precipitation, slope length and gradient, vegetative cover, and erosion control. These factors are used to calculate an estimate of the tons of sediment per acre per year which will be eroded from a site. Soil samples were taken from the areas where material was borrowed to cover the refuse pile. The results of analyses of 34 of these soil samples are reported in the J.B. King permit. It is assumed that during reclamation activities these materials were mixed and combined. The extension of this assumption is that the average soil covering the refuse pile can be, in general, represented by the average of the results of the soil analyses of samples taken from the borrow area. Average soil characteristics are presented in the following table.

AVERAGE SOIL CHARACTERISTICS

	Sand	Clay	Silt	Total
Average	63.9%	19.3%	16.7%	99.9%
Standard Deviation	19.6%	10.7%	10.4%	

The slope length used in the calculations was 200 feet as taken from the face of the refuse pile. A slope of 4 to 1 (25%) was used for the gradient factor even though the actual measured slope is slightly less at around 22.5%.

For vegetative cover it was assumed that there is no canopy and that ground cover is 20%. A vegetation survey conducted on July 15-18, 1992, determined that the actual ground cover is 50.1% for the whole site and 46.5% for the refuse pile. Again, the assumption used is conservative.

If no erosion control is practiced the erosion control factor is 1.0 and if contour tillage is employed the factor is 0.90. Since the face of the pile at one time was cross tilled and even though the contour furrows have been eroded, there are still remnants of the furrows and since there is a concentration of vegetation in the furrows a value of 0.95 was selected for this factor.

The result obtained by combining all of these factors is an erosion rate for the steep face of the refuse pile of approximately 4.0 tons per acre per year. The total area of the refuse pile is around 12.8 acres. The erosion rate for the steep face of the refuse pile was applied to the total area even though most of the area of the refuse pile is considerably flatter. This results in a total rate of erosion for the refuse pile area of 51.2 tons per year. Calculations of this rate are shown in Appendix 2.

AMOUNT OF REFUSE

The permit states that a total of 1.5 million tons of coal have been mined at J.B. King. Recent (1975 to 1981) mine workings are easily identified on the mine map and the volume of these workings was measured to be 588,300 tons of coal. The remainder of approximately 912,000 tons were, therefore, mined earlier.

In the engineering section of the permit (817.59 page 1) it states that 24.3% of the raw coal which entered the wash plant was rejected. It further states that of the rejected material 9.6% was coal, the rest was shale and sandstone. By applying these percentages to the number of tons of coal mined it is determined that the wash plant would have produced 142,960 tons of refuse and the refuse would have contained 13,724 tons of coal. This does not account for refuse which may have been generated by early mining. Coal mined before the wash plant was installed was probably sorted to remove the shale from the coal. If it is assumed that the shale contained in the 1.5 foot parting was removed from the raw coal and that an additional 10% of the material removed from the raw coal was coal, then the total amount of material accumulated on site from earlier mining would be around 125,400 tons of which 11,400 tons would be coal (See Appendix 3). By adding the amounts of material rejected during recent mining to the amounts estimated to have been rejected during earlier mining a the total amount of refuse on the order of 268,360 tons (of which 25,124 tons are coal) is calculated. The overall percentage of coal in the refuse material is, therefore, estimated to be 9.4% (See Appendix 3).

In order to test the validity of this estimate a thickness contour map of the refuse pile area was developed and measured to determine a volume of the amount of refuse material disposed of on site. The volume calculated from this measurement is 269,492 tons. This is within 0.4% of the amount of refuse estimated above which is an extremely high correlation. It can therefore be fairly safely accepted that there are 268,360 total tons of material in the refuse pile, 25,124 tons of which are coal.

COMBUSTION OF REFUSE MATERIAL

Even though the purpose of this report is not to determine whether or not the refuse material will sustain combustion, concern has been expressed over that possibility if the refuse material were to be exposed. MSHA has required that coal fines underground must contain 65% or more noncoal material in order to render the fines incombustible (30 CFR, 75.403). The above calculations demonstrate that the J.B. King refuse material is approximately 90.6% noncoal. Under the above stated conditions, it can be said with a high degree of certainty that the refuse material at J.B. King will not support combustion.

TIME TO EXPOSE REFUSE MATERIAL BY EROSION

To determine a time range in which the refuse material will be exposed by erosion two cases were examined. The first case assumed that the surface of the refuse pile will erode uniformly. This will result in the longest time before the refuse material is exposed. The second case assumed that gullies will form on the surface of the refuse pile and will concentrate the erosion in these gullies which will expose portions of the refuse material more quickly. These two cases were selected because they appear to be the extremes.

Uniform Erosion Case

The average rate of erosion on the refuse pile is 51.2 tons per year. This number is conservative because it assumes that the flat and low gradient areas of the refuse pile will erode at the same rate as the highest gradient face of the refuse pile. It is assumed that the refuse pile has been covered with 4 feet of soil material as a requirement of reclamation. Using information from the Chen & Associates June 10, 1983 report which is contained in the permit, it was determined that 51.2 tons of the fill material is equal to 1,027 cubic feet. The area of the refuse pile is 12.8 acres. The volume of material lost each year divided by this area calculates that 0.022 inches of soil will be lost per year. According to the calculations shown in Appendix 5 it would take 2,180 years to remove 4 feet of material and expose refuse at this rate.

Gully Erosion Case

It is assumed that all of the erosion on the entire 12.8 acre surface of the refuse pile will be concentrated into three gullies on the steep sloping face of the pile, (an unrealistically conservative assumption). As shown in Appendix 5, each gully is assumed to be 200 feet long and have 2 to 1 sideslopes. The time for these gullies to erode to a depth of 4 feet and begin exposure of the refuse material is 18.7 years.

The quickest way to expose refuse is to erode the 4 feet of cover material through gully erosion. The gully erosion case selected here is believed to be conservative and would result in exposure of refuse more quickly that would be expected possible. If more than three gullies are assumed to form on the sloping face of the refuse pile the time to exposure will increase. Consequently it can be stated confidently that coal refuse will be exposed at J.B. King sometime between 20 and 2,000 years from now. While this is a very wide time range the lower limit on the order of 20 years is the limiting time factor.

IMPACT OF EXPOSURE OF REFUSE

At this time the coal seam outcrop in the J.B. King basin is covered by material placed during reclamation. As erosion takes place the seam will be exposed and will eventually contribute to coal in the eroded sediment. However, this will not take place until most, or probably all, of the reclamation material has been eroded away. The reason for this is that erosion of the coal seam in this area is inhibited by a sandstone unit directly above the seam. In order for the coal seam to erode, the material beneath the coal must slough and be eroded away to undercut the seam. Subsequent sloughing of the coal seam will undercut the massive sandstone causing it to collapse which will expose the coal seam and subject it to erosion. For this analysis it is assumed that the face of the refuse pile will erode back toward the cliff, where the outcrop is located, at a constant 4 to 1 slope (See Appendix 6). This results in relatively complete erosion of the coal refuse material before the outcrop is exposed and erosion of the coal seam begins, assuming that the coal refuse material erodes at approximately the same rate as the soil.

A range of relative impacts will be determined by examining two extreme cases just as was done above. The two cases to be examined here include uniform erosion and gully erosion.

Uniform Erosion Case

In this case it is assumed that the sloping face of the refuse pile will be exposed first because of more rapid erosion. The size of the exposed area will be approximately 200 feet wide and 1000 feet long for a total area of 200,000 square feet (See Appendix 6). However, it was shown above that only 9.4% of the refuse material is coal, the rest is shale and sandstone. To determine the amount of coal exposed in 200,000 square feet of refuse this number must be multiplied by the percent of coal in the material to give 18,800 square feet of exposed coal. This area is then divided by the width of the J.B. King basin to determine the equivalent area of coal per unit width, which is:

$$\frac{18{,}800 \ \textit{square feet} \ x \ 1 \ \textit{foot}}{2{,}850 \ \textit{feet}} = 6.6 \ \textit{square feet}$$

To compare this area of coal exposure to that of the adjacent basin the following calculation is made:

$$\frac{6.6 \textit{ square feet}}{10.5 \textit{ square feet}} = 63\%$$

This means that the amount of coal exposed in the J.B. King basin, after the face of the refuse pile has been exposed is only 63% of the coal exposed in the adjacent basin. It was shown earlier that the equivalent coal area per unit width of the J.B. King basin in its natural state was approximately 7.1 square feet. Exposure of the face of the refuse pile will, therefore, expose less coal area than is believed to have been exposed in the J.B. King basin prior to disturbance.

Gully Erosion Case

Since this case will be used as the extreme lower limit of the impact range very conservative conditions will be assumed. The refuse pile will be exposed in only one gully which will have vertical sides and will cut through the refuse pile from the crest of the steep face of the pile to the toe of the pile (a horizontal distance of 200 feet). According to the thickness contour map used to measure the volume of the refuse pile the maximum refuse thickness is around 30 feet. Since the thicknesses of refuse at the ends of this imaginary gully are zero, the average thickness is estimated to be 15 feet. Appendix 7 shows the calculations of the equivalent area of coal exposed in the two walls of this gully, which is:

$$6{,}000 \textit{ square feet} \times 9.4\% = 564 \textit{ square feet}$$

The equivalent area per unit width would be 0.2 square feet which is 2% of the surface area of coal exposed in the adjacent basin.

Under these assumptions, the uniform erosion case forms the upper limit of erosion and the gully erosion case forms the lower limit of erosion. The upper limit is an equivalent exposed coal surface area per unit width which is 63% of the area per unit width exposed in the adjacent undisturbed basin. The lower limit is an equivalent exposed coal surface area per unit width which is 2% of the coal area exposed in the adjacent undisturbed basin. Any combination of gully erosion and uniform erosion will result in a situation somewhere between the limits of gully erosion only and uniform erosion only. It is, therefore, estimated, assuming that the coal seam will not erode until the refuse has eroded away, that the amount of coal exposed as the refuse pile is eroded will be a minimum of 2% and a maximum of 63% of amount of coal exposed in the undisturbed basin adjacent to the J.B. King basin.

After the refuse pile has eroded away the coal outcrop will be exposed in the J.B. King basin and the basin will return to its natural state in which coal will naturally erode into the sediment. In this case the amount of coal exposed will be 7.1 square feet per unit width compared to 10.5 square feet per unit width for the adjacent basin. The conclusion is that while the refuse pile is eroding there will be less coal exposed than would naturally be exposed in the hypothetically undisturbed J.B. King basin and less than is exposed in the adjacent undisturbed basin. After the refuse is eroded away, and the coal outcrop is exposed, conditions will return to their natural state wherein less coal will be exposed in the J.B. King basin than in the adjacent basin.

TIME BEFORE ESCAPE OF SEDIMENT FROM J.B. KING SITE

On August 21, 1992, the sediment pond at J.B. King was surveyed to confirm the depth and spillway elevations. The survey indicates that a conservative assumption for the elevation of the spillway is 6250 feet and the bottom of the pond is at an elevation of 6241.3 feet. The most recent map of the J.B. King site (1990) shows a pond bottom elevation of 6241.7 feet. In order to be conservative the higher elevation (6241.7 feet) was used to determine the volume of the pond. The estimated volume, as calculated in Appendix 8, is 200,298 cubic feet.

All sediment from the J.B. King basin is currently trapped in the sediment pond located at the far down gradient edge of the mine permit area. Above, an erosion rate of 1,027 cubic feet per year was determined, whether the sediment is composed of soil or coal refuse material. An assumption that this amount of erosion is one half the total erosion on site is believed to be conservative for the following reasons:

- The refuse pile composes about 13% of the total area of the drainage basin and, for purposes of calculating erosion, was given the steepest slope (25%) in the area and the most erodible characteristics.

- The area above the cliff, about 70% of the total area, is composed primarily of a hard massive sandstone surface which is not highly erodible. The slopes of most of these upper surfaces average only 10.1%.

- The area below the cliff, excluding the refuse pile, is around 18% of the total area and has a flatter slope than the refuse pile. Also this area has a greater vegetation cover than the refuse pile. The refuse pile has a cover of 46.5% (20% was used to calculate the rate of erosion), the drainages have a cover of 54.8%, and the rest of the area below the cliff has a cover of 48.5%.

- There is evidence on site that much of the material eroded from the steeper areas is deposited on the flatter areas before reaching the sediment pond. In other words the sediment pond is not the only location on site where sediment is accumulated.

Using this assumption the net total erosion on site is estimated to be 2,054 cubic feet per year. With a sediment pond volume of 200,298 cubic feet as determined in Appendix 8, it will take, conservatively, 97.5 years of erosion to fill the sediment pond. To be even more conservative assume that one third of the erosion comes from the refuse pile, one third from the area above the cliff, and one third from the rest of the area below the cliff. In this case the total erosion would be 3,081 cubic feet per year. Even at this rate it is calculated to take 65 years to fill the sediment pond. As the pond fills with sediment the detention time will decrease resulting is decreased settling efficiencies. The result is that as the 100 year time frame is approached there is an increasing probability that sediment will escape the basin.

SUMMARY

This study has resulted in the following conclusions:

- The "I" coal seam was exposed in the J.B. King basin prior to disturbance.
- Erosion will expose the coal refuse pile on the J.B. King site within 20 to 2,000 years.
- The refuse material is 9.4% coal - the rest of the material is shale and sandstone.
- Because of the low percentage of coal in the refuse material (9.4%) it is highly unlikely that this material will support combustion.
- When the refuse material is exposed there will be between 2% and 63% of the amount of coal exposed in the J.B. King basin as is naturally exposed in the undisturbed basin adjacent to J.B. King.
- Regardless of the time before exposure of refuse material or the amount of exposure, the sediment pond will significantly inhibit the escape of sediment from the J.B. King site for 65 to 100 years.

APPENDIX 1

ON AUGUST 21, 1992, THE COAL OUTCROP WAS MAPPED IN THE J.B. KING DRAINAGE BASIN AND IN THE BASIN JUST NORTH OF J.B. KING. IT WAS FOUND THAT THE NORTH BASIN CONTAINS AN OUTCROP ALONG THE ENTIRE WIDTH OF THE BASIN. THE COAL SEAM MEASURED FROM 12 TO 14 FEET THICK.

IN THE J.B. KING DRAINAGE EVIDENCE OF THE COAL SEAM WAS FOUND AT AN ELEVATION WHICH SUGGESTS THAT THE COAL WAS ORIGINALLY EXPOSED AT AN ELEVATION WHICH WOULD HAVE ALLOWED THE SEAM TO CROP OUT ALONG THE ENTIRE WIDTH OF THE J.B. KING BASIN.

HOWEVER, FROM THE NORTH END OF THE BASIN TO A POINT JUST WEST OF THE "FEEDER DITCH" RAMP THE SEAM HAS BEEN COVERED. THE TOP OF THE SEAM CAN BE SEEN BY THE FEEDER DITCH RAMP AND IN THE BOTTOM OF THE DRAINAGE JUST EAST OF THE FEEDER DITCH. SINCE THE SEAM IS COVERED THE THICKNESS COULD NOT BE MEASURED. THE PERMIT STATES THAT THE SEAM IS 12 FT. THICK WITH A 9"-18" PARTING. THIS AGREES WITH THE MEASUREMENTS MADE IN THE ADJACENT DRAINAGE.

WEST OF THE FEEDER DITCH THE LOCATION OF THE COAL OUTCROP IS EXPOSED, HOWEVER, THERE IS NO COAL. IT IS UNKNOWN AT THIS TIME WHETHER THE SEAM HAS PINCHED OUT OR IF IT HAS BURNED AT THIS LOCATION. THE POINT WHERE THE ROAD WHICH PROVIDES ACCESS TO THE AREA ABOVE MINE CROSSES THE ELEVATION WHERE THE SEAM SHOULD BE SHOWS EVIDENCE OF COAL BURN. THE TOTAL WIDTH OF THE J.B. KING BASIN AT THE ELEVATION OF THE COAL OUTCROP IS 2850 FT. THIS IS THE POTENTIAL COAL SEAM LENGTH. HOWEVER, THERE IS NO COAL PRESENT FOR 925 FT. OF THIS EXPOSURE. THERE WAS COAL ACTUALLY EXPOSED FOR 1925 FT. OF THE WIDTH OF THE BASIN. THIS IS THE ACTUAL COAL SEAM LENGTH. EVEN THOUGH THIS COAL WAS ORGINALLY EXPOSED IN THE BASIN IT HAS BEEN COVERED AS PART OF RECLAMATION. IN THIS CASE THE ACTUAL SEAM LENGTH IS:

$$\frac{1925}{2850} = 67.5\% \text{ OF THE POTENTIAL SEAM LENGTH.}$$

USE 68%

HANSEN ALLEN & LUCE inc

CLIENT WSMC
PROJECT J.B. KING
FEATURE SUMMARY OF GEOLOGIC MAPPING
PROJECT NO.

COMPUTED
CHECKED
DATE 8/25/92

THE BASIN NORTH OF J.B. KING HAS AND ACTUAL COAL SEAM LENGTH WHICH IS 100% OF THE POTENTIAL COAL SEAM LENGTH SINCE THERE IS A FULL SEAM OF COAL EXPOSED FOR THE ENTIRE WIDTH OF THE BASIN.

WHEN COMPARED TO J.B. KING, EROSION OVER GEOLOGIC TIME, WOULD PRODUCE

$$100\% - 68\% = \underline{\underline{32\%}}$$

MORE COAL IN THE SEDIMENT PER UNIT WIDTH OF THE NORTH DRAINAGE BASIN. BEFORE MINING AND AFTER ALL EFFECTS OF MINING HAVE BEEN ERODED AWAY SO THAT THE SITE RETURNS TO NATURE THE J.B. KING WILL ERODE ONLY 67.3% AS MUCH COAL AS THE NORTH BASIN PER FOOT OF WIDTH OF DRAINAGE BASIN. THIS MEANS THAT NATURALLY THE J.B. KING BASIN IS LESS CONTAMINATING BY COAL EROSION THAT THE ADJACENT BASIN.

APPENDIX 2

HANSEN ALLEN & LUCE inc	CLIENT WESTERN STATES MINERALS CORP.	SHEET 1 OF 8	
	PROJECT J.B. KING	COMPUTED BJB	
	FEATURE RATE OF EROSION ON REFUSE PILE	CHECKED	
	PROJECT NO.	DATE 8/25/92	

EROSION RATE

TO ESTIMATE THE RATE AT WHICH EROSION WILL TAKE PLACE ON THE SURFACE OF THE REFUSE PILE THE UNIVERSAL SOIL LOSS EQUATION IS USED. (USDA, SOIL CONSERVATION SERVICE, 1972, 1977 AND EPA, 1973) THE GENERAL FORM OF THE EQUATION IS:

$$X = RKSLCP$$

WHERE: X = SOIL LOSS TONS/ACRE/YEAR

R = EROSION INDEX, ANNUAL

K = SOIL ERODIBILITY FACTOR

L = SLOPE LENGTH

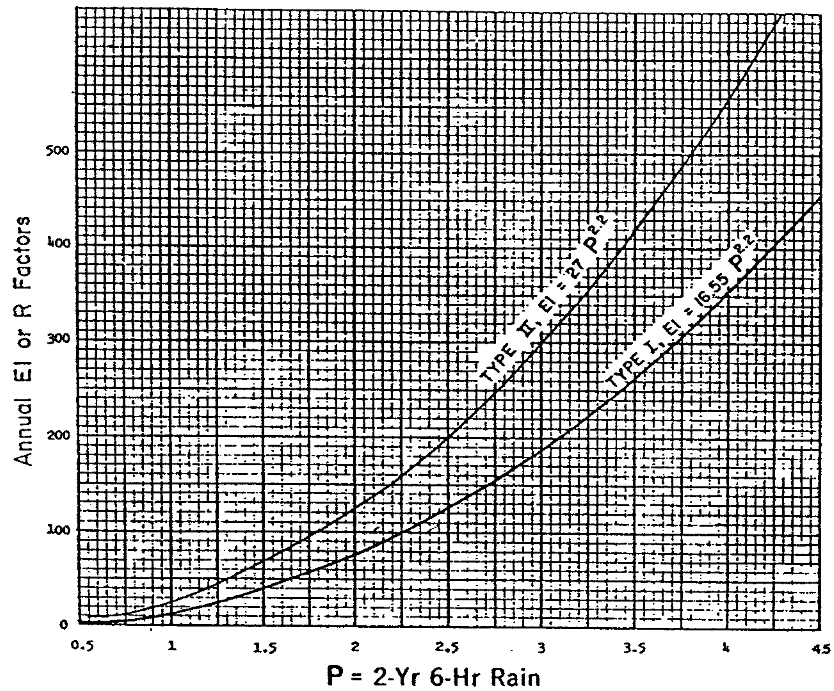
S = SLOPE GRADIENT

C = CROP MANAGEMENT

P = EROSION CONTROL FACTOR

R - EROSION INDEX

THE SOIL CONSERVATION SERVICE (1972) ESTABLISHED A RELATIONSHIP BETWEEN THE TYPE II, 2 YEAR 6 HOUR STORM AND THE ANNUAL EROSION INDEX. THIS RELATIONSHIP IS SHOWN IN THE FOLLOWING FIGURE.



Relation between annual average rainfall index and the 2-year, 6-hour rainfall depth for two rainfall types.

ACCORDING TO THE PRECIPITATION-FREQUENCY ATLAS BY NOAA THE 2 YEAR 6HOUR STORM IS 0.8" FOR THE J.B. KING AREA. FROM THE ABOVE FIGURE A P OF 0.8" CORRESPONDS TO AN ANNUAL R FACTOR OF 20.

K- SOIL ERODIBILITY FACTOR

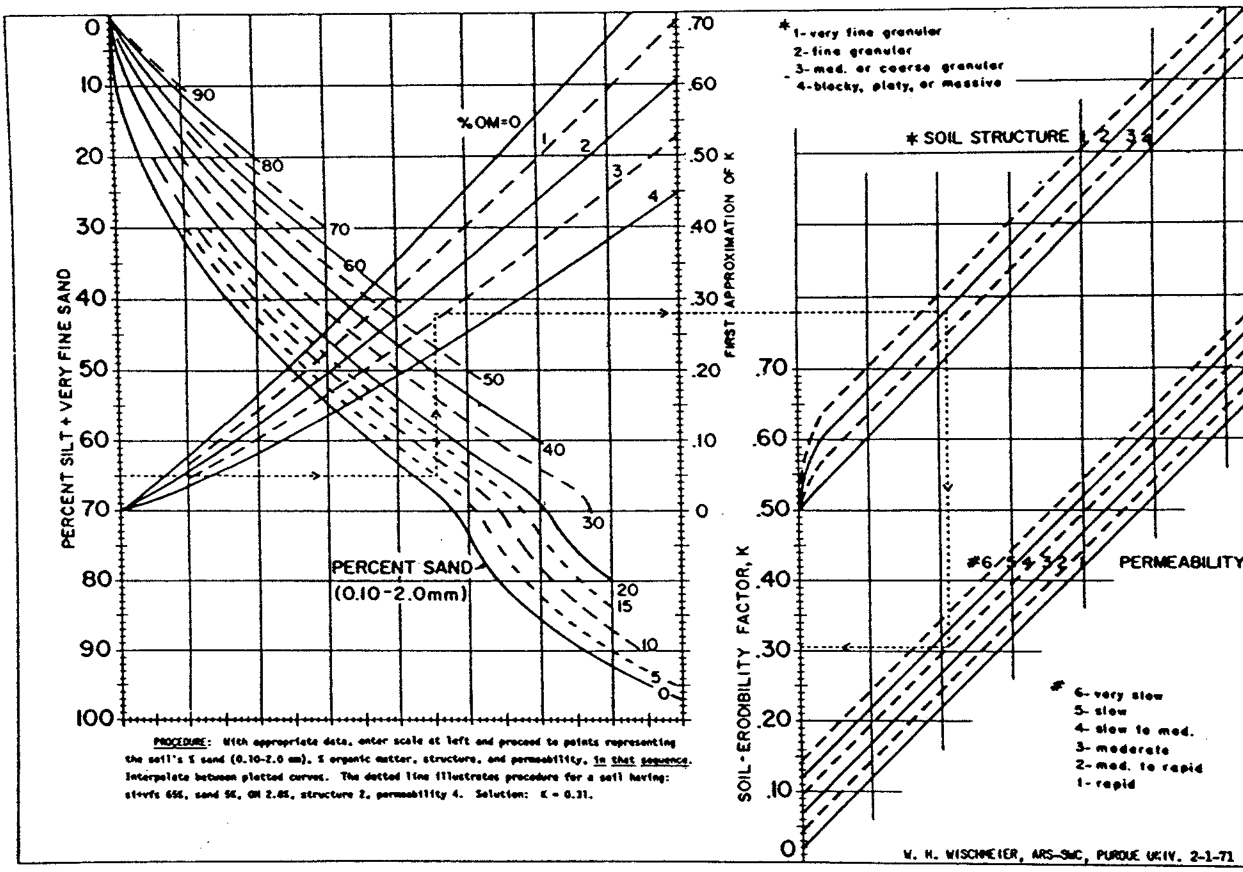
IN MAY, 1984, 34 SOIL SAMPLES WERE TAKEN AND ANALYZED. THESE SAMPLES WERE OF THE BORROW MATERIAL WHICH WAS USED TO COVER THE REFUSE PILE. THE RESULTS OF THESE ANALYSES ARE CONTAINED IN THE J.B. KING PERMIT. IT IS ASSUMED THAT AS THE REFUSE PILE WAS COVERED THIS MATERIAL WAS EXCAVATED, TRANSPORTED, DUMPED, SPREAD, GRADED TO CONTOUR, AND TILLED WHICH MIXED THE MATERIAL SO THAT IT IS NO LONGER SEGREGATED. THE LOGICAL EXTENSION OF THIS ASSUMPTION IS THAT THE AVERAGE CHARACTERISTICS OF THE SOIL SAMPLES WILL APPROXIMATE THE AVERAGE CHARACTERISTICS OF THE MATERIAL COVERING THE REFUSE PILE.

OF THE 34 SAMPLES THE FOLLOWING ARE THE AVERAGE CHARACTERISTICS:

	SAND	CLAY	SILT		
AVERAGE	63.9%	19.3%	16.7%	=	99.9%
STAN. DEV.	19.6%	10.7%	10.4%		

HANSEN ALLEN & LUCE inc		
	CLIENT WSMC	SHEET 4 OF 8
	PROJECT J.B. KING	COMPUTED BTB
	FEATURE RATE OF EROSION ON REFUSE PILE	CHECKED
	PROJECT NO.	DATE 8/25/92

THE FOLLOWING NOMOGRAPH IS USED TO DETERMINE THE K-VALUE.



THE K VALUE FOR THIS SOIL IS ON THE ORDER OF 0.13

L, S - SLOPE LENGTH AND STEEPNESS FACTORS

THE LENGTH OF THE SLOPE OF THE REFUSE PILE IS APPROXIMATELY 200 FT. THE GRADIENT OF THE SLOPE IS SLIGHTLY FLATTER THAN 4 TO 1 - USE 4 TO 1.

THE FACTORS HAVE BEEN EMPIRICALLY COMBINED BY THE SOIL CONSERVATION SERVICE (1972) IN THE FOLLOWING CHART.

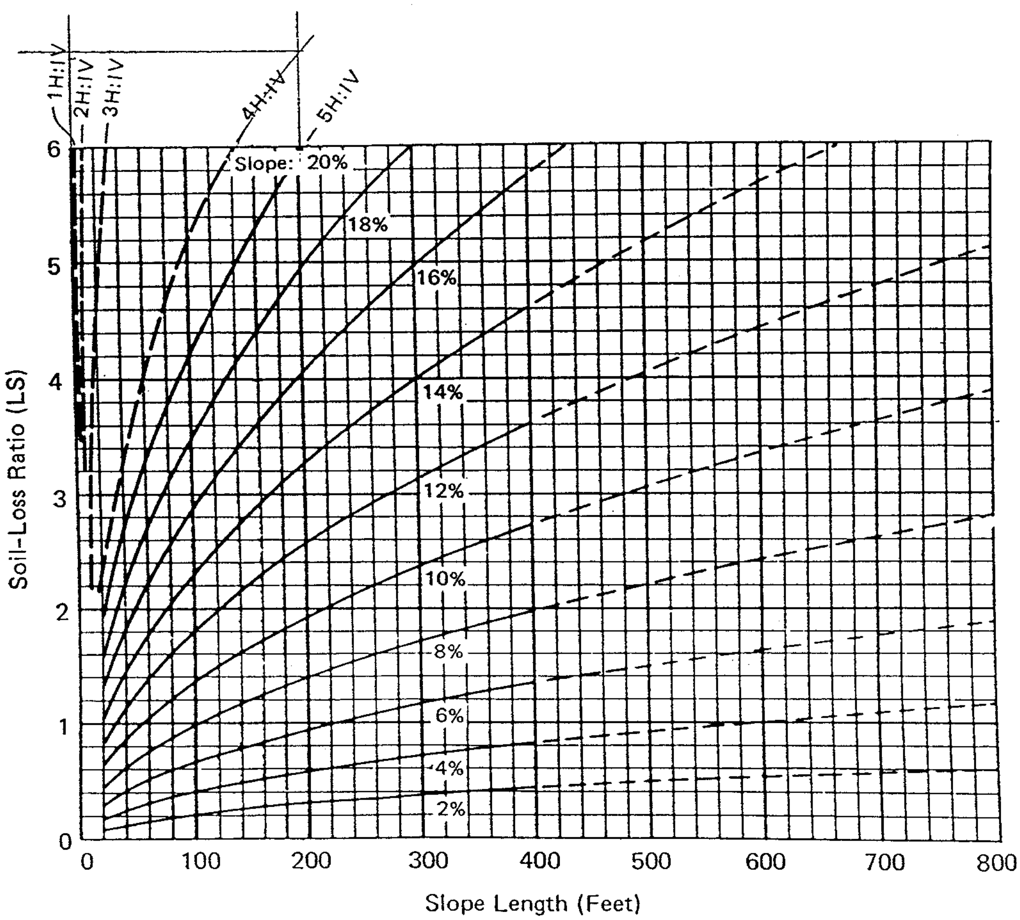


Chart for determination of topographic factors, *LS*.

EXTRAPOLATION FROM THE ABOVE CHART RESULTS IN A L·S FACTOR OF 6.8.

C - CROP MANAGEMENT

THIS FACTOR TAKES INTO ACCOUNT THE AFFECT OF VEGETATION ON EROSION. THE FOLLOWING TABLE ALLOWS DETERMINATION OF THIS FACTOR.

C factors for pasture, rangeland, and idle land.[1]

Vegetal Canopy			Cover That Contacts the Surface					
			Percent Ground cover					
Type and height of raised canopy[2]	Canopy cover[3] %	Type[4]	0	20	40	60	80	95–100
Column no.:	2	3	4	5	6	7	8	9
No appreciable canopy		G	.45	.20	.10	.042	.013	.003
		W	.45	.24	.15	.090	.043	.011
Canopy of tall weeds	25	G	.36	.17	.09	.038	.012	.003
or short brush		W	.36	.20	.13	.082	.041	.011
(0.5 m fall ht.)	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.075	.039	.011
	75	G	.17	.10	.06	.031	.011	.003
		W	.17	.12	.09	.067	.038	.011
Appreciable brush	25	G	.40	.18	.09	.040	.013	.003
or bushes		W	.40	.22	.14	.085	.042	.011
(2 m fall ht.)	50	G	.34	.16	.085	.038	.012	.003
		W	.34	.19	.13	.081	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.077	.040	.011
Trees but no appre-	25	G	.42	.19	.10	.041	.013	.003
ciable low brush		W	.42	.23	.14	.087	.042	.011
(4 m fall ht.)	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.085	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.083	.041	.011

[1]All values shown assume: (1) random distribution of mulch or vegetation, and (2) mulch of appreciable depth where it exists.

[2]Average fall height of waterdrops from canopy to soil surface: m = meters.

[3]Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[4]G: Cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 inches deep.

W: Cover at surface is mostly broadleaf herbaceous plants (as weeds) with little lateral-root network near the surface, and/or undecayed residue.

Source: USDA Soil Conservation Service, 1978

IN THIS CASE IT IS CONSERVATIVELY ASSUMED THAT THERE IS NO CANOPY (BRUSH) COVER AND THAT THERE IS 20% GROUND COVER. BASED ON THESE ASSUMPTIONS THE C-FACTOR IS ESTIMATED TO BE 0.24.

P- EROSION CONTROL FACTOR

THE FOLLOWING TABLE SHOWS THE P-FACTORS FOR VARIOUS CONDITIONS.

***P* factors for standard erosion control practices.**

Slope, %	Up and down hill	Cross slope farming without strips	Contour tillage	Cross slope farming with strips	Contour stripcropping
2.0–7	1.0	.75	.50	.37	.25
7.1–12	1.0	.80	.60	.45	.30
12.1–18	1.0	.90	.80	.60	.40
18.1–24	1.0	.95	.90	.67	.45

(From USDA Soil Conservation Service, 1978)

THE ACTUAL SLOPE OF THE FACE OF THE REFUSE PILE IS 22.5%. CONTOUR FURROWS WERE PLACED ON THE FACE OF THE REFUSE PILE AND REMNANTS OF THOSE FURROWS STILL EXIST. BASED ON THIS CONDITION A CONSERVATIVE P-FACTOR OF 0.95 IS SELECTED.

CALCULATION OF SOIL LOSS

$$X = RKSLCP$$

WHERE:

R = 20
K = 0.13
LS = 6.8
C = 0.24
P = 0.95

$$X = 20 \times 0.13 \times 6.8 \times 0.24 \times 0.95 = 4.0 \text{ TONS/ACRE/YR.}$$

THE TOTAL AREA OF THE REFUSE PILE, INCLUDING THE FLAT AREAS ON TOP OF AND WEST OF THE FACE OF THE REFUSE PILE, IS 12.8 ACRES (SEE).

TOTAL SOIL LOSS FROM THE REFUSE PILE AREA IS:

$$4.0 \times 12.8 = 51.2 \text{ TONS/YEAR}$$

APPENDIX 3

AMOUNT OF REFUSE

THE J.B. PERMIT STATES THAT BETWEEN 1939 AND 1981 A TOTAL OF 1.5 MILLION TONS OF COAL WAS MINED. THE MAP SHOWING THE OLD AND NEW MINE WORKINGS WAS EXAMINED AND APPEARS TO VERIFY THIS NUMBER. THE NEW WORKINGS WERE ACCURATELY MEASURED AND BASED ON THE RESULTING VOLUME CALCULATIONS IT IS ESTIMATED THAT 588,300 TONS WERE MINED IN RECENT TIMES. THIS LEAVES ABOUT 912,000 TONS WHICH WERE MINED IN TIMES PAST.

ACCORDING TO ENGINEERING INFORMATION IN THE PERMIT (817.59 PAGE 1) FOR EVERY 150 TONS OF COAL PUT INTO THE WASH PLANT 36.5 TONS (24.3%) WOULD BE REJECTED. OF THE 36.5 TONS REJECTED 3.5 TONS (9.6%) IS COAL. THE MAJORITY OF THE REFUSE MATERIAL IS SHALE AND SANDSTONE. SINCE THE WASH PLANT WAS USED TO PROCESS THE COAL MINED IN RECENT TIMES THESE NUMBERS WILL APPLY TO THE 588,300 TONS MINED RECENTLY.

588,300 TONS × 24.3% = 142,960 TONS OF REFUSE

142,960 TONS OF REFUSE × 9.6% = 13,724 TONS OF COAL IN THE REFUSE.

THE COAL MINED IN TIMES PAST (912,000 TONS) WAS MINED BEFORE THE WASH PLANT WAS INSTALLED. BEFORE WASH PLANTS WERE USED COAL WAS GENERALLY SORTED BY HAND. ALTHOUGH THIS PRACTICE WAS NOT EFFICIENT IS WAS RELATIVELY EFFECTIVE BECAUSE COAL PRODUCED BY CONVENTIONAL (DRILL & BLAST) MINING WAS PRIMARILY LUMP COAL WHICH MADE SORTING EASIER. THE PERMIT STATES THAT THE COAL SEAM WHICH WAS MINED HERE IS 12 FEET THICK WITH AN 18 INCH PARTING. SORTING WOULD REMOVE THE PARTING MATERIAL. THE PERCENT OF MATERIAL REMOVED WOULD BE

$$\frac{18''}{12' \times 12''/FT} = .125 = 12.5\%$$

ASSUME THAT THE SORTING PROCESS WAS 10% INEFFICIENT SO THAT 10% OF THE MATERIAL REMOVED WAS COAL.

THE PERCENTAGE OF COAL REMOVED

WOULD BE 10% x 12.5% = 1.25%

TOTAL MATERIAL REJECTED WOULD BE

12.5% PARTING + 1.25% COAL = 13.75%

THE ESTIMATED AMOUNT OF REJECT (REFUSE)

MATERIAL FOR MINING IN TIMES PAST IS:

912,000 TONS x 13.75% = 125,400 TONS

ADD TO THIS THE REFUSE GENERATED

BY RECENT MINING:

125,400 TONS + 142,960 TONS = 268,360 TONS

OF REFUSE MATERIAL.

IN THE REFUSE FROM TIMES PAST THE AMOUNT

OF COAL WAS ESTIMATED TO BE 1.25% OF

THE TOTAL MINED MATERIAL WHICH IS:

912,000 TONS x 1.25% = 11,400 TONS.

ADD TO THIS THE AMOUNT OF COAL IN THE

REFUSE MATERIAL FROM RECENT MINING:

13,724 TONS + 11,400 TONS = 25,124 TONS.

THE OVERALL PERCENT OF COAL IN THE

REFUSE MATERIAL IS:

$$\frac{25{,}124 \text{ TONS}}{268{,}360 \text{ TONS}} = .094 \text{ OR } 9.4\%$$

TO PROVIDE AN INDEPENDENT CHECK OF THESE OVERALL ASSUMPTIONS THE SIZE OF THE REFUSE PILE WAS MEASURED BY ESTIMATING THE BASE CONTOURS BENEATH THE REFUSE PILE AND SUBTRACTING THE VALUES OF THE BASE CONTOURS FROM THE VALUES OF THE SURFACE CONTOURS THE DIFFERENCES IN THE VALUES WERE CONTOURED AND THE VOLUME OF REFUSE WAS MEASURED BASED ON THESE THICKNESS CONTOURS. THE MEASURED VOLUME IS 5,406,062 CUBIC FT. THE DENSITY OF THE REFUSE IS 99.7 POUNDS/FT³ (CHEN & ASSOC., JUNE 10, 1983).

$$\frac{99.7\ \text{lbs/FT}^3 \times 5{,}406{,}062\ \text{FT}^3}{2000\ \text{lbs/TON}} = 269{,}492\ \text{TONS.}$$

COMPARE THIS TO THE TONNAGE OF MATERIAL ESTIMATED ABOVE

$$\frac{269{,}492\ \text{TONS}}{268{,}360\ \text{TONS}} = 1.004$$

THE AGREEMENT OF THESE TWO METHODS IS .004 OR 0.4% WHICH VERIFIES THE ASSUMPTIONS USED ABOVE.

APPENDIX 4

UNIFORM EROSION CASE

51.2 TONS/YR OF SOIL WILL BE ERODED FROM THE REFUSE AREA. WITH A DENSITY OF 99.7 LBS/FT^3 (CHEN & ASSOC., JUNE 10, 1983) THE VOLUME OF MATERIAL ERODED EACH YEAR IS:

$$\frac{51.2 \text{ TONS} \times 2000 \text{ LB/TON}}{99.7 \text{ LB/FT}^3} = 1027 \text{ FT}^3\text{/YR}$$

THE AREA OF THE REFUSE PILE AREA IS 12.8 ACRES SO THE DEPTH OF SOIL ERODED EACH YEAR WILL BE:

$$\frac{1027 \text{ FT}^3}{12.8\text{A} \times 43560 \text{ FT}^2\text{/ACRE}} = .002'$$

OR .022 INCHES PER YEAR.

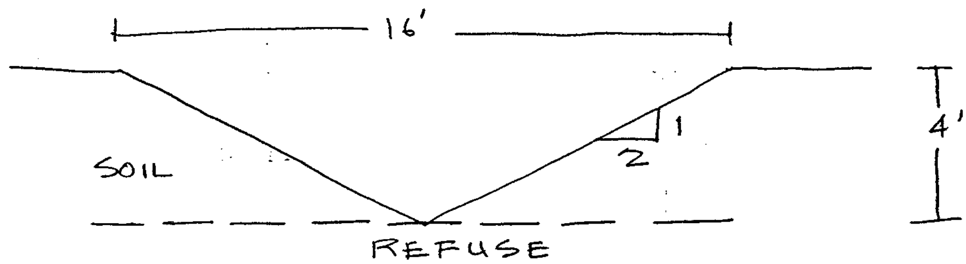
AT A RATE OF .022"/YR THE TIME TO ERODE 4' OF COVER OVER THE REFUSE IS:

$$\frac{4' \times 12''\text{/FT}}{.022''\text{/YR}} = \underline{\underline{2,180 \text{ YEARS}}}$$

APPENDIX 5

GULLY EROSION CASE

ASSUME THAT 3 GULLIES WILL DEVELOP ON THE FACE OF THE REFUSE PILE AND THAT ALL EROSION FROM THE ENTIRE REFUSE AREA WILL TAKE PLACE WITHIN THESE GULLIES. FURTHER ASSUME THAT THE GULLIES WILL HAVE 2 TO 1 SIDE SLOPES AND WILL ONLY BE 200 FT. LONG.



ASSUMING THE ABOVE CROSS-SECTION FOR EACH GULLY THE VOLUME OF SOIL WHICH WILL BE ERODED BEFORE REFUSE IS EXPOSED IS:

$$\frac{4' \times 16'}{2} \times 200' = 6{,}400\ FT^3/\text{GULLY}$$

$$3\ \text{GULLIES} \times 6400\ FT^3/\text{GULLY} = 19{,}200\ FT^3$$

THE EROSION RATE FOR THE ENTIRE AREA IS $1{,}027\ FT^3/YR$. THE TIME TO ERODE THE GULLIES TO EXPOSE REFUSE IS:

$$19{,}200\ FT^3 / 1{,}027\ FT^3/YR = \underline{18.7\ \text{YEARS}}$$

APPENDIX 6

WORST CASE EROSION - UNIFORM

THE WORST CASE FOR EROSION OF THE REFUSE MATERIAL IS WHEN THE ENTIRE FACE OF THE REFUSE PILE IS EXPOSED AT ONCE. IN THIS CASE THE AMOUNT OF COAL IN THE SEDIMENT WILL BE EQUAL TO THE PERCENTAGE OF COAL IN THE REFUSE. THE PERCENTAGE OF COAL IN THE REFUSE WAS CALCULATED TO BE 9.4 %. THEREFORE, ASSUMING THAT ALL EROSION WILL TAKE PLACE ON THE FACE OF THE REFUSE PILE A MAXIMUM OF 9.4% OF THE SEDIMENT WILL BE COMPOSED OF COAL PARTICLES. SEDIMENT FROM THE REST OF THE DRAINAGE BASIN WILL DILUTE THE PERCENTAGE OF COAL IN THE SEDIMENT.

THE EQUIVALENT COAL SEAM LENGTH IS:

$$\frac{200\,FT \times 1000\,FT \times .094}{10.5\,FT} = 1790.5\,FT$$

WHICH IS $\frac{1790.5\,FT}{2850\,FT} = 62.8\%$ OF THE POTENTIAL COAL SEAM EXPOSURE.

OR USING EQUIVALENT AREA PER UNIT WIDTH THE AREA WILL BE:

$$200 \text{ FT} \times 1000 \text{ FT} \times .094 = 18{,}800 \text{ FT}^2$$

THE AREA/UNIT WIDTH WILL BE

$$\frac{18{,}800 \text{ FT}^2}{2850 \text{ FT}} = 6.6 \text{ FT}^2$$

FOR COMPARISON TO THE ADJACENT AREA THE J.B. KING SITE WILL BE:

$$\frac{6.6 \text{ FT}^2}{10.5 \text{ FT}^2} = 63\%$$ OF THE COAL EROSION IMPACT OF THE ADJACENT BASIN.

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CLIENT WSMC
PROJECT J.B. KING
FEATURE UNIFORM EROSION
PROJECT NO.

COMPUTED BJB
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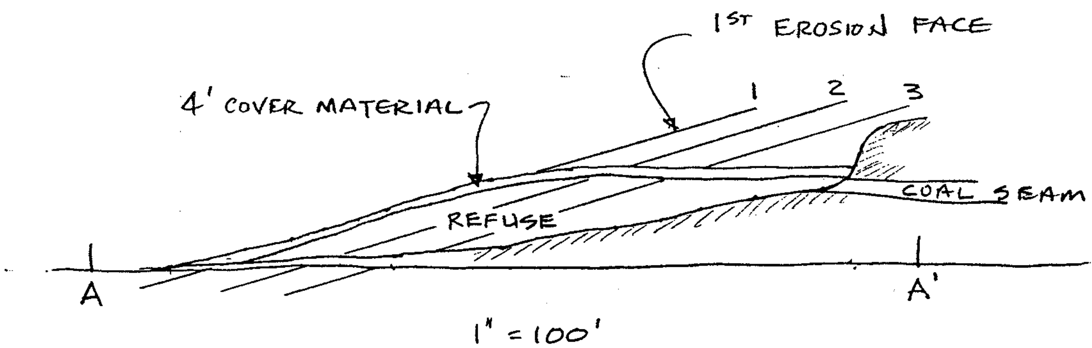


SEQUENCE OF EROSION -

APPENDIX 7

3 GULLY EROSION

BECAUSE OF THE CONFIGURATION OF THE REFUSE PILE THE MAXIMUM THICKNESS OF THE REFUSE MATERIAL IS LESS THAN 30 FT. AND THE MINIMUM THICKNESS IS 8 FT. SO THE AVERAGE THICKNESS IS APPROXIMATELY 15 FT. IF GULLIES ERODE TO THE BOTTOM OF THE REFUSE PILE THE AVERAGE THICKNESS OF EXPOSED REFUSE WILL BE 15'. AT A DEPTH OF 30 FEET THE 2 TO 1 ASSUMED SIDESLOPES WILL CAUSE A CHANNEL 120 FT WIDE AT THE TOP. THE TOTAL EXPOSED AREA OF REFUSE PER GULLY WILL BE:

$$2 \times \sqrt{30^2 + 60^2} \times 200 \text{ FT. LENGTH} = 26,833 \text{ FT.}^2$$

AGAIN, ASSUMING 3 CHANNELS THE TOTAL EXPOSED REFUSE IS $3 \times 26,833 \text{ FT}^2 = 80,499 \text{ FT}^2$

THE EQUIVALENT COAL SEAM LENGTH IS:

$$\frac{80,499 \text{ FT}^2 \times .094}{10.5} = 721 \text{ FT.}$$ WHICH IS

$$\frac{721 \text{ FT}}{1925 \text{ FT.}} = 37.5\%$$ OF THE COAL EXPOSE PER FT. OF WIDTH OF J.B. KING AND

$$\frac{721 \text{ FT.}}{2850 \text{ FT.}} = 25.3\%$$ OF THE CONTAMINATION PER FT. OF WIDTH OF THE ADJACENT BASIN.

GULLY BEST CASE - 1 GULLY

THE ACTUAL SIZE OF THE FACE OF THE REFUSE PILE WHERE THE MAJORITY OF EROSION WILL TAKE PLACE IS 200 FEET WIDE AND ABOUT 1000 FEET LONG. BECAUSE OF THE CONFIGURATION OF THE REFUSE PILE (SEE CROSS-SECTION IN APPENDIX 6) THE MAXIMUM THICKNESS OF THE REFUSE IS LESS THAN 30 FT. AND THE MINIMUM THICKNESS IS Ø FT SO THE AVERAGE THICKNESS IS 15 FT. A SINGLE VERTICAL WALLED GULLY WOULD EXPOSE THE FOLLOW AMOUNT OF REFUSE

200 FT. LENGTH × 15 FT. AVE. HT. × 2 WALLS = 6,000 FT^2

THE EQUIVALENT COAL SEAM LENGTH IS:

$$\frac{6{,}000\ FT^2 \times .094}{10.5\ FT} = 54\ FT.$$

WHICH IS $\frac{54\ FT.}{2850\ FT} = 2\%$ OF THE POTENTIAL COAL EXPOSURE.

APPENDIX 8

SEDIMENT POND

ON AUG. 21, 1992, THE SEDIMENT POND AT J.B. KING WAS SURVEYED TO VERIFY MAPPING OF THE POND. IT WAS CONFIRMED THAT THE SPILLWAY ELEVATION IS APPROXIMATELY 2 FT. BELOW THE TOP OF THE EMBANKMENT AND THE BOTTOM OF THE POND IS APPROXIMATEY 8.7 FT. BELOW THE SPILLWAY THIS PUTS THE BOTTOM AT AN ELEVATION OF 6241.3 FT. AND THE SPILLWAY AT A CONSERVATIVE ELEVATION OF 6250 FT.

FOR SEDIMENT CAPACITY IT IS ASSUMED THAT THERE WILL BE NO DISCHARGE OF SEDIMENT UNTIL THE SEDIMENT LEVEL REACHES THE LIP OF THE SPILLWAY. IT IS FURTHER ASSUMED THAT SEDIMENT WILL BE DEPOSITED TO FORM A NATURALLY STABLE SLOPE OF 1.0 % UPSTREAM FROM THE SPILLWAY.

THE VOLUME OF THE SEDIMENT POND WAS MEASURED USING THE FOLLOWING FIGURE. THIS FIGURE IS USED BECAUSE IT IS THE SAME MAP BASE AS HAS BEEN USED TO CALCULATE OTHER VOLUMES IN THIS REPORT SO IT PROVIDES CONSISTENCY.

ALSO THIS FIGURE SHOWS A BOTTOM ELEVATION

OF 6241.7 FT. WHILE AN ACTUAL BOTTOM OF 6241.3 FT. WAS SURVEYED ON AUG. 21. THE 6241.7 FT. ELEVATION WILL BE USED TO BE CONSERVATIVE.

THE AREA WITHIN THE 6250 CONTOUR IS 29,864 FT^2

THE AREA WITHIN THE 6245 CONTOUR IS 18,893 FT^2

THE AVERAGE THICKNESS WITHIN THE 6250 CONTOUR IS $(0+5)/2 = 2.5$ FT. AND THE AVERAGE THICKNESS WITHIN THE 6245 CONTOUR IS

$(6245-6241.7)/2 + 5' = 6.65$ FT.

THE VOLUME, THEREFORE, IS:

$$29{,}864\ FT^2 \times 2.5\ FT. = 74{,}660\ FT^3$$

$$+\ 18{,}893\ FT^2 \times 6.65\ FT. = 125{,}638\ FT^3$$

$$200{,}298\ FT^3 = 7418\ YD^3$$

HANSEN ALLEN & LUCE inc

CLIENT WSMC
PROJECT J.B. KING
FEATURE VOLUME OF SED. POND
PROJECT NO.

COMPUTED BJB
CHECKED
DATE 8/25/92

TIME BEFORE ESCAPE OF SEDIMENT.

ON AUGUST 21, 1992, THE SEDIMENT POND AT THE J.B. KING SITE WAS SURVEYED AND A REMAINING VOLUME OF 200,298 FT^3 WAS DETERMINED.

ASSUME THAT ALL EROSION WILL GO INTO THE SEDIMENT POND AND THAT THE EROSION FROM THE REFUSE AREA IS ONE HALF THE TOTAL EROSION ON AND PASSING THROUGH THE SITE. TOTAL EROSION WILL, THEREFORE, BE:

$$1{,}027\ FT^3/YR \times 2 = 2{,}054\ FT^3/YR.$$

THE TIME TO FILL THE SEDIMENT POND WITH SEDIMENT IS:

$$\frac{200{,}298\ FT^3}{2{,}054\ FT^3/YR} = \underline{\underline{97.5\ YRS.}}$$

THIS NUMBER IS VERY CONSERVATIVE.

APPENDIX 3

WESTERN STATES MINERALS CORPORATION

TECHNICAL MEMORANDUM

September 10, 1992

To: **Edward M. Gerick, Vice President of Operations (WSMC)**
From: **Larry D. Berg, P.E. / Environmental Engineer (WSMC)**
Subject: **J.B. King Mine, Analytical Results of Coal Refuse and Surrounding Soils**

cc: **B.J. Barnum (Hansen, Allen, & Luce, Inc.), D.J. Crossland (WSMC)**

INTRODUCTION:

Western States Minerals Corporation (WSMC) recently performed an investigation of our J.B. King Mine located in Emery County, Utah, to characterize the contents of the coal refuse material, surrounding native soils, and accumulated sediments in the runoff control structure located on-site. Field sampling was performed on July 18, 1992 by WSMC personnel. Analytical results (raw data) were presented to Utah Division of Oil, Gas & Minerals (UDOGM) on August 11, 1992 during a meeting with WSMC personnel. The purpose of this investigation was to assess potential impacts (if any) to the surrounding environment due to the coal refuse material being leached by meteoric waters or being mechanically transported to adjacent lands. Based on a series of prior meetings between UDOGM and WSMC, it became apparent that additional data was needed to accurately characterize the physical and chemical nature of the coal refuse and surrounding soils. While this report is not intended to be a stand-alone-document addressing contaminant transport/ fate analysis, it is intended to be a technical supplement to the present issues at the J.B. King Coal Mine, upon which final conclusions may be made when accompanied by supporting documentation. Presented is a summary of WSMC's findings of the investigation for the J.B. King Coal Mine presented to the Division.

FIELD INVESTIGATION:

On July 18, 1992, WSMC personnel collected a total of seven soil and coal refuse samples (See Figure 1). Samples were excavated using a post-hole digger and taken at a depth of approximately 30-inches. Samples TPCS-1, TPCS-2, and TPCS-3 were taken in the exposed coal refuse area adjacent to a metal "T" post located at each sampling point. Samples RPS-1, RPS-2, and RPS-3 were taken from native soils near the toe of the coal refuse pile (See Figure 1). The sediment pond sample (SPM-1) was taken from the deepest point (visually located) in the sediment retention pond. All samples were

250 S. Rock Blvd., Ste. 130 • Reno, Nevada 89502 • (702) 856-3339 • FAX (702) 856-1818

placed in a heavy duty plastic sample bags, sealed, labeled, and transported to CHEM-X Laboratories in Reno, NV for analyses.

ANALYTICAL TESTING PROGRAM:

The purpose of the analytical testing program was to characterize the existing coal refuse material regarding adverse impacts to the surrounding environment should these materials be eroded or leached from their present location. In addition, the surrounding native soils and sediment from the retention pond were also evaluated as to their ability to resist potential adverse impacts and to see if the existing sediments contained any evidence of contaminants already migrating from the refuse pile or native cover soils into the catchment structure. CHEM-X Laboratories performed the following tests on all samples collected for this investigation: Nevada Meteoric Water Mobility Test (includes Acid Neutralization / Acid Generation Potential), Sodium Adsorption Ratio (SAR), Electrical Conductance, and Ignitability Test (non-standard test). The analytical results are discussed below and summarized in Tables 1 and 2. The complete laboratory reports for this investigation are presented in Appendix A.

ANALYTICAL RESULTS AND FINDINGS:

A summary of the Meteoric Water Mobility Test (MWMT) results are presented in Table 1. Only those parameters having a positive detection are listed (with the exception of the Primary Drinking Water Standard Metals). The analytical results for all other parameters (including the 33-Element ICP Scan) are presented in Appendix A. None of the seven samples analyzed using the MWMT exceeded Primary Drinking Water Standards for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and fluoride. All samples analyzed were reported as having nitrate concentrations below the maximum contaminant level (MCL) of 10 mg/l with the exception of coal refuse sample TPCS-1 (13 mg/l). Secondary Drinking Water Standards (MCLs) were exceeded for Total Dissolved Solids (TDS) and sulfate for all samples collected from the coal refuse pile and two of the three samples collected from the native soils. The reported concentrations of TDS and sulfate for samples collected from the coal refuse material exceeded those reported concentrations of the native soils. Analyses of the sediment retention pond materials show that these sediments have the lowest reported concentrations of TDS and sulfates.

Acid Neutralization / Generation Potential:

All samples collected on July 18, 1992, at the J.B. King mine were analyzed for Acid Generation/ Neutralization Potential (See Table 2). The acid generation potential is calculated as the neutralization potential minus the acidification potential. When the neutralization potential is greater than the acidification potential, the resulting acid generating potential is a positive value. All units are reported in "tons of calcium carbonate per 1,000 tons of material (See Appendix B for further explanation of the Acid Neutralization / Acid Generation Potential Test). Samples taken from the native soils and the sediment retention pond were reported as being non acid generating (a positive value). In addition, the native soils have a strong neutralization potential, thus they have the ability to neutralize low pH fluids. Coal refuse samples TPCS-1 and TPCS-3 are reported to have a negative acid generating potential, thus having the ability to generate low pH solutions under certain conditions (note sample TPCS-2 was reported as be non-acid generating). The strong neutralization potential of the native soils surrounding the coal spoils / refuse piles would have the capacity to neutralize any low pH fluid generated at the J.B. King Mine.

Ignitability:

All samples collected from the J.B. King Mine were evaluated for their ability to ignite and burn. The sampling procedure consisted of sweeping an open flame (propane torch) over the surface of the sample, observing any evidence of ignition and self-sustaining combustion. The coal refuse samples TPCS-1, TPCS-2, and TPCS-3 all exhibited a positive ignitability characteristic when directly exposed to an open flame. However, based on studies by Hansen, Allen and Luce, Inc. (located in Salt Lake City, Utah), the coal refuse material is comprised of approximately 90.6 % of noncoal material and 9.4 % coal refuse. According to 30 CFR, Part 75.403, coal refuse material with greater than 65 % noncoal materials are incombustible. Based on the known composition of the coal refuse, sustained combustion of the refuse pile is highly unlikely, if not impossible. The native soil samples and the sediment pond samples showed no evidence of ignition or self sustaining combustion. The test methodology used to evaluate the ignitability of the materials is a non-standardized test developed at the request of WSMC personnel by CHEM-X Laboratories.

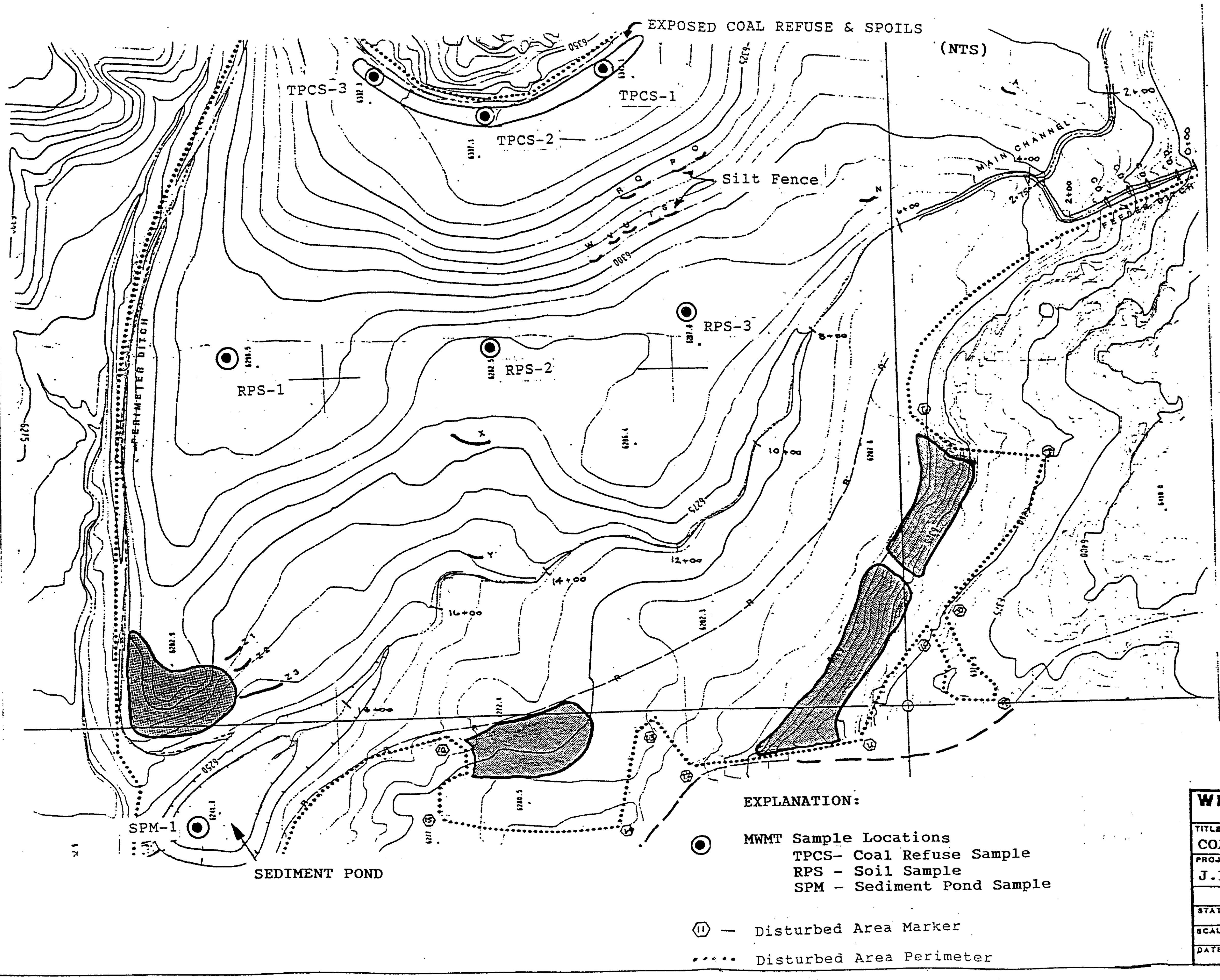
Sodium Adsorption Ratio:

The Sodium Adsorption Ratio (SAR) was measured for all samples and found to be well below the threshold level typically ranging from SAR = 8-12. The SAR is a measure of the availability of water in the soil substrate for vegetation. The higher the SAR value the more difficult it is for vegetation to pull moisture from the surrounding soil. The results of the SAR testing are presented in Table 2. The sample having the highest SAR was native soil sample RPS-1 (SAR = 6.7), and the lowest reported SAR was for coal refuse sample TPCS-1 (SAR = 1.5).

CONCLUSIONS:

Based on the data presented it appears the coal refuse material presents no apparent potential for degradation of the surrounding environment due to leaching of metals. Analyses of the lixiviant from the MWMT for Secondary Drinking Water parameters showed the coal refuse and spoils materials are able to leach higher concentrations of TDS and sulfate than the surrounding soils. The SAR values for all samples were acceptable for all samples collected and analyzed. The coal refuse and spoils material did indicate the potential to be acid generating in two of the three samples analyzed. However, the high neutralization potential of the surrounding soils would effectively neutralize any migration of low pH fluids generated at the J.B King Mine. The study also showed that the coal refuse materials when exposed to a proper heat source (open flame) combined with sufficient oxygen, will ignite. Based on the high composition of noncoal materials (90.6 %), sustained combustion of the refuse pile is not likely and not considered a problem at the reclaimed J.B. King Mine.

Attachments: (4)



RECEIVED
SEP 15 1992
DIVISION OF
OIL GAS & MINING

WESTERN STATES MINERALS CORPORATION	
TITLE: COAL REFUSE & SOIL SAMPLE LOC.	
PROJECT: J.B. KING MINE	
STATE: UTAH	COUNTY: EMERY
SCALE: 1"=143 FT.	DATA BY: DJC
DATE: 9/10/92	DRAFTED BY: LDB Figure 1

TABLE 1

SUMMARY OF MWMT ANALYTICAL RESULTS

J.B. KING MINE, July 1992

PARAMETER:	Units	MCL	COAL REFUSE JBK TPCS-1	JBK TPCS-2	JBK TPCS-3	SOIL JBK RPS-1	JBK RPS-2	JBK RPS-3	SEDIMENT POND JBK SPM-1
Meteroric Water Mobility Test									
Inital pH	pH-units	(6.5-8.5)	6.15	6.36	6.20	6.20	6.20	6.15	6.15
Final pH	pH-units	(6.5-8.5)	7.54	7.16	6.43	7.53	7.85	7.70	7.75
Alkalinity, as CaCo3	mg/l	--	78	38	14	60	70	68	116
Total Dissolved Solids (TDS)	mg/l	500	2960	2870	1170	878	346	946	232
Fluoride	mg/l	(2.0)	0.32	0.21	0.12	0.82	0.64	2.0	0.76
Chloride	mg/l	250	<1	<1	<1	53	<1	1.0	1.8
Nitrate, As NO3	mg/l	10	13	<4	<4	<4	<4	<4	<4
Sulfate	mg/l	250	1960	1920	831	498	180	637	66
Arsenic	mg/l	(0.05)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	mg/l	(1.0)	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1
Cadmium	mg/l	(0.01)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/l	(0.05)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.032
Lead	mg/l	(0.05)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mercury	mg/l	(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/l	(0.05)	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/l	(0.10)	<0.025	<0.025	<0.025	0.026	<0.025	<0.025	<0.025
33-Element ICP Scan (Pos. Detections) **									
Aluminum	mg/l	--	<0.25	<0.25	<0.025	<0.25	<0.25	<0.25	3.3
Calcium	mg/l	--	110	110	88	55	41	91	32
Iron	mg/l	(0.3)	0.082	0.19	0.15	0.24	0.39	0.17	12
Magnesium	mg/l	--	76	74	41	38	11	35	11
Potassium	mg/l	--	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	9.1
Sodium	mg/l	--	24	7	59	60	5.6	16	7.9
Strontium	mg/l	--	2.1	0.91	0.86	0.55	<0.5	1.3	<0.5
Zinc	mg/l	(5.0)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.078

< Denotes Non-detect at Concentration Shown

(MCL) -Maximum Contaminant Level

** ICP Scan For Remaining 25 Elements Presented in Appendix A

TABLE 2 (Summary)

J.B. KING MINE ANALYTICAL RESULTS (July 1992)

	Units		Coal Refuse			Soil		Sed. Pond
		JBK TPCS-1	JBK TPCS-2	JBK TPCS-3	JBK RPS-1	JBK RPS-2	JBK RPS-3	JBK SPM-1
ACID GENERATION/ NEUTRALIZATION POTENTIAL:								
pH (Saturated Paste)	pH	6.69	6.49	5.64	7.55	7.62	7.67	7.37
Neutralization Potential	**	34	33	14	71	84	89	68
Acidification Potential	**	57	20	84	<1	<1	<1	1
Acid Generating Potential or "Acid Base Potential"	**	-23	+13	-70	+71	+84	+89	+67
SODIUM ADSORPTION RATIO:								
Sodium	mg/l	130	32	48	1000	70	140	79
Magnesium	mg/l	38	330	260	500	150	220	100
Calcium	mg/l	61	640	570	580	580	570	270
Sodium Adsorption Ratio:	--	1.5	6.6	5.5	7.7	3.1	4.4	2.8
ELECTRICAL CONDUCTANCE AND IGNITABILITY:								
Electrical Conductance	m℧/cm	3.6	2.9	2.8	6.7	2.6	3	1.8
Ignitability,(Pos/Neg)	--	Pos.	Pos.	Pos.	Neg.	Neg.	Neg.	Neg.

** Units, Tons Calcium Carbonate Equivalent/1000 Tons of Material

Note- Laboratory Data Sheets Presented in Appendix A

APPENDIX A

LABORATORY TEST RESULTS, J.B KING MINE

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
250 South Rock Boulevard, Suite 130
Reno, NV 89502

Lab Report No.: 8609
Account No.: WSMIN

Telephone: 856-3339
Fax: 856-1818

Work Authorized By: Larry Berg
Date Sampled: 07/18/92
Number of Samples: 7
Source: See Below
Chemax Control No. 92-3574 thru 3580
Notes:

Date Submitted: 07/20/92
Sampled By: Client
Your Reference: P.O. #02-10228

Parameter	Results		
NDEP METEORIC WATER MOBILITY PROCEDURE:	JBK-TPCS-1	JBK-TPCS-2	JBK-TPSC-3
Procedure for collecting representative sample	Field sampling by client. Subsample taken for analysis by "coning-and-quartering"		
Adjusted pH of original lixiviant	6.15	6.36	6.20
Final pH of fluid after mixing	7.54	7.16	6.43
Percentage of sample passing through 200-mesh	<1	5	1
Total weight of solid sample, grams	5,000	5,000	5,000
Moisture required to saturate sample, approx., mL	710	850	700
Time of contact in extraction device, hours	23	23	23
Synopsis of technique and equipment	Batch mixing process using submersible pump to effect continuous agitation		

Remarks:

Analysis By: Joyce/Nannini
Date: 08/06/92

Approved By: [signature]
Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

CHEMAX Laboratories, Inc.
Analytical and Environmental Chemists
EPA Lab ID #NV004
(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals

Lab Report No.: 8609

Parameter	Results		
NDEP METEORIC WATER MOBILITY PROC.	JBK-TPCS-1	JBK-TPCS-2	JBK-TPCS-3
pH	7.54	7.16	6.43
Alkalinity, mg/L as $CaCO_3$	78	38	14
Total Dissolved Solids, mg/L	2,960	2,870	1,170
Fluoride, mg/L	0.32	0.21	0.12
Chloride, mg/L	<1	<1	<1
Nitrate, mg/L as NO_3	13	<4	<4
Sulfate, mg/L	1,960	1,920	831
Primary Drinking Water Standards, Metals	See Page 3	See Page 4	See Page 5
33-Element Semi-Quant. ICP Scan	See Page 3	See Page 4	See Page 5
ACID GENERATING POTENTIAL*			
pH (saturated paste)	6.69	6.49	5.64
Neutralization Potential**	34	33	14
Acidification Potential**	57	20	84
Acid Generating Potential**	- 23	+ 13	- 70

Remarks: * Per EPA 600/2-78-054, "*Field and Laboratory Methods Applicable to Overburdens and Mine Soils*".
** In tons $CaCO_3$ equivalent/1,000 tons material.
Acid Generating Potential = (Neutralization Potential) - (Acidification Potential)

Analysis By: Joyce/Nannini/Lettice/Steele Date: 08/06/92

Approved By: [signature] Date: 08/06/92

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CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
Sample ID: JBK-TPCS-1

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS			
All results below in mg/L			
Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	<0.01
Chromium	<0.025	Silver	<0.025

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ______________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.082	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	24
Bismuth	<0.5	Magnesium	76	Strontium	2.1
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	110	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen/*SEM   Date: 08/06/92

Approved By: [signature]   Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

CHEMAX *Laboratories, Inc.*

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
Sample ID: JBK-TPCS-2

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS			
All results below in mg/L			
Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	<0.01
Chromium	<0.025	Silver	<0.025

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)					
Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction [X] Digestion for Total Metals [ ] Other: ______					
All results below in ppm: [X] mg/L [ ] mg/kg					
Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.19	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	7.0
Bismuth	<0.5	Magnesium	74	Strontium	0.91
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	110	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen/*SEM   Date: 08/06/92

Approved By: [signature]   Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
Sample ID: JBK-TPCS-3

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS			
All results below in mg/L			
Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	0.01
Chromium	<0.025	Silver	<0.025

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ____________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.15	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	59
Bismuth	<0.5	Magnesium	41	Strontium	0.86
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	88	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen/*SEM — Date: 08/06/92

Approved By: [signature] — Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
250 South Rock Boulevard, Suite 130
Reno, NV 89502

Lab Report No.: 8609
Account No.: WSMIN

Telephone: 856-3339
Fax: 856-1818

Work Authorized By: Larry Berg
Date Sampled: 07/18/92
Number of Samples: 7
Source: See Below
Chemax Control No. 92-3574 thru 3580
Notes:

Date Submitted: 07/20/92
Sampled By: Client
Your Reference: P.O. #02-10228

Parameter	Results		
NDEP METEORIC WATER MOBILITY PROCEDURE:	JBK-RPS-1	JBK-RPS-2	JBK-RPS-3
Procedure for collecting representative sample	Field sampling by client. Subsample taken for analysis by "coning-and-quartering"		
Adjusted pH of original lixiviant	6.20	6.20	6.15
Final pH of fluid after mixing	7.53	7.85	7.70
Percentage of sample passing through 200-mesh	9	12	6
Total weight of solid sample, grams	5,000	5,000	5,000
Moisture required to saturate sample, approx., mL	700	830	830
Time of contact in extraction device, hours	23	23	23
Synopsis of technique and equipment	Batch mixing process using submersible pump to effect continuous agitation		

Remarks:

Analysis By: Joyce/Nannini
Date: 08/06/92

Approved By: [signature]
Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

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Analytical and Environmental Chemists
EPA Lab ID #NV004
(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals

Lab Report No.: 8609

Parameter	Results		
NDEP METEORIC WATER MOBILITY PROC.	JBK-RPS-1	JBK-RPS-2	JBK-RPS-3
pH	7.53	7.85	7.70
Alkalinity, mg/L as $CaCO_3$	60	70	68
Total Dissolved Solids, mg/L	878	346	946
Fluoride, mg/L	0.82	0.64	2.0
Chloride, mg/L	53	<1	1.0
Nitrate, mg/L as NO_3	<4	<4	<4
Sulfate, mg/L	498	180	637
Primary Drinking Water Standards, Metals	See Page 8	See Page 9	See Page 10
33-Element Semi-Quant. ICP Scan	See Page 8	See Page 9	See Page 10
ACID GENERATING POTENTIAL*			
pH (saturated paste)	7.55	7.62	7.67
Neutralization Potential**	71	84	89
Acidification Potential**	<1	<1	<1
Acid Generating Potential**	+ 71	+ 84	+ 89

Remarks: * Per EPA 600/2-78-054, "*Field and Laboratory Methods Applicable to Overburdens and Mine Soils*".
** In tons $CaCO_3$ equivalent/1,000 tons material.
Acid Generating Potential = (Neutralization Potential) - (Acidification Potential)

Analysis By: Joyce/Nannini/Lettice/Steele

Date: 08/06/92

Approved By: [signature]

Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
Sample ID: JBK-RPS-1

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS

All results below in mg/L

Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	<0.01
Chromium	<0.025	Silver	0.026

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ______________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.24	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	60
Bismuth	<0.5	Magnesium	38	Strontium	0.55
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	55	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen/*SEM Date: 08/06/92

Approved By: Date: 08/06/92

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FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
Sample ID: JBK-RPS-2

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS			
All results below in mg/L			
Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	<0.01
Chromium	<0.025	Silver	<0.025

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ______________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.39	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	5.6
Bismuth	<0.5	Magnesium	11	Strontium	<0.5
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	41	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen/*SEM — Date: 08/06/92

Approved By: [signature] — Date: 08/06/92

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EPA Lab ID #NV004

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FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals

Sample ID: JBK-RPS-3

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS			
All results below in mg/L			
Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	<0.01
Chromium	<0.025	Silver	<0.025

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ______________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.17	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	16
Bismuth	<0.5	Magnesium	35	Strontium	1.3
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	91	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen/*SEM   Date: 08/06/92

Approved By: Date: 08/06/92

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CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
250 South Rock Boulevard, Suite 130
Reno, NV 89502

Lab Report No.: 8609
Account No.: WSMIN

Telephone: 856-3339
Fax: 856-1818

Work Authorized By: Larry Berg
Date Sampled: 07/18/92
Number of Samples: 7
Source: See Below
Chemax Control No. 92-3574 thru 3580
Notes:

Date Submitted: 07/20/92
Sampled By: Client
Your Reference: P.O. 02-10228

Parameter	Result
NDEP METEORIC WATER MOBILITY PROCEDURE:	JBK-SPM-1
Procedure for collecting representative sample	Field sampling by client. Subsample taken for analysis by "coning-and-quartering"
Adjusted pH of original lixiviant	6.15
Final pH of fluid after mixing	7.79
Percentage of sample passing through 200-mesh	21
Total weight of solid sample, grams	5,000
Moisture required to saturate sample, approx., mL	940
Time of contact in extraction device, hours	23
Synopsis of technique and equipment	Batch mixing process using submersible pump to effect continuous agitation

Remarks:

Analysis By: Joyce/Nannini
Date: 08/06/92

Approved By: [signature]
Date: 08/06/92

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CHEMAX Laboratories, Inc.
Analytical and Environmental Chemists
EPA Lab ID #NV004
(702) 355-0202
FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals

Lab Report No.: 8609

Parameter	Result
NDEP METEORIC WATER MOBILITY PROC.	JBK-SPM-1
pH	7.79
Alkalinity, mg/L as $CaCO_3$	116
Total Dissolved Solids, mg/L	232
Fluoride, mg/L	0.76
Chloride, mg/L	1.8
Nitrate, mg/L as NO_3	<4
Sulfate, mg/L	66
Primary Drinking Water Standards, Metals	See Page 13
33-Element Semi-Quant. ICP Scan	See Page 13
ACID GENERATING POTENTIAL*	
pH (saturated paste)	7.37
Neutralization Potential**	68
Acidification Potential**	1
Acid Generating Potential**	+ 67

Remarks: * Per EPA 600/2-78-054, *"Field and Laboratory Methods Applicable to Overburdens and Mine Soils"*.
** In tons $CaCO_3$ equivalent/1,000 tons material.
Acid Generating Potential = (Neutralization Potential) - (Acidification Potential)

Analysis By: Joyce/Nannini/Lettice/Steele — Date: 08/06/92

Approved By: [signature] — Date: 08/06/92

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Analytical and Environmental Chemists
EPA Lab ID #NV004

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LABORATORY REPORT

Report To: Western States Minerals
Sample ID: JBK-SPM-1

Lab Report No.: 8609

QUANTITATIVE ANALYSIS, PRIMARY DRINKING WATER STANDARDS, METALS			
All results below in mg/L			
Arsenic*	<0.005	Lead	<0.005
Barium	<0.1	Mercury	<0.001
Cadmium	<0.005	Selenium*	<0.01
Chromium	0.032	Silver	<0.025

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [X] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ______________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	3.3	Gallium	<0.5	Potassium	9.1
Antimony	<0.5	Iron	12	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	7.9
Bismuth	<0.5	Magnesium	11	Strontium	<0.5
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	32	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	0.078

Remarks:

Analysis By: Faulstich/Knudsen/*SEM Date: 08/06/92

Approved By: [signature] Date: 08/06/92

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CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

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FAX (702) 355-0817

LABORATORY REPORT

Report To: Western States Minerals
250 South Rock Boulevard, Suite 130
Reno, NV 89502

Lab Report No.: 8610
Account No.: WSMIN

Telephone: 856-3339

Fax: 856-1818

Work Authorized By: Larry Berg
Date Sampled: 07/18/82
Number of Samples: 7
Source: See Below
Chemax Control No. 92-3574 thru 3580
Notes:

Date Submitted: 07/20/92
Sampled By: Client
Your Reference: P.O. #02-10228

Parameter	Results			
	JBK-TPCS-1	JBK-TPCS-2	JBK-TPCS-3	JBK-RPS-1
Sodium, mg/L	130	32	48	1,000
Magnesium, mg/L	38	330	260	500
Calcium, mg/L	61	640	570	580
Sodium Adsorption Ratio	1.5	6.6	5.5	7.7
EC, m℧/cm	3.6	2.9	2.8	6.7
Ignitability*, Pos./Neg.	Pos.	Pos.	Pos.	Neg.

Remarks: * By sweeping an open flame over the surface of the sample and observing any evidence of ignition and self-sustaining combustion.

Analysis By: Faulstich/Joyce

Date: 08/06/92

Approved By:

Date: 08/06/92

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EPA Lab ID #NV004

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LABORATORY REPORT

Report To: Western States Minerals
250 South Rock Boulevard, Suite 130
Reno, NV 89502

Lab Report No.: 8610
Account No.: WSMIN

Telephone: 856-3339

Fax: 856-1818

Work Authorized By: Larry Berg
Date Sampled: 07/18/82
Number of Samples: 7
Source: See Below
Chemax Control No. 92-3574 thru 3580
Notes:

Date Submitted: 07/20/92
Sampled By: Client
Your Reference: P.O. #02-10228

Parameter	Results		
	JBK-RPS-2	JBK-RPS-3	JBK-SPM-1
Sodium, mg/L	70	140	79
Magnesium, mg/L	150	220	100
Calcium, mg/L	580	570	270
Sodium Adsorption Ratio	3.1	4.4	2.8
EC, m℧/cm	2.6	3.0	1.8
Ignitability*, Pos./Neg.	Neg.	Neg.	Neg.

Remarks: * By sweeping an open flame over the surface of the sample and observing any evidence of ignition and self-sustaining combustion.

Analysis By: Faulstich/Joyce

Date: 08/06/92

Approved By:

Date: 08/06/92

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

APPENDIX B

METEORIC WATER MOBILITY TEST PROCEDURE

EXPLANATION: ACID GENERATION POTENTIAL CALCULATION

BOB MILLER, *Acting Governor*

STATE OF NEVADA

Administration 702/885-4670
Air Quality 885-5065
Construction Grants 885-5870

Groundwater 702/885-4670
Waste Management 885-5872
Water Pollution 885-4670

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

201 South Fall Street
Carson City, Nevada 89710

NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
BUREAU OF MINING REGULATION AND RECLAMATION

METEORIC WATER MOBILITY PROCEDURE

May 23, 1990

Collect a representative sample of the material. The minimum sample size for this procedure is 5 kilograms. If the material to be sampled has particle sizes greater than 5 centimeters, sufficient material must be classified to provide 5 kilograms of sample with maximum particle size less than 5 centimeters. This classified sample is placed in an extraction device which allows the sample to be continuously wetted by circulation of the synthetic meteoric water (lixiviant). The volume of the synthetic meteoric water must be equal in weight to the weight of the classified sample plus the additional volume necessary to saturate the sample. The lixiviant is circulated, agitated, or mixed for 24 hours, continuously wetting the full surface of the sample. For this procedure the lixiviant is laboratory grade water whose hydrogen ion activity (pH) has been adjusted to between pH 5.5 and 6.5 with reagent grade nitric acid before charging it to the extraction device. No further adjustment of the pH during extraction is required. One hour after ceasing to circulate, a sample of the lixiviant is decanted and prepared for analysis. Analysis shall be performed for the constituents listed at the end of this procedure. Elements for which a standard has been established shall have a lower level of quantification equal to or less than that standard.

The extraction device can be a packed column with small recycle reservoir or bottle roll or large barrel fitted with internal circulation/agitation or equivalent.

The information to be recorded and reported is:

1. The procedure used to collect a representative sample.

2. The adjusted pH of original lixiviant;

3. The fi[illegible]pH of fluid after mixing[illegible]
4. Percentage of sample passing 200 mesh;
5. Total weight of solid sample;
6. Moisture required to saturate sample;
7. Time of contact in extraction device;
8. Synopsis of the technique and equipment used to leach sample, i.e., column, batch, etc.; and
9. Results of the analysis of the lixiviant after ending the extraction.

Alkalinity	Gallium	Scandium
Aluminum	Iron	Selenium
Antimony	Lanthanum	Silver
Arsenic	Lead	Sodium
Barium	Lithium	Strontium
Beryllium	Magnesium	Sulfate
Bismuth	Manganese	Thallium
Cadmium	Mercury	Tin
Calcium	Molybdenum	Titanium
Chloride	Nickel	Total Disolved Solid
Chromium	Nitrate	Vanadium
Cobalt	pH	*WAD CN
Copper	Phosphorus	Zinc
Fluoride	Potassium	

* When Appropriate

HvD/tjd/sld:56
revised 5/23/90

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists

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IMPORTANT NOTE

We have recently modified the manner in which we report Acid Generation Potential data by adopting the more conventional practice of expressing the Acid Generation Potential (or "acid-base account") as a positive or negative value. The formula used for the calculation is:

Acid Generating Potential =
(Neutralization Potential) - (Acidification Potential)

A Neutralization Potential which is higher than the Acidification Potential will result in a *positive* net result. Conversely, an Acidification Potential which is higher than the Neutralization Potential will result in a *negative* net result. As before, all units are in "tons of calcium carbonate equivalent per 1,000 tons of material".

Please call if you have any questions.

CHEMAX LABORATORIES, INC.

June, 1992

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

APPENDIX 4

August 28, 1992

SEP 1 0 1992
HA&L

Samuel A. Bamberg, PhD
RA Consultants
26050 E. Jamison Circle
Aurora, Colorado 80016

Buzz Gerick
Western States Minerals
250 South Rock Blvd., Suite 130
Reno, Nevada 89502

Re: Information in support of approach and recommendations for revegetation and erosion control program at the Western States Minerals (WSM) J.B. King Project

The following is a discussion of the recent observations and monitoring program results at the reclaimed J.B. King Mine. Some of the observations and results were presented at the informal presentation to the DOGM at the site visit on August 11, 1992.

The general basis for the information presented here is that the mine reclamation has been successful to the present time given the procedures used, length of time since these procedures were started, present site conditions, and the trends in vegetative growth and erosion control. In particular, the trends in vegetation succession and erosion features support the position that now, and into the foreseeable future, the reclaimed site will persist in a stable condition comparable to the surrounding landscape. The reclaimed site will not degrade, and present a hazard or risk from sediment and exposed coal on and off site greater than the other basins along the sandstone bluffs around Dog Valley. Erosion and exposed coal seals are a natural part of this part of the Colorado Plateau in central Utah.

The following information is provided in addition to that supplied in our two reports to WSM, the Erosion Control Plan provided in March 1992, and Plant Surveys provided in August 1992. The erosion control plan details the present site conditions in relationship to local geomorphic processes, and proposed a plan to measure erosion, and allow the site to adjust to regional erosion rates. Results of the plant surveys indicated the site has good vegetation cover of around 50%, although there was still a large weed component in this early stage of plant succession. There has been good germination of desirable grass species to complement the large shrub cover, and some native plant species not originally seeded are beginning to establish from the surrounding vegetation communities.

The information will be presented as observations and present trends to date from 1989 through 1992 in vegetation succession and surface erosion on the site, followed by predictions of what these trends indicate for the future stability and permanency. This will support for recommendations for future actions on the site.

<u>Observations on present trends</u>

Vegetation and successional status: The site has been successfully revegetated for species composition, cover and density. The vegetation is functioning to provide food and habitat for wildlife. The site is in an early stage of plant succession characterized by recent soil disturbance, more cover by seeded shrubs than grasses, a weedy component, but with native and seeded grasses and other forbs beginning to become established. There are a large number of grass seedlings growing with the weeds that will eventually replace and crowd out the weeds. Halogeton, an undesirable weed, was common on the site in bare areas, but with continued grazing protection, will decrease in abundance. Halogeton is mainly a problem with sheep grazing when no other forage is available.

The vegetation will continue to change in species composition, but probably not in total cover, currently at 50%, for the next 10 to 15 years. The trend at the present time is an increase in native plant species, especially grasses and forbs, a greater diversity of shrub species, and a decrease in the dominant four-wing saltbush and weeds. Cover will vary year to year from about 20% to 50% depending on the local and seasonal weather patterns. If no other disturbance factors, such as construction or heavy grazing by cattle, or a change in the weather patterns occur, then the vegetation should reach a natural mature state of equilibrium with plant species composition in around 35 years. The greatest change will occur when grazing is allowed at the end of WSM's lease in 7 years. Grazing should ideally be controlled for timing and intensity with stocking rates and fencing. Grazing has the potential to decrease plant cover and increase erosion by soil disturbance from cattle congregating in this sheltered basin.

Habitat conditions and wildlife use: The site has increased in habitat values for food and shelter for animal species. Noted on the site were evidence of recent heavy elk use which was new for this past winter and spring season. Other animals and birds were using the site to a large extent probably because of the good cover by shrubs and recent good vegetative growth and seed production. Harvester ants have recently established nests throughout the site, and the rodent and cottontail populations have increased along with predation by coyotes and foxes.

The site should continue to provide quality habitat for the wildlife in the area. There will be some change in local wildlife use as the vegetation matures, but the site in a sere successional stage of plant development may have greater productivity and diversity than some of the more mature plant communities in the vicinity on poor range sites. Successional stages in vegetation communities form excellent habitat for a large number of wildlife species.

Erosional and soil features: The initial stage of rapid erosion and sediment-ation of recent soil disturbance has been completed, and the surfaces on the site have begun to armor through two fairly rapid processes:
1. Loose soil materials have been removed, and the residual rocks and cobbles left on the surface prevent further rapid erosion. The rocks prevent rain splash and slow the rate or water running across the surfaces, and the amount of sediment that can be carried.
2. The cycles of wetting/drying and freeze/thaw of the soil begins to provide soil structure by clay movement and formation of aggregates. This formation of soil structure prevents rapid soil erosion by resisting detachment of soil particles and movement as sediment.

The soil formation processes will continue at a ever slower rate as the site matures, until a state is reached when erosion processes reach the rate of soil formation. In this region of rapid erosion, most soil profiles are not well developed except on stable and protected slopes. On the J. B. King site there are a few areas that will reach a stable state that soil formation will occur. The rate of soil formation in this part of Utah is measured, however, in hundreds of years.

The rate of erosion and sediment transport as observed on the site and in the vicinity of Dog Valley will remain at a fairly high rate due to climate and geomorphic processes. This rate or erosion will be dependent, as the vegetation is, on regional and local climatic patterns, and the variable weather. The repeated cycle over the past 150 years is a variable stable period, followed by drought that may be interrupted by heavy rains, especially summer thunderstorms. This cycle is expected to be repeated into the near future. A prediction of erosion rates on the site should be based on observations of past recent erosion rates in the vicinity, and a review of historic studies and records.

Recommendations for continued management on the site:

Based on the observed trends and characteristics of the site, the following management and controls are recommended:

1. Continue to protect the site from grazing. When grazing is again started, control the rate of stocking and grazing periods to a carrying capacity for the region.
2. Allow the vegetation communities and soils formation to continue to mature, and prevent any more disturbance to the soil that will prevent natural plant succession and soil formation to continue.
3. Remove the remaining sediment control structures to allow the site to adjust to natural erosion rates given the configuration of the site and local climatic conditions.

These recommendations mean leaving the site without additional construction or erosion control measures for the amount of time it takes to observe if the present trends continue. These trends are the changes in vegetation successional status and habitat conditions, and the decreasing rates of erosion and sediment production.

Respectfully,

Samuel A. Bamberg

REPLACEMENT SHEETS

During reclamation of the J.B. King mine the "main feeder ditch" and "feeder ditch" were designed and installed as temporary riprap channels to reduce erosion and promote revegetation. These channels have fulfilled these purposes and the original configurations of the channels need no longer be maintained. The channels will now be allowed to seek the optimal natural configurations without interference from man. Allowing the channels to become "naturalized" will enhance reclamation success of the site. The existing configurations of the channels are artificial and do not allow the reclaimed site to blend in with the natural terrain as required by the regulations. The naturalized channels will enable the site to become more compatible, both visually and functionally, with the surrounding environment. Allowing the channels to develop the most direct route to the bottom main channel will minimize the potential for future damage to the site caused by unusually severe storm events. In their current configurations failure of the channels would result in more widespread erosion. In a natural configuration the channels will not fail because the route of the natural channel would be the route the flow would naturally take to the bottom channel anyway so the only consequence of a severe flow would be deepening and some widening of the channels. Erosion would be confined to the course of each channel. This is preferable to maintaining the channels in their current unnatural configurations in which severe runoff could breach the channels and cause widespread damage. Allowing the channels to naturalize without interference by man offers at least two benefits. The first benefit is that the channels will naturally seek the optimal courses and configurations. Designing and constructing channels admit the possibility of error on the part of either the design or the installation, or both. The second benefit is that the impact on existing vegetation will be minimized. Construction activities which would be required on site would destroy much of the vegetation which has taken several years to establish. Construction will also bring less armored soil to the surface. The results of destroying vegetation and disturbing the soil which has begun to armor, are increased erosion on the site, visual degradation, and a delay in achieving reclamation goals.

UMC 817.101

The control of erosion will predominantly entail standard reclamation activities associated with grading and revegetation procedures. Surface areas will be appropriately ripped and scarified in order that minimal erosion is possible prior to establishment of the rooted vegetational communities.

UMC 817.103 BACKFILLING AND GRADING: COVERING COAL AND ACID AND TOXIC FORMING MATERIALS

Analytical tests of samples taken to determine acid and toxic forming properties of the refuse material indicate that the refuse is not toxic forming and is only mildly acid forming. However, testing indicates that the soil in the area has an acid neutralizing potential high enough to neutralize the acid forming properties of the refuse.

The volume of refuse material is 5,406,062 cubic feet. The analysis of three samples of the refuse showed acid/base potentials of -23, 13, and -70 for an average of -26.7 tons of $CaCO_3$ per 1,000 tons of material. The volume of covering material is:

$$4\ feet \times 12.8\ acres \times \frac{43{,}560\ sqr.\ feet}{1\ acre} = 2{,}230{,}272\ cubic\ feet$$

Analysis of three samples of the material covering the refuse pile showed acid/base potentials of 71, 84, and 89 for an average of 81.3 tons of $CaCO_3$ per 1,000 tons of material. The overall average acid/base potential of the refuse pile and the material covering the refuse pile is:

$$\frac{-26.7 \times 5{,}406{,}062\ cf + 81.3 \times 2{,}230{,}272\ cf}{5{,}406{,}062\ cf + 2{,}230{,}272\ cf} = 4.8\ tons\ CaCO_3\ per\ 1{,}000\ tons$$

The result is that for practical purposes the refuse material is not acid or toxic forming. There is enough neutralization potential in the material covering the refuse to neutralize any acid formed, not counting the neutralization potential of other soil on the site.

As the 4 feet of cover material erodes the refuse will eventually become exposed. Based on the quality analyses it is determined that exposure of the refuse material and even escape of refuse material from the site will have insignificant impact on the environment.

UMC 817.106 REGRADING OR STABILIZING RILLS AND GULLIES

The Applicant commits to the maintenance of the reclaimed surface area until the time for application of bond release. Rills and gullies will be filled, graded or otherwise stabilized at the Applicant's discretion using the means deemed appropriate by the Applicant, including the use of motorized equipment.