Uranium
Mill
Tailings
Remedial
Action
Project

United States
Department of Energy

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ECONOMIC
EVALUATION
OF
INACTIVE URANIUM
MILL TAILINGS

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GUNNISON SITE
GUNNISON, COLO.

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**ECONOMIC EVALUATION
OF
INACTIVE URANIUM MILL TAILINGS**

**GUNNISON SITE
GUNNISON, COLORADO**

DECEMBER 1982

For

SANDIA NATIONAL LABORATORIES
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By

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FOREWORD

This report entitled "Economic Evaluation of Inactive Uranium Mill Tailings" for the Gunnison Site, Gunnison, Colorado, was produced for Sandia National Laboratories of Albuquerque, New Mexico, under Contract 74-2749. This report is one of a series of reports covering studies on a total of twelve separate inactive uranium mill tailings sites located in the states of Arizona, Colorado, New Mexico, Utah and Wyoming. These economic evaluations were conducted to provide input for the Department of Energy's program to develop remedial action plans for each site in accordance with the provisions of the Uranium Mill Tailings Radiation Control Act of 1978 (PL 95-604).

Mountain States Research and Development (MSRD) gratefully acknowledges the cooperation of The Mill, a Limited Partnership, and Mr. N. Marcus Bishop, General Partner in providing access to the Gunnison Site for drilling and sampling purposes. Particular recognition is given to the following for their assistance in this project:

1. Sandia Laboratories project personnel who have provided valuable radiation information and assistance to the field operations.
2. Mr. Richard Gamewell of the State of Colorado Department of Public Health for provision of information on the Colorado sites.

In addition, the Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings produced by Ford, Bacon and Davis Utah Inc. has provided valuable background data on the site and has been utilized as a reference volume during the course of the project.

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SECTION 1.0
INTRODUCTION

SECTION 1.0

INTRODUCTION

Mountain States Research and Development was contracted on March 1, 1981 to make an economic evaluation study at each of 12 abandoned uranium mill tailings sites in the western states. The sites are:

- ✓ Vitro Site - Salt Lake City, Utah
- ✓ Shiprock Site - Shiprock, New Mexico
- ✓ Gunnison Site - Gunnison, Colorado
- Grand Junction Site - Grand Junction, Colorado
- Old Rifle Site - Rifle, Colorado
- New Rifle Site - Rifle, Colorado
- Maybell Site - Maybell, Colorado
- Riverton Site - Riverton, Colorado
- Spook Site - Converse County, Wyoming
- Ambrosia Lake Site - Ambrosia Lake, New Mexico
- Mexican Hat Site - Mexican Hat, Utah
- Tuba City Site - Tuba City, Arizona

The objective of this work was to obtain the data necessary at each site to determine the possible revenue that could be derived from reprocessing the tailings. To accomplish this objective a drilling and sampling program was established for each site to determine the total amount of tailings and subbase material available for treatment and the amount of recoverable uranium, vanadium and molybdenum. These three metals were selected due to their common occurrence in uranium ores and common extractability in the leaching process. Laboratory leaching was then conducted on the samples obtained to determine the extractability of each of these metals and the optimum plant process to be applied.

The economic evaluation is based upon the recoverable values in the tailings and subbase material and is limited to consideration of the direct capital and operating costs required in connection with processing of each respective site.

Excavating, transportation and disposal of the material from each site in an environmentally acceptable location and manner was not within the scope of this project. It will be necessary to complete a separate study of these areas in order to determine the total costs involved. The processing costs, added to the excavating, transportation and disposal costs will then provide a complete overview of the potential profitability (or loss) from reprocessing tailings at each site.

This report contains the results of the investigations of the Gunnison Site.

SECTION 2.0

SUMMARY

SECTION 2.0

SUMMARY

Investigation of the abandoned uranium and vanadium mill tails at the old Gunnison Mining Company mill site in Gunnison, Colorado, was carried out by Mountain States Research and Development (MSRD), as authorized by contract with Sandia National Laboratories of Albuquerque, New Mexico. This work was conducted as part of the Uranium Mill Tailings Remedial Action Project of the Department of Energy. This section summarizes the results of MSRD's investigations.

2.1 PROJECT DESCRIPTION

The primary objective of these investigations were to:

- . Determine the total quantity of uranium bearing material at the site.
- . Determine the total quantity of uranium, vanadium and molybdenum present in the material at the site.
- . Determine the extractability of uranium, vanadium, and molybdenum by leaching methods.
- . Evaluate the economics of reprocessing the tailings for recovery of any or all of these three metals.
- . Obtain data on the concentration of various trace metals normally associated with uranium mill tailings, including Radium 226.

In order to accomplish these objectives it was necessary to drill and sample the entire tailings deposit at the site. A sufficient number of samples were required to assure a statistical accuracy of 90% with a minimum 12% confidence interval. A total of 106 holes (samples) with 103 on pile and 3 off pile were taken at the site. Samples of each 2.5-foot interval were taken to provide moisture determinations throughout the pile. Each hole was drilled into the subbase material to investigate the amount of uranium migration from the tails into the subbase. Penetration into the subbase was generally less than 2.5 feet due to refusal of the sampler and/or auger on cobbles present in this material.

All samples were transported to the Tucson laboratories of MSRD where they were dried, analyzed and prepared into composite charges for leach testing. Approximately 10% of the samples were taken with Shelby Tube samplers so that bulk density determinations could be made on the tailings.

Utilizing survey data for the drill holes, hole depths, moisture data, bulk density data, and chemical analyses, the volume, tonnage, and metal content of the tailings and subbase material were calculated.

Laboratory leach testing was conducted on composite test charges to determine optimum conditions and methods for leaching of the uranium, vanadium and molybdenum.

2.2 SITE DESCRIPTION

The Gunnison mill site and tailings pile is located in the Gunnison River valley and southwest of the town of Gunnison, Colorado. The tailings are at an elevation of 7,640' and are just upstream of the Gunnison River - Tomicha Creek Confluence. The pile is bordered on the north and east by Highway 341 and on the west side by a canal. The main runway of the Gunnison Airport parallels the north edge of the pile at a distance of approximately 350-feet.

The tailings were deposited in a single pile approximately rectangular in shape measuring 1,400 feet long by 1,000 feet wide. The pile generally slopes downward going from south to north and from east to west, with the lowest area in the northwest corner. The base under the tailings is river sand and cobbles. While the average moisture content of the tails is unusually low, water was noted in some of the existing piezometers on the pile.

The tailings are typical of beneficiated ore, being sandy in nature and relatively fine. Screen analyses indicate they are 100% minus 20 mesh and 36% minus 200-mesh.

A drilling and sampling program was conducted at the site to provide the physical and analytical data required to determine the total quantity of tailings and uranium bearing subbase material at the site and the total content of uranium, vanadium and molybdenum. From these data the following statistics were developed:

Tailings, wet tons	716,379
Water, %	12.22
Tailings, dry tons	628,847
U ₃ O ₈ , %	0.0057
pounds	72,098
V ₂ O ₅ , %	0.0098
pounds	123,514
Mo, %	0.0037
pounds	46,101
Subbase, wet tons	120,203
Water, %	8.89
Subbase, dry tons	109,521
U ₃ O ₈ , %	0.0038
pounds	8,319
Total material, wet tons	836,582
Water, %	11.74
Total material, dry tons	738,368
U ₃ O ₈ , %	0.0055
pounds	80,417

2.3 AMENABILITY TESTING

Laboratory testing was conducted at MSRD's laboratories on composited samples from the site. Testing was conducted on samples representing each section and for the entire site. Testing procedures included:

- . Agitation leach with sulfuric acid
- . Agitation leach with carbonate solution
- . Extended acid agitation leach
- . Column leach with acid.

The tailings were generally unresponsive to alkaline leaching with significantly lower extractions of uranium and vanadium than with sulfuric acid.

Agitation leaching with acid gave low extractions for both uranium and vanadium. However, a standard acid column leach indicated 48% extraction of the uranium and 74% extraction of molybdenum. Vanadium extraction, however, remained low at 12%. The vanadium content of the tailings is quite low and is

in the detection limit range of 0.010% (100 ppm) V_2O_5 . Accordingly, leach test results were erratic due to assaying residues below this level.

Based upon treatment of the estimated tonnage of tailings and subbase material at the site, theoretical recovery of the three metals is as follows:

U_3O_8	80,417 x 48%	=	38,600 pounds
V_2O_5	123,514 x 12%	=	14,822 pounds
Mo	46,101 x 74%	=	34,115 pounds

2.4 ECONOMIC EVALUATION

If all three metals were produced from the Gunnison tails, the sales value with current prices would be as tabulated below:

<u>Product</u>	<u>Total Pounds</u>	<u>Unit Price</u>	<u>Total Value</u>	<u>\$/Ton Feed</u>
U_3O_8	38,600	\$23.00	\$ 887,800	\$1.20
V_2O_5	14,822	3.00	44,466	0.06
Mo	34,115	8.50	<u>289,978</u>	<u>0.39</u>
Total Value			\$1,222,244	\$1.65

Production of vanadium from this site is neither technically or economically feasible. Production of uranium and molybdenum is technically, but not economically feasible as illustrated below.

Capital Cost - A 1000-ton per day capacity plant would provide for treatment of the 738,368 DST of tailings and subbase in two years. The capital cost of a similar 1000-ton per day plant at Tuba City to produce uranium and molybdenum products is estimated at \$8,896,100. It is assumed a plant at Gunnison would cost an equal amount.

Operating Cost - Annual operating costs for Tuba City are estimated to be in the range of \$5,500,000. Adjusting for the very high acid cost at Tuba City, annual operating costs of \$3,750,000 appear reasonable. This is equal to \$10.42 per ton to be treated.

Based upon the above, the economics of treating this material is as follows:

Capital Cost	\$8,896,000
Operating Cost	<u>7,691,000</u>
TOTAL ESTIMATED COST	\$16,587,000
Marketable Production (U + Mo)	<u>1,178,000</u>
Profit or (Loss)	(\$15,409,000)

Note: Costs rounded to \$000.

In order to break even, the market prices of uranium and molybdenum would have to increase to the levels shown below:

$$\$16,587,000 / 1,178,000 = 14.1$$

$$\text{U}_3\text{O}_8: \$23.00 \times 14.1 = \$324.30/\text{lb}$$

$$\text{Mo}: 8.50 \times 14.1 = \$119.85/\text{lb}$$

SECTION 3.0
CONCLUSIONS AND RECOMMENDATIONS

SECTION 3.0

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were drawn from results of the investigation of Gunnison Site tailings.

1. Recovery of additional uranium and molybdenum is technically feasible.
2. It is not economic to reprocess the tailings at present market values for uranium.

It is recommended that:

1. In view of the very large economic losses indicated, reprocessing of these tailings be dropped from consideration.

SECTION 4.0
SITE INVESTIGATIONS

SECTION 4.0

SITE INVESTIGATIONS

The primary objectives of the site field investigations were to determine the total quantity of uranium bearing material and the amount of uranium, vanadium and molybdenum contained in this material. To meet these objectives it was necessary to establish a drill pattern for the tails deposit, locate the holes by survey, and drill the deposit. Continuous samples of each borehole were required to provide a representative analysis of the volume of tails represented by the borehole. Moisture, density and metal analyses in conjunction with the survey data provided the necessary data to quantify the material on site.

4.1 Description of Drill Site

The Gunnison tailings pile is at the southwest corner of Gunnison, Colorado in Section 2 and 11, Township 49 North, Range 1 West, New Mexico Principal Meridian. It is in the valley of the Gunnison River at an elevation of 7,640' just upstream from the confluence of the river and Tomichi Creek. The pile is bordered on the north and east by Highway 341, on the west by a canal, and on the south by a former ore-storage area and millsite. The only runway at the Gunnison Airport parallels the north edge of the pile 350' away. The base under the tails is river sands and cobbles.

The cubication of the Gunnison tailings pile was carried out by Mountain States with a block for each hole. The pile was also divided into four quadrants or sections, A to D. For purposes of the present discussion, however, the uniformity and low grade in uranium make a separate description of each section academic. The pile is roughly rectangular, 1,400' N-S by 1,000' E-W, and the only relief is a gentle N-S ridge 10' higher at the top, at the center of the pile, than at the crest of the edge all the way around. Thickness of tails in excess of 15' is confined to the south center and southeast part of the pile, but as no holes are over 20' in tails and as the vast majority of holes in all parts of the pile run 7.5' to 12.5' in thickness of tails, eight holes with 15' to 20' of tails, out of 103 holes total, is not too much of a variation.

There is a normal variation in grade, which, if the average grade were three times as high, might warrant separate descriptions of the four sections of the pile. The following table suggests, however, that the grade is too low to warrant a detailed description of values.

Taking the Gunnison Site as a single unit, the area is 31.29 acres, and the average thickness of tails is 9.9'. The tonnage is 716,379 wet short tons, running 0.0057% U_3O_8 and 0.0098% V_2O_5 . Shallow piles of mixed tailings and contaminated soil between the pile and the runway, resulting from cleanup, have been ignored.

Two hundred and fifty feet south of the Gunnison tailings pile, three off-pile holes were drilled in an E-W line 230' to 260' apart in the general area of the millsite. The assay results are shown in the following table:

	<u>Westernmost</u> <u>Hole C-1</u>	<u>Hole C-2B</u>	<u>Easternmost</u> <u>Hole D-3</u>
Depth	1.5'	5.5'	4.0'
U_3O_8 Assay	0.0006%	0.0077%	0.0021%
		0.0044%	0.0011%
		0.0034%	

The Gunnison Site Plan showing the section and hole locations is shown in Figure 4.1.1.

4.2 Drill Pattern

In order to establish a reasonable spacing of holes which would still provide an acceptable degree of confidence in the accuracy of results, a statistical method was used to determine the number of holes to be drilled at each site in the project. The method used was the same as that used for a study of the tails deposit at Monticello, Utah, utilizing analytical data from an extensive drilling and sampling program at that site. The accuracy of this method, in turn, is dependent largely upon each tails site having a variability pattern similar to the Monticello pile.

Based upon the assumption that the variation in grades of uranium in different drill holes in the various piles (4) at Monticello is more or less typical of uranium tailings in the Western U.S.A., the formula shown below gives the number of samples (i.e. drill holes) needed to provide given confidence intervals at 90% confidence level.

The formula is:

$$n = \left[\frac{\sigma t_{\alpha/2, n-1}}{h} \right]^2$$

where:

n = number of samples required (number of holes)

σ = an estimate of the standard deviation in parts per million (ppm)

$t_{\alpha/2, n-1}$ = the value of the statistic required for a 100 $(1-\alpha)$ % two sided confidence interval on the mean of a sample of n items. For the Monticello study this was taken as 1.67.

h = half the desired width of the confidence interval (same units as the mean).

The values determined for the Monticello tails deposits were:

$$\sigma = 188$$

$$t_{\alpha/2, n-1} = 1.67$$

$$h = 25.4$$

When using these values, a confidence interval of $\pm 10\%$ U_3O_8 grade at a confidence level of 90% results in 153 samples required per pile. At $\pm 12\%$, n is approximately 106 per pile. As the number of holes decreases for a given site, the confidence interval increases providing the pile has the same characteristics as the Monticello piles.

From available information, the following data were developed for the Gunnison Site.

Approximate area:	39 acres
Approximate number of holes:	106
Holes/acre:	2.7
Average depth:	11 feet
Confidence interval:	$\pm 12\%$

As there is one rectangular shaped tails area at Gunnison, the drill pattern was laid out to fit the area in accordance with the calculated spacing. A rectangular grid was used throughout the pile except for the perimeter where other polygonic forms were used to conform to the principal sides of the pile. The adjacent sides of the rectangles were made of similar lengths to the extent possible to fit distances between opposite sides of the pile and geometric relationships. Where sides of the pile drifted off line, the outside line of holes was curved in the same direction in order to keep the outer holes reasonably close to the outer crest.

Following determination of the desired drill pattern, each bore hole location was set and marked by a surveying team. In addition, appropriate survey data were obtained to delineate the boundaries of each tails area and surface contours.

Figure 4.1.1, Site Plan, shows the final drill pattern for the Gunnison Site.

4.3 Drilling and Sampling Procedures

Drilling equipment consisted of two truck mounted Central Mine Equipment Drills, Models CME 55 and CME 75. These two units had a 6-ton hydraulic pull-down capacity and 7,000 and 8,450 foot-pounds of torque to the drill stem respectively. The drill and sampling equipment listed below was utilized as required to meet the varying conditions encountered.

Principal drill assembly: 6-5/8" OD, 3-1/4" ID hollow-stem auger

Auxiliary drill tools: 4-1/4" continuous-flight auger

Auger bits with carbide inserts

Tri-cone bits with N rod

NX diamond drill string

Down-the-hole hammer, 140-lb.

Drive hammer, 140-lb.

Hollow-stem auger, 6-5/8" OD, 3-1/4" ID

Sampling tools: Split spoon (2" OD, 1-3/8" ID)

Ring Sampler (2.42" ID)

Shelby Tube (3" OD thin wall)

The sample program was designed to provide individual samples at 2.5-foot intervals in each borehole. Each sample was sealed in a plastic bag to retain its moisture for subsequent determination. Ten percent of the holes, located in a predetermined pattern throughout the site, were designated bulk density holes. These were sampled with thin-walled Shelby Tube samplers to provide uncompressed samples. A measured amount from the sampler was placed in a sealed jar for subsequent bulk density determination. Moistures and routine uranium, vanadium and molybdenum assays were run on the balance of the sample.

Typically the following procedures were used for the two types of sample holes.

Split Spoon (SPT)

After setting up at the hole location, the 2.5-foot split spoon sampler was driven into the tailings with a 140-lb hammer to its full depth and then withdrawn. A second sampler was then driven from a depth of 2.5 to 5.0 feet and withdrawn. Upon withdrawal, the samplers were opened, the sample examined by a field engineer to determine its physical characteristics for logging purposes, and the entire sample placed in a plastic sample bag. The sample was appropriately identified and sealed to preserve its moisture content. The hollow-stem auger was then drilled to the 5.0-foot depth, leaving the auger in place. The next two samplers were then driven through the auger's hollow stem to sample the next

5.0-feet of tails. Thus by alternating sampling and augering, the sample was obtained ahead of the auger, and the auger emplacement prevented collapse of the hole above the sampler. This procedure was varied where the tailings were sufficiently competent to avoid collapse of the sample hole and allowed sampling without the auger.

While theoretically the sample tube will always be filled with sample, the amount actually retained in the tube will normally be less than 100%. When sampling material as varied in physical condition as wet tailings, it is anticipated that recovery will be less than 100%, irrespective of the drilling method used. However, as the objective was to determine an average value for the full depth of tailings, and not strata intervals, any inaccuracies due to sample recoveries should be compensating and, therefore, would not adversely affect the sought-for results.

Shelby Tube

The procedure used for Shelby Tube holes was similar to the split spoon procedure except that the sampler was pushed into the tailings by hydraulic pressure. Upon removal, approximately 3-inches of tailings were carefully removed from the end of the tube and packaged for bulk density determination. Careful measurement was made of the sample volume removed from the tube for future calculation of the bulk density. The balance of the sample was extruded from the sampler, logged and packaged.

Where the tailings were too compact to push the Shelby Tube, a ring sampler was used. This sampler is similar to a split spoon sampler but is large enough to hold a series of tightly fitting brass rings. When full, these rings held a known volume which allowed calculation of the bulk density.

Subbase Determination

As the subbase, or foundation, material under most tailings piles built in the 1950's and 1960's was generally pervious in nature, it was assumed that some solution migration into the subbase had occurred. Accordingly, samples were continued into the subbase material to varying depths depending upon conditions. The tailings/subbase interface was determined by the geotechnical engineer based upon examination of the samples and observance of the change in physical characteristics of the sample from the observed tailings characteristics to material with in situ characteristics. After the tailings subbase interface was penetrated, the following samples of subbase material still in the sampler were placed in a detection device operated by Sandia Laboratories personnel to determine the radium content. The sample was then removed from the sampler, logged, and packaged the same as for the tails.

4.4 Reserve Calculations

The tonnages of material in the tailings piles were calculated using the standard polygonic volume approach which has long been used by the mining industry for determination of ore reserves. Each polygonic volume included one or more drill holes, and the assays of these holes were used to determine the moisture and metal contents of that particular volume. The methodology is described in greater detail in Subsection 4.4.1. Summary and detail tables are presented respectively in Subsections 4.4.2 and 4.4.3.

4.4.1 Methodology

Calculation of the tailings volume, tonnage and pounds of contained material was accomplished in a series of steps. These are:

1. Divide the section into blocks
2. Calculate the horizontal area of each block
3. Calculate the volume of each block
4. Calculate the weight of each block
5. Calculate the metal content of each block
6. Calculate section and site tonnages

The basic work sheet was a scale drawing of the entire site with each borehole (sample) location identified and its metal grade noted. In practice, a simple color code was used in noting the grade range of U_3O_8 in order to readily indicate the variability over the section. Assays for each hole are found in Table 4.4.1. The code used, for example, was:

white	-	0	to 0.004%
blue	-	0.004	to 0.01%
orange	-	0.01	to 0.02%
purple	-	0.02	to 0.03%
brown	-	0.03	to 0.04%
green	-	0.04	to 0.05%

After coding, the blocks were delineated with a varying number of holes to each block. Where the variation in grade was small, between a number of holes, it was found that there was no significant difference between a series of blocks with single holes and a single block with a number of holes. Three conditions of occurrence in particular dictate a calculation of separate blocks with only a few holes, or with up to 15 to 20 holes. These conditions are considerable variation in grade, considerable variation in thickness of tailings, and whether holes are peripheral or interior. Site sections also separate blocks. In all cases, U_3O_8 was used as the controlling metal.

GUNNISON SITE

TABLE 4.4.1

Assay Summary

	Sample	XU308	XV205	XMo
G C	001S01	0.0006		
G C	002S01	0.0077		
G C	002S02	0.0044		
G C	002S03	0.0034		
G D	003S01	0.0021		
G D	003S02	0.0011		
G C	004 03	0.0094	0.0140	0.0040
G C	004S01	0.0023		
G C	005 02	0.0055	0.0100	0.0050
G C	005S01	0.0008		
G C	005S02	0.0006		
G C	006 03	0.0112	0.0120	0.0070
G C	006S01	0.0011		
G C	007 03	0.0161	0.0120	0.0070
G C	008 04	0.0094	0.0070	0.0040
G C	009 02	0.0121	0.0120	0.0090
G C	009S01	0.0028		
G C	010 05	0.0046	0.0080	0.0030
G A	011 03	0.0040	0.0110	0.0080
G A	011S01	0.0022		
G A	011S02	0.0012		
G C	012 04	0.0089	0.0130	0.0050
G A	013 03	0.0030	0.0130	0.0080
G A	013S01	0.0016		
G C	014 03	0.0025	0.0090	0.0050
G C	014S01	0.0058		
G A	015 03	0.0028	0.0100	0.0050
G C	016 03	0.0044	0.0090	0.0060
G C	016S01	0.0034		
G A	017 02	0.0016	0.0110	0.0040
G A	017S01	0.0029		
G C	018 04	0.0043	0.0060	0.0040
G A	019 02	0.0054	0.0150	0.0050
G A	019S01	0.0015		
G C	020 03	0.0054	0.0090	0.0050
G C	020S01	0.0030		
G D	021 05	0.0070	0.0090	0.0030
G D	021S01	0.0106		
G D	021S02	0.0202		
G A	022 04	0.0040	0.0110	0.0080
G A	023 03	0.0077	0.0100	0.0050
G A	023S01	0.0088		
G A	024 04	0.0042	0.0140	0.0070
G A	024S01	0.0019		
G A	025 03	0.0056	0.0100	0.0030
G A	025S01	0.0031		
G A	026 03	0.0048	0.0150	0.0050
G A	026S01	0.0053		
G A	027 05	0.0049	0.0100	0.0040

Sample	XU308	XU208	XMc
G A 028 03	0.0012	0.0140	0.0010
G A 028S01	0.0016		
G A 029 03	0.0048	0.0080	0.0030
G A 029S01	0.0042		
G A 029S02	0.0036		
G A 030 02	0.0040	0.0160	0.0050
G A 030S01	0.0026		
G C 031 03	0.0026	0.0070	0.0030
G C 031S01	0.0048		
G C 031S02	0.0012		
G A 032 02	0.0050	0.0130	0.0040
G A 032S01	0.0009		
G C 033 05	0.0050	0.0080	0.0070
G A 034 03	0.0022	0.0130	0.0030
G C 035 04	0.0051	0.0100	0.0050
G A 036 04	0.0036	0.0080	0.0030
G C 037 06	0.0060	0.0090	0.0050
G A 038 04	0.0045	0.0100	0.0030
G A 038S01	0.0042		
G C 039 04	0.0045	0.0110	0.0050
G C 039S01	0.0043		
G A 040 04	0.0030	0.0080	0.0040
G A 040S01	0.0018		
G C 041 05	0.0121	0.0080	0.0050
G C 042 04	0.0032	0.0090	0.0040
G C 043 05	0.0077	0.0070	0.0020
G C 044 03	0.0046	0.0100	0.0040
G C 045 04	0.0073	0.0100	0.0030
G C 045S01	0.0057		
G C 046 03	0.0067	0.0100	0.0030
G C 047 04	0.0051	0.0100	0.0050
G C 047S01	0.0062		
G C 048 04	0.0061	0.0100	0.0050
G C 049 05	0.0060	0.0080	0.0030
G C 049S01	0.0019		
G C 050 04	0.0072	0.0110	0.0040
G C 051 05	0.0048	0.0070	0.0020
G D 052 04	0.0082	0.0090	0.0020
G D 052S01	0.0016		
G C 053 05	0.0104	0.0100	0.0030
G C 053S01	0.0080		
G D 054 06	0.0082	0.0090	0.0030
G C 055 07	0.0136	0.0100	0.0040
G D 056 07	0.0110	0.0090	0.0030
G D 056S01	0.0030		
G C 057 05	0.0077	0.0130	0.0030
G C 057S01	0.0046		
G D 058 08	0.0109	0.0090	0.0030
G D 058S01	0.0034		
G C 059 07	0.0065	0.0080	0.00

Table 4.4.1 (cont)

Sample	%U308	%V205	%Mo
G D 060 07	0.0060	0.0070	0.0040
G C 061 05	0.0056	0.0070	0.0040
G C 061S01	0.0141		
G D 062 07	0.0058	0.0080	0.0040
G D 062S01	0.0030		
G A 063 05	0.0047	0.0080	0.0040
G A 063S01	0.0041		
G A 063S02	0.0103		
G B 064 06	0.0067	0.0060	0.0030
G B 064S02	0.0029		
G A 065 05	0.0045	0.0100	0.0030
G A 065S01	0.0032		
G B 066 05	0.0067	0.0090	0.0040
G B 066S01	0.0100		
G A 067 04	0.0034	0.0080	0.0030
G A 067S01	0.0031		
G B 068 03	0.0040	0.0080	0.0030
G B 068S01	0.0037		
G A 069 03	0.0028	0.0130	0.0020
G A 069S01	0.0016		
G B 070 03	0.0031	0.0130	0.0020
G A 071 04	0.0035	0.0130	0.0030
G A 071S01	0.0024		
G B 072 02	0.0039	0.0230	0.0030
G B 072S01	0.0020		
G B 073 03	0.0059	0.0170	0.0020
G B 073S01	0.0022		
G B 074 02	0.0044	0.0170	0.0030
G B 074S01	0.0034		
G B 075 04	0.0068	0.0200	0.0030
G B 075S01	0.0017		
G B 076 03	0.0008	0.0280	0.0010
G B 076S01	0.0038		
G B 077 04	0.0046	0.0110	0.0040
G B 077S01	0.0017		
G B 078 04	0.0050	0.0090	0.0030
G B 078S01	0.0047		
G B 078S02	0.0019		
G B 079 05	0.0071	0.0100	0.0040
G B 079S01	0.0022		
G B 080 06	0.0064	0.0120	0.0030
G B 080S01	0.0019		
G B 080S02	0.0014		
G B 081 05	0.0085	0.0090	0.0030
G B 082 05	0.0076	0.0080	0.0040
G B 082S01	0.0137		
G B 082S02	0.0141		
G D 083 04	0.0052	0.0080	0.0040
G D 084 04	0.0030	0.0290	0.0020
G D 084S01	0.0049		

Table 4.4.1 (cont)

	Sample	W302	W207	2M2
G D 085 05	0.0071	0.0107	0.0030	
G D 085S01	0.0030			
G D 085S03	0.0004			
G D 086 06	0.0044	0.0110	0.0040	
G D 086S01	0.0037			
G D 087 06	0.0083	0.0120	0.0040	
G D 087S01	0.0046			
G D 088 05	0.0037	0.0140	0.0030	
G D 088S01	0.0067			
G D 089 05	0.0021	0.0100	0.0020	
G D 089S01	0.0019			
G D 090 06	0.0111	0.0130	0.0030	
G D 090S01	0.0059			
G D 091 06	0.0042	0.0080	0.0030	
G D 091S01	0.0046			
G D 092 06	0.0064	0.0080	0.0040	
G D 092S01	0.0059			
G D 093 06	0.0049	0.0070	0.0030	
G D 093S01	0.0038			
G D 094 04	0.0051	0.0070	0.0030	
G D 094S01	0.0046			
G D 095 05	0.0078	0.0100	0.0030	
G D 095S01	0.0011			
G D 096 03	0.0045	0.0070	0.0020	
G D 096S01	0.0012			
G D 097 04	0.0019	0.0130	0.0020	
G B 098 02	0.0012	0.0100	0.0030	
G B 098S01	0.0007			
G D 099 04	0.0031	0.0120	0.0050	
G D 099S01	0.0013			
G B 100 02	0.0034	0.0100	0.0030	
G B 100S01	0.0018			
G D 101 04	0.0035	0.0140	0.0090	
G D 101S01	0.0007			
G B 102 03	0.0031	0.0100	0.0040	
G B 102S01	0.0023			
G D 103 04	0.0025	0.0100	0.0070	
G B 104 03	0.0019	0.0100	0.0040	
G B 104S01	0.0024			
G B 104S02	0.0012			
G D 105 03	0.0040	0.0090	0.0020	
G D 105S01	0.0081			
G B 106 03	0.0035	0.0110	0.0030	

Table 4.4.1 (cont)

Before starting calculations of tonnage and grade, blocks were outlined along the periphery containing only the periphery holes on the pile. One or more of these holes were included in a block, depending upon the conditions previously discussed and section lines. The outer edge of each peripheral block was established as a line half way between the crest and toe of the pile. The interior holes were then grouped into blocks to cover each section of the tailings.

After delineation of all the blocks, the area of each was calculated using geometrical methods. The volume of each block was then calculated by multiplying the area by the average depth of tailings in each hole. The depth of tailings used for each hole was determined from the drill logs made by the Sergeant, Hauskins, and Beckwith field engineer at the time the hole was drilled. Hole depths are listed in Table 4.4.2. On rare occasions the indicated tailings depth was modified where incontrovertible evidence existed that an error had been made.

In order to calculate the wet short tons of material in each block, it was necessary to use the bulk density, or weight per unit volume, as determined from Shelby Tube samples. The volume of each block in cubic feet was divided by the cubic feet per short ton. This latter figure was obtained by dividing 2,000 by the product of specific gravity times 62.425. Bulk density data is found in Table 4.4.3.

At the Gunnison Site, 10 holes were drilled with the Shelby Tube in a random pattern. The average bulk density was determined for each hole and this value used for all blocks within the control area of that hole.

As the percent solids, or percent moisture, was determined for each 2.5-foot sample in each hole, an arithmetical average of these determinations was used to determine the dry short tons of tailings in the pile. Moisture data for each hole is found in Table 4.4.4. The dry short tons were then multiplied by applicable assays for the entire hole to determine the weight of uranium, vanadium and molybdenum in each block. The tons of tailings and contained metals were then totaled for all blocks within a given section. The average assay for the section was derived by dividing the total tons of metal in the section by the total tons of tailings. The contents of all sections were then similarly totaled to obtain quantities and average assays for the entire site. Figure 4.4.1, Reserve Block calculations, provides an example of the calculation procedure used.

The subbase material below the tailings was cubicated and metal content determined by the same method as the tailings. However, as drilling was generally stopped at a depth of one foot below the tailings

(continued on Page 4-21)

TABLE 4.4.2

BORE HOLE DEPTHS - GUNNISON SITE
(all depths in feet)

<u>Hole</u>	<u>Tails</u>	<u>Subbase</u>	<u>Hole</u>	<u>Tails</u>	<u>Subbase</u>	<u>Hole</u>	<u>Tails</u>	<u>Subbase</u>	<u>Hole</u>	<u>Tails</u>	<u>Subbase</u>
C-1	0	1.5	C-31	7.0	4.5	C-61	12.5	1.2	D-91	15.0	0.8
2A	0	1.5	A-32	6.0	0.6	D-62	16.0	2.0	92	14.5	2.0
B	0	5.5	C-33	11.0	2.0	A-63	12.5	1.3	93	13.5	1.8
D-3	0	4.0	A-34	7.0	0	B-64	15.5	3.0	94	10.0	1.5
C-4	6.5	1.0	C-35	10.0	0	A-65	11.0	2.3	95	10.5	2.0
5	5.5	2.5	A-36	8.3	1.0	B-66	11.0	2.0	96	7.0	2.0
6	5.5	2.5	C-37	14.7	0	A-67	7.0	1.0	97	8.0	1.5
7	6.5	2.5	A-38	9.6	1.0	B-68	7.0	2.0	B-98	5.0	1.5
8	10.0	0	C-39	10.0	1.5	A-69	6.0	1.0	D-99	10.0	1.0
9	6.75	2.25	A-40	9.0	2.3	B-70	6.0	1.0	B-100	5.0	2.0
10	11.0	0	C-41	12.0	0.7	A-71	6.0	2.5	D-101	8.0	1.7
A-11	6.5	4.5	42	8.0	1.5	B-72	3.0	1.0	B-102	6.5	3.5
C-12	8.0	1.0	43	11.5	1.0	73	7.0	1.8	D-103	9.7	0
A-13	7.0	1.0	44	6.0	1.0	74	4.0	1.5	B-104	6.0	4.0
C-14	7.5	0.5	45	10.0	1.5	75	8.0	0.5	D-105	9.4	0
A-15	6.0	2.5	46	5.0	1.5	76	5.0	2.0	B-106	5.5	1.5
C-16	7.5	1.0	47	10.5	1.5	77	9.0	1.2			
A-17	5.0	1.5	48	9.5	1.0	78	11.6	2.4			
C-18	9.5	0	49	11.5	1.0	79	11.0	2.0			
A-19	7.5	0	50	9.0	1.0	80	13.2	3.3			
C-20	8.3	1.5	51	10.0	2.5	81	11.5	0.5			
D-21	14.0	2.0	D-52	11.0	2.0	82	10.2	4.8			
A-22	9.0	1.0	53	14.0	1.0	D-83	8.0	0.3			
23	6.5	2.0	54	13.6	0.4	84	9.5	0.5			
24	11.5	1.0	C-55	17.0	0	85	11.5	6.5			
25	7.0	1.5	D-56	16.5	2.0	86	12.5	1.5			
26	8.5	1.0	C-57	13.0	2.0	87	12.5	1.5			
27	11.0	0	D-58	19.5	1.5	88	13.0	1.5			
28	8.0	0	C-59	15.5	0.5	89	11.5	1.0			
29	8.0	3.0	D-60	16.0	1.0	90	14.5	1.0			
30	5.5	1.5									

Soils Testing Procedures and Study

Table 4.4.3 Bulk Density Results

Sample ID	GRAMS	IN3	GM/IN3	GM/CM3	LB/FT3	PI3/TON
G-A-025- 01	517.00	20.65	25.02	1.67	101.4	19.7
G-A-025- 02	540.35	19.75	28.37	1.73	108.1	18.5
G-A-025- 03	562.15	20.01	28.09	1.71	107.0	18.7
AVERAGE OF 3 INTERVALS:			27.66	1.69	105.4	19.0
G-C-031- 01	517.75	19.78	26.17	1.60	99.4	20.1
G-C-031- 02	524.45	19.70	26.41	1.61	100.6	19.9
G-C-031- 03	643.85	20.30	31.71	1.94	120.8	16.3
AVERAGE OF 3 INTERVALS:			28.09	1.71	105.0	18.7
G-C-046- 01	515.75	19.21	26.86	1.57	97.7	20.6
G-C-046- 02	625.15	19.44	31.83	1.74	121.3	16.5
G-C-046- 03	461.45	16.67	27.39	1.62	105.1	19.0
AVERAGE OF 3 INTERVALS:			28.35	1.73	108.0	18.0
G-C-051- 02	536.15	22.53	23.82	1.59	99.7	20.1
G-C-051- 03	466.05	21.00	22.22	1.32	82.3	24.7
G-C-051- 04	445.65	22.75	19.59	1.20	74.9	26.8
AVERAGE OF 3 INTERVALS:			22.44	1.37	85.5	23.4
G-C-057- 01	534.75	22.21	23.82	1.61	100.7	19.9
G-C-057- 03	564.35	20.14	28.05	1.71	106.8	18.7
G-C-057- 04	570.25	16.55	30.74	1.88	117.1	17.1
AVERAGE OF 3 INTERVALS:			28.37	1.73	108.1	18.5
G-A-065- 02	366.15	15.66	23.38	1.43	89.1	27.5
G-A-065- 03	453.95	16.17	27.56	1.68	105.0	19.1
AVERAGE OF 2 INTERVALS:			25.47	1.55	97.0	20.6
G-B-072- 01	501.25	19.64	25.52	1.56	97.2	20.6
G-B-072- 02	537.05	17.69	30.36	1.85	115.7	17.3
AVERAGE OF 2 INTERVALS:			27.94	1.71	106.4	18.6
G-B-076- 01	583.25	19.02	29.87	1.82	113.8	17.6
G-B-076- 02	472.85	19.36	24.42	1.49	93.0	21.0
AVERAGE OF 2 INTERVALS:			27.15	1.66	103.4	19.3
G-D-084- 01	509.85	19.62	25.98	1.59	98.0	20.7
G-D-084- 02	532.55	20.16	26.42	1.61	100.6	19.9
G-D-084- 03	552.35	20.21	27.34	1.67	104.1	19.2
G-D-084- 04	585.55	18.54	31.59	1.93	120.4	16.6
AVERAGE OF 4 INTERVALS:			27.83	1.70	104.0	18.9
G-D-092- 01	573.25	20.56	27.98	1.70	106.2	18.8
G-D-092- 02	545.45	19.95	27.35	1.67	104.2	19.2
G-D-092- 03	437.55	12.27	35.66	2.18	135.9	14.7
AVERAGE OF 3 INTERVALS:			30.30	1.85	115.4	17.3

Gunnison Site

Table 4.4.4 Percent Solids Results

Sample ID	Present	No Recov	Lab Err	Field Err	Minimum	Maximum	Average	Std Dev
G-C-001-S01	1				99.22	99.22	99.22	
G-C-002-S03	3				95.37	97.31	96.42	1.03
G-C-003-S02	3				89.62	92.39	91.01	1.94
G-C-004-03	2				81.39	91.99	87.43	4.45
G-C-004-S01	1				96.32	96.32	96.32	
G-C-005-02	1				78.75	88.88	83.81	7.16
G-C-005-S01	1				92.82	97.35	95.08	3.20
G-C-006-03	2				77.12	83.07	79.50	3.15
G-C-006-S01	1				96.99	96.99	96.99	
G-C-007-03	3				74.42	87.65	81.44	6.65
G-C-007-S01	1				85.04	85.04	85.04	
G-C-008-04	1				80.49	97.55	89.20	7.50
G-C-009-02	1				80.10	82.80	81.45	1.91
G-C-009-S01	1				93.41	93.41	93.41	
G-C-010-05	1				90.30	95.20	92.07	1.88
G-A-011-03	2				79.79	89.10	84.33	4.66
G-C-011-S02	3				92.08	94.76	93.41	1.91
G-C-012-04	3	1			64.58	79.37	73.77	8.03
G-A-013-03	1				83.88	83.88	83.88	
G-A-013-S01	1				97.97	97.97	97.97	
G-C-014-03	3				84.23	93.74	88.06	5.02
G-C-014-S01	1				85.31	85.31	85.31	
G-A-015-03	3				79.36	95.24	87.07	7.95
G-C-016-03	3				79.40	93.93	88.14	7.70
G-C-016-S01	1				95.25	95.25	95.25	
G-A-017-02	2				79.91	95.17	87.54	10.74
G-A-017-S01	1				85.10	85.10	85.10	
G-C-018-04	4				85.28	96.19	92.36	4.83
G-A-019-02	1				74.85	77.40	76.13	1.80
G-A-019-S01	1				93.33	93.33	93.33	
G-C-020-03	1				73.49	94.71	86.91	11.67
G-C-020-S01	1				90.64	90.64	90.64	
G-U-021-05	1				89.56	92.78	91.26	1.37
G-U-021-S02	1	1			86.73	86.73	86.73	
G-A-022-04	4				70.45	95.09	82.16	13.23
G-A-023-03	3				84.56	90.22	87.25	2.84
G-A-023-S01	1				94.24	94.24	94.24	
G-A-024-04	4				76.06	90.54	81.29	6.38
G-A-024-S01	1				93.72	93.72	93.72	
G-A-025-03	3				87.74	96.92	92.46	4.60
G-A-025-S01	1				96.50	96.50	96.50	
G-A-026-03	2	1			79.51	80.30	79.91	0.55
G-A-026-S01	1				77.58	77.58	77.58	
G-A-027-05	5				75.75	92.42	85.57	6.58
G-A-028-03	1	1			95.99	95.99	95.99	
G-A-028-S01	1				95.08	95.08	95.08	
G-A-029-03	3				88.07	91.93	90.57	2.17
G-A-029-S02	2				86.27	95.62	90.95	6.61
G-A-030-02	2				70.10	76.89	73.50	4.80

Sample ID	Families			Percent		Average	Std Dev
	Present	No Focus	Lab Err	fold	Minimum	Maximum	
G-A-030-S01	1				86.27	86.27	86.27
G-C-031-03	3				4.11	96.71	95.62
G-C-031-S02	2				95.56	97.07	96.31
G-A-032-02	2				77.46	78.95	78.20
G-A-032-S01	1				85.17	85.17	85.17
G-C-033-05	5				80.75	95.51	88.62
G-C-033-S01					0.00	0.00	0.00
G-A-034-03	3				89.72	94.16	91.52
G-C-035-04	4				88.15	93.98	91.94
G-C-035-S01		1			0.00	0.00	0.00
G-A-036-04	4				90.66	95.70	92.45
G-C-037-06	6				84.30	94.36	89.85
G-A-038-04	4				90.01	94.66	92.08
G-A-038-S01	1				91.50	91.50	91.50
G-C-039-04	4				77.90	91.34	86.45
G-C-039-S01	1				90.81	90.81	90.81
G-A-040-04	4				89.54	93.02	91.18
G-A-040-S01	1				95.11	95.11	95.11
G-C-041-05	5				76.55	93.55	86.70
G-C-042-04	4				85.37	94.26	91.41
G-C-043-05	5				84.89	94.16	90.02
G-C-044-03	3				79.46	91.31	84.75
G-C-045-04	4				38.27	89.46	71.67
G-C-045-S01					83.57	83.57	83.57
G-C-046-04					76.27	84.40	80.71
G-C-047-04					77.12	95.81	86.47
G-C-047-S01					0.00	0.00	0.00
G-C-048-04					0.00	0.00	0.00
G-C-049-05	5				76.02	93.87	85.63
G-C-049-S01	1				98.23	98.23	98.23
G-C-050-04	4				81.30	96.73	88.11
G-C-051-05	5				88.95	93.18	91.42
G-D-052-04	4				90.25	94.47	93.21
G-D-052-S01	1				89.00	89.00	89.00
G-C-053-05	5				90.55	94.15	92.53
G-C-053-S01	1				88.17	88.17	88.17
G-D-054-06	6				80.70	95.36	89.32
G-C-055-07	7				76.74	94.56	86.54
G-D-056-07	7				62.48	94.39	90.40
G-D-056-S01	1				95.55	95.55	95.55
G-C-057-05	5				79.68	96.10	87.78
G-C-057-S01	1				80.67	80.67	80.67
G-D-058-08	8				82.44	93.95	90.03
G-D-058-S01	1				86.58	86.58	86.58
G-C-059-07	7				83.45	95.07	88.57
G-D-060-07	7				77.73	95.91	88.54
G-C-061-05	5				78.16	92.40	86.25
G-C-061-S01	1				86.51	86.51	86.51
G-D-062-07	6				87.28	91.91	88.51
G-D-062-S01	1				96.51	96.51	96.51

Table 4.4.4 continued

Sample ID	Present	Sample No	Recovery	Lab Err	Field Er	Minimum	Percent Maximum	Solids Average	Std Dev
G-A-063-05	5					81.02	92.37	89.03	4.83
G-A-063-001	1					93.07	93.07	93.07	
G-B-064-06	6					87.89	94.58	91.78	2.21
G-E-064-007	7					90.30	97.78	94.04	5.29
G-A-065-05	5					87.81	94.01	91.34	1.71
G-A-065-001	1					95.59	95.59	95.59	
G-B-066-05	5					87.60	92.45	89.53	2.15
G-E-066-001	1					96.24	96.24	96.24	
G-A-067-04	4	1				85.60	91.85	87.70	3.59
G-A-067-001	1					81.25	81.25	81.25	
G-E-068-03	3					90.02	91.26	90.68	0.62
G-E-068-001	1					91.26	91.26	91.26	
G-A-069-03	3					91.71	93.70	92.56	1.03
G-A-069-001	1					97.69	97.69	97.69	
G-B-070-03	3					87.28	94.24	90.22	3.60
G-E-070-001	1					0.00	0.00	0.00	
G-A-071-04	4	1				81.92	88.09	84.88	3.00
G-E-071-001	1					88.04	88.04	88.04	
G-B-072-02	2					84.24	93.40	88.82	6.48
G-E-072-001	1					91.38	91.38	91.38	
G-B-073-03	3					73.01	85.21	77.22	6.92
G-E-073-001	1					87.33	89.33	89.33	
G-B-074-02	2					78.60	89.45	84.03	7.67
G-E-074-001	1					95.31	95.31	95.31	
G-B-075-04	4					79.41	90.80	84.40	5.16
G-A-075-001	1					91.58	91.58	91.58	
G-B-076-03	3	1				88.61	91.59	90.10	2.11
G-E-076-001	1					84.65	84.65	84.65	
G-B-077-04	4					76.97	92.77	86.13	6.11
G-E-077-001	1					92.68	92.68	92.68	
G-B-078-04	4					79.95	91.03	86.90	5.04
G-B-078-002	2					80.40	92.05	86.22	8.24
G-B-079-05	5					78.16	90.97	84.32	5.84
G-B-079-001	1					93.87	93.87	93.87	
G-B-080-06	6			1		87.31	92.24	89.10	2.17
G-E-080-001	1					90.00	91.80	90.90	1.27
G-B-081-05	5					76.56	91.50	84.75	5.97
G-E-081-001	1					0.00	0.00	0.00	
G-B-082-05	5					85.66	92.78	89.44	2.86
G-B-082-002	2					90.21	90.36	90.29	0.10
G-B-083-04	4					84.10	91.08	87.47	3.65
G-B-083-001	1					0.00	0.00	0.00	
G-B-084-04	4					82.90	87.66	85.39	2.42
G-B-084-001	1					92.61	92.61	92.61	
G-B-085-05	5					83.25	94.93	89.37	5.11
G-B-085-003	3					87.22	92.40	89.81	3.66
G-B-086-06	6					78.24	92.44	85.78	5.90
G-B-086-001	1					98.34	98.34	98.34	
G-B-087-06	6					79.31	93.88	88.10	5.12
G-B-087-001	1					0.00	0.00	0.00	

Table 4.4.4 continued

Sample ID	Samples				Percent		Solids	Std Dev
	Percent	No Recov	Lab Fr	Field Er	Minimum	Maximum		
C-D-082-05	5				81.84	92.95	88.71	4.51
G-D-088-S01	1				89.71	89.71	89.71	
G-D-089-05	4	1			91.71	94.86	89.81	8.14
G-D-089-S01	-				97.41	97.41	97.41	
G-L-090-06	6				86.25	92.97	89.78	2.44
G-D-090-S01	1				96.28	96.28	96.28	
G-D-091-06	-				74.92	95.56	86.02	7.97
E-D-091-S01	1				91.15	91.15	91.15	
G-L-092-06	6				87.98	95.27	92.05	2.78
G-D-092-S01	1				96.13	96.13	96.13	
G-I-093-06	5	1			61.10	88.51	85.61	2.93
G-D-093-S01	1				92.92	92.92	92.92	
G-L-094-04	3	1			72.36	93.66	92.9	0.65
G-D-094-S01	1				90.78	90.78	90.78	
G-L-095-05	5				65.38	93.01	81.98	10.73
G-D-095-S01	1				95.59	95.59	95.59	
G-L-096-06	1	1			93.81	94.83	94.32	0.73
G-D-096-S01	1				93.88	93.88	93.88	
E-L-097-04	1	1			86.54	94.55	90.55	5.67
G-D-097-S01	1				91.74	91.74	91.74	
G-B-098-02	1	1			92.38	92.38	92.38	
G-B-098-S01	1				94.76	94.76	94.76	
G-D-099-04	4				72.55	95.28	80.04	10.31
G-D-099-S01	1				98.22	98.22	98.22	
G-F-100-01	1				79.81	96.89	88.35	12.06
G-B-100-S01	1				91.72	91.72	91.72	
G-L-101-04	1	1			81.66	84.92	83.29	2.31
G-D-101-S01	1				96.60	96.60	96.60	
G-B-102-03	3				83.04	95.86	87.52	7.23
G-B-102-S01	1				92.36	92.36	92.36	
G-D-103-04	2	1			75.60	80.38	77.99	3.37
G-F-103-S01	1				0.00	0.00	0.00	
G-F-104-03	5				76.28	98.32	87.35	11.02
G-B-104-S02	5				93.82	96.23	95.03	1.70
G-L-105-03	1	1			87.22	97.21	91.22	8.48
G-D-105-S01	1				83.65	83.65	83.65	
G-F-106-03	5				77.39	86.61	81.79	4.63

Table 4.4.4 continued

FIGURE 4.4.1
RESERVE BLOCK CALCULATIONS - TYPICAL

The following calculations are typical for a multihole block. The block illustrated is atypical as the shape may be an irregular shaped polygon to fit the site and assay variables. Data is assumed.

Distance between holes, etc., are obtained by laying out the blocks and scaling from the site plan (Figure 4.1.1).

	<u>% U₃O₈</u>	<u>V₂O₅</u>	<u>Mo</u>	<u>% Solids</u>	<u>Depth Tails</u>
Hole 1	0.0250	0.0400	0.015	76.0	15.0'
Hole 2	0.0300	0.0400	0.015	75.0	14.0'
Hole 3	0.0350	0.0200	0.015	74.0	13.0'
Ave. % Solids				75.0	
% Moisture				25.0	

Bulk Density: 19.8 cu ft/ton.

Calculation of Volume & Tonnage

Length of Block - 500' (to 1/2 way down slope).

Width of Block - 150' (to 1/2 way down slope).

Area = 500 x 150 = 75,000 square feet.

Depth = 15 + 14 + 13 = 14 feet average depth.

Volume = 75,000 x 14 = 1,050,000 cubic feet.

Wet Tons = 1,050,000/19.8 = 53,030.3 wet short tons.

Dry Tons = 53,030 x .75 = 39,773 dry short tons.

Calculation of Grade

$$15 \times 0.025 = 0.375$$

$$14 \times 0.030 = 0.420$$

$$13 \times 0.035 = 0.455$$

$$\frac{42}{1.250}$$

$$1.250/42 = 0.0298\% \text{ U}_3\text{O}_8$$

Ave. assays for V₂O₅ and Mo calculated by same procedure.

$$\text{Ave. V}_2\text{O}_5 = 0.0338\%$$

$$\text{Ave. Mo} = 0.015\%$$

interface due to refusal on cobbles, the calculated subbase tonnage is considered to be the minimum amount present. Subbase samples were assayed for U_3O_8 but were not assayed for vanadium or molybdenum as interest was primarily in the degree of migration of radioactive compounds. Accordingly the average assay for a block with more than one hole was a weighted average based upon the hole depths in the subbase.

Figure 4.4.2 shows the general outline of the Gunnison tailings, with the block arrangements used for the reserve calculations.

4.4.2 Tailings and Subbase Reserve - Summary

The tonnages of material located at the Gunnison Site which contain significant quantities of uranium, vanadium, and molybdenum are summarized by sections in Table 4.4.5.

In determining the reserves, two categories of material were considered. These are tailings, which includes all material previously subjected to chemical processing, and subbase, which consists of the material lying below the tailings and on which the tailings were deposited.

The subbase material quantity is arbitrary to a large extent due to the variability in depth and assays. While random holes were drilled deeper, the majority of holes were stopped due to refusal on cobbles in the subbase. Thus, the depth of sampling was the controlling factor in calculating subbase reserves and not the uranium content. Thus, it is possible that some subbase material below the calculated reserves may be sufficiently high enough in uranium to require remedial consideration in addition to the reserves reported.

The tailings/subbase relationship is as follows.

	Dry Weight	% Wt.	lb. U_3O_8	% Wt.
Tailing	628,847	85.17	72,098	89.7
Subbase	109,521	14.83	8,319	10.3
Total	738,368	100.00	80,417	100.0

While the tonnages and metal contents were determined using the polygonic method, a computer program was developed using assays on a weighted average basis to calculate the statistical assay confidence level. Each composite assay was weighted by the associated hole depth as shown on Pages 4-24 and 4-25.

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TABLE 4.4.5

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SUMMARY

	<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>
<u>TAILINGS</u>									
Section "A"	122,672	12.68	107,114	0.0042	9,014	0.0109	23,291	0.0039	8,460
Section "B"	123,708	12.42	108,342	0.0057	12,294	0.0109	23,692	0.0032	7,011
Section "C"	224,641	12.44	196,696	0.0069	27,200	0.0092	36,073	0.0042	16,358
Section "D"	245,358	11.68	216,695	0.0054	23,590	0.0093	40,458	0.0033	14,272
Total	716,379	12.22	628,847	0.0057	72,098	0.0098	123,514	0.0037	46,101
<u>SUBBASE</u>									
Section "A"	23,753	9.41	21,519	0.0034	1,464				
Section "B"	28,966	8.95	26,374	0.0045	2,394				
Section "C"	33,646	9.04	30,606	0.0039	2,397				
Section "D"	33,838	8.32	31,022	0.0033	2,064				
Total	120,203	8.89	109,521	0.0038	8,319				
<u>TAILINGS + SUBBASE</u>									
Total	836,582	11.74	738,368	0.0055	80,417		>123,514		>46,101

$$\text{Average assay, } \bar{X} = \frac{\text{SUM}}{N}$$

$$\text{where: } \text{SUM} = \frac{1}{\bar{D}} \sum_{i=1}^N X_i D_i$$

N = number of holes

D_i = depth of hole

$\bar{D}$ = average depth

X_i = composite assay

The standard deviation was determined using the following equations:

$$\text{Sigma} = \sqrt{\frac{N \bullet \text{SSQ} - \text{SUM}^2}{N^2 - N}}$$

$$\text{where: } \text{SSQ} = \frac{1}{\bar{D}} \sum_{i=1}^N D_i X_i^2$$

$$\text{SUM} = \frac{1}{\bar{D}} \sum_{i=1}^N D_i X_i$$

N = number of holes

The confidence intervals calculated for each section and for the total site at a 90% confidence level were:

Section A = $\pm 11.36\%$

B = $\pm 15.71\%$

C = $\pm 13.12\%$

D = $\pm 14.05\%$

Site = $\pm 7.61\%$

As the confidence interval is a function of the number of samples (see Subsection 4.2), it is apparent that each section will be higher than for the total site.

4.4.3 Tailings and Subbase Reserve - Section Details

Tables 4.4.6 through 4.4.9 present details of the volumes used to determine the quantities of material and metal contents for each section.

TABLE 4.4.6

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION A

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>
					<u>TAILINGS</u>					
(A-11)	1	2,178	15.67	1,836	0.0090	330	0.0110	404	0.0060	220
(A-22)	2	5,917	17.84	4,862	0.0040	389	0.0110	1,070	0.0080	778
(A-29)	3	6,262	9.43	5,665	0.0048	544	0.0080	906	0.0030	340
(A-40)	4	7,045	8.82	6,423	0.0030	385	0.0080	1,127	0.0040	514
(A-63)	5	9,784	10.97	8,711	0.0047	819	0.0080	1,394	0.0040	697
(A-13)	6	1,831	16.12	1,536	0.0030	92	0.0130	399	0.0080	246
(A-24)	7	6,157	18.71	5,005	0.0042	420	0.0140	1,401	0.0070	701
(A-27)	8	8,365	14.43	7,158	0.0049	701	0.0100	1,432	0.0040	573
(A-38)	9	7,300	7.92	6,722	0.0045	604	0.0100	1,344	0.0030	403
(A-65)	10	8,365	8.66	7,641	0.0045	688	0.0100	1,528	0.0030	458
(A-15)	11	1,307	12.93	1,138	0.0028	64	0.0100	228	0.0050	114
(A-26)	12	4,510	20.09	3,604	0.0048	346	0.0150	1,081	0.0050	360
(A-25)	13	5,188	7.54	4,797	0.0056	537	0.0100	959	0.0030	288
(A-36)	14	6,151	7.55	5,687	0.0036	409	0.0080	910	0.0030	341
(A-67)	15	5,188	12.30	4,550	0.0034	309	0.0080	728	0.0030	273
(A-17)	16	1,493	12.46	1,307	0.0016	42	0.0110	288	0.0040	105
(A-28)	17	4,922	4.01	4,725	0.0012	113	0.0140	1,323	0.0010	94
(A-23)	18	4,901	12.75	4,276	0.0077	659	0.0100	855	0.0050	428
(A-34)	19	5,278	8.48	4,830	0.0022	213	0.0130	1,256	0.0030	290
(A-69)	20	4,524	7.44	4,187	0.0028	234	0.0130	1,089	0.0020	167
(A-30)	21	4,445	26.50	3,267	0.0040	261	0.0160	1,045	0.0050	327
(A-19)	22	4,447	13.09	3,386	0.0054	366	0.0150	1,016	0.0050	339
(A-32)	23	3,557	21.80	2,782	0.0050	278	0.0130	723	0.0040	223
(A-71)	24	3,557	15.92	3,019	0.0035	211	0.0130	785	0.0030	181
Total		122,672	12.68	107,114	0.0042	9,014	0.0109	23,291	0.0039	8,460

(continued next page)

TABLE 4.4.6 (cont)

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION A

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>	<u>Thickness</u>
					<u>SUBBASE</u>						
(A-11)	1	1,378	6.59	1,287	0.0017	44					4.5'
(A-22)	2	611	(10.00)	550	(0.0030)	33					1.0'
(A-29)	3	2,348	9.05	2,136	0.0039	167					3.0'
(A-40)	4	1,800	13.30	1,561	0.0018	56					2.3'
(A-63)	5	1,018	6.93	947	0.0072	136					1.3'
(A-13)	6	259	2.03	254	0.0016	8					1.0'
(A-24)	7	537	6.28	503	0.0019	19					1.0'
(A-27)	8	(1,127)	10.00	1,014	(0.0035)	71					(1.5')
(A-38)	9	760	8.50	696	0.0042	58					1.0'
(A-65)	10	1,749	4.41	1,672	0.0032	107					2.3'
(A-15)	11	556	10.00	500	(0.0035)	35					2.5'
(A-26)	12	531	22.42	412	0.0053	44					1.0'
(A-25)	13	1,112	3.5	1,073	0.0031	67					1.5'
(A-36)	14	735	10.07	661	(0.0031)	41					1.0'
(A-67)	15	741	18.75	602	0.0031	37					1.0'
(A-17)	16	448	14.90	381	0.0029	22					1.5'
(A-28)	17	(972)	10.00	875	(0.0016)	28					(1.6')
(A-23)	18	1,508	5.78	1,421	0.0088	250					2.0'
(A-34)	19	(1,055)	10.00	950	(0.0040)	76					(1.4')
(A-69)	20	754	2.31	737	0.0016	24					1.0'
(A-30)	21	1,212	13.73	1,046	0.0026	54					1.5'
(A-19)	22	(704)	10.00	633	(0.0015)	19					(1.2')
(A-32)	23	356	14.83	303	0.0009	5					0.6'
(A-71)	24	1,482	11.96	1,305	0.0024	63					2.5'
Total		23,753	9.41	21,519	0.0034	1,464					
					<u>TAILINGS + SUBBASE</u>						
Total		146,425	12.15	128,633	0.0041	10,478		>23,291			>8,460

NOTE: Figures in parenthesis are interpolated from surrounding drill holes.

TABLE 4.4.7

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION B

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>
					<u>TAILINGS</u>					
(B-64)	1	12,132	8.22	11,135	0.0067	1,492	0.0060	1,336	0.0030	668
(B-82)	2	7,984	10.56	7,141	0.0076	1,085	0.0080	1,143	0.0040	571
(B-81)	3	10,334	15.25	8,758	0.0085	1,489	0.0090	1,576	0.0030	525
(B-106)	4	3,323	18.21	2,718	0.0035	190	0.0110	598	0.0030	163
(B-66)	5	8,365	10.47	7,489	0.0067	1,004	0.0090	1,348	0.0040	599
(B-80)	6	10,038	10.88	8,946	0.0064	1,145	0.0120	2,147	0.0030	537
(B-79)	7	10,072	15.68	8,492	0.0071	1,206	0.0100	1,698	0.0040	679
(B-104)	8	3,577	12.65	3,125	0.0019	119	0.0100	625	0.0040	250
(B-68)	9	5,188	9.32	4,704	0.0040	376	0.0080	753	0.0030	282
(B-78)	10	8,597	13.10	7,471	0.0050	747	0.0090	1,345	0.0030	448
(B-77)	11	8,004	13.87	6,894	0.0046	634	0.0110	1,517	0.0040	552
(B-102)	12	3,815	12.48	3,339	0.0031	207	0.0100	668	0.0040	267
(B-70)	13	4,524	9.78	4,082	0.0031	253	0.0130	1,061	0.0020	163
(B-76)	14	3,770	9.90	3,397	0.0008	54	0.0280	1,902	0.0010	68
(B-75)	15	7,625	15.58	6,437	0.0068	875	0.0200	2,575	0.0030	386
(B-100)	16	2,797	11.66	2,471	0.0034	168	0.0100	494	0.0030	148
(B-72)	17	1,779	11.18	1,580	0.0039	123	0.0230	727	0.0030	95
(B-74)	18	2,372	15.97	1,993	0.0044	175	0.0170	678	0.0030	120
(B-93)	19	7,748	14.39	6,633	0.0069	915	0.0090	1,194	0.0030	398
(B-98)	20	1,664	7.63	1,537	0.0012	37	0.0100	307	0.0030	92
Total		123,708	12.42	108,342	0.0057	12,294	0.0109	23,692	0.0032	7,011

(continued next page)

TABLE 4.4.7 (cont)

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION B

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>	<u>Thickness</u>
					<u>SUBBASE</u>						
(B-64)	1	2,348	5.96	2,208	0.0029	128					3.0'
(B-82)	2	3,756	9.71	3,391	0.0139	943					4.8'
(B-81)	3	448	9.20	407	(0.0074)	60					0.5'
(B-106)	4	902	9.20	819	(0.0049)	80					1.5'
(B-66)	5	1,521	3.76	1,464	0.0100	293					2.0'
(B-80)	6	2,510	9.10	2,281	0.0016	73					3.3'
(B-79)	7	1,831	15.68	1,544	0.0022	68					2.0'
(B-104)	8	<0.004 U ₃ O ₈	4.97		0.0018	82					4.0'
(B-68)	9	1,482	8.74	1,353	0.0037	100					2.0'
(B-78)	10	1,779	13.78	1,534	0.0033	101					2.4'
(B-77)	11	1,067	7.32	989	0.0017	34					1.2'
(B-102)	12	2,054	7.64	1,897	0.0023	87					3.5'
(B-70)	13	766	9.20	696	(0.0028)	39					1.0'
(B-76)	14	1,508	15.35	1,277	0.0038	97					2.0'
(B-75)	15	477	8.42	436	0.0017	15					0.5'
(B-100)	16	1,119	8.28	1,026	0.0018	37					2.0'
(B-72)	17	593	8.62	542	0.0020	22					1.0'
(B-74)	18	889	4.69	848	0.0034	58					1.5'
(B-93)	19	1,033	10.67	923	0.0038	70					1.8'
(B-98)	20	499	5.24	473	0.0007	7					1.5'
Total		28,966	8.95	26,374	0.0045	2,394					
					<u>TAILINGS + SUBBASE</u>						
Total		152,674	11.76	134,716	0.0055	14,688		>23,692		>7,011	

TABLE 4.4.8

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION C

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>
<u>TAILINGS</u>										
(C-6)	1	3,127	20.50	2,486	0.0112	557	0.0120	597	0.0070	348
(C-16)	2	6,427	11.86	5,665	0.0044	499	0.0090	1,020	0.0060	680
(C-42)	3	6,082	8.59	5,559	0.0032	356	0.0090	1,001	0.0040	445
(C-39)	4	7,560	13.55	6,864	0.0045	618	0.0110	1,510	0.0050	686
(C-57)	5	9,828	12.22	8,627	0.0077	1,329	0.0130	2,243	0.0030	518
(C-7)	6	3,309	18.56	2,695	0.0161	868	0.0120	647	0.0070	270
(C-18)	7	7,667	7.64	7,082	0.0043	609	0.0060	850	0.0040	567
(C-33)	8	8,536	11.18	7,582	0.0050	758	0.0080	1,213	0.0070	1,061
(C-37)	9	11,408	10.15	10,250	0.0060	1,230	0.0090	1,845	0.0050	1,025
(C-59)	10	12,029	11.43	10,650	0.0065	1,385	0.0080	1,704	0.0030	639
(C-9)	11	2,899	18.55	2,361	0.0121	571	0.0120	567	0.0090	425
(C-20)	12	6,185	13.09	5,376	0.0054	581	0.0090	968	0.0050	538
(C-31)	13	5,526	4.38	5,322	0.0026	277	0.0070	745	0.0030	319
(C-35)	14	7,894	8.06	7,258	0.0051	740	0.0100	1,452	0.0050	726
(C-61)	15	9,868	13.75	8,511	0.0056	953	0.0070	1,192	0.0040	681
(C-5)	16	3,772	16.19	3,162	0.0055	348	0.0100	632	0.0050	316
(C-14)	17	7,621	13.94	6,711	0.0025	366	0.0090	1,208	0.0050	671
(C-44)	18	4,763	15.25	4,037	0.0046	371	0.0100	807	0.0040	323
(C-41)	19	9,526	13.30	8,259	0.0121	1,999	0.0080	1,321	0.0050	826
(C-55)	20	13,495	13.46	11,679	0.0136	3,177	0.0100	2,336	0.0040	934
(C-8)	21	2,531	10.80	2,258	0.0094	425	0.0070	316	0.0040	181
(C-4)	22	4,425	12.57	3,869	0.0094	727	0.0140	1,083	0.0040	310
(C-12)	23	6,759	26.23	5,053	0.0089	899	0.0130	1,314	0.0050	505
(C-46)	24	3,868	19.09	3,130	0.0067	419	0.0070	438	0.0030	188
(C-43)	25	8,897	9.98	8,009	0.0077	1,233	0.0070	1,121	0.0020	320

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TABLE 4.4.8 (Cont)

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION C

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>
<u>TAILINGS (Cont)</u>										
(C-53)	26	10,831	7.47	10,022	0.0104	2,085	0.0100	2,004	0.0030	601
(C-10)	27	8,932	7.93	8,224	0.0046	757	0.0080	1,316	0.0030	493
(C-48)	28	4,724	16.81	3,930	0.0061	479	0.0100	786	0.0050	393
(C-45)	29	6,147	28.33	4,406	0.0073	643	0.0100	881	0.0030	264
(C-51)	30	7,500	8.58	6,857	0.0048	658	0.0070	960	0.0020	274
(C-50)	31	2,387	11.89	2,103	0.0072	303	0.0110	463	0.0040	168
(C-47)	32	4,096	13.53	3,542	0.0051	361	0.0100	708	0.0050	354
(C-49)	33	6,022	14.37	5,157	0.0060	619	0.0080	825	0.0030	309
TOTAL		224,641	12.44	196,696	0.0069	27,200	0.0092	36,073	0.0042	16,358
<u>SUBBASE</u>										
										<u>Thickness</u>
(C-6)	1	1,420	3.01	1,377	0.0011	30				2.5'
(C-16)	2	857	4.75	816	0.0034	55				1.0'
(C-42)	3	922	9.40	835	(0.0038)	63				1.2'
(C-39)	4	1,134	9.19	1,030	0.0043	89				1.5'
(C-57)	5	1,512	19.33	1,220	0.0046	112				2.0'
(C-7)	6	1,273	14.96	1,082	(0.0019)	41				2.5'
(C-18)	7	1,452	9.40	1,316	(0.0018)	47				(1.8')
(C-33)	8	1,551	9.40	1,405	(0.0032)	90				2.0'
(C-37)	9	1,008	9.40	913	(0.0036)	66				(1.3')
(C-59)	10	388	9.40	352	(0.0074)	52				0.5'
(C-9)	11	966	6.59	903	0.0028	51				2.35'
(C-20)	12	1,118	9.36	1,013	0.0030	61				1.5'
(C-31)	13	3,552	3.69	3,421	0.0030	205				4.5'
(C-35)	14	1,814	9.40	1,643	(0.0056)	184				(2.3')
(C-61)	15	947	13.49	820	0.0141	231				1.2'
(C-5)	16	1,713	4.92	1,629	0.0007	23				2.5'
(C-14)	17	508	14.69	433	0.0058	50				0.5'

(continued next page)

NOTE: Figures in parenthesis are interpolated from surrounding drill holes.

TABLE 4.4.8 (Cont)

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION C

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>	<u>Thickness</u>
<u>SUBBASE (Cont)</u>											
(C-44)	18	793	9.40	718	(0.0043)	62					1.0'
(C-41)	19	555	9.40	503	(0.0055)	55					0.7'
(C-55)	20	1,031	9.40	934	(0.0054)	101					(1.3')
(C-8)	21	430	9.40	390	(0.0023)	18					(1.7')
(C-4)	22	680	3.68	655	0.0023	30					1.0'
(C-12)	23	844	9.40	765	(0.0041)	63					1.0'
(C-46)	24	1,159	9.40	1,050	(0.0042)	90					1.5'
(C-43)	25	773	9.40	700	(0.0051)	71					1.0'
(C-53)	26	774	11.83	682	0.0080	109					1.0'
(C-10)	27	748	9.40	677	(0.0032)	43					(1.0')
(C-48)	28	497	9.40	450	(0.0044)	40					1.0'
(C-45)	29	922	16.43	771	0.0057	88					1.5'
(C-51)	30	931	9.40	843	(0.0043)	72					2.5'
(C-50)	31	265	9.40	240	(0.0046)	22					1.0'
(C-47)	32	585	13.53	506	0.0062	63					1.5'
(C-49)	33	524	1.77	514	0.0019	20					1.0'
Total		33,646	9.04	30,606	0.0039	2,397					
<u>TAILINGS + SUBBASE</u>											
Total		258,287	11.00	227,302	0.0065	29,597		>36,073			>16,358

NOTE: Figures in parenthesis are interpolated from surrounding holes

TABLE 4.4.9

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION D

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>
<u>TAILINGS</u>										
(D-60)	1	12,096	11.46	10,710	0.0060	1,285	0.0070	1,499	0.0040	857
(D-88)	2	9,828	11.29	8,718	0.0067	1,168	0.0090	1,569	0.0030	523
(D-87)	3	10,092	11.90	8,891	0.0083	1,476	0.0120	2,134	0.0040	711
(D-101)	4	4,209	16.71	3,506	0.0035	245	0.0140	982	0.0090	631
(D-21)	5	10,865	8.74	9,915	0.0070	1,388	0.0090	1,785	0.0030	595
(D-86)	6	9,700	14.22	8,321	0.0064	1,065	0.0110	1,831	0.0040	666
(D-85)	7	9,853	10.63	8,805	0.0071	1,250	0.0100	1,761	0.0030	528
(D-103)	8	5,299	12.01	4,133	0.0025	207	0.0100	827	0.0070	579
(D-62)	9	12,631	11.49	11,179	0.0058	1,297	0.0080	1,789	0.0040	894
(D-84)	10	7,499	14.61	6,404	0.0030	384	0.0290	3,714	0.0020	256
(D-83)	11	7,124	12.53	6,231	0.0052	648	0.0080	997	0.0040	498
(D-105)	12	5,313	8.78	4,847	0.0040	388	0.0090	872	0.0020	194
(D-58)	13	15,480	9.97	13,937	0.0109	304	0.0090	2,509	0.0030	836
(D-90)	14	11,511	10.22	10,334	0.0111	2,294	0.0100	2,067	0.0030	620
(D-89)	15	9,677	10.19	8,691	0.0021	365	0.0100	1,738	0.0020	348
(D-99)	16	5,716	19.96	4,575	0.0031	284	0.0120	1,098	0.0050	458
(D-56)	17	12,765	9.60	11,540	0.0110	253	0.0090	208	0.0030	692
(D-92)	18	11,218	7.95	10,326	0.0064	1,322	0.0080	1,652	0.0040	826
(D-91)	19	12,301	13.98	10,581	0.0042	889	0.0080	1,693	0.0030	635
(D-97)	20	4,506	9.45	4,080	0.0019	155	0.0130	1,060	0.0020	163
(D-52)	21	9,850	11.89	8,679	0.0082	1,423	0.0090	1,562	0.0020	347
(D-94)	22	9,486	7.01	8,821	0.0051	900	0.0070	1,235	0.0030	529
(D-93)	23	17,919	14.39	15,341	0.0069	2,117	0.0090	2,761	0.0030	920
(D-95)	24	5,888	18.02	4,827	0.0078	753	0.0100	965	0.0030	290
(D-54)	25	8,056	10.68	7,195	0.0082	1,180	0.0090	1,295	0.0030	432
(D-96)	26	6,476	5.68	6,108	0.0045	550	0.0070	855	0.0020	244
Total		245,358	11.68	216,695	0.0054	23,590	0.0093	40,458	0.0033	14,272

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TABLE 4.4.9 (cont)

GUNNISON SITE TAILINGS & SUBBASE RESERVE - SECTION D

		<u>Wet Short Tons</u>	<u>% H₂O</u>	<u>Dry Tons</u>	<u>% U₃O₈</u>	<u>Lbs. U₃O₈</u>	<u>% V₂O₅</u>	<u>Lbs. V₂O₅</u>	<u>% Mo</u>	<u>Lbs. Mo</u>	<u>Thickness</u>
					<u>SUBBASE</u>						
(D-60)	1	1,360	8.20	1,248	(0.0050)	125					(1.8')
(D-88)	2	1,134	10.29	1,017	0.0069	140					1.5'
(D-87)	3	1,211	11.90	1,067	0.0046	98					1.5'
(D-101)	4	894	3.40	864	0.0007	12					1.7'
(D-21)	5	1,552	13.27	1,346	(0.0047)	127					2.0'
(D-86)	6	1,164	1.66	1,145	0.0033	76					1.5'
(D-85)	7	5,569	10.19	5,001	0.0017	170					6.5'
(D-103)	8	1,474	8.20	1,353	(0.0041)	111					(2.7')
(D-62)	9	1,579	11.49	1,397	0.0030	84					2.0'
(D-84)	10	395	7.39	366	0.0049	36					0.5'
(D-83)	11	267	8.20	245	(0.0055)	27					0.3'
(D-105)	12	842	16.35	704	0.0081	114					(1.5')
(D-58)	13	1,191	13.42	1,031	0.0034	70					1.5'
(D-90)	14	794	3.72	764	0.0059	90					1.0'
(D-89)	15	838	2.59	817	0.0019	31					1.0'
(D-99)	16	572	1.78	561	0.0013	15					1.0'
(D-56)	17	1,547	4.45	1,478	0.0030	89					2.0'
(D-92)	18	1,547	3.87	1,487	0.0059	175					2.0'
(D-91)	19	656	8.85	598	0.0046	55					0.8'
(D-97)	20	844	8.20	775	(0.0023)	36					1.5'
(D-52)	21	1,791	11.00	1,594	0.0016	51					2.0'
(D-94)	22	1,423	9.22	1,292	0.0046	119					1.5'
(D-93)	23	1,989	7.08	1,848	0.0038	140					1.5'
(D-95)	24	1,120	4.41	1,071	0.0011	24					2.0'
(D-54)	25	237	8.20	218	(0.0016)	7					0.4'
(D-96)	26	1,848	6.12	1,735	0.0012	42					2.0'
Total		33,838	8.32	31,022	0.0033	2,064					
					<u>TAILINGS + SUBBASE</u>						
Total		279,196	11.27	247,717	0.0052	25,654		>40,458		>14,272	

4.5 Site Materials Characteristics

The Gunnison Site tailings are uniformly distributed and probably developed by gravity flow and settling. Separate treatment of any area in the tailings site is doubtful due to the continuously uniform nature of the piles.

At various depths within the Gunnison tailings, size segregation and fines layering probably exist. The overall size distribution shows an even distribution typical of ball milled ground tailings.

Following are observations of specific physical characteristics which will have a significant effect on the remedial action cost.

1. Although the moisture retention is low with a site average of 11.74%, the water table is very near the tailings surface. The tailings drain well; however, site conditions for removal could be very wet and require pumping.
2. Standing water was found in the pre-existing peziometer holes at the Gunnison site.
3. Subbase material underlying the tailings consisted of silty sand mixed with cobbles. Generally, subbase drilling could not penetrate farther than one foot before auger refusal due to large cobbles. The movement of water into and out of the Gunnison tailings was evident.

SECTION 5.0
AMENABILITY TESTING

SECTION 5.0

AMENABILITY TESTING

Mountain States Research and Development (MSRD) conducted amenability leach testing on Gunnison Site uranium tailings from composites made from the field drill samples. The test objectives were to determine reagent consumption and overall laboratory extraction for uranium, vanadium, and molybdenum from the Gunnison tailings.

The field samples were weighed wet, oven dried, weighed dry, crushed to minus 10-mesh, blended and mixed for the appropriate composite test sample. The individual test samples were leached using two separate standard agitation leach procedures; one with sulfuric acid and the other with sodium carbonate.

When agitation leach results indicated sufficient extraction, standard column leach tests were made on composite test samples to simulate heap leaching.

5.1 Procedures

The tailings samples received from the site were prepared into section and site composites by standard laboratory techniques. The sample weight and dry weights were recorded for compiling by computer.

Tracking of individual samples was accomplished by log book entry upon completion of the sample preparation task.

Several standard leach test procedures were used on each section and the site composite. Careful attention was made to pH ranges, agitation time, temperature, leaching time, slurry density, and reagent addition.

5.1.1 Laboratory Sample Preparation Procedures

The field drilling samples were processed to obtain the percent moisture; hole assay for U_3O_8 , V_2O_5 , and Mo; subbase assay for U_3O_8 ; and appropriate test composites.

Samples Received

The drill samples were shipped by truck in sealed drums to Mountain States Research and Development, Tucson, Arizona.

Samples delivered to MSRD were inventoried into a barrel receiving log book and placed in a fenced, designated area for uranium tailings.

Sample Drying

The individual barrels were processed in sequential order by hole number. The double bagged hermetically heat sealed polyethylene sample bags were removed from the barrel.

The plastic seal was opened and the contents dumped into a tared aluminum pan. The pan and contents were weighed and the weight was recorded as the wet weight in the drying log book. Each sample was field tagged with an aluminized cardboard identification number. This field tag remained with the sample throughout the drying step.

The pan and sample were placed in an electric oven and dried for 20 hours at 90° Celsius. The pan and sample were again weighed after drying. The sample dry weight was recorded opposite the wet weight in the drying log.

Sample Crushing

The dried sample was broken up to minus 10-mesh. This was done by working the sample through a 10-mesh screen with a rubber muller or by passing the sample through a secondary cone crusher when hard plus 10-mesh particles were present.

Sample Splitting

The sample was mixed at least 3 times by repeated splitting through a Jones riffle followed by recombination of the split on each pass. The mixed sample was split through the Jones riffle into a 500-gram sample. The remainder was bagged, labeled, and drummed for Sandia National Laboratories use.

The 500-gram sample was put into a pan for compositing with drill samples of the same hole number. The pan was labeled with the hole number for compositing.

After all the 500-gram drill sample splits with identical hole numbers were composited, the hole composite was thoroughly mixed using the Jones riffle.

Drill Hole Composite

The hole composite, after mixing and blending, was split with a Jones Riffle as follows:

1. 500 grams for assay U_3O_8 , V_2O_5 , Mo.
2. Site composite using 60 grams per sample interval. (Weight = 60 x hole depth in intervals).
3. Section composite using 200 grams per sample interval.
4. Remainder of hole composite to reject barrel storage.

Section Composite

When the total samples from hole composite splitting were collected for a section, the section composite was mixed and blended. The completed section composite was riffle split into 1,000-gram test samples.

Site Composite

When all samples from the site were hole composited and section composited, the total site composite was mixed and blended. The site composite was riffle split into 1,000-gram test samples.

Subbase Samples

All samples below the tailings interface were dried individually; split; 500 grams sent for U_3O_8 assay; and the split reject packaged and labeled for Sandia National Laboratories.

Shelby Tube

All Shelby Tube samples, in addition to the normal sample procedure, were hand sampled while damp and the damp sample assayed for mercury. No sample drying was done before mercury assay.

Assay Sample Preparation

Assay samples weighing a minimum of 500 grams were pulverized to -150 mesh in a Braun pulverizer. The pulverized sample was rolled 100 times and sampled for assay using standard techniques by a rolling cloth and spatula.

Bulk Densities

Samples of known volume were received in sealed plastic jars. The sealed jar plus contents were weighed. The weight was recorded with the sample interval identification number. The jar contents were removed and the jar cleaned and air dried. The dry weight of the jar was recorded opposite the correct sample identification number. The difference between the jar weight and the weight as received was the bulk "in-place" tailings weight. The recorded bulk weight was divided by the known sample volume to find the sample bulk density.

5.1.2 Leach Testing Procedures

The test procedures used simulate actual plant process controlled variables. The test pulp density, pH, EMF, temperature, and reagent combinations were kept within normal plant operating ranges.

In order to properly select the correct tailings treatment process, two basic process approaches were made. Sulfuric acid leaching and alkaline carbonate leaching are the two proven methods. The leach test program was established to determine the percent extraction, extraction rates, and reagent consumptions. The following standard tests were used:

- Agitation leach - 24 hour Alkaline
- Agitation leach - 24 hour Acid
- Agitation leach - 72 hour Acid
- Column leach - 15 days

Of necessity, leach testing was conducted on previously dried samples which required re-wetting. A limited number of undried samples were prepared for test leaching to provide a comparison of the results obtained on dried samples in the laboratory with the results to be obtained in plant leaching of the tails in their normally wet condition.

Leach Test Procedure - Alkaline Agitation - 24-Hour

Test samples weighing 1,000 or 500 grams were mechanically agitated at 55% solids using tap water. The pH and temperature of the slurry were measured. Glass beakers (2,000 and 1,000 milliliter size) were used for the first 2 hours with mechanical agitation at 200 rpm.

The pH was adjusted to 9.0 - 10.0 range and maintained for 2 hours of mechanical agitation using sodium carbonate. Sodium bicarbonate was added to yield a 7.5 g/l leach solution strength. Potassium permanganate was added at 2 pounds per ton of test solids.

Mechanical agitation and bottle roll agitation equipment and speeds were identical to the acid leach agitation test.

After 2 hours of mechanical agitation, the slurry was transferred to a glass bottle and placed on the bottle rolls for 20 hours. The pH, temperature, and EMF were measured before filtering the slurry. The filter cake was washed once with 1 g/l sodium carbonate wash of 250 milliliters and final wash of 250 milliliters of tap water.

A 100-milliliter aliquot of pregnant leach solution was taken for sodium carbonate and sodium bicarbonate determination. The pregnant plus wash solution and solid residue were each assayed for U_3O_8 , V_2O_5 , and Mo.

Leach Test Procedure - Acid Agitation - 24-Hour

Sample test weights of 1,000 or 500 grams were added to a 2,000 or 1,000 milliliter beaker, respective of test weight. Tap water was added to the beaker to make a slurry density of 55% solids.

After the 4 hours of mechanical agitation, the beaker contents were transferred to a 3.78 liter (1,000 gm test weight), or 2.4 liter (500 gm test weight) glass bottle. The tared glass bottle plus slurry was weighed to give the slurry weight. The unstoppered bottle was placed on mechanical rolls at 96 rpm for 20 hours.

The pH and EMF, after 20 hours of bottle roll agitation leach time, were measured, slurry filtered, and the filter cake washed 3 times with 333 milliliters for each wash. Wash solution was tap water with sulfuric acid added to pH 2.

The pregnant plus wash solution and the solid residue were each assayed for U_3O_8 , V_2O_5 , and Mo. An iron assay and free acid determination were made on acid leach pregnant plus wash solutions.

Leach Test Procedure - Acid Agitation - 72-Hour

The test procedure for the 72-hour acid agitation leach was identical to the 24-hour acid agitation leach with the following additions.

After 24 hours of bottle roll agitation, the pH was measured and adjusted to 1.5, minimum. The solids in the bottle were allowed to settle and 25 milliliters of pregnant solution were removed by pipette. The bottle was returned to the rolls for agitation.

When 48 hours of total agitation time occurred, a second 25 milliliter aliquot of pregnant solution was extracted after settling. Again the pH was measured and adjusted to 1.5, and agitation continued.

Finally, after 72 hours of total agitation, the slurry was filtered similar to the 24 hour agitation leach method.

All pregnant solutions were assayed for U_3O_8 , V_2O_5 , Mo and Fe. Solid residue was assayed for U_3O_8 , V_2O_5 , and Mo. The site-composited solid residue was wet screened at 200 mesh. Then the +200 mesh residue was dry screened from 10-mesh through 200-mesh (Tyler $\sqrt{2}$ screen series). Each size fraction was assayed for U_3O_8 , V_2O_5 , and Mo.

Column Leach Test Procedure

A total of 3,000 grams of test sample were agglomerated with 300 grams per liter of sulfuric acid solution. The test sample was wetted with the acid solution. Then the sample was drum agglomerated in a 5-gallon pail until small balls approximately 1/8 to 1/2 inches in diameter were formed. The amount of solution used in agglomeration was measured.

The Plexiglas test columns, simulating heap leaching, measured 3 inches in diameter and 28 inches in height. A 20-mesh by 3 inch diameter screen was used on the bottom of the column with a grooved 1 inch high by 2 inch diameter PVC pipe resting on the one hole rubber-stoppered end. The column was loaded in stages by tapping the sides until all 3,000 grams had been fed. A 20-mesh by 3 inch diameter screen was placed on the top of the column test charge.

The loaded column was air dried at room temperature (26°C) for 72 hours. Then a 20 or 10 g/l sulfuric acid solution was fed into the column at .75 cc/min feed rate. The strength of the feed solution was determined by previous agitation leach tests. Feed was one pass with no recirculation.

Effluent leach solution volume was measured every 24 hours and sampled for assay. Fresh feed solution was mixed daily.

Daily effluent assays were made for U_3O_8 , V_2O_5 , Mo, Fe and Free H_2SO_4 . After 15 days of column leaching, the feed solution was stopped. The column was drained 24 hours. Then fresh tap water was fed at 1.5 cc/min for 24 hours. The final column drain was 72 hours.

The column residue solids were wet screened on 200-mesh and then dry screened on 10-mesh through 200-mesh (Tyler $\sqrt{2}$ screen series). The size fractions were assayed for U_3O_8 , V_2O_5 , and Mo.

5.1.3 Assaying Procedures

Blank and standard reagents were used in series with unknown samples for assay to provide control comparison. Duplicate samples were run periodically along with certified reference standards to maintain the internal quality control.

The standard solutions were carefully prepared and made up fresh to assure accuracy. Then new standards were checked against the old standard.

U₃O₈ ANALYSISINDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROPHOTOMETER (ICP)

1. Weigh 2 grams of sample into a 250 ml beaker. Add 0.5 to 0.75 grams of ammonium bifluoride to aid in the digestion of silicate minerals. (2 ml of hydrofluoric acid may be added in Step 3 in place of the ammonium bifluoride in this step).
2. Wet down the sample with distilled water.
3. Add 10 ml of concentrated nitric acid and 2 ml of 1:1 sulfuric acid.
4. Place on a medium heat hot plate.
5. Cook uncovered until the volume is reduced to about one-half of the original volume. Without removing from the hot plate, add 5 ml of concentrated hydrochloric acid and take to dryness uncovered. Bake until there are no more fumes or sulfur trioxide emitted.
6. Remove from the hot plate and allow to cool sufficiently to avoid beaker breakage in Step 7.
7. Wet the residue with 2 - 5 ml of nitric acid. Then add approximately 30 ml distilled water. Add the water from a jet in order to stir up the residue.
8. Place on a medium heat hot plate and bring to a near boil with the beaker uncovered.
9. Remove from the hot plate and allow to cool to room temperature.
10. Transfer to a Nessler tube containing 5.0 ml Lanthanum Chloride Solution (Note 1). Fill the tube to the 100 ml mark, stopper, and mix. Filter approximately 1/3 of the solution through No. 40, 12.5 cm Whatman Dry Filter Paper (fluted) into a dry Nessler tube.
11. Transfer a portion of the filtered solution into an I.C.P. tube and read on the Perkin-Elmer ICP 5500 unit. An emission wavelength of 424.17 nm is used for determination of uranium. Replicate readings are made for each sample with the average reported as the analysis.

NOTE 1: Lanthanum Chloride solution must be from the same stock solution for each series of sample run through the I.C.P.

Vanadium and Molybdenum Analysis

The V_2O_5 and Mo assay determinations are made from the same solution as the U_3O_8 determination but are read on an atomic absorption spectrophotometer ("A.A.").

Mercury Analysis

Procedure

1. Weigh 10 grams of concentrate and place into an 800 ml beaker.
2. Add HNO_3 (conc.) in 25 ml increments until 75 ml have been added.
REACTION CAN BE VIOLENT.
3. When vigorous reactions have subsided, place on hot plate.
4. Cook until brown fumes have almost disappeared.
5. Cautiously add 25 ml HCl and continue cooking. NOTE: Do not permit the cooking to go to dryness; not even one small spot.
6. When all black sulfides are in solution or have turned light yellow or whitish, and are floating on the surface of the solution, then dissolution is complete as far as the mercury is concerned.
7. When total volume is approximately 40 ml, remove from heat and cool.
8. Add about 20 ml of cold water; then filter off insol.
9. Add 10 grams of tartaric acid crystals.
10. Swirl beaker to dissolve.
11. Cautiously add NH_4OH until a definite odor of ammonia persists.
12. Cool, add one or two mls of KI solution, then transfer to separatory funnel, leaving room for the 10 ml of Ketone and shaking space.
13. Add 10 ml Methyl Isobutyl Ketone (M.I.B.K.) to sample in funnel and stopper and shake vigorously for 15 seconds.
14. When layers have separated, drain off aqueous portion in stages, whirling funnels to effect a cleaner separation.
15. Before draining off the last ml of aqueous layer, add a small amount (five ml) of water and again whirl, but do not mix by shaking.

16. Finally, place Ketone portion in a small bottle, and cap tightly.
17. Read as soon as possible on "A.A." using a low profile blue flame.

Uranium Assay by Volumetric Procedure

Procedure

1. Weigh the finely ground sample into a 250 ml Griffin low form beaker. Generally two to ten grams are taken for most ores. One gram or less is better if the uranium content exceeds 1 percent U_3O_8 .
2. Add 10 ml of concentrated HNO_3 .
3. Take to dryness on slow plate. If samples are high in carbon, leach the uranium by gently boiling in a 5% HNO_3 solution, filtering and taking to dryness.
- 3a. An alternate carbon removal method for very carbonaceous ores or shales, consists of burning off the carbon on the weighed sample in a laboratory muffle at 1300°F, (700°C) in a scorifier dish with the door ajar. Rabble without raising dust every 15 minutes until no visible carbon is left. Usually an hour suffices.
4. Cool sample and add 1 ml of nitric acid and 20 ml of saturated aluminum nitrate solution.
5. Bring to vigorous boil. An open coil "shaking hot plate" is useful at this stage, boiling the sample on "high" heat for 30 seconds, on "medium" for 30 seconds, then on "low" for 30 seconds and finally coasting on "off" position for thirty more seconds. The temperature of the solution is approximately 115°C at this stage. If this temperature is not reached, there will be a tendency towards low results. If it is much higher than 115°C, crystals will form in step 8 causing difficulties at that stage.
6. Cool for two minutes with covers drawn partially off. Do not use water to rinse off covers or to effect any transfers at this point. Use only a saturated solution of aluminum nitrate in a plastic squeeze-bottle to transfer the sample to a 125 ml separatory funnel containing 30-40 ml of ethyl acetate.

7. Stopper and shake for 50-60 seconds. Let stand until the layers separate. If this separation does not start to take place quickly, add 5-10 ml more of ethyl acetate and give the funnel a whirl. This will generally cause the separation to take place immediately. Samples high in carbon content will sometimes froth and remain like an emulsion until the second addition of ethyl acetate. If problem persists, start over, burning off the carbon in a muffle.
8. Place the original beakers under the funnels and drain off the nitrate solution layer, taking care not to drain off the cloudy portion that sometimes forms between the layers. If the insoluble matter, or some crystals, plug up the opening in the petcock, a stiff wire can be used to start the flow. If the insol is drained off as soon as it starts to settle, this trouble can sometimes be avoided. Do not attempt to make this first separation too complete. It is sometimes difficult to judge the line of demarcation between the layers due to the frothing of certain samples.
9. Add 10-15 ml of aluminum nitrate solution to the funnel and shake for 20-30 seconds. Let separate and again draw off the impurities slowly, allowing time for the nitrate layer to settle.
10. As long as impurities remain, repeat step 9. Generally three washings are sufficient to give a clean acetate solution.
11. Wash off the outside and inside of the funnel tips with water and discard the original beaker's contents.
12. Transfer the ethyl acetate solution to a clean separatory funnel to avoid contamination by the impurities that generally are held as a scum on the inside of the first funnels used. Do not wash but let drain only.
13. Place a 250 ml beaker under the funnel.
14. Add 10 ml of water to the funnel containing the acetate solution and shake for 15 seconds.
15. Let the layers separate and draw off the aqueous layer into the beakers.
16. Repeat steps 14 and 15 two more times.
17. Place beakers on high heat and boil off the ethyl acetate.

18. Add 5 ml of 1-1 sulphuric acid to beakers and take to strong fumes of SO_3 , but not to dryness.
19. Cool, add 60 ml of water and 20 ml of HCl and boil gently until clear.
20. Cool and pass through a Jones reductor filled with lead, catching reduced solution in a 500 ml Erlenmeyer flask. Follow with two 80 ml portions of 10% HCl solution. Keep the lead covered with water at all times while not actually passing a sample through the column. The reductor was given a preliminary treatment consisting of one passage of 50 ml of 3N HCl containing 200 mg of ferric chloride per liter, followed by a passage of 100 ml of 1N HCl and then flushed out with 100 ml of distilled water.
21. Add 1 ml of ferroin indicator solution to the flask and one drop of phosphoric acid.
22. Titrate with standard ceric sulphate solution until the almost complete disappearance of color. Add 2 ml of phosphoric acid and let stand 30 seconds. Continue titrating dropwise and when color starts to fade again, split the drops until the color has completely disappeared. CAUTION: Sometimes high phosphate samples will not give a returning color upon the addition of the last 2 ml of phosphoric acid. If the presence of phosphate is known beforehand, it is best to add the full 2 ml of phosphoric acid at the start and titrate with care.

NOTES: A blank should be run with every set of samples. The ferroin indicator solution influences the blank more than any other reagent.

In Step 18 there sometimes appears a darkening due to organic matter. A drop of perchloric acid while the sample is fuming on the hot plate will clear up this color.

Radium 226 Assay Procedure

1. Weigh 0.5000 gram of well-mixed sample.
2. Put into the Teflon container of a Parr Bomb.
3. Add 1 ml Aqua Regia and 3 ml HF; cover quickly.
4. Screw on the top of the Parr Bomb as tight as possible without use of mechanical force.
5. Heat in oven at 120°C for one hour.
6. Let cool (at least cool enough to handle).
7. Open the bomb and rinse solution into 100 ml nalgene flask with 2.8% boric acid. Dilute with 2.8% boric acid.
8. Mix well and transfer to smaller plastic tube with lid, and label.
9. The final precipitate is read on a low background type gross alpha-beta proportional counter (Tennelec System 5100).
10. Gross alpha counts were run for 20 to 30 minutes per sample.

Radium 226 assay procedure by permission EDA Instruments Inc.,
5151 Ward Road, Wheat Ridge, Colorado 80033.

Trace Element Assay Procedure

The analyses for Barium, Arsenic, Cadmium, Selenium, Iron, Lead, Silver, and Chromium were done by wet chemistry techniques and then were read on the Atomic Absorption Spectrophotometer (AA).

5.2 Summary Results

The leach testing results are summarized for the site. The specific leach results by areas within the site are covered under section 5.3, Leach Testing.

Testing began with agitation leach tests and due to low extractions only one site column leach was performed. Comparison results of the test methods are presented in Table 5.2.1.

5.2.1 Site Results

- . The best overall extractions were attained in the 17-day acid column leach test. These were as follows:

Uranium (U_3O_8)	-	48%
Vanadium (V_2O_5)	-	12%
Molybdenum (Mo)	-	74%

- . A comparison of agitation leach and column leach site extraction results (Table 5.2.1) shows significantly lower extractions for agitation leaching.
- . The increased extraction for column leaching over agitation is attributed to the following:
 1. Elevated temperatures during acid agglomeration for column leaching.
 2. Fresh acid feed solution during column leaching.
 3. Low U_3O_8 , V_2O_5 , and Mo content of the site.
- . Sulfuric acid consumption was low, ranging from 41 to 77 lb/ton.
- . Vanadium extraction results are subject to large variations due to the very low content of 0.01%. The lower detection limit of feed assay does not allow for good test V_2O_5 accountability.
- . Alkaline column leach method would probably show higher molybdenum extractions than the acid column leach; however, uranium extraction was too low to justify further testing.
- . Uranium processing from leach solutions may be difficult due to the low ratio of uranium content to molybdenum content, 1.6:1.0.
- . The column leach test is similar to the leaching action found in vat and heap leaching circuits. The heap leach method was selected as the most technically feasible method for treating Gunnison site tailings.

5.2.2 Results Analysis

The test data presented indicates the following processing points:

- . Laboratory column leach test on the Gunnison site required acid agglomeration for solution percolation.
- . Although acid consumption was low in all cases, the 17-day column leach test consumed almost twice the sulfuric acid as agitation leach tests.
- . Examination of the Gunnison leach test residue size fractions shows the decreased agitation leach extractions were primarily in the fine (-200 mesh) size. (See Table 5.3.7).
- . Increased agitation leach time from 24 to 72 hours did not affect the value extractions.

TABLE 5.2.1

GUNNISON SITE % EXTRACTION COMPARISONS

% U ₃ O ₈ EXTRACTION				
<u>Wet or Dry</u>	<u>24 Hr. Acid Agitation Leach</u>	<u>24 Hr. Alkaline Agitation Leach</u>	<u>72 Hr. Acid Agitation Leach</u>	<u>17 Day Acid Column Leach</u>
Dry Site	34	19	35	48
"Wet" Site	27	13	--	--

% V ₂ O ₅ EXTRACTION*				
<u>Wet or Dry</u>	<u>24 Hr. Acid Agitation Leach</u>	<u>24 Hr. Alkaline Agitation Leach</u>	<u>72 Hr. Acid Agitation Leach</u>	<u>17 Day Acid Column Leach</u>
Dry Site	4	0	5	12
"Wet" Site	3	2	--	--

% Mo EXTRACTION				
<u>Wet or Dry</u>	<u>24 Hr. Acid Agitation Leach</u>	<u>24 Hr. Alkaline Agitation Leach</u>	<u>72 Hr. Acid Agitation Leach</u>	<u>17 Day Acid Column Leach</u>
Dry Site	23	54	22	74
"Wet" Site	12	20	--	--

TABLE 5.2.2

GUNNISON SITE REAGENT ADDITION/CONSUMPTION

ACID LEACH

<u>Wet or Dry</u>	<u>H₂SO₄ Consumption (lb/ton)</u>			<u>(lb/ton) NaClO₃ Addition</u>		
	<u>24 Hr. Agitation</u>	<u>72 Hr. Agitation</u>	<u>17 Day Column</u>	<u>24 Hr. Agitation</u>	<u>72 Hr. Agitation</u>	<u>17 Day Column</u>
Dry Site	46	41	77	34	0	0.6
"Wet Site"		---	---	0		---

ALKALINE LEACH

		<u>NaHCO₃ (lb/ton)</u>			<u>Na₂CO₃ (lb/ton)</u>			
		<u>24 Hr. Agitation</u>	<u>100°C Agitation</u>	<u>72 Hr. Agitation</u>	<u>24 Hr. Agitation</u>	<u>100°C Agitation</u>	<u>72 Hr. Agitation</u>	<u>KMnO₄ Addition</u>
Dry Site	[1]	12.1	12.4	12.4	41	60	80	2
Dry Site	[2]	35	49	70	10	17	24	---

[1] Reagent addition at start of test.

[2] Reagent lb/ton remaining in the Final Pregnant Solution.

GUNNISON SITE COLUMN LEACH
DV-69
EXTRACTION vs TIME

FIGURE 5.2.3

Cumulative
% Extraction

100

80

60

40

20

① U_3O_8

LEACH TIME IN DAYS

△ V_2O_5

□ Mo

5.3 Detail Results

The leach testing results are summarized by test method.

Comparisons by leaching method are made for the same Gunnison section. The leach results are presented by section with the site sample representing the composite of the total tailings. The "wet" site test sample represents a site composite of the Shelby tube samples with no oven drying prior to leach testing.

The column leach site residue (remains after acid leaching) and agitation leach site residue were analyzed by +200 and -200 mesh sizes.

5.3.1 Discussion of Results

The leach test extractions are summarized by leaching method in Table 5.3.1. Graphical comparisons for leach method extractions are shown in Figures 5.3.2 and 5.3.3. Detailed leach test summary data is given in Tables 5.3.4 and 5.3.5.

Examination of the test results and tables gives the following:

- . Comparisons between 24 and 72-hour acid agitation leaching shows good repeatability in extraction results.
- . Sulfuric acid leaching showed much higher extraction of uranium than alkaline leaching for all sections.
- . The sulfuric acid heap leach method is recommended as the best extraction method based on laboratory investigations.

5.3.2 Section Results

The distribution of the values in the Gunnison site are uniformly low in all the sections. The individual section leach tests reflect the metallurgical homogenous response of the Gunnison site.

Section Extractions

The uranium, vanadium and molybdenum extractions of each section were approximately the same as the total site composite test results. No unusual section test occurrence was noted.

Reagent Consumption

Total acid consumption was low for all sections. The variation of acid consumed was from 25 lb/ton to 59 lb/ton. The addition of sodium chlorate appeared to aid vanadium extraction. However, the low vanadium content of the tailings may not warrant the sodium chlorate addition.

TABLE 5.3.1

**GUNNISON SITE AND SECTION
% EXTRACTION COMPARISON BY LEACHING METHOD**

<u>Section</u>	24 hr. Acid Agitation Leach % Extraction <u>U₃O₈</u>	24 hr. Alkaline Agitation Leach % Extraction <u>U₃O₈</u>	72 hr. Acid Agitation Leach % Extraction <u>U₃O₈</u>
A	41	10	34
B	41	17	40
C	36	24	38
D	32	16	29
Dry Site	34	19	35
"Wet" Site	27	13	--

<u>Section</u>	% Extraction <u>V₂O₅</u>	% Extraction <u>V₂O₅</u>	% Extraction <u>V₂O₅</u>
A	8	2	8
B	4	1	8
C	3	1	5
D	4	1	6
Dry Site	4	0	5
"Wet" Site	3	2	--

<u>Section</u>	% Extraction <u>Mo</u>	% Extraction <u>Mo</u>	% Extraction <u>Mo</u>
A	40	43	29
B	33	32	31
C	22	33	16
D	26	57	21
Dry Site	23	54	22
"Wet" Site	12	20	--

FIGURE 5.3.2
GUNNISON SITE AND SECTION

% EXTRACTION

COMPARISON BY LEACHING METHOD

Section	FEED ASSAY
	%U ₃ O ₈
A	0.0071
B	0.0076
C	0.0092
D	0.0091
"Dry" Site	0.0084
"Wet" Site	0.0062

CUMULATIVE
% EXTRACTION

100

80

60

40

20

FIGURE 5.3.3
GUNNISON SITE AND SECTION

%Mo EXTRACTION COMPARISON BY LEACHING METHOD

Section	FEED ASSAY
	%Mo
A	0.004
B	0.003
C	0.004
D	0.003
"Dry" Site	0.004
"Wet" Site	0.003

CUMULATIVE
% EXTRACTION

100

80

60

40

20

24 Hr. Acid Agitation

24 Hr. Alkaline Agitation

72 Hr. Acid Agitation

TABLE 5.3.4

GUNNISON LEACH TEST SUMMARY

ACID LEACH BOTTLE ROLL - 24 HOURS

TEST NO.	SECTION	FEED ASSAY (%)			% EXTRACTION			ADDITION REAGENT Lb/Ton	
		U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo	H ₂ SO ₄	NaClO ₃
DV-12	A	0.0071	0.01	0.004	40.8	8	40	191.2	40.0
DV-13	B	0.0076	0.01	0.003	40.6	4	33.3	169.9	36.9
DV-14	C	0.0092	0.01	0.004	35.5	3	21.8	102.7	20.0
DV-15	D	0.0091	0.01	0.003	32.0	4	26.8	81.4	31.6
DV-16	SITE	0.0084	0.01	0.004	33.9	4	23.1	102.7	34.4
DV-41	WET SHELBY	0.0062	0.01	0.003	26.9	3	11.8	97.7	0

ALKALINE LEACH BOTTLE ROLL - 24 HOURS

TEST NO.	SECTION	FEED ASSAY (%)			% EXTRACTION			ADDITION REAGENT Lb/Ton		
		U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo	Na ₂ CO ₃	NaHCO ₃	KMnO ₄
DV-28	A	0.0071	0.01	0.004	9.77	2	42.5	40.8	12.4	2.0
DV-29	B	0.0076	0.01	0.003	17.42	1	31.5	40.8	12.4	2.0
DV-30	C	0.0092	0.02	0.004	23.8	1	33.1	40.8	12.2	2.0
DV-31	D	0.0091	0.01	0.003	16.4	1	56.8	40.8	12.2	2.0
DV-32	SITE	0.0084	0.01	0.004	19.1	0	54.1	40.8	12.2	2.0
DV-43	WET SHELBY	0.0062	0.01	0.003	13.4	2	19.7	80.0	12.4	2.0

ALKALINE LEACH AUTOCLAVE - 24 HOURS

TEST NO.	SECTION	FEED ASSAY (%)			% EXTRACTION			ADDITION REAGENT Lb/Ton		
		U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo	Na ₂ CO ₃	NaHCO ₃	KMnO ₄
DV-39	SITE	0.0084	0.01	0.004	15.4	2.6	79.6	60.0	12.4	2.0

TABLE 5.3.5

GUNNISON LEACH TEST SUMMARY

ACID LEACH BOTTLE ROLL - 72 HOURS

TEST NO.	SECTION	FEED ASSAY (%)			% EXTRACTION			ADDITION REAGENT Lb/Ton	
		U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo	H ₂ SO ₄	NaClO ₃
DV-82	A	0.0071	0.01	0.004	34.2	7.9	29.0	131.7	0
DV-83	B	0.0076	0.01	0.003	39.8	7.7	31.0	114.7	0
DV-84	C	0.0092	0.01	0.004	37.5	5.2	15.5	59.4	0
DV-85	D	0.0091	0.01	0.003	28.5	6.0	20.8	65.1	0
DV-86	SITE	0.0084	0.01	0.004	35.2	4.8	22.3	83.5	0

ALKALINE LEACH BOTTLE ROLL - 72 HOURS

TEST NO.	SECTION	FEED ASSAY (%)			% EXTRACTION			ADDITION REAGENT Lb/Ton		
		U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo	Na ₂ CO ₃	NaHCO ₃	KMnO ₄
DV-46	SITE	0.0084	0.01	0.0040	21.2	1.3	35.4	80	12.4	2.0

5.3.3 Discussion of Results by Test Method

Agitation-Bottle Leach Test

The agitation leach time of 24 or 72 hours was not a factor in extraction or reagent consumption. Tables 5.3.4 and 5.3.5 summarize the agitation leach tests.

Sulfuric acid leaching gave better uranium extraction than alkaline leaching. The highest molybdenum extraction, 79.6% was obtained by 100°C alkaline leaching for 24 hours, Test No. DV-39.

"Wet" Versus Oven-Dried Site Composite Leach Test

The comparison of the leach response effect of oven drying test samples showed:

1. Similar uranium extraction to "wet" sample tests.
2. Higher molybdenum extraction compared to "wet" feed sample.
3. Vanadium content was too low for valid comparisons.

The analysis comparison shows lower uranium content in the "wet" (not dried) feed sample. The sample preparation with the "wet" sample is very difficult to maintain a representative sample. The reason for oven drying the drill core sample was to provide a more representative/even sample splitting.

Sulfuric Acid Column Leach Test

Only one site sample was column leached due to the homogeneity of the tailings. The extractions were higher for column leaching because of increased acid contact time and fresh daily acid feed solution.

5.3.4 Leach Size Analysis Investigation

Table 5.3.7 and Figures 5.3.8 through 5.3.10 present size analysis data on the site column and agitation leaching.

The distribution of uranium by size follows the weight distribution of the sample. For the column leach the coarse and fine size fractions responded similarly to uranium extraction.

The vanadium and molybdenum feed values were concentrated in the fine (-200 mesh) size. The coarse (+200 mesh) feed size fractions can not be rejected because of high uranium content, 53.9% of the U_3O_8 .

5.3.5 Detail Test Data

All test data was recorded showing reagent additions and measured variables. From the test data sheets in the Appendix, the test can be duplicated by any other laboratory. All test data sheets contain a metallurgical balance which compares the calculated and assay feed. The percent distribution of the values are also shown.

The column leach test data sheet displays the daily log of solution volume, assays, and cumulative extraction for U_3O_8 , V_2O_5 and Mo. All test data sheets appear in the Appendix.

TABLE 5.3.6

**GUNNISON ANALYSIS COMPARISON OF TEST FEED SAMPLES WITH
DRILL HOLE WEIGHTED AVERAGES**

SECTION	DRILL HOLE WEIGHTED AVE. IN %			TEST FEED SAMPLE IN %			% DIFFERENCE		
	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
A	0.0039	0.01	0.0042	0.0071	0.01	0.004	+82	0	0
B	0.0052	0.01	0.0033	0.0076	0.01	0.003	+46	0	0
C	0.0068	0.01	0.0042	0.0092	0.01	0.004	+35	0	0
D	0.0062	0.01	0.0035	0.0091	0.01	0.003	+47	0	-17
SITE	0.0058	0.01	0.0038	0.0084	0.01	0.004	+45	0	0

TABLE 5.3.7

**GUNNISON COMPARISON OF COLUMN LEACH
AND AGITATION LEACH RESIDUES**

+200M COARSE SIZE FRACTION

<u>Test No.</u>	<u>Sample Name</u>	<u>Mesh Size</u>	<u>% Weight</u>	<u>% Distribution</u>		
				<u>U₃O₈</u>	<u>V₂O₅</u>	<u>Mo</u>
Gunnison	Feed Sample	-10+200	63.8	53.9	12.2	16.7
DV-69	Column Residue	-10+200	58.2	26.4	37.5	16.4
DV-86	Agitation Residue	-10+200	53.1	37.0	49.2	16.1

-200M FINE SIZE FRACTION

<u>Test No.</u>	<u>Sample Name</u>	<u>Mesh Size</u>	<u>% Weight</u>	<u>% Distribution</u>		
				<u>U₃O₈</u>	<u>V₂O₅</u>	<u>Mo</u>
Gunnison	Feed Sample	-200	36.2	46.1	87.8	83.3
DV-69	Column Residue	-200	41.8	25.2	50.7	9.8
DV-86	Agitation Residue	-200	46.9	35.5	43.6	64.5

PREGNANT AND WASH SOLUTION

<u>Test No.</u>	<u>Sample Name</u>	<u>% Distribution</u>		
		<u>U₃O₈</u>	<u>V₂O₅</u>	<u>Mo</u>
DV-69	Column Leach	48.4	11.8	73.8
DV-86	Agitation Leach	27.3	7.2	19.4

The Tyler Standard Screen Scale

5-28

Cumulative Logarithmic Diagram of Screen Analysis on Sample of Gunnison Site "Wet Shelby"

Name Head Sample

Date 8-27-81

SCREEN SCALE RATIO 1.414				○ % Wt.			△ % U308					
Openings		Tyler Mesh	U. S. No.	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights
Milli-meters	Inches											
26.67	1.060											
18.85	.742											
13.33	.525											
9.423	.371											
6.680	.263	3										
4.699	.185	4	4									
3.327	.131	6	6									
2.362	.093	8	8									
1.651	.065	10	12									
1.168	.046	14	16									
.833	.0328	20	20									
.589	.0232	28	30		5.38	5.38		0.00	0.00			
.417	.0164	35	40		4.74	10.12		5.97	5.97			
.295	.0116	48	50		4.52	14.64		5.97	11.94			
.208	.0082	65	70		--	--		--	--			
.147	.0058	100	100		27.49	42.14		34.33	46.27			
.104	.0041	150	140		7.23	49.37		4.48	50.75			
.074	.0029	200	200		14.41	63.77		13.43	64.18			
Pass	.074	200	200		36.23	100.00		35.82	100.00			
Totals,					100.00			100.00				

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METALLURGICAL RESULTS

Project No. 2354

Sample I.D. Gunnison Site
Wet Shelby

Test No.	Feed Composite
----------	----------------

Date 8/27/82

[illegible]

Remarks:

5.4 Selected Trace Elements

Approximately every tenth drill hole composite sample was assayed for Barium, Arsenic, Cadmium, Selenium, Iron, Lead, Silver, Chromium, and Radium 226. The elements analysis results are shown in Table 5.4.1.

The Radium 226 analysis was subcontracted to an outside laboratory specializing in this element. The analysis method used was bomb acid digestion with readings made by a Tennelec -System 5100.

The mercury analysis was made on the Shelby Tube samples as received from the field site. Laboratory control tests using a standard 10-gram per liter mercury solution mixed into pure silica samples showed oven drying at 50°C and 80°C resulted in an 80% mercury loss. The mercury analysis results are shown in Table 5.4.2.

TABLE 5.4.1

GUNNISON TAILINGS ELEMENT ANALYSIS

Section	Hole Number	% Ba	% As	% Cd	ppm Se	% Fe	% Pb	oz/Ton Ag	% Cr	pci/g Ra 226
C	010	0.05	0.015	0.00003	<1	1.74	0.010	0.023	0.012	138 <u>+25</u>
C	020	--	--	--	--	--	--	--	--	280 <u>+50</u>
D	021	0.02	0.023	0.00003	<1	1.87	0.010	0.023	0.010	---
A	030	--	--	--	--	--	--	--	--	236 <u>+42</u>
C	031	0.03	0.010	0.00004	<1	1.38	0.011	0.018	0.008	---
A	040	--	--	--	--	--	--	--	--	569 <u>+102</u>
C	041	0.02	0.026	0.00009	1	1.26	0.011	0.023	0.006	---
C	049	--	--	--	--	--	--	--	--	332 <u>+60</u>
C	050	0.013	0.015	0.00011	2	1.15	0.012	0.030	0.003	---
D	060	--	0.030	0.00012	<1	1.13	0.010	0.030	0.002	295 <u>+53</u>
B	070	--	0.015	<0.00003	<1	3.30	0.008	0.050	0.007	181 <u>+33</u>
B	080	0.033	0.018	0.00010	<1	2.00	0.009	0.050	0.005	259 <u>+47</u>
D	090	0.013	0.027	0.00011	3	1.20	0.010	0.030	0.008	391 <u>+70</u>
B	100	0.020	0.014	<0.00003	<1	1.13	0.009	0.050	0.003	308 <u>+55</u>
AVERAGE			0.019	0.00007	--	1.62	0.010	0.033	0.006	299 <u>+54</u>

TABLE 5.4.2
GUNNISON TAILINGS MERCURY ANALYSIS

<u>Section</u>	<u>Hole Number</u>	<u>Mercury in PPM</u>
A	025	<.5
C	046	<.5
C	051	<.5
C	057	<.5
A	065	<.5
B	072	<.5
B	076	<.5
D	084	<.5
D	092	<u><.5</u>
SITE AVERAGE		<.5

SECTION 6.0
ECONOMIC EVALUATION

SECTION 6.0

ECONOMIC EVALUATION

The Site Investigations (Section 4.0) and Amenability Testing (Section 5.0) Programs were undertaken to.

1. Determine the total tonnage of uranium, vanadium, and molybdenum bearing material at the site
2. The total quantities of uranium, vanadium and molybdenum available for extraction
3. The maximum extractability of these three metals
4. The best technical extraction method.

With the data established, the economic study in this section was undertaken to determine the potential profit to be gained from treatment of the tailings for recovery of any or all three metals present.

The study includes labor and reagent costs for a leach-solvent extraction process plant. As site excavation, haulage, and final deposition in a new location are beyond the scope of this project, the economic study is based upon delivery of material to and haulage of leached residue from the process plant at zero cost. Accordingly, any net profit from processing the tailings should be used as the basis of a separate study directed to excavation, transportation and redeposition in a new location or at the same location.

6.1 Summary Analysis

The Gunnison Site contains an estimated 738,368 dry short tons (DST) of tailings and subbase material containing 80,417 lbs of U_3O_8 , 123,514 lbs of V_2O_5 and 46,101 lbs of molybdenum as Mo. Average assays are, respectively, 0.0055% U_3O_8 , 0.0098% V_2O_5 , and 0.0037% Mo, with the moisture content calculated at 11.74%.

The vanadium and molybdenum contents of the subbase material were not determined but it is assumed that these metals have migrated to some degree along with the uranium. Based upon this assumption, the quantities of vanadium and molybdenum available for recovery are considered to be minimum for the entire site.

Current prices used in the evaluation are as follows:

U ₃ O ₈ (yellowcake)	\$23.00/lb
V ₂ O ₅ (Vanadic Acid or Acid Red Cake)	3.00/lb
Mo (MoS ₂ 95%)	8.50/lb

Total Recoverable Value

Based upon 48%, 12% and 74% extraction values, respectively, recoverable values without adjustment for solution and precipitation losses are on the order of 38,600 lbs U₃O₈, 14,822 lbs V₂O₅ and 34,115 lbs Mo. The value would be:

		<u>Total</u>	<u>Per Ton Feed</u>
U ₃ O ₈ :	38,600 x \$23.00 =	\$ 887,800	\$1.20
V ₂ O ₅ :	14,822 x 3.00 =	44,466	0.06
Mo:	34,115 x 8.50 =	<u>289,978</u>	<u>0.39</u>
TOTAL		\$1,222,244	\$1.65

The very low dollar value of recoverable metal from the Gunnison Site precludes the possibility of reprocessing this material at a profit. This conclusion is based upon the following:

Production of vanadium from this site is neither technically or economically feasible. Production of uranium and molybdenum is technically, but not economically feasible, as illustrated below.

Capital Cost - A 1000-ton per day capacity plant would provide for treatment of the 738,368 DST of tailings and subbase in two years. The capital cost of a similar 1000-ton per day plant at Tuba City to produce uranium and molybdenum products is estimated at \$8,876,100. It is assumed a plant at Gunnison would cost an equal amount.

Operating Cost - Annual operating costs for Tuba City are estimated to be in the range of \$5,500,000. Adjusting for the very high acid cost at Tuba City, annual operating costs of \$3,750,000 appear reasonable. This is equal to \$10.42 per ton to be treated.

Based upon the above, the economics of treating this material is as follows:

Capital Cost	\$8,896,000
Operating Cost	<u>7,691,000</u>
TOTAL ESTIMATED COST	\$16,587,000
Marketable Production (U + Mo)	<u>1,178,000</u>
Profit or (Loss)	(\$15,409,000)

Note: Costs rounded to \$000.

In order to break even, the market prices of uranium and molybdenum would have to increase to the levels shown below:

$$\$16,587,000 / 1,178,000 = 14.1$$

$$\text{U}_3\text{O}_8: \$23.00 \times 14.1 = \$324.30/\text{lb}$$

$$\text{Mo}: 8.50 \times 14.1 = \$119.85/\text{lb}$$

A P P E N D I X A

SECTION 7

LABORATORY TEST DATA SHEETS

GUNNISON TEST DATA LISTING

<u>Test Number</u>	<u>Test Type</u>	<u>Leach Time</u>	<u>Section</u>
DV-12	Acid Agitation	24 Hours	A
DV-13	Acid Agitation	24 Hours	B
DV-14	Acid Agitation	24 Hours	C
DV-15	Acid Agitation	24 Hours	D
DV-16	Acid Agitation	24 Hours	Site
DV-28	Alkaline Agitation	24 Hours	A
DV-29	Alkaline Agitation	24 Hours	B
DV-30	Alkaline Agitation	24 Hours	C
DV-31	Alkaline Agitation	24 Hours	D
DV-32	Alkaline Agitation	24 Hours	Site
DV-39	Alkaline 100° C	24 Hours	Site
DV-41	Acid Agitation	24 Hours	*Wet
DV-43	Alkaline Agitation	24 Hours	*Wet
DV-46	Alkaline Agitation	72 Hours	Site
DV-69	Acid Column	19 Hours	Site
DV-82	Acid Agitation	72 Hours	A
DV-83	Acid Agitation	72 Hours	B
DV-84	Acid Agitation	72 Hours	C
DV-85	Acid Agitation	72 Hours	D
DV-86	Acid Agitation	72 Hours	Site

*Wet Shelby Tube Site Composite

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-A Type Acid Bottle Test No. DV-12

Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 1.0 Time 24 hours Reagent H₂SO₄ Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
7-30	0		/27°	3.9/ 1.0		27 cc	50 cc	
	3				270			Gross weight of leach bottle: 2121.4 g
	3½				/470			Tare weight of bottle: 1057.1 g
	4			1.0	510			Mechanical Agitation: 4 hours Bottle Roll: 20 hours
	24		/29°	1.0	630			Leach start: 1030 hrs, 7/30 Leach end: 1030 hrs, 7/31
						acid consumed		Preg & Wash free H ₂ SO ₄ = 23.9 g/l
						59.2 Lb/T		

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	1380 cc/282.2%	0.00071	0.0003	0.0007	--	0.0020	0.0008	0.0020	40.82	8.16	40.00
Leach Residue	489 g/100%	0.0029	0.009	0.003		0.0029	0.009	0.0030	59.17	91.84	60.00
Calculated Head		0.0049	0.01	0.005		0.0049	0.0098	0.0050			
Assayed Head		0.0071	0.01	0.004							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-B Type Acid Bottle Test No. DV-13
Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 1.0 Time 24 hours Reagent H₂SO₄ Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
7-30	0		/27°	1.0/ 3.6		24 cc	46.1 cc	
	3				280			Gross weight of leach bottle: 2042.9 g
	3				420/			Tare weight of bottle: 967.0 g
	4			1.0	500			Leach start = 1030 hours, 7/30 Leach end = 1030 hours, 7/31
	24		/29°	1.3	650			Mechanical agitation: 4 hours Bottle Roll: 20 hours
						acid consumed		Preg & Wash H ₂ SO ₄ : 26.4 g/l
						41.2 Lb/T		

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & WASH	1220 cc/251%	0.00102	0.0003	0.0006	0.160	0.0026	0.0008	0.0015	40.63	4.41	33.33
Leach Residue	486 g/100%	0.0038	0.010	0.003		0.0038	0.010	0.003	59.37	95.59	66.67
Calculated Head		0.0064	0.01	0.005		0.0064	0.0108	0.0045			
Assayed Head		0.0076	0.01	0.003							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-C Type Acid Bottle Leach Test No. DV-14
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 1.0 Time 24 hours Reagent H₂SO₄ Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
7/30	0		/27°	3.4/ 1.0		29 cc	50 cc	
	3				280			Gross weight of leach bottle: 3194.5 g
	3				400/			Tare weight of bottle: 1213.7 g
	4			1.0	470			Leach start: 1030 hours, 7/30 Leach end: 1030 hours, 7/31
	24		/28°	1.3	600			
						acid consumed		Preg & Wash free H ₂ SO ₄ = 21 g/l
						38.8 Lb/T		

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	1520 cc/154 %	0.01436 0.001436	0.001 0.0001	0.009 0.0009	1.57 --	0.0022	0.0002	0.0014	35.48	2.78	21.88
Leach Residue	988.9 g/100%	0.0040	0.007	0.005		0.0040	0.007	0.005	64.52	97.22	78.12
Calculated Head		0.0062	0.01	0.006		0.0062	0.0072	0.0064			
Assayed Head		0.0092	0.01	0.004							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-D Type Acid Bottle Test No. DV-15
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 1.0 Time 24 hours Reagent H₂SO₄ Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
7-30	0		/27°	3.4/ 1.0		23 cc	79.1 cc	
	3				320/ 410			Gross weight of leach bottle: 3206.1 g
	4			1.0	470			Tare weight of bottle: 1206.4 g
	24		/28	1.3	610			Leach start = 1030 hours, 7/30 Leach end = 1030 hours, 7/31
								Mechanical agitation: 4 hours Bottle Roll: 20 hours
						acid consumed		Preg & Wash H ₂ SO ₄ : 16.3 g/l
						29 Lb/T		

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	1610 cc/164%	0.00144	0.0002	0.0007	0.193	0.0024	0.0003	0.0011	32.00	4.11	26.83
Leach Residue	982g/100%	0.0051	0.007	0.003		0.0051	0.007	0.003	68.00	95.89	73.17
Calculated Head		0.0075	0.01	0.004		0.0075	0.0073	0.0041			
Assayed Head		0.0091	0.01	0.003							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-Site Comp. Type Acid Bottle Leach Test No. DV-16
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 1.0 Time 24 hrs. Reagent H₂SO₄ Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
7-30	0		/27°	3.3/ 1.0		29 cc	86 cc	
	3				340			Gross weight of leach bottle: 3217.7 g
	3				410/			Tare weight of bottle: 1195.4 g
	4			1.0	490			Leach start: 1030 hours, 7/30 Leach end: 1030 hours, 7/31
	24		/29°	1.3	620			Mechanical agitation: 4 hours Bottle Roll: 20 hours
						acid consumed		Preg & Wash H ₂ SO ₄ = 17.5 g/l
						22.9 g/ 45.8 Lb/T		

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	1620 cc/ 165%	0.00129	0.0003	0.0007	0.173	0.0021	0.0005	0.0012	33.87	4.11	23.08
Leach Residue	983 g/100 %	0.0041	0.007	0.004		0.0041	0.007	0.004	66.13	95.89	76.92
Calculated Head		0.0062	0.01	0.005		0.0062	0.0075	0.0052			
Assayed Head		0.0084	0.01	0.004							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample Gunnison-A Type Alkaline Bottle Test No. DV-28
Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 9-10 Time 24 hours Reagent Na₂CO₃ Auxil. Reagent NaHCO₃, KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-5	0	408 ml	/28	3.9		3.1 g	10.2 g	
	1			8.9/ 9.8				
	2			9.8/	160			Tare Weight: 999.6 g) Gross Weight: 2073.9 g) 1074.3 g
	3			9.8				Added: 8cc NaOH (20%), 0.5 g KMnO ₄
	24		/31	9.7	150			
		wash 250 ml						
		wash 250 ml				final preg	final preg	
						9.0 g	1.9 g	Final Preg, Titration

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	830 cc	*	*	*		0.0025	0.0008	0.0071	9.77	1.63	42.51
Leach Residue	482 g	0.0048	0.01	0.002		0.0231	0.0482	0.0096	90.23	98.37	57.49
Gram Weight Feed Content						0.0256	0.0490	0.0167	100.00	100.00	100.00
Calculated Head (in %)		0.0051	0.01	0.003		0.0053	0.01	0.003			
Assayed Head (in %)		0.0071	0.01	0.004							

* Preg & Wash Assay in g/l

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample Gunnison-B Type Alkaline Bottle Test No. DV-29
Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 9-10 Time 24 hours Reagent Na₂CO₃ Auxil. Reagent NaHCO₃, KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-5	0	408 ml	/28	3.5		3.1 g	10.2 g	
	1			11.0/ 10.4				
	2			10.4/ 10.4	140			Tare Weight: 1025.7 g) 1080.2 g net Gross Weight: 2105.9 g)
	24		/31	10.3	190			Added: 17 cc NaOH (20%) and 0.5 g KMnO ₄
		wash 250 ml						
		wash 250 ml				final preg	final preg	
						8.8 g	3.7 g	Final Preg Titration

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	730 cc	0.00072	0.0001	0.00098		0.0050	0.0007	0.0068	17.42	1.17	31.48
Leach Residue	493 g	0.0048	0.012	0.003		0.0237	0.0592	0.0148	82.58	98.83	68.52
Gram Weight Feed						0.0287	0.0599	0.0216	100.00	100.00	100.00
Calculated Head (in %)		0.0057	0.01	0.004		0.0058	0.0001	0.004			
Assayed Head (in %)		0.0076	0.01	0.003							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample Gunnison-C Type Alkaline Bottle Test No. DV-30
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 9-10 Time 24 hours Reagent Na₂CO₃ Auxil. Reagent NaHCO₃, KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-5	0	816 ml	/28	3.3		6.1 g	20.4 g	
	1			7.9/ 10.0				Tare Weight: 1208.4 g) 2022.5 g Gross Weight: 3230.9 g)
	2			10.0/ 10.0	140			Added: 21cc NaOH (20%) and 1.0 g KMnO ₄
	24		/31	10.0	130			
		wash 250 ml						
		wash 250 ml						
						final preg	final preg	
						18.6 g	6.2 g	Final preg titration

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	1130 cc	* 0.00133	* 0.0001	* 0.00136		0.0158	0.0011	0.0147	23.83	1.22	33.11
Leach Residue	990 g	0.0051	0.009	0.003		0.0505	0.0891	0.0297	76.17	98.78	66.89
Gram Weight Feed						0.0663	0.0902	0.0444	100.00	100.00	100.00
Calculated Head	%	0.0066	0.01	0.004		0.0067	0.0001	0.004			
Assayed Head	%	0.0092	0.01	0.004							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample Gunnison-D Type Alkaline Bottle Test No. DV-31
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 9-10 Time 24 hours Reagent Na₂CO₃ Auxil. Reagent NaHCO₃, KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-5	0	816 ml	/28	3.2		6.1 g	20.4 g	
	1			8.5/ 9.9				
	2			9.9/ 9.9	160			Tare Weight: 1172.6 g) Gross Weight: 3167.1 g) 1994.5 g net
	24		/31	9.8	130			Added: 17cc NaOH (20%) and 1.0 g KMnO ₄
		wash 250 ml						
		wash 250 ml				final preg	final preg	
	total=	1316 ml				19.3 g	5.1 g	Final Preg Titration

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	950 cc	* 0.00115	* 0.0001	* 0.00145		0.0103	0.0009	0.0130	16.43	1.00	56.77
Leach Residue	989 g/100%	0.0053	0.009	0.001		0.0524	0.0890	0.0099	83.57	99.00	43.23
Gram Weight Feed Content						0.0627	0.0899	0.0229	100.00	100.00	100.00
Calculated Head (%)		0.0063	0.01	0.002		0.0063	0.0001	0.002			
Assayed Head (%)		0.0091	0.01	0.003							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample Gunnison-Site Type Alkaline Bottle Test No. DV-32
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50 % pH 9-10 Time 24 hours Reagent Na₂CO₃ Auxil. Reagent NaHCO₃, KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-5	0	816 ml	/28	3.5		6.1 g	20.4 g	
	1			8.0/ 9.9				Tare Weight: 1221.4 g) 2016.8 Gross Weight: 3238.2 g)
	2			9.9/ 9.9	150			Added: 19 cc NaOH (20%) and 1.0 g KMnO ₄ at start
	24		/31	9.8	130			
		wash 250 ml						
		wash 250 ml						
						final preg	final preg	
	total	1316 ml				17.5 g	5.0 g	Final preg titration

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	900 c	* 0.00121	* ND	* 0.0014		0.0100	ND	0.0118	19.08	0.00	54.13
Leach Residue	988 g	0.0043	0.012	0.001		0.0424	0.1186	0.0100	80.92	100.00	45.87
Gram Weight Feed Content						0.0524	0.1186	0.0218	100.00	100.00	100.00
Calculated Head (%)		0.0052	0.01	0.002		0.0053		0.002			
Assayed Head (%)		0.0084	0.01	0.004							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-Site Comp. Type Alkaline Autoclave Test No. DV-39

Weight Solids 500 g Size of Grind - 10 Mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50 (%) pH 9-10 Time 24 hrs Reagent Na₂CO₃ Auxil. Reagent KMnO₄ ; NaHCO₃

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-12	0	500	/23	4.3		3.1 g	15 g	Leach Start: 0730, 8/12 Leach End: 0720, 8/13
	1/4			8.1				Tare wt: 5998 g) Gross wt: 7156 g) 1158 g
	1/2			10.2	120			KMnO ₄ : 0.5 g NaOH: 8.4 cc (25%)
								0900: 100°C temp.
			100°C					Titration factor: 0.968 pH 8.2 @ 108.5 cc; pH 4.0 @ 339.5 cc
8-13	24		100°C	10.2	70			Note: 1 250 cc Na ₂ CO ₃ wash 2 250 cc H ₂ O washes
						Final Preg. 12.36 g.	Final Preg. 3.66 g.	

METALLURGICAL BALANCE		ASSAY				CONTENT g			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	1320 cc	0.0052	0.001	0.0143	--	0.0069	0.0013	0.0191	15.44	2.58	79.58
Leach Residue	490.0 g	0.0077	0.01	0.001		0.0378	0.0490	0.0049	84.56	97.42	20.42
Gram wt. feed						0.0447	0.0503	0.0240	100.00	100.00	100.00
Calculated Head	%	0.0089	0.01	0.005							
Assayed Head	%	0.0084	0.01	0.004							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample Wet Shelby Tube G-Comp. Type Acid Bottle Roll Test No. DV-41

Weight Solids 500 g Size of Grind _____ Site Name Gunnison

LEACH CONDITIONS

Solids 50 (%) pH 1.0 Time 24 hrs Reagent H₂SO₄ (96.5%) Auxil. Reagent NaClO₃ (9%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
8-12	0	410	27	4.0		13.8 cc	0	Leach start: 1000 hrs., 8/12 Leach end: 1000 hrs., 8/13
	1/4			1.0				Tare wt: 987.6 Gross wt: 2026.4
	1/2			1.1				
	1			1.0				
	1 1/4			1.0	470			
	1 1/2			1.0				
8-13	24		/27	1.2	450	Acid Consumed		Preg. & wash free acid = 12.9 g/l
						32.4 lb/T		

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg. & Wash	1340 cc/ 2.93	0.0087 0.00087	0.001 0.0001	0.0012 0.00012	0.700 0.0700	0.0025	0.0003	0.0004	26.88	2.91	11.76
Leach Residue	457.1 g/1.00	0.0068	0.01	0.003	--	0.0068	0.0100	0.0030	73.12	97.09	88.23
									100.00	100.00	100.00
Calculated Head		0.0093	0.01	0.003		0.0093	0.0103	0.0034			
Assayed Head		0.0062	0.01	0.003							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-Comp. (Wet Shelby Tube) Type Alkaline Bottle Roll Test No. DV-43
Weight Solids 500 g Size of Grind _____ Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 9-10 Time 24 hrs Reagent Na₂CO₃ Auxil. Reagent NaHCO₃ KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-13	0	410	/28	4.5		3.1 g	20 g	Leach start: 1345 hours, 8/13 Leach end: 1345 hours, 8/14
	1/4			10.2				Tare Weight: 999.3 g) 1024.7 net Gross Weight: 2024.0 g)
	3/4			10.1				pH 8.2 @ 236.9 ml; pH 4.0 @ 598.0 ml Titration Factor: 0.986
	1			10.1	140			1-250 ml Na ₂ CO ₃ wash 2-250 ml H ₂ O washes
8-14	24		/29	10.1	150			Added 0.5 g KMnO ₄ and 5 cc NaOH (20%) for pH adjustment at start
		wash 250 ml						
		wash 250 ml				final preg	final preg	Final preg titration
						29.9 g	12.4 g	

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	860 cc	* 0.00056	* 0.0001	* 0.0004	--	0.0047	0.0008	0.0034	13.35	1.70	19.65
Leach Residue	462.6	0.0066	0.01	0.003		0.0305	0.0463	0.0139	86.65	98.30	80.35
Gram Weight Feed Content						0.0352	0.0471	0.0173	100.00	100.00	100.00
Calculated Head (in %)		0.0076	0.01	0.003		0.0076	0.01	0.003			
Assayed Head (in %)		0.0062	0.01	0.003							

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-Site Comp. Type Alkaline Bottle Test No. DV-46

Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50% (%) pH 10 Time 72 hours Reagent Na₂CO₃ Auxil. Reagent NaHCO₃, KMnO₄

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	NaHCO ₃ Add/Use	Na ₂ CO ₃ Add/Use	Remarks
8-14	0	410	/26	4.1		3.1 g	20 g	Leach Start: 0845, 8/14 Leach End: 0845, 8/17
	1/2			7.7				Tare Weight: 1026.4 g) 1055.4 g net Gross Weight: 2081.8 g)
	1			10.2				Titration Factor: 0.986 pH 8.2 @ 210.7 ml; pH 4.0 @ 590.2 ml
	2			10.0				Added 8 cc NaOH (20%) at start; 0.5 g KMnO ₄
	6			10.4				
8/17	71			10.1				
	72		/25	10.1	110	final preg	final preg	
						17.4 g	6.1 g	Final Preg Titration

METALLURGICAL BALANCE		ASSAY (%)				CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg & Wash	830 cc	0.*0110	0.*001	0.*010		0.0089	0.0008	0.0081	21.24	1.34	35.37
Leach Residue	492.0	0.0067	0.012	0.003		0.0330	0.0590	0.0148	78.76	98.66	64.63
Gram Weight Feed Content						0.0419	0.0598	0.0229	100.00	100.00	100.00
Calculated Head (%)		0.0084	0.01	0.004		0.0085		0.004			
Assayed Head (%)		0.0084	0.01	0.004							

COLUMN LEACH DATA

GUNNISON SITE TEST NO. DV-69

Leach Time Days	(Liter) Effluent Volume	Effluent Assay (g/l)				g Content			Cumulative % Extraction		
		U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
1	0.890	0.1035	0.019	0.057	16.0	0.0921	0.017	0.0510	34.42	4.86	42.43
2	1.080	0.0166	0.007	0.0137	2.70	0.0179	0.008	0.0150	41.11	7.14	54.91
3	1.120	0.0054	0.002	0.0031	0.550	0.0060	0.002	0.0030	43.35	7.72	57.40
4	1.120	0.0015	0.004	0.0023	0.350	0.0020	0.004	0.0026	44.10	8.86	59.57
5	0.980	0.0019	0.003	0.002	0.350	0.0018	0.0029	0.0019	44.77	9.69	61.15
6	1.035	0.0012	0.001	0.002	0.300	0.0012	0.0010	0.0020	45.22	9.97	62.81
7	1.300	N.D.	0.001	0.001	0.24	N.D.	0.001	0.0010	45.22	10.26	63.64
8	1.120	N.D.	0.001	0.001	0.22	N.D.	0.001	0.0010	45.22	10.55	64.48
9	1.130	0.0037	0.001	0.002	0.18	0.0040	0.001	0.0020	46.71	10.83	66.14
10	1.030	N.D.	0.001	0.002	0.17	N.D.	0.001	0.0020	46.71	11.12	67.80
11	0.900	N.D.	N.D.	0.001	0.16	N.D.	N.D.	0.0010	46.71	11.12	68.64
12	1.090	0.0019	N.D.	0.001	0.14	0.0020	N.D.	0.0010	47.46	11.12	69.47
13	0.940	0.0012	N.D.	0.001	0.15	0.0011	N.D.	0.0010	47.87	11.12	70.30
14	1.120	0.0012	0.001	0.001	0.14	0.0015	0.001	0.0010	48.43	11.41	71.13
15	1.155	N.D.	0.001	0.001	0.15	N.D.	0.001	0.0010	48.43	11.69	71.96
16	0.290	N.D.	0.001	0.001	0.08	N.D.	0.0003	0.0003	48.43	11.78	72.21
17	0.50	N.D.	0.001	0.001	0.15	0	0	0	48.43	11.78	72.21
Wash	1.880	N.D.	0	0	0.023	0	0	0.0019	48.43	11.78	73.79
Drain	0.045	N.D.	0.002	N.D.	--	0	0	0	48.43	11.78	73.79
Residue	2825 g	0.0033	0.0057	0.0022	--	0.1380	0.3087	0.0315	51.57	88.22	26.21

	<u>% U₃O₈</u>	<u>% V₂O₅</u>	<u>% Mo</u>
Calculated Feed	0.0089	0.01	0.004
Assay Feed	0.0084	0.01	0.004

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-A Type Acid Bottle Test No. DV-82
Weight Solids 500 g Size of Grind - 10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50 (%) pH 1.0 Time 72 hrs Reagent H₂SO₄ (96.5%) Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
9-14	0	409	27	3.4		18.6 ml	0	Leach start: 1330, 9/14 Leach end: 1330, 9/17
	1/2			1.0	430			Tare wt: 992.5 g Gross wt: 2008.6 g
9-15	24			1.0				Final gross wt: 2309.3 g
9-16	48			1.1				
9-17	72		28	1.2	420			Preg/Wash free acid 11.3 g/l
						acid		
						consumption 54 #/Ton		

METALLURGICAL BALANCE solution assays in g/l		ASSAY g/l				gm CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume	U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg #1	25 ml (516 ml)	0.0169	0.008	0.011	1.80	0.0004	0.0002	0.0003	32.1	8.3	29.1
Preg #2	25 ml (666 ml)	0.0115	0.010	0.007	1.65	0.0003	0.0003	0.0002	29.6	13.8	25.5
Preg/Wash	1720 ml	0.0050	0.002	0.003	0.65	0.0086	0.0034	0.0052	34.2	7.9	29.0
Leach Residue	459.3 g	0.0039	0.01	0.003		0.0179	0.0459	0.0138	65.8	92.1	71.0
Calculated Head		0.0054	0.01	0.004		0.0272	0.0498	0.0195			
Assayed Head		0.0071	0.01	0.004	--	0.0295	0.05	0.02			

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-B Type Acid Bottle Test No. DV-83
Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnisison

LEACH CONDITIONS

Solids 50 (%) pH 1.0 Time 72 hrs Reagent H₂SO₄ (96.5%) Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
9-14	0	409	28	3.0		16.2 ml	0	Leach start: 1330, 9/14 Leach end: 1330, 9/17
	½			1.0	430			Tare wt: 1006.9 g Gross wt: 2027.5 g
9-15	24			1.1				Final gross wt: 2220.7 g
9-16	48			1.1				
9-17	72		28	1.3	420			
						acid consumption 41 #/Ton		Preg/wash free acid 11.9 g/l

METALLURGICAL BALANCE			Solution assay in g/l ASSAY (%)				gm CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume		U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg #1	25 ml	(521 ml)	0.0213	0.007	0.011	1.80	0.0005	0.0002	0.0003	36.6	7.4	34.5
Preg #2	25 ml	(618 ml)	0.0178	0.019	0.006	2.17	0.0004	0.0005	0.0002	38.0	24.2	24.1
Preg/Wash	1550 ml		0.0072	0.002	0.003	0.77	0.0112	0.0031	0.0047	39.8	7.7	31.0
Leach Residue	455.8 g		0.0040	0.01	0.0025		0.0182	0.0456	0.0114	60.2	92.3	69.0
Calculated Head			0.0061	0.01	0.003		0.0303	0.0494	0.0166			
Assayed Head			0.0076	0.01	0.003		0.030	0.05	0.015			

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-C Type Acid Bottle Test No. DV-84
Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnision

LEACH CONDITIONS

Solids 50 (%) pH 1.0 Time 72 hrs Reagent H₂SO₄ (96.5%) Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
9-15	0	409	/25	3.2		8.4	0	Leach start: 0830, 9/15 Leach end: 0830, 9/18
	1			1.1				Tare wt: 1085.5 g Gross wt: 2106.7 g
	2 ½			1.0	420			Final gross wt: 2197.6 g
9-16	24			1.3				
9-17	48			1.4				
9-18	72		25	1.3	410	acid		
						consumption 22#/Ton		Preg/Wash free acid 6.5 g/l

METALLURGICAL BALANCE			Solution assays in g/l ASSAY (%)				gm CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume		U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg #1	25 ml	(521 ml)	0.0214	0.004	0.007	1.53	0.0005	0.0001	0.0002	31.9	3.5	17.0
Preg #2	25 ml	(567 ml)	0.0205	0.004	0.007	1.29	0.0005	0.0001	0.0002	34.6	4.0	19.5
Preg/Wash	1460 ml		0.0083	0.002	0.002	0.49	0.0121	0.0121	0.0029	37.5	5.2	15.5
Leach Residue	476.0 g		0.0046	0.01	0.0038		0.0219	0.0476	0.0181	62.5	94.8	84.5
Calculated Head			0.0070	0.01	0.004		0.0350	0.0599	0.0214			
Assayed Head			0.0092	0.01	0.004	--	0.0365	0.05	0.02			

HR

24

48

72

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-D Type Acid Bottle Test No. DV-85
Weight Solids 500 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50 (%) pH 1.0 Time 72 hrs Reagent H₂SO₄ (96.5%) Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
9-15	0	409	25	3.1		9.2 ml	0	Leach start: 0830, 9/15 Leach end: 0830, 9/18
	1			1.1				Tare wt: 959.4 g Gross wt: 1974.3 g
	2½			1.0	420			Final gross wt: 2078.7 g
9-16	24			1.3				
9-17	48			1.1				
9-18	72		25	1.1	410	acid		
						consumption 25 #/Ton		Preg/wash free acid 7.3 g/l

METALLURGICAL BALANCE			Solution assay in g/l ASSAY (%)				gm CONTENT			DISTRIBUTION (%)		
Product			U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg #1	25 ml	(515 ml)	0.0124	0.003	0.005	1.21	0.0003	0.0001	0.0001	17.2	3.1	17.6
Preg #2	25 ml	(567 ml)	0.0169	0.003	0.006	1.31	0.0004	0.0001	0.0002	26.6	3.4	24.0
Preg/Wash	1370 ml		0.0072	0.002	0.002	0.57	0.0099	0.0027	0.0027	28.5	6.0	20.8
Leach Residue	465.3 g		0.0057	0.01	0.0025		0.0265	0.0465	0.0116	71.5	94.0	79.2
Calculated Head			0.0074	0.01	0.003		0.0371 0.0074	0.0494 0.011	0.0146 0.003			
Assayed Head			0.0091	0.01	0.003	--	0.0375	0.05	0.015			

24hr
48hr
72hr

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URANIUM TAILINGS LEACH TEST DATA

Project No. 2354 Sample G-Site Type Acid Bottle Test No. DV-86
Weight Solids 1000 g Size of Grind -10 mesh Site Name Gunnison

LEACH CONDITIONS

Solids 50 (%) pH 1.0 Time 72 hrs Reagent H₂SO₄ (96.5%) Auxil. Reagent NaClO₃ (20%)

Sample Date/No.	Time (Hrs.)	Volume (ml)	Temp. °F/°C	pH	EMF	H ₂ SO ₄ Add/Use	NaClO ₃ Add/Use	Remarks
9-15	0	818	26	3.0		23.6 ml	0	Leach start: 0830, 9/15 Leach end: 0830, 9/18
	1			1.1				Tare wt: 1292.2 g Gross wt: 3220.8 g
	2½			1.0	430			Final Gross wt: 3294.6 g
9-16	24			1.3				
9-17	48			1.3				
9-18	72		25	1.3	410	acid		
						consumption 4l #/Ton		Preg/wash free acid 13.5 g/l

METALLURGICAL BALANCE			Solution assays in g/l ASSAY (%)				gm CONTENT			DISTRIBUTION (%)		
Product	Weight/Volume		U ₃ O ₈	V ₂ O ₅	Mo	Fe	U ₃ O ₈	V ₂ O ₅	Mo	U ₃ O ₈	V ₂ O ₅	Mo
Preg #1	25 ml	(929 ml)	0.0157	0.004	0.007	1.43	0.0004	0.0001	0.0002	18.7	3.7	17.4
Preg #2	25 ml	(1003 ml)	0.0244	0.004	0.010	2.10	0.0006	0.0001	0.0003	31.5	4.1	27.4
Preg/Wash	1560 ml		0.0128	0.003	0.005	1.10	0.0200	0.0047	0.0078	26.92	4.8	22.3
Leach Residue	966.1 g		0.0059	0.01	0.003		0.057	0.0966	0.0290	73.08	95.2	77.7
Calculated Head			0.0078	0.01	0.004		0.078	0.1015	0.0373			
Assayed Head			0.0084	0.01	0.004							

HR

24

48

72

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