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CORPORATE MANAGER  
RECLAMATION

ENVIRONMENTAL, HEALTH, SAFETY  
AND GOVERNMENT AFFAIRS

February 26, 2001

UPS Next Day Air: 1Z 875 261 01 1002 006 8

Mr. Philip Ting, Branch Chief  
U.S. Nuclear Regulatory Commission  
Fuel Cycle Licensing Branch, MS T-8A33  
11545 Rockville Pike  
Washington, DC 20555-0001

RE: Docket No. 40-8903  
License No. SUA-1471  
Semi-Annual Environmental Monitoring Report  
Period - July through December 2000

Dear Mr. Ting:

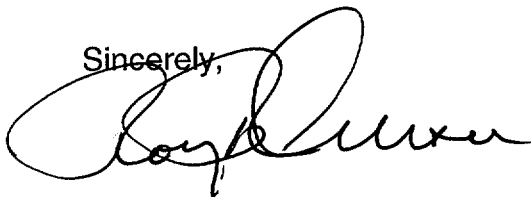
Pursuant to US Nuclear Regulatory Commission Regulation 10 CFR 40.85 and Part 20, Homestake Mining Company of California hereby submits two (2) copies of their semi-annual report for the second half of 2000 (July - December) for the Homestake Grants Project.

The content of the attached semi-annual report follows the general theme used for previously submitted reports. Pursuant to License Condition No. 15 of Amendment 31, the ground water data included with the report represents the results received from the point of compliance (POC) wells and the background P for this time period.

Homestake continued testing the effectiveness of the re-injected RO product water on the aquifer restoration program during the second half of 2000. The RO operated at an average of 295 gpm while producing product water, for re-injection, at an average of 252 gpm. The results to date are very encouraging. It appears that using the very pure water has a positive effect on restoration. However, it is to early to really measure the potential effect on the overall closure schedule.

If you or your staff have any questions or comments regarding this report, please do not hesitate to contact me at the Grants site (505) 287-4456.

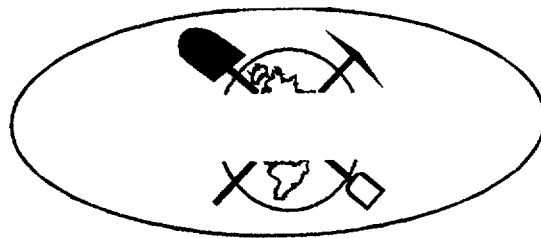
Sincerely,

A handwritten signature in black ink, appearing to read 'Philip Ting', written over the word 'Sincerely,'.

Enclosure

xc: Mr. Blair Spilzberg, Chief, Decommissioning Branch, w/enclosure  
Mr. Harold F. Barnes, Director EHSG&A, SFO, w/enclosure  
Mr George Hoffman, Hydro Engineering, w/enclosure  
File HMC Grants

**HOMESTAKE MINING COMPANY  
OF  
CALIFORNIA  
GRANTS PROJECT**



**SEMI-ANNUAL ENVIRONMENTAL  
REPORT**

**JULY – DECEMBER**

**2000**

**State of New Mexico DP-200  
U.S. Nuclear Regulatory Commission License SUA-1471**

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## 1.0 INTRODUCTION

This Semi-Annual Environmental Monitoring Report summarizes effluent monitoring data recorded for Homestake Mining Company of California - Grants Project (Homestake) from July through December 2000. The submittal of this report to the appropriate Nuclear Regulatory Commission (NRC) Regional Office and State of New Mexico within 60 days after January 1, and July 1 for each year of operation is required for all uranium mill facilities pursuant to 10 CFR Part 40.65. The monitoring data and the report format have been selected by Homestake representatives to satisfy the requirements of 10 CFR Part 40.65.

Homestake's monitoring and surveillance program for radioactive effluent releases have been designed to ensure the project compliance with 10 CFR Part 40, and Part 20 U.S. NRC Standards for Protection Against Radiation and closely approximates programs as described in NRC's Regulatory Guide 4.14, Radiological Effluent and Environmental Monitoring at Uranium Mills. Some effluent monitoring activities differ from those presented in the Regulatory Guide 4.14 as required by Homestake's Radioactive Materials License (SUA-1471).

Recontouring reclamation activities began in September 1993 and mill demolition commenced in late October 1993 and was completed December 10, 1995. A mill decommissioning completion report was submitted in February 1996 and approved by the NRC on January 28, 1999. The large tailings pile has been recontoured and covered with interim cover on the top and radon barrier on the outcrops. Bedding and erosion protection was placed on outcrops. Soil verification of the removal of off-pile contaminated soil is complete; the completion report submitted December 18, 1995 and approved by the NRC on January 29, 1999. In addition, a decommissioning report for the mine ion-exchange (IX) plant was completed and approved on December 22, 1997.

During the 2000 reporting period Homestake operated a water treatment plant or reverse osmosis (RO) plant. The plant was constructed in 1999 and began full operation in January 2000. For the operating year of 2000 the RO plant processed an average 295 gpm while producing an average of 252 gpm of product water that was used for re-injection.

Homestake has been testing the effectiveness of the re-injected RO product water on the aquifer restoration program for the past 12 months. The results to date are very encouraging. It appears that using the very pure water has a positive effect on restoration. However, it is too early to really measure the potential effect on the overall closure schedule.

A new Table 2 (8-99) was approved by the NRC on September 28, 2000, really too late in the year to be used; therefore, Table 2 (8-97) is used for this report.

Homestake's groundwater monitoring program, as outlined in license Condition No. 35 continued as an ongoing program during this period. The requirements set forth in Condition No. 35 include the reporting of both radiological and non-radiological water quality parameters for specified wells, as well as the documentation of water injection and collection volumes of the groundwater cleanup system. The performance review of the corrective action program is submitted annually as a separate document and contains the groundwater monitoring information for January 1 through December 31 of each year. In order to meet NRC's requirement for semi-annual reporting, groundwater-monitoring data for the point-of-compliance (POC) wells and background well P are

included in the semi-annual environmental monitoring reports. It should be noted that while these POC wells will eventually be used to demonstrate groundwater restoration, they are not representative of off-site effluent levels.

## **2.0 ENVIRONMENTAL MONITORING PROGRAMS**

The monitoring requirements for the site are summarized in Tables 1, 2, and 3. Details of the monitoring program are discussed in the following sections:

### **2.1 Air Particulate Monitoring**

Homestake continuously samples total suspended particulate at six locations around the reclamation site (see Figure 1). Those locations identified as HMC-1, HMC-2 and HMC-3 are areas at the property boundary expected to have the highest predictable concentrations of airborne radioactive particulate. The predominant wind direction is from the Southwest; accordingly, HMC-1, HMC-2 and HMC-3 are generally located down wind from Homestake's reclamation activities. The location identified at HMC-6 represents background conditions, and is located due west of the large tailings pile at the western most side of the property boundary. Locations HMC-4 and HMC-5 represent the sites of the nearest residences. The results are presented in Attachment 1.

Homestake uses a Sierra Instruments Model #305-200 High Volume Air Sampler (or equivalent) to continuously sample the ambient air of the locations shown in Figure 1. The samples are collected on 8-inch by 10-inch Whatman glass fiber filters (or equivalent) which are changed weekly or more frequently as required by dust loading. Energy Laboratories, Inc analyzes the collected samples quarterly for Natural Uranium, Radium-226, and Thorium-230.

### **2.2 Radon Gas Monitoring**

Radon gas concentrations are monitored on a continuous basis at the eight locations identified in Figure 1. The background station for radon gas is HMC #16, located Northwest of the site. Landauer Corporation's track-etch passive radon monitors (PRM), or the equivalent, are used to continuously monitor radon gas at each sampling location. Semi-annually, Homestake personnel place new alpha particle sensitive detectors at monitoring locations and the exposed detectors are retrieved and returned to Landauer Corporation for analysis. The technique by which the PRM detectors measure radon gas concentrations consists of exposing an alpha-particle sensitive plastic detector, which is mounted in a plastic container, to ambient air. The decay of radon gas contained in the ambient air causes imprint tracks on the alpha-sensitive detector that can then be counted at a later time. The radon gas concentration can subsequently be calculated by determining the number of tracks per unit area of the detector. A filter is placed over the container opening to inhibit the entrance of any alpha-emitting dust particles. The results are presented in Attachment 2.

### **3.0 WATER QUALITY MONITORING**

Table 2 (8-97) outlines the sampling frequency and parameters monitored. Additionally, the volumes of water injected and recovered as part of the ground-water cleanup program is monitored on a weekly frequency and the values are documented. A performance review report is submitted by March 31 of each year according to License Condition 35E. In order to comply with 10 CFR 40.65, the groundwater monitoring data for the POC wells and background well P are included in this Semi-Annual Environmental Report. These data are reported in Tables 2.1.1-2.1.9.

The Groundwater Monitoring Table 2 (8-97) was reviewed in 1999. As a result, a new Table 2 was developed; approved by the NMED on October 13, 1999; submitted for approval by the NRC on September 29, 1999, and approved September 28, 2000. Since NRC approval was received late in the year, the Groundwater Monitoring Table 2 (8-97) continued to be used during this monitoring period.

The water quality of the POC wells is currently being restored and therefore the reported levels are not representative of effluent from the site. The concentration levels are therefore not compared to 10 CFR 20 effluent limits. A hydraulic barrier forces the water in the aquifer near these POC wells to move in the direction of the collection wells where the water is withdrawn and treated.

### **4.0 DIRECT RADIATION**

Gamma exposure rates are continuously monitored through the use of thermoluminescent dosimeters (TLD) badges placed at each of the seven locations identified in Figure 1. HMC #16 is considered the background location for direct radiation. The data are reported in Attachment 3.

Each badge contains TLD's sealed in plastic for protection against the elements and radioactive particulate. Landauer, Inc. purchased Eberline's dosimetry business, discontinuing the practice of a six-month deployment period. At the end of the third quarter, the Eberline badges were retrieved and analyzed. Badges were then deployed for the fourth quarter.

### **5.0 SURFACE CONTAMINATION**

The Occupational Monitoring Program requirements are summarized in Table 3. The aspects related to contamination control are discussed briefly below.

#### **5.1 Personnel Skin and Clothing**

The monitoring of personnel for alpha contamination is required as part of all radiation work permits using standard operating procedures. No releases of personnel or clothing above administrative limits were reported during this reporting period.

#### **5.2 Survey of Equipment Prior to Release for Unrestricted Use**

Equipment surveys are required for all equipment that is to be removed from contaminated areas as specified in radiation work permits. Standard Operating Procedures are used for these surveys. No releases of contaminated material above NRC release criteria were reported.



## 6.0 LOWER LIMIT OF DETECTION

Homestake representatives have calculated the Lower Limit of Detection (LLD) for each measurement system, where applicable; to more accurately evaluate concentrations of radioactive material measured in the environment surrounding the mill site. The lower limit of detection is defined in the U.S. Nuclear Regulatory Guide 4.14 as the smallest concentration of radioactive material sampled that has a 95% probability of being detected, with only a 5% probability that a blank sample will yield a response interpreted to mean that radioactive material is present. Since the LLD is a function of sample volume, counting efficiency, radiochemical yield, etc., it varies for different sampling and analysis procedures.

For the individual measurement systems for which Homestake has calculated LLDs, the following formula was utilized:

$$LLD = \frac{4.66 S_b}{3.7 E 4 EVY \exp(-\lambda \Delta t)}$$

Where:

- LLD is the lower limit of detection (microCuries per milliliter);
- $S_b$  is the standard deviation of the instrument background counting rate (counts per second);
- $3.7 E 4$  is the number of disintegrations per second per microCurie;
- $E$  is the counting efficiency (counts per disintegration);
- $V$  is the sample volume (milliliters);
- $Y$  is the fractional radiochemical yield (when applicable);
- $\lambda$  is the radioactive decay constant for the particular radionuclide; and;
- $\Delta t$  is the elapsed time between sample collection and counting

The value of  $S_b$  used in the calculation of the LLD for a particular measurement system will be based on the actual observed variance of the instrument background counting rate. The laboratory has been instructed to report the LLD for each measurement considering all of the parameters associated with the measurement system and the sample size.

The vendor laboratory that performed the analyses reported herein has documented that the LLD for air and water samples will meet or exceed the requirements in Regulatory Guide 4.14. This assumes a minimum water sample size of 1 liter and an air sample volume of 2 E09 ml. Landauer, Inc reports the LLD for radon-222. The LLDs for the constituents are:

Ra-226, Th-230 in air	1 E-16 $\mu$ Ci/ml
Rn-222 in air	30 pCi(d/l)
U-nat in air	1 E-16 $\mu$ Ci/ml
U-nat in water	2 E-10 $\mu$ Ci/ml
Ra-226, Th-230 in water	2 E-9 $\mu$ Ci/ml
Ra-228 in water	1 E-9 $\mu$ Ci/ml

U-nat is analyzed by a fluorometric method by the current vendor laboratory. In order to determine the LLD, the laboratory has performed the analysis on a blank sample many times and uses the standard deviation of these background measurements to calculate the LLD. This LLD is specified for all analyses as long as the sample size or volume meets the minimum value.

## **7.0 ANNUAL STATUS REPORT FOR TAILINGS AND EVAPORATION POND EMBANKMENTS**

License Condition 12 specifies that periodic inspection of the large and small tailing embankments are made and documented. An annual status report summarizing the monthly inspections for 2000 is included as Attachment No. 5.

## **8.0 DATA SUMMARY AND CONCLUSIONS**

The summaries of Homestake's effluent monitoring program included in this submittal contain data for each of the regulated parameters released to unrestricted areas. DP-200, dated November 15, 1995, and 10 CFR Part 40.65 requires that Homestake submit its effluent release monitoring data to the State of New Mexico and the NRC within 60 days of the end of the six-month period ending January 1 and July 1 of each year. Homestake is submitting this report to satisfy the regulatory requirements cited above. Included in this report's attachments are summaries of the results of the effluent monitoring activities conducted by Homestake and pertinent to the required monitoring time period.

The data collected in many of Homestake's effluent monitoring programs can be readily compared to 10 CFR Part 20 values. Homestake has not exceeded 10 CFR Part 20 values in any of their effluents monitored during the period covered by this report. This, of course, does not include the ground water values at the POC wells as discussed earlier. The maximum annual effective dose equivalent to the public has been calculated for the year 2000, based upon the environmental monitoring data. The report, Attachment 4, shows that the effective dose equivalent to the nearest resident is less than the 100-mrem/year NRC limit.

Vegetation and soil samples are no longer required on an annual basis per Amendment 24 to Source Material License.

**Table 1 - Environmental Monitoring Program Excluding  
Groundwater Monitoring**

TABLE 1 - Environmental Monitoring Program Excluding Groundwater Monitoring

Type of Sample	Number	Locations	Method	Frequency	Analytical Parameters
AIR Particulates	3	HMC1, HMC2, HMC3 at or near the site boundary in sectors that have the highest predicted concentrations of radioactive airborne particulates.	Continuous (High Vol.)	Weekly filter change or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230
	2	HMC4, HMC5 at nearest occupied residences	Continuous (High Vol.)	Weekly filter change, or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230
	1	HMC6 background location	Continuous (High Vol.)	Weekly filter change, or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230
Radon Gas	8	Locations described in Air - Particulates & HMC7 on S boundary & HMC16 as a background	Continuous Track-etch	Semi-Annual	Rn-222
DIRECT RADIATION	7	Locations described in Air - Particulates & HMC-16 as a background	Continuous Track-etch	Semi-Annual	Gamma Exposure Rate

**Table 2 – Groundwater Monitoring Program (8-97)**

**TABLE 2 – Groundwater Monitoring Program (8-97)**

Well Number	Parameters to be Monitored	Frequency of Monitoring
#1 & #2 Deepwell	C	Quarterly
#1 & #2 Deepwell	D	Annually
All Active Injection Wells	Rate & Monthly Total Volume	Monthly
Broadview Acres SUB1, SUB3, 453	A	Semi-Annually
Broadview Acres SUB2	A (except water level)	Semi-Annually
Broadview Acres SUB1, SUB2, SUB3, 434, 446, 453	B (except water level)	Annually
Felice Acres 490, 492, 493, 494	A	Semi-Annually
Felice Acres 490, 492, 493, 494	B	Annually
Murray Acres 802, 844	A	Semi-Annually
Murray Acres 802, 804, 820, 844, WCW	B(no water level in 804)	Annually
Pleasant Valley 688, 835, 846	A (no water level in 835)	Semi-Annually
Pleasant Valley 688, 835, 846	B (no water level in 835)	Annually
Regional 905, 910, 917, 920, 942	B (except water level)	Annually
Site Monitoring Wells B, CW2, CW3, CW4R, PM, WR7, WR11, X, Y	A	Quarterly
Site Monitoring Wells B, CW2, CW3, CW4R, PM, WR7, WR11, X, Y	B & F	Semi-annually
Secondary Site Monitoring Wells BC, B1, BP, D1, DC, DM, DZ, F, FB, I, K2, KM, KZ, M4, MO, N, O, S, SO, SV, T, W, WR5, WR9	A	Semi-annually
Secondary Site Monitoring Wells GH, CW2-1	Water Level Only	Semi-annually

**TABLE 2 – Groundwater Monitoring Program (8-97)**

Well Number	Parameters to be Monitored	Frequency of Monitoring
Secondary Site Monitoring Wells BC, B1, BP, CW9, D1, DC, DM, DZ, F, FB, I, K2, KM, KZ, M4, MO, N, ND, O, S, SO, SV, S2, T, W, WR9, WR5	B	Annually
Secondary Site Monitoring Wells 931, 934	B	Semi-Annually
Secondary Site Monitoring Well NC	A B	Quarterly Semi-Annually
Secondary Site Monitoring Wells 929, 933, 945, CW40	B (no water level in 933 or 945)	Semi-Annually
All Active Collection Wells	E	Monthly
All Active Collection Wells	B	Annually
All Active Collection Wells	Collection rate, water level and total volume for week	Weekly
Reversal Wells B, BA, KZ, KF, SO, SP, S1, S2	Water Level	Weekly
E Coll Pond, W Coll Pond	B (W Coll Pond - no water level )	Quarterly
E Coll Pond, W Coll Pond	F	Semi-annually
DQ, M5, S3, S4	B	Quarterly
DQ, M5, S3, S4	F	Semi-annually
Background Wells P, P1, P2	B F	Quarterly Semi-annually
Background Wells DD, Q, R	B & F	Annually

A = Water Level, SO<sub>4</sub>, U-Nat, Se, TDS

B = Water Level, pH, TDS, SO<sub>4</sub>, Cl, HCO<sub>3</sub>, CO<sub>3</sub>, Na, Ca, Mg, K, NO<sub>3</sub>, U-Nat, Se, Mo, Ra-226

C = SO<sub>4</sub>, TDS

D = Ca, Mg, K, Na, HCO<sub>3</sub>, CO<sub>3</sub>, Cl, SO<sub>4</sub>, pH, TDS, Al, As, Ba, Cd, Co, Cr, Cu, CN, F, Fe, Pb, Mn, Hg, Mo, Ni, NO<sub>3</sub> as N, Se, Ag, Zn, U-Nat, Filtered Ra-226

E = Water Level, SO<sub>4</sub>, U-Nat, TDS

F = V, Ra-228, Th-230

**Table 2.1.1 - Water Quality Analyses for Well BP**





# ENERGY LABORATORIES, INC.

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 Helena • Rapid City

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

BP	BP
08/01/2000 13:21	11/21/2000 10:16
08-04-00	11-29-00
Water	Water
00-34940-2	00-37853-2
August 31, 2000	January 3, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	200	226
Magnesium	2	EPA 200.7	mg/L	1.0	53.0	60.5
Sodium	4	EPA 200.7	mg/L	1.0	343	371
Potassium	3	EPA 200.7	mg/L	1.0	3.7	4.1
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	492	439
Sulfate	8	EPA 200.7	mg/L	1.0	788	979
Chloride	7	EPA 200.7	mg/L	0.10	191	178
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	3.07	3.84

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	2040	2290
Alkalinity	75	SM 2320-B	mg/L	1.0	404	360
pH	9	SM 4500-H-B	std. units	0.10	7.92	7.88

Trace Metals						
Chromium	27	EPA 200.8	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	0.23	0.26
Selenium	40	EPA 200.8	mg/L	0.005	0.136	0.335
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	0.956	1.09
*Uranium Precision ±	244				0.086	0.098
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	6.5E-07	7.4E-07
*Uranium Precision ±	114				5.8E-08	6.6E-08
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±	245				0.2	0.2
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10	2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	2.3
Radium Error Estimate ±	257				0.8	1.0
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	1.0E-09	2.3E+00
Radium Error Estimate ±	360				8.0E-10	1.0E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	< 0.2	0.2
Thorium Error Estimate ±	248				0.2	0.3
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	< 2.0E-10	2.0E-10
Thorium Error Estimate ±	363				2.0E-10	3.0E-10

Quality Assurance Data			Target Range	
Anion	meq		30.1	32.9
Cation	meq		29.4	32.6
SM A/C Balance	%	-5 - +5	-1.16	-0.51
Calc TDS	mg/L		1839	2056
TDS A/C Balance	dec. %	0.80 - 1.20	1.11	1.11

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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**Table 2.1.2 - Water Quality Analyses for Well D1**



# ENERGY LABORATORIES, INC.

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## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
Sample Date/Time:  
Date Received:  
Sample Matrix:  
Laboratory ID:  
Report Date:

D1	D1
08/01/2000 12:48	11/21/2000 10:58
08-04-00	11-29-00
Water	Water
00-34940-3	00-37853-1
August 31, 2000	January 3, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	195	202
Magnesium	2	EPA 200.7	mg/L	1.0	48.7	49.0
Sodium	4	EPA 200.7	mg/L	1.0	350	352
Potassium	3	EPA 200.7	mg/L	1.0	3.8	3.8
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	545	529
Sulfate	8	EPA 200.7	mg/L	1.0	735	781
Chloride	7	EPA 200.7	mg/L	0.10	191	180
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	2.38	3.10

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	2010	2050
Alkalinity	75	SM 2320-B	mg/L	1.0	447	434
pH	9	SM 4500-H-B	std. units	0.10	7.82	7.91

Trace Metals						
Chromium	27	EPA 200.8	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	1.20	0.98
Selenium	40	EPA 200.8	mg/L	0.005	0.080	0.144
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	1.66	1.62
*Uranium Precision ±	244				0.149	0.146
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	1.1E-06	1.1E-06
*Uranium Precision ±	114				1.0E-07	9.9E-08
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±	245				0.2	0.2
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10	2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	1.4
Radium Error Estimate ±	257				0.9	1.0
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	< 1.0E-09	1.4E-09
Radium Error Estimate ±	360				9.0E-10	1.0E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.2	0.3
Thorium Error Estimate ±	248				0.2	0.3
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	2.0E-10	3.0E-10
Thorium Error Estimate ±	363				2.0E-10	3.0E-10

Quality Assurance Data			Target Range	
Anion	meq		29.8	30.3
Cation	meq		29.1	29.6
SM A/C Balance	%	-5 - +5	-1.20	-1.14
Calc TDS	mg/L		1808	1847
TDS A/C Balance	dec. %	0.80 - 1.20	1.11	1.11

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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COMPLETE ANALYTICAL SERVICES

**Table 2.1.3 - Water Quality Analyses for Well DQ**



# ENERGY LABORATORIES, INC.

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PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

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Helena • Rapid City

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
Sample Date/Time:  
Date Received:  
Sample Matrix:  
Laboratory ID:  
Report Date:

DQ	DQ
08/01/2000 11:21	11/21/2000 11:16
08-07-00	11-29-00
Water	Water
00-34978-3	00-37853-3
September 6, 2000	January 3, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	259	398
Magnesium	2	EPA 200.7	mg/L	1.0	101	181
Sodium	4	EPA 200.7	mg/L	1.0	4060	4440
Potassium	3	EPA 200.7	mg/L	1.0	9.4	11.8
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	2080	2310
Sulfate	8	EPA 200.7	mg/L	1.0	7130	7620
Chloride	7	EPA 200.7	mg/L	0.10	698	778
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	15.5	13.9

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	15600	15400
Alkalinity	75	SM 2320-B	mg/L	1.0	1710	1900
pH	9	SM 4500-H-B	std. units	0.10	7.70	7.87

Trace Metals						
Chromium	27	EPA 200.8	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	67.6	58.1
Selenium	40	EPA 200.8	mg/L	0.005	1.37	0.980
Vanadium	42	EPA 200.8	mg/L	0.01	0.02	0.03

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	45.0	63.2
*Uranium Precision ±	244				4.05	5.69
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	3.0E-05	4.3E-05
*Uranium Precision ±	114				2.7E-06	3.9E-06
Radium 226	45	EPA 903.0	pCi/L	0.2	0.2	< 0.2
Radium Error Estimate ±	245				0.2	0.2
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10	2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	2.4
Radium Error Estimate ±	257				0.8	1.0
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	< 1.0E-09	2.4E+00
Radium Error Estimate ±	360				8.0E-10	1.0E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.4	0.3
Thorium Error Estimate ±	248				0.4	0.3
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	4.0E-10	3.0E-10
Thorium Error Estimate ±	363				4.0E-10	3.0E-10

Quality Assurance Data			Target Range	
Anion	meq		203	220
Cation	meq		198	228
SM A/C Balance	%	-5 - +5	-1.32	1.96
Calc TDS	mg/L		13367	14646
TDS A/C Balance	dec. %	0.80 - 1.20	1.17	1.05

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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COMPLETE ANALYTICAL SERVICES

**Table 2.1.4 - Water Quality Analyses for Well M5**



# ENERGY LABORATORIES, INC.

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 PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

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 Helena • Rapid City

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

M5	M5
02-03-00/09:19	08/08/00 12:46
	08/11/2000
Water	Water
30707-5	00-35136-2
March 3, 2000	September 5, 2000

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	223	217
Magnesium	2	EPA 200.7	mg/L	1.0	48.2	48.0
Sodium	4	EPA 200.7	mg/L	1.0	314	342
Potassium	3	EPA 200.7	mg/L	1.0	5.4	4.0
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	414	509
Sulfate	8	EPA 200.7	mg/L	1.0	901	836
Chloride	7	EPA 200.7	mg/L	0.10	191	208
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	3.95	3.17

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	2210	2150
Alkalinity	75	SM 2320-B	mg/L	1.0	339	417
pH	9	SM 4500-H-B	std. units	0.10	7.77	7.69

Trace Metals						
Chromium	27	EPA 200.7	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	1.64	2.39
Selenium	40	EPA 200.8	mg/L	0.005	0.317	0.204
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	2.36	3.39
*Uranium Precision ±	244				0.212	0.305
Uranium, Rad.	113		µCi/mL	2.0E-10	1.6E-06	2.3E-06
*Uranium Precision ±	114				1.4E-07	2.1E-07
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	8.8
Radium Error Estimate ±	245				0.3	0.5
Radium 226	256		µCi/mL	2.0E-10	< 2.0E-10	8.8E-09
Radium Error Estimate ±	258				3.0E-10	5.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±	257				0.9	0.9
Radium 228	359		µCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±	360				9.0E-10	9.0E-10
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.2	0.2
Thorium Error Estimate ±	248				0.2	0.2
Thorium 230	362		µCi/mL	2.0E-10	2.0E-10	2.0E-10
Thorium Error Estimate ±	363				2.0E-10	2.0E-10

Quality Assurance Data			Target Range	
Anion	meq		31.3	31.9
Cation	meq		29.0	29.8
SM A/C Balance	%	-5 - +5	-3.81	-3.32
Calc TDS	mg/L		1908	1925
TDS A/C Balance	dec. %	0.80 - 1.20	1.16	1.12

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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# ENERGY LABORATORIES, INC.

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 E-mail: casper@energylab.com • FAX: (307) 234-1639  
 PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

M5
11/29/2000 10:08
12/07/2000 10:30
Liquid, Water
00-38065-4
January 12, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results
Calcium	1	EPA 200.7	mg/L	1.0	241
Magnesium	2	EPA 200.7	mg/L	1.0	52.0
Sodium	4	EPA 200.7	mg/L	1.0	329
Potassium	3	EPA 200.7	mg/L	1.0	4.2
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	481
Sulfate	8	EPA 200.7	mg/L	1.0	892
Chloride	7	EPA 200.7	mg/L	1.0	191
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	3.65

Non-Metals					
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	2200
Alkalinity	75	SM 2320-B	mg/L	1.0	394
pH	9	SM 4500-H-B	std. units	0.10	7.77

Trace Metals					
Chromium	27	EPA 200.8	mg/L	0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	1.59
Selenium	40	EPA 200.8	mg/L	0.005	0.206
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01

Radiometric					
Uranium	15	EPA 200.8	mg/L	0.0003	2.17
*Uranium Precision ±	244				0.195
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	1.5E-06
*Uranium Precision ±	114				1.3E-07
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±	245				0.2
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	2.4
Radium Error Estimate ±	257				1.2
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	2.4E+00
Radium Error Estimate ±	360				1.2E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.2
Thorium Error Estimate ±	248				0.2
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	2.0E-10
Thorium Error Estimate ±	363				2.0E-10

Quality Assurance Data			Target Range	
Anion	meq			32.1
Cation	meq			30.8
SM A/C Balance	%		-5 - +5	-2.14
Calc TDS	mg/L			1967
TDS A/C Balance	dec. %		0.80 - 1.20	1.12

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.



**Table 2.1.5 - Water Quality Analyses for Well S3**



# ENERGY LABORATORIES, INC.

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 E-mail: casper@energylab.com • FAX: (307) 234-1639  
 PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

S3	S3
08/08/2000 13:38	12/06/2000 12:46
08/11/2000	12-11-00
Liquid, Water	Liquid, Water
00-35136-1	00-38137-4
September 5, 2000	January 9, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1 ✓	EPA 200.7	mg/L	1.0	190	266
Magnesium	2 ✓	EPA 200.7	mg/L	1.0	50.0	68.9
Sodium	4 ✓	EPA 200.7	mg/L	1.0	770	814
Potassium	3 ✓	EPA 200.7	mg/L	1.0	5.3	7.2
Carbonate	6 ✓	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5 ✓	SM 2320-B	mg/L	1.0	667	596
Sulfate	8 ✓	EPA 200.7	mg/L	1.0	1540	1610
Chloride	7 ✓	EPA 200.7	mg/L	0.10	262	360
Nitrate + Nitrite as N	39 ✓	EPA 353.2	mg/L	0.10	2.38	4.67

Non-Metals						
Total Dissolved Solids	10 ✓	SM 2540-C	mg/L	10.0	3530	3830
Alkalinity	75 ✓	SM 2320-B	mg/L	1.0	547	489
pH	9	SM 4500-H-B	std. units	0.10	7.81	7.64

Trace Metals						
Chromium	27 ✓	EPA 200.8	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36 ✓	EPA 200.8	mg/L	0.03	10.3	8.93
Selenium	40 ✓	EPA 200.8	mg/L	0.005	0.091	0.119
Vanadium	42 ✓	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15 ✓	EPA 200.8	mg/L	0.0003	10.5	10.7
*Uranium Precision ±	244				0.945	0.963
Uranium, Rad.	113		µCi/mL	2.0E-10	7.1E-06	7.2E-06
*Uranium Precision ±	114				6.4E-07	6.5E-07
Radium 226	45 ✓	EPA 903.0	pCi/L	0.2	0.3	< 0.2
Radium Error Estimate ±	245				0.2	0.2
Radium 226	256		µCi/mL	2.0E-10	3.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10	2.0E-10
Radium 228	57 ✓	EPA 904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±	257				0.8	1.0
Radium 228	359		µCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±	360				8.0E-10	1.0E-09
Thorium 230	48 ✓	EPA 907.0	pCi/L	0.2	< 0.2	0.3
Thorium Error Estimate ±	248				0.2	0.3
Thorium 230	362		µCi/mL	2.0E-10	< 2.0E-10	3.0E-10
Thorium Error Estimate ±	363				2.0E-10	3.0E-10

Quality Assurance Data		Target Range	
Anion	meq		50.6
Cation	meq		53.82
SM A/C Balance	%	-5 - +5	47.3
Calc TDS	mg/L		54.62
TDS A/C Balance	dec. %	0.80 - 1.20	-3.39
			0.74
			3162
			3446
			1.12
			1.11

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

ENTERED JAN 19 2001

**Table 2.1.6 - Water Quality Analyses for Well S4**



# ENERGY LABORATORIES, INC.

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 E-mail: casper@energylab.com • FAX: (307) 234-1639  
 PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

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## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

S4	S4
08/09/00 09:16	12-06-00 11:11
08/11/2000	12-11-00
Water	Liquid, Water
00-35136-3	00-38137-5
September 5, 2000	January 9, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	390	419
Magnesium	2	EPA 200.7	mg/L	1.0	90.8	87.6
Sodium	4	EPA 200.7	mg/L	1.0	487	478
Potassium	3	EPA 200.7	mg/L	1.0	6.7	7.2
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	497	476
Sulfate	8	EPA 200.7	mg/L	1.0	1820	1750
Chloride	7	EPA 200.7	mg/L	0.10	188	165
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	0.17	0.11

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	3630	3660
Alkalinity	75	SM 2320-B	mg/L	1.0	408	391
pH	9	SM 4500-H-B	std. units	0.10	7.73	7.67

Trace Metals						
Chromium	27	EPA 200.8	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	0.65	0.67
Selenium	40	EPA 200.8	mg/L	0.005	0.080	0.042
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	5.83	4.13
*Uranium Precision ±	244				0.525	0.372
Uranium, Rad.	113		µCi/mL	2.0E-10	3.9E-06	2.8E-06
*Uranium Precision ±	114				3.6E-07	2.5E-07
Radium 226	45	EPA 903.0	pCi/L	0.2	1.4	0.9
Radium Error Estimate ±	245				0.2	0.2
Radium 226	256		µCi/mL	2.0E-10	1.4E-09	9.0E-10
Radium Error Estimate ±	258				2.0E-10	2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	2.9
Radium Error Estimate ±	257				0.9	1.1
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	< 1.0E-09	2.9E-09
Radium Error Estimate ±	360				9.0E-10	1.1E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	< 0.2	< 0.2
Thorium Error Estimate ±	248				0.2	0.3
Thorium 230	362		µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Thorium Error Estimate ±	363				2.0E-10	3.0E-10

Quality Assurance Data			Target Range	
Anion	meq		51.4	49.0
Cation	meq		48.4	49.2
SM A/C Balance	%	-5 - +5	-3.01	0.27
Calc TDS	mg/L		3232	3146
TDS A/C Balance	dec. %	0.80 - 1.20	1.12	1.16

ENTERED JAN 19 2001

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

**Table 2.1.7 - Water Quality Analyses for Well X**



# ENERGY LABORATORIES, INC.

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PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

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## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
Sample Date/Time:  
Date Received:  
Sample Matrix:  
Laboratory ID:  
Report Date:

X	X
08-02-00 09:59	10-17-00 14:04
08-04-00	10-19-00
Water	Water
00-34940-4	00-36916-3
August 31, 2000	November 21, 2000

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	43.5	128
Magnesium	2	EPA 200.7	mg/L	1.0	12.4	36.1
Sodium	4	EPA 200.7	mg/L	1.0	78.1	92.4
Potassium	3	EPA 200.7	mg/L	1.0	2.5	3.8
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	287	254
Sulfate	8	EPA 200.7	mg/L	1.0	51.1	277
Chloride	7	EPA 200.7	mg/L	0.10	28.3	109
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	2.48	2.07

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	387	915
Alkalinity	75	SM 2320-B	mg/L	1.0	236	208
pH	9	SM 4500-H-B	std. units	0.10	7.93	7.85

Trace Metals						
Chromium	27	EPA 200.7	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	0.43	0.30
Selenium	40	EPA 200.8	mg/L	0.005	0.006	0.017
Vanadium	42	EPA 200.8	mg/L	0.01	0.03	0.02

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	0.064	0.096
*Uranium Precision ±	244				0.006	0.009
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	4.4E-08	6.5E-08
*Uranium Precision ±	114				3.9E-09	5.9E-09
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±	245				0.2	0.3
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10	3.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±	257				0.9	0.8
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±	360				9.0E-10	8.0E-10
Thorium 230	48	EPA 907.0	pCi/L	0.2	< 0.2	< 0.2
Thorium Error Estimate ±	248				0.2	0.2
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Thorium Error Estimate ±	363				2.0E-10	2.0E-10

Quality Assurance Data			Target Range	
Anion	meq		6.78	13.2
Cation	meq		6.67	13.5
SM A/C Balance	%	-5 - +5	-0.81	1.26
Calc TDS	mg/L		371	783
TDS A/C Balance	dec. %	0.80 - 1.20	1.04	1.17

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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COMPLETE ANALYTICAL SERVICES

36916R00003

**Table 2.1.8 - Water Quality Analyses for Well Y**



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 PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

Billings • Casper • Gillette  
 Helena • Rapid City

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

Y	Y
08-02-00 09:33	10-17-00 13:33
08-04-00	10-19-00
Water	Water
00-34940-5	00-36916-4
August 31, 2000	November 21, 2000

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	129	53.8
Magnesium	2	EPA 200.7	mg/L	1.0	33.8	14.8
Sodium	4	EPA 200.7	mg/L	1.0	501	303
Potassium	3	EPA 200.7	mg/L	1.0	5.2	3.3
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	576	456
Sulfate	8	EPA 200.7	mg/L	1.0	850	361
Chloride	7	EPA 200.7	mg/L	0.10	162	71.0
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	3.14	2.55

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	2180	1200
Alkalinity	75	SM 2320-B	mg/L	1.0	473	374
pH	9	SM 4500-H-B	std. units	0.10	7.84	8.02

Trace Metals						
Chromium	27	EPA 200.7	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	7.90	3.79
Selenium	40	EPA 200.8	mg/L	0.005	0.687	0.227
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	2.690	1.52
*Uranium Precision ±	244				0.242	0.137
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	1.8E-06	1.0E-06
*Uranium Precision ±	114				1.6E-07	9.3E-08
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2	< 0.2
Radium Error Estimate ±	245				0.2	0.3
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10	3.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±	257				0.8	0.8
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	< 1.0E-09	< 1.0E-09
Radium Error Estimate ±	360				8.0E-10	8.0E-10
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.2	< 0.2
Thorium Error Estimate ±	248				0.2	0.2
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	< 2.0E-10	< 2.0E-10
Thorium Error Estimate ±	363				2.0E-10	2.0E-10

Quality Assurance Data			Target Range	
Anion	meq		32.0	17.2
Cation	meq		31.2	17.2
SM A/C Balance	%	-5 - +5	-1.26	-0.09
Calc TDS	mg/L		1984	1047
TDS A/C Balance	dec. %	0.80 - 1.20	1.10	1.15

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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**Table 2.1.9- Water Quality Analyses for Background Well P**



# ENERGY LABORATORIES, INC.

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PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

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## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
Sample Date/Time:  
Date Received:  
Sample Matrix:  
Laboratory ID:  
Report Date:

P	P
05/09/00 15:05	08-31-00 14:34
	09-06-00
Water	Water
00-32676-1	00-35806-1
June 7, 2000	September 27, 2000

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results	Results
Calcium	1	EPA 200.7	mg/L	1.0	201	198
Magnesium	2	EPA 200.7	mg/L	1.0	43.6	42.6
Sodium	4	EPA 200.7	mg/L	1.0	228	234
Potassium	3	EPA 200.7	mg/L	1.0	5.5	4.9
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	251	265
Sulfate	8	EPA 200.7	mg/L	1.0	858	851
Chloride	7	EPA 200.7	mg/L	0.10	45.4	45.5
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	7.77	5.08

Non-Metals						
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	1800	1760
Alkalinity	75	SM 2320-B	mg/L	1.0	207	217
pH	9	SM 4500-H-B	std. units	0.10	8.00	7.71

Trace Metals						
Chromium	27	EPA 200.7	mg/L	0.05	< 0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	< 0.03	< 0.03
Selenium	40	EPA 200.8	mg/L	0.005	0.133	0.090
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01	< 0.01

Radiometric						
Uranium	15	EPA 200.8	mg/L	0.0003	0.052	0.035
*Uranium Precision ±	244				0.005	0.003
Uranium, Rad.	113		µCi/mL	2.0E-10	3.5E-08	2.4E-08
*Uranium Precision ±	114				3.2E-09	2.1E-09
Radium 226	45	EPA 903.0	pCi/L	0.2	0.9	1.0
Radium Error Estimate ±	245				0.2	0.2
Radium 226	256		µCi/mL	2.0E-10	9.0E-10	1.0E-09
Radium Error Estimate ±	258				2.0E-10	2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	< 1.0	< 1.0
Radium Error Estimate ±	257				1.0	0.9
Radium 228	359		µCi/mL	1.0E-09	< 1.0E-09	3.0E-01
Radium Error Estimate ±	360				1.0E-09	9.0E-10
Thorium 230	48	EPA 907.0	pCi/L	0.2	0.3	< 0.2
Thorium Error Estimate ±	248				0.3	0.2
Thorium 230	362		µCi/mL	2.0E-10	3.0E-10	< 2.0E-10
Thorium Error Estimate ±	363				3.0E-10	2.0E-10

Quality Assurance Data			Target Range	
Anion	meq		23.9	23.8
Cation	meq		23.7	23.7
SM A/C Balance	%	-5 - +5	-0.29	0.00
Calc TDS	mg/L		1542	1532
TDS A/C Balance	dec. %	0.80 - 1.20	1.17	1.15

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.

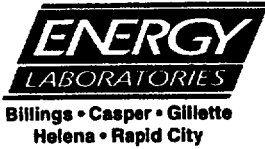
"Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

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COMPLETE ANALYTICAL SERVICES

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 PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

## LABORATORY ANALYSIS REPORT HOMESTAKE MINING COMPANY

Sample ID:  
 Sample Date/Time:  
 Date Received:  
 Sample Matrix:  
 Laboratory ID:  
 Report Date:

P
11/28/2000 9:03
12/07/2000 10:30
Liquid, Water
00-38065-3
January 12, 2001

Major Ions	Parameter Code	Method	Units	"Lower Limit of Detection"	Results
Calcium	1	EPA 200.7	mg/L	1.0	214
Magnesium	2	EPA 200.7	mg/L	1.0	45.2
Sodium	4	EPA 200.7	mg/L	1.0	231
Potassium	3	EPA 200.7	mg/L	1.0	4.9
Carbonate	6	SM 2320-B	mg/L	1.0	< 1.0
Bicarbonate	5	SM 2320-B	mg/L	1.0	256
Sulfate	8	EPA 200.7	mg/L	1.0	910
Chloride	7	EPA 200.7	mg/L	1.0	49.0
Nitrate + Nitrite as N	39	EPA 353.2	mg/L	0.10	6.85

Non-Metals					
Total Dissolved Solids	10	SM 2540-C	mg/L	10.0	1790
Alkalinity	75	SM 2320-B	mg/L	1.0	210
pH	9	SM 4500-H-B	std. units	0.10	7.71

Trace Metals					
Chromium	27	EPA 200.8	mg/L	0.05	< 0.05
Molybdenum	36	EPA 200.8	mg/L	0.03	< 0.03
Selenium	40	EPA 200.8	mg/L	0.005	0.137
Vanadium	42	EPA 200.8	mg/L	0.01	< 0.01

Radiometric					
Uranium	15	EPA 200.8	mg/L	0.0003	0.029
*Uranium Precision ±	244				0.003
Uranium, Rad.	113	EPA 200.8	µCi/mL	2.0E-10	1.9E-08
*Uranium Precision ±	114				1.7E-09
Radium 226	45	EPA 903.0	pCi/L	0.2	< 0.2
Radium Error Estimate ±	245				0.2
Radium 226	256	EPA 903.0	µCi/mL	2.0E-10	< 2.0E-10
Radium Error Estimate ±	258				2.0E-10
Radium 228	57	EPA 904.0	pCi/L	1.0	2.6
Radium Error Estimate ±	257				1.2
Radium 228	359	EPA 904.0	µCi/mL	1.0E-09	2.6E+00
Radium Error Estimate ±	360				1.2E-09
Thorium 230	48	EPA 907.0	pCi/L	0.2	< 0.2
Thorium Error Estimate ±	248				0.2
Thorium 230	362	EPA 907.0	µCi/mL	2.0E-10	< 2.0E-10
Thorium Error Estimate ±	363				2.0E-10

Quality Assurance Data			Target Range	
Anion	meq			25.1
Cation	meq			24.6
SM A/C Balance	%		-5 - +5	-0.85
Calc TDS	mg/L			1613
TDS A/C Balance	dec. %		0.80 - 1.20	1.11

\*Precision is calculated using standard deviation of mean of replicate analysis multiplied by concentration.  
 "Lower Limit of Detection" is related to reporting limits suggested by Regulatory Guideline 4.14 in some cases.

**Table 3 - Occupational Monitoring Program**

**Table 3 - Occupational Monitoring Program**

Type of Sample	Number	Locations	Method	Frequency	Analytical Parameters
Lapel Personal Air Sample	As required by RWP	As required by RWP (2 L/min or eq.)	HP-1	As required by RWP	Alpha, U-Nat
Lapel Personal Air Sampler Calibration	As required by RWP	N/A	HP-1	As required by RWP	Flow rate
Release of Equip.	As required by RWP	Potentially Contaminated Equipment and Materials	HP-4	As required by RWP	Alpha, beta gamma
ALARA	N/A	As required by RPA	HP-6	N/A	As required by RPA
Respiratory Protection	As required by RWP	As required by RWP	HP-7	N/A	N/A
Bioassay	As required by RWP	As required by RWP	HP-8 after mill decommissioning; termination	Baseline, Semi-annual	U-Nat in urine
Instrument Calibration	Variable	Radiation Detection Instruments in use	HP-10	6 months or less	N/A
Personnel Gamma (TLD)	Variable	Personnel	HP-11	Quarterly	Gamma
Personnel Contam.	As required by RWP	As required by RWP	HP-12	As required by RWP	Alpha
Radiation Protection Training	As required	Mill Site taught by RPA (certified individual) subjects as per Reg Guide 8.31	HP-14 for people working with groundwater or physical work with tailings sand/slimes	Initial & annual refresher	Training Class & Written Test

HP-# = Homestake procedure number; RPA = Radiation Protection Administrator; RWP =

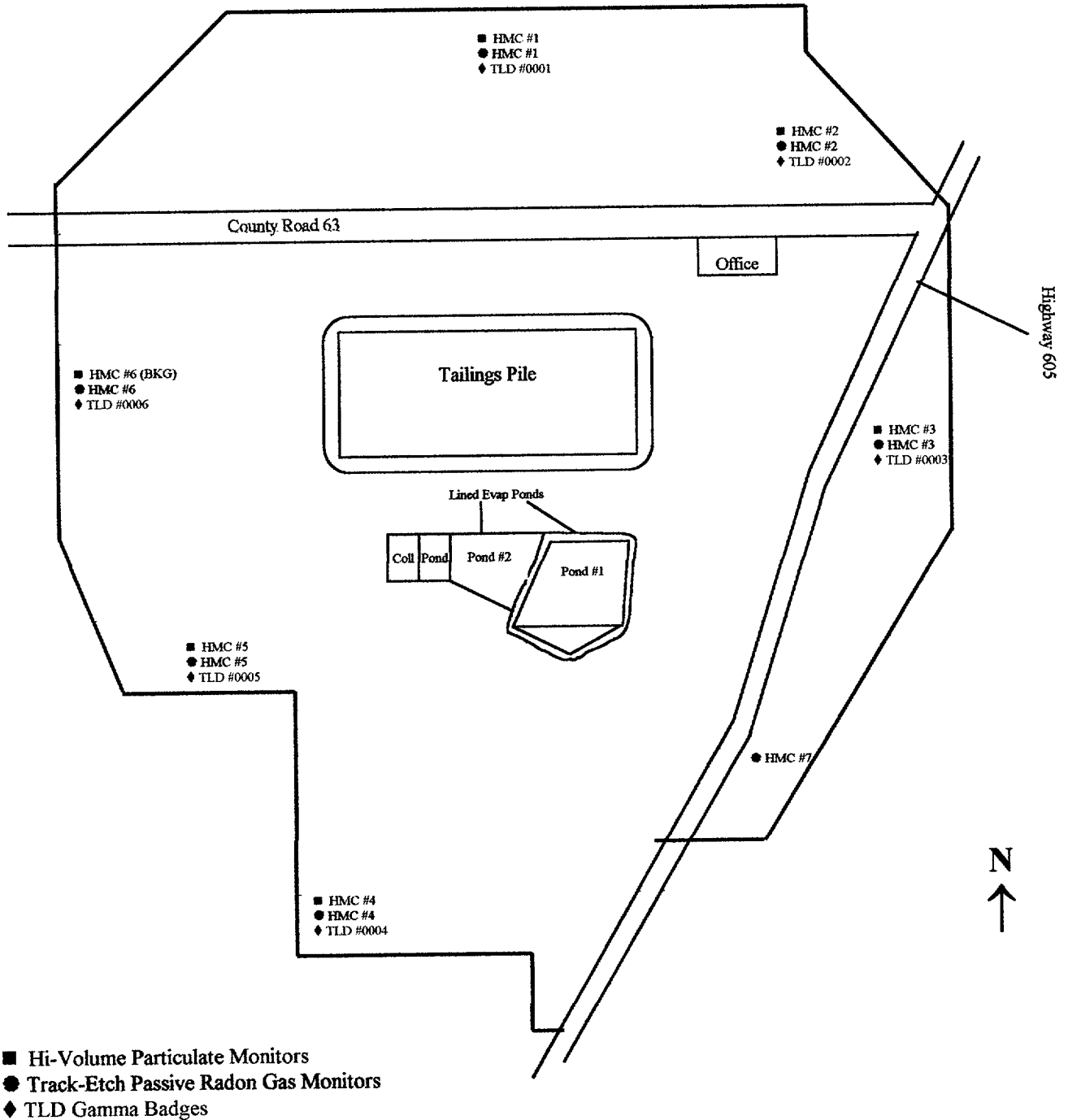
Radiation Work Permit; TLD = Thermoluminescent Dosimeter

**Figure 1 – Monitoring & Sampling Locations**

# HOMESTAKE MINING COMPANY GRANTS PROJECT

## Monitoring & Sampling Locations

- HMC #0016 (BKG)
- ◆ TLD #0016 (BKG)



**FIGURE 1**

**Attachment 1 – High Volume Air Sampling Results**





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PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

## HIGH VOLUME AIR ANALYSIS REPORT

**CLIENT:** HOMESTAKE MINING - GRANTS, NEW MEXICO  
**REPORT DATE:** January 19, 2001  
**DATE SAMPLED:** 4th Quarter 2000

EPA Method		200.8	903.0		907.0	
Laboratory Number	Sample I.D.	Uranium-nat pCi/filt.	Radium 226 pCi/filt. +/-		Thorium 230 pCi/filt. +/-	
00-38457-1	HMC 1	92.1	3.2	0.9	2.6	1.1
00-38457-2	HMC 2	53.7	3.0	0.9	3.4	1.1
00-38457-3	HMC 3	141	2.1	0.8	2.6	1.1
00-38457-4	HMC 4	127	3.4	0.9	2.5	1.1
00-38457-5	HMC 5	220	1.9	0.8	5.3	1.9
00-38457-6	HMC 6	36.2	2.8	0.9	2.1	1.1
00-38457-7	HMC 7	1.2	1.1	0.8	<0.4	0.2
LLD	pCi/L	0.4	0.4		0.4	



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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 19, 2001

SAMPLE ID: HMC 1

Quarter/Date Sampled Air Volume	Radionuclide	Conc. μCi/mL	Error Est. μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% of Effluent Concentration
31661-1 First Quarter 2000 Air Volume in mLs 1.33E+11	<sup>nat</sup> U	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	<sup>230</sup> Th	< 1.00E-16	1.28E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	7.11E-18	1.00E-16	9.00E-13	< 1.11E-02
33918-1 Second Quarter 2000 Air Volume in mLs 1.45E+11	<sup>nat</sup> U	1.79E-15	N/A	1.00E-16	9.00E-14	1.99E+00
	<sup>230</sup> Th	< 1.00E-16	9.12E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	7.82E-18	1.00E-16	9.00E-13	< 1.11E-02
36437-1 Third Quarter 2000 Air Volume in mLs 1.46E+11	<sup>nat</sup> U	1.73E-15	N/A	1.00E-16	9.00E-14	1.92E+00
	<sup>230</sup> Th	< 1.00E-16	1.29E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.18E-18	1.00E-16	9.00E-13	< 1.11E-02
00-38457-1 Fourth Quarter 2000 Air Volume in mLs 1.45E+11	<sup>nat</sup> U	6.35E-16	N/A	1.00E-16	9.00E-14	7.06E-01
	<sup>230</sup> Th	< 1.00E-16	7.82E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.52E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 19, 2001

SAMPLE ID: HMC 2

Quarter/Date Sampled Air Volume	Radionuclide	Concentration μCi/mL	Error Estimate μCi/mL	L.L.D. μCi/mL	Effluent Conc.* μCi/mL	% Effluent Concentration
31661-2 First Quarter 2000 Air Volume in mLs 1.37E+11	<sup>nat</sup> U	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	<sup>230</sup> Th	1.39E-16	2.62E-17	1.00E-16	2.00E-14	6.97E-01
	<sup>226</sup> Ra	< 1.00E-16	5.52E-18	1.00E-16	9.00E-13	< 1.11E-02
33918-2 Second Quarter 2000 Air Volume in mLs 1.46E+11	<sup>nat</sup> U	1.74E-15	N/A	1.00E-16	9.00E-14	1.94E+00
	<sup>230</sup> Th	< 1.00E-16	6.47E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.47E-18	1.00E-16	9.00E-13	< 1.11E-02
36437-2 Third Quarter 2000 Air Volume in mLs 1.46E+11	<sup>nat</sup> U	7.74E-16	N/A	1.00E-16	9.00E-14	8.60E-01
	<sup>230</sup> Th	< 1.00E-16	1.17E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.18E-18	1.00E-16	9.00E-13	< 1.11E-02
00-38457-2 Fourth Quarter 2000 Air Volume in mLs 1.45E+11	<sup>nat</sup> U	3.71E-16	N/A	1.00E-16	9.00E-14	4.12E-01
	<sup>230</sup> Th	< 1.00E-16	7.82E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.52E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

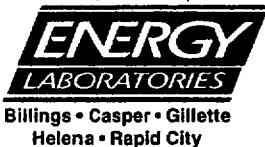
All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 19, 2001

SAMPLE ID: HMC 3

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci}/\text{mL}$	Error Estimate $\mu\text{Ci}/\text{mL}$	L.L.D. $\mu\text{Ci}/\text{mL}$	Effluent Conc.* $\mu\text{Ci}/\text{mL}$	% Effluent Concentration
31661-3 First Quarter 2000 Air Volume in mLs 1.46E+11	<sup>nat</sup> U	1.24E-16	N/A	1.00E-16	9.00E-14	1.37E-01
	<sup>230</sup> Th	< 1.00E-16	1.04E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.18E-18	1.00E-16	9.00E-13	< 1.11E-02
33918-3 Second Quarter 2000 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	6.02E-15	N/A	1.00E-16	9.00E-14	6.69E+00
	<sup>230</sup> Th	< 1.00E-16	6.56E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.63E-18	1.00E-16	9.00E-13	< 1.11E-02
36437-3 Third Quarter 2000 Air Volume in mLs 1.46E+11	<sup>nat</sup> U	2.34E-15	N/A	1.00E-16	9.00E-14	2.60E+00
	<sup>230</sup> Th	< 1.00E-16	1.29E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.18E-18	1.00E-16	9.00E-13	< 1.11E-02
00-38457-3 Fourth Quarter 2000 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	9.77E-16	N/A	1.00E-16	9.00E-14	1.09E+00
	<sup>230</sup> Th	< 1.00E-16	7.88E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.25E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 19, 2001

SAMPLE ID: HMC 4

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci}/\text{mL}$	Error Estimate $\mu\text{Ci}/\text{mL}$	L.L.D. $\mu\text{Ci}/\text{mL}$	Effluent Conc.* $\mu\text{Ci}/\text{mL}$	% Effluent Concentration
31661-4 First Quarter 2000 Air Volume in mLs 1.38E+11	<sup>nat</sup> U	2.42E-16	N/A	1.00E-16	9.00E-14	2.69E-01
	<sup>230</sup> Th	< 1.00E-16	1.51E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	9.59E-18	1.00E-16	9.00E-13	< 1.11E-02
33918-4 Second Quarter 2000 Air Volume in mLs 1.41E+11	<sup>nat</sup> U	1.05E-14	N/A	1.00E-16	9.00E-14	1.17E+01
	<sup>230</sup> Th	< 1.00E-16	1.21E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	1.07E-17	1.00E-16	9.00E-13	< 1.11E-02
36437-4 Third Quarter 2000 Air Volume in mLs 1.47E+11	<sup>nat</sup> U	3.83E-15	N/A	1.00E-16	9.00E-14	4.26E+00
	<sup>230</sup> Th	< 1.00E-16	1.03E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.14E-18	1.00E-16	9.00E-13	< 1.11E-02
00-38457-4 Fourth Quarter 2000 Air Volume in mLs 1.42E+11	<sup>nat</sup> U	8.96E-16	N/A	1.00E-16	9.00E-14	9.95E-01
	<sup>230</sup> Th	< 1.00E-16	7.99E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.65E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

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## HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 19, 2001

SAMPLE ID: HMC 5

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
31661-5 First Quarter 2000 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	5.33E-16	N/A	1.00E-16	9.00E-14	5.92E-01
	<sup>230</sup> Th	< 1.00E-16	9.19E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.25E-18	1.00E-16	9.00E-13	< 1.11E-02
33918-5 Second Quarter 2000 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	6.21E-14	N/A	1.00E-16	9.00E-14	6.90E+01
	<sup>230</sup> Th	< 1.00E-16	1.18E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	2.63E-18	1.00E-16	9.00E-13	< 1.11E-02
36437-5 Third Quarter 2000 Air Volume in mLs 1.45E+11	<sup>nat</sup> U	1.24E-14	N/A	1.00E-16	9.00E-14	1.37E+01
	<sup>230</sup> Th	< 1.00E-16	1.30E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.52E-18	1.00E-16	9.00E-13	< 1.11E-02
00-38457-5 Fourth Quarter 2000 Air Volume in mLs 1.34E+11	<sup>nat</sup> U	1.64E-15	N/A	1.00E-16	9.00E-14	1.82E+00
	<sup>230</sup> Th	< 1.00E-16	1.41E-17	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.64E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

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### HIGH VOLUME AIR SAMPLING REPORT

CLIENT: HOMESTAKE MINING COMPANY - GRANTS, NEW MEXICO

REPORT DATE: January 19, 2001

SAMPLE ID: HMC 6

Quarter/Date Sampled Air Volume	Radionuclide	Concentration $\mu\text{Ci/mL}$	Error Estimate $\mu\text{Ci/mL}$	L.L.D. $\mu\text{Ci/mL}$	Effluent Conc.* $\mu\text{Ci/mL}$	% Effluent Concentration
31661-6 First Quarter 2000 Air Volume in mLs 1.46E+11	<sup>nat</sup> U	< 1.00E-16	N/A	1.00E-16	9.00E-14	< 1.11E-01
	<sup>230</sup> Th	< 1.00E-16	7.77E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.47E-18	1.00E-16	9.00E-13	< 1.11E-02
33918-6 Second Quarter 2000 Air Volume in mLs 1.42E+11	<sup>nat</sup> U	6.15E-15	N/A	1.00E-16	9.00E-14	6.84E+00
	<sup>230</sup> Th	< 1.00E-16	7.99E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.65E-18	1.00E-16	9.00E-13	< 1.11E-02
36437-6 Third Quarter 2000 Air Volume in mLs 1.47E+11	<sup>nat</sup> U	1.74E-15	N/A	1.00E-16	9.00E-14	1.93E+00
	<sup>230</sup> Th	< 1.00E-16	7.71E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	5.14E-18	1.00E-16	9.00E-13	< 1.11E-02
00-38457-6 Fourth Quarter 2000 Air Volume in mLs 1.44E+11	<sup>nat</sup> U	2.51E-16	N/A	1.00E-16	9.00E-14	2.79E-01
	<sup>230</sup> Th	< 1.00E-16	7.88E-18	1.00E-16	2.00E-14	< 5.00E-01
	<sup>226</sup> Ra	< 1.00E-16	6.56E-18	1.00E-16	9.00E-13	< 1.11E-02

N/A not applicable for ICP-MS

LLD = Lower Limit of Detection per Regulatory Guide 4.14

All LLDs were met

\*Effluent Concentrations per 10 CFR Part 20 Appendix B Table 2, Effluent Concentration

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COMPLETE ANALYTICAL SERVICES

38457R00007



**RADIOCHEMICAL QUALITY ASSURANCE REPORT  
HOMESTAKE MINING COMPANY**

Laboratory ID Range:  
Sample Matrix:  
Sample Date:  
Date Received:  
Report Date:

36437-1-7
Air Filter
3rd Quarter 2000
09-29-00
October 30, 2000

	Method	Relative Percent Difference <sup>1</sup>	Spike Recovery (Percent) <sup>2</sup>	LCS Recovery (Percent)	Method Blank $\mu\text{Ci/mL}$	Date Analyzed	Analyst
Laboratory #:		36437-7	36548-1				
Uranium:	200.8	0.0	102	-	<1.00E-16	10-24-00	ts
Laboratory #:		36464-1	36464-2		RA-249		
Radium-226:	903.0	5.8	101	104	<1.00E-16	10-19-00	rs
Laboratory #:		36437-7	36437-7		AS-89		
Thorium-230:	907.0	4.4	113	113	<1.00E-16	10-10-00	ph
Digestion:		Volume	Units				
	SW3050	1.89	Liter			10-03-00	rcb

- (1) These values are an assessment of analytical precision. The acceptance range is 0-20% for sample results above 10 times the reporting limit. This range is not applicable to samples with results below 10 times the reporting limit.
- (2) These values are an assessment of analytical accuracy. They are a percent recovery of the spike addition. ELI performs a matrix spike on 10 percent of all samples for each analytical method.

Report Approved By: *[Signature]*

Reviewed By: *[Signature]*  
CATHY FORSTNER  
PROJECT MANAGER

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**RADIOCHEMICAL QUALITY ASSURANCE REPORT  
HOMESTAKE MINING COMPANY**

**Laboratory ID Range:**  
**Sample Matrix:**  
**Sample Date:**  
**Date Received:**  
**Report Date:**

00-38457-1-7
Air Filter
4th Quarter 2000
12/22/2000
January 19, 2001

	<u>Method</u>	<u>Relative Percent Difference<sup>1</sup></u>	<u>Spike Recovery (Percent)<sup>2</sup></u>	<u>LCS Recovery (Percent)</u>	<u>Method Blank μCi/mL</u>	<u>Date Analyzed</u>	<u>Analyst</u>
<b>Laboratory #:</b>	01-30030-1    00-30030-2						
<b>Uranium:</b>	200.8	0.1	110	-	< 1.00E-16	01-08-2001	ts
<b>Laboratory #:</b>	00-38506-1    00-38506-1				RA-2		
<b>Radium-226:</b>	903.0	2.2	99	105	< 1.00E-16	01/09/2001	rs
<b>Laboratory #:</b>	00-38270-1    00-38270-1				AS-1		
<b>Thorium-230:</b>	907.0	16.4	101	101	< 1.00E-16	01/09/20001	ph
<b>Digestion:</b>		<u>Volume</u>	<u>Units</u>				
	SW3050	1.89	Liter			12/29/2000	rcb

- (1) These values are an assessment of analytical precision. The acceptance range is 0-20% for sample results above 10 times the reporting limit. This range is not applicable to samples with results below 10 times the reporting limit.
- (2) These values are an assessment of analytical accuracy. They are a percent recovery of the spike addition. ELI performs a matrix spike on 10 percent of all samples for each analytical method.

**Attachment 2 - Radon Gas Monitoring Results**

Attachment 2 - Radon Gas Monitoring Results  
Track-Etch Passive Survey

Location	Monitoring Period	Rn Concentration ( $\mu\text{Ci/ml}$ )	Error Estimate ( $\mu\text{Ci/ml}$ )	% Limit* (%)	LLD ( $\mu\text{Ci/ml}$ )
Hi-Vol #1 N Outer Perimeter	6/23/2000 - 12/29/2000	2.2E-09	3.9E-10	22	1.6E-10
Hi-Vol #2 NE Outer Perimeter	6/23/2000 - 12/29/2000	1.6E-09	3.4E-10	16	1.6E-10
Hi-Vol #3 E Outer Perimeter	6/23/2000 - 12/29/2000	1.2E-09	2.8E-10	12	1.6E-10
Hi-Vol #4 S Outer Perimeter	6/23/2000 - 12/29/2000	2.0E-09	4.8E-10	20	1.6E-10
Hi-Vol #5 N of Nearest Residence	6/23/2000 - 12/29/2000	1.8E-09	3.6E-10	18	1.6E-10
Hi-Vol #6 W of Outer Perimeter	6/23/2000 - 12/29/2000	1.1E-09	2.7E-10	11	1.6E-10
HMC #7 S Boundary	6/23/2000 - 12/29/2000	1.2E-09	2.8E-10	12	1.6E-10
HMC #16 Background	6/23/2000 - 12/29/2000	1.1E-09	2.7E-10	11	1.6E-10

\*Limit of  $1\text{E-}8 \mu\text{Ci/ml}$  for radon-222 with daughters removed as given in 10 CFR20, Appendix B, Table 2

**Attachment 3 - Environmental Gamma Radiation Results**

Attachment 3 - Environmental Gamma Radiation Results  
TLD Perimeter Survey

Direct Radiation Measurements

Location	Monitoring Period	Exposure Rate (mrem/qr)	Error (mrem/qr)*
Hi-Vol #1 N Outer Perimeter	7/7/2000-10/12/2000	20.9	0.7
Hi-Vol #2 NE Outer Perimeter	7/7/2000-10/12/2000	22.6	8.3
Hi-Vol #3 E Outer Perimeter	7/7/2000-10/12/2000	19.5	2.4
Hi-Vol #4 S Outer Perimeter	7/7/2000-10/12/2000	22.8	6.0
Hi-Vol #5 N of Nearest Residence	7/7/2000-10/12/2000	20.3	5.3
Hi-Vol #6 W of Outer Perimeter	7/7/2000-10/12/2000	20.3	5.3
#16 Background	7/7/2000-10/12/2000	23.9	3.0
Hi-Vol #1 N Outer Perimeter	10/12/2000-1/14/2001	33	3.2
Hi-Vol #2 NE Outer Perimeter	10/12/2000-1/14/2001	37	3.6
Hi-Vol #3 E Outer Perimeter	10/12/2000-1/14/2001	37	3.6
Hi-Vol #4 S Outer Perimeter	10/12/2000-1/14/2001	40	3.9
Hi-Vol #5 N of Nearest Residence	10/12/2000-1/14/2001	42	4.1
Hi-Vol #6 W of Outer Perimeter	10/12/2000-1/14/2001	40	3.9
#16 Background	10/12/2000-1/14/2001	34	3.3

\*Error is 1.96 std. dev.; error for fourth quarter calculated based on vendor's estimate.

**Attachment 4 - Annual Effective Dose Equivalent to  
Individuals of the Public**

## Annual Effective Dose Equivalent to Individuals of the Public

### 1.0 Introduction

There were very few activities in 2000 at the Grants Uranium Mill Site other than those associated with the groundwater restoration program. All off-pile tailings were consolidated with the tailings in 1995 and covered with a soil cover. All tailings currently have either an interim or permanent cover.

The 10 CFR 20.1301 radiation dose limit for individual members of the public from NRC-licensed facilities is specified as a total effective dose equivalent (TEDE) of 100 mrem/year. A licensee may request permission from the NRC to operate a facility up to a maximum of 500 mrem/year. Compliance may be demonstrated by calculations or measurements showing that the individual likely to receive the maximum dose from the facility does not exceed the limit, or by comparing the concentrations at the site perimeter to those specified in Table 2 of Appendix B to 10 CFR 20.000120.2401. Radiation from external sources for individuals in the unrestricted area may not deliver a dose equivalent of 0.002 rem in any hour or 0.050 rem in one year.

HMC has submitted environmental monitoring reports as required by 10 CFR 40.65 and License No. SUA-1471. The data from these reports along with data from background monitoring stations have been used in this dose assessment.

### 2.0 DOSE ASSESSMENT

The important pathways for assessing the dose to the maximum exposed individual are: inhalation of airborne particulate from the site, exposure to radon generated at the site, and the exposure to direct gamma radiation at the site boundary. The nearest residence is located within 100 yards of the HMC-4 sampling station. It is known that the residents have a typical lifestyle.

NUREG/CR-5512 recommends default values for the residential scenario. The values for indoor and outdoor occupancy are 200 effective days/year and 71 effective days/year, respectively. This is equivalent to a 75 percent total occupancy factor. This has been used in this analysis for all pathways.

#### 2.1 Inhalation of Radionuclides

The committed effective dose equivalent from inhalation of particulate was calculated for the four principal long-lived radionuclides, U-238, U-234, Th-230, and Ra-226, using the quarterly environmental monitoring data given in the Semi-Annual Environmental Reports for 2000. The sampling location HMC #4 was chosen as the Nearest Residence Location since the environmental levels were higher than at the other possible Nearest Residence Location, HMC#5. These stations are located on the southwestern perimeter of the site near existing residences. The use of these data to predict the dose to the nearest resident is very conservative in that the exposure at the residences should be less than that at the site perimeter.

Committed Effective Dose Equivalent per Unit Intake via Inhalation factors were taken from ICRP 30 tables. The values are given below:

<u>Nuclide</u>	<u>CEDE (mrem/<math>\mu</math>Ci)</u>
U-234	13.2E4
U-238	11.8E4
Th-230	32.6E4
Ra-226	8.6E3

Continuous occupancy at a breathing rate of 20,000 liters/day (Table A-1, NUREG-0859) was assumed. The CEDE was calculated for each of the radionuclides at each station. The CEDE at the principal residence for 100 percent occupancy was calculated to be 3.7 mrem/year while that at the background location (HMC#6) was calculated to be 2.1 mrem/y, for a net CEDE at the principal residence of 1.6 mrem/y. The results from these calculations are shown in Table 2-1 and Table 2-2. Considering the occupancy factor, this results in a net dose equivalent of 1.2 mrem/year.

## 2.2 Exposure to Radon

The outdoor radon levels in the Grants Uranium Belt are known to be high and variable, depending on the location relative to mine vents, surface ore deposits, and topographical features. The natural background radon concentrations, arising from the calm winds during the evenings and at times from temperature inversions, generally follow the drainage path of the heavy air. The HMC site is situated at the lowest point in the drainage path for radon generated over a very large area to the North, Northwest, and Lobo Canyon to the East. Therefore the natural background levels at the site are expected to be very high and variable over short periods of time due to being in this drainage path.

The radon data for the two monitoring periods are provided in Attachment 2 of the semi-annual monitoring reports. Monitoring Station 16 has been accepted as the radon background location for the site. The nearest residence exposure was chosen as HMC#4. The time-weighted average of the radon concentration for HMC#4 is 1.95 pCi/l while the time-weighted average for the background location is 1.0 pCi/l. This results in a net radon concentration at the nearest residence is 0.95 pCi/l.

Since the nearest residence is within a few hundred feet of Monitoring Station HMC #4 and within 3500 feet of the major source of radon, the equilibrium should be low. We have selected 20 percent radon daughter equilibrium as an estimate for use in the calculations. NRC uses continuous exposure to 0.1 pCi/l Rn-222 in full equilibrium with the daughter products as being equivalent to a CEDE of 50 mrem/y (10CFR Part 20, Appendix B). With 20 percent equilibrium, the CEDE would be 100 mrem/pCi/l. Considering the 75 percent occupancy factor, the net radon concentration at the nearest residence therefore results in a calculated CEDE of 71 mrem/y.

## 2.3 Dose from Exposure to Direct Radiation

An estimate of the dose equivalent from direct exposure to radiation sources at the site is obtained from the environmental TLDs placed at the monitoring stations. The Nearest Residence location, HMC#4, was used since it was higher than the alternative location HMC#5 as shown in Attachment 3 at the end of the semiannual reports. The time-weighted-average exposure rate at HMC#4 was 130.2 mrem/year while the background location, HMC#16, had a time-weighted average exposure rate of 109.9 mrem/quarter. Taking into consideration that the monitoring period was for 54 weeks, the dose equivalent rate at the HMC#4 station is an additional 20 mrem/year above that at the background location. Considering the 75 percent occupancy time, the dose equivalent to the nearest resident is 15 mrem/year.

## 2.4 Total Effective Dose Equivalent to the Nearest Resident

The TEDE to the Nearest Resident can be calculated by adding the EDE from inhalation of airborne particulate, the exposure to radon coming from the site, and the dose equivalent from direct gamma radiation. As indicated in the previous sections, there are 1.2 mrem/y from airborne particulate, 71 mrem/y from radon, and 15 mrem/y from direct gamma radiation for a total TEDE of 87 mrem/y. This is within the 100 mrem/year limit.



Table 2-1 Annual Effective Dose at the Nearest Residence from Airborne Particulate

Year: 2000

STATION: HMC #4 Nearest Residence

	AIRBORNE CONCENTRATION				
	U-nat μCi/ml =====	U-234 μCi/ml =====	U-238 μCi/ml =====	Th-230 μCi/ml =====	Ra-226 μCi/ml =====
1st qtr	2.42E-16	1.18E-16	1.18E-16	1.00E-16	1.00E-16
2nd qtr	1.05E-14	5.12E-15	5.12E-15	1.00E-16	1.00E-16
3rd qtr	3.83E-15	1.87E-15	1.87E-15	1.00E-16	1.00E-16
4th qtr	8.96E-16	4.37E-16	4.37E-16	1.00E-16	1.00E-16
Average	3.87E-15	1.88E-15	1.88E-15	1.00E-16	1.00E-16

ANNUAL EFFECTIVE DOSE EQUIVALENT				
U-234 mrem =====	U-238 mrem =====	Th-230 mrem =====	Ra-226 mrem =====	TOTAL mrem =====
1.816	1.624	0.238	0.006	3.7

Table 2-2 Annual Effective Dose at the Site Background Location from Airborne Particulate

Year:2000

STATION: HMC #6 Background

AIRBORNE CONCENTRATION

	U-nat μCi/ml =====	U-234 μCi/ml =====	U-238 μCi/ml =====	Th-230 μCi/ml =====	Ra-226 μCi/ml =====
1st qtr	1.00E-16	4.87E-17	4.87E-17	1.00E-16	1.00E-16
2nd qtr	6.15E-15	3.00E-15	3.00E-15	1.00E-16	1.00E-16
3rd qtr	1.74E-15	8.48E-16	8.48E-16	1.00E-16	1.00E-16
4th qtr	2.15E-16	1.05E-16	1.05E-16	1.00E-16	1.00E-16
Average	----- 2.05E-15	----- 1.00E-15	----- 1.00E-15	----- 1.00E-16	----- 1.00E-16

ANNUAL EFFECTIVE DOSE EQUIVALENT

U-234 mrem =====	U-238 mrem =====	Th-230 mrem =====	Ra-226 mrem =====	TOTAL mrem =====
0.963	0.861	0.238	0.006	2.1

**Attachment 5 – 2000 Annual Status Report for the Large  
and Small Tailings Embankments**

INTEROFFICE CORRESPONDENCE

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**TO:** Roy Cellan  
**FROM:** Ron Waterland  
**DATE:** February 15, 2001  
**RE:** **2000 Annual Status Report for the Large and Small Tailings Embankments**

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Monthly inspections were conducted of the Large and Small Tailings Embankments from January through December 2000. As a result of the inspections some minor maintenance work was periodically scheduled and completed. The maintenance for 2000 consisted of minor repair to the interim cover in several places on the top of the Large Tailings. Additional clay was placed in areas on top of the Large Tailings where rain had caused minor erosion.

The Small Tailings embankments did not require any repair work during the 2000 season.