



Bluewater Mill
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March 29, 1994

Mr. Joseph Holonich, Branch Chief
United States Nuclear Regulatory Commission
Uranium Recovery Branch
Division of Low-Level Waste Management
and Decommissioning, NMSS (5 E2)
11555 Rockville Pike
Rockville, MD 20850

Re: License No. SUA-1470
Docket No. 40-8902

Sent Via Facsimile and Courier

Dear Mr. Holonich:

As a followup to telephone conversations on March 22 and March 24, 1994 between Kenneth R. Baker, ARCO consultant, Natver Patel of my staff, and Elaine Brummett of your staff, we have prepared the following responses to Ms. Brummett's questions regarding our submittal, "Final Radon Barrier Design for the Bluewater Mill Main Tailings Pile (FDESIGN)."

1. Attached is a listing of all radon barrier density tests that were completed on the 5:1 side slopes. The average density was 116.4 lb/cu.ft. This is slightly higher than the as-placed density of the radon barrier that was placed on the sands portion of the Main Tailings Pile (MTP). Therefore this demonstrates that the same radon barrier physical properties should be used for the side slopes as those used for the MTP sands area. This should apply to all side slope radon barrier that has been placed to date.

The density data for the radon barrier material placed to date indicate that the compaction achieved has been higher than the design specifications. This has greatly enhanced the effectiveness of the radon barrier. ARCO, however, has not changed the construction specifications for radon barrier to be placed in the future although there is no basis for assuming that the higher densities will not continue to be achieved. In our analyses for the side slopes, radon barrier placed after this date is assumed to be compacted to only 95 % of standard proctor values for the maximum

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density. The RAECOM input parameters for 95 % compacted radon barrier are provided in Appendix C of ARCO's Reclamation Plan for the Bluewater Mill, 1990 (1990RP).

2. The slide slopes of the MTP have been constructed on the sands portion of the MTP in accordance with Figure 5.7-1 of the 1990RP. As can be seen from the drawing, only the top portion of the side slope is within ten feet of tailings. Source terms greater than ten feet from the surface have little influence on the flux. A reasonable assumption for the Ra-226 source term "beneath the barrier" is to use the same Ra-226 profile that was used for the top portion of the sands (from Table 3-1 of FDESIGN). The east embankment of the mixed area has a similar construction. The side slope on a portion of the west side of the mixed area and slimes area abuts the old acid tailings area, as shown in Figure 5.7-3 of 1990RP. While much of the underlying material will be clean or slightly contaminated material, we suggest that the radon source term will be no larger than that used for the top ten feet of the mixed area of the MTP.

The embankments around the slimes were constructed of earthen material with sand tailings moisture drains as shown in Figure 5.7-2 of 1990RP. While the northern portion of the side slopes have not been completed, the radon barrier will primarily be underlain by borrow soils and clean dike material. Therefore the average Ra-226 concentration is believed to be similar to that for the top ten feet of the pile in the slimes area.

While an argument has been presented above that the top portion of the slimes and mixed area of the MTP accurately reflects the radon source term for those portions of the side slopes, ARCO will continue to use the source term for the sands area of the MTP as the source term for all the side slopes where tailings are within 10 feet of the radon barrier. Where tailings are not within ten feet of the radon barrier, the flux is assumed to be zero. This is reasonable since material used for constructing the fill was clean dike material and borrow soils.

A recent engineering analysis of the constructed pile shows that the total top surface of the MTP is approximately 250 acres. To date, 47 of the total 68 acres of side slopes have been completed. The radon barrier portion of the side slopes was completed at the compaction specified in No. 1 above. This includes all of the side slopes contiguous to the sands area, 60 % of the side slopes contiguous to the mixed area, and 15 % of the side slopes contiguous to the slimes. We should note that these percentages and acreage may change once the final embankments are completed.

The RAECOM runs are attached for the side slopes of the MTP for the existing radon barrier as well as radon barrier to be placed in the future (95 % compaction). The calculations show that the flux from the existing 2.4 feet thick radon barrier, assuming the tailings sands as a source term, is projected to reach a maximum of 10.5 pCi/m²s. Using the same assumptions and applying 2.4 feet of cover at a 95 % compaction will result in a maximum flux of 20 pCi/m²s. Twenty-four of the total 34 acres of radon barrier have already been placed on the side slopes. Assuming the different flux for the material to be placed in the future, the area-weighted average flux from the radon barrier portion of the side slopes is 13.3 pCi/m²s.

As indicated above, the area of the side slopes where the distance between the radon barrier and the tailings material is greater than ten feet will be assumed to emit zero flux. This should correspond roughly to the area where the cover is not considered radon barrier quality (the primary difference is that particle size, plasticity index, and more frequent density measurements were not made during construction). Using cross-sections, the engineering analysis shows that 28 acres of the side slopes currently have tailings within 10 feet of the radon barrier. This agrees well with the estimated 24 acres of radon barrier completed to date. Assuming that only 34 acres of the side slopes will have radon emissions above background, then the area-weighted average projected flux from the side slopes is 6.7 pCi/m². If the side slopes are considered in the average flux for the MTP (see Table 4-2 in FDESIGN), then the average flux from the MTP is projected to be 10.6 pCi/m²s. This shows that the average flux of 11.6 pCi/m²s as presented in FDESIGN is reduced even further if the flux from the side slopes is considered.

In order to demonstrate the conservatism of using the sands tailings as a source term, the flux through 2.4 feet (73 cm) of radon barrier was calculated using the mixed area and slimes area source terms. For the 95 % compaction, the side-slope flux for the slimes area is calculated to be 4.3 pCi/m²s. This compares to a flux of 20 pCi/m²s using the sands source term. For the Mixed area, the flux for the side slope for the currently-placed material is 8.7 pCi/m²s and for the 95 % compacted material is 16 pCi/m²s. The corresponding flux values using the sand tailings as the source term was calculated to be 10.5 and 20 pCi/m²s, respectively. The RAECOM runs for these analyses are attached.

3. The increase in Ra-226 concentration with depth in the sands tailings area arises from the fact that the lower grade tailings that were produced in more recent years were placed on the top of the pile. There was additional dilution in the top 2-ft layer when the temporary cover that had been placed on the pile was mixed with the sands during the reshaping of the pile.

Mr. Joseph Holonich
March 29, 1994
Page 4

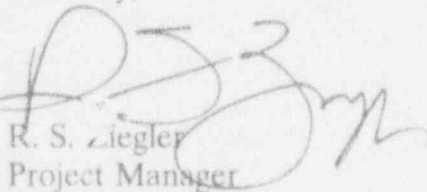
4. On page 50 of the report, "Final Radon Barrier Design, ARCO Bluewater Mill Main Tailings Pile", we wish to replace No. 1 by,

"1. ARCO will characterize the Ra-226 profile within 8 feet of the surface on which the radon barrier is placed. Continuous 24-inch core samples will be taken to a depth of 8 ft or until the bottom of the tailings has been reached, whichever occurs first. For the 22-acre Acid Tailings Pile, continuous 24-inch core samples will be taken at 10 locations. For the 4-acre extension to the Carbonate Tailings Pile, the core samples will be taken at 3 locations. All samples will be analyzed for Ra-226 content."

5. It is apparent that the average source term beneath the side slopes is a small fraction of that which exists beneath the respective portions of the MTP. The plan calls for placing 2.4 feet of radon barrier on all side slopes. Considering that our calculations show that the long-term projected flux from the top of the tailings pile is only 11.6 pCi/m²s, the overall average flux for the pile should decrease if the side slopes are considered. Considering the assumptions given in 2 above, the average flux for the pile including side slopes is 10.6 pCi/m²s.

Should you have any questions regarding this response, please contact me or Natver Patel of my staff.

Sincerely,



R. S. Ziegler
Project Manager

Attachment

pc: Natver Patel
Sherry Purdy
Christopher Sanchez
Pete Garcia, United States NRC, URFO, Denver, CO
Elaine Brummett, United States NRC, Washington, DC



3/28/94

Calculations

- ① 95% Compacted Radon Barrier - 10 acres at $\phi = 20 \text{ pCi/m}^2$
Current Compacted Radon Barrier - 24 acres at $\phi = 10.5$
- Area-Weighted Average $\phi = \frac{10}{34} (20) + \frac{24}{34} (10.5)$
 $= 13.3 \text{ pCi/m}^2$

- ② Side Slopes
- 34 acres with $\phi = 13.3 \text{ pCi/m}^2$
34 acres with $\phi = \phi \text{ pCi/m}^2$
Area-weighted flux = 6.7 pCi/m^2

- ③ Side Slope
- 68 acres with $\phi = 6.7 \text{ pCi/m}^2$
250 acres with $\phi = 11.6 \text{ pCi/m}^2$ (MTP)
- $\frac{68}{318} (6.7) + \frac{250}{318} (11.6) = 10.6 \text{ pCi/m}^2$

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OUTPUT INFORMATION : 10:33:59 03-28-1994
 BOTTOM FLUX = 0 pCi/m²/sec
 AIR CONC. = 0 pCi/l
 BARE LAYER 1 FLUX = 292.37 pCi/m²/s
 NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm ³)	DIFF COEF	FLUX (pCi/m ² /s)	CONC. (pCi/cm ³)	MIC
11	73.0	.3133	9.5	1	.2	1.854	0.00753	10.48	0.0	0.584
10	61.0	.4037	8	55.8	.2	1.61	0.02380	12.84	58.7	0.764
9	61.0	.4037	8	78.6	.2	1.61	0.02380	14.56	78.8	0.764
8	61.0	.4037	8	117	.2	1.61	0.02380	11.99	106.6	0.764
7	61.0	.4037	8	132	.2	1.51	0.02380	15.87	122.9	0.764
6	61.0	.4037	8	203	.2	1.61	0.02380	28.28	136.3	0.764
5	61.0	.4037	8	252	.2	1.61	0.02380	15.95	154.4	0.764
4	122.0	.4037	8	186	.2	1.61	0.02380	-7.01	157.6	0.764
3	122.0	.4037	8	210	.2	1.61	0.02380	-0.09	153.0	0.764
2	305.0	.4037	8	137	.2	1.61	0.02380	-18.61	142.2	0.764
1	305.0	.4037	8	409	.2	1.61	0.02380	96.16	218.9	0.764

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***** TOP *****
*- 11 -* radon barrier on sands area, current compaction *
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*- 10 -* *
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*- 9 -* *
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*- 8 -* *
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*- 7 -* *
*****
*- 6 -* *
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*- 5 -* *
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*- 4 -* *
*****
*- 3 -* *
*****
*- 2 -* sands-long term *
*****
*- 1 -* sands *
*****
***** BOTTOM *****
    
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RAECOBPC.BAS

OUTPUT INFORMATION : 10:17:03 03-28-1994
 BOTTOM FLUX = 0 pCi/m²/sec
 AIR CONC. = 0 pCi/l
 BARE LAYER 1 FLUX = 292.37 pCi/m²/s
 NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm ³)	DIFF COEF	FLUX (pCi/m ² /s)	CONC. (pCi/cm ³)	MIC
11	73.0	.341	9.5	1	.2	1.78	0.01390	20.04	0.0	0.633
10	61.0	.4037	8	55.8	.2	1.61	0.02380	12.84	58.7	0.764
9	61.0	.4037	8	78.6	.2	1.61	0.02380	14.56	78.8	0.764
8	61.0	.4037	8	117	.2	1.61	0.02380	11.99	106.6	0.764
7	61.0	.4037	8	132	.2	1.61	0.02380	15.87	122.9	0.764
6	61.0	.4037	8	203	.2	1.61	0.02380	28.28	136.3	0.764
5	61.0	.4037	8	252	.2	1.61	0.02380	15.95	154.4	0.764
4	122.0	.4037	8	186	.2	1.61	0.02380	-7.01	157.6	0.764
3	122.0	.4037	8	210	.2	1.61	0.02380	-0.09	153.0	0.764
2	305.0	.4037	8	137	.2	1.61	0.02380	-18.61	142.2	0.764
1	305.0	.4037	8	409	.2	1.61	0.02380	96.16	218.9	0.764

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***** TOP *****
*- 11 -* radon barrier 95 % compaction *
*****
*- 10 -* *
*****
*- 9 -* *
*****
*- 8 -* *
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*- 7 -* *
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*- 6 -* *
*****
*- 5 -* *
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*- 4 -* *
*****
*- 3 -* *
*****
*- 2 -* sands-long term *
*****
*- 1 -* sands *
*****
***** BOTTOM *****
    
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RAECOBPC.BAS

OUTPUT INFORMATION : 10:14:07 03-28-1994
 BOTTOM FLUX = 0 pCi/m²/sec
 AIR CONC. = 0 pCi/l
 BARE LAYER 1 FLUX = 55.99 pCi/m²/s
 NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm ³)	DIFF COEF	FLUX (pCi/m ² /s)	CONC. (pCi/cm ³)	MIC
12	73.0	.341	9.5	1	.2	1.78	0.01390	4.33	0.0	0.633
11	61.0	.38	9.5	14.75	.22	1.68	0.01260	5.57	7.8	0.689
10	61.0	.38	9.5	13.11	.22	1.68	0.01260	3.86	13.5	0.689
9	61.0	.38	9.5	10.57	.22	1.68	0.01260	5.52	19.2	0.689
8	61.0	.38	9.5	10.72	.22	1.68	0.01260	12.12	29.9	0.689
7	37.0	.38	22	71.1	.22	1.68	0.01260	26.53	21.7	0.280
6	40.0	.42	22	157	.2	1.56	0.00077	2.15	129.4	0.395
5	61.0	.42	22	434	.2	1.56	0.00077	-0.02	322.3	0.395
4	61.0	.42	22	424	.2	1.56	0.00077	0.08	315.4	0.395
3	61.0	.42	22	450	.2	1.56	0.00077	1.81	325.7	0.395
2	61.0	.42	22	522	.2	1.56	0.00077	4.48	360.1	0.395
1	31.0	.42	22	483	.2	1.56	0.00077	-2.17	372.7	0.395

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***** TOP *****
*- 12 -* slimes area side slopes radon barrier 95% compaction *
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*- 11 -* windblown/evaporation pond *
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*- 10 -* windblown/evaporation pond *
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*- 9 -* windblown/evaporation pond *
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*- 8 -* windblown/evaporation pond *
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*- 7 -* slimes/cover *
*****
*- 6 -* slimes *
*****
*- 5 -* slimes *
*****
*- 4 -* slimes *
*****
*- 3 -* slimes *
*****
*- 2 -* slimes *
*****
*- 1 -* slimes-bottom *
*****
***** BOTTOM *****
    
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RAECOBPC.BAS

OUTPUT INFORMATION : 10:22:07 03-28-1994
 BOTTOM FLUX = 0 pCi/m²/sec
 AIR CONC. = 0 pCi/l
 BARE LAYER 1 FLUX = 146.75 pCi/m²/s
 NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm ³)	DIFF COEF	FLUX (pCi/m ² /s)	CONC. (pCi/cm ³)	MIC
8	73.0	.341	9.5	1	.2	1.78	0.01390	16.34	0.0	0.633
7	61.0	.411	9.5	37.2	.22	1.59	0.02107	22.75	32.5	0.728
6	61.0	.411	9.5	47.1	.22	1.59	0.02107	27.54	49.7	0.728
5	61.0	.411	9.5	59.5	.22	1.59	0.02107	38.15	72.1	0.728
4	61.0	.411	9.5	122	.22	1.59	0.02107	57.44	104.8	0.728
3	61.0	.411	15	242	.24	1.59	0.00850	68.94	116.0	0.571
2	61.0	.411	15	272	.24	1.59	0.00850	36.73	201.7	0.571
1	91.0	.411	15	323	.24	1.59	0.00850	23.93	251.0	0.571

***** TOP *****
 - 8 - slide slope mixed area, 95 % compaction *

 - 7 - *

 - 6 - *

 - 5 - *

 - 4 - *

 - 3 - *

 - 2 - *

 - 1 - mixed area side slopes *

 ***** BOTTOM *****

RAECOBPC.BAS

OUTPUT INFORMATION : 10:10:32 03-28-1994
 BOTTOM FLUX = 0 pCi/m²/sec
 AIR CONC. = 0 pCi/l
 BARE LAYER 1 FLUX = 146.75 pCi/m²/s
 NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm ³)	DIFF COEF	FLUX (pCi/m ² /s)	CONC. (pCi/cm ³)	MIC
8	73.0	.3133	9.5	1	.2	1.854	0.00753	8.68	0.0	0.584
7	61.0	.411	9.5	37.2	.22	1.59	0.02107	15.25	41.2	0.728
6	61.0	.411	9.5	47.1	.22	1.59	0.02107	23.49	54.4	0.728
5	61.0	.411	9.5	59.5	.22	1.59	0.02107	35.99	74.8	0.728
4	61.0	.411	9.5	122	.22	1.59	0.02107	56.35	106.3	0.728
3	61.0	.411	15	242	.24	1.59	0.00850	68.50	116.8	0.571
2	61.0	.411	15	272	.24	1.59	0.00850	36.57	202.0	0.571
1	91.0	.411	15	323	.24	1.59	0.00850	23.87	251.1	0.571

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***** TOP *****
*- 8 -* side-slope radon barrier *
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*- 7 -* *
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*- 6 -* *
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*- 5 -* *
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*- 4 -* *
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*- 3 -* *
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*- 2 -* *
*****
*- 1 -* mixed area side slopes *
*****
***** BOTTOM *****
    
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ATLANTIC RICHFIELD COMPANY
 BLUEWATER MILL RECLAMATION-PHASE I
 MAIN TAILINGS IMPOUNDMENT 84:1V SLOPE
 RADON BARRIER DENSITY TESTS

DATE TEST NO	LOCATION	O MAT. E CODE P	PROCTOR NO	MAX DENSITY LBS/CF	CPT MOIST	NUCLEAR			SANDCONE			RETEST DATE	NO	+- DEN %	+- MOIS %	NUCLEUS CORRELATION		COMMENTS		
						DRY DENSITY LBS/CF	% COM	+- CPT	DRY DENSITY LBS/CF	% COM	+- CPT					DENS %	MOIS %			
507	#63 MAIN TAILINGS DWE STA 105+50.22 RT @ 3.0' BFG		116	116.7	13.0	115.3	16.0	99	3.0											
507	#64 MAIN TAILINGS DWE STA 103+00.37 LT @ 2.0' BFG		116	116.7	13.0	115.5	13.9	99	0.9											
507	#65 MAIN TAILINGS DWE STA 108+00.17 RT @ 3.0' BFG		116	116.7	13.0	115.7	11.8	96	-1.2											
401	475 MAIN TAILINGS DWE STA 105+80.23 RT @ 1.0' BFG		123	116	12.4	115.3	13.6	99	1.2											
401	474 MAIN TAILINGS DWE STA 108+00.18 RT @ 5.5' BFG		123	116	12.4	117.1	13.0	101	0.8											
401	475 MAIN TAILINGS DWE STA 114+50.55 RT @ 2.0' BFG		123	116	12.4	118.8	12.6	102	0.2											
401	476 MAIN TAILINGS DWE STA 107+00.28 RT @ 3.0' BFG		123	116	12.4	117.0	15.0	101	2.8											
						TOTAL # OF TESTS			181											
						AVERAGE INITIAL TEST			116.2			12.3								
						AVERAGE PASSING TEST			116.4			12.4								

DRAFT

ATLANTIC RICHFIELD COMPANY BLUEWATER MILL RECLAMATION PHASE I MAIN TAILINGS IMPOUNDMENT #4-1V SLOPE RADON BARRIER DENSITY TESTS																			
DATE/TEST NO	D MATR E 000 P	PROCTOR NO	MAX DENSITY LBS/CF	NUCLEAR			SAND/STONE			% +/-	COMPT OPT	% +/-	RETEST DATE	DRY DENSITY LBS/CF	% +/-	CORRELATION DEN %	NICOLS CONE	CORRELATION DEN %	COMMENTS
				OPT	MOIST	DRY	DENSITY	MOIST	DRY										
102	51	022	120.5	11.8	114.3	11.6	95	-0.2	115.4	10.8	95	-1.0							
106	52	022	120.5	11.8	118.6	11.8	98	0.0	117.8	11.6	97	-0.2							
108	60	031	114.3	14.6	116.0	11.8	101	-2.8	121.2	11.6	106	3.0							
108	61	031	114.3	14.6	110.8	8.9	96	-5.7	116.7	8.8	101	-6.0	061V	3/21	124.5	11.9	109	-2.7	95 +/-3 99.0 107.4
108	62	031	114.3	14.6	111.2	8.4	97	-6.2	112.5	9.0	98	-5.6	062V	1/01	115.3	10.5	100	-4.1	95 +/-3 98.2 90.3
108	63	031	114.3	14.6	115.1	8.8	101	-5.8	117.3	8.9	102	-5.7	063V	3/21	122.8	13.1	107	-1.5	95 +/-3 98.1 96.9
101	64	034	116.4	14.5	117.7	13.4			119.7	13.5	102	-1.0							
101	66	034	116.4	14.5	114.6	12.6	98	-1.9	119.9	11.6	102	-2.9							
101	68	034	116.4	14.5	118.4	12.6	101	-1.9	121.2	11.7	104	-2.8							
101	70	034	116.4	14.5	110.6	12.1	95	-2.4	113.3	11.6	97	-2.9							
101	71	034	116.4	14.5	117.7	11.9	101	-2.8	117.8	14.1	101	-0.4							
204	74	037	116.1	12.9	116.6	12.5	100	-0.4	117.9	13.5	101	0.6							
204	75	037	116.1	12.9	114.9	9.0	98	-3.9	118.1	8.2	102	-4.7	075R	2/04	118.2	10.8	100	-2.3	95 +/-3 97.3 109.9
204	78	037	116.1	12.9	116.3	10.9	102	-2.0	121.4	10.2	104	-2.7							
204	79	037	116.1	12.9	116.1	12.9	100	-0.4	117.9	13.5	101	0.6							
204	80	037	116.1	12.9	116.1	12.9	100	-0.4	117.9	13.5	101	0.6							
204	81	037	116.1	12.9	116.1	12.9	100	-0.4	117.9	13.5	101	0.6							
204	82	037	116.1	12.9	116.1	12.9	100	-0.4	117.9	13.5	101	0.6							
205	83	040	114.3	14.1	114.5	12.1	100	-2.0	114.5	12.1	100	-2.0							
205	84	040	114.3	14.1	117.5	13.4	102	-0.7	117.5	13.4	102	-0.7							

TRIPLET

DATE TEST NO	LOCATION	D. MAT. PROCTOR NO	MAX DENSITY LBS/CF	OPT MOIST %	NUCLEAR		SANDCONE		RETEST DATE NO	DRY DENSITY LBS/CF	% +/-	COMPARISON	NUCLEAR CORRELATION	
					DRY DENSITY LBS/CF	MOIST %	DRY DENSITY LBS/CF	MOIST %					DRY DENSITY LBS/CF	MOIST %
	STA 20+00, 20LT @ 2.5 BFG													
2/05	MAIN TAILINGS DIKE STA 29+00, 15RT @ 1.5 BFG	5	144.3	14.1										
2/05	MAIN TAILINGS DIKE STA 27+40, 31RT @ 3.0 BFG	5	114.3	14.1										
2/05	MAIN TAILINGS DIKE STA 23+00, 60RT @ 1.0 BFG	5	114.3	14.1										
2/05	MAIN TAILINGS DIKE STA 24+00, 60RT @ 2.5 BFG	5	114.3	14.1										
2/05	MAIN TAILINGS DIKE STA 28+00, 32RT @ 3.0 BFG	5	114.3	14.1										
2/11	MAIN TAILINGS DIKE STA 28+75, 70RT @ 1.5 BFG	5	117.2	12.8										
2/11	MAIN TAILINGS DIKE STA 27+00, 82RT @ 1.5 BFG	5	117.2	12.8										
2/11	MAIN TAILINGS DIKE STA 24+00, 70RT @ FG	5	117.2	12.8										
2/11	MAIN TAILINGS DIKE STA 26+00, 50RT @ 0.5 BFG	5	117.2	12.8										
2/11	MAIN TAILINGS DIKE STA 27+00, 25RT @ 2.0 BFG	5	117.2	12.8										
2/13	MAIN TAILINGS DIKE STA 18+00, 45LT @ 2.0 BFG	5	117.4	11.9										
2/13	MAIN TAILINGS DIKE STA 16+00, 30LT @ 1.5 BFG	5	117.4	11.9										
2/13	MAIN TAILINGS DIKE STA 16+00, 60LT @ 2.5 BFG	5	117.4	11.9										
2/13	MAIN TAILINGS DIKE STA 19+00, 6 LT @ 1.0 BFG	5	117.4	11.9										
2/14	MAIN TAILINGS DIKE STA 16+00, 51LT @ FG	5	116.7	11.9										
2/14	MAIN TAILINGS DIKE STA 16+00, 01LT @ 2.0 BFG	5	116.7	11.9										
2/14	MAIN TAILINGS DIKE STA 20+00, 30RT @ 7.5 BFG	5	116.7	11.9										
2/14	MAIN TAILINGS DIKE STA 20+50, 50RT @ 1.5 BFG	5	116.7	11.9										

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ATLANTIC RICHFIELD COMPANY																		
BLUEWATER MILL RECLAMATION-PHASE I																		
MAIN TAILINGS IMPOURMENT 8:1:1.5 SLOPE																		
RADON BARRIER DENSITY TESTS																		
DATE TEST	NO	LOCATION	D MAT. PROCTOR E LOD P	NO	MAX DENSITY LBS/CF	MOIST OPT	NUCLEAR			SANDCORE			RETEST DATE NO	DRY DENSITY LBS/CF	% +/-	CORRELATION	MOIST	COMMENTS
							DENSITY LBS/CF	MOIST %	COM OPT	DENSITY LBS/CF	MOIST %	COM OPT						
2/21	173	MAIN TAILINGS DIKE STA 15+00 70RT @ 1.5BFG	5	064	115.5	14.3	122.3	11.7	106	-2.6				95	+1.3			
2/21	174	MAIN TAILINGS DIKE STA 15+25 70RT @ 0.5BFG	5	064	115.5	14.3	111.6	13.0	96	-1.3				95	+1.3			
2/21	175	MAIN TAILINGS DIKE STA 13+50 35RT @ 1.5BFG	5	064	115.5	14.3	115.3	13.6	100	-0.7				95	+1.3			
2/21	176	MAIN TAILINGS DIKE STA 17+75 95RT @ 3.0BFG	5	064	115.5	14.3	113.5	13.3	86	-1.0				95	+1.3			
2/21	177	MAIN TAILINGS DIKE STA 13+25 40RT @ 1.0BFG	5	064	115.5	14.3	109.9	12.8	95	-1.5				95	+1.3			
2/21	178	MAIN TAILINGS DIKE STA 23+75 42RT @ 2.0BFG	5	064	115.5	14.3	121.7	13.4	105	-0.9				95	+1.3			
2/25	190	MAIN TAILINGS DIKE STA 18+00 83RT @ 3.0BFG	5	066	114.8	14.8	111.1	13.1	97	-1.7				95	+1.3			
2/25	191	MAIN TAILINGS DIKE STA 13+00 45RT @ 1.5BFG	5	066	114.8	14.8	112.9	13.6	98	-1.2				95	+1.3			
2/25	194	MAIN TAILINGS DIKE STA 23+00 40RT @ 1.0BFG	5	066	114.8	14.8	114.7	11.9	96	-2.9				95	+1.3			
2/25	195	MAIN TAILINGS DIKE STA 17+75 87RT @ 1.0BFG	5	066	114.8	14.8	116.5	13.9	103	-0.9				95	+1.3			
2/25	196	MAIN TAILINGS DIKE STA 16+75 90RT @ 1.5BFG	5	066	114.8	14.8	111.6	15.1	97	0.3				95	+1.3			
2/26	206	MAIN TAILINGS DIKE STA 24+25 93RT @ 1.0BFG	5	066	115.6	14.6	117.4	12.4	101	-2.2				95	+1.3			
2/26	210	MAIN TAILINGS DIKE STA 19+00 90RT @ 0.5BFG	5	066	115.6	14.6	118.6	11.6	102	-3.0				95	+1.3			
2/26	211	MAIN TAILINGS DIKE STA 13+50 72RT @ 1.0BFG	5	066	115.6	14.6	117.1	11.8	101	-2.8				95	+1.3			
2/26	212	MAIN TAILINGS DIKE STA 7+50 18RT @ 1.0BFG	5	066	115.6	14.6	111.4	12.7	96	-1.9				95	+1.3			
2/26	214	MAIN TAILINGS DIKE STA 7+00 35RT @ 3.0BFG	5	066	115.6	14.6	111.8	16.2	96	1.8				95	+1.3			
2/27	217	MAIN TAILINGS DIKE STA 14+50 95RT @ 1.0BFG	5	072	114.7	14.8	115.8	13.6	100	-1.2				95	+1.3			
2/27	218	MAIN TAILINGS DIKE STA 11+75 60RT @ 1.5BFG	5	072	114.7	14.8	121.3	13.1	105	-1.7				95	+1.3			
2/27	219	MAIN TAILINGS DIKE STA 6+75 45RT @ 3.0BFG	5	072	114.7	14.8	117.1	14.3	102	-0.5				95	+1.3			
2/27	220	MAIN TAILINGS DIKE	5	072	114.7	14.8	119.0	12.6	104	-2.2				95	+1.3			

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ATLANTIC RICHFIELD COMPANY																
BLUEWATER MILL RECLAMATION-PHASE I																
MAIN TAILINGS IMPROVEMENT 6H-1V SLOPE																
RADON BARRIER DENSITY TESTS																
DATE TEST NO	LOCATION	D MAT. PROCTOR NO	MAX DENSITY LB/CF	OPT MOIST %	NUCLEAR			SANDCONE			RETEST DATE NO	DRY DENSITY LB/CF	% COMPT	+/- OPT	CORRELATION	COMMENTS
					DRY DENSITY LB/CF	MOIST %	COMPT %	DRY DENSITY LB/CF	MOIST %	COMPT %						
	STA 6+75 CL @ 0.5 BFG															
227	222 MAIN TAILINGS DKE	5	114.7	14.8	115.5	13.0	100	-1.8						95 +/-3		
	STA 12+50 78RT @ 2.5 BFG															
227	223 MAIN TAILINGS DKE	5	114.7	14.8	114.3	12.2	96	-2.6						95 +/-3		
	STA 9+28 42RT @ 3.0 BFG															
228	224 MAIN TAILINGS DKE	5	114.7	14.8	113.4	11.9	95	-2.9						95 +/-3		
	STA 9+25 11RT @ 1.0 BFG															
228	225 MAIN TAILINGS DKE	5	116.1	12.9	112.6	14.2	96	1.3						95 +/-3		
	STA 9+00 45RT @ 1.0 BFG															
228	226 MAIN TAILINGS DKE	5	116.1	12.9	119.0	12.8	102	-0.1						95 +/-3		
	STA 0+25 5RT @ 1.5 BFG															
228	227 MAIN TAILINGS DKE	5	116.1	12.9	111.5	11.2	96	-1.7						95 +/-3		
	STA 5+50 50RT @ 1.5 BFG															
228	228 MAIN TAILINGS DKE	5	116.1	12.9	125.7	11.2	106	-1.7						95 +/-3		
	STA 19+75 99RT @ 2.5 BFG															
228	229 MAIN TAILINGS DKE	5	116.1	12.9	110.6	15.5	95	2.6						95 +/-3		
	STA 128+25 41T @ 2.0 BFG															
228	230 MAIN TAILINGS DKE	5	116.1	12.9	121.3	15.0	104	2.1						95 +/-3		
	STA 12+00 17RT @ 3.0 BFG															
304	247 MAIN TAILINGS DKE	5	118.5	13.2	119.8	13.0	100	-0.2						95 +/-3		
	STA 14+00 86RT @ 1.5 BFG															
304	248 MAIN TAILINGS DKE	5	118.5	13.2	120.1	12.1	101	-1.1						95 +/-3		
	STA 12+50 14RT @ 1.0 BFG															
304	249 MAIN TAILINGS DKE	5	118.5	13.2	119.8	12.4	100	-0.8						95 +/-3		
	STA 8+00 77RT @ 3.0 BFG															
304	251 MAIN TAILINGS DKE	5	118.5	13.2	120.7	13.0	101	-0.2						95 +/-3		
	STA 9+00 2RT @ 1.5 BFG															
304	252 MAIN TAILINGS DKE	5	118.5	13.2	122.9	12.7	103	-0.5						95 +/-3		
	STA 124+50 11RT @ 1.0 BFG															
304	253 MAIN TAILINGS DKE	5	118.5	13.2	120.3	12.1	101	-1.1						95 +/-3		
	STA 124+00 17RT @ 0.5 BFG															
304	254 MAIN TAILINGS DKE	5	118.5	13.2	118.9	11.3	96	-1.9						95 +/-3		
	STA 126+50 14RT @ 1.0 BFG															
304	255 MAIN TAILINGS DKE	5	118.5	13.2	122.3	11.0	103	-2.2						96 +/-3		
	STA 2+15 38RT @ 1.5 BFG															
305	256 MAIN TAILINGS DKE	5	118.3	12.9	117.1	10.4	101	-2.5						95 +/-3		
	STA 120+75 32RT @ 1.0 BFG															
305	259 MAIN TAILINGS DKE	5	118.3	12.9	114.9	11.4	98	-1.5						95 +/-3		
	STA 120+00 26RT @ 0.5 BFG															

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 11/15/07

ATLANTIC RICHFIELD COMPANY															
BLUEWATER MILL RECLAMATION PHASE I															
MAIN TAILINGS IMPOUNDMENT BK-1V SLOPE															
RADON BARRIER DENSITY TESTS															
DATE TEST NO	LOCATION	D MAT. PROCTOR NO	MAX DENSITY LBS/CF	OPT MOIST %	NUCLEAR			SANDSTONE			RETEST DATE NO	DRY DENSITY LBS/CF	MOIST DENS %	CORRELATION %	COMMENTS
					DRY DENSITY LBS/CF	MOIST DENSITY LBS/CF	%	DRY DENSITY LBS/CF	MOIST DENSITY LBS/CF	%					
3005	260 MAIN TAILINGS DIKE STA 126+50 41RT @ 1.5 BFG	5	076	116.3	12.9	115.3	9.9	98	-3.0						
3005	261 MAIN TAILINGS DIKE STA 127+75 53RT @ 2.0 BFG	5	078	116.3	12.9	111.6	10.8	95	-2.1						
3005	262 MAIN TAILINGS DIKE STA 128+75 47RT @ 1.5 BFG	5	076	116.3	12.9	114.2	11.0	99	-1.9						
3005	264 MAIN TAILINGS DIKE STA 2+50 88RT @ 3.0 BFG	5	076	116.3	12.9	117.9	11.2	101	-1.7						
3005	265 MAIN TAILINGS DIKE STA 124+25 44RT @ 3.0 BFG	5	076	116.3	12.9	114.4	11.2	98	-1.7						
3005	266 MAIN TAILINGS DIKE STA 123+00 53RT @ 1.0 BFG	5	077	116.2	13.7	121.7	11.8	104	1.9						
3006	270 MAIN TAILINGS DIKE STA 122+50 56RT @ 1.0 BFG	5	076	116.0	13.4	113.6	15.9	97	2.4						
3006	271 MAIN TAILINGS DIKE STA 2+75 68RT @ 0.5 BFG	5	076	116.0	13.4	113.5	13.6	97	0.2						
3006	272 MAIN TAILINGS DIKE STA 133+75 77RT @ 2.0 BFG	5	078	116.0	12.4	115.4	11.4	99	-2.0						
3006	273 MAIN TAILINGS DIKE STA 127+00 80RT @ 1.0 BFG	5	078	116.0	13.4	124.5	12.7	107	-0.7						
3006	274 MAIN TAILINGS DIKE STA 120+00 40RT @ 1.5 BFG	5	076	116.0	13.4	123.2	10.4	106	-3.0						
3006	275 MAIN TAILINGS DIKE STA 128+25 92RT @ 3.0 BFG	5	076	116.0	13.4	117.4	14.1	101	0.7						
3007	288 MAIN TAILINGS DIKE STA 121+50 47RT @ 0.5 BFG	5	080	117.6	13.9	111.9	12.0	95	-1.9						
3007	290 MAIN TAILINGS DIKE STA 124+00 93RT @ 1.5 BFG	5	080	117.6	13.9	112.6	11.2	95	-2.7						
3007	291 MAIN TAILINGS DIKE STA 128+00 105RT @ 2.5 BFG	5	080	117.3	13.9	112.3	11.6	95	-2.3						
3007	292 MAIN TAILINGS DIKE STA 122+25 82RT @ 2.0 BFG	5	080	117.9	13.9	115.0	13.0	98	-0.9						
3007	293 MAIN TAILINGS DIKE STA 4+10 74RT @ 3.0 BFG	5	080	117.6	13.9	114.8	15.5	97	1.6						
3007	294 MAIN TAILINGS DIKE STA 7+75 68RT @ 2.0 BFG	5	080	117.6	13.9	112.9	11.5	95	-2.1						
3007	295 MAIN TAILINGS DIKE STA 30+50 CL @ 1.5 BFG	5	082	114.9	13.2	115.2	13.3	100	0.1						

3/11/07

ATLANTIC RICHFIELD COMPANY BLUEWATER MILL RECLAMATION-PHASE I MAIN TAILINGS IMPOUNDMENT #H-TV SLOPE RADON BARRIER DENSITY TESTS																
DATE TEST NO	LOCATION	D E P	MATERIAL PROCTOR NO	MAX DENSITY LBS/CF	DPT MOIST	NUCLEAR DRY DENSITY LBS/CF	NUCLEAR MOIST %	SAND CONE DRY DENSITY LBS/CF	SAND CONE MOIST %	+/- OPT COM	+/- OPT DEN %	RETEST DATE NO	DRY DENSITY LBS/CF	NUCLEAR CORRELATION DENS MOIST %	COMMENTS	
																NUCLEAR DRY DENSITY LBS/CF
3/11	296	MAIN TAILINGS DIKE STA 10+00, 95 RT @ FG	5	082	114.9	13.2		115.7	12.1	100	-1.1				95 +/-3	
3/11	299	MAIN TAILINGS DIKE STA 9+00, 97 RT @ 0.5BFG	5	082	114.9	13.2		115.4	11.6	100	-1.6				95 +/-3	
3/11	300	MAIN TAILINGS DIKE STA 7+80, 95 RT @ 1.0BFG	5	082	114.9	13.2		112.4	10.8	97	-2.4				95 +/-3	
3/11	301	MAIN TAILINGS DIKE STA 6+00, 115 RT @ 1.5BFG	5	087	116.2	14.3		111.5	13.0	96	-1.1				95 +/-3	
3/12	302	MAIN TAILINGS DIKE STA 5+00, 90 RT @ 1.0BFG	5	087	116.2	14.3		114.3	11.5	98	-2.8				95 +/-3	
3/12	303	MAIN TAILINGS DIKE STA 2+50, 90 RT @ FG	5	087	116.2	14.3		111.2	12.8	96	-1.5				95 +/-3	
3/12	304	MAIN TAILINGS DIKE STA 0+00, 100 RT @ 0.5BFG	5	087	116.2	14.3		114.7	14.3	98	0.0				95 +/-3	
3/12	305	MAIN TAILINGS DIKE STA 128+00, 98 RT @ 1.0BFG	5	087	116.2	14.3		117.3	11.4	101	-2.9				95 +/-3	
3/12	306	MAIN TAILINGS DIKE STA 122+00, 90 RT @ 1.5BFG	5	087	116.2	14.3		117.2	12.5	101	-1.8				95 +/-3	
3/12	307	MAIN TAILINGS DIKE STA 117+60, 25 RT @ 2.0BFG	5	087	116.2	14.3		110.4	12.2	95	-2.1				95 +/-3	
3/12	312	MAIN TAILINGS DIKE STA 121+60, 90 RT @ 3.0BFG	5	090	115.6	14.5		119.2	11.7	103	-2.8				95 +/-3	
3/13	314	MAIN TAILINGS DIKE STA 122+00, 92 RT @ FG	5	090	115.6	14.5		115.7	12.1	99	-2.4				95 +/-3	
3/13	315	MAIN TAILINGS DIKE STA 119+75, 50 RT @ 0.5BFG	5	090	115.6	14.5		112.2	11.9	97	-2.6				95 +/-3	
3/13	319	MAIN TAILINGS DIKE STA 118+00, 84 RT @ 1.0BFG	5	090	115.6	14.5		115.6	13.6	99	-0.6				95 +/-3	
3/13	320	MAIN TAILINGS DIKE STA 115+00, CL @ 1.5BFG	5	090	115.6	14.5		117.1	12.1	101	-2.4				95 +/-3	
3/13	321	MAIN TAILINGS DIKE STA 119+00, 50 RT @ FG	5	090	115.6	14.5		111.2	12.6	96	-1.9				95 +/-3	
3/13	324	MAIN TAILINGS DIKE STA 118+00, 40 RT @ 1.5BFG	5	092	117.2	13.1		113.5	12.2	96	-0.9				95 +/-3	
3/14	345	MAIN TAILINGS DIKE STA 123+00, 110 RT @ FG	5	092	117.2	13.1		119.2	11.0	102	-2.1				95 +/-3	
3/14	346	MAIN TAILINGS DIKE STA 121+80, 110 RT @ 0.5BFG	5	092	117.2	13.1		112.8	13.7	96	0.6				95 +/-3	
3/14	347	MAIN TAILINGS DIKE	5	092	117.2	13.1		114.5	13.2	97	0.1				95 +/-3	

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ATLANTIC RICHFIELD COMPANY																		
BLUEWATER MILL RECLAMATION PHASE I																		
MAIN TAILINGS IMPROVEMENT #41 TV SLOPE																		
RADON BARRIER DENSITY TESTS																		
DATE TEST NO	LOCATION	D E P	MATERIAL NO	PROCTOR NO	MAX DENSITY LBS/CF	OPT MOIST %	NUCLEAR DRY DENSITY LBS/CF	NUCLEAR MOIST COM %	NUCLEAR OPT DENSITY LBS/CF	NUCLEAR DRY DENSITY LBS/CF	SAND/COKE DRY DENSITY LBS/CF	SAND/COKE MOIST COM %	SAND/COKE OPT DENSITY LBS/CF	RETEST DATE NO	% +/-	% +/-	CORRELATION %	COMMENTS
320	404 MAIN TAILINGS DIKE		5	105	119.7	13.8					115.3	14.7	99	0.9			95 +/-3	
	STA 107+25, 101 RT @ 1.5BFG																	
3201	410 MAIN TAILINGS DIKE		5	109	118.8	12.2					117.5	10.7	98	-1.5			95 +/-3	
	STA 108+00, 38 LT @ 0.5 BFG																	
3201	410 MAIN TAILINGS DIKE		5	109	118.8	12.2					113.1	14.1	95	1.9			95 +/-3	
	STA 110+00, 54 LT @ 0.5 BFG																	
3201	410 MAIN TAILINGS DIKE		5	109	118.8	12.2					116.8	11.2	99	-1.0			95 +/-3	
	STA 111+50, 48 LT @ 1.0 BFG																	
3201	410 MAIN TAILINGS DIKE		5	109	118.8	12.2					116.2	11.0	99	-1.2			95 +/-3	
	STA 106+75, 63 RT @ 0.5 BFG																	
3201	420 MAIN TAILINGS DIKE		5	109	118.8	12.2					115.9	10.9	97	-1.3			95 +/-3	
	STA 108+50, 48 LT @ 0.5 BFG																	
3201	421 MAIN TAILINGS DIKE		5	109	118.8	12.2					116.4	10.6	98	-1.6			95 +/-3	
	STA 103+50, 66 RT @ 1.0 BFG																	
3201	422 MAIN TAILINGS DIKE		5	109	118.8	12.2					112.9	11.2	95	-1.0			95 +/-3	
	STA 101+00, 96 LT @ 2.5 BFG																	
3201	423 MAIN TAILINGS DIKE		5	109	118.8	12.2					112.9	12.0	95	-0.2			95 +/-3	
	STA 109+00, 38 LT @ 2.5 BFG																	
3205	430 MAIN TAILINGS DIKE		5	113	116.0	13.4					117.2	12.1	101	-1.3			95 +/-3	
	STA 105+25, 13 LT @ 1.0 BFG																	
3205	433 MAIN TAILINGS DIKE		5	113	116.0	13.4					110.3	12.6	95	-0.8			95 +/-3	
	STA 109+50, 26 LT @ 1.5 BFG																	
3205	434 MAIN TAILINGS DIKE		5	113	116.0	13.4					114.6	13.4	98	0.0			95 +/-3	
	STA 111+00, 37 LT @ 0.5 BFG																	
3205	435 MAIN TAILINGS DIKE		5	113	116.0	13.4					117.5	11.3	101	-2.1			95 +/-3	
	STA 104+25, 13 LT @ 3.0 BFG																	
3205	436 MAIN TAILINGS DIKE		5	113	116.0	13.4					115.0	11.0	99	-2.4			95 +/-3	
	STA 106+00, 17 LT @ 2.0 BFG																	
3205	437 MAIN TAILINGS DIKE		5	113	116.0	13.4					112.5	12.3	97	-1.1			95 +/-3	
	STA 109+10, 37 LT @ 0.5 BFG																	
3205	438 MAIN TAILINGS DIKE		5	113	116.0	13.4					110.5	13.8	95	0.4			95 +/-3	
	STA 101+50, 87 LT @ 1.0 BFG																	
3207	460 MAIN TAILINGS DIKE		5	116	116.7	13.0					117.4	15.5	100	2.5			95 +/-3	
	STA 107+50, 71 LT @ 1.0 BFG																	
3207	461 MAIN TAILINGS DIKE		5	116	116.7	13.0					117.2	15.4	100	2.4			95 +/-3	
	STA 110+00, 131 LT @ 0.5 BFG																	
3207	462 MAIN TAILINGS DIKE		5	116	116.7	13.0					117.4	13.3	100	0.3			95 +/-3	
	STA 112+50, 41 RT @ 2.0 BFG																	

ATLANTIC RICHFIELD COMPANY