



Bluewater Mill
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September 23, 1996

Mr. Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management (Mail Stop T7J9)
U. S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, Maryland 20852

RE: Bluewater Mill Site Reclamation Completion Report Comments
License No. SUA-1470, Docket No. 40-8902

Dear Mr. Holonich:

Enclosed please find five copies of responses to the September 20, 1996 U. S. Nuclear Regulatory Commission (NRC) technical staff comments on the radiological sections of the Atlantic Richfield Company's (ARCO) Bluewater Mill Site Reclamation Completion Report. The responses are prepared as an Addendum 1 to the Completion Report. Revised figures included in Attachment 1 are to replace appropriate figures in the Completion Report. Also, the revised Completion Report text pages included in Attachment 6 are for replacing appropriate Completion Report pages.

Should you have any questions, please do not hesitate to contact me or Mr. Natver Patel of AVM Environmental Services, Inc. at (505) 287-4593.

Sincerely,

For

R. S. Ziegler
Operations Manager

enclosure

250050
pc: J. Virgona, US DOE
C. Cains, USNRC, Region IV
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Drawings located in Central File

Response to NRC's Comments

Comment: 1

Follow-up to 1992 Cleanup Report:

ARCO should provide information in the Completion Report (CR) to follow-up on the information in the 1992 Windblown Contamination Cleanup Report, such as:

Response: 1

As indicated in the October 1992 Windblown Cleanup Report, three anomalous areas (Area A, C, and H) were not excavated to the cleanup level during windblown cleanup. These areas contained tailings or ore material which were not due to windblown tailing contamination. They were cleaned during the subsequent reclamation activities as discussed in the response to comment 1a, 1b, and 1c.

In addition to the "Atlantic Richfield Company, Bluewater Mill Completion Report" (CR), the January 1994 "Radiological Dose and Risk Assessment of the Residual Windblown Tailings, ARCO Bluewater Mill Site" (Exemption Request), follows up on some information of the 1992 Windblown Cleanup Report.

Comment: 1a

Area H was determined to have elevated gamma levels due to natural material. Indicate how this was determined and where the data resides, or if the area was excavated, which grid approximates this area.

Response: 1a

Area H falls in Grid Block I10, with approximate coordinates of N32200 E 29100 at the center of the area. During windblown cleanup excavation control survey, average gamma radiation levels in Area H remained at about 4000 to 4500 cphm after several excavations to approximately 7 feet. A grab soil sample revealed Ra-226 concentration at 25 pCi/gm. Unlike the gray color of

ore or the tailings, the material in Area H was black in color and had a shale type texture, which was determined to be a natural deposit of lignite in the form of a small lens. Another grab soil sample (#92-840S), the where gamma radiation level averaged at approximately 3700 cphm, was collected and sent to Acculab for analysis. The sample results indicated Ra-226 concentrations at 8 pCi/gm. Nevertheless, additional excavation was conducted after October 1992. With additional excavation, the small pocket of natural deposit was cleaned up. Revised Figure 6-3 and 6-4, included in Attachment 1, depicts Area H and show that Area H meets the cleanup criteria.

Comment: 1b

Indicate the location of the verification data for the other 2 areas with anomalous gamma readings (Areas A and C) that was determined to be due to tailings. Area A is not indicated on Figure 6-1 or 6-3, but using the coordinates on map B-3 of the 1992 report, it appears to extend well beyond the exemption area.

Response: 1b

As stated in the Windblown Cleanup Report, Area C anomalous gamma readings were due to tailings material from the raffinate line near the eastern edge of the evaporation ponds. The raffinate line was remediated during Phase II reclamation, which followed the windblown cleanup. Revised Figures 6-3 and 6-4, included in Attachment 1, depict Area C and show that Area C meets the cleanup criteria.

As for Area A, additional excavation was conducted after August 1992 utilizing excavation control survey. However, soil sampling verification survey was not conducted because most of the area was located in the Exemption Boundary. The gamma radiation survey and soil sampling were conducted during August 1996 in the portion of Area A which was outside the Exemption boundary. Revised Figures 6-3 and 6-4, included in Attachment 1, depicts Area A, outside the Exemption Boundary, which show that Area A meets the cleanup criteria. Attachment 2 includes soil sampling results for this area in Grid Block E03 and E04.

Comment: 1c

Indicate whether or not the 1.3 acre wet area was determined to be "official" wetlands.

Response: 1c

The U.S. Corp. of Engineers inspected this area and confirmed that this was not a wetland. This information is included in the Supplemental Environmental Report submitted to the NRC in April 1993.

Comment: 2

In CR Section 4.5 (Off-pile Contamination), ARCO indicates that approximately 400 acres of windblown tailings plus portions of the golf course, housing area, and other areas (evaporation pond area 325 acres) were remediated.

Comment: 2a

Resolve the inconsistency of this statement with the account in the 1992 Windblown Contamination Cleanup Report which states that 590 acres were known to be contaminated, 210 acres of these are in the Malpais exemption, 30 acres are rock, and an additional 20 acres of contamination were found. That left 388 (370?) acres to be cleaned, but 188 acres "rocked out" so 116 acres of these exceed the standard (p. 18). Thus, 273 areas were cleaned to meet the standards. In addition, present the information so that the cleanup history of each area (location & size of areas cleaned or partially cleaned, when & why exemption obtained) is clearer.

Response: 2a

On November 17, 1988, ARCO requested a modification to the Reclamation Plan to exclude the 210 acre malpais area from the cleanup criteria. The NRC, by License Amendment No. 8, approved the exclusion. The modification for the Malpais Exclusion was also included in Volume 3 of ARCO's 1990 Reclamation Plan.

The approximate 590 acres of windblown contaminated area stated in the 1992 Windblown Cleanup report were estimate. The actual windblown area was approximately 620 acres, slightly more than 590 acres. The 388 acre excavation stated in the Windblown Cleanup Report was determined from engineering surveys of the actual areas excavated during the cleanup in 1992. With some additional excavation which may have resulted from identification of additional contamination during the cleanup verification, it is estimated that a total of approximately 400 acres of excavation was conducted during the Site reclamation.

As indicated in Table 6.1 of the Windblown Cleanup Report, a total of 273 of 388 acres met the cleanup level. These 273 acres included 73 acres of the rocked out areas. Thus in 1992, approximately 115 of the 188 acres of rocked out areas did not meet the cleanup level. This preliminary determination of areas meeting the cleanup level was made based on the excavation control surveys, not the verification survey. As indicated in the Windblown Cleanup Report, a formal verification survey, in accordance with the approved verification procedure to demonstrate compliance with the cleanup criteria, was to be implemented later.

The windblown cleanup area was divided into small areas as shown in the Drawing 1 of the Windblown Cleanup Report. The Final Excavation Control Survey maps for each area, which show the depth of excavation as well as gamma radiation survey levels, are included in Appendix F of the Windblown Cleanup Report.

Comment: 2b

Clarify if the 42 acres with elevated readings Ra-226 mentioned on the bottom of page 22 as granted an exemption to the cleanup standards (no indication of why the exemption was granted), are related to the statement on the top of page 22 that license amendment 23 addressed rock outcrops.

Response: 2b

The 42 acres with elevated Ra-226 readings mentioned on the bottom of page 22 of the CR are same as rock outcrop areas discussed on top of page 22 of the CR which was addressed by License Amendment 23. Following the windblown cleanup in 1992, and some additional cleanup attempts during the subsequent work, a soil sampling program, which is a part of the verification procedure, was implemented to determine residual Ra-226 levels in soils. The soil sampling results, which are shown in Figure 3-2 of the January 1994 Exemption Request, indicate that 42 acres of rocked out areas, scattered within the Exemption Area exceeded the cleanup standard. The 42 acre areas not meeting the cleanup criteria in the 1994 Exemption Request are less than the 116 acres stated in the 1992 Windblown Cleanup Report because of additional cleanup attempts after the windblown cleanup, as well as the more precise assessment of Ra-226 levels using soil sampling program. The Exemption Request, which includes basis and justification from cleanup, was approved by the NRC as License Amendment No. 23. As shown in Figure 3-2 of the Exemption Request, the 1,288 acre Exemption Area includes the 210 acre Malpais Exclusion, in addition to the other rocked out areas at the Site.

Comment: 2c

For the housing area, indicate the estimated size of the remaining area of elevated gamma that is attributed to high levels of K-40.

Response: 2c

It is difficult to determine the actual size of the remaining area of elevated gamma that is attributed to high levels of K-40 because it is in a form of a lens at a depth of over 5 feet which resulted from a fill during the housing construction activities. However, it is estimated to be less than one acre. Figure 6-6 in Attachment 1 depicts this area.

Comment: 3

Section 4.6.2 (Figure 4-3), indicates the location of the El Paso gas line near the east end of the evaporation ponds. CR page 70, states that the old pipeline was left in place, but there is no mention whether or not tailings were found in the trench, or if the new trench was dug in clean soil. Indicate the cleanup status of the trenches and if Figure 4-3 depicts the new or the old trench.

Response: 3

El Paso's old gas pipeline passed between the Main Tailings Pile and the Evaporation Ponds. Figure 3-2 of the January 1994 Exemption Request shows the location of the old pipeline. The pipeline existed prior to the discharging of tailings into the Main Tailings Pile (MTP) near the pipeline. Therefore, tailings are not expected to be inside the pipeline trench. During the windblown cleanup work, surface contamination was cleaned from the pipeline Right-of-Way (ROW), except near the MTP dike, where the pipeline was under the TOE of the northeast dike. Soil sampling results are presented in Figure 3-2 of the Exemption Request. The pipeline was not excavated. It was abandoned in place, which is within the Exemption Area boundary. Figure 4-3 depicts the new pipeline. Most of the new pipeline was routed through the unaffected outlying area of the Site. Excavated areas where portions of the pipeline passed through were previously verified to meet the cleanup criteria as part of the verification program. The unaffected outlying area was verified as unaffected in accordance with verification Method C. In addition, radiation protection surveillance and gamma exposure rate measurements conducted for occupational health physics monitoring indicated that no tailings were encountered during the new pipeline trench excavation. Revised Figures 6-3 and 6-8, which are included in Attachment 1, depict the new pipeline and shows that these areas meet the cleanup criteria.

Comment: 4

Table 5.1 (page 77) presents background exposure rates, but does not indicate or reference the measurement locations and what year the study was done. Also, the paragraph following the

table should indicated that exposure rates on the disposal piles are provided in Appendices G - I.

Response 4

The exposure rates reported in Table 5.1 were taken by Kenneth Baker, consultant to ARCO, in 1993 at locations that were accessible by vehicle. The Ludlum Model 19 microR-meter that was used to make these measurements was also used to make the final exposure rate measurements on the disposal sites. Using the same instrument was desirable since the standards call for reducing the gamma exposure rates to background levels. The exposure rates measured in this study agree with those made by Rogers and Associates Engineering Company as reported in Appendix C of the Reclamation Plan. Figure AD1-1 showing the measurement locations is included in Attachment 3. The disposal site verification measurements are discussed in Section 7 of the CR.

Comment: 5

Several Figures in Section 6 indicate an exemption boundary, but the bounded area seems to include much more than the Malpais exemption area (see Drawing 1 in the 1992 Cleanup Report). ARCO should clarify why the areas between the disposal cells and west of the Main Tailings Cell are included within the exemption boundary, and perhaps provide the map from the 1994 exemption request.

Response 5

As discussed in the response to Comment No.1, Drawing 1 in 1992 Windblown Cleanup Report shows only the 210 acre Malpais Exclusion, which ARCO requested in the November 17, 1987 request for Modification of the Reclamation Plan. The Exemption Boundary in Figure 3-1, 3-2 and B-1 (Appendix B) of the 1994 Exemption Request, includes the Malpais Exclusion as well as other areas within the Site, including the areas between the disposal cells and west of the MTP.

The areas between the disposal cells and west of the MTP are also malpais outcrops where sampling and cleanup was impractical. Therefore, the areas between the disposal cells and west

of the MTP were included within the Exemption Boundary. The January 1994 Exemption Request was approved by the NRC by License Amendment No. 23. Figures in Section 6 of the CR have the same Exemption Boundary as Figures 3-1, 3-2, and B-1 of the Exemption Request. Copy of Figure 3-2 of the 1994 Exemption Request is included in Attachment 3.

Comment: 6

On Figure 6-9, indicate the position of the former golf course, housing areas, county road, and guard station. Also, correct the north coordinate numbers and provide block numbers that correspond to those used on the other figures in Section 6.

Response 6:

Figure 6-9 has been revised and is included in Attachment 1.

Comment: 7

Page 82, first paragraph of Section 6.4, indicates that a soil sample was analyzed for grid D3-10-35, but the data does not appear in Appendix J. Provide the Ra-226 data or an explanation.

Response 7

Soil sample #95-521S at grid D3-10-35 was collected to investigate the elevated gamma radiation measurement during the cleanup verification. Because this sample was a special sample, and not part of the soil sampling point as required by method B of the verification procedure, it was not included in Appendix J. The Ra-226 analytical result of this sample was 3.8 pCi/gm, as discussed in the CR text.

Comment: 8

Page 82, second paragraph of Section 6.4, indicates that the area south of the exemption boundary meets the criteria, but ARCO should explain why Figure 6-5 indicates approximately 13 grids above the 3350 cphm action level. If these are the same grids mentioned at the bottom

of page 86 as being "rocked out" areas of the former golf course, page 82 should be revised to include this discussion.

Response: 8

The comment is correct in that the second paragraph in Section 6.4, page 82 does not accurately describe the data. The second paragraph should be replaced as follows:

Soils within the area south of the exemption boundary were contaminated primarily by the transport of contaminated material when constructing site features. Gamma surveys were done to identify areas requiring remediation. After cleanup, Method B gamma and soil verification measurements were made in the affected areas as represented in Figures 6-5 and 6-6. Actual values for the soil samples are presented in Appendix J. Since none of these contaminated areas had the properties of windblown contamination, the details of the cleanup are discussed further in Section 6.5.

Comment: 9

The same paragraph also indicates that Figure 6-6 shows that all Ra-226 measurements are below 6.9 pCi/g, but ARCO should explain why Figure 6-6 indicates 5 grids have Ra-226 values above 6.9 pCi/g (supported by Appendix J elevated values in grids 07-8-8, P5-18-8, P8-18-26, P10-8-29, and P10-13-11).

Response: 9

The following paragraphs provide additional discussion to more fully explain the data.

The gamma data represented by color ranges on Figure 6-5 shows 12 grid blocks that exceeded the 3350 cphm gamma-ray action level. Those areas near the intersection of Grid Blocks N5 and O5, large piles of lava flow, exhibited elevated gamma count rates while not having any soil to sample. Other areas were sampled and found to meet the Ra-226 cleanup criteria.

In all but five cases, the soil samples for the grid blocks indicated that the Ra-226 criterion was met. For the remaining five grid blocks, the soil was removed to bedrock and the small amount of residual soil sampled and analyzed. For those locations (07-8-8, P5-18-8, P8-18-26, P10-8-29, and P10-13-11), the Ra-226 concentration did not meet the cleanup criteria. However, since the area was rocked out, no additional remediation was practical.

Comment: 10

Figure 6-4 is missing Ra-226 data symbol for grids in block F12 and Ra-226 data is not in Appendix J, but gamma data is presented on Figure 6-3. ARCO should explain if this area was excavated.

Response: 10

Soil samples were collected in August 1996 at locations where Ra-226 data symbols were missing but gamma data was presented in grid block F12. This was one of the excavated areas and soil sampling was inadvertently missed. Figure 6-4 has been revised to incorporate the data and is included in Attachment 1. In addition, soil sample results for Ra-226 are included in Attachment 2 for inclusion in Appendix J of the CR.

Comment: 11

Figure 6.5

Comment: 11a

The grid gamma readings stop abruptly at the Q block row. Indicate why there aren't readings for every 1000-foot grid (unaffected area, Figure 6-7) to demonstrate that no removal was necessary. The restricted area boundary is not a sufficient reason for lack of data.

Response: 11a

Where gamma readings stopped at the Q block row is the southern edge of the golf course area. Gamma radiation surveys were conducted to characterize the golf course area as it was determined affected during the later stages of the Site reclamation. Isolated pockets of tailings material were identified in the golf course area, which appeared to be the result of golf course

construction activity by man, rather than windblown tailings contamination. Therefore, it is not expected to be beyond the golf course area. In addition, gamma radiation scan was conducted during the golf course area cleanup to assure boundary of contamination. Therefore, the gamma survey for cleanup verification was stopped at the Q block row. Nevertheless, a 200' grid gamma radiation survey was conducted in September 1996 which demonstrate that area south of the Q block row is unaffected. Revised Figure 6-5, included in Attachment 1, shows result of the September 1996 gamma survey.

Comment: 11b

Explain why there are gamma readings where part of the Plant Site Disposal Cell should be (refer to Figure 6-1).

Response: 11b

Prior to placement of the cover on the Plant Site Disposal Cell, excavation was conducted in areas near the western edges of the Cell. The gamma survey for cleanup verification was conducted to complete the entire grids which may have overlapped the excavated area and the Plant Site Disposal Cell. Nevertheless, the survey indicates the excavated area meets the cleanup level.

Comment: 12

Explain why Figure 6-6 indicates 3 soil samples in block K11, but there are no corresponding gamma readings in Figure 6-5.

Response: 12

The gamma radiation readings in Figure 6-5 corresponding to the soils samples in Figure 6-6 were inadvertently missed. The gamma radiation measurements were made at this location in August 1996, and Figure 6-5 has been revised and included in Attachment 1.

Comment: 13

Comparing Figure 6-6 to Appendix J Ra-226 data, it appears that grids N4-16 to 20, with values of 11.6 to 7.5 pCi/g, should be outside the exemption zone and on the figure. Similarly, grids N5-21 to 23, with values of 33.4 to 8.3 pCi/g, should be on the figure. Explain why Figure 6-6 appears incomplete, or provide a corrected figure.

Response: 13

Using a larger scale map, we have reviewed the locations of grid blocks N4-16 through N4-20 and find the soil sampling location designations correct as plotted on the map. This also applies to grid blocks N5-21 to N5-23. The presentation may be somewhat deceptive in that the soil sampling grid is a 33.3' by 33.3' grid block centered in each quadrant. However, the presentation on the maps indicates that this represents an area of 100' by 100'. The computer selected the samples on the basis of whether the 33.3' by 33.3' grid block that was sampled was within the boundary.

Comment: 14

The bottom of page 82 and top of 83 discuss sampling for Th-230 in the residue beneath the liner of the evaporation ponds. It indicates that no soil samples were taken for evaporation pond 3A because the pond was in use at the time the other pond areas were sampled. Data should have been obtained for the CR, or justification provided concerning the lack of sampling. This should be addressed in the proposed plan for additional sampling (see b).

Comment: 14a

The CR indicates that 5 samples exceed the Th-230 guideline of 17 pCi/g for surface contamination. ARCO should note that, in calculating the 1000-year Ra-226 (including background), one must consider the contribution from existing Ra-226 that is not always at background levels and should choose a Th-230 cleanup guideline of approximately 14.5 pCi/g (plus consider ALARA) for surface material.

Response: 14a

ARCO has considered the NRC's recommended 14.5 pCi/gm Th-230 level in responding to Comment 14.b

Comment: 14b

ARCO has submitted (June 24, 1996) a plan for additional Th-230 sampling in order to demonstrate that the location of the highest value has been mixed with clean soil during excavation of the ditch, and to clarify how much contamination remains uncontrolled (in surface 6 inches). ARCO should provide the test results to NRC with a cleanup plan, or a discussion of the potential long-term health hazards and environmental damage that could result from the residual Th-230.

Response: 14b

Section 6.4 of the Completion Report presented the set of verification QA samples for the Evaporation Pond area that were available for thorium analysis. The Ra-226 concentration for the set averaged only 1.7 pCi/g, or indistinguishable from background. The Th-230 results averaged 6.6 pCi/g with five samples being above 14.5 pCi/g, the level at which the ingrowth of Ra-226 would reach 5 pCi/g after 1000 years. It was also acknowledged that Evaporation Pond 3A was still in use at the time of submitting the samples for Th-230 analysis and since that pond liner had maintained its integrity, it was unlikely that the soils beneath the liner contained elevated Th-230.

At the request of the NRC, ARCO conducted additional Th-230 sampling in the former evaporation ponds area in accordance with the Sampling Plan submitted to the NRC on June 24, 1996. The samples were analyzed by Energy Laboratory in Casper, Wyoming. Figure AD1-2, included in Attachment 4, shows the sampling points and Th-230 concentration values for the original analyses (shown in red) as well as 48 additional samples taken according to a sampling plan submitted to the NRC on June 24, 1996. The average Th-230 concentration for this additional set of samples is 12.5 pCi/g, with eight of the samples exceeding the 14.5 pCi/g value. The average of all sample results is 9.6 pCi/g. Results of initial and additional Th-230 samplings are presented in the following table.

Table 14-1
Th-230 Sampling Results from the Evaporation Pond Area

| Sample Number | Th-230 pCi/gm | Sample Number | Th-230 pCi/gm | Sample Number | Th-230 pCi/gm | Sample Number | Th-230 pCi/gm |
|---------------|---------------|---------------|---------------|----------------|---------------|----------------|---------------|
| 93-1620 S | 2.1 | 93-3840 S | 3.1 | 96-02, Pt #504 | 2.7 | 96-26, Pt #533 | 9.5 |
| 93-1640 S | 1.2 | 93-3860 S | 2.7 | 96-03, Pt #502 | 2.2 | 96-27, Pt #532 | 30.4 |
| 93-1660 S | 9.2 | 93-3920 S | 10.4 | 96-04, Pt #501 | 13.9 | 96-28, Pt #536 | 13.9 |
| 93-1680 S | 1.9 | 93-3940 S | 1.5 | 96-05, Pt #546 | 2.2 | 96-29, Pt #542 | 13.1 |
| 93-1700 S | 1.8 | 93-3980 S | 7.5 | 96-06, Pt #503 | 5.7 | 96-30, Pt #541 | 26.1 |
| 93-1720 S | 1.7 | 93-4100 S | 2.9 | 96-07, Pt #507 | 0.2 | 96-31, Pt #535 | 14.1 |
| 93-1740 S | 3.8 | 93-4120 S | 0.7 | 96-08, Pt #506 | 0.9 | 96-32, Pt #539 | 58.6 |
| 93-1760 S | 0.0 | 93-4260 S | 2.9 | 96-09, Pt #505 | 0.8 | 96-33, Pt #540 | 13.0 |
| 93-1780 S | 2.8 | 93-4280 S | 19.3 | 96-10, Pt #508 | 1.3 | 96-34, Pt #538 | 6.6 |
| 93-1800 S | 11.6 | 93-4360 S | 2.6 | 96-11, Pt #511 | 1.4 | 96-35, Pt #537 | 9.6 |
| 93-1820 S | 12.6 | 93-4380 S | 3.5 | 96-12, Pt #510 | 5.8 | 96-36, Pt #529 | 27.3 |
| 93-1860 S | 3.0 | 93-4560 S | 21.4 | 96-13, Pt #513 | 7.8 | 96-37, Pt #523 | 3.2 |
| 93-1900 S | 3.2 | 93-4620 S | 4.1 | 96-14, Pt #512 | 1.9 | 96-38, Pt #528 | 2.9 |
| 93-1920 S | 79.9 | 93-4700 S | 2.3 | 96-15, Pt #515 | 1.7 | 96-39, Pt #527 | 3.4 |
| 93-1940 S | 5.2 | 93-4720 S | 0.7 | 96-16, Pt #516 | 11.0 | 96-40, Pt #526 | 25.8 |
| 93-1960 S | 6.5 | 93-4760 S | 0.4 | 96-17, Pt #518 | 5.5 | 96-41, Pt #525 | 5.0 |
| 93-2040 S | 1.4 | 93-4780 S | 17.8 | 96-18, Pt #517 | 9.1 | 96-42, Pt #524 | 1.3 |
| 93-2060 S | 3.4 | 93-4800 S | 4.9 | 96-19, Pt #520 | 0.5 | 96-43, Pt #514 | 2.2 |
| 93-2080 S | 17.3 | 93-4820 S | 0.6 | 96-20, Pt #521 | 68.6 | 96-44, Pt #545 | 2.0 |
| 93-2380 S | 0.9 | 93-4840 S | 1.2 | 96-21, Pt #522 | 76.7 | 96-45, Pt #544 | 1.5 |
| 93-2480 S | 5.5 | 93-4860 S | 1.2 | 96-22, Pt #519 | 13.7 | 96-46, Pt #543 | 1.1 |
| 93-2500 S | 10.9 | 93-4880 S | 2.9 | 96-23, Pt #530 | 10.3 | 96-47, Pt #509 | 4.2 |
| 93-3720 S | 0.9 | 92-0040 S | 9.2 | 96-24, Pt #531 | 65.8 | 96-48, Pt #548 | 3.3 |
| 93-3820 S | 1.3 | | | 96-25, Pt #534 | 5.4 | 96-49, Pt #547 | 4.3 |
| AVERAGE | | | | | | | 9.6 |

In accordance with the Sampling Plan, five QA/QC samples for additional Th-230 sampling were sent to another vendor laboratory, Acculab Research in Golden, Colorado. The following table shows the results of QA/QC samples.

Table 14-2
QA/QC SAMPLE RESULTS

| Sample Number | Th-230, pCi/gm | |
|----------------|----------------|-----------|
| | Energy Labs | Accu Labs |
| 96-02, Pt #504 | 2.7 | 1.8 |
| 96-12, Pt #510 | 5.8 | 15.0 |
| 96-22, Pt #519 | 13.7 | 9.2 |
| 96-32, Pt #539 | 58.6 | 62.0 |
| 96-42, Pt #524 | 1.3 | 2.6 |

The most highly elevated values were from samples taken from former Evaporation Ponds 2A and 1B areas. It was speculated that the drainage channel would have removed the top layer in most of the Evaporation Pond 1B area. However, a resampling of the area did not prove this to be the case since other elevated samples were taken from the general area during the second sampling event. The second sampling event did, however, confirm ARCO's belief that the newer ponds (Nos. 3A, 3B, and 3C) had not leaked.

In summary, this very large set of samples for the area shows that the average Th-230 concentration is approximately 10 pCi/g with a few isolated areas with concentrations of up to 80 pCi/g. The Ra-226 concentrations appear to be near background levels. A risk assessment follows that shows that the consequence of no further remediation of this area is insignificant.

Risk Assessment

The former evaporation pond area is in the watershed above the stabilized tailings. The design feature to protect the stabilized tailings includes the drainage channel. Therefore, this area has been included in the area to be transferred for Long Term Surveillance.

The surveillance of the Site will require a periodic inspection of the main features of the Site. This may include walking the drainage channel (approximately 15 minutes) to look for excessive erosion once each year or observing the vegetation cover. Assuming a worse case scenario of maintenance of the drainage channel, it is reasonable to assume that an operator could work in this area for up to one week.

In order to be conservative, we have assumed that the maintenance work would occur at the end of 1000 years and occur in an area averaging 70 pCi/g of Th-230. At the end of 1000 years, the Ra-226 ingrowth would reach 25 pCi/g while the Th-230 concentration would remain essentially unchanged. The most exposed worker would be the operator working 40 hours in a year. The primary exposure pathway for this worker would be radiation exposure from direct radiation. Measurements of the

radiation exposure from Ra-226 contaminated soils have shown that the gamma exposure rate ranges from 0.5 to 2 mR/h per pCi/g. Taking the maximum value, a 40-hour exposure time would result in an increase of 2 mrem/year for the worker.

Another pathway that may be considered for the worker is the intake of contaminated soils by inhalation. A dusty work environment would normally result in less than $200 \mu\text{g}/\text{m}^3$ of respirable dust. Assuming a breathing rate of 20 liters per minute, a Th-230 concentration of 70 pCi/g, a Ra-226 concentration of 25 pCi/g, an exposure time of 40 hours per year, the worker would be expected to receive a Committed Effective Dose Equivalent of approximately 0.2 mrem/y. Factors for Committed Dose Equivalent per unit intake via inhalation from the Health Physics and Radiological Health Handbook were used for dose assessment.

The nearest resident lives downwind at a distance of more than 1.5 miles. The downwind fence line of the area to be transferred is approximately 1 mile away from the evaporation pond area. A risk assessment to support the exemption from cleanup limits was done and submitted to the NRC in January 1994 for all areas within the Exemption Boundary. That report, "Radiological Dose and Risk Assessment of the Residual Windblown Tailings", was used to obtain an upper bound incremental annual Total Effective Dose Equivalent (TEDE) for an individual living at the boundary of the Site to be transferred to the Government. Scaling factors were used for nearby contaminated areas considered in the previous analysis to estimate the off-site impact of the evaporation pond area. The resulting incremental dose to an individual living downwind at the Site boundary is estimated to be less than 0.3 mrem/y, assuming an average Th-230 concentration of 10 pCi/g. This incremental dose of 0.3 mrem/y is consistent with a 0.36 mrem/y TEDE calculated based on 1995 average Th-230 airborne concentration at the down wind boundary, which was determined from continuous environmental monitoring.

In summary, a worker or inspector working in the highest Th-230 concentration portions of the former evaporation ponds area for one week of the year would be expected to receive a TEDE of approximately 2.2 mrem. The impact to an individual living at the Site boundary was estimated to be

less than 0.3 mrem/y. These small incremental doses do not justify further remediation of the former evaporation pond area.

Comment: 15

Page 83 discusses verification data from the outlying (unaffected) areas where soil samples were taken every 1000 feet (Figure 6-7) and gamma readings every 500 feet (Figure 6-8). Figure 6-7 indicates that no soil samples exceed 6.9 pCi/g, but Ra-226 data at the end of Appendix J (without grid numbers) indicates that 5 samples exceed the guideline. ARCO should explain why these elevated radiation areas were not cleaned.

Response: 15

Ra-226 data, at the end of Appendix J for outlying area, for 5 soil samples which exceed the cleanup criteria are for locations within the Exemption boundary. Figures 6-7 and 6-8 included in Attachment 1 have been revised to include coordinates at the grid block lines to identify the areas.

Comment: 16

Table 6.2 (page 84) indicates that one of the QA samples from the bottom of the evaporation pond area has a Ra-226 value of 12.0 pCi/g. ARCO should discuss the conclusion that the grid meets the standard.

Response: 16

Sample #93-2500S was a 6"-12" deep sample taken in Grid Block G6-25-29 during the remediation. Since it was elevated, additional material was removed and a 0"-6" sample was taken from that location to represent the final remediated area. The sample number was 94-0630S and was reported in the CR as 4.5 pCi/g.

Comment: 17

Revise page 89 (Section 7.3) to include justification for indicating that values up to 25 $\mu\text{R/hr}$ are within the variation of local background, or otherwise justify the acceptability of values above background for this site (background 10-14 $\mu\text{R/hr}$, CR page 77).

Response: 17

The elevated direct gamma exposure rate values, up to 25 $\mu\text{R/hr}$ at the Ore Stockpile thumb area, are due to shine from residual natural ore rocks on the nearby rocked out slope around the thumb area. During the June 1996 NRC inspection, the NRC's inspectors and ARCO's representative conducted surveys and an investigation of these elevated readings. The August 1, 1996 NRC inspection report concluded that the elevated gamma readings were due to the shine. The NRC inspection report also contains results of the surveys. Page 89 of the CR, included in Attachment 6, has been revised to incorporate explanation.

Comment: 18

In Appendix G (Radon Flux and Gamma Data), the radon flux measurement information for the Main and Carbonate Tailings Piles were reviewed and approved by staff previously (March 10 and November 13, 1995). The flux data for the other disposal cells was provided by letter dated June 17, 1996. NRC staff has reviewed this report that presumably will be incorporated into the CR and determined that:

Comment: 18a

The typographic error in paragraph 1 of Section 1.0 (date for completion of barrier should be 1995) should be corrected.

Response: 18a

The "Radon Flux Measurement on the Plant Site, Former Ore Stockpile Area, Disposal Area No 10, Asbestos Disposal Area, and North and South Landfill; Blewater Mill Site" was submitted to the NRC June 17, 1996. The typographic error of date for completion of barrier in

paragraph 1 of section 1.0 has been corrected. The entire report is included in Attachment 5 for inclusion in the CR.

Comment: 18b

ARCO should demonstrate that the error on duplicate counts (precision) and the accuracy is acceptable per Method 115 Section 4.0 E.

Response: 18b

The accuracy requirement of Method 115 is to calibrate the spectrometer using two independent sources which agree within 10 percent. On May 24, 1996, the two sources were run at the radon flux counting geometry. The measured efficiency of the 609 keV photopeak for the two sources was 0.00716 and 0.00691. On May 24, 1996, the two sources were run prior to running the second batch of canisters at the radon flux counting geometry with measured efficiencies for the 609 keV peak of 0.00753 and 0.00763, clearly within 10 percent. Each batch showed that the two sources agreed within 10 percent. The slight change in efficiency from the first batch to the second batch was probably due to the background determination for the runs. These data clearly indicate that the accuracy requirement was met. Printouts of the standard runs are given in Table 18-1 and Table 18-2.

TABLE 18-1

| Date | Count Time | Standard (nCi) | Counts | Error | Bkg. Counts | Bkg. Error | Efficiency | Error (1.00 SD) |
|-------|------------|----------------|--------|-------|-------------|------------|------------|-----------------|
| 05/10 | 1200 | 80 | 25505 | 433 | 71 | 176 | 0.00716 | 0.00013 |
| 05/10 | 1200 | 78.83 | 24259 | 432 | 71 | 176 | 0.00691 | 0.00013 |

TABLE 18-2

| Date | Count Time | Standard (nCi) | Counts | Error | Bkg. Counts | Bkg. Error | Efficiency | Error (1.00 SD) |
|-------|------------|----------------|--------|-------|-------------|------------|------------|-----------------|
| 05/24 | 1200 | 80 | 26540 | 457 | -213 | 190 | 0.00753 | 0.00014 |
| 05/24 | 1200 | 78.83 | 26494 | 454 | -213 | 190 | 0.00763 | 0.00014 |

The precision of the measurements is specified as 10 percent for samples measuring more than a flux of 1 pCi/m²s. The results for 13 duplicate measurements are presented in Table 18-3. Averaging the first set and comparing the results to the second set of measurements, the means compare within 10 percent. The reported standard deviation for individual measurements below about 3 pCi/m²s quite often exceeds 10 percent of the value. This reported error is based on the statistical counting error and the error in the peak shaping algorithms of the MCA. For canisters where more than one count was taken, the average of the two measurements was reported. When this is considered, only one duplicate measurement above a flux of 1 pCi/m²s differed from the mean by more than 10 percent of the mean of the two counts. In order to determine whether the precision of this measurement was within 10 percent of the mean at the 67 percent confidence interval, several additional measurements would have been required. All canisters were counted for 20 minutes, a very reasonable length of time for commercial laboratories.

TABLE 18-3

| Canister Number | Radon Flux Measurement | | | % Deviation from Mean |
|--------------------|------------------------|--------------|--------------|--------------------------|
| | First Count | Second Count | Mean | |
| 16 | 0.43 | 0.40 | 0.415 | 3.6 |
| 101 | 0.21 | 0.10 | 0.155 | 35.5 |
| 251 | 0.44 | 0.33 | 0.385 | 14.3 |
| 250 | 0.48 | 0.35 | 0.415 | 15.7 |
| 53 | 0.16 | 0.07 | 0.115 | 39.1 |
| 258 | 0.41 | 0.73 | 0.570 | 28.1 |
| 1 | 0.14 | 0.47 | 0.305 | 54.1 |
| 4 | 0.46 | 0.66 | 0.560 | 17.9 |
| 61 | 0.78 | 0.64 | 0.710 | 9.9 |
| 95 | 1.09 | 1.52 | 1.305 | 16.5 |
| 20 | 16.51 | 17.02 | 16.765 | 1.5 |
| 108 | 2.22 | 2.61 | 2.415 | 8.1 |
| 95 | 9.35 | 10.23 | 9.790 | 4.5 |
| AVERAGE | 2.51 | 2.70 | 2.605 | |

The flux measurements for all trip blanks were near zero, indicating that the charcoal was not being influenced by factors other than the radon flux from the Site.

In summary, the accuracy and precision of the measurements are consistent with state-of-the art measurement performance for NaI spectrometers using a 20 minute count time. Considering the low average flux for the Site compared to the standard, these measurements are certainly adequate to demonstrate compliance with the standard.

Comment: 19

Ra-226 verification data in Appendix J was compared to information represented on Figures 6-4, 6-6 and 6-7 and resulted in the following concerns:

Comment: 19a

Grids N5-22-8, N5-22-11 appear to be outside the exemption boundary, but the Ra-226 values are 15.6 and 9.1 pCi/g, respectively. ARCO should clarify why these grids meet the cleanup criterion.

Response: 19a

Please see the response to No. 13.

Comment: 19b

For the outlying areas (end of Appendix J), there is no Ra-226 value for grid point N38000 E22000, but data are indicated on Figure 6-7.

Comment: 19c

The outlying area Ra-226 data in Appendix J are difficult to compare to Figure 6-7, because many of the values are not in order by either the N or E coordinate. ARCO should revise the last 6 pages of Appendix J to make the information easier to evaluate by comparison to Figure 6-7.

Response: 19b&c

The Ra-226 value for grid point N38000 E22000 was in Appendix J. However, it was difficult to review the Ra-226 data for the outlying area in Appendix J because the data was not in order by either N or E Coordinates. The Ra-226 data for the outlying area have been arranged in N coordinate order for easier review, and are included in Attachment 2.

Comment: 20

Appendix L contains the raffinate trench verification data, and

Comment: 20a

ARCO should indicate if the gamma readings for the walls were obtained from the mid-point of the wall, or if the value is the average obtained by scanning the entire section of wall.

Response: 20a

The gamma readings on the walls of the raffinate line trench are average values obtained by scanning the entire section of the wall.

Comment: 20b

ARCO should indicate why the area of wall 1 reading 12900 cphm was not excavated and resurveyed.

Response: 20b

It is highly likely that after the initial elevated reading of 12900 cphm on Wall 1, that additional cleanup was conducted at that section of the wall and resurveyed prior to backfilling. Nevertheless, section of Wall 1, between station 54 and 55, where the gamma reading was elevated, was exposed by excavation in September 1996. The section was surveyed and the gamma reading for Wall 1 was 2008 cphm, which demonstrates that it is clean.

Comment: 21

The first paragraph of Section 2 indicates that 3,766 acres were within the radiological restricted area. ARCO should indicate the map that demonstrates this boundary, and also indicate the number of acres within the transfer and exemption boundaries.

Response: 21

The Site encompasses 5,064 acres, of which 3,761 acres were within the radiological restricted area which is shown in Figure 6-1 included in Attachment 1. Figure 6-1 also shows the Exemption Area and the area to be transfer to the Department of Energy, which are 1,288 and 3,305 acres, respectively.

Comment: 22

Attachment 13 in Appendix E provides Ra-226 data from three laboratories and two types of analysis. Indicate the evaluation and conclusions from these data.

Response: 22

At the beginning of the project, a Ra-226 soil standard was prepared for use in calibrating the gamma-ray spectrometer. In order to demonstrate that the on-site spectrometer was accurate, soil samples that had been collected for the initial correlation study were analyzed by ARCO, as well as two vendor laboratories. A comparison of the results indicates good agreement between laboratories, indicating acceptability of the vendor laboratories as a QA laboratory, as well as acceptability of the ARCO on-site spectrometer. At the time, no statistical analyses were performed.

The results of the routine QA sample splits are included in Appendix K. At first, ARCO insisted on agreement within 30 percent. If this criterion was not met, the samples were reanalyzed by both laboratories. This criterion became too difficult to meet because of the statistical errors in some of the samples. Another criterion was developed where the difference of the numbers was calculated with the errors propagated. If the difference plus or minus the error, at the 95 percent confidence level, overlapped zero, then the numbers were considered in good agreement. If either of these criteria were

met, then the values were accepted. Some of the samples, even after reanalyzes, did not meet either criteria. It could only be concluded that a bad sample split had occurred. Results of cleanup verification QA/QC sample analysis by vendor laboratories, which did not meet QA/QC criteria, were also below the cleanup level, in most cases near the background level.

This QA Program was discussed and reviewed by the NRC during the June 1996 inspection of the Site.

MINOR (EDITORIAL) COMMENTS

Editorial Comment: 1

The second paragraph of the CR Executive Summary indicates that milling operations were discontinued in 1992. This should indicate 1982.

Response: 1

The typographic error of date has been corrected and a revised page is included in Attachment 6.

Editorial Comment: 2

On page 11, Table 4.3.1 is incomplete for data on amendment 18.

Response: 2

Amendment No. 18 was in the wrong row of the table. Error has been corrected and a revised page is included in Attachment 6.

Editorial Comment: 3

Section 6.5 (pages 84-87) discusses characterization and verification in the golf course, housing, and miscellaneous areas, but the text should refer to Figures 6-5 and 6-6, not 6-7 and 6.8.

Response: 3

The typographic error of figure number has been corrected and a revised page is included in Attachment 6

Editorial Comment: 4

Revise Figure 7-1 to include labels for areas discussed in the text. For example, acid tailings pile, asbestos disposal area, and landfill areas.

Response: 4

Figure 7-1 has been revised to address the comment, and is included in Attachment 6.

Editorial Comment: 5

Revise Section 7.2 to indicate that the Asbestos Disposal Area data is with that for Disposal Area 1 (Figure 7-4).

Response: 5

Section 7.2 has been revised and the replacement page is included in Attachment 6.

Editorial Comment: 6

Correct the typographic error in Section 7.4, as 100 radon flux measurements were not performed on the landfills.

Response: 6

The typographic error in Section 7.4 has been corrected and the revised page is included in Attachment 6.

Editorial Comment: 7

The first paragraph of Section 10 (page 97) states that the transfer boundary is indicated on Figure 1-1, but it is on Figure 2.1.

Response: 7

The typographic error of figure number has been corrected in Section 10. Revised page is included in Attachment 6.

Editorial Comment: 8

The title page of Appendix D indicates that the appendix contains the Technical Evaluation Reports for the license amendments, but Appendix D only contains the covers letters.

Response 8

The title page of Appendix D has been corrected to eliminate the indication that it contains Technical Evaluation Reports and a revised cover page is included in Attachment 6.

Editorial Comment: 9

The second page of Appendix K is titled Appendix H and the second page of Appendix L is titled Appendix I.

Response 9

The typographic errors on second pages of Appendix K and L have been corrected. Revised pages are included in Attachment 6.

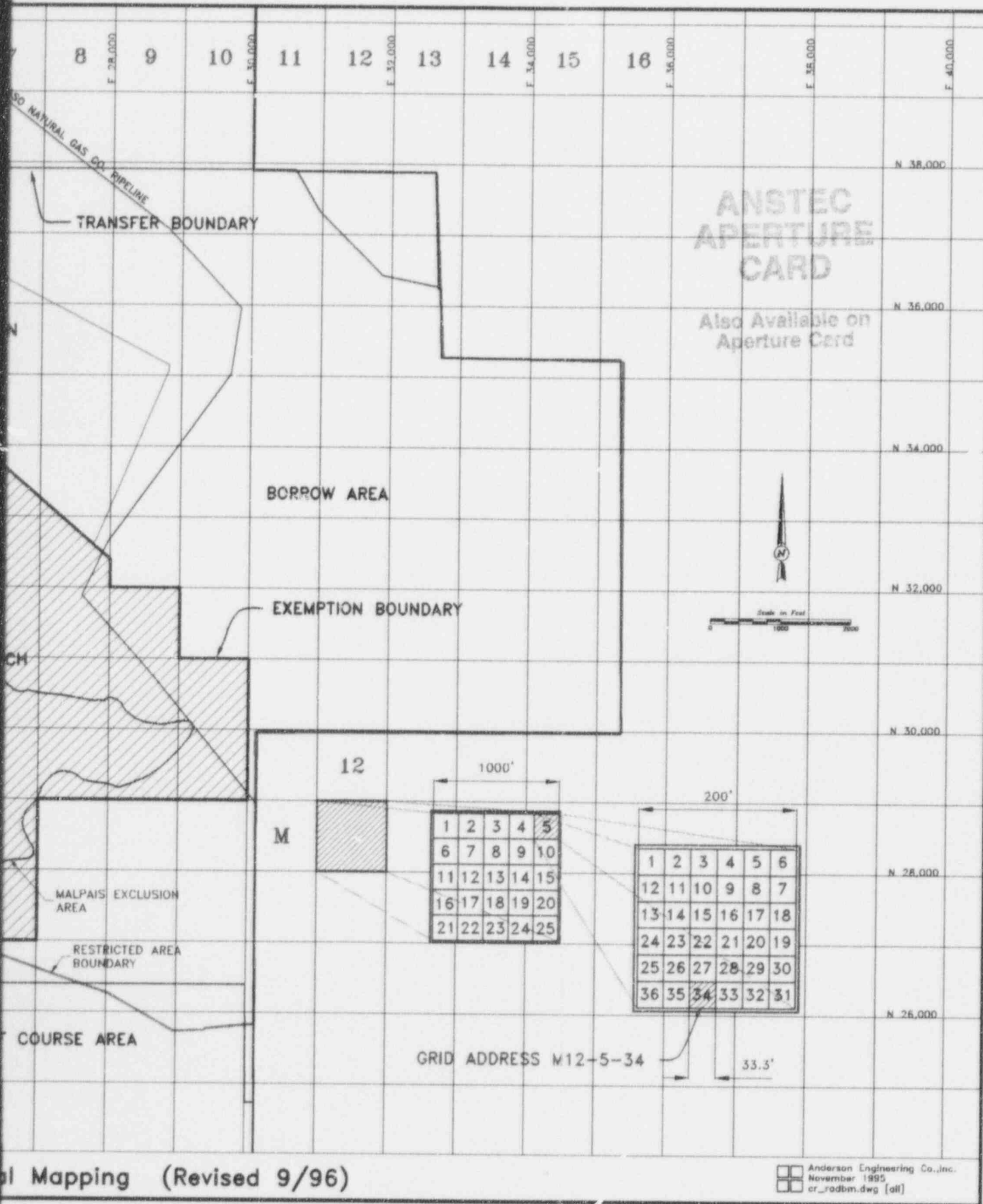
ATTACHMENT 1
FIGURES

TO

ADDENDUM 1
RESPONSE TO NRC COMMENTS



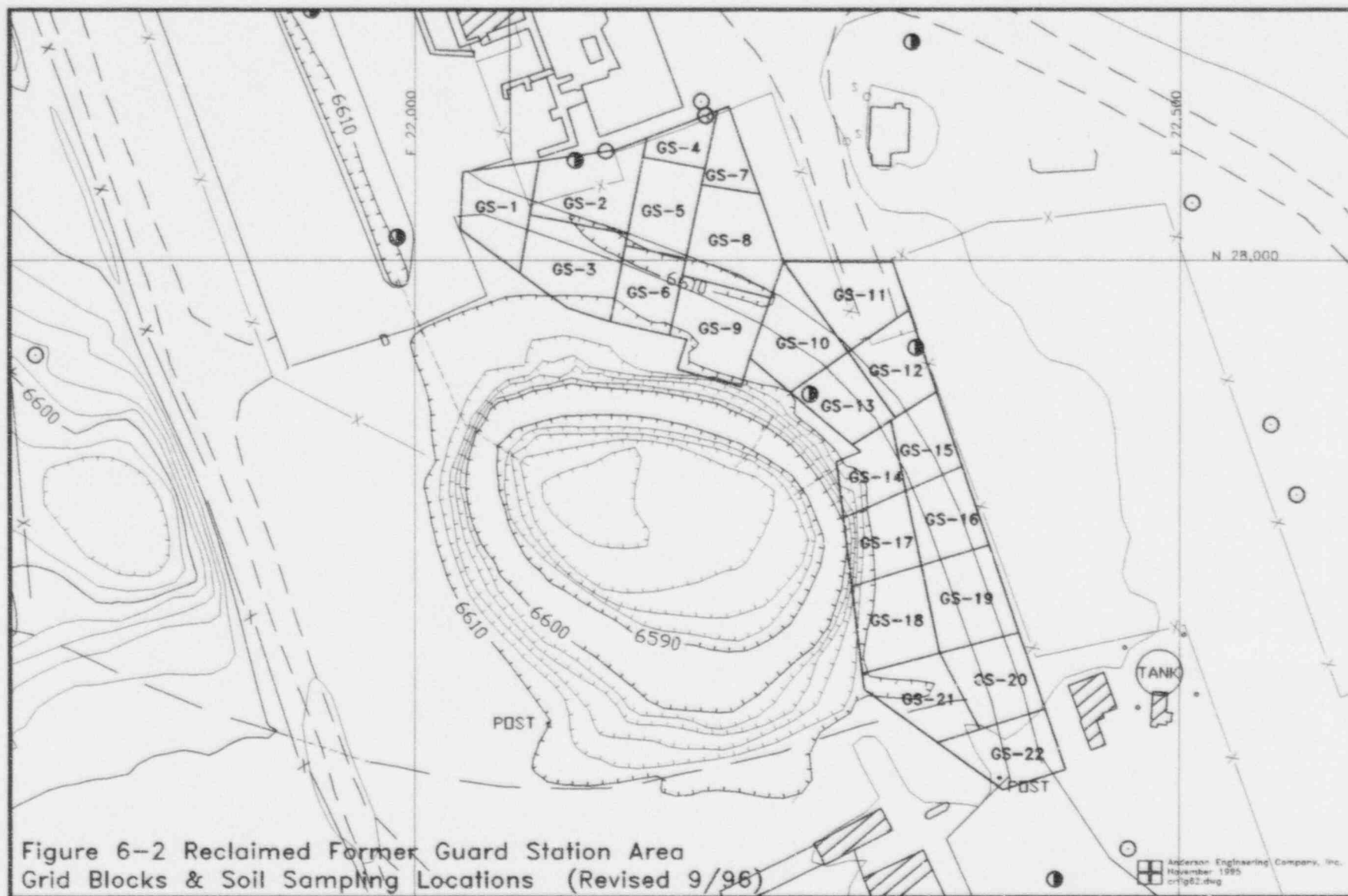
Figure 6-1 Area Features and Grid Block Nomenclature for Radiologic



Mapping (Revised 9/96)

Anderson Engineering Co., Inc.
November 1995
cr_rodbm.dwg (all)

9609250302-01



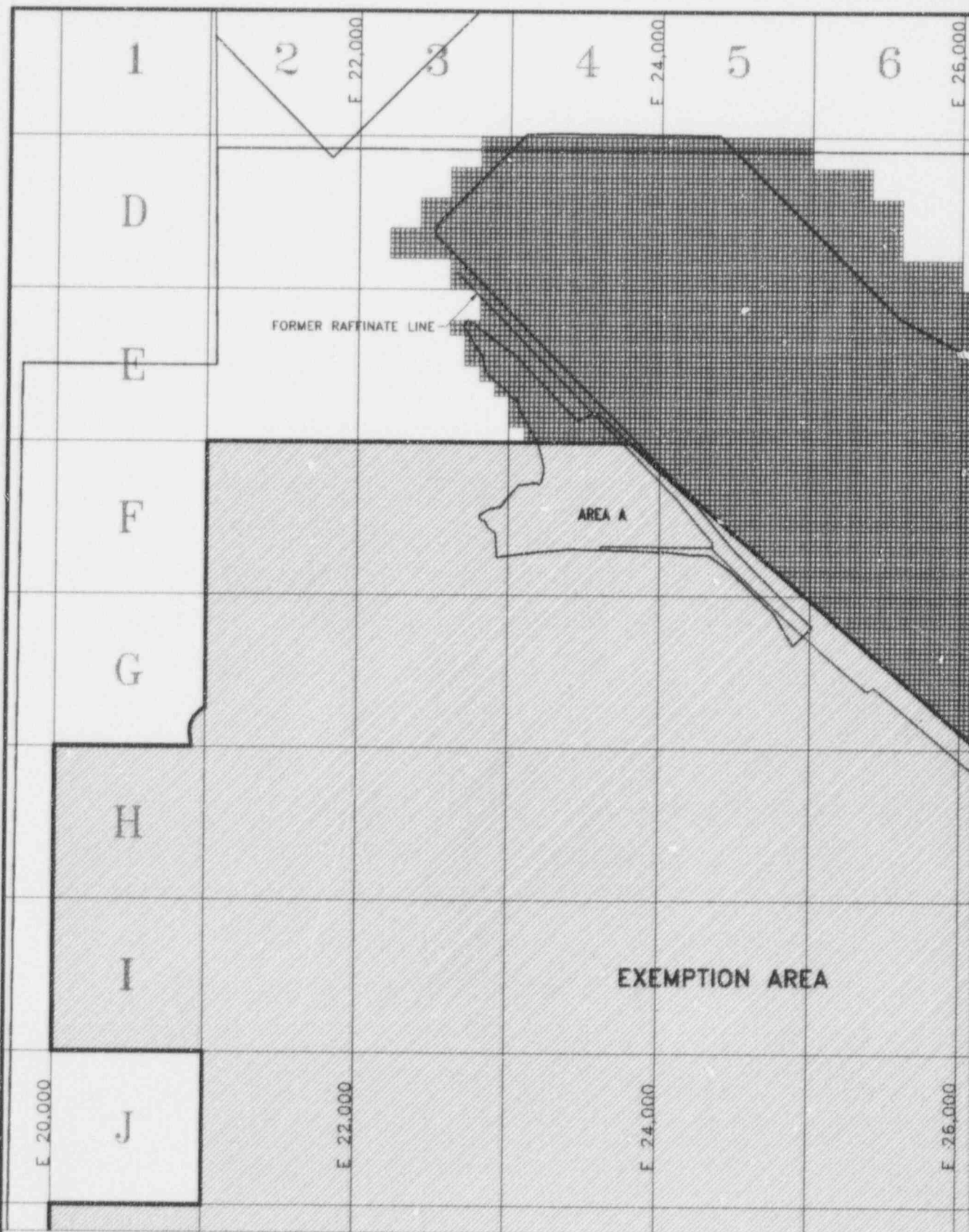
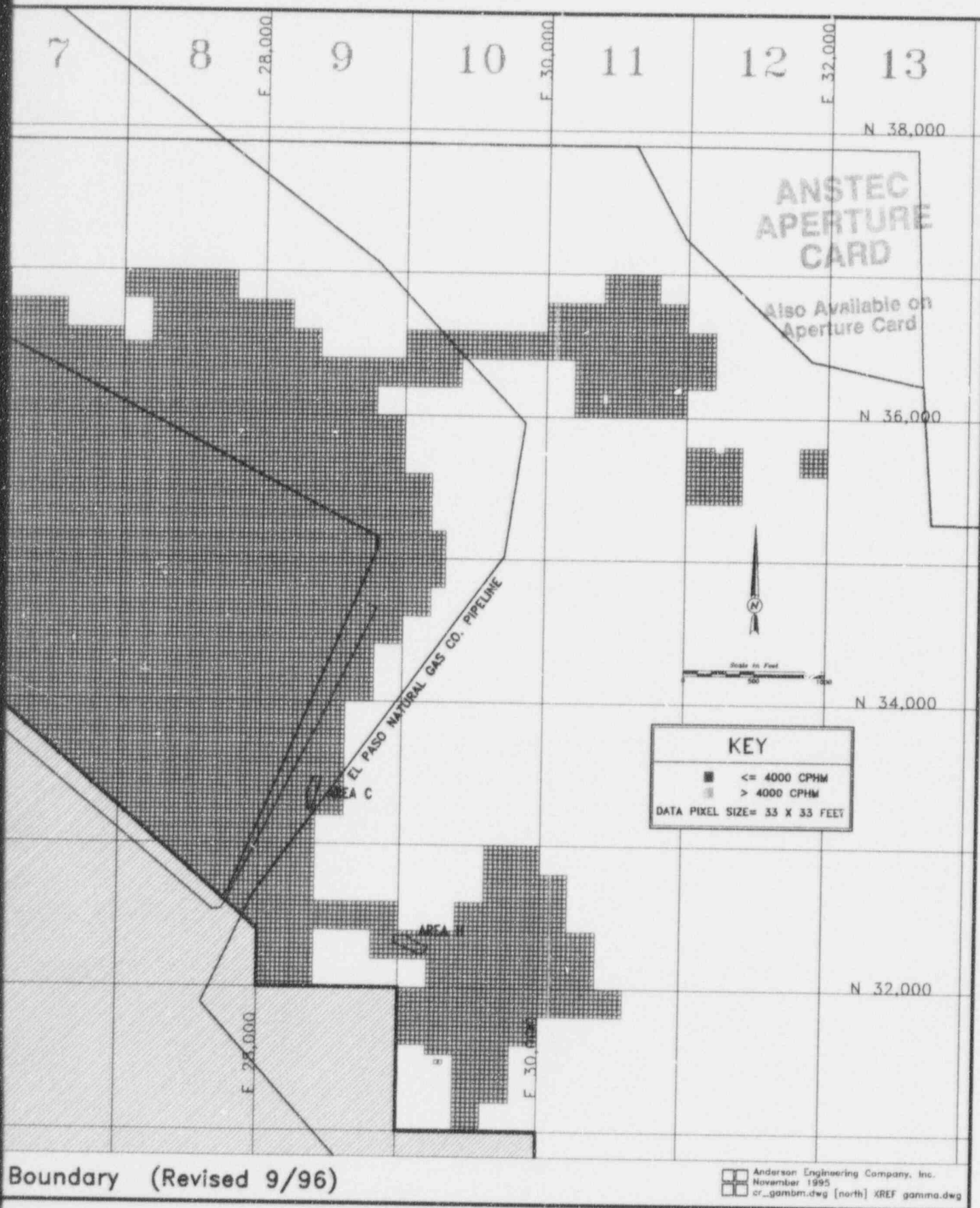


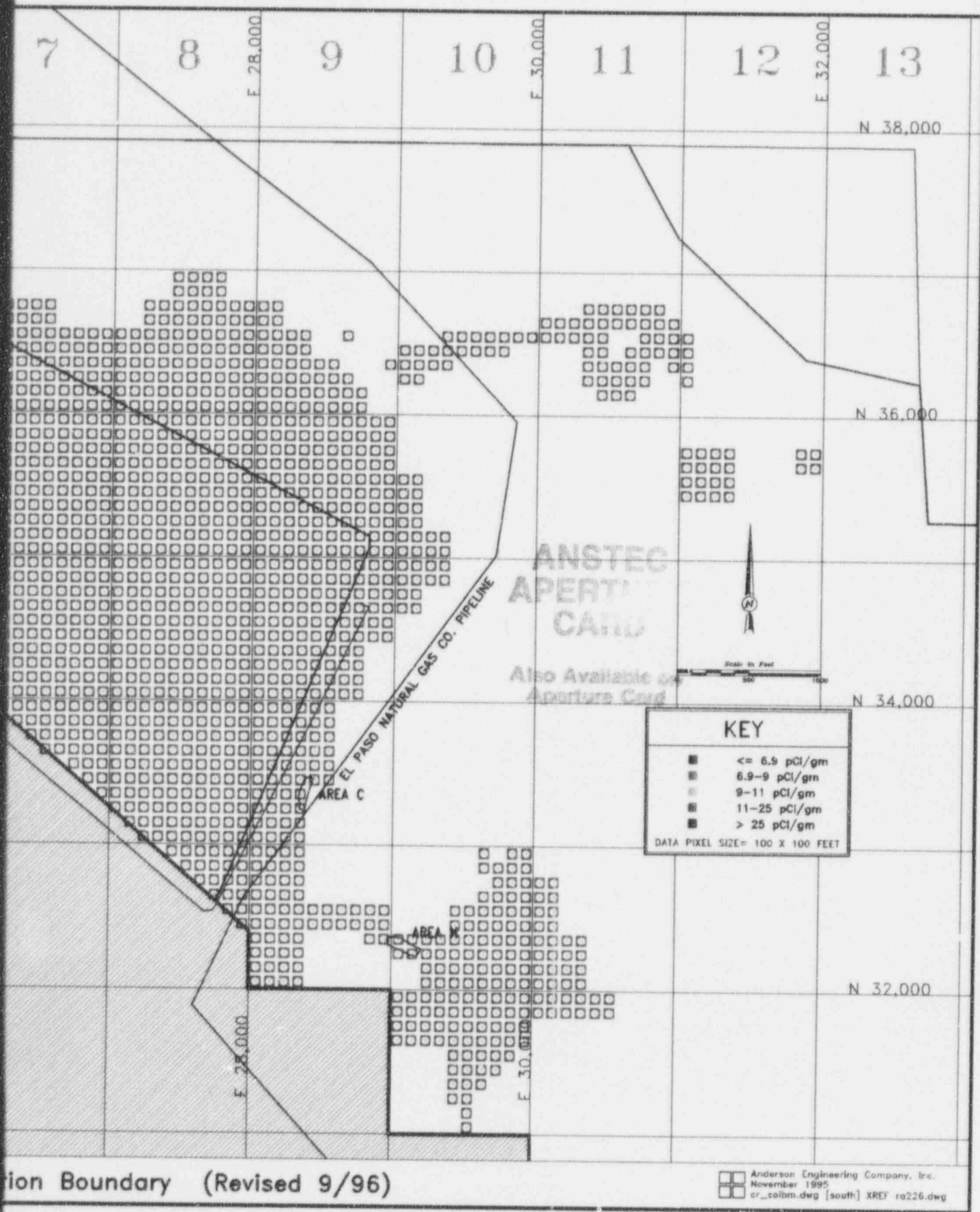
Figure 6-3 Gamma-Ray Count Rate Measurements North of Exemption



9609250302-02



Figure 6-4 Ra226 Concentration in Soil Samples taken North of Exem



9609250302-03

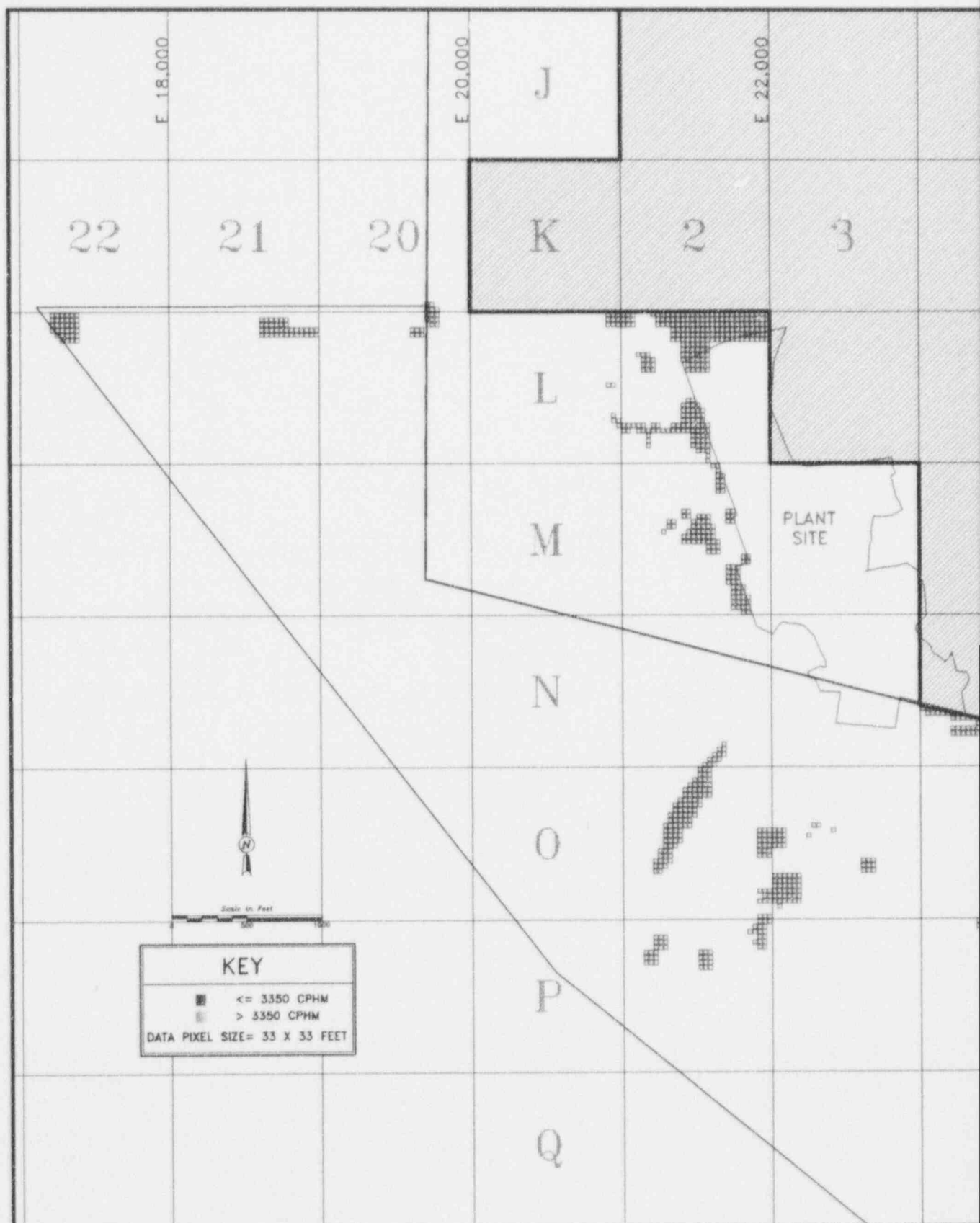
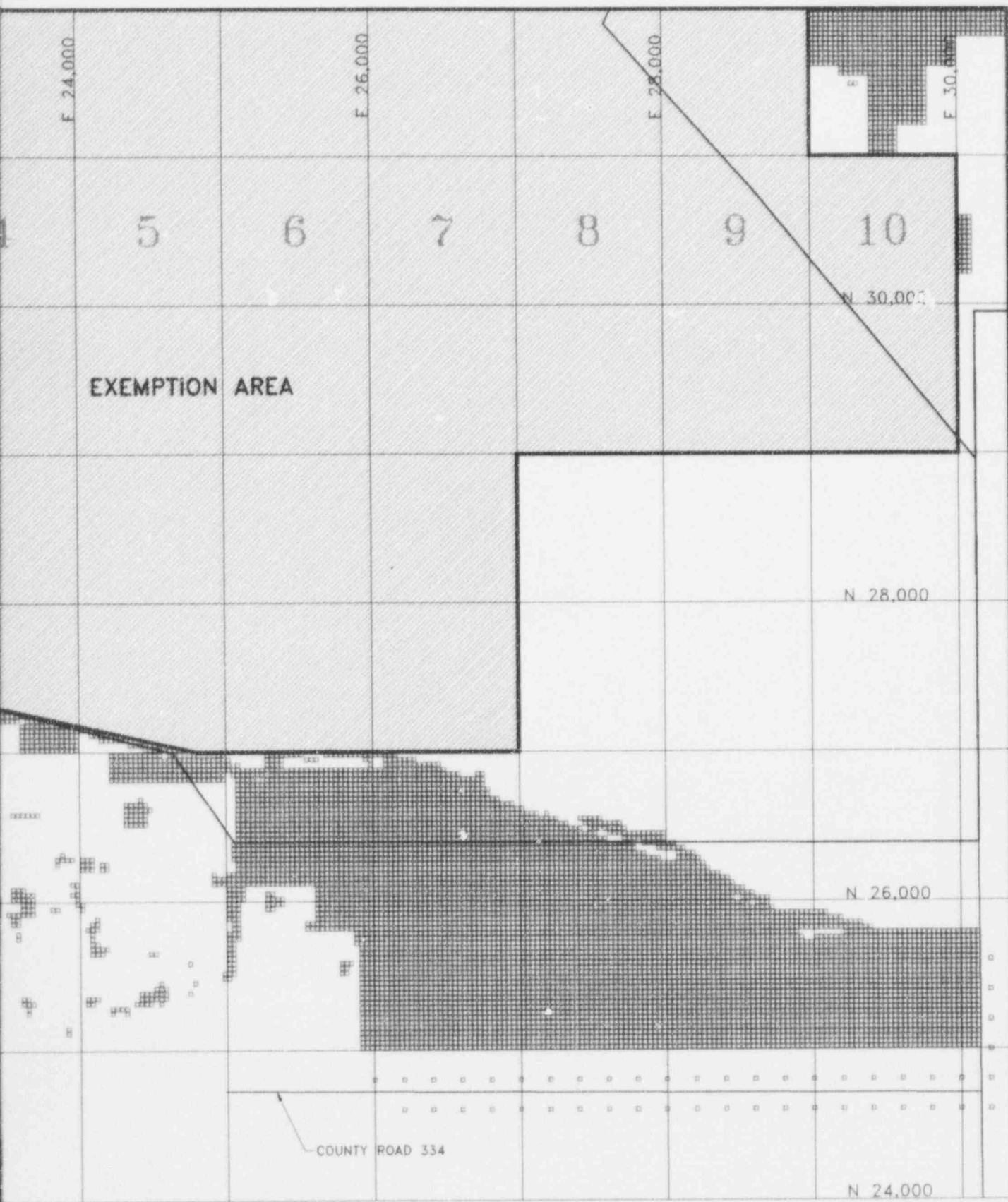


Figure 6-5 Gamma-Ray Count Rate Measurements South of Exemption



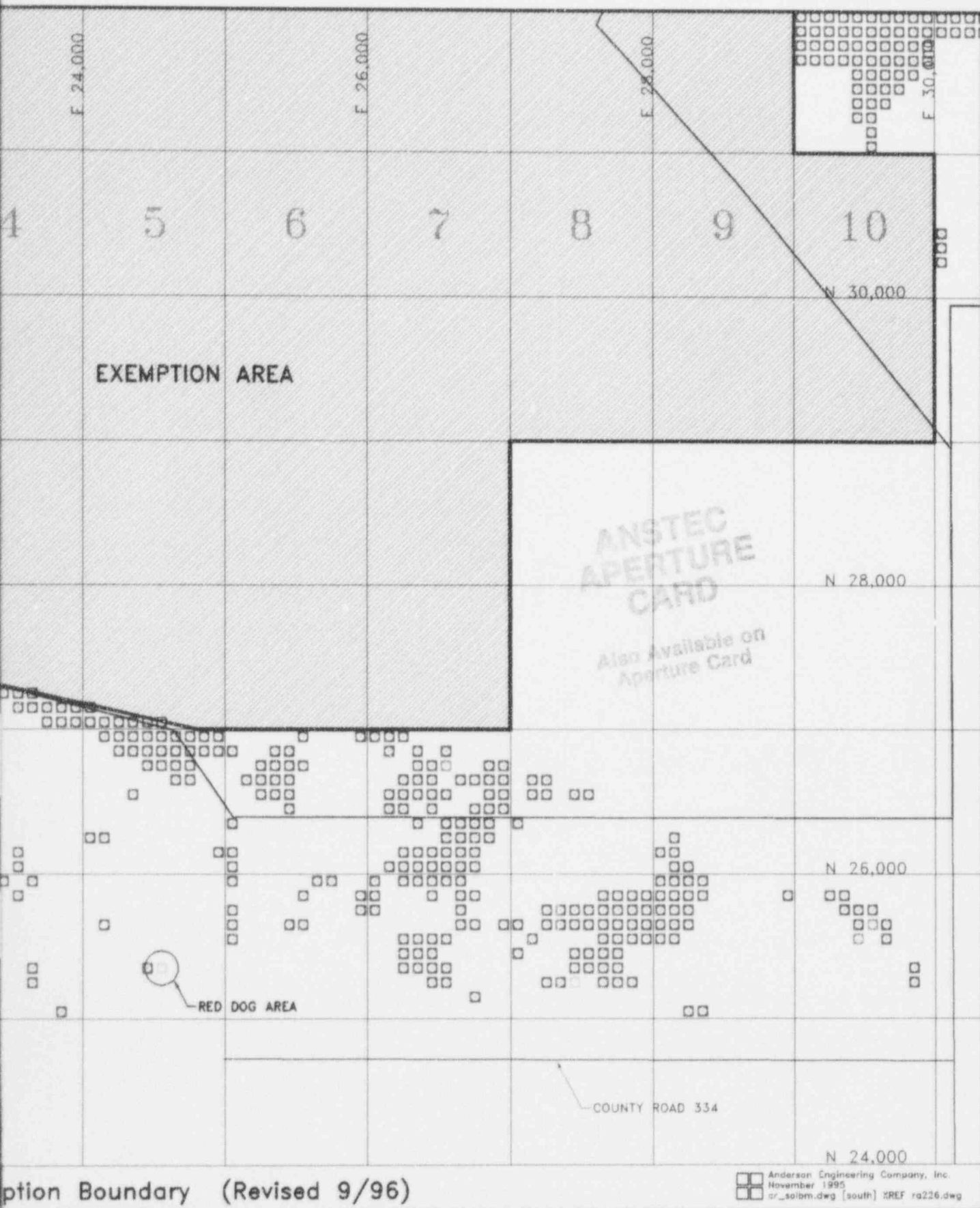
Boundary (Revised 9/96)

Anderson Engineering Company, Inc.
November 1995
cr_gamma.dwg [north] XREF gamma.dwg

9609250302-04



Figure 6-6 Ra226 Concentration in Soil Samples taken South of Exen



9609250302-05

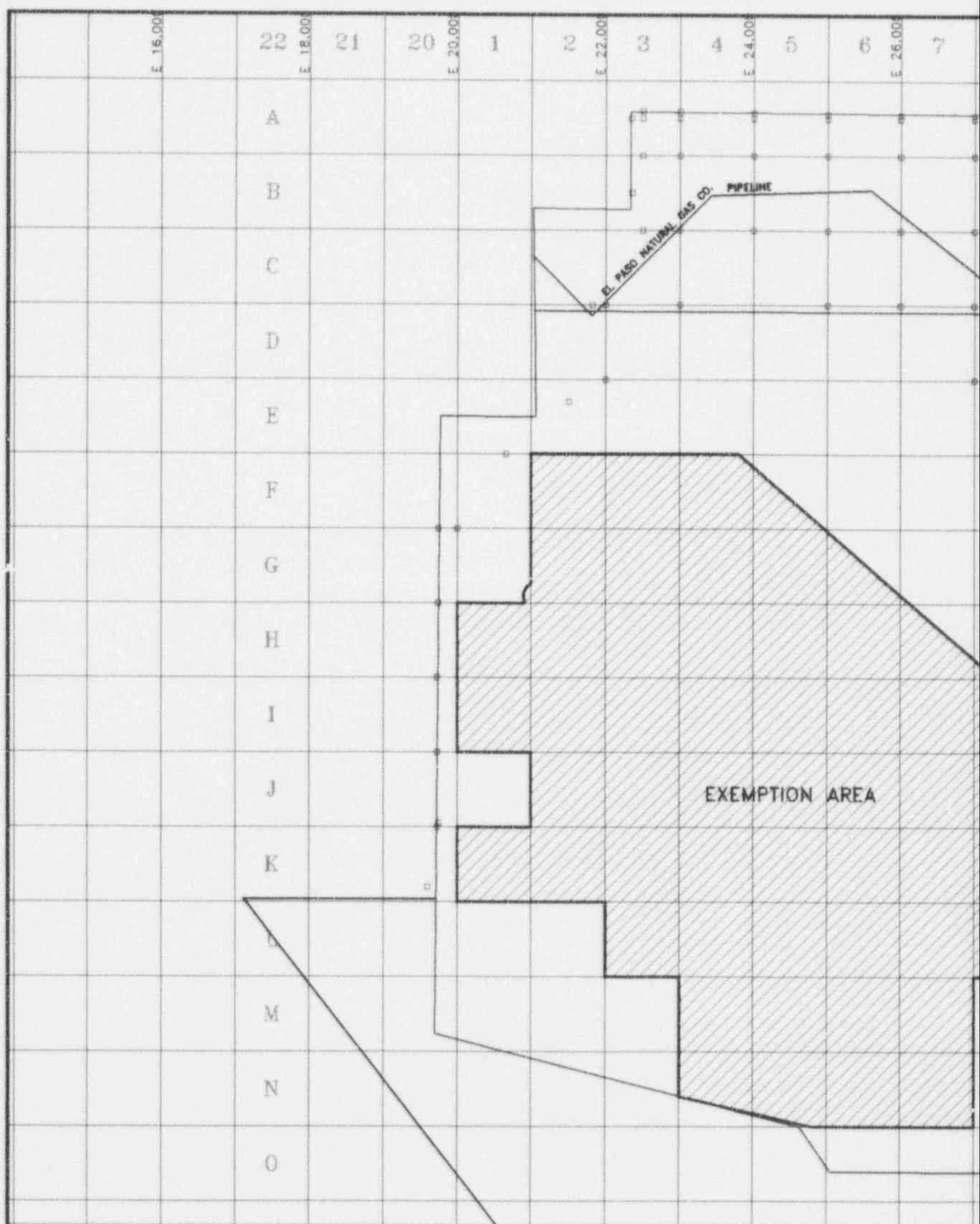
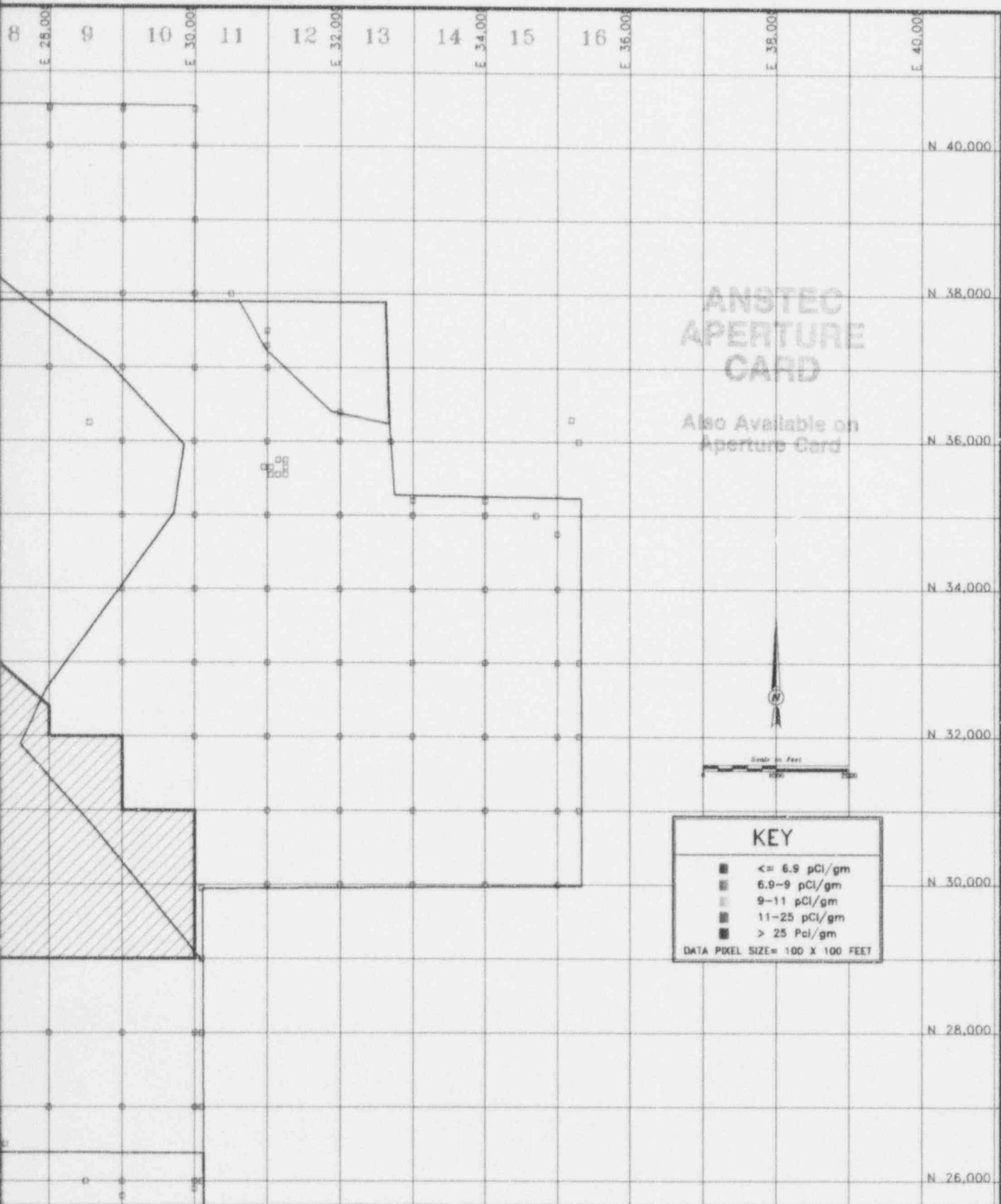


Figure 6-7 Ra-226 Concentration in Soil Samples taken in Outlying Area



as (Revised 9/96)

Anderson Engineering Company, Inc.
November 1995
crsolout.dwg XRET ra226.dwg

9609250302-06

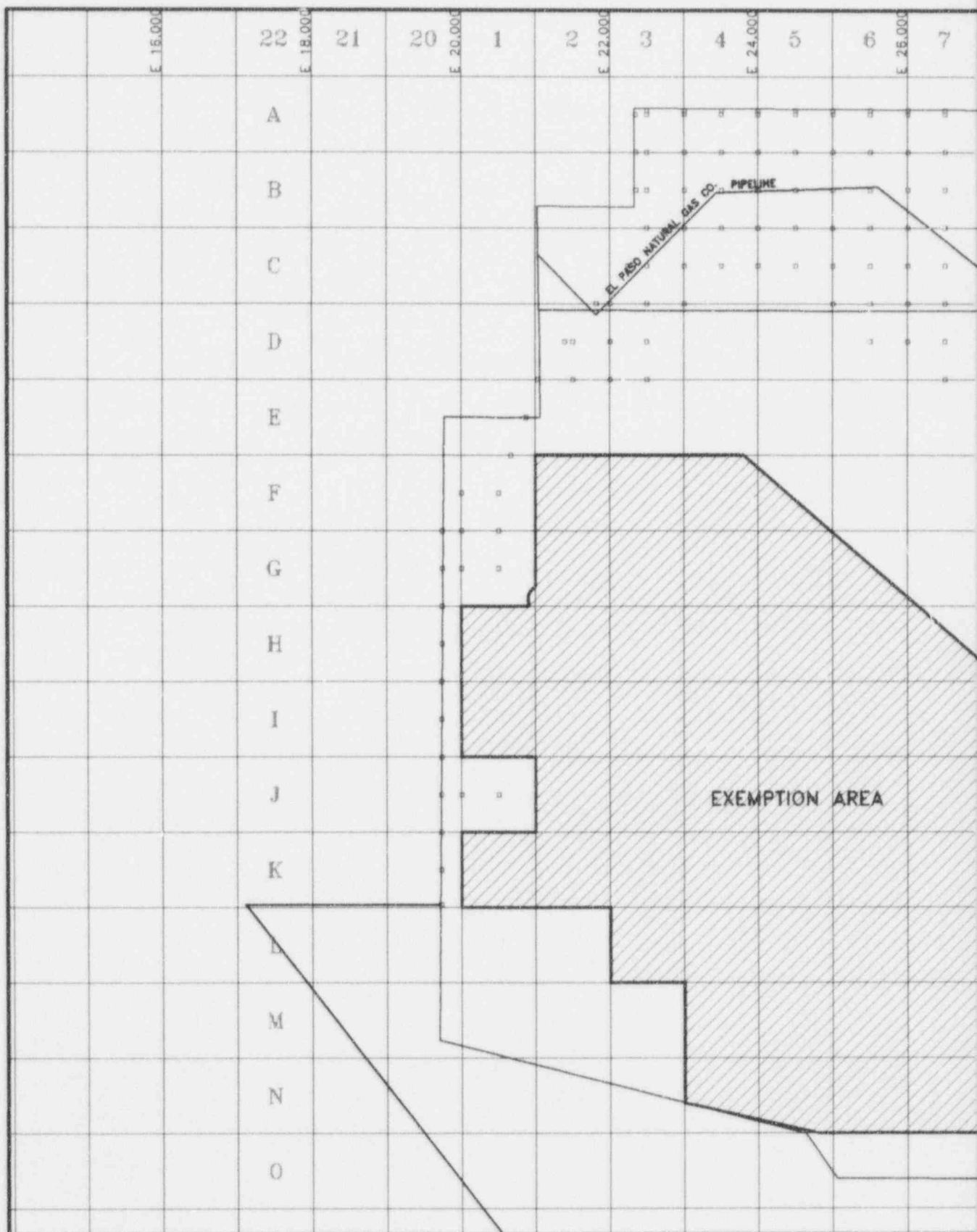
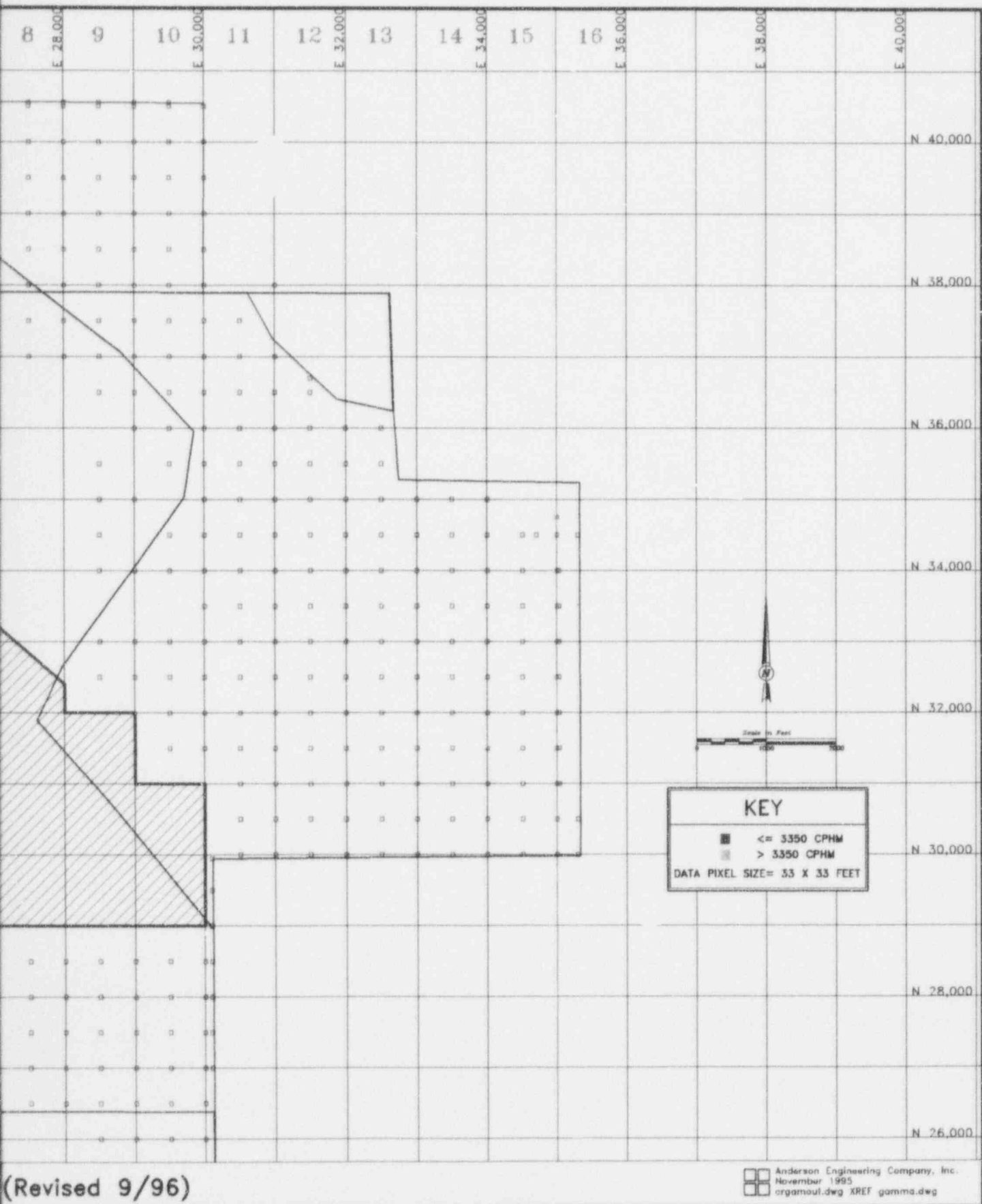


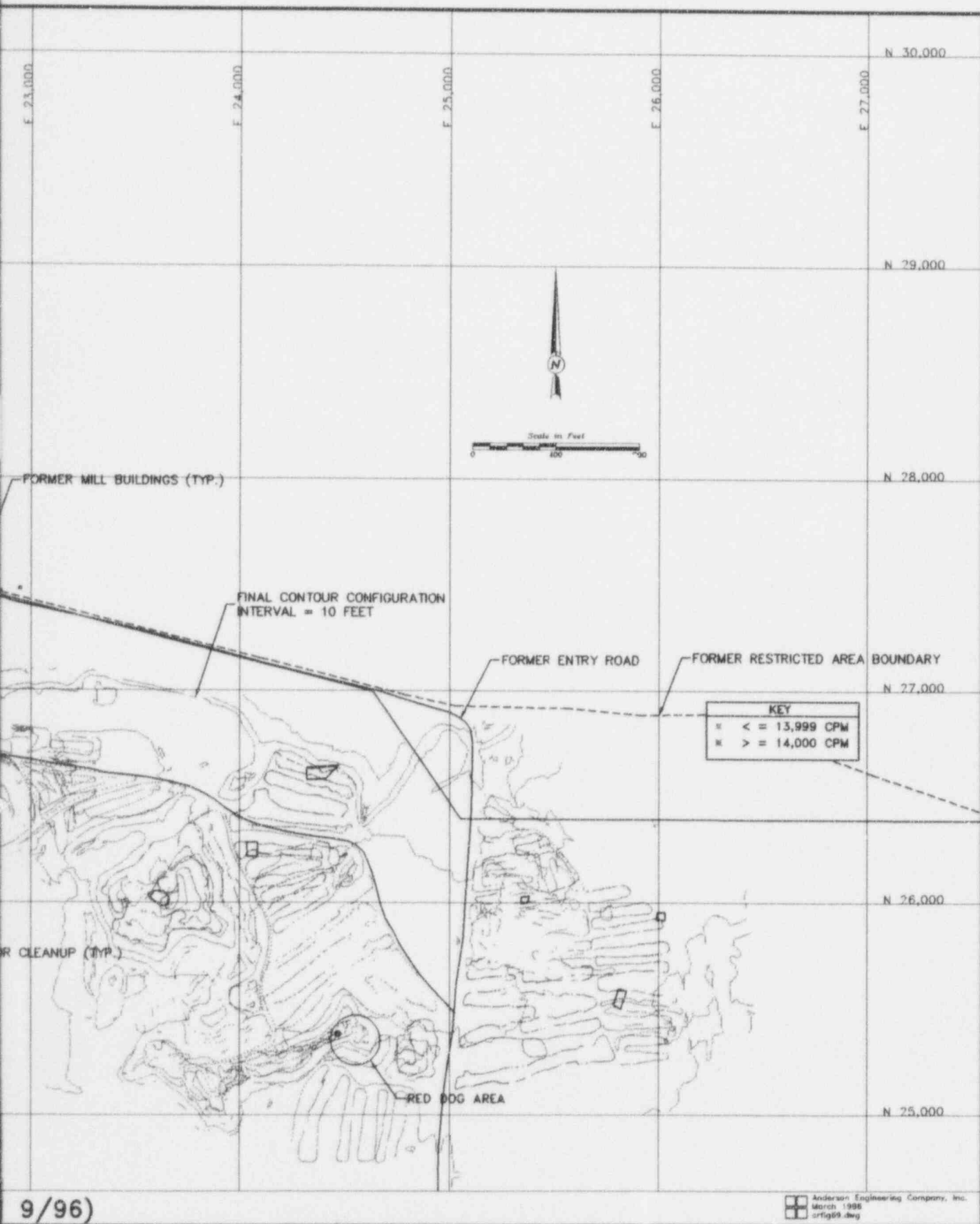
Figure 6-8 Gamma-Ray Count Rate Measurements in Outlying Areas



9609250302-07



Figure 6-9 GPS Based Gamma Ray Count Rate Measurements (Revised)



9609250302-08

ATTACHMENT 2
Ra-226 Results for Soil Samples in
Grid Block E03, E04, and F12

TO

ADDENDUM 1
RESPONSE TO NRC COMMENTS

ARCO Bluewater Mill
Verification Soil Sample Results

Grid Block E03

| <u>Grid</u> <u>Description</u> | <u>North</u> <u>Coordinate</u> | <u>East</u> <u>Coordinate</u> | <u>Ra-226</u> <u>Concentration</u> |
|-----------------------------------|-----------------------------------|----------------------------------|---------------------------------------|
| E03-09-08 | 36750 | 22750 | 2.1 |
| E03-09-11 | 36750 | 22650 | 1.0 |
| E03-09-29 | 36650 | 22750 | 1.7 |
| E03-10-08 | 36750 | 22950 | 1.3 |
| E03-10-11 | 36750 | 22850 | 1.6 |
| E03-10-26 | 36650 | 22950 | 1.5 |
| E03-10-29 | 36650 | 22950 | 1.3 |
| E03-14-08 | 36550 | 22750 | 2.0 |
| E03-15-08 | 36550 | 22950 | 1.5 |
| E03-15-11 | 36550 | 22850 | 1.3 |
| E03-15-26 | 36450 | 22850 | 1.1 |
| E03-15-29 | 36450 | 22950 | 3.6 |
| E03-20-08 | 36350 | 22950 | 1.2 |

ARCO Bluewater Mill
Verification Soil Sample Results

Grid Block E04

| Grid Description | North Coordinate | East Coordinate | Ra-226 Concentration |
|---------------------|---------------------|--------------------|-------------------------|
| E04-06-11 | 36750 | 23050 | 1.1 |
| E04-06-26 | 36650 | 23050 | 1.2 |
| E04-06-29 | 36650 | 23150 | 1.1 |
| E04-11-08 | 36550 | 23150 | 0.9 |
| E04-11-11 | 36550 | 23050 | 0.9 |
| E04-11-26 | 36450 | 23050 | 1.2 |
| E04-11-29 | 36450 | 23150 | 3.2 |
| E04-16-08 | 36350 | 23150 | 2.0 |
| E04-16-11 | 36350 | 23050 | 1.4 |
| E04-16-26 | 36250 | 23050 | 1.4 |
| E04-16-29 | 36250 | 23150 | 1.2 |
| E04-17-08 | 36350 | 23350 | 1.2 |
| E04-17-11 | 36350 | 23250 | 1.1 |
| E04-17-26 | 36250 | 23250 | 2.6 |
| E04-17-29 | 36250 | 23350 | 2.0 |
| E04-21-08 | 36150 | 23150 | 1.4 |
| E04-21-11 | 36150 | 23050 | 1.4 |
| E04-21-29 | 36050 | 23150 | 0.7 |
| E04-22-08 | 36150 | 23350 | 2.7 |
| E04-22-11 | 36150 | 23250 | 0.4 |
| E04-22-26 | 36050 | 23250 | 0.9 |
| E04-22-29 | 36050 | 23350 | 0.8 |

ARCO Bluewater Mill
Verification Soil Sample Results

Grid Block F12

| <u>Grid Description</u> | <u>North Coordinate</u> | <u>East Coordinate</u> | <u>Ra-226 Concentration</u> |
|-----------------------------|-----------------------------|----------------------------|---------------------------------|
| F12-06-08 | 35750 | 31150 | 3.3 |
| F12-06-11 | 35750 | 31050 | 2.1 |
| F12-06-26 | 35650 | 31050 | 0.9 |
| F12-06-29 | 35650 | 31150 | 1.2 |
| F12-07-08 | 35750 | 31350 | 1.1 |
| F12-07-11 | 35750 | 31250 | 0.7 |
| F12-07-26 | 35650 | 31250 | 0.5 |
| F12-07-29 | 35650 | 31350 | 2.6 |
| F12-10-08 | 35750 | 31950 | 1.1 |
| F12-10-11 | 35750 | 31850 | 2.5 |
| F12-10-26 | 35650 | 31850 | 0.8 |
| F12-10-29 | 35650 | 31950 | 2.7 |
| F12-11-08 | 35550 | 31150 | 1.5 |
| F12-11-11 | 35550 | 31050 | 1.1 |
| F12-11-26 | 35450 | 31050 | 1.2 |
| F12-11-29 | 35450 | 31150 | 1.6 |
| F12-12-08 | 35550 | 31350 | 2.5 |
| F12-12-11 | 35550 | 31250 | 1.7 |
| F12-12-26 | 35450 | 31250 | 2.2 |
| F12-12-29 | 35450 | 31350 | 1.8 |

ARCO Bluewater Mill
Outlying Areas Verification Sample Results

| North Coordinate | East Coordinate | Ra-226 Concentration |
|------------------------------|--------------------|-------------------------|
| North/Easting Coordinates | | |
| ===== | ===== | ===== |
| N25800 E29000 | 25800 29000 | 2.1 |
| N25900 E30000 | 25900 30000 | 1.8 |
| N26000 E28500 | 26000 28500 | 4.5 |
| N26000 E29000 | 26000 29000 | 2.0 |
| N26000 E30000 | 26000 30000 | 0.9 |
| N26000 E30100 | 26000 30100 | 1.6 |
| N26500 E27400 | 26500 27400 | 4.7 |
| N27000 E25000 | 27000 25000 | 9.0 |
| N27000 E26000 | 27000 26000 | 4.7 |
| N27000 E27000 | 27000 27000 | 3.8 |
| N27000 E28000 | 27000 28000 | 1.3 |
| N27000 E29000 | 27000 29000 | 0.9 |
| N27000 E30000 | 27000 30000 | 1.0 |
| N27000 E30100 | 27000 30100 | 1.1 |
| N28000 E25000 | 28000 25000 | 19.9 |
| N28000 E26000 | 28000 26000 | 6.8 |
| N28000 E27000 | 28000 27000 | 4.4 |
| N28000 E28000 | 28000 28000 | 1.5 |
| N28000 E29000 | 28000 29000 | 1.7 |
| N28000 E30000 | 28000 30000 | 1.2 |
| N28000 E30100 | 28000 30100 | 1.6 |
| N29000 E25000 | 29000 25000 | 7.0 |
| N29000 E26000 | 29000 26000 | 1.6 |
| N29000 E27000 | 29000 27000 | 4.1 |
| N29000 E28000 | 29000 28000 | 2.3 |
| N29000 E29000 | 29000 29000 | 2.4 |
| N29000 E30000 | 29000 30000 | 2.5 |
| N29000 E30100 | 29000 30100 | 1.1 |
| N29950 E30100 | 29950 30100 | 3.1 |
| N30000 E24000 | 30000 24000 | 1.3 |
| N30000 E25000 | 30000 25000 | 11.5 |
| N30000 E26000 | 30000 26000 | 11.0 |
| N30000 E27000 | 30000 27000 | 0.8 |
| N30000 E28000 | 30000 28000 | 10.4 |
| N30000 E29000 | 30000 29000 | 4.6 |
| N30000 E30000 | 30000 30000 | 4.4 |
| N30000 E31000 | 30000 31000 | 3.7 |
| N30000 E32000 | 30000 32000 | 1.5 |
| N30000 E33000 | 30000 33000 | 1.4 |

ARCO Bluewater Mill
Outlying Areas Verification Sample Results

| Northing/Easting Coordinates ===== | North Coordinate ===== | East Coordinate ===== | Ra-226 Concentration ===== |
|--|------------------------------|-----------------------------|----------------------------------|
| N30000 E34000 | 30000 | 34000 | 0.8 |
| N30000 E35000 | 30000 | 35000 | 0.9 |
| N30031 E20000 | 30031 | 20000 | 1.5 |
| N30200 E19600 | 30200 | 19600 | 1.8 |
| N31000 E19727.5 | 31000 | 19728 | 1.3 |
| N31000 E20000 | 31000 | 20000 | 1.2 |
| N31000 E21000 | 31000 | 21000 | 1.5 |
| N31000 E29000 | 31000 | 29000 | 3.7 |
| N31000 E30000 | 31000 | 30000 | 2.1 |
| N31000 E31000 | 31000 | 31000 | 1.8 |
| N31000 E32000 | 31000 | 32000 | 1.5 |
| N31000 E33000 | 31000 | 33000 | 1.5 |
| N31000 E34000 | 31000 | 34000 | 1.3 |
| N31000 E35000 | 31000 | 35000 | 1.1 |
| N31000 E35300 | 31000 | 35300 | 1.0 |
| N31050 E19750 | 31050 | 19750 | 2.3 |
| N32000 E19732 | 32000 | 19732 | 1.7 |
| N32000 E20000 | 32000 | 20000 | 0.8 |
| N32000 E21000 | 32000 | 21000 | 1.4 |
| N32000 E29000 | 32000 | 29000 | 1.3 |
| N32000 E30000 | 32000 | 30000 | 0.4 |
| N32000 E31000 | 32000 | 31000 | 0.5 |
| N32000 E32000 | 32000 | 32000 | 1.1 |
| N32000 E33000 | 32000 | 33000 | 1.4 |
| N32000 E34000 | 32000 | 34000 | 2.2 |
| N32000 E35000 | 32000 | 35000 | 1.1 |
| N32000 E35300 | 32000 | 35300 | 1.7 |
| N32000 E35300 | 32000 | 35300 | 1.3 |
| N33000 E19730 | 33000 | 19730 | 1.3 |
| N33000 E20000 | 33000 | 20000 | 1.0 |
| N33000 E29000 | 33000 | 29000 | 1.2 |
| N33000 E30000 | 33000 | 30000 | 0.7 |
| N33000 E31000 | 33000 | 31000 | 0.6 |
| N33000 E32000 | 33000 | 32000 | 0.5 |
| N33000 E33000 | 33000 | 33000 | 1.6 |
| N33000 E34000 | 33000 | 34000 | 1.8 |
| N33000 E35000 | 33000 | 35000 | 0.4 |
| N33000 E35300 | 33000 | 35300 | 1.6 |
| N34000 E19742 | 34000 | 19742 | 1.6 |

ARCO Bluewater Mill
Outlying Areas Verification Sample Results

| Northing/Easting Coordinates ===== | North Coordinate ===== | East Coordinate ===== | Ra-226 Concentration ===== |
|--|------------------------------|-----------------------------|----------------------------------|
| N34000 E20000 | 34000 | 20000 | 1.1 |
| N34000 E22351 | 34000 | 22351 | 0.6 |
| N34000 E29000 | 34000 | 29000 | 0.7 |
| N34000 E30000 | 34000 | 30000 | 0.7 |
| N34000 E31000 | 34000 | 31000 | 4.6 |
| N34000 E32000 | 34000 | 32000 | 3.3 |
| N34000 E33000 | 34000 | 33000 | 1.8 |
| N34000 E34000 | 34000 | 34000 | 1.6 |
| N34000 E35000 | 34000 | 35000 | 3.6 |
| N34750 E35000 | 34750 | 35000 | 2.1 |
| N34825 E24900 | 34825 | 24900 | 0.7 |
| N35000 E19746 | 35000 | 19746 | 1.1 |
| N35000 E20000 | 35000 | 20000 | 2.6 |
| N35000 E21000 | 35000 | 21000 | 2.9 |
| N35000 E29000 | 35000 | 29000 | 1.1 |
| N35000 E30000 | 35000 | 30000 | 5.4 |
| N35000 E31000 | 35000 | 31000 | 2.4 |
| N35000 E32000 | 35000 | 32000 | 3.7 |
| N35000 E33000 | 35000 | 33000 | 4.4 |
| N35000 E34000 | 35000 | 34000 | 2.4 |
| N35000 E34000 | 35000 | 34000 | 2.0 |
| N35000 E34700 | 35000 | 34700 | 3.0 |
| N35200 E33000 | 35200 | 33000 | 2.4 |
| N35200 E34000 | 35200 | 34000 | 1.9 |
| N35550 E31050 | 35550 | 31050 | 1.2 |
| N35550 E31150 | 35550 | 31150 | 1.9 |
| N35550 E31250 | 35550 | 31250 | 1.9 |
| N35650 E30950 | 35650 | 30950 | 2.0 |
| N35650 E31050 | 35650 | 31050 | 1.5 |
| N35650 E31250 | 35650 | 31250 | 1.0 |
| N35750 E31150 | 35750 | 31150 | 1.8 |
| N35750 E31250 | 35750 | 31250 | 1.4 |
| N36000 E20664 | 36000 | 20664 | 1.5 |
| N36000 E21000 | 36000 | 21000 | 0.9 |
| N36000 E21028 | 36000 | 21028 | 2.2 |
| N36000 E22000 | 36000 | 22000 | 2.3 |
| N36000 E23000 | 36000 | 23000 | 1.4 |
| N36000 E29000 | 36000 | 29000 | 2.3 |
| N36000 E30000 | 36000 | 30000 | 2.3 |

ARCO Bluewater Mill
Outlying Areas Verification Sample Results

| Northing/Easting Coordinates ===== | North Coordinate ===== | East Coordinate ===== | Ra-226 Concentration ===== |
|--|------------------------------|-----------------------------|----------------------------------|
| N36000 E31000 | 36000 | 31000 | 1.3 |
| N36000 E32000 | 36000 | 32000 | 1.2 |
| N36000 E32700 | 36000 | 32700 | 1.7 |
| N36000 E35300 | 36000 | 35300 | 2.0 |
| N36250 E28550 | 36250 | 28550 | 1.3 |
| N36300 E35200 | 36300 | 35200 | 2.2 |
| N36400 E32000 | 36400 | 32000 | 3.4 |
| N36700 E21500 | 36700 | 21500 | 2.9 |
| N37000 E22000 | 37000 | 22000 | 0.8 |
| N37000 E27000 | 37000 | 27000 | 1.7 |
| N37000 E28000 | 37000 | 28000 | 0.7 |
| N37000 E29000 | 37000 | 29000 | 4.1 |
| N37000 E30000 | 37000 | 30000 | 1.2 |
| N37000 E31000 | 37000 | 31000 | 4.2 |
| N37300 E31000 | 37300 | 31000 | 2.4 |
| N37500 E31000 | 37500 | 31000 | 1.9 |
| N38000 E21819 | 38000 | 21819 | 0.9 |
| N38000 E22000 | 38000 | 22000 | 0.1 |
| N38000 E23000 | 38000 | 23000 | 1.3 |
| N38000 E25000 | 38000 | 25000 | 1.6 |
| N38000 E26000 | 38000 | 26000 | 1.3 |
| N38000 E27000 | 38000 | 27000 | 0.8 |
| N38000 E28000 | 38000 | 28000 | 1.1 |
| N38000 E29000 | 38000 | 29000 | 1.7 |
| N38000 E30000 | 38000 | 30000 | 1.8 |
| N38000 E30500 | 38000 | 30500 | 1.5 |
| N39000 E22500 | 39000 | 22500 | 0.8 |
| N39000 E23000 | 39000 | 23000 | 0.7 |
| N39000 E24000 | 39000 | 24000 | 1.1 |
| N39000 E25000 | 39000 | 25000 | 0.8 |
| N39000 E26000 | 39000 | 26000 | 0.7 |
| N39000 E27000 | 39000 | 27000 | 1.2 |
| N39000 E28000 | 39000 | 28000 | 2.0 |
| N39000 E29000 | 39000 | 29000 | 1.9 |
| N39000 E30000 | 39000 | 30000 | 1.2 |
| N39500 E22354 | 39500 | 22354 | 0.8 |
| N40000 E22500 | 40000 | 22500 | 0.8 |
| N40000 E23000 | 40000 | 23000 | 0.5 |
| N40000 E24000 | 40000 | 24000 | 1.4 |

ARCO Bluewater Mill
Outlying Area: Verification Sample Results

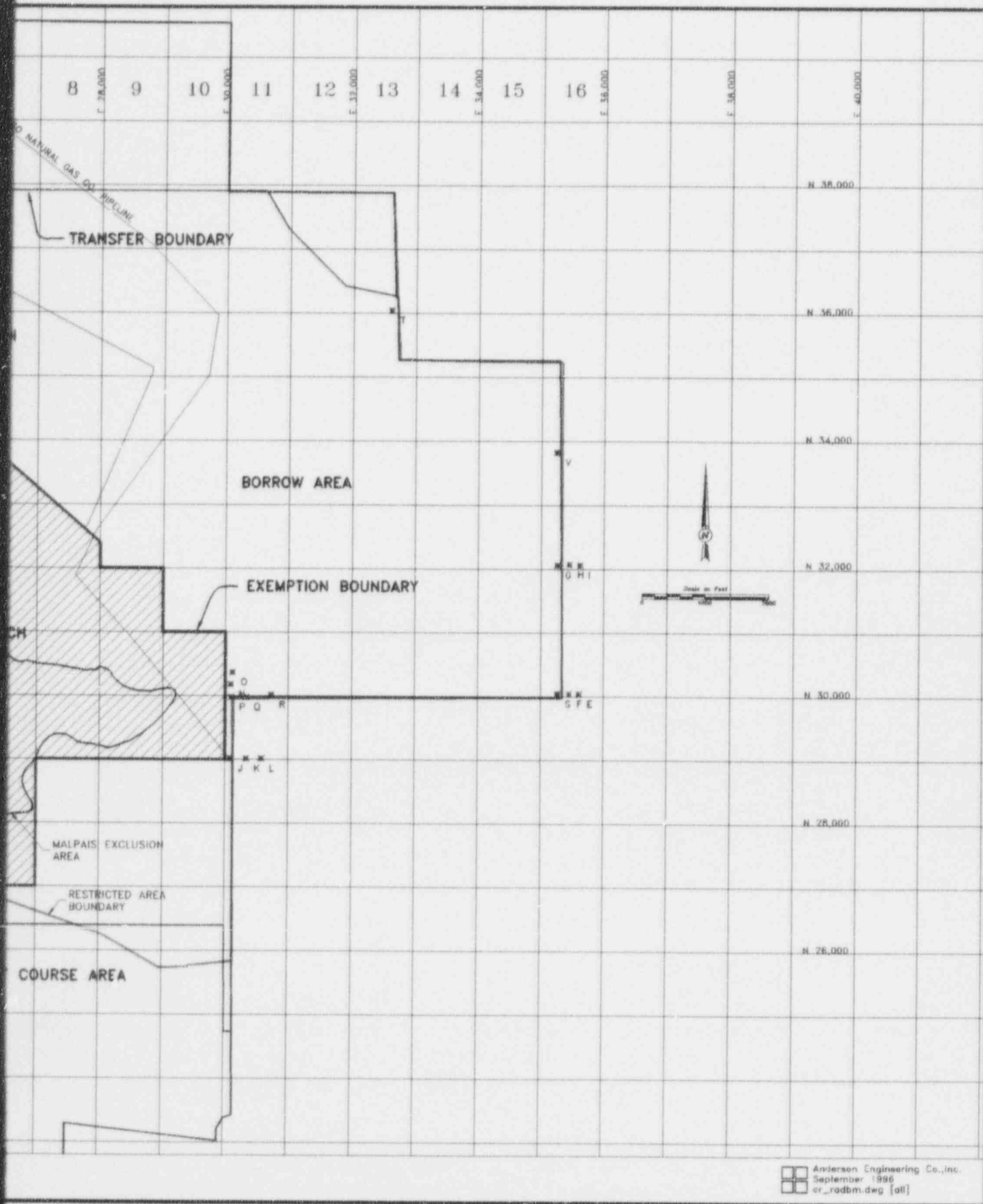
| Northing/Easting Coordinates | North Coordinate | East Coordinate | Ra-226 Concentration |
|---------------------------------|---------------------|--------------------|-------------------------|
| ===== | ===== | ===== | ===== |
| N40000 E25000 | 40000 | 25000 | 0.9 |
| N40000 E26000 | 40000 | 26000 | 0.5 |
| N40000 E27000 | 40000 | 27000 | 1.2 |
| N40000 E28000 | 40000 | 28000 | 0.8 |
| N40000 E29000 | 40000 | 29000 | 1.7 |
| N40000 E30000 | 40000 | 30000 | 1.6 |
| N40500 E22347 | 40500 | 22347 | 0.4 |
| N40500 E22500 | 40500 | 22500 | 0.6 |
| N40500 E23000 | 40500 | 23000 | 0.6 |
| N40500 E24000 | 40500 | 24000 | 1.1 |
| N40500 E25000 | 40500 | 25000 | 0.9 |
| N40500 E26000 | 40500 | 26000 | 1.2 |
| N40500 E27000 | 40500 | 27000 | 0.7 |
| N40500 E28000 | 40500 | 28000 | 1.5 |
| N40500 E29000 | 40500 | 29000 | 1.0 |
| N40500 E30000 | 40500 | 30000 | 1.1 |
| N40525 E28000 | 40525 | 28000 | 1.5 |
| N40530 E29000 | 40530 | 29000 | 1.6 |
| N40540 E27000 | 40540 | 27000 | 1.4 |
| N40545 E26000 | 40545 | 26000 | 0.6 |
| N40550 E25000 | 40550 | 25000 | 1.1 |
| N40570 E24000 | 40570 | 24000 | 1.3 |
| N40590 E23000 | 40590 | 23000 | 0.5 |
| N40600 E22500 | 40600 | 22500 | 0.7 |

ATTACHMENT 3
Exposure Rate Measurement
Locations Figure

TO

ADDENDUM 1
RESPONSE TO NRC COMMENTS





9609250302-09



| DATE | REVISION | NO. |
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ANDERSON ENGINEERING CO., INC.

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California

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Grants
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Telephone (801) 731-4596

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CIVIL ENGINEERS

CONSTRUCTION MANAGERS

BULK AVERAGE
RANGES I

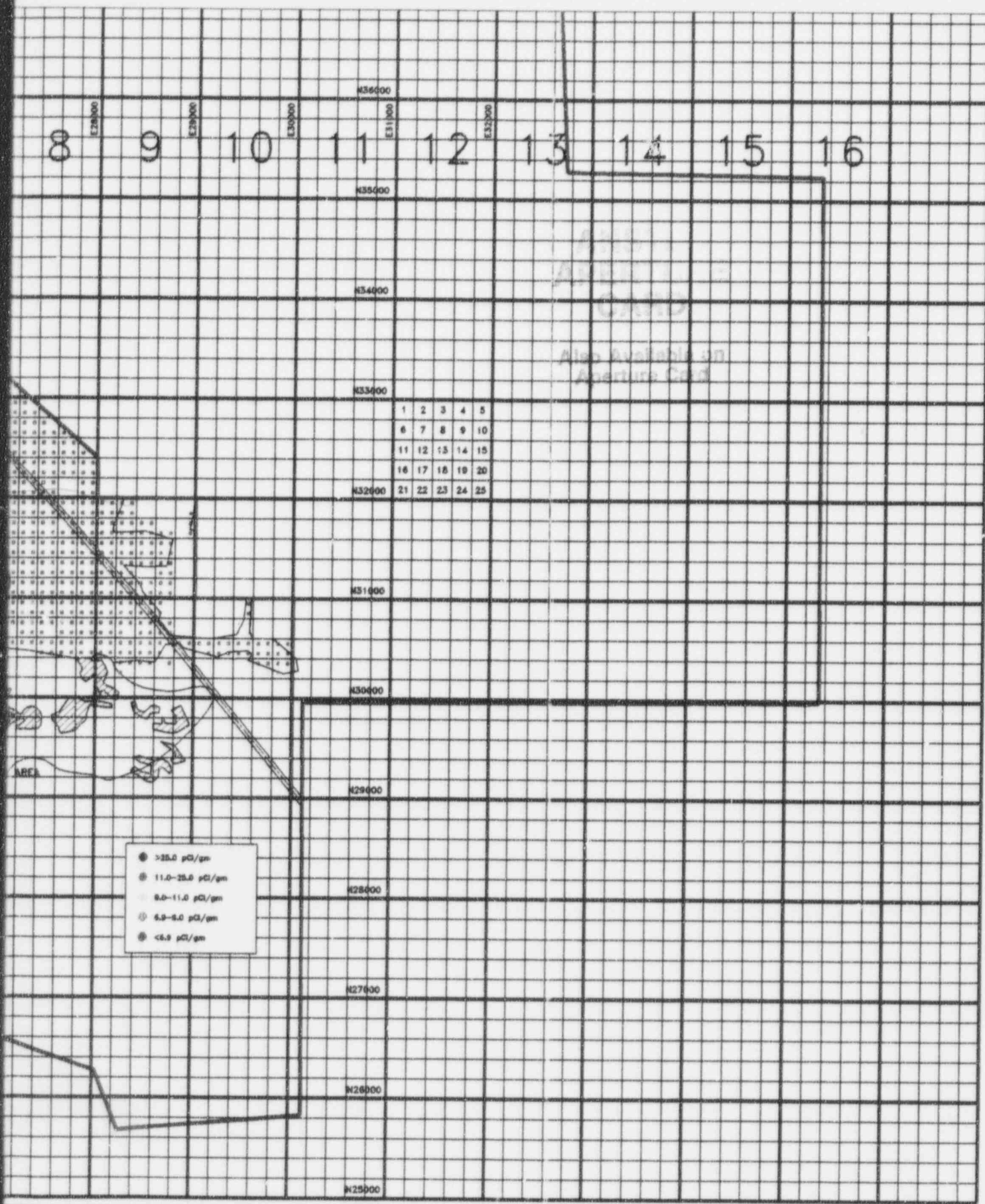


FIGURE 3-2
Ra-226 CONCENTRATION
FOR SURFACE LAYER

ATLANTIC RESEARCH COMPANY
BETHLEHEM, PA.

9609250302-10

DRAWN BY: MJD
ENGINEER: SDV
APPROVED: KB
DATE: 1-4-94
HORIZ. SCALE: NO SCALE
VERT. SCALE:
REFERENCE:

ATTACHMENT 4
Evaporation Pond Area
Th-230 Sample Locations Figure

TO

ADDENDUM 1
RESPONSE TO NRC COMMENTS

OVERSIZE DOCUMENT PAGE PULLED

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NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS

1

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RECORDS AND REPORTS MANAGEMENT BRANCH

ATTACHMENT 5

**“Radon Flux Measurements on Plant Site,
Former Ore Stockpile Area, Disposal Area No. 1,
Asbestos Disposal Area, and North & South
Landfill Report”**

June 17, 1996

TO

**ADDENDUM 1
RESPONSE TO NRC COMMENTS**



Bluewater Mill
Post Office Box 638
Grants, New Mexico 87020
Telephone 505 876 2211
Facsimile 505 876 2772

June 17, 1996

Mr. Joseph Holonich, Branch Chief
United States Nuclear Regulatory Commission
Uranium Recovery Branch
Division of Waste Management, NMSS (T7J9)
11545 Rockville Pike
Rockville, MD 20852

**Re: Radon Flux Measurements on Remainder of the Site
License No. SUA-1470, Docket No. 40-8902**

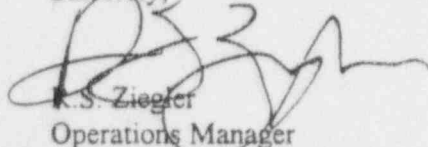
Dear Mr. Holonich:

Atlantic Richfield Company (ARCO) completed placement of Radon Barrier on the remainder of the Plant Site, former Ore Stockpile Area, Disposal Area No. 1, and the North and South Landfills in late 1995. Consistent with my December 18, 1995 correspondence to you, radon flux measurements were made on the above disposal sites in May 1996. The flux measurements were made using EPA Method 115 (40 CFR Part 61) according to the requirements of 10 CFR Part 40, Appendix A, Criterion 6(2) and the references cited therein.

The enclosed report, "Radon Flux Measurements on Plant Site, Former Ore Stockpile Area, Disposal Area No. 1, Asbestos Disposal Area, and North and South Landfill; Bluewater Mill Site," documents the method and the results of the measurements in accordance with the 10 CFR Part 40, Appendix A, Criterion 6, paragraph (4). The data shows that the average radon flux over each disposal site is well within the 20 pCi/m²s.

Should you have any questions regarding this submittal, please do not hesitate to contact me or Mr. Natver Patel of AVM Environmental Services, Inc. at (505) 287-4593.

Sincerely,



R.S. Ziegler
Operations Manager

pc: N. Patel, AVM
C. Cains, USNRC, Region IV
J. Virgona, DOE
File

1.0 Introduction

The final radon barrier placement in accordance with the U. S. Nuclear Regulatory Commission (NRC)-approved Reclamation Plan on the Plant Site, former Ore Stockpile Area, Disposal Area No. 1, and North and South landfills, and Asbestos Disposal Area was completed during the last part of 1995. Because of freezing temperatures during the winter season, the radon flux measurements were made in May 1996 when it could be assured that the temperature requirements of EPA Method 115 could be met.

Consistent with ARCO's December 18, 1995 correspondence, the Plant Site, former Ore Stockpile Area, and Disposal Area No. 1 are considered as one contiguous area for the purpose of radon flux measurements to demonstrate compliance with the 20 pCi/m²/sec. On May 9, 1996 one hundred radon flux measurements were made in this area. In addition five radon flux measurements were made on Asbestos Disposal Area, North and South landfills comprising of 2.0, 2.0, and 1.2 acres respectively. This report provides a description of method, the procedures, and the data to demonstrate that radon flux meets the 20 pCi/m²/sec. standard.

2.0 Method

The requirements in 10 CFR Part 40, Appendix A indicate that as soon as possible after placement of the final radon barrier and prior to placement of erosion protection, appropriate testing must be conducted to assure that the radon flux, averaged over the entire surface of the disposal site, does not exceed 20 pCi/m²/sec standard. Approved procedures for performing the testing is described in 40 CFR Part 61, Appendix B, Method 115.

Method 115 requires placement of 100 large area charcoal canisters on surface of large disposal site for approximately 24 hours and measurements of the absorbed radioactivity using gamma spectroscopy. An area weighted average is to be calculated and compared with the standard.

As shown in Figures 1 through 3, 100 evenly spaced points on the Plant Site, former Ore Stockpile Area, and Disposal Area No. 1; five on Asbestos Disposal Area; and five each on North and South landfills were located through a land survey. Radon flux measurements at these locations were made by Environmental Restoration Group, Inc. (ERG) using ERG canisters and procedures previously submitted to the NRC. The ERG canisters and procedures fully comply with EPA Method 115 and have been reviewed previously by the NRC.

3.0 Results

Radon flux canisters were placed at the locations shown in Figure 1 in the morning of May 9, 1996. Two trip blanks (canisters 31 and 26) were used to check the effectiveness of the charcoal bake-out, the integrity of the plastic bags, and the calibration of the spectrometer. The results of the two trip blanks were reported as 0.17 ± 0.23 and 0.03 ± 0.23 pCi/m²/sec., where the error is one standard deviation. Since the trip blanks were not removed from the plastic bags, a value overlapping zero clearly shows that the trip blanks were not effected by environmental conditions and that the spectrometer reading is not bias high or low.

No rainfall occurred at least two days prior to the flux measurement, and the lowest temperature during the 24 hour flux measurement period was 41 degrees Fahrenheit, which meets conditions specified in Method 115. These data were recorded at the Bluewater Mill Site meteorological

station, which is consistent with the Grants Municipal Airport weather data. The laboratory results are provided in Appendix A to this report. Method 115 requires that ten percent of the canisters be counted twice. Canister No. with "B" suffix indicate duplicate counting. An arithmetic average of the two values was used as the flux values for these canisters. Since the flux measurement locations are evenly spaced and each measurement represents approximately the same area, the arithmetic average is equal to the area weighted average.

Radon flux measurements data for the Plant Site, former Ore Stockpile Area, and Disposal Area No. 1 are presented in Table 3-1 where the canister results for each location are listed. The average radon flux value of 6.20 pCi/m²/sec clearly shows that the flux is in compliance with the 20 pCi/m²/sec. standard.

Table 3-1

| Location ID | Northing Coordinates | Easting Coordinates | Canister Number | Radon Flux pCi/m ² /sec. |
|-------------|----------------------|---------------------|-----------------|-------------------------------------|
| 201 | 29800 | 21800 | 8 | 1.72 |
| 202 | 29800 | 22000 | 29 | 0.63 |
| 203 | 29600 | 22000 | 17 | 0.53 |
| 204 | 29600 | 21800 | 251 | 0.39 |
| 205 | 29600 | 21600 | 262 | 0.47 |
| 206 | 29400 | 21600 | 90 | 1.48 |
| 207 | 29400 | 21800 | 71 | 0.17 |
| 208 | 29400 | 21992 | 6 | 0.77 |
| 209 | 29200 | 22000 | 73 | 0.33 |
| 210 | 29200 | 21800 | 93 | 0.46 |
| 211 | 29200 | 21600 | 89 | 0.05 |
| 212 | 29000 | 21800 | 101 | 0.16 |
| 213 | 29000 | 22000 | 79 | 1.18 |
| 214 | 29000 | 22800 | 14 | 0.58 |
| 215 | 28800 | 22800 | 107 | 0.83 |
| 216 | 28800 | 22600 | 23 | 4.68 |
| 217 | 28800 | 22400 | 96 | 3.56 |
| 218 | 28800 | 22200 | 100 | 0.40 |
| 219 | 28800 | 22000 | 11 | 0.51 |
| 220 | 28800 | 21800 | 62 | 0.28 |
| 221 | 28600 | 21800 | 85 | -0.04 |
| 222 | 28600 | 22000 | 81 | 2.21 |
| 223 | 28600 | 22200 | 83 | 1.48 |
| 224 | 28600 | 22200 | 78 | 1.22 |
| 225 | 28600 | 22600 | 38 | 3.89 |
| 226 | 28400 | 22800 | 52 | 0.16 |
| 227 | 28400 | 22600 | 30 | 0.18 |
| 228 | 28400 | 22400 | 202 | 3.47 |

Table 3-1 (Continued)

| Location ID | Northing Coordinates | Easting Coordinates | Canister Number | Radon Flux pCi/m ² /sec. |
|-------------|----------------------|---------------------|-----------------|--|
| 229 | 28400 | 22200 | 67 | 0.73 |
| 230 | 28400 | 22000 | 61 | 0.71 |
| 231 | 28200 | 22200 | 51 | 0.28 |
| 232 | 28200 | 22400 | 4 | 0.56 |
| 233 | 28200 | 22400 | 5 | 5.86 |
| 234 | 28200 | 22800 | 72 | 8.21 |
| 235 | 28200 | 23000 | 58 | 0.66 |
| 236 | 28000 | 23000 | 109 | 2.20 |
| 237 | 28000 | 22800 | 33 | 0.08 |
| 238 | 28000 | 22600 | 45 | 0.87 |
| 239 | 28000 | 22400 | 92 | 0.14 |
| 240 | 27800 | 22600 | 104 | 0.07 |
| 241 | 27800 | 22800 | 36 | 0.59 |
| 242 | 27800 | 23000 | 59 | 89.26 |
| 243 | 27800 | 23143 | 74 | -0.11 |
| 244 | 27600 | 23187 | 263 | 4.01 |
| 245 | 27600 | 23000 | 66 | 4.46 |
| 246 | 27600 | 22800 | 48 | 3.60 |
| 247 | 27600 | 22600 | 44 | 0.01 |
| 248 | 27400 | 23200 | 60 | -0.16 |
| 249 | 28800 | 22979 | 70 | 0.10 |
| 250 | 28600 | 22800 | 261 | 0.45 |
| 251 | 28600 | 22990 | 16 | 0.12 |
| 252 | 28600 | 23200 | 88 | 0.07 |
| 253 | 28400 | 23200 | 200 | -0.28 |
| 254 | 28400 | 23000 | 1 | 0.31 |
| 255 | 28200 | 23200 | 40 | -0.29 |
| 256 | 28000 | 23200 | 105 | -0.08 |
| 257 | 29193 | 23800 | 63 | 0.58 |
| 258 | 29200 | 24000 | 102 | 1.72 |
| 259 | 29000 | 24000 | 259 | 1.28 |
| 260 | 29000 | 23800 | 250 | 0.42 |
| 261 | 29000 | 23600 | 3 | 0.42 |
| 262 | 28800 | 23600 | 68 | 0.89 |
| 263 | 28800 | 23800 | 84 | 0.76 |
| 264 | 28800 | 24000 | 64 | 2.00 |
| 265 | 28800 | 24200 | 258 | 0.57 |
| 266 | 28600 | 24000 | 54 | 0.91 |
| 267 | 28600 | 23800 | 69 | 0.79 |

Table 3-1 (Continued)

| Location ID | Northing Coordinates | Easting Coordinates | Canister Number | Radon Flux pCi/m ² /sec. |
|-------------|----------------------|---------------------|-----------------|-------------------------------------|
| 268 | 28600 | 23600 | 35 | -0.01 |
| 269 | 28400 | 23600 | 257 | 2.03 |
| 270 | 28400 | 23800 | 18 | 1.84 |
| 271 | 28400 | 24000 | 9 | 0.63 |
| 272 | 28400 | 24200 | 12 | 5.25 |
| 273 | 28400 | 24400 | 50 | 0.59 |
| 274 | 28200 | 24600 | 75 | 0.72 |
| 275 | 28200 | 24400 | 22 | 11.31 |
| 276 | 28200 | 24200 | 57 | 5.42 |
| 277 | 28200 | 24000 | 103 | 9.20 |
| 278 | 28200 | 23800 | 252 | 17.60 |
| 279 | 28200 | 23600 | 19 | 14.43 |
| 280 | 28200 | 23400 | 13 | 0.23 |
| 281 | 28000 | 23400 | 203 | 0.88 |
| 282 | 28000 | 23600 | 42 | 9.56 |
| 283 | 28000 | 23800 | 25 | 203.03 |
| 284 | 28000 | 24000 | 27 | 4.65 |
| 285 | 28000 | 24200 | 97 | 1.46 |
| 286 | 28000 | 24400 | 95 | 1.30 |
| 287 | 28000 | 24600 | 256 | 20.08 |
| 288 | 27800 | 24400 | 28 | 6.11 |
| 289 | 27800 | 24200 | 34 | 16.71 |
| 290 | 27800 | 24000 | 21 | 27.80 |
| 291 | 27800 | 23800 | 201 | 24.73 |
| 292 | 27800 | 23600 | 86 | 1.84 |
| 293 | 27800 | 23400 | 20 | 16.77 |
| 294 | 27600 | 23400 | 46 | 20.57 |
| 295 | 27600 | 23600 | 41 | 4.35 |
| 296 | 27600 | 24200 | 39 | 19.33 |
| 297 | 27400 | 24200 | 37 | 0.56 |
| 298 | 27400 | 24400 | 254 | 2.44 |
| 299 | 27200 | 24400 | 87 | 1.17 |
| 300 | 27200 | 24605 | 108 | 2.42 |
| | | | Average | 6.20 |

Radon flux measurements data for the South Landfill Disposal Area are presented in Table 3-2 where the canister results for each location are listed. The average radon flux value of 0.25 pCi/m²/sec clearly shows that the flux is in compliance with the 20 pCi/m²/sec. standard.

Table 3-2

| Location ID | Northing Coordinates | Easting Coordinates | Canister Number | Radon Flux pCi/m ² /sec. |
|-------------|----------------------|---------------------|-----------------|-------------------------------------|
| 301 | 29636.54 | 24332.34 | 76 | -0.18 |
| 302 | 29565.97 | 24338.63 | 94 | 0.51 |
| 303 | 29534.82 | 24451.25 | 24 | 0.68 |
| 304 | 29494.26 | 24316.86 | 55 | 0.16 |
| 305 | 29478.75 | 24418.35 | 47 | 0.06 |
| | | | Average | 0.25 |

Radon flux measurements data for the North Landfill are presented in Table 3-3 where the canister results for each location are listed. The average radon flux value of 0.37 pCi/m²/sec clearly shows that the flux is in compliance with the 20 pCi/m²/sec. standard.

Table 3-3

| Location ID | Northing Coordinates | Easting Coordinates | Canister Number | Radon Flux pCi/m ² /sec. |
|-------------|----------------------|---------------------|-----------------|-------------------------------------|
| 306 | 29688.05 | 24836.03 | 253 | 0.23 |
| 307 | 29616.34 | 24865.52 | 91 | 0.31 |
| 308 | 29606.77 | 24964.40 | 255 | 0.53 |
| 309 | 29531.79 | 25007.97 | 7 | 0.25 |
| 310 | 29514.67 | 25093.85 | 43 | 0.52 |
| | | | Average | 0.37 |

Radon flux measurements data for the Asbestos Disposal Area are presented in Table 3-4 where the canister results for each location are listed. The average radon flux value of 0.15 pCi/m²/sec clearly shows that the flux is in compliance with the 20 pCi/m²/sec. standard.

Table 3-4

| Location ID | Northing Coordinates | Easting Coordinates | Canister Number | Radon Flux pCi/m ² /sec. |
|-------------|----------------------|---------------------|-----------------|-------------------------------------|
| 311 | 29101 | 22956 | 260 | -0.09 |
| 312 | 29007 | 22956 | 80 | 0.34 |
| 313 | 29007 | 23062 | 99 | 0.24 |
| 314 | 28902 | 23062 | 56 | 0.12 |
| 315 | 28902 | 23166 | 53 | 0.12 |
| | | | Average | 0.15 |

At about eleven locations in former Ore Stockpile area showed radon flux measurements above 10 pCi/m²/sec., including one location measured at 203.03 pCi/m²/sec. Even though the average radon flux was much less than the 20 pCi/m²/sec. standard, ARCO decided to conduct another measurement at those eleven locations. The results of the second measurements were similar to the first measurements, except the highest measurement (203 pCi/m²/sec.) location, which dropped to 32.87 pCi/m²/sec. The average for the second set of eleven measurements was 25.6 pCi/m²/sec compared to the first measurements average of 42.4 pCi/m²/sec. For calculation of average radon flux in above tables for demonstration of compliance with the standard, ARCO used only the first measurements. The data for the second set of measurements at those eleven locations is included in ERG's lab report in Appendix A to this report.

APPENDIX A



Environmental Restoration Group, Inc.
12809 Arroyo de Vista NE
Albuquerque, New Mexico 87111
(505) 298-4224

June 4, 1996

Mr. Natver Patel
AVM Environmental Services, Inc.
920 Lobo Canyon Rd., Suite 2A
Grants, NM 87020

Dear Mr. Patel:

Enclosed is the final radon flux measurement report for verification of reclaimed areas of the Bluewater Uranium Mill, owned by Atlantic Richfield Company. The former Plantsite and Ore Stockpile areas along with the Asbestos Disposal Area were contiguous and therefore considered as one area. One hundred five canisters were placed on that area on May 9, 1996. Five canisters were placed on each of the North and South Landfills. They were also deployed on May 9. Canisters numbered 31 and 26 were trip blanks used for quality assurance purposes. Deployment times were assigned to these canisters consistent with the remaining canisters. The near zero fluxes measured for these two canisters demonstrated that the technique is accurate without bias.

Upon analysis of the canisters, a verbal report was made to you that the flux from several canister locations exceeded $10 \text{ pCi/m}^2\text{s}$. ERG was directed to send eleven canisters plus two trip blanks so that another measurement could be made at those elevated locations. The canisters were placed on May 22, 1996. Canisters 61 and 203 were trip blanks. The results of the second measurement were similar to the first measurement other than the highest measurement dropped by a factor of more than six. The average for the second set of eleven measurements was $25.6 \text{ pCi/m}^2\text{s}$ compared to the first set of $42.4 \text{ pCi/m}^2\text{s}$. The data for the second set of measurements is also enclosed.

Our procedures require that ten percent of the canisters be counted twice. Where this was done, the canister number was recorded with a "B" suffix. An arithmetic average of the two values is suggested for use as the best value.

Please advise me if you have any questions.

Sincerely,

A handwritten signature in cursive script, reading "Kenneth R. Baker".

Kenneth R. Baker, Ph.D.
Principal

Radon Flux Measurements

Site: ARCO Bluewater Plantsite and Former Ore Stockpile Area

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity(pCi) | Flux pCi/m ² s | Flux Error 1.00 S.D. | LLD pCi/m ² s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|------------------------|---------------------------|----------------------|--------------------------|
| 43 | 05/10/96 | 16:16 | 05/09 | 13:54 | 05/10 | 13:48 | 86040 | 1200 | 703 | 196 | 71 | 176 | 7.04E-03 | 2.43E+03 | 0.52 | 0.22 | 0.67 |
| 7 | 05/10/96 | 16:38 | 05/09 | 13:53 | 05/10 | 13:47 | 86040 | 1200 | 371 | 183 | 71 | 176 | 7.04E-03 | 1.15E+03 | 0.25 | 0.21 | 0.67 |
| 255 | 05/10/96 | 17:17 | 05/09 | 13:52 | 05/10 | 13:47 | 86100 | 1200 | 718 | 181 | 71 | 176 | 7.04E-03 | 2.49E+03 | 0.53 | 0.21 | 0.68 |
| 91 | 05/10/96 | 17:39 | 05/09 | 13:51 | 05/10 | 13:46 | 86100 | 1200 | 451 | 184 | 71 | 176 | 7.04E-03 | 1.46E+03 | 0.31 | 0.21 | 0.68 |
| 253 | 05/10/96 | 18:02 | 05/09 | 13:50 | 05/10 | 13:45 | 86100 | 1200 | 343 | 182 | 71 | 176 | 7.04E-03 | 1.04E+03 | 0.23 | 0.21 | 0.68 |
| 83 | 05/10/96 | 18:25 | 05/09 | 11:04 | 05/10 | 11:00 | 86160 | 1200 | 1817 | 220 | 71 | 176 | 7.04E-03 | 6.71E+03 | 1.48 | 0.24 | 0.70 |
| 78 | 05/10/96 | 18:47 | 05/09 | 11:02 | 05/10 | 10:59 | 86220 | 1200 | 1511 | 192 | 71 | 176 | 7.04E-03 | 5.53E+03 | 1.22 | 0.22 | 0.70 |
| 81 | 05/10/96 | 19:08 | 05/09 | 11:05 | 05/10 | 11:01 | 86160 | 1200 | 2659 | 209 | 71 | 176 | 7.04E-03 | 9.94E+03 | 2.21 | 0.23 | 0.70 |
| 38 | 05/10/96 | 19:29 | 05/09 | 11:01 | 05/10 | 10:57 | 86160 | 1200 | 4619 | 252 | 71 | 176 | 7.04E-03 | 1.75E+04 | 3.89 | 0.26 | 0.70 |
| 164 | 05/10/96 | 19:50 | 05/09 | 10:57 | 05/10 | 10:54 | 86220 | 1200 | 572 | 166 | 71 | 176 | 7.04E-03 | 1.92E+03 | 0.43 | 0.21 | 0.70 |
| 164 | 05/10/96 | 20:12 | 05/09 | 10:57 | 05/10 | 10:54 | 86220 | 1200 | 532 | 172 | 71 | 176 | 7.04E-03 | 1.77E+03 | 0.40 | 0.21 | 0.71 |
| 14 | 05/10/96 | 20:33 | 05/09 | 10:55 | 05/10 | 10:53 | 86280 | 1200 | 739 | 200 | 71 | 176 | 7.04E-03 | 2.57E+03 | 0.58 | 0.23 | 0.71 |
| 261 | 05/10/96 | 20:53 | 05/09 | 10:59 | 05/10 | 10:56 | 86220 | 1200 | 596 | 190 | 71 | 176 | 7.04E-03 | 2.02E+03 | 0.45 | 0.22 | 0.71 |
| 107 | 05/10/96 | 21:15 | 05/09 | 10:52 | 05/10 | 10:52 | 86400 | 1200 | 1032 | 179 | 71 | 176 | 7.04E-03 | 3.69E+03 | 0.83 | 0.22 | 0.71 |
| 96 | 05/10/96 | 21:36 | 05/09 | 10:49 | 05/10 | 10:38 | 85740 | 1200 | 4133 | 242 | 71 | 176 | 7.04E-03 | 1.56E+04 | 3.56 | 0.26 | 0.72 |
| 100 | 05/10/96 | 21:42 | 05/09 | 10:47 | 05/10 | 10:37 | 85800 | 1200 | 525 | 182 | 71 | 176 | 7.04E-03 | 1.74E+03 | 0.40 | 0.22 | 0.72 |
| 23 | 05/10/96 | 22:05 | 05/09 | 10:50 | 05/10 | 10:50 | 86400 | 1200 | 5438 | 258 | 71 | 176 | 7.04E-03 | 2.06E+04 | 4.68 | 0.27 | 0.71 |
| 62 | 05/10/96 | 22:26 | 05/09 | 10:46 | 05/10 | 10:37 | 85860 | 1200 | 393 | 180 | 71 | 176 | 7.04E-03 | 1.24E+03 | 0.28 | 0.22 | 0.72 |
| 79 | 05/10/96 | 22:48 | 05/09 | 10:41 | 05/10 | 10:33 | 85920 | 1200 | 1403 | 204 | 71 | 176 | 7.04E-03 | 5.12E+03 | 1.18 | 0.24 | 0.72 |
| 11 | 05/10/96 | 23:10 | 05/09 | 10:44 | 05/10 | 10:34 | 85800 | 1200 | 645 | 182 | 71 | 176 | 7.04E-03 | 2.20E+03 | 0.51 | 0.22 | 0.73 |

Radon Flux Measurements

Site: ARCO Bluewater Plant site and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity(nCi) | Flux pCi/m ² s | Flux Error 1.00 S.D. | LLD pCi/m ² s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|------------------------|---------------------------|----------------------|--------------------------|
| 101a | 05/10/96 | 23:32 | 05/09 | 10:40 | 05/10 | 10:32 | 85920 | 1200 | 308 | 181 | 71 | 176 | 7.04E-03 | 9.10E+02 | 0.21 | 0.22 | 0.73 |
| 101b | 05/10/96 | 00:17 | 05/09 | 10:40 | 05/10 | 10:32 | 85920 | 1200 | 207 | 182 | 71 | 176 | 7.04E-03 | 5.22E+02 | 0.10 | 0.19 | 0.61 |
| 89 | 05/11/96 | 01:30 | 05/09 | 10:39 | 05/10 | 10:31 | 85920 | 1200 | 115 | 182 | 56 | 179 | 7.04E-03 | 2.27E+02 | 0.05 | 0.23 | 0.75 |
| 73 | 05/11/96 | 01:51 | 05/09 | 10:35 | 05/10 | 10:28 | 85980 | 1200 | 426 | 176 | 56 | 179 | 7.04E-03 | 1.42E+03 | 0.33 | 0.23 | 0.75 |
| 93 | 05/11/96 | 02:13 | 05/09 | 10:37 | 05/10 | 10:30 | 85980 | 1200 | 564 | 186 | 56 | 179 | 7.04E-03 | 1.95E+03 | 0.46 | 0.23 | 0.76 |
| 6 | 05/11/96 | 02:34 | 05/09 | 10:32 | 05/10 | 10:28 | 86160 | 1200 | 910 | 188 | 56 | 179 | 7.04E-03 | 3.23E+03 | 0.77 | 0.24 | 0.76 |
| 71 | 05/11/96 | 02:56 | 05/09 | 10:31 | 05/10 | 10:27 | 86160 | 1200 | 242 | 189 | 56 | 179 | 7.04E-03 | 7.15E+02 | 0.17 | 0.24 | 0.76 |
| 262 | 05/11/96 | 03:18 | 05/09 | 10:28 | 05/10 | 10:25 | 86220 | 1200 | 577 | 174 | 56 | 179 | 7.04E-03 | 2.00E+03 | 0.47 | 0.23 | 0.76 |
| 17 | 05/11/96 | 03:40 | 05/09 | 10:21 | 05/10 | 10:21 | 86400 | 1200 | 633 | 189 | 56 | 179 | 7.04E-03 | 2.22E+03 | 0.53 | 0.24 | 0.76 |
| 90 | 05/11/96 | 04:02 | 05/09 | 10:30 | 05/10 | 10:26 | 86160 | 1200 | 1669 | 204 | 56 | 179 | 7.04E-03 | 6.20E+03 | 1.48 | 0.25 | 0.76 |
| 251a | 05/11/96 | 04:44 | 05/09 | 10:24 | 05/10 | 10:24 | 86400 | 1200 | 531 | 169 | 56 | 179 | 7.04E-03 | 1.82E+03 | 0.44 | 0.23 | 0.77 |
| 251b | 05/11/96 | 05:08 | 05/09 | 10:24 | 05/10 | 10:24 | 86400 | 1200 | 412 | 174 | 56 | 179 | 7.04E-03 | 1.37E+03 | 0.33 | 0.23 | 0.77 |
| 29 | 05/11/96 | 05:40 | 05/09 | 10:18 | 05/10 | 10:19 | 86460 | 1200 | 732 | 169 | 56 | 179 | 7.04E-03 | 2.60E+03 | 0.63 | 0.23 | 0.77 |
| 8 | 05/11/96 | 06:16 | 05/09 | 10:15 | 05/10 | 10:16 | 86460 | 1200 | 1907 | 212 | 56 | 179 | 7.04E-03 | 7.11E+03 | 1.72 | 0.26 | 0.78 |
| 31 | 05/11/96 | 06:37 | 05/09 | 10:15 | 05/10 | 10:16 | 86460 | 1200 | 239 | 170 | 56 | 179 | 7.04E-03 | 7.03E+02 | 0.17 | 0.23 | 0.78 |
| 26 | 05/11/96 | 06:59 | 05/09 | 10:15 | 05/10 | 10:16 | 86460 | 1200 | 93 | 175 | 56 | 179 | 7.04E-03 | 1.42E+02 | 0.03 | 0.23 | 0.78 |
| 47 | 05/11/96 | 07:20 | 05/09 | 13:42 | 05/10 | 13:36 | 86040 | 1200 | 119 | 193 | 56 | 179 | 7.04E-03 | 2.42E+02 | 0.06 | 0.24 | 0.77 |
| 94 | 05/11/96 | 07:41 | 05/09 | 13:46 | 05/10 | 13:39 | 85980 | 1200 | 608 | 183 | 56 | 179 | 7.04E-03 | 2.12E+03 | 0.51 | 0.24 | 0.77 |
| 55 | 05/11/96 | 08:03 | 05/09 | 13:44 | 05/10 | 13:37 | 85980 | 1200 | 233 | 193 | 56 | 179 | 7.04E-03 | 6.80E+02 | 0.16 | 0.24 | 0.77 |
| 24 | 05/11/96 | 08:24 | 05/09 | 13:45 | 05/10 | 13:38 | 85980 | 1200 | 788 | 186 | 56 | 179 | 7.04E-03 | 2.81E+03 | 0.68 | 0.24 | 0.77 |

Radon Flux Measurements

Site: ARCO Bluewater Plantsite and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity(nCi) | Flux pCi/m ² s | Flux Error 1.00 S.D. | LLD pCi/m ² s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|------------------------|---------------------------|----------------------|--------------------------|
| 102 | 05/11/96 | 08:45 | 05/09 | 13:35 | 05/10 | 13:30 | 86100 | 1200 | 1906 | 220 | 56 | 179 | 7.04E-03 | 7.11E+03 | 1.72 | 0.26 | 0.77 |
| 250a | 05/11/96 | 09:07 | 05/09 | 13:33 | 05/10 | 13:29 | 86160 | 1200 | 569 | 187 | 56 | 179 | 7.04E-03 | 1.97E+03 | 0.48 | 0.24 | 0.78 |
| 250b | 05/11/96 | 09:28 | 05/09 | 13:33 | 05/10 | 13:29 | 86160 | 1200 | 435 | 191 | 56 | 179 | 7.04E-03 | 1.46E+03 | 0.35 | 0.24 | 0.78 |
| 259 | 05/11/96 | 09:50 | 05/09 | 13:37 | 05/10 | 13:31 | 86040 | 1200 | 1422 | 196 | 56 | 179 | 7.04E-03 | 5.25E+03 | 1.28 | 0.25 | 0.78 |
| 76 | 05/11/96 | 10:33 | 05/09 | 13:42 | 05/10 | 13:40 | 86280 | 1200 | 248 | 191 | 444 | 164 | 7.04E-03 | -7.53E+02 | -0.18 | 0.24 | 0.72 |
| 3 | 05/11/96 | 10:54 | 05/09 | 13:30 | 05/10 | 13:27 | 86220 | 1200 | 889 | 196 | 444 | 164 | 7.04E-03 | 1.71E+03 | 0.42 | 0.24 | 0.72 |
| 56 | 05/11/96 | 11:15 | 05/09 | 13:22 | 05/10 | 13:11 | 85740 | 1200 | 573 | 184 | 444 | 164 | 7.04E-03 | 4.96E+02 | 0.12 | 0.23 | 0.73 |
| 63 | 05/11/96 | 11:36 | 05/09 | 13:31 | 05/10 | 13:28 | 86220 | 1200 | 1056 | 204 | 444 | 164 | 7.04E-03 | 2.35E+03 | 0.58 | 0.25 | 0.72 |
| 260 | 05/11/96 | 11:57 | 05/09 | 13:20 | 05/10 | 13:14 | 86040 | 1200 | 353 | 193 | 444 | 164 | 7.04E-03 | -3.50E+02 | -0.09 | 0.24 | 0.73 |
| 80 | 05/11/96 | 12:18 | 05/09 | 13:19 | 05/10 | 13:12 | 85980 | 1200 | 797 | 182 | 444 | 164 | 7.04E-03 | 1.36E+03 | 0.34 | 0.23 | 0.73 |
| 68 | 05/11/96 | 12:39 | 05/09 | 13:17 | 05/10 | 13:07 | 85800 | 1200 | 1369 | 204 | 444 | 164 | 7.04E-03 | 3.55E+03 | 0.89 | 0.25 | 0.74 |
| 53a | 05/11/96 | 13:12 | 05/09 | 13:21 | 05/10 | 13:10 | 85740 | 1200 | 612 | 178 | 444 | 164 | 7.04E-03 | 6.45E+02 | 0.16 | 0.23 | 0.74 |
| 53b | 05/11/96 | 13:33 | 05/09 | 13:21 | 05/10 | 13:10 | 85740 | 1200 | 516 | 179 | 444 | 164 | 7.04E-03 | 2.77E+02 | 0.07 | 0.24 | 0.74 |
| 99 | 05/11/96 | 13:55 | 05/09 | 13:21 | 05/10 | 13:15 | 86040 | 1200 | 695 | 188 | 444 | 164 | 7.04E-03 | 9.64E+02 | 0.24 | 0.24 | 0.74 |
| 50 | 05/11/96 | 14:00 | 05/09 | 12:51 | 05/10 | 12:44 | 85980 | 1200 | 1049 | 199 | 444 | 164 | 7.04E-03 | 2.32E+03 | 0.59 | 0.25 | 0.74 |
| 9 | 05/11/96 | 14:23 | 05/09 | 12:48 | 05/10 | 12:42 | 86040 | 1200 | 1091 | 190 | 444 | 164 | 7.04E-03 | 2.49E+03 | 0.63 | 0.24 | 0.75 |
| 54 | 05/11/96 | 14:44 | 05/09 | 12:54 | 05/10 | 12:46 | 85920 | 1200 | 1371 | 201 | 444 | 164 | 7.04E-03 | 3.56E+03 | 0.91 | 0.25 | 0.75 |
| 12 | 05/11/96 | 15:06 | 05/09 | 12:50 | 05/10 | 12:43 | 85980 | 1200 | 5798 | 266 | 444 | 164 | 7.04E-03 | 2.06E+04 | 5.25 | 0.31 | 0.75 |
| 69 | 05/11/96 | 15:28 | 05/09 | 12:55 | 05/10 | 12:47 | 85920 | 1200 | 1251 | 201 | 444 | 164 | 7.04E-03 | 3.10E+03 | 0.79 | 0.26 | 0.75 |
| 105 | 05/11/96 | 15:49 | 05/09 | 13:02 | 05/10 | 12:54 | 85920 | 1200 | 362 | 174 | 444 | 164 | 7.04E-03 | -3.15E+02 | -0.08 | 0.24 | 0.75 |

Radon Flux Measurements

Site: ARCO Bluewater Plantsite and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity(nCi) | Flux pCi/m2s | Flux Error 1.00 S.D. | LLD pCi/m2s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|------------------------|--------------|----------------------|-------------|
| 40 | 05/11/96 | 16:10 | 05/09 | 13:03 | 05/10 | 12:55 | 85920 | 1200 | 149 | 183 | 444 | 164 | 7.04E-03 | -1.13E+03 | -0.29 | 0.24 | 0.76 |
| 35 | 05/11/96 | 16:53 | 05/09 | 12:56 | 05/10 | 12:48 | 85920 | 1200 | 430 | 202 | 444 | 164 | 7.04E-03 | -5.38E+01 | -0.01 | 0.26 | 0.76 |
| 258a | 05/11/96 | 17:14 | 05/09 | 13:12 | 05/10 | 13:04 | 85920 | 1200 | 620 | 199 | 208 | 169 | 7.04E-03 | 1.58E+03 | 0.41 | 0.26 | 0.78 |
| 258b | 05/11/96 | 17:35 | 05/09 | 13:12 | 05/10 | 13:04 | 85920 | 1200 | 937 | 190 | 208 | 169 | 7.04E-03 | 2.80E+03 | 0.73 | 0.25 | 0.79 |
| 200 | 05/11/96 | 17:56 | 05/09 | 13:05 | 05/10 | 12:56 | 85860 | 1200 | -70 | 189 | 208 | 169 | 7.04E-03 | -1.07E+03 | -0.28 | 0.25 | 0.79 |
| 64 | 05/11/96 | 18:18 | 05/09 | 13:15 | 05/10 | 13:05 | 85800 | 1200 | 2197 | 209 | 208 | 169 | 7.04E-03 | 7.64E+03 | 2.00 | 0.27 | 0.79 |
| 84 | 05/11/96 | 18:39 | 05/09 | 13:16 | 05/10 | 13:06 | 85800 | 1200 | 959 | 182 | 208 | 169 | 7.04E-03 | 2.88E+03 | 0.76 | 0.25 | 0.79 |
| 88 | 05/11/96 | 19:00 | 05/09 | 11:54 | 05/10 | 11:58 | 86640 | 1200 | 282 | 190 | 208 | 169 | 7.04E-03 | 2.84E+02 | 0.07 | 0.26 | 0.79 |
| 70 | 05/11/96 | 19:24 | 05/09 | 11:55 | 05/10 | 11:59 | 86640 | 1200 | 309 | 189 | 208 | 169 | 7.04E-03 | 3.88E+02 | 0.10 | 0.26 | 0.80 |
| 60 | 05/11/96 | 19:45 | 05/09 | 12:00 | 05/10 | 12:03 | 86580 | 1200 | 50 | 198 | 208 | 169 | 7.04E-03 | -6.07E+02 | -0.16 | 0.26 | 0.80 |
| 46 | 05/11/96 | 20:07 | 05/09 | 12:03 | 05/10 | 12:05 | 86520 | 1200 | 20411 | 406 | 208 | 169 | 7.04E-03 | 7.76E+04 | 20.57 | 0.45 | 0.80 |
| 109 | 05/11/96 | 20:28 | 05/09 | 11:47 | 05/10 | 11:34 | 85620 | 1200 | 2331 | 236 | 208 | 169 | 7.04E-03 | 8.16E+03 | 2.20 | 0.30 | 0.81 |
| 36 | 05/11/96 | 20:49 | 05/09 | 11:44 | 05/10 | 11:32 | 85680 | 1200 | 777 | 185 | 208 | 169 | 7.04E-03 | 2.19E+03 | 0.59 | 0.26 | 0.82 |
| 1a | 05/11/96 | 21:10 | 05/09 | 11:52 | 05/10 | 11:37 | 85500 | 1200 | 346 | 187 | 208 | 169 | 7.04E-03 | 5.30E+02 | 0.14 | 0.26 | 0.82 |
| 1b | 05/11/96 | 21:31 | 05/09 | 11:52 | 05/10 | 11:37 | 85500 | 1200 | 658 | 172 | 208 | 169 | 7.04E-03 | 1.73E+03 | 0.47 | 0.25 | 0.82 |
| 58 | 05/11/96 | 21:54 | 05/09 | 11:49 | 05/10 | 11:36 | 85620 | 1200 | 843 | 170 | 208 | 169 | 7.04E-03 | 2.44E+03 | 0.66 | 0.25 | 0.82 |
| 263 | 05/11/96 | 22:15 | 05/09 | 11:39 | 05/10 | 11:29 | 85800 | 1200 | 4037 | 222 | 208 | 169 | 7.04E-03 | 1.47E+04 | 4.01 | 0.29 | 0.82 |
| 66 | 05/11/96 | 22:36 | 05/09 | 11:37 | 05/10 | 11:27 | 85800 | 1200 | 4456 | 234 | 208 | 169 | 7.04E-03 | 1.63E+04 | 4.46 | 0.30 | 0.83 |
| 74 | 05/11/96 | 22:57 | 05/09 | 11:41 | 05/10 | 11:30 | 85740 | 1200 | 101 | 188 | 208 | 169 | 7.04E-03 | -4.11E+02 | -0.11 | 0.27 | 0.83 |
| 59 | 05/11/96 | 23:19 | 05/09 | 11:42 | 05/10 | 11:31 | 85740 | 1200 | 84720 | 777 | 208 | 169 | 7.04E-03 | 3.25E+05 | 89.26 | 0.84 | 0.83 |

Radon Flux Measurements

Site: ARCO Bluewater Plantsite and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity(pCi) | Flux pCi/ml.s | Flux Error 1.00 S.D. | LLD pCi/ml.s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|------------------------|---------------|----------------------|--------------|
| 33 | 05/11/96 | 23:40 | 05/09 | 11:46 | 05/10 | 11:21 | 84900 | 1200 | 284 | 186 | 206 | 169 | 7.04E-03 | 2.92E+02 | 0.08 | 0.27 | 0.84 |
| 44 | 05/12/96 | 00:01 | 05/09 | 11:33 | 05/10 | 11:25 | 85920 | 1200 | 213 | 176 | 208 | 169 | 7.04E-03 | 1.92E+01 | 0.01 | 0.26 | 0.84 |
| 104 | 05/12/96 | 00:22 | 05/09 | 11:31 | 05/10 | 11:24 | 85980 | 1200 | 273 | 187 | 208 | 169 | 7.04E-03 | 2.50E+02 | 0.07 | 0.27 | 0.84 |
| 48 | 05/12/96 | 00:42 | 05/09 | 11:35 | 05/10 | 11:26 | 85860 | 1200 | 3585 | 258 | 208 | 169 | 7.04E-03 | 1.30E+04 | 3.60 | 0.31 | 0.84 |
| 4a | 05/12/96 | 01:25 | 05/09 | 11:24 | 05/10 | 11:15 | 85860 | 1200 | 576 | 190 | 151 | 171 | 7.04E-03 | 1.63E+03 | 0.46 | 0.27 | 0.86 |
| 4b | 05/12/96 | 01:46 | 05/09 | 11:24 | 05/10 | 11:17 | 85860 | 1200 | 761 | 181 | 151 | 171 | 7.04E-03 | 2.34E+03 | 0.66 | 0.27 | 0.86 |
| 51 | 05/12/96 | 02:07 | 05/09 | 11:25 | 05/10 | 11:16 | 85860 | 1200 | 407 | 178 | 151 | 171 | 7.04E-03 | 9.83E+02 | 0.28 | 0.27 | 0.86 |
| 92 | 05/12/96 | 02:28 | 05/09 | 11:27 | 05/10 | 11:18 | 85860 | 1200 | 282 | 173 | 151 | 171 | 7.04E-03 | 5.03E+02 | 0.14 | 0.26 | 0.86 |
| 45 | 05/12/96 | 02:49 | 05/09 | 11:29 | 05/10 | 11:19 | 85800 | 1200 | 949 | 191 | 151 | 171 | 7.04E-03 | 3.07E+03 | 0.87 | 0.28 | 0.86 |
| 30 | 05/12/96 | 03:09 | 05/09 | 11:16 | 05/10 | 11:09 | 85980 | 1200 | 312 | 177 | 151 | 171 | 7.04E-03 | 6.18E+02 | 0.18 | 0.27 | 0.87 |
| 52 | 05/12/96 | 03:30 | 05/09 | 11:17 | 05/10 | 11:10 | 85980 | 1200 | 797 | 186 | 151 | 171 | 7.04E-03 | 5.61E+02 | 0.16 | 0.28 | 0.87 |
| 72 | 05/12/96 | 03:51 | 05/09 | 11:20 | 05/10 | 11:13 | 85980 | 1200 | 7668 | 295 | 151 | 171 | 7.04E-03 | 2.89E+04 | 8.21 | 0.37 | 0.87 |
| 5 | 05/12/96 | 04:11 | 05/09 | 11:22 | 05/10 | 11:14 | 85920 | 1200 | 5502 | 251 | 151 | 171 | 7.04E-03 | 2.06E+04 | 5.86 | 0.33 | 0.87 |
| 85 | 05/12/96 | 04:32 | 05/09 | 11:07 | 05/10 | 11:05 | 86280 | 1200 | 118 | 190 | 151 | 171 | 7.04E-03 | -1.27E+02 | -0.04 | 0.28 | 0.87 |
| 67 | 05/12/96 | 04:54 | 05/09 | 11:12 | 05/10 | 11:07 | 86100 | 1200 | 811 | 178 | 151 | 171 | 7.04E-03 | 2.54E+03 | 0.73 | 0.27 | 0.88 |
| 61a | 05/12/96 | 05:15 | 05/09 | 11:09 | 05/10 | 11:06 | 86220 | 1200 | 858 | 188 | 151 | 171 | 7.04E-03 | 2.72E+03 | 0.78 | 0.28 | 0.88 |
| 61b | 05/12/96 | 05:35 | 05/09 | 11:09 | 05/10 | 11:06 | 86220 | 1200 | 726 | 192 | 151 | 171 | 7.04E-03 | 2.21E+03 | 0.64 | 0.28 | 0.88 |
| 202 | 05/12/96 | 05:56 | 05/09 | 11:14 | 05/10 | 11:08 | 86040 | 1200 | 3280 | 230 | 151 | 171 | 7.04E-03 | 1.20E+04 | 3.47 | 0.32 | 0.88 |
| 19 | 05/12/96 | 06:17 | 05/09 | 12:43 | 05/10 | 12:35 | 85920 | 1200 | 13241 | 336 | 151 | 171 | 7.04E-03 | 5.03E+04 | 14.43 | 0.42 | 0.88 |
| 257 | 05/12/96 | 06:39 | 05/09 | 12:45 | 05/10 | 12:38 | 85980 | 1200 | 1994 | 209 | 151 | 171 | 7.04E-03 | 7.08E+03 | 2.03 | 0.30 | 0.88 |

Radon Flux Measurements

Site: ARCO Bluewater Plantsite and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity (nCi) | Flux pCi/m ² s | Flux Error 1.00 S.D. | LLD pCi/m ² s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|-------------------------|---------------------------|----------------------|--------------------------|
| 13 | 05/12/96 | 07:00 | 05/09 | 12:44 | 05/10 | 12:36 | 85920 | 1200 | 356 | 198 | 151 | 171 | 7.04E-03 | 7.87E+02 | 0.23 | 0.29 | 0.88 |
| 18 | 05/12/96 | 07:21 | 05/09 | 12:47 | 05/10 | 12:39 | 85920 | 1200 | 1806 | 202 | 151 | 171 | 7.04E-03 | 6.35E+03 | 1.84 | 0.29 | 0.88 |
| 57 | 05/12/96 | 07:42 | 05/09 | 12:39 | 05/10 | 12:32 | 85980 | 1200 | 5016 | 260 | 151 | 171 | 7.04E-03 | 1.87E+04 | 5.42 | 0.35 | 0.89 |
| 22 | 05/12/96 | 08:03 | 05/09 | 12:38 | 05/10 | 12:31 | 85980 | 1200 | 10276 | 307 | 151 | 171 | 7.04E-03 | 3.89E+04 | 11.31 | 0.39 | 0.89 |
| 252 | 05/12/96 | 08:24 | 05/09 | 12:42 | 05/10 | 12:34 | 85920 | 1200 | 15861 | 359 | 151 | 171 | 7.04E-03 | 6.03E+04 | 17.60 | 0.45 | 0.89 |
| 103 | 05/12/96 | 09:08 | 05/09 | 12:40 | 05/10 | 12:33 | 85980 | 1200 | 8325 | 278 | 151 | 171 | 7.04E-03 | 3.14E+04 | 9.20 | 0.37 | 0.90 |
| 95a | 05/12/96 | 09:30 | 05/09 | 12:34 | 05/10 | 12:28 | 86040 | 1200 | 1040 | 212 | 76 | 177 | 7.04E-03 | 3.70E+03 | 1.09 | 0.31 | 0.93 |
| 95b | 05/12/96 | 09:51 | 05/09 | 12:34 | 05/10 | 12:28 | 86040 | 1200 | 1416 | 206 | 76 | 177 | 7.04E-03 | 5.15E+03 | 1.52 | 0.31 | 0.93 |
| 97 | 05/12/96 | 10:11 | 05/09 | 12:32 | 05/10 | 12:27 | 86100 | 1200 | 1359 | 186 | 76 | 177 | 7.04E-03 | 4.93E+03 | 1.46 | 0.29 | 0.94 |
| 256 | 05/12/96 | 10:32 | 05/09 | 12:35 | 05/10 | 12:29 | 86040 | 1200 | 17727 | 393 | 76 | 177 | 7.04E-03 | 6.78E+04 | 20.08 | 0.49 | 0.94 |
| 75 | 05/12/96 | 10:53 | 05/09 | 12:37 | 05/10 | 12:30 | 85980 | 1200 | 708 | 200 | 76 | 177 | 7.04E-03 | 2.43E+03 | 0.72 | 0.30 | 0.94 |
| 42 | 05/12/96 | 11:14 | 05/09 | 12:28 | 05/10 | 12:24 | 86160 | 1200 | 8441 | 291 | 76 | 177 | 7.04E-03 | 3.21E+04 | 9.56 | 0.39 | 0.94 |
| 203 | 05/12/96 | 11:35 | 05/09 | 12:26 | 05/10 | 12:23 | 86220 | 1200 | 842 | 191 | 76 | 177 | 7.04E-03 | 2.94E+03 | 0.88 | 0.30 | 0.94 |
| 25 | 05/12/96 | 11:56 | 05/09 | 12:30 | 05/10 | 12:25 | 86100 | 1200 | 176698 | 1108 | 76 | 177 | 7.04E-03 | 6.78E+05 | 203.03 | 1.29 | 0.95 |
| 27 | 05/12/96 | 12:18 | 05/09 | 12:31 | 05/10 | 12:26 | 86100 | 1200 | 4113 | 249 | 76 | 177 | 7.04E-03 | 1.55E+04 | 4.65 | 0.35 | 0.95 |
| 201 | 05/12/96 | 12:39 | 05/09 | 12:21 | 05/10 | 12:20 | 86340 | 1200 | 21517 | 429 | 76 | 177 | 7.04E-03 | 8.24E+04 | 24.73 | 0.54 | 0.95 |
| 21 | 05/12/96 | 13:00 | 05/09 | 12:20 | 05/10 | 12:18 | 86280 | 1200 | 24087 | 431 | 76 | 177 | 7.04E-03 | 9.22E+04 | 27.80 | 0.54 | 0.95 |
| 20a | 05/12/96 | 13:21 | 05/09 | 12:24 | 05/10 | 12:22 | 86280 | 1200 | 14304 | 357 | 76 | 177 | 7.04E-03 | 5.47E+04 | 16.51 | 0.46 | 0.96 |
| 20b | 05/12/96 | 13:42 | 05/09 | 12:24 | 05/10 | 12:22 | 86280 | 1200 | 14707 | 350 | 76 | 177 | 7.04E-03 | 5.62E+04 | 17.02 | 0.46 | 0.96 |
| 86 | 05/12/96 | 14:03 | 05/09 | 12:23 | 05/10 | 12:21 | 86280 | 1200 | 1655 | 203 | 76 | 177 | 7.04E-03 | 6.07E+03 | 1.84 | 0.31 | 0.96 |

Radon Flux Measurements

Site: ARCO Bluewater Plant site and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity (nCi) | Flux pCi/m ² s | Flux Error 1.00 S.D. | LLD pCi/m ² s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|-------------------------|---------------------------|----------------------|--------------------------|
| 37 | 05/12/96 | 14:23 | 05/09 | 12:14 | 05/10 | 12:14 | 86400 | 1200 | 554 | 179 | 76 | 177 | 7.04E-03 | 1.84E+03 | 0.56 | 0.29 | 0.96 |
| 87 | 05/12/96 | 14:44 | 05/09 | 12:13 | 05/10 | 12:13 | 86400 | 1200 | 1070 | 190 | 76 | 177 | 7.04E-03 | 3.82E+03 | 1.17 | 0.30 | 0.97 |
| 34 | 05/12/96 | 15:05 | 05/09 | 12:19 | 05/10 | 12:17 | 86280 | 1200 | 14282 | 357 | 76 | 177 | 7.04E-03 | 5.46E+04 | 16.71 | 0.47 | 0.97 |
| 28 | 05/12/96 | 15:49 | 05/09 | 12:17 | 05/10 | 12:16 | 86340 | 1200 | 5243 | 257 | 76 | 177 | 7.04E-03 | 1.98E+04 | 6.11 | 0.37 | 0.97 |
| 41 | 05/12/96 | 16:10 | 05/09 | 12:04 | 05/10 | 12:08 | 86640 | 1200 | 3821 | 237 | 144 | 180 | 7.04E-03 | 1.41E+04 | 4.35 | 0.35 | 0.99 |
| 254 | 05/12/96 | 16:31 | 05/09 | 12:10 | 05/10 | 12:11 | 86460 | 1200 | 2195 | 214 | 144 | 180 | 7.04E-03 | 7.88E+03 | 2.44 | 0.33 | 1.00 |
| 39 | 05/12/96 | 16:52 | 05/09 | 12:06 | 05/10 | 12:10 | 86640 | 1200 | 16409 | 370 | 144 | 180 | 7.04E-03 | 6.25E+04 | 19.33 | 0.49 | 1.00 |
| 108a | 05/12/96 | 17:14 | 05/09 | 12:12 | 05/10 | 12:12 | 86400 | 1200 | 2006 | 222 | 144 | 180 | 7.04E-03 | 7.15E+03 | 2.22 | 0.34 | 1.00 |
| 108b | 05/12/96 | 17:35 | 05/09 | 12:12 | 05/10 | 12:12 | 86400 | 1200 | 2321 | 215 | 144 | 180 | 7.04E-03 | 8.36E+03 | 2.61 | 0.34 | 1.00 |
| std | 05/12/96 | 17:56 | 05/09 | | 05/10 | | 86400 | 1200 | 27779 | 443 | 144 | 180 | 7.04E-03 | 1.06E+05 | 36.39 | 0.63 | 1.10 |
| std | 05/12/96 | 18:17 | 05/09 | | 05/10 | | 86400 | 1200 | 27002 | 452 | 144 | 180 | 7.04E-03 | 1.03E+05 | 35.46 | 0.64 | 1.11 |
| 25a | 05/12/96 | 18:53 | 05/09 | 12:30 | 05/10 | 12:25 | 86100 | 1200 | 176560 | 1108 | 144 | 180 | 7.04E-03 | 6.78E+05 | 213.71 | 1.36 | 1.02 |

| Date | Count time | Standard (nCi) | Counts | Error | Bkg Counts | Bkg error | Efficiency | Error(1.00 SD) |
|-------|------------|----------------|--------|-------|------------|-----------|------------|----------------|
| 05/10 | 1200 | 80 | 25505 | 433 | 71 | 176 | 0.00716 | 0.00013 |
| 05/10 | 1200 | 78.83 | 24259 | 432 | 71 | 176 | 0.00691 | 0.00013 |

Radon-222 Canister Chain of Custody Record

page 1 of 1

Facility
Pile or Stack Name
Area of Pile or Stack
Field Representative

ARCO BLUE WATER
PLANT 1000, 1500, 2000
R3/J5

| | Deployment | Retrival |
|-------------|--|----------|
| Date | 5/9/96 | 5/10/96 |
| Rel. Humid. | Very warm Very dry - no precipitation for several weeks prior to measurement. | |
| Bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

| Item | Location ID or Description | Coordinates | | Canister Number | Deployment | | Retrieval | | Comments |
|------|----------------------------|-------------|------|-----------------|------------|----|-----------|-------|----------|
| | | North | East | | Time | By | Time | By | |
| 1 | 201 | | ✓ | 8 | 1015 | | 1016 | JS/RM | 12 MR/h |
| 2 | 202 | | ✓ | 29 | 1018 | | 1019 | | 9 |
| 3 | 203 | | ✓ | 17 | 1021 | | 1021 | | 11 |
| 4 | 204 | | ✓ | 251 | 1024 | | 1024 | | 19 9.5 |
| 5 | 205 | | ✓ | 262 | 1028 | | 1028 | | 18 5 |
| 6 | 206 | | ✓ | 90 | 1030 | | 1026 | | 16 8 |
| 7 | 207 | | ✓ | 71 | 1031 | | 1027 | | 14 7 |
| 8 | 208 | | ✓ | 6 | 1032 | | 1028 | | 14 5.5 |
| 9 | 209 | | ✓ | 73 | 1032 | | 1028 | | 16 8 |
| 10 | 210 | | ✓ | 93 | 1037 | | 1030 | | 14 7 |
| 11 | 211 | | ✓ | 89 | 1039 | | 1031 | | 16 8 |
| 12 | 212 | | ✓ | 101 | 1040 | | 1032 | | 18 7.5 |
| 13 | 213 | | ✓ | 79 | 1041 | | 1033 | | 17 8.5 |
| 14 | 214 | | ✓ | 11 | 1044 | | 1034 | | 16 8 |
| 15 | 220 | | ✓ | 62 | 1046 | | 1035 | | 16 8 |
| 16 | 218 | | ✓ | 100 | 1047 | | 1037 | | 18 9 |
| 17 | 217 | | ✓ | 90 | 1049 | | 1038 | | 19 9.5 |
| 18 | 216 | | ✓ | 23 | 1050 | | 1050 | | 19 9.5 |
| 19 | 215 | | ✓ | 107 | 1052 | | 1052 | | 20 10 |
| 20 | 214 | | ✓ | 14 | 1053 | ✓ | 1053 | ✓ | 18 9 |

#26 } ~~ET~~ TRIP BLANKS
#31 }

Radon-222 Canister Chain of Custody Record

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Facility ARCO Bluewater
 Pile or Stack Name _____
 Area of Pile or Stack _____
 Field Representative _____

| | Deployment | Retrival |
|-------------|------------|----------|
| Date | 5/5/96 | 5/10/96 |
| Rel. Humid. | | |
| Bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

| Item | Location ID or Description | Coordinates | | Canister Number | Deployment | | Retrieval | | Comments |
|------|----------------------------|-------------|------|-----------------|------------|-------|-----------|-------|---------------|
| | | North | East | | Time | By | Time | By | |
| 21 | 251 | | ✓ | 16 | 1057 | KB/JS | 1054 | JS/KM | FS 17 MRLH |
| 22 | 250 | | ✓ | 261 | 1059 | | 1056 | | 189.5 |
| 23 | 225 | | ✓ | 38 | 1101 | | 1057 | | 199.5 |
| 24 | 224 | | ✓ | 78 | 1102 | | 1059 | | 2011 |
| 25 | 223 | | ✓ | 83 | 1104 | | 1100 | | 189 |
| 26 | 222 | | ✓ | 81 | 1105 | | 1101 | | 189 |
| 27 | 221 | | ✓ | 85 | 1107 | | 1105 | | 168 |
| 28 | 230 | | ✓ | 61 | 1109 | | 1106 | | 10 |
| 29 | 229 | | ✓ | 67 | 1112 | | 1107 | | 9 |
| 30 | 228 | | ✓ | 202 | 1114 | | 1108 | | 10 |
| 31 | 227 | | ✓ | 30 | 1116 | | 1109 | | 10 |
| 32 | 226 | | ✓ | 52 | 1117 | | 1110 | | 9 |
| 33 | 234 | | ✓ | 72 | 1120 | | 1113 | | 12 |
| 34 | 233 | | ✓ | 5 | 1122 | | 1114 | | 10 |
| 35 | 232 | | ✓ | 4 | 1124 | | 1115 | | 10 |
| 36 | 231 | | ✓ | 51 | 1125 | | 1116 | | 9 |
| 37 | 239 | | ✓ | 92 | 1127 | | 1118 | | 8 |
| 38 | 238 | | ✓ | 45 | 1129 | | 1119 | | 12 |
| 39 | 240 | | ✓ | 104 | 1131 | | 1124 | | 9 |
| 40 | 247 | | ✓ | 44 | 1133 | ▽ | 1125 | ▽ | 11 |

Radon-222 Canister Chain of Custody Record

page 3 of 7

Facility
 Pile or Stack Name
 Area of Pile or Stack
 Field Representative

ANCO Mountain/State pile area

KB/JS

| | Deployment | Retrival |
|-------------|---------------|----------------|
| Date | <u>5/9/96</u> | <u>5/10/96</u> |
| Rel. Humid. | | |
| bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

| Item | Location ID or Description | Coordinates | | Canister Number | Deployment | | Retrieval | | Comments |
|------|----------------------------|-------------|------|-----------------|------------|-------|-----------|-------|----------|
| | | North | East | | Time | By | Time | By | |
| 41 | 246 | | ✓ | 48 | 1135 | KB/JS | 1126 | JS/RM | 10 |
| 42 | 245 | | ✓ | 66 | 1137 | | 1127 | | 9 |
| 43 | 244 | | ✓ | 263 | 1137 | | 1129 | | 9 |
| 44 | 243 | | ✓ | 74 | 1141 | | 1130 | | 8 |
| 45 | 242 | | ✓ | 59 | 1142 | | 1131 | | 13 |
| 46 | 241 | | ✓ | 36 | 1144 | | 1132 | | 10 |
| 47 | 237 | | ✓ | 33 | 1146 | | 1121 | | 12 |
| 48 | 236 | | ✓ | 109 | 1147 | | 1134 | | 11 |
| 49 | 235 | | ✓ | 58 | 1149 | | 1136 | | 10 |
| 50 | 254 | | ✓ | 1 | 1152 | | 1137 | | 9 |
| 51 | 252 | | ✓ | 88 | 1154 | | 1158 | | 7 |
| 52 | 249 | | ✓ | 70 | 1155 | | 1159 | | 7 |
| 53 | 248 | | ✓ | 60 | 1200 | | 1203 | | 12 |
| 54 | 294 | | ✓ | 46 | 1202 | | 1205 | | 16 |
| 55 | 295 | | ✓ | 41 | 1204 | | 1208 | | 17 |
| 56 | 296 | | ✓ | 39 | 1206 | | 1210 | | 15 |
| 57 | 298 | | ✓ | 254 | 1210 | | 1211 | | 16 |
| 58 | 300 | | ✓ | 108 | 1212 | | 1212 | | 22 |
| 59 | 299 | | ✓ | 87 | 1213 | | 1213 | | 22 |
| 60 | 297 | | ✓ | 37 | 1214 | | 1214 | | 19 |

Radon-222 Canister Chain of Custody Record

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Facility
 Pile or Stack Name
 Area of Pile or Stack
 Field Representative

ARCO Plant Site / Storage Pile Area
 KB/JS

| | Deployment | Retrieval |
|-------------|------------|-----------|
| Date | 5/9/96 | 5/10/96 |
| Rel. Humid. | | |
| Bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

| Item | Location ID or Description | Coordinates | | Canister Number | Deployment | | Retrieval | | Comments |
|------|----------------------------|-------------|------|-----------------|------------|-------|-----------|-------|--------------|
| | | North | East | | Time | By | Time | By | |
| 61 | 288 | | ✓ | 28 | 1217 | KB/JS | 1216 | JS/RM | 14 MARK @ 1m |
| 62 | 289 | | ✓ | 34 | 1219 | | 1217 | | 14 |
| 63 | 290 | | ✓ | 21 | 1220 | | 1218 | | 12 |
| 64 | 291 | | ✓ | 201 | 1221 | | 1220 | | 15 |
| 65 | 292 | | ✓ | 86 | 1223 | | 1221 | | 13 |
| 66 | 293 | | ✓ | 20 | 1224 | | 1222 | | 14 |
| 67 | 281 | | ✓ | 203 | 1224 | | 1223 | | 11 |
| 68 | 282 | | ✓ | 42 | 1228 | | 1224 | | 10 |
| 69 | 283 | | ✓ | 25 | 1230 | | 1225 | | 11 |
| 70 | 284 | | ✓ | 27 | 1231 | | 1226 | | 12 |
| 71 | 285 | | ✓ | 97 | 1232 | | 1227 | | 11 |
| 72 | 286 | | ✓ | 95 | 1234 | | 1228 | | 12 |
| 73 | 287 | | ✓ | 256 | 1235 | | 1229 | | 11 |
| 74 | 274 | | ✓ | 75 | 1237 | | 1230 | | 14 |
| 75 | 275 | | ✓ | 22 | 1238 | | 1231 | | 11 |
| 76 | 276 | | ✓ | 57 | 1239 | | 1232 | | 12 |
| 77 | 277 | | ✓ | 103 | 1240 | | 1233 | | 11 |
| 78 | 278 | | ✓ | 252 | 1242 | | 1234 | | 10 |
| 79 | 279 | | ✓ | 19 | 1243 | | 1235 | | 11 |
| 80 | 280 | | ✓ | 13 | 1244 | | 1236 | | 11 |

Radon-222 Canister Chain of Custody Record

page 5 of 7

Facility _____
 Pile or Stack Name _____
 Area of Pile or Stack _____
 Field Representative K Baker / J Sanchez

| | Deployment | Retrival |
|-------------|------------|----------|
| Date | | |
| Rel. Humid. | | |
| Bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

| Item | Location ID or Description | Coordinates | | Canister Number | Deployment | | Retrieval | | Comments |
|------|----------------------------|-------------|------|-----------------|------------|-------|-----------|-------|----------|
| | | North | East | | Time | By | Time | By | |
| 81 | 269 | | ✓ | 257 | 1245 | KB/JS | 1238 | JS/RM | 10 MK/h |
| 82 | 270 | | ✓ | 18 | 1247 | | 1239 | | 12 |
| 83 | 271 | | ✓ | 9 | 1248 | | 1242 | | 11 |
| 84 | 272 | | ✓ | 12 | 1250 | | 1243 | | 10 |
| 85 | 273 | | ✓ | 50 | 1251 | | 1244 | | 11 |
| 86 | 260 | | ✓ | 54 | 1254 | | 1246 | | 11 |
| 87 | 267 | | ✓ | 69 | 1255 | | 1247 | | 10 |
| 88 | 268 | | ✓ | 35 | 1256 | | 1248 | | 11 |
| 89 | 256 | | ✓ | 105 | 1302 | | 1254 | | 8 |
| 90 | 255 | | ✓ | 40 | 1303 | | 1255 | | 8 |
| 91 | 253 | | ✓ | 200 | 1305 | | 1256 | | 8 |
| 92 | 265 | | ✓ | 258 | 1312 | | 1304 | | 12 |
| 93 | 264 | | ✓ | 64 | 1315 | | 1305 | | 11 |
| 94 | 263 | | ✓ | 84 | 1316 | | 1306 | | 9 |
| 95 | 262 | | ✓ | 68 | 1318 | | 1307 | | 12 |
| 96 | 315 | | ✓ | 53 | 1321 | | 1308 | | 9 |
| 97 | 314 | | ✓ | 56 | 1322 | | 1311 | | 14 |
| 98 | 312 | | ✓ | 80 | 1314 | | 1312 | | 12 |
| 99 | 311 | | ✓ | 260 | 1320 | | 1314 | | 13 |
| 100 | 313 | | ✓ | 99 | 1321 | | 1315 | | 11 |

Radon-222 Canister Chain of Custody Record

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Facility ARCO PLANT SITE / SIGHT PILE
 Pile or Stack Name _____
 Area of Pile or Stack _____
 Field Representative KB / JS

| | Deployment | Retrival |
|-------------|------------|----------|
| Date | 5/7/86 | 5/10/86 |
| Rel. Humid. | | |
| Bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

[illegible]

Radon-222 Canister Chain of Custody Record

page 7 of 7

Facility ALCO ALANTITE/STOCKPILE
 Pile or Stack Name _____
 Area of Pile or Stack _____
 Field Representative _____

| | Deployment | Retrival |
|-------------|---------------|----------------|
| Date | <u>5/9/96</u> | <u>5/10/96</u> |
| Rel. Humid. | | |
| Bar. Press | | |
| Temp. (F) | | |

Deployment/Retrieval Record

| Item | Location ID or Description | Coordinates | | Canister Number | Deployment | | Retrieval | | Comments |
|------|----------------------------|-------------|------|-----------------|------------|----|-----------|----|----------|
| | | North | East | | Time | By | Time | By | |
| 121 | | | | | | | | | |
| 122 | | | | | | | | | |
| 123 | | | | | | | | | |
| 124 | | | | | | | | | |
| 125 | | | | | | | | | |
| 126 | | | | | | | | | |
| 127 | | | | | | | | | |

Custody Transfer Record

| Items Nos. | Relinquished By | Date | Time | Accepted By | Date | Time |
|--------------|--------------------|----------------|-------------|-------------------|----------------|-------------|
| <u>1-117</u> | <u>K. G. S. G.</u> | <u>5/9/96</u> | <u>1420</u> | <u>A. Sanchez</u> | <u>5/9/96</u> | <u>1420</u> |
| <u>1-117</u> | <u>A. Sanchez</u> | <u>5/10/96</u> | <u>1354</u> | <u>R. Miller</u> | <u>5/10/96</u> | <u>1355</u> |
| | | | | | | |
| | | | | | | |

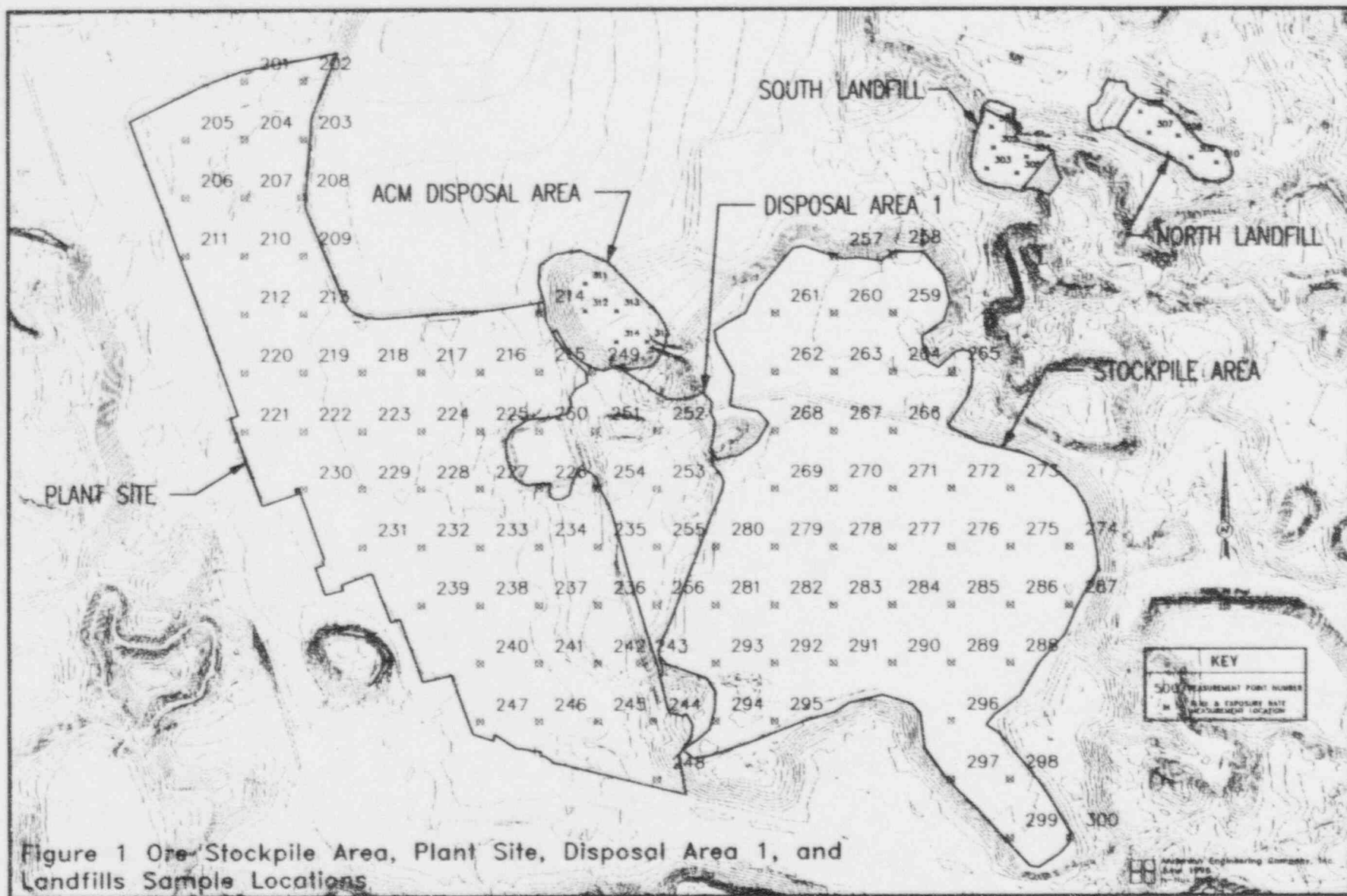
RAOON - 222

CHAIN OF STUDY RECORD

| PROJ. NO. | | PROJECT NAME | | | | ERG NO. (Container) OF CAN VALVES | Retired Time Date | | | | | | REMARKS | |
|---|---------|------------------------------------|-------|------|------------------|--|----------------------|---|--|--|------------------------------|--|---|--------------------------|
| 102 | | ARCO BLUEWATER MILL - GRANTS, N.M. | | | | | | | | | | | | |
| SAMPLERS: (Signature) <i>F. Sanchez</i> | | | | | | | | | | | | | | |
| STAT. NO. | DATE | TIME | COMP. | GRAB | STATION LOCATION | | | | | | | | | |
| 242 | 5/22/96 | 0750 | | | | ✓ 258 | 8:00 | 5/23 | | | | | No Precipitation - Dry TEMPERATURE HIGH 88°F " Low 50°F BAROMETRIC PRESS. HIGH 30.05 in. Hg " " Low 29.92 | |
| 293 | " | 0802 | | | | ✓ 95 | 8:03 | 5/23 | | | | | | |
| 291 | | 0806 | | | | ✓ 42 | 8:05 | 5/23 | | | | | | |
| 290 | | 0807 | | | | ✓ 105 | 8:06 | 5/23 | | | | | | |
| 289 | | 0810 | | | | ✓ 4 | 8:08 | 5/23 | | | | | | |
| 296 | | 0811 | | | | ✓ 64 | 8:09 | 5/23 | | | | | | |
| 287 | | 0816 | | | | ✓ 75 | 8:10 | 5/23 | | | | | | |
| 275 | | 0818 | | | | ✓ 97 | 8:12 | 5/23 | | | | | | |
| 278 | | 0820 | | | | ✓ 51 | 8:13 | 5/23 | | | | | | |
| 279 | | 0822 | | | | ✓ 41 | 8:14 | 5/23 | | | | | | |
| 283 | ✓ | 0826 | | | | ✓ 69 | 8:16 | 5/23 | | | | | | |
| Relinquished (Signature) <i>F. Sanchez</i> | | | | | | Date/Time 5/23/96 ~1200 | | Received by: (Signature) | | | Relinquished by: (Signature) | | Date/Time | Received by: (Signature) |
| Relinquished (Signature) | | | | | | Date/Time | | Received by: (Signature) | | | Relinquished by: (Signature) | | Date/Time | Received by: (Signature) |
| Relinquished (Signature) | | | | | | Date/Time | | Received for Laboratory by: (Signature) | | | Date/Time | | Remarks | |

Split Samples:
☐ Accepted ☐ Declined

Signature



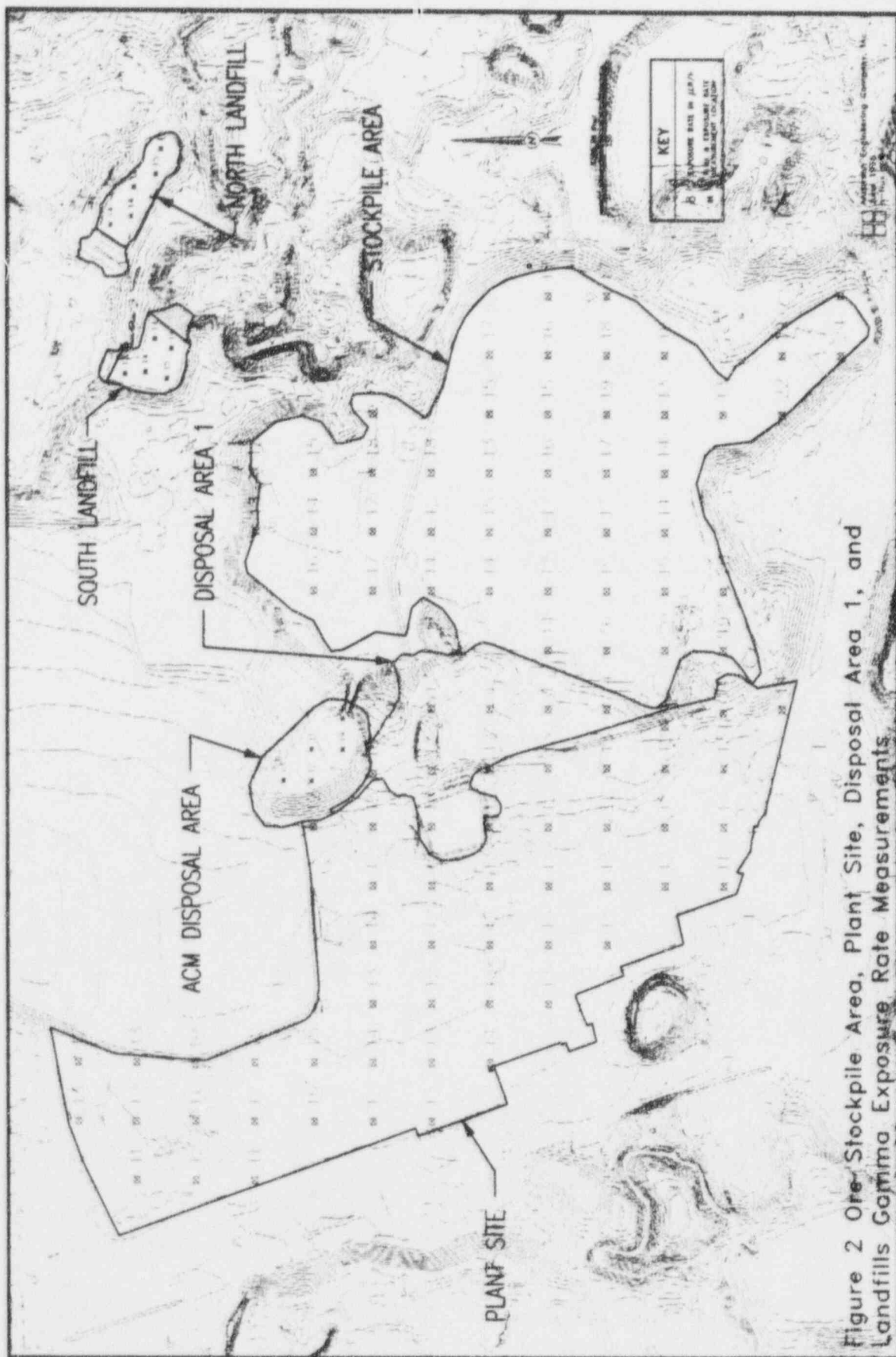
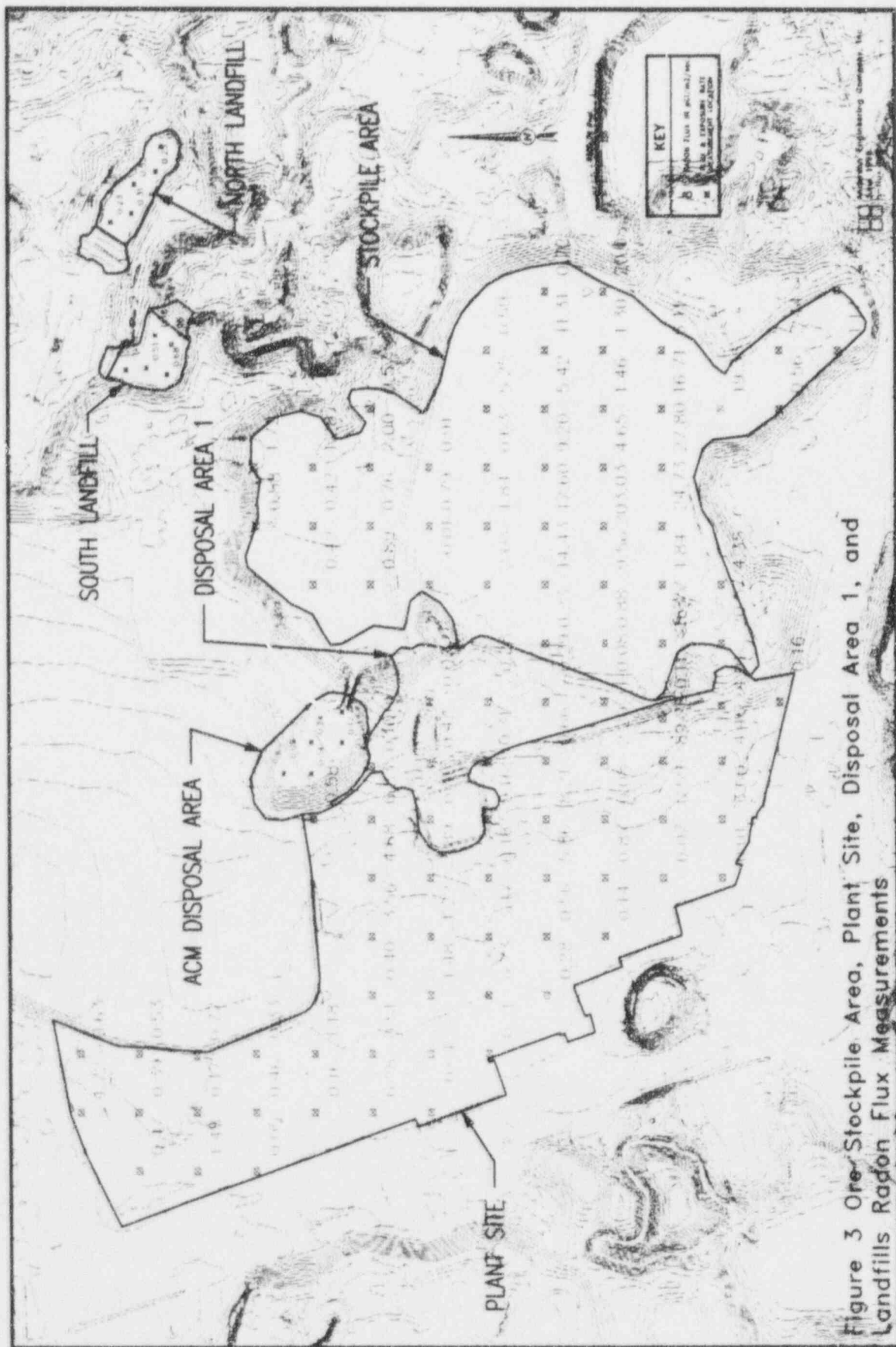


Figure 2 Ore Stockpile Area, Plant Site, Disposal Area 1, and Landfills Gamma Exposure Rate Measurements.



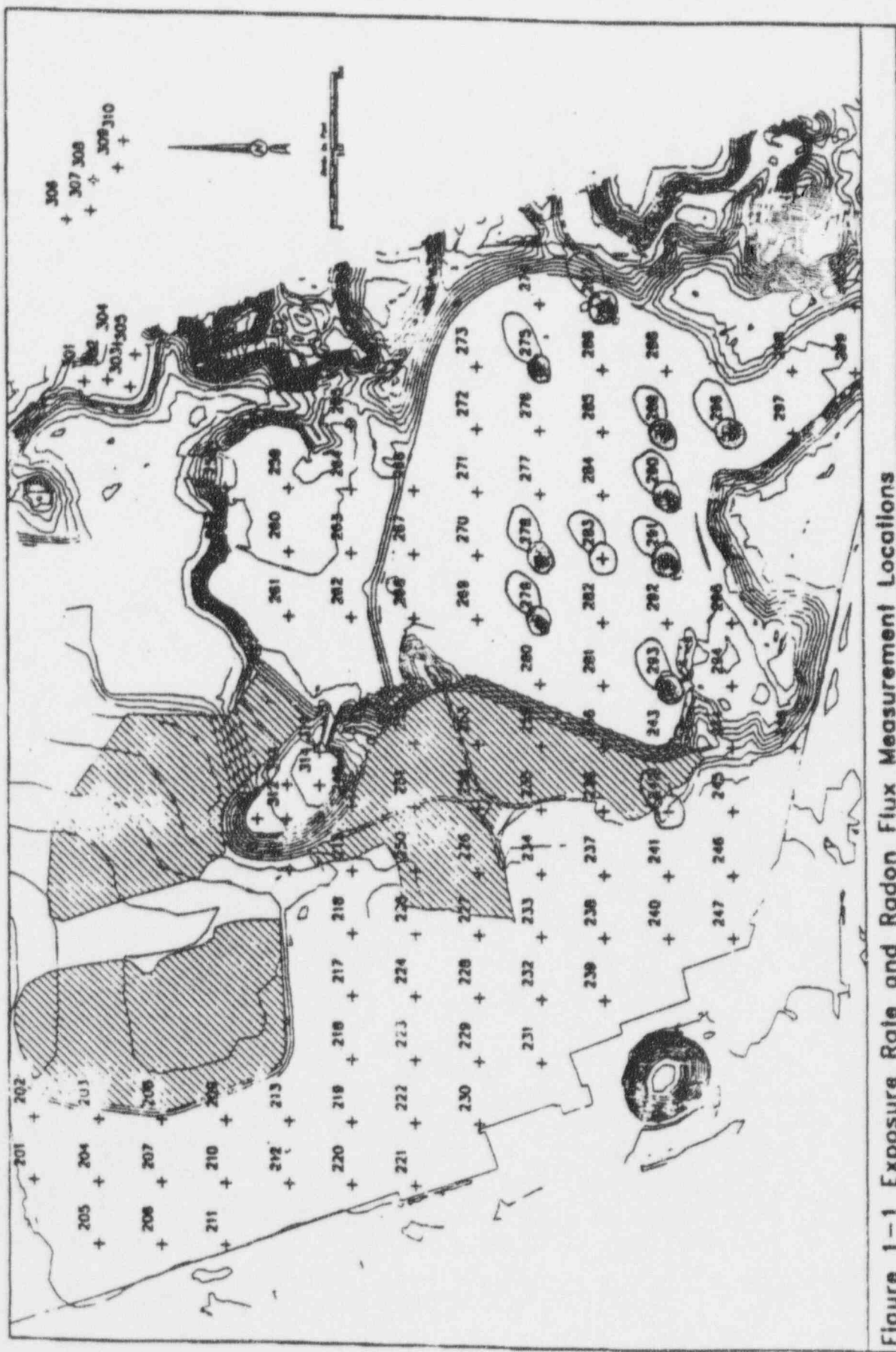


Figure 1-1 Exposure Rate and Radon Flux Measurement Locations

Radon Flux Measurements

(Second Measurement at Elevated Points)

Site: ARCO Bluewater Plantsite and Former Ore Stockpile Areas

EG&G System

| Canister Number | Lab Date | Start Count Time | Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Collection Time (sec) | Count Time (sec) | Peak Counts | Error | Bkg counts | Error | Detector Efficiency | Canister Activity(nCi) | Flux pCi/m2s | Flux Error 1.00 S.D. | L.L.D. pCi/m2s |
|-----------------|----------|------------------|-------------|-------------|---------------|---------------|-----------------------|------------------|-------------|-------|------------|-------|---------------------|------------------------|--------------|----------------------|----------------|
| std1R | 05/24/96 | 12:49 | 05/22 | 00:00 | 05/23 | 00:00 | 86400 | 1200 | 26540 | 457.0 | -213 | 190 | 7.58E-03 | 9.54E+04 | 26.24 | 0.49 | 0.87 |
| std3R | 05/24/96 | 13:15 | 05/22 | 00:00 | 05/23 | 00:00 | 86400 | 1200 | 26494 | 454.0 | -213 | 190 | 7.58E-03 | 9.52E+04 | 26.28 | 0.48 | 0.87 |
| 69 | 05/24/96 | 13:35 | 05/22 | 08:26 | 05/23 | 08:16 | 85800 | 1200 | 34481 | 508.0 | -213 | 190 | 7.58E-03 | 1.24E+05 | 32.36 | 0.51 | 0.83 |
| 41 | 05/24/96 | 13:58 | 05/22 | 08:22 | 05/23 | 08:14 | 85920 | 1200 | 14639 | 340.0 | -213 | 190 | 7.58E-03 | 5.29E+04 | 13.88 | 0.36 | 0.83 |
| 51 | 05/24/96 | 14:19 | 05/22 | 08:20 | 05/23 | 08:13 | 85980 | 1200 | 11284 | 325.0 | -213 | 190 | 7.58E-03 | 4.10E+04 | 10.77 | 0.35 | 0.83 |
| 97 | 05/24/96 | 14:40 | 05/22 | 08:18 | 05/23 | 08:12 | 86040 | 1200 | 13279 | 338.0 | -213 | 190 | 7.58E-03 | 4.81E+04 | 12.66 | 0.36 | 0.83 |
| 75 | 05/24/96 | 15:02 | 05/22 | 08:16 | 05/23 | 08:10 | 86040 | 1200 | 20067 | 399.0 | -213 | 190 | 7.58E-03 | 7.23E+04 | 19.09 | 0.42 | 0.83 |
| 64 | 05/24/96 | 15:24 | 05/22 | 08:11 | 05/23 | 08:09 | 86280 | 1200 | 6639 | 271.0 | -213 | 190 | 7.58E-03 | 2.44E+04 | 6.45 | 0.31 | 0.83 |
| 4 | 05/24/96 | 15:45 | 05/22 | 08:10 | 05/23 | 08:08 | 86280 | 1200 | 17210 | 387.0 | -213 | 190 | 7.58E-03 | 6.21E+04 | 16.45 | 0.41 | 0.84 |
| 105 | 05/24/96 | 16:05 | 05/22 | 08:07 | 05/23 | 08:06 | 86340 | 1200 | 35597 | 514.0 | -213 | 190 | 7.58E-03 | 1.28E+05 | 33.89 | 0.52 | 0.84 |
| 42 | 05/24/96 | 16:26 | 05/22 | 08:06 | 05/23 | 08:05 | 86340 | 1200 | 36831 | 517.0 | -213 | 190 | 7.58E-03 | 1.32E+05 | 35.15 | 0.52 | 0.84 |
| 95A | 05/24/96 | 16:48 | 05/22 | 08:02 | 05/23 | 08:03 | 86460 | 1200 | 9619 | 315.0 | -213 | 190 | 7.58E-03 | 3.51E+04 | 9.35 | 0.35 | 0.84 |
| 95B | 05/24/96 | 17:13 | 05/22 | 08:02 | 05/23 | 08:03 | 86460 | 1200 | 10512 | 312.0 | -213 | 190 | 7.58E-03 | 3.82E+04 | 10.23 | 0.35 | 0.84 |
| 258 | 05/24/96 | 17:35 | 05/22 | 07:50 | 05/23 | 08:00 | 87000 | 1200 | 95849 | 815.0 | -213 | 190 | 7.58E-03 | 3.42E+05 | 91.38 | 0.80 | 0.84 |
| 61 | 05/25/96 | 09:07 | 05/22 | 07:50 | 05/23 | 08:00 | 87000 | 1200 | 90 | 179.0 | 354 | 181 | 7.58E-03 | -9.41E+02 | -0.28 | 0.27 | 0.90 |
| 203 | 05/25/96 | 09:35 | 05/22 | 07:50 | 05/23 | 08:00 | 87000 | 1200 | -163 | 188.0 | 354 | 181 | 7.58E-03 | -1.84E+03 | -0.55 | 0.28 | 0.91 |
| 69 | 05/25/96 | 09:51 | 05/22 | 08:26 | 05/23 | 08:16 | 85800 | 1200 | 30591 | 474.0 | 354 | 181 | 7.58E-03 | 1.08E+05 | 32.87 | 0.55 | 0.92 |
| 258 | 05/25/96 | 10:28 | 05/22 | 07:50 | 05/23 | 08:00 | 87000 | 1200 | 83648 | 772.0 | 354 | 181 | 7.58E-03 | 2.97E+05 | 90.00 | 0.86 | 0.91 |

| Date | Count time | Standard (nCi) | Counts | Error | Bkg Counts | Bkg error | Efficiency | Error(1.00 SD) |
|-------|------------|----------------|--------|-------|------------|-----------|------------|----------------|
| 05/24 | 1200 | 80 | 26540 | 457 | -213 | 190 | 0.00753 | 0.00014 |
| 05/24 | 1200 | 78.83 | 26494 | 454 | -213 | 190 | 0.00763 | 0.00014 |

ATTACHMENT 6
Revised Pages for Completion Report
and Disposal Areas Figure

TO

ADDENDUM 1
RESPONSE TO NRC COMMENTS

EXECUTIVE SUMMARY

The Bluewater Uranium Mill Site is located ten miles northwest of the City of Grants, in Cibola County, New Mexico. The Bluewater Uranium Mill Site is a Title II site as defined by the Uranium Mill Tailings Radiation Control Act and is licensed by the United States Nuclear Regulatory Commission (Materials License No. SUA-1470).

Atlantic Richfield Company (ARCO), the Bluewater Uranium Mill Site (Site) owner, discontinued milling operations in 1982. ARCO began decommissioning of the mill under a NRC approved Decommissioning Plan in 1987 and the project was completed in 1990. The details of the mill decommissioning activities are presented in the March 28, 1991 Mill Decommissioning Report. On June 12, 1991, the NRC issued a memorandum to file acknowledging receipt and acceptance of the report with the conclusion that ARCO performed and documented the decommissioning activities in accordance with the requirements of the Decommissioning Plan.

Reclamation work at the Site began with dewatering of the Main Tailings Pile (MTP) in 1982. ARCO developed and submitted a Reclamation Plan in accordance with the mill tailings disposal and longevity reclamation criteria specified in 10 CFR Part 40, Appendix A in March of 1990. The Site Reclamation Plan was approved by the NRC in August 1990.

The reclamation work completed at the Bluewater Uranium Mill Site involved relocation of tailings materials from areas outside the tailings impoundments to the Main Tailings Facility, surface shaping of the tailings and Mill Site related facilities for long term stabilization and placement of protective covers. Approximately 3.2 million cubic yards of tailings contaminated soils and evaporation pond residues were excavated and placed onto the Main Tailings Pile and Acid Tailings Pile for final disposal.

ARCO implemented cleanup verification methods to demonstrate windblown tailings cleanup in accordance with the approved Reclamation Plan, as modified by various License Amendments, and the cleanup criteria of 10 CFR Part 40, Appendix A, Criterion 6. The cleanup verification methods, which were approved by the NRC in the Reclamation Plan, consisted of extensive soil sampling, gamma ray measurements, and a quality assurance program.

from the restricted area, most of the areas were excavated until the gamma count rate was below the 3,350 cphm action level. A soil sample was then taken from the excavated area.

In Housing Area HA-16, a large lens of fill material was discovered at a depth of 3 ft. that exhibited an elevated gamma count rate. The material was a mixture of red or grey clay and was similar to other material that had been removed from the housing area. This material is referred to locally as "red dog". A sample was taken and sent to an outside vendor laboratory for analysis. The analysis for natural uranium (U-Nat), radium 226, (Ra-226), thorium 230 (Th-230), and thorium 232 (Th-232) was reported as 2.0, 1.2, 1.1, and < 0.02 pCi/g, respectively. This clearly showed that the elevated gamma rates were not attributable to source or byproduct material. A split of the soil sample was analyzed on the ARCO gamma spectrometer. The Ra-226 result of 1.7 pCi/g agrees well with the outside vendor. The K-40 content was measured using the ARCO onsite spectrometer. The results show that the K-40 content was approximately four times that of the natural soils, or approximately 30 pCi/g. Since a large fraction of the count rate from natural soils arises from K-40 decay, the increase in count rate from the "red dog" material most likely is due to the abundance of K-40. Since this material did not originate at the Site, the "red dog" was not removed from HA-16. No verification soil samples were taken.

The housing pads were numbered HA-1 through HA-18 for reference purposes. After excavation, each site was checked for radioactive contamination using a NaI detector. Areas exceeding the gamma action level of 3,350 cphm were cleaned and verified using Verification Method B in the affected area.

Areas within the Golf Course Area were discovered to contain contaminated soil as a result of tailings contamination and windblown ore dust from the ore storage area. A gamma survey was done over each 100 m² area using the gamma verification method. Areas elevated above the gamma action level of 3,350 cphm were excavated and sampled. The samples were analyzed for Ra-226. The gamma and soil sample results are represented on Figures 6-5 and 6-6 by colors representing gamma count rate and soil Ra-226 concentration ranges. The gamma count rates all were either below the 3,350 cphm action level or were sampled to assure compliance with the 6.9 pCi/g cleanup standard. Gamma ray counts at a total of twelve 33.3 x 33.3 ft. grid blocks were above 3,350 cphm action level where the area rocked out during cleanup. Nevertheless, these grid blocks are near the

7.2 Carbonate Tailings Pile (includes Disposal Areas No. 2 and No. 3)

The CT is made up of the main carbonate tailings area and Disposal Areas No. 2 and No. 3. Disposal Areas No. 2 and No. 3 were depressions in the main carbonate tailings area which were filled with debris. Disposal Area No. 2 was divided into two areas, one portion was reserved for radiologically contaminated asbestos while the other area was for debris. The Asbestos Disposal Area is not considered a part of the CT. The Asbestos Disposal Area verification data is with the Disposal Area 1 data. Both disposal areas have been covered with radon barrier as part of the carbonate tailings pile reclamation.

One hundred evenly spaced measurement locations were established on the CT. A gamma ray exposure rate measurement was made at each point. The values, as shown on Figure 7-3, were within the normal background range of from 10 to 14 $\mu\text{R/h}$ as discussed in Section 5.2.2. The values ranged from less than the normal background range to a maximum of 15 $\mu\text{R/h}$. These values are considered near background levels.

Radon flux measurements were made at each measurement point on July 13-14, 1995. The results are provided in Appendix H. The maximum measured value was 10.6 $\text{pCi/m}^2\text{s}$ with an average of 1.3 $\text{pCi/m}^2\text{s}$. Since the measurement locations were evenly spaced and each measurement represents approximately the same area, the area-weighted-average is equal to the arithmetic mean of the measurements, or 1.3 $\text{pCi/m}^2\text{s}$. This clearly shows that the flux is in compliance with the standard of 20 $\text{pCi/m}^2\text{s}$. Further details are provided in Appendix H.

7.3 Ore Stockpile Area, Plant Site, and Disposal Area No. 1

The NRC agreed to a plan where the Ore Stockpile Area, Plant Site, and DA-1 could be considered one area for the purpose of radiological verification. One hundred evenly spaced locations have been established over the area. Gamma ray exposure rate measurements were made at 100 evenly-spaced locations over the area. The values ranged from 10 $\mu\text{R/h}$ to 25 $\mu\text{R/h}$ with a mean of 14.4 $\mu\text{R/h}$ and a standard deviation of 2.8 $\mu\text{R/h}$. The exposure rate values are shown on Figure 7-4 and presented in Appendix I. The elevated exposure rates values, up to 25 $\mu\text{R/h}$ at the Ore Stockpile Thumb area are due to shine from residual natural ore rocks on the nearby rocked out slope around the thumb area.

The final radon barrier placement was completed in the late fall of 1995 when temperatures were consistently below 32°F during a portion of a 24-hour period. Radon flux measurements at a temperature below 32°F would be inconsistent with the requirements of the Environmental Protection Agency's (EPA) Method 115. Radon flux measurements will be made at 100 evenly-spaced locations consistent with EPA Method 115 requirements. One hundred charcoal canisters will be placed at the measurement points in the spring of 1996. The results will be provided to the NRC as soon as the measurements have been completed. Details of the verification data are presented in Appendix I.

7.4 North and South Landfills

The NRC agreed to a verification plan for the North and South Landfills where five measurement locations were established on each of the 1-acre landfills for performing radiological verification measurements. Gamma ray exposure rate measurements were made at each of the locations, as shown on Figure 7-5. The values range from 13-15 $\mu\text{R/h}$ which closely follow the background range. The exposure rate values are shown on Figure 7-5, and presented in Appendix I.

The remediation was completed in the late fall of 1995 when temperatures were consistently below 32°F during a portion of a 24-hour period. Radon flux measurements will be made at five evenly spaced locations on each landfill consistent with EPA Method 115 requirements. Five charcoal canisters will be placed at the measurement points in the spring of 1996. The results will be provided to the NRC as soon as the measurements have been completed.

7.5 Asbestos Disposal Area

Five measurement points will be established in this small area in the spring of 1996 where gamma exposure rate and radon flux measurements will be performed. This data will be provided to the NRC as soon as the measurements have been completed.

10.0 PROPERTY TRANSFER

The disposal areas and an appropriate buffer will be transferred to the Federal Government for ultimate care under the United States Department of Energy. The portion of the Site that will be transferred is shown on Figure 2-1. ARCO will transfer the title of all land within this boundary, including the subsurface rights, to the Federal Government with the appropriate documentation.

The DOE has prepared a Long-Term Surveillance and Maintenance Plan for the Bluewater Mill Site (DOE, 1996). ARCO has communicated with the DOE to facilitate information for preparation of the plan.

10.1 Land and Subsurface Rights

Abstracts of title and the appropriate land research for verification of ownership have been prepared by ARCO. The land title documentation is being prepared following NRC and Department of Justice (DOJ) formats. ARCO has clear title to the real property to be transferred to the DOE.

The subsurface rights for the Site to be transferred are owned by ARCO with the original purchase of the surface or have been recently obtained from local owners and the railroad company. The subsurface rights include oil, gas and minerals. Those rights belonging to the United States that are on site remain.

10.2 Easements and Rights-of-Way

The easements and rights-of-way at the Site predate the purchase of the property by ARCO. The 115KV power line and the natural gas pipeline have been relocated away from reclaimed features and updated rights-of-way prepared. Also, a power transformer station exists on the Site. The utility rights-of-way or easements have been fenced and agreements with operating companies exist to limit their access to within the fenced areas of their utilities.

Appendix D

United States Nuclear Regulatory Commission Materials License No. SUA-1470 Amendments

Appendix L

Raffinate Line Decommissioning Report

Figure I-1 Raffinate Line Stations (have draft)

The raffinate line was used to pump tailings liquids that were decanted from the slimes portion of the Main Tailings Pile (MTP) to the evaporation ponds. Reclamation work to remove the line and contaminated soils above the cleanup criteria began around April 13 and terminated around May 20, 1993. A track hoe was used to remove the pipe which lay 2-4 feet beneath the surface. Residual contamination was then removed with the track hoe, creating a trench approximately 4-feet wide and up to 6-feet deep. After the trench sidewalls and bottom were verified as meeting the cleanup criteria, the trench was backfilled with clean soil.

The depth of the trench was sufficient that personnel were not allowed to enter. Therefore all measurements and soil samples were obtained remotely.

Excavation control monitoring was done using collimated Eberline SPA-3s coupled to Eberline ESP1s and ESP2s. A rig was developed consisting of a pole held at each end by technicians on opposite sides of the trench. The SPA-3 was slung so that it could be focused sideways or downward. Station Points were located every 100 ft by land surveyors along the length of the trench as shown in Figure I-1. The length of the trench was divided into 3 sections. A 30-second integrated count was obtained while scanning each of the 3 sections of the floor and two side walls. The data are presented in Table I-1. A composite soil sample was prepared from five samples taken from the floor of the trench for each 100-ft section. The samples were analyzed for Ra-226. Table I-2 provides the Ra-226 concentrations for the soil samples taken from the floor of the trench. Samples were obtained using a track hoe.

Appendix K

Interlaboratory QA Results for Analyses of Ra-226 in Soil Samples

Prior to conducting the verification activities, the NRC approved a revision to the analytical Quality Control Program whereby five percent of the verification soil samples would be split and sent to an outside laboratory for analysis. All samples would be analyzed on ARCO's gamma-ray spectrometer using standard operating procedures. This approval was done through an amendment to ARCO's radioactive materials license (License SUA-1470, Amendment No. 15).

ARCO evaluated several vendor laboratories for accuracy and consistency. ACCULAB Research Laboratories was chosen as the QA Laboratory for the project. The samples were selected in the sample preparation laboratory where every 20th sample was split for submittal to the QA Laboratory. Approximately 420 of a total of about 8000 soil samples were split and sent to the vendor laboratory.

In addition to the interlaboratory comparison program, ARCO retained an independent QA contractor to review procedures, monitor the implementation of the procedures, and audit the results of the analytical program.

The ARCO Radiation Safety Officer and the independent QA contractor reviewed all results. A spread sheet was used to calculate the difference, percent difference, and the error of the difference. The values were always acceptable if the difference in the numbers plus or minus the error overlapped zero. Other values were accepted provided that the difference was within 30 percent. Several samples were reanalyzed at ARCO and the vendor laboratories. In a few cases, it could only be concluded that the difference arose from a bad split of the sample. The results from the two laboratories were, with the exception of a few samples, in excellent agreement. All data have been included in this appendix.

Table 4.3.1
License Amendment Tracking Matrix

| AMENDMENT | CORRESPONDENCE DATE | Main Tailings Pile | Acid Tailings Pile | Carbonate Tailings Pile | South Bench | Off-Pile Contamination | Dre Stockpile Area | Evaporation Ponds | Appendix A - Specifications | Site Monitoring | Landfills | Disposal Area No. 1 | APPLICABILITY |
|-----------|------------------------|--------------------|--------------------|-------------------------|-------------|------------------------|--------------------|-------------------|-----------------------------|-----------------|-----------|---------------------|---|
| 12 | 2 August 1991 | | | | | | | | | X | | | Reduction in air monitoring locations |
| 13 | 24 September 1991 | | | X | | | | | | | | | Approval to track etch monitors |
| 14 | 10 December 1991 | | | | | | | | | | | | Surety bond update |
| 15 | 9 January 1992 | | | | | | | | X | | | | Approval of correlation methods for soil testing |
| 16 | 30 January 1992 | | | X | | X | | | X | | | | Early closure of asbestos repository Modification of 1st lift depth on slimes Correlation requirements for QA tests |
| 17 | 28 October 1992 | | | | | | | | | | | | Surety bond update |
| 18 | 9 November 1992 | | | | | | | | | | | | Milestone schedule update Windblown - August 31, 1992 Interim cover - August 31, 1992 Radon barrier - December 28, 1994 Erosion protection - October 23, 1995 Groundwater Corrective Action Plan December 1, 1992 |

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