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REV. 4

COMPLETION REPORT FOR THE UMTRA PROJECT VITRO PROCESSING SITE SALT LAKE CITY, UTAH

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6.0 SUPPLEMENTAL STANDARDS FOR THE VITRO PROCESSING SITE

During the cleanup of the Vitro processing site in Salt Lake City, residual radioactive materials were not completely removed from various locations. Characterization of these areas and the problems associated with the remediation are discussed below.

6.1 3300 SOUTH STREET INTERFACE

The south side of the Vitro site is bounded by 3300 South Street. This street had been widened and the right-of-way overlaps the edge of the tailings along parts of the south side of the site. Areas east of the right-of-way interface at 1+98N-14+85E, "Vitro Site Plan Drawing 0036," were cleaned using standard verification procedures. The cleanup of the interface with 3300 South Street, west of 1+98N-14+85E, was complicated in some locations due to underground utilities. The complications included an old 48-inch (1220-mm) nonreinforced concrete storm drain and a 10-inch (250-mm) high-pressure gas line. Both pipes were located at the interface of the tailings material and the right-of-way. The storm drain contained water at the time of excavation and began leaking when surrounding fill material was removed. Leaking and the stress caused by washout under the pipe necessitated immediate backfill when possible. The tailings material on top and on both sides of the storm drainpipe were removed. Material on which the pipe was resting had to be left in place to ensure pipeline integrity. Moving the pipe would have affected the stability of the road base under 3300 South Street. The high-pressure natural gas line parallels the drainpipe at the last 500 ft (150 m) of the right-of-way interface (going west).

The gas line is one of the major supply lines in the area and disturbing the pipe in any way could have caused a leak. After Mountain Fuel Company located the pipe for the contractor, tailings material was removed to within 18 inches (460 mm) of the pipe. Most backfill material around the gas pipe was not contaminated. However, hot spot areas exist along the gas line. The benefit of removing the contaminated material closer to the pipe, compared with the risks associated with moving the gas line, did not justify continued efforts.

The contaminated soil under the street and under the pipeline was mixed with road base, gravel, and native soils. The UBRC obtained several soil samples from contaminated areas and determined an average Ra-226 concentration of 30 pCi per gram. The UBRC located the area of the highest exposure rate and sampled this material. Ra-226 concentration for this material was approximately 150 pCi per gram. All on-site sample analysis used the opposed crystal system. Attempts were made to determine how far the tailings extended under the street. Indications are that, in some places, they may extend 2 to 3 ft (0.6 to 0.9 m). Due to traffic problems and safety concerns, no test holes were drilled in the street. Tailings material was left in small pockets around the junction boxes, under the storm drainpipe, and around the gas line. The material under the storm drainpipe appeared to be only 1 to 2 inches (20 to 50 mm) thick and mixed with native soils. All determinations were made by visual assessments of the material along the side of the excavation (looking south into the cut face), and by gamma surveys in the street. All the contaminated materials along 3300 South Street are at least 1 ft (0.3 m) below the surface of the road and in some cases

at least 4 ft (1.2 m) under final grade. The tailings left along the right-of-way are not evenly distributed but are in isolated pockets, indicating random spillover from the main pile on the site. The contaminated material is dispersed along a 620-ft (190-m)-long excavation face and the total quantity left in place is estimated at less than 200 yd^3 (150 m^3).

Supplemental standards were applied in this area due to the risk of damaging the gas line, breaching the drainpipe, and collapsing the road base; danger from vehicles using 3300 South Street; and loss of westbound traffic lanes on a state highway. The state of Utah believes that leaving small pockets of tailings material along the right-of-way interface will not severely impact the safety of the public and the environment.

6.2 SUPPLEMENTAL STANDARDS APPLICATION FOR THORIUM-230

When the site was being cleaned up, it was thought that remediating the site for Ra-226 would include all other residual radionuclides associated with uranium milling in the cleanup process. Therefore, the cleanup effort at the Vitro site was targeted to meet Ra-226 standards. About the time site cleanup was coming to conclusion, the UMTRA Project determined that cleanup of Ra-226 did not necessarily mean the site was free of other radionuclides. On other UMTRA sites Th-230 migrated relative to Ra-226. To determine whether Th-230 had migrated relative to Ra-226 on this site, 50 archived verification samples were reanalyzed. Of these verification samples, 14 were found to have high Th-230 concentrations. Also, a percentage of verification samples collected were split and sent to EPA in Las Vegas for QC check analyses. These QC splits were analyzed for both Ra-226 and Th-230. Ten of these samples exceeded 50 pCi per gram (EPA minimum detectable activity levels for Th-230). Because only a fraction of the site was sampled for Th-230 the location of any Th-230 that might remain on the site can only be hypothesized. Therefore, the verification sample grids that have elevated Th-230 are grouped into 4 general areas. These areas are shaded on Figure 6.1.

Figure 6.1 identifies all the locations sampled for Th-230 (both elevated grids and nonelevated grids). Evaluation of the areas where elevated Th-230 was found shows that the Th-230 generally migrated from the Ra-226 in areas that were used as evaporation ponds or where ditches crossed the property. Th-230 would be expected to migrate relative to the Ra-226 due to the relatively higher mobility of thorium compared to radium under the chemical conditions that existed in these areas. The Th-230 found in Area 1 is the only elevated Th-230 grid not associated with a known evaporation pond or ditch. It is not known why elevated Th-230 exists in this area. Because only one verification sample was analyzed for this portion of the site, it is very difficult to determine the extent of Th-230 contamination in this area. However, since most of the Th-230 was found in evaporation ponds and ditches only a small amount of Th-230 is thought to remain in this area. In all areas of the site where Th-230 has been identified, the extent of Th-230 contamination may extend beyond the specific grids for which data have

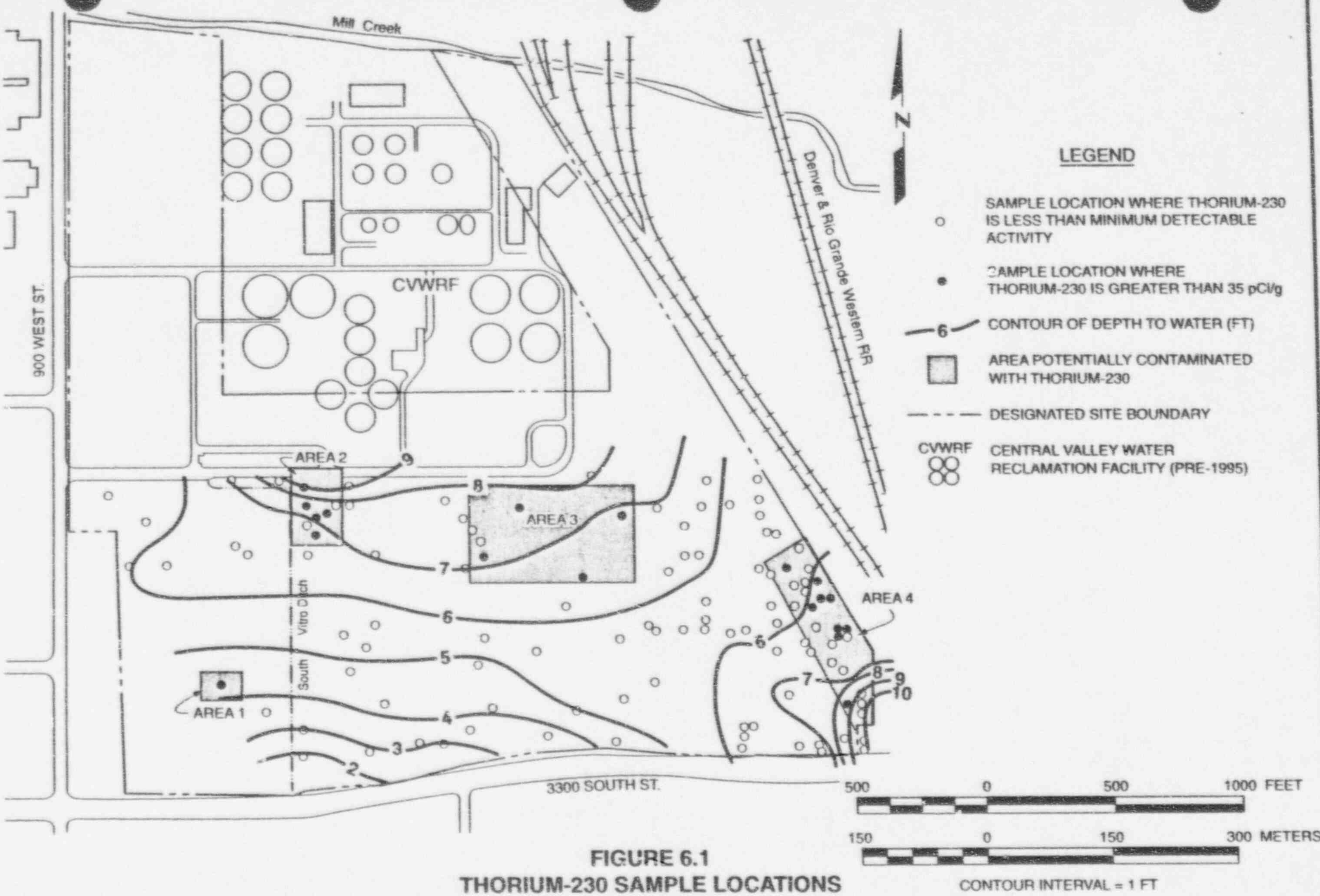

FIGURE 6.1
THORIUM-230 SAMPLE LOCATIONS AND APPROXIMATE DEPTH TO WATER DURING DEWATERING SALT LAKE CITY, UTAH, VITRO PROCESSING SITE

MAC: SITE/SLC/VITRO COMP RPT/DEPTH2

been collected. Future users of the site should note that any areas in the vicinity of known Th-230 contamination grids should be considered potentially contaminated.

Supplemental standards in 40 CFR 192.21(f) may be applied if residual radionuclides other than Ra-226 and its decay products are present in sufficient quantity and concentration that they pose a significant radiation hazard. To determine whether the known Th-230 that was left on the processing site is a significant radiation hazard, the quantity was estimated and a health risk assessment was performed based on the available Th-230 information.

It is estimated that at least 1480 m^3 of Th-230 remain on the site. The average concentration of the Th-230 is 234 pCi per gram with a low value of 44 pCi per gram and a high value of 650 pCi per gram. The average radon flux of the Th-230 as calculated by the RAECOM model is 11.8 $pCi/m^2/sec$, with a low value of 2.8 $pCi/m^2/sec$ and a high value of 56.9 $pCi/m^2/sec$. These radon flux values equate to an average indoor working level of 0.06 with a low value of 0.014 and a high value of 0.29, assuming a slab-on-grade structure and 50 percent equilibrium between radon and its short-lived decay products. The EPA cleanup standard as outlined in 40 CFR 192.12(b)(1) requires reasonable effort to be made to reduce the working levels below 0.02 and not to exceed 0.03. Table 6.1 provides the results of these calculations. The health risk analysis is discussed in detail in Section 6.2.1. The depth of fill as noted in Table 6.1 is the depth of uncontaminated backfill that currently covers each of these grids. If the radon flux calculation was performed using a lesser valve for the depth of uncontaminated backfill, the radon flux would increase, thus increasing the health hazard associated with exposure to radon gas.

Because the Vitro site is in an industrial area zoned for commercial use, future home construction is not likely. The property owner's long-term plan for the site is to expand the water treatment facility currently on the adjacent vicinity property. Until then, the near-term plan is to construct a golf course on the site. Because the Th-230 lens is not expected to be greater than 2 ft (0.6 m) thick, any future excavation will mix the contamination with clean materials and dilute the concentration.

Effects on ground water quality are expected to be negligible because the Th-230 appears to be in the insoluble hydroxide form, which is not mobile. Available water quality analyses indicate the Th-230 and chemical-contaminant concentrations do not exceed proposed EPA ground water standards. Under the UMTRA Ground Water Project, the DOE will further evaluate ground water conditions at the Vitro site and take any action required to ensure compliance with the appropriate standards.

Based on the results of the health risk assessment, the Th-230 that is present on the Vitro processing site meets the requirement for applying supplemental standards. Therefore, additional remediation should not be necessary.

Table 6.1 Grids exceeding 35 pCi per gram

Grid location North	Grid location East	Th-230 (pCi per gram)	Ra-226 (pCi per gram)	Ra-226 in 1000 years (pCi per gram)	Fill depth (ft)	Rn-222 flux (pCi/m²/s)
Area 1 - southwest corner						
429	429[a]	650.0	3.1	229.4	6.1	24.9
Area 2 - Vitro ditch						
1089	099	60.2	5.4	24.6	5.0	3.6
990	066	90.3	5.3	35.0	5.9	3.8
1056	066	166.0	11.0	65.1	4.9	7.3
1122	066	213.0	9.0	80.4	3.8	12.4
1188	066	361.0	5.8	130.1	2.1	37.3
Area 3 - north-central evaporation pond						
1353[b]	132	380.0	3.4	135.1	4.9	14.8
1353[b]	297	330.0	5.1	118.8	5.5	10.9
990	693	85.0	1.7	30.8	4.7	4.5
1122	858	400.0	5.1	143.3	0.5	56.9
1320	1023	51.0	2.1	19.2	2.2	5.5
1386	924	390.0	5.5	140.0	3.6	22.0
Area 4 - evaporation pond						
891	1089	84.0	2.2	30.8	3.8	5.5
1122	1221	240.0	6.4	88.1	1.4	27.0
363	2178	60.0	1.7	22.1	2.9	5.2
627[b]	2178	44.0	3.0	17.3	5.0	2.8
627	2145	320.0	4.3	113.7	7.0	7.2
660	2145	410.0	5.4	147.0	7.0	8.9
660	2178	200.0	2.2	71.4	6.9	5.1
726	2046	129.0	2.9	47.0	3.0	9.6
759[b]	2145	300.0	4.3	107.8	6.7	7.3
759[b]	2112	360.0	4.4	128.8	8.5	5.5
825[b]	2079	228.0	5.4	83.3	7.4	5.1
924	1947	52.5	2.3	19.9	4.8	3.3

[a]This point represents a westing coordinate; all others represent an easting coordinate as indicated by the column heading.

[b]Thorium data for these grids were collected after the initial verification sampling.

6.2.1 Health Risk Assessment

Site Th-230 data analysis

Any Th-230 concentration that is less than 35 pCi per gram is considered to meet the EPA cleanup standard for Ra-226. This limit was determined by estimating how much Th-230 would produce 16.5 pCi per gram (15 pCi per gram plus background) Ra-226 in 1000 years when the current Ra-226 concentration is less than or equal to 6.5 pCi per gram.

Table 6.1 gives the location coordinates, sample Ra-226 concentration, sample Th-230 concentration, projected 1000-year Ra-226 concentrations, the depth of uncontaminated fill placed over a grid location, and projected 1000-year radon flux for samples with Th-230 concentrations greater than 35 pCi per gram. The maximum observed Th-230 concentrations were 410 pCi per gram in the pond area and 650 pCi per gram in the southwest corner area.

Figure 6.1 shows the locations of the known contaminated areas. The Vitro ditch area, designated as area 2 in Figure 6.1, was the only section of the ditch characterized by the additional Th-230 analysis of verification samples. This figure also illustrates the entire Vitro ditch. Because similar geochemical characteristics exist across the site, the remainder of the ditch would be expected to exhibit similar Th-230 contamination.

RAECOM analysis

The radon flux produced by the Th-230 contaminated areas was estimated using the RAECOM computer code. RAECOM was run for each area with an unsaturated backfill layer and a saturated contaminated area.

RAECOM requires seven input parameters. The following input parameters were obtained from the MK-F report on vicinity property SL-018S (MK-F, 1988) and the NRC guideline:

- Unsaturated backfill layer moisture content of 6 percent and radon diffusion coefficient of 0.020 centimeters squared per second (cm^2/s).
- Saturated contaminated layer moisture content of 15 (contaminated lens) and 24 (foundation) percent and radon diffusion coefficient of 0.007 and 0.0001 cm^2/s, respectively.
- Bulk density of 1.60 grams per cm^3 for all layers.
- Porosity of 0.40 for all layers.

In addition, the ambient radon concentration was assumed to be 0.5 pCi/L and the flux into the bottom layer was assumed to be 0 $pCi/m^2/s$. The site-specific emanating fraction of Rn-222 produced from Th-230 decay is not available. Literature suggests that the emanating fraction would be similar to or less than that from Ra-226 decay.

An emanating fraction of 0.3 was assumed, based on information in NUREG (1979) and NRC (1989). All Th-230 remaining on the site is assumed to remain in the saturated zone. This assumption is made because excavation over most of the site reached a depth where saturated conditions were present. In addition, the Th-230 lens is estimated to be 2 ft (0.6 m) thick. This estimation was determined based on remediation of an adjacent property, SL-018. Because of the proximity of this property to the Vitro site and because it is believed the evaporation pond probably extended onto this property, this property is expected to exhibit similar Th-230 contamination and geochemical characteristics as the site evaporation pond. On SL-018 the Th-230 generally consisted of a thin lens approximately 2 ft (0.6 m) thick.

The projected Ra-226 concentration for each of the four areas was determined for Ra-226 ingrowth over 1000 years. The 40 CFR 192 standards reference a 1000-year design life for "designated processing or depository sites under Section 108 of the Uranium Mill Tailings Radiation Control Act of 1978" (42 USC §7901 *et seq.*). After 1000 years, the Ra-226 concentration would be 35.2 percent of the present Th-230 concentration plus 64.8 percent of the Ra-226 concentration remaining following remedial action. RAECOM analyses showed that the highest radon flux in the Vitro ditch area following remedial action would be 37.3 $pCi/m^2/s$ in 1000 years. A similar calculation for the north-central area following remedial action would produce a radon flux of 56.9 $pCi/m^2/s$.

Impact analysis for a hypothetical structure

Radon concentration in a hypothetical structure built over a Ra-226 deposit is given in Appendix J of NUREG (1979) by:

$$C = FAB/(VR \times 1000)$$

Where:

- C = Rn-222 concentration (pCi/L)
- F = Rn-222 flux ($pCi/m^2/s$)
- A = Area over which flux enters (m^2)
- B = Flux reduction factor in entering structure
- V = Volume of structure (m^3)
- R = Effective Rn-222 removal rate (s^{-1})

The coefficients used in the analysis were:

- F = 37 $pCi/m^2/s$ for Vitro ditch and 57 $pCi/m^2/s$ for north central area
- A = 103 m^2
- B = 0.5
- V = 250 m^3
- R = 1.98E-4 s^{-1} (one air change per 1.4 hour).

Radon-222 flux (F) for each area was calculated by RAECOM. The flux reduction factor (B) is a fairly conservative value (NUREG, 1979). The effective Rn-222 removal rate (R) is conservatively based on information in ICRP (1979).

Slab-on-grade construction was assumed for the structure, based on the depth-to-ground water information. Basements are not common in the area and would be unlikely due to the shallow ground water conditions. Radon escaping from the contaminated material layer must diffuse first through the saturated soil layer and then through the unsaturated backfill layer.

Results

Results indicate that when excavated to the level of the saturated zone and backfilled to a depth of 2.1 ft (0.6 m), a residual Th-230 concentration of 361 pCi per gram and a radium concentration of 5.8 pCi per gram in the Vitro ditch area would produce a radon flux of 37 pCi/m^2/s in 1000 years. This radon flux would produce an indoor working level (WL) of 0.19 in a hypothetical slab-on-grade structure, assuming 50 percent equilibrium between radon and its short-lived decay products. A residual Th-230 concentration of 400 pCi per gram and a radium concentration of 5.1 pCi per gram in the north central area and a backfill depth of 0.5 ft (0.15 m) would produce a radon flux of 57 pCi/m^{2}s and an indoor WL of 0.29 in 1000 years.

A scenario for possible health impacts is one where future construction activities bring the contaminated material to the ground surface. The Th-230 contaminated material would then be available for dispersion by both natural and human forces. Possible pathways for human exposure would then be inhalation of airborne radioactive particulates and radon daughters and direct gamma radiation. If the material were excavated after being backfilled, the contaminated material would be diluted by the volume of clean fill covering the deposit. Mixing the contaminated material with clean fill would lower the projected Ra-226 concentration. The resulting concentrations should not be significantly greater than the EPA standard for Ra-226 in surface soil (5 pCi per gram) and probably would be below the standard for subsurface soil (15 pCi per gram). Therefore, the possible health impacts from excavation of the contaminated material would not be excessive. To "bracket" potential health impacts from the various Th-230-contaminated areas, five RESRAD scenario computer calculations were conducted for radiation doses that a worker or shopkeeper in a light industrial shop constructed over the areas might receive 1000 years from today. At that time, some Ra-226 will have grown in from decaying Th-230. Values of Th-230 from Table 6.1 were selected as possible inputs; Table 6.2 presents the results of those calculations. Two additional scenarios were run to estimate the potential exposure that a future construction worker might receive while building a structure on the property. They were assumed to work for a period of 3 months on either the "average" grid, or the highest Th-230 concentration grid (429N-429W). The projected exposures were 26 millirem (mrem)/3 months for the "average" grid and 71 mrem/3 months for the highest grid.

Table 6.2 1000-year radiation dose projections from selected Th-230 grids

Grid	Th-230 (pCi per gram)	Ra-226 (pCi per gram)	Backfill depth (ft)	mrem/year @1000 years
627N-2178E	44.0	3.0	5.0	83
"avg. of 24"	233.5	4.4	4.6	390
429N-429W	650.	3.1	6.1	544
1122N-858E	400.	5.1	0.5	1206
429N-429W	650	3.1	0.0	2119

Based on the results of the radon flux calculations discussed earlier, and the results of the RESRAD calculations, it is important that future users of the site are aware of the presence of residual contamination. For comparison, the National Council on Radiation Projection and Measurements in Report No. 93 estimates the total average dose to United States residents is about 300 mrem/year (NCRP, 1987). By taking appropriate radiological measurements during excavation and construction, the actual lateral and vertical extent and concentration of the contaminants can be determined and appropriate mitigative measures (if necessary) can be taken. The scenarios modeled assume the contaminated layer is 2 ft (0.6 m) thick, which may or may not be the case, since this assumption was based on data obtained on an adjacent vicinity property and was not confirmed by any measurements on the Vitro site.

A future inhabitant of the site could drill a shallow well to obtain drinking water. This scenario is unlikely because of the available municipal sources of drinking water. As discussed in the final EIS, shallow ground water is not the primary source for domestic, municipal, or industrial water supplies in the Salt Lake City area because of the insufficient quantity or poor chemical quality of the water (DOE, 1984a).

7.0 STATEMENT OF CERTIFICATION

The last of the tailings material was removed from the Vitro site on 20 November 1987. The Vitro site in South Salt Lake is bounded by 3300 South Street on the south, Roper railroad yard on the east, 900 West Street on the west, and Mill Creek on the north. The CVWRF occupies the northern half of the site. The CVWRF was not part of the Vitro mill that was on the site, but was contaminated by material from the mill site.

Verification of the site involved dividing the site into more than five thousand 33 x 33-ft (10 x 10-m) grids. Direct oversight by UBRC staff was continual, for all hours of operation. Excavation continued until the clean interface level was located. This level then was marked by the UBRC technician on the site. The contractor cleaned to this level, ensuring that all material above this level was removed. Due to the type of equipment used to clean up the tailings materials, overexcavation up to 1 ft (0.3 m) was considered acceptable. However, on-site UBRC staff tried to keep the level of overexcavation to 6 inches (150 mm) or less. Cleanup was monitored by the UBRC staff with handheld instruments and the initial removal was guided by measurements taken during excavation. Final verification measurements then were taken to ensure that the floor of the excavation was clean. More than 14,000 samples were analyzed to ensure that more than 5000-plus grids were cleaned to the levels required under UMTRA guidelines.

Most of the construction drawings have at least one partial grid that might be missing data. In almost all cases, the problem is at the edge of the property. All the grids were laid out to cover the entire site as far as it could be determined. The existence of a grid square does not mean that contamination on the area is represented by the drawing. The work progressed from known contaminated areas to the edge of the property and the end of tailings. All of the contamination did not stop exactly on the property line. Vicinity properties surrounded the site. Ditch beds were boundaries in some places and they did not always run exactly on a given line as drawn. When tailings or contamination ran out, data were gathered only to confirm the end had been reached. When the end of contamination was in the middle of a grid, excavation ended but the end of the tailings was not reflected by redrawing the grids. In some cases, two small bits of a grid were combined to try to enclose a standard grid size. In some cases, the partial grid was not addressed as shown on the drawing because the grid outlined the property line but not the property contamination.

In all cases, the depth of backfill exceeds limits for the 5-pCi per gram-plus-background standard. Therefore, the only standard applicable for the Vitro site is 15pCi/g. Most of the grid squares were cleaned to the 5-pCi per gram limit, not because it was required but because the geology of the area made it almost impossible to do otherwise. The bottom of the Vitro mill site is an ancient lake bed and removing the contaminated material required excavation to that level. Permeation into the lake bed was a matter of fractions of inches for most of the site. For example, at a given depth of excavation, contamination could be 200 pCi per gram of Ra-226, yet at 1 inch (25 mm) deeper the level would be 1.9 pCi per gram. The nature of the project and the speed for verification did not allow restructuring the drawings to conform to exact conditions of each grid.

The record drawings show a number of grid blocks with no certified cleanup values listed. Justifications for the lack of information in each grid block are shown in Table 7.1.

Table 7.1 Grids that fail acceptance criteria or are missing data verifying cleanup conditions

Grid identification	Ra-226 (actual)	Backfill (ft)	Ra-226 (calc.)	Backfill (calc.ft.)	Comments
Drawing SLC-CL-0022					
13+20N - 0+00RT "B"	7.9	0.3		3.9	a,e
Drawing SLC-CL-0023					
5+28N - 0+99 "B"	28.1	2.3	4.81	N/A	a
3+96N - 1+32 "	17.9	4.2	1.72	N/A	a
Drawing SLC-CL-0024					c
13+20 - 8+58W "A"	9.5	0.3	4.3	0.8	a,e
12+87 - 264W	9.9	-0.3	N/A	N/A	e
12+54 - 6+93W "	7.0	0	N/A	3.9	a,e
Drawing SLC-CL-0025					
11+22 - 8+58W "A"	7.6	0.4	N/A	1.2	a,e
Drawing SLC-CL-0028					d
25+08 - 8+58E "A"	-	-	3.3	4.4	a,e
24+42 - 8+91E "	-	-	N/A	N/A	b
25+41 - 8+25E "	-	-	N/A	N/A	f
Drawing SLC-CL-0029					
16+50 - 1+32W "A"	8.2	-	N/A	7.9	a,e
16+50 - 2+97E "	12.3	-	N/A	10.3	a,e
12+21 - 0+66E "	11.6	0	N/A	4.6	a,e
13+20 - 0+66E "	-	8.2	3.1	N/A	a
13+53 - 0+66E "	-	5.0	3.1	N/A	a
13+20 - 0+33E "	-	9.8	3.1	N/A	a
13+53 - 0+33E "	-	6.9	3.1	N/A	a

Table 7.1 Grids that fail acceptance criteria or are missing data verifying cleanup conditions (Continued)

Grid identification	Ra-226 (aActual)	Backfill (feet)	Ra-226 (calc.)	Backfill (calc.ft.)	Comments
12+21 - 1+32E "	6.9	0	-	4.1	a,e
12+87 - 4+29E "	42.0	4.7	5.5	N/A	a
15+18 - 5+61E "	-	0.3	5.2	0.6	a,e
15+51 - 5+61E "	8.1	0	5.3	0.3	a,e
15+51 - 5+94E "	19.2	0	4.3	0.2	a,e
Drawing #SLC-CL-0032					d
Drawing #SLC-CL-0033					f
25+74 - 10+56E "A"	17.6	5.5	3.0	N/A	a,e
Drawing SLC-CL-0034					g
12+54 - 11+22E "A"	-	1.4	2.96	N/A	a
12+54 - 17+16E "	-	2.3	1.74	N/A	a
16+17 - 16+50E "	16.8	7.6	N/A	N/A	
15+51 - 16+83E "	6.9	-2.3	N/A	7.1	a,e
14+52/14+85-17+49E"	-	-	2.1	7.0	a,b,e
13+86/14+19-17+82E"	-	7.4	2.7	5.6	a,b
13+53/13+86-18+15E"	-	-	2.1	6.3	a,b,e
12+87/13+20-18+48E"	-	-	1.8	6.8	a,b,e
12+54 - 18+81E "	-	-	1.0	7.3	a,e
Drawing SLC-CL-0035					
8+58 - 14+85E "	-	0.6	2.5	N/A	a
Drawing #SLC-CL-0036					
1+32 - 17+82E "A"	7.0	0	N/A	1.5	a,e
1+32 - 18+48E "	6.8	0	N/A	2.1	a,e
1+32 - 19+47E "	6.6	0	N/A	2.9	a,e

Table 7.1 Grids that fail acceptance criteria or are missing data verifying cleanup conditions (Concluded)

Grid identification	Ra-226 (actual)	Backfill (feet)	Ra-226 (calc.)	Backfill (calc.ft.)	Comments
Drawing #SLC-CL-0037					
6+93 - 22+11E "A"	-	-	3.15	5.95	a,e
8+58 - 21+12E "	-	8.0	3.45	N/A	a
9+57 - 20+46E "	-	3.6	1.72	N/A	a
10+89 - 19+80E "	-	-	3.37	6.82	a,e
Drawing #SLC-CL-0038					
5+28 - 20+79E "A"	-	0.3	1.72	4.2	a,e
5+28 - 21+12E "	-	3.6	2.45	N/A	a

Comments for Table 7.1 that identify grids missing data pertaining to extent of contamination:

a. Calculated Ra-226 concentrations and backfill levels were determined by averaging known concentrations and known backfill levels from grids adjacent to the grid with missing data. When adjacent grids did not provide the required information, data from the next closest grids were used to calculate the missing information. Only known concentrations were used to determine averages assigned to the grids with missing information.

b. Grids and partial grids combined to equal 100 m^2 for sampling.

c. In the center of the drawing containing this grid, data apparently are missing on the south side of Vitro ditch. In reality, cleanup at the ditch area was accomplished by chasing the tailings south to the banks of Vitro ditch; then the ditch was moved to the north and its new path was laid down in clean backfill. Later, tailings were chased from south to north until the remediation had removed all the material up to the backfill material placed during remediation from the north. The drawings do not show the actual interface between the locations, but the north boundary and the south boundary lined from the two separate grid groups actually overlap the grids at the indicated Vitro ditch interface. It was decided that redrawing the grids and joining the grids might be more confusing than leaving them as they were already drawn. No grids were overlooked and all areas were remediated.

d. The end of the dig did not always extend to the outside edge of the grid as drawn. In almost all cases, the perimeter of the site is shown as a straight line right to the end of the grid; however, the tailings did not extend completely across the grid. No effort was made to draw the end of remediation to scale. Some grids appear to be missing data, but in reality are outside the area of excavation.

e. Backfill elevations were documented for payment of the work. Therefore when backfill elevations indicate less than 6 inches, it is because the state did not perform the backfill activities. Members of the UBRC staff that worked on the project are willing to testify that all areas of the site were backfilled with a minimum of 6 inches (150 mm) of fill after excavation was finished. Some of these areas were left open for a period of time so that CVWRF could do the required work but the areas were backfilled to a uniform level when the work was completed. In addition, the areas identified as having zero inches of backfill were visited by UBRC staff during July 1993. Twenty-five test holes were dug to a depth of 12 inches (300 mm) at random locations over the site and backfill material filled all of these holes. In addition, most of the areas in this drawing that indicate "0" of backfill are now covered with grass. The CVWRF staff informed the UBRC that at least 6 inches (150 mm) of backfill (topsoil) were placed on existing grade prior to landscaping.

f. The property line on the east side of the property in some cases extends onto adjacent vicinity property and additional cleaning at this junction was accomplished by cleaning from the vicinity property toward the Vitro property until contact with backfill material that was placed during the remediation effort. The edge of construction does not necessarily follow property lines.

g. Data referring to partial grids north of 16 + 50 between 8 + 91E and 12 + 87E can be found on Drawing SLC-CL-0038B. Information for grids 12 + 54E to 16 + 50 through 18 + 48 can be found on drawing SLC-CL-0038B.

A comment column in Table 7.1 deals with special conditions of that grid or that particular drawing. In some cases, it may reference other drawings or other methods used to verify conditions at the site. Note that missing grid information that did not appear to be needed was not provided. For example, if a grid were missing depth of backfill information but the concentration was less than 5 pCi per gram of Ra-226, the grid information was not provided. If a grid were missing both Ra-226 concentration data and depth of backfill data, only the concentration as averaged by adjacent area grids was provided, if less than 5 pCi per gram Ra-226 was determined.

The comment column may indicate that some grids were not cleaned because they were at the end of the dig, or that they were part of other grids. Notwithstanding all of the calculations to determine conditions at the Vitro site, three additional walkover surveys were conducted in site locations where information appears to be missing, as well as across the entire facility from east to west in five random passes to verify exposure levels. Except for one spot that was at 24 microR per hour at contact (crossover of the Vitro ditch) in the west-central portion of the site, all measurements indicated normal background levels for Salt Lake Valley.

Due to the extensive amount of verification samples taken, the constant oversight by the UBRC staff, and follow-up gamma surveys of the site, the UBRC is confident that cleanup of the Vitro site complies with all UMTRA criteria for certification and that only minimal tailings material is left on the site, if any.

Supplemental standards were used when radionuclides other than Ra-226 were encountered (i.e., Th-230) and when safety was a primary concern. Upon considering the risk of removal due to natural or manmade hazards, and the risk to transportation systems, the state of Utah made a final decision to initiate supplemental standards. To accomplish this, the UDOT and UBRC examined each location where supplemental standards were proposed. (For supplemental standards criteria see Section 6.0.) Upon determining that further work in a given area was unsafe, that removal of tailings would weaken various nonreplaceable structures, or that future exposures would not increase by leaving tailings in place, the areas were documented and the UBRC approved bypassing these areas. Supplemental standards were applied to all proposed locations in accordance with criteria established under UMTRA Project guidelines.

In addition to the areas where supplemental standards were applied, six grids exceed the Ra-226 concentration limit of 15 pCi per gram + background (Figure 7.1). The reported values are 42.0, 28.1, 19.2, 17.9, 17.6, and 16.8. These elevated grids were identified after the site had been backfilled. Due to the geology of the site and the way excavation was performed it is believed that any contamination remaining on these grids is confined to a very thin lens or randomly distributed spots. Locating and removing this contamination would be virtually impossible. To determine the potential health hazards associated with these grids, an analysis was performed to determine the projected radon flux if a hypothetical slab-on-grade house were built on the grid with 42 pCi/g. Using a backfill depth of 4.7 feet, a radon flux of 3.7 $pCi/m^2/s$ is projected. A radon flux of this magnitude is equivalent to a radon working level of 0.02, which is in compliance with the EPA cleanup standard as outlined in 40 CFR 192.12(b). If a slab-on-grade house were constructed over this grid with a reduced depth of backfill, the radon working level would increase, thus increasing the health risks associated with exposure to radon gas. Because

of the relatively low radioactivity and small quantity of contaminated material remaining, these grids are not considered to be health hazards as long as the backfill that covers them remains in place. Therefore, these grids will remain in place and no further remediation will be performed. An analysis of the projected radon flux from the grid with 42 pCi per gram of Ra-226 was performed. This analysis projects a radon flux of 3.7 pCi/m^2/s, which would produce 0.02 radon working levels if a hypothetical slab-on-grade house were built on the grid. These elevated grids are not considered health hazards because of their relatively low radioactivity and small quantity. Therefore these grids will remain in place.

All the record drawings in Appendix A of the Vitro site shown in "UMTRAP, Uranium Mill Tailings Remedial Action Project, Salt Lake City, Utah," construction drawing set (rev. 10-1-89) "Record Drawing," are certified by the state of Utah to be in accordance with DOE UMTRA cleanup criteria.

7.1 REGULATORY CONTACTS

The Vitro site was one of the first UMTRA sites designed and remediated. Under DOE and NRC guidelines, the regulation governing remedial action at Vitro was the UMTRCA of 1978 (42 USC §7901 *et seq.*). The state, federal, and local authorities listed below were contacted about coordinating their regulations with the UMTRCA.

- Salt Lake County Health Department.
- South Salt Lake City Police Department.
- Utah Department of Natural Resources.
- Utah Department of Transportation.
- Utah Department of Public Safety (Highway Patrol).
- Salt Lake County Public Works Department.
- Utah Department of Health, Bureau of Water Pollution Control and Bureau of Air Quality.
- Utah Occupational Safety and Health Administration.
- Utah Department of Health, Utah Bureau of Radiation Control (Utah Division of Radiation Control - new division title as of 1992).

7.2 FUTURE LAND USE

Since ground water compliance as mandated by 40 CFR Part 192 has not been demonstrated, use of the Vitro processing site by the landowner, CVWRF, must be restricted. Land use restrictions will be in effect to ensure that future development activities do not hinder access to the site, aggravate the present contaminant conditions, preclude ground water compliance actions from being performed, or disturb/alter any wells or monitoring devices that have been installed. The DOE's authority to restrict use of this property is stated in Section IV.B(b) of RAA Number DE-R004-83AL22142, between the DOE, the state of Utah, and CVWRF, whereby the DOE has the right to restrict access to the Vitro processing site to facilitate remedial action, and to protect and ensure public health and safety. This clause is in effect until the UMTRA Ground Water Project for this site has been certified as complete by the NRC. To ensure land use restrictions are followed, all proposed plans for development of the Vitro processing site must be approved by the DOE.

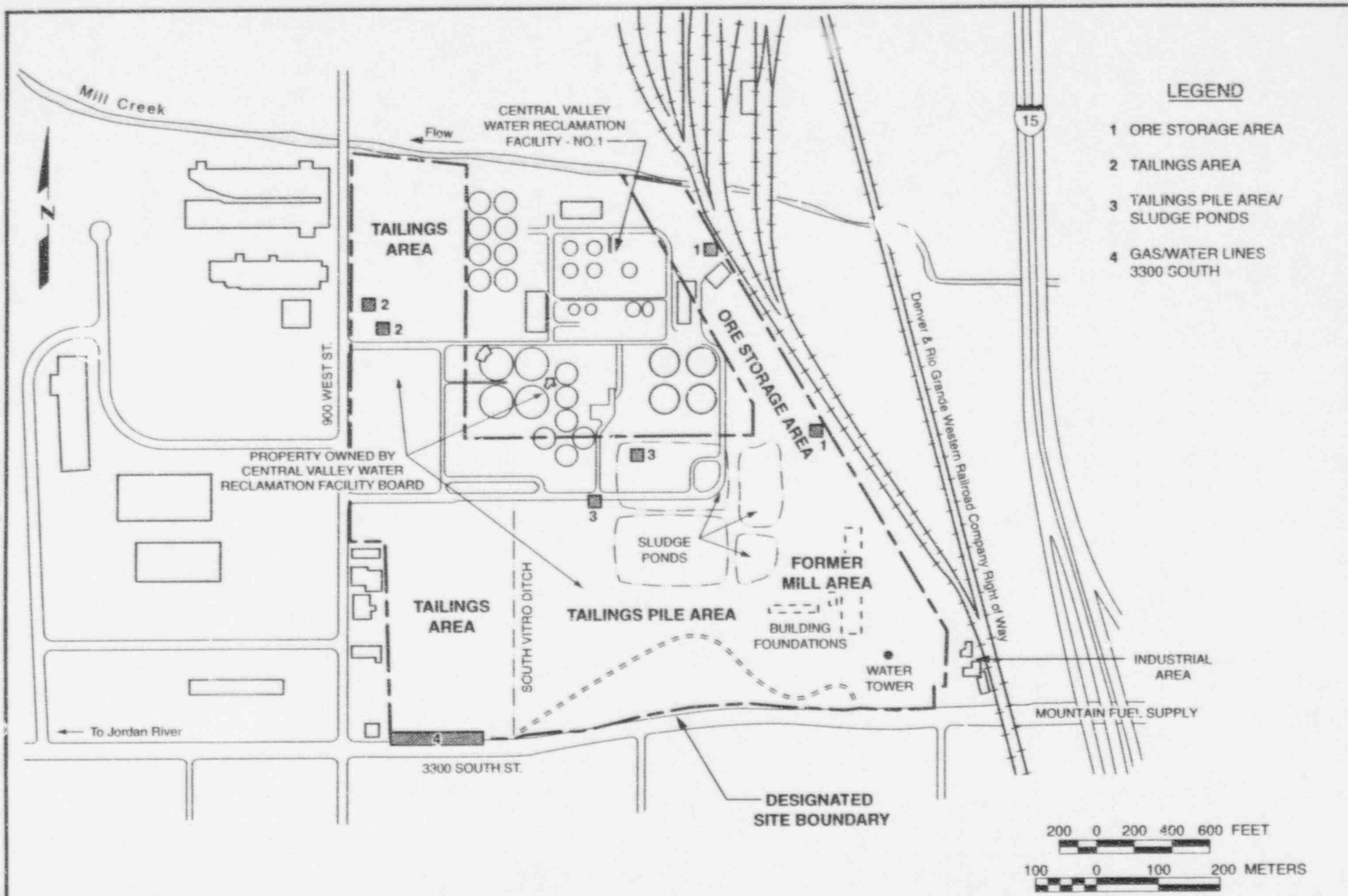

FIGURE 7.1
LOCATIONS OF RADIUM-226 CONTAMINATED AREAS
SALT LAKE CITY, UTAH, VITRO PROCESSING SITE

MAC: SITE/SLC...COMPREPORT/CONTAMAREAS2

DOE/AL/62350-129
REV. 4

United States Department of Energy

Completion Report for the UMTRA Project Vitro Processing Site Salt Lake City, Utah

June 1997

Uranium Mill Tailings Remedial Action Project