UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

FEB 08 1993

MEMORANDUM FOR: Docket File No. 40-8989

FROM: John J. Surmeier, Chief
Uranium Recovery Branch
Division of Low-Level Waste Management
and Decommissioning, NMSS

SUBJECT: INFORMATION FROM THE STATE OF UTAH USED IN THE ENVIROCARE 11e.(2) BYPRODUCT MATERIAL LICENSE APPLICATION REVIEW

On February 1, 1993, the U.S. Nuclear Regulatory Commission (NRC) received a telefax from the State of Utah, transmitting the 1985 Environmental Monitoring Summary Report for the Vitro Site (Enclosure 1). The NRC already had already received the 1986 and 1987 reports by telefax on May 11, 1986 (Enclosures 2 and 3). This information was referenced in preparing the Draft Environmental Impact Statement. Therefore, in order to assure that this document is available to the public, I am sending copies of the correspondence under cover of this letter to Docket File 40-8989.

John J. Surmeier, Chief
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Enclosures: As stated

cc: L. Anderson, Utah

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ORIGINAL SIGNED BY

John J. Surmeier, Chief
Uranium Recovery Branch
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Docket Number: 40-8989

Distribution: See attached list

SUBJECT ABSTRACT: ENVIROCARE ER CHAPTER 10 - ALTERNATIVES

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ENCLOSURE 1

1985 VITRO UMTRA PROJECT ANNUAL ENVIRONMENTAL MONITORING SUMMARY

Introduction

The Environmental Impact Statement (EIS) for remedial action at the former Vitro Chemical Company Site, Salt Lake County, Utah was completed in July, 1984. The Vitro site is a 128-acre property four miles south-southwest of the center of Salt Lake City, Utah, in the City of South Salt Lake (see Figure 1A). The selected remedial action option is excavation and removal of the uranium mill tailings and structural debris from the Vitro site. The contaminated material is then transported by rail to the South Clive, Utah site for disposal (see Figure 1B). The construction is managed by the State of Utah, Bureau of Radiation Control. Standards used are those set by the Environmental Protection Agency, the Title 10 Code of Federal Regulations, the State of Utah's Division of Environmental Health, and applicable OSHA standards.

Monitoring Site Descriptions

Figures 2, 3 and 4 show the locations of current environmental monitoring stations on the perimeter and in the vicinities of the Vitro and Clive Sites. In addition to the environmental monitoring stations shown in these figures, Hi-Volume air samplers are used on-site during excavation. They are generally not at one station, but moved daily according to excavation locations. Radon Concentrations are monitored by placement of 15 vicinity and 11 boundary Passive Environmental Radon Monitors (PERM) at Vitro and 5 PERMs at Clive. Radon is also monitored using Radon Progeny Integrated Sampling Units (RPISU) at 2 locations at Clive and 3 locations at Vitro. Radiological airborne particulate monitoring for gross alpha is performed using Hoffman high volume air samplers. Water monitoring in 1985 has been limited to sampling of treated discharge and on-site grab water samples.

Weather Patterns

Vitro Site - The project is located in the Jordan River Valley Basin of the Great Salt Valley at an altitude of 1289.3m (4230 feet) above sea level. The valley lies between the Wasatch Mountains to the east and the Oquirrh Mountains to the west. The Great Salt Lake is located approximately 19.3km (12 mi.) northwest of the site. Local prevailing winds are generally from the south and southeast. The major storms which effect the Salt Lake Valley are generally from the northwest, associated with the prevailing regional westerly winds.

The mountains sometimes act as a barrier to invasions of cold continental air. However, in the late fall and winter months, high pressure systems tend to settle over the area. Smoke, haze, and pollutants accumulate in the lower levels of the stagnant air for weeks at a time. The Vitro Site is semi-arid, with temperature extremes from -34.4°C to 41.7°C (-30°F to 107°F), and annual precipitation varies between 25.4 and 50.8cm (10 and 20 in.). Precipitation is generally very light during summer and early fall, reaching a maximum in the spring.

South Clive Disposal Site - The South Clive Site is arid desert located at altitudes approximately 1432.6m (4700 ft) above sea level. It is slightly warmer than the Vitro Site, with temperature extremes from -28.3°C to 44.4°C (-19°F to 112°F). Normal annual precipitation averages less than 12.7cm (5 in.). No published wind data is available for the South Clive Site. Studies and on-going monitoring by United States Pollution Control, Inc. at the Grassy Mountain facility north of Clive indicate that prevailing winds are generally from the south in the spring and summer and generally from northerly directions in the late fall into winter.

Population

Vitro - Population census have indicated that 497 persons resided within 0.5 miles of the Vitro Site (FBDU, 1981) for an average population density of about one person/acre. Within two miles, the resident density increases rapidly to 4.3 persons/acre, or approximately 9,753 persons. Also, within this radius, the daytime population due to the commercial-industrial sector in this part of South Salt Lake increases to about 40,000.

Clive - Most of the area is uninhabited. The closest residents, 7 in number, live 15-20 miles northeast of the site. The largest number live 30-50 miles to the east and southeast of the Clive Site in the Tooele-Grantsville area (see Figure 1B). In 1980, Tooele City had a population of 14,335.

Hydro-geologic Conditions

Vitro - The Vitro Site is in the Jordan River Valley in South Salt Lake. Groundwater in the valley is generally a two aquifer system comprised of a near-surface, unconfined aquifer and a deeper, confined aquifer. However, in the vicinity of Vitro, the stratigraphy of the unconfined aquifer (the upper 50' - 70' below the surface) is very similar to that of the underlying "confined" system. The background water quality of the two systems is substantially different. The unconfined system is brackish with high Total Dissolved Solids (TDS) and limited agricultural or domestic use. The "leaky" confined aquifer is a principal supply of domestic, agricultural, and industrial water in the Jordan River Valley. Its relatively good water quality is maintained by the upward hydraulic gradient between the two systems. However, if the hydraulic gradient were to be reversed, by heavy utilization of the lower aquifer or other conditions, downward migration of contaminants could result. Elevated levels of sodium, sulfate, chloride, TDS, and uranium have been found in the upper groundwater system down gradient (west-northwest) from the tailings pile. No radioactive constituents or metals associated with the tailings pile were found above background levels in the lower aquifer system, although higher levels of sulfate and chloride were measured. The deepest monitoring well was 137'. Both aquifers flow generally west - northwest toward the Jordan River. However, current dewatering from an approximately 25' deep sump and pump system in the Central Valley Water Reclamation Facility is currently discharging an average of 0.64 million gallons/day into Millcreek, and has modified the gradient patterns in the

upper system. (See Figure 5). The unconfined system is principally recharged by upward flow from the "confined" aquifer and by surface infiltration. The lower system is recharged by the Wasatch Mountains to the east. The upper system discharges into surface water courses such as the north and south Vitro ditches, Millcreek and the Jordan River. A well monitoring program is currently being developed by the Bureau of Radiation Control.

Clive - The water table below the Clive Site ranges from about 25' - 35' below ground surface with saturated conditions extending at least 230' deep. Apparent hydraulic gradient slopes gradually to the north-northeast. Groundwater recharge occurs from the east. (See Figure 6). Measured fluctuations in groundwater elevations are generally less than 1'.

Radon Concentrations

Sampling Methods

Sampling is performed bi-weekly. Detectors are shipped from EPA, Las Vegas and inspected upon receipt.

PERMs - The silica gel canisters are always changed before the installation of a fresh detector. A voltage check is also performed. The stopper with the exposed chip is removed and placed into its appropriate shipping envelope with date, time, and initials of sampler recorded on the envelope. All information is also recorded on the data sheet. Detector numbers and dedose dates are coordinated by EPA. Then, the unexposed detector is inserted into the PERM. Location, Perm #, date, time, and initials of sampler are recorded on the envelope as well as the data sheet.

RPISUs - Sampling is performed bi-weekly while on the PERM route. RPISU detectors arrive with the PERM detector shipment from EPA in Las Vegas and are checked upon receipt. To begin sampling, the flowrate through the exposed detector on the RPISU is first checked with a rotameter calibrated by EPA. Flowrate, date, time, rotameter number, and the initials of the sampler are recorded both on the appropriate envelope and the data sheet. Filter #'s, Alpha TLD #'s, and Gamma TLD #'s are already given by EPA. The exposed detector is then removed. The new detector is then removed from its envelope and placed at the end of the air inlet tubing. The flowrate through the new detector is checked with the rotameter. Location, pump number, date, time, flowrate, rotameter number, and sampler's initials are then recorded on the envelope and data sheet.

For proper documentation, all entries are recorded legibly within the indicated columns on both envelopes and data sheets.

After all detectors have been retrieved and placed in their appropriate envelopes, the data sheets are checked to ensure all applicable information is recorded properly. Detectors are then shipped back to the EPA Las Vegas office for analysis.

Quality Assurance

All procedures described above are performed the same by all Bureau of Radiation Control personnel. Two Vitro PERM sites have duplicate PERMs for result comparisons.

Pre-Excavation

Vitro - Radon in air concentration monitoring was done prior to remedial action by the Monsanto Research Corporation and Mound utilizing 36 Passive Environmental Radon Monitors (PERMS) around the Vitro Site. Background radon concentration in the Salt Lake Valley determined by Monsanto to be 0.25 pCi/l was approached a little more than a mile from the site. Maximum average for that period was 4 to 5 pCi/l at the perimeter of the site.

Clive - The Radon Gas Monitor - II measurement for the week of February 17-23, 1982 averaged 0.8 pCi/l. The track-etch detector gave a monthly average of 0.31 pCi/l, for the quarter 12/81 - 2/82.

During Remedial Action

The State of Utah, Bureau of Radiation Control and EPA started monitoring for Radon -222 concentrations in air in April, 1985. Both Passive Environmental Radon Monitors (PERMs) and Radon Progeny Integrating Sampling Units (RPISUs) are used surrounding both the Vitro and Clive Sites. The PERMs are capable of measuring ambient levels of Radon -222. The sampling is performed bi-weekly at both sites by Bureau of Radiation Control personnel. Analysis is performed by the EPA Las Vegas Office. See Figures 2, 3 and 4 for PERM and RPISU locations. There are 26 PERM and 3 RPISU locations around the Vitro Site. There are 5 PERM and 2 RPISU locations around the Clive Site.

Radon Monitoring Summary

Figure 7 is an isopleth map showing the 1985 average concentrations at the PERM locations in Salt Lake City. The 10 CFR 20 Standards for Radon-222 in air are 30 pCi/l for radiation workers and 3.0 pCi/l for members of the general public.

See Table 1 for a summary of results for the Passive Environmental Radon Monitors in 1985. Please refer to Figure 2 for location correlation.

The 1985 average monthly radon concentrations around Vitro are lower than those reported by Mound previous to excavation. Radon concentrations around the Clive site have averaged lower than those reported by Mound. An isopleth map showing Mound's average concentration data surrounding the Vitro site can be found in the EIS. Highest monthly average concentrations around Clive occur in September and October. The highest monthly average concentrations around Vitro generally occur from June through October.

Radiological Airborne Particulate Monitoring

Description of Monitoring Methodology

High volume vacuum-air sampler pumps (Hi-Vols), Hi-Q Environmental Products Company model CF-900V-2C. - These pumps, with 4" diameter Micro Filtration Systems borosilicate microfibre filters, are used to monitor airborne particulate concentrations downwind of areas where highest dust levels occur (i.e., excavations, haulroads, train loading areas). They are set on tripods at chest level and powered by gasoline generators placed downwind of the sampling pumps.

Samples are started by centering the preweighed filter on the screen with the pump on at a low rate of flow. The faceplate is then replaced, the minute meter is zeroed, and the flow adjusted to eight cubic feet per minute. The flowrate is then written on the filter envelope along with the date, starting time, sampling location, initials of Bureau of Radiation Control personnel and any unusual conditions. The envelope is then stored with the air sampler.

At the end of the sampling period, the flow is recorded along with the date, stopping time, minute meter reading, and technicians' initials. The filter is carefully removed and placed in the envelope.

After a five-day waiting period which allows for the decay of Rn-222 daughter products, the filter is removed from the envelope. The envelope is checked for dislodged particles, which, if present, are brushed out onto the filter. The sample is then alpha-counted. The 10 CFR 20 regulation radiation worker standard of 2.0 pCi/m^3 for Th-230 is applied. The alpha activity detected is assumed to be from Th-230 decay. A background count is taken daily with a National Bureau of Standards traceable Th-230 source.

Hoffman High Volume Air Sampler - There are four Hoffman high-volume air samplers at the South Clive Disposal Site. One operates only when the generator for the train car rollover is operating. There are also four at the Vitro Site (three prior to November 1985). They are produced by General Metal Works, Inc., and utilize Whatman 8" x 10" glass microfiber filters. Filters are changed daily at the Vitro Site, and at the Clive disposal site, except during times of shutdown, when they are changed weekly.

Quality Assurance - Calibration, Standardization and Laboratory Analysis

The high-volume vacuum-air sampler pumps are calibrated quarterly according to the Utah Bureau of Air Quality pamphlets entitled "Field Calibration of Hi-Vols", "Audit Procedure for Hi-Volume Sampler Flow Rate" and "Calculation and Table Generation for Hi-Vol Calibrators".

Laboratory analyses are performed at the site radiation control trailer. The scale used is a Mettler AE 50. The alpha counter is a Ludlum model 1,000 scaler, with a Ludlum model 43-1 alpha probe. A background count is taken daily with a National Bureau of Standards traceable Th-230 source, and is used to calculate the probe's counting efficiency. Filters are counted for 10 minutes each.

Approximately 10% of all filters collected at the site are sent to the Utah State Health Laboratory for a second alpha count, and are also analyzed for Lead, Cadmium and Arsenic. Filters are also sent to EPA, Las Vegas for radiologic analysis. For the first half of 1985, the correlation coefficient between Vitro laboratory and the Utah State Health Laboratory was 0.637. The second half of 1985 showed correlation coefficients from 0.835 to 0.965. A coefficient of 1.0 represents a correlation of 100%.

Radiological Airborne Particulate Monitoring Results

Figures 8 - 11 are graphs showing 1985 monthly gross alpha average concentrations in pCi/m^3. Hi-vol averages are consistently higher than the Hoffman averages possibly because of sampler location placement. Hi-Vols are located on-site in work areas where most dust is generated. Gross alpha averages also increase during the drier summer months, when dust is more apt to be generated. The 10 CFR 20 Thorium 230 in air standard for radiation workers is 2.0 pCi/m^3. This action level was never exceeded in monthly average concentrations on the Hi-Vols. Thorium 230 standard in air for the public from 10 CFR 20 is 0.08 pCi/m^3. This action level, used for the Hoffmans, was exceeded only once in the monthly average for July 1985 which is the driest time of the year.

Surface Water Monitoring

Surface water samples have been taken on the Vitro Site in various disturbed areas for contamination information. This water is not to be discharged off-site before treatment. Much effort has been made to minimize and restrict water being discharged to unrestricted areas. Grab samples are analyzed for Gross Alpha activity and Radium -226 by the Utah State Health Laboratory. Uranium and heavy metals analysis is also performed periodically. Grab samples taken from the surface of the Vitro Ditch exiting the site show that no radiologic standards as set forth by the National Pollution Discharge Elimination System (NPDES) Permit are being exceeded.

Effluent Water Monitoring

A NPDES Permit No. UT-0024406 has been issued to the Utah State Bureau of Radiation Control for the Vitro Site. The water treatment plant through which contaminated water must be processed before discharge utilizes a filtration and ion exchange resin treatment system. Monthly reports are sent to EPA in Denver and to the Utah State Bureau of Water Pollution Control. The plant has thus far only been used to discharge for four days, 12/16/85 - 12/19/85 with a total discharge of 723,200 gallons. Water samples are analyzed for parameters specified in the NPDES permit at the Utah State Health Laboratory. The treatment plant is located in the northwest corner of the Vitro Site and discharges into Millcreek.

Sampling Procedure

A composite water sample is taken for monitoring requirements. The sample is obtained through a valve in the system located at a point following the last treatment and prior to mixing with the Millcreek. Four grab samples are collected in graduated cylinders at equally spaced two hour intervals and proportioned according to flow. This takes place over an eight hour time period, representing a 24 hour time period. The exact place, date, time of sampling, and pH meter reading at sampling times are all logged. The composite samples are stored in a locked cooler specifically used for water samples and taken to the Utah State Health Laboratory within 48 hours for analysis.

NPDES Permit Requirements and Monitoring Results

See Table 2 for NPDES Permit Requirements and Monitoring Results. The discharge cannot exceed 10% of the flow in Millcreek, which it has not. The pH cannot be less than 6.5 standard units nor greater than 9.0 standard units, and the pH was observed during the discharge period on the meter at the treatment plant to stay within these limits. The Utah State Health Laboratory pH results obtained at 23°C, one month after sampling was 6.7 standard units. All sample analyses indicate compliance with NPDES Permit requirements.

References

Environmental Impact Statement for the Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah. July, 1984

Ford, Bacon, and Davis Report Update, 1981

Utah State Bureau of Air Quality

Utah State Health Laboratory

Environmental Protection Agency, Las Vegas Facility

Mound-Monsanto Laboratories

U.S. Pollution Control, Inc.

Utah State Bureau of Radiation Control

Table 1. Average Radon Concentration (pCi/l) Values From The Vitro and Clive Sites

VITRO

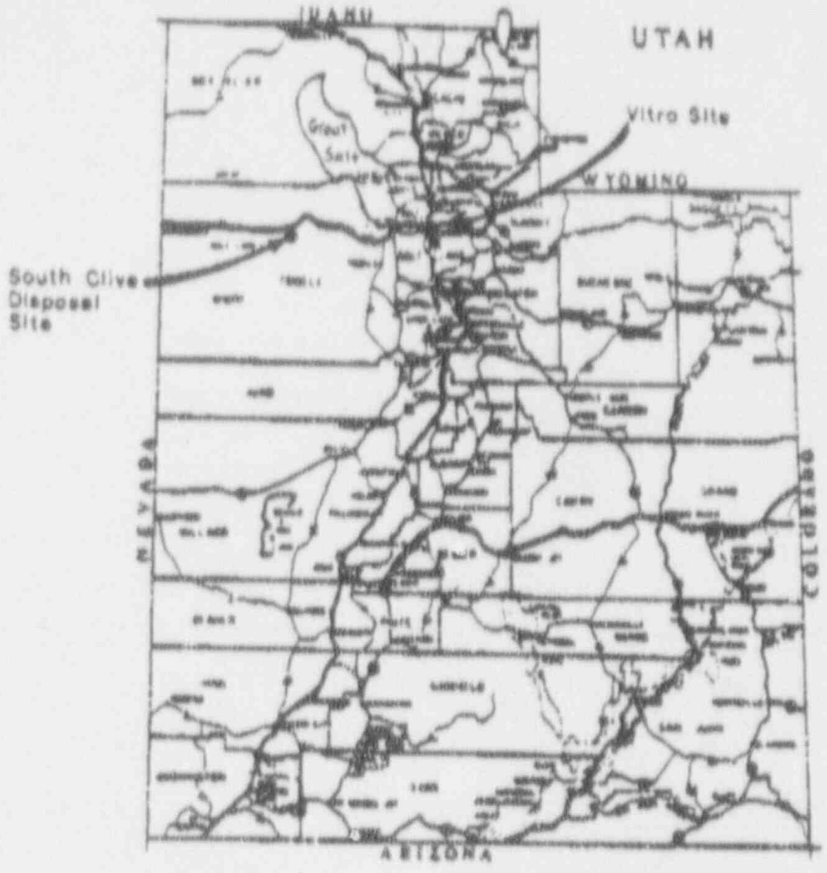
EPA Code #	Average Concentration	Range	Standard Deviation
VT001	3.30	0.13-5.7	1.869
VT005	1.50	0.58-2.5	.662
VT010	2.20	0.57-4.3	1.102
VT016	1.60	0.64-2.3	.505
VT021	0.72	0.43-1.1	.233
VT025	1.00	0.47-4.2	.340
VT030	2.10	0.47-4.2	.980
VT035	1.70	0.72-3.1	.540
VT040	1.20	0.27-3.1	.757
VT045	1.30	0.48-1.9	.455
VT050	0.64	0.48-1.9	.217
VT055	0.53	0.13-1.4	.280
VT060	0.42	0.14-0.71	.177
VT065	0.32	0.12-0.72	.166
VT070	0.36	0.12-0.85	.212
VT075	0.33	0.11-0.77	.153
VT080	0.30	0.17-0.50	.093
VT085	0.28	0.10-0.73	.143
VT090	0.35	0.17-0.95	.197
VT095	0.31	0.16-0.53	.097
VT100	0.28	0.15-0.39	.087
VT105	0.19	0.15-0.31	.041
VT110	0.22	0.15-0.33	.062
VT115	1.40	0.73-2.00	.422
VT998	0.25	0.12-0.97	.241
VT999	0.24	0.12-0.35	.073

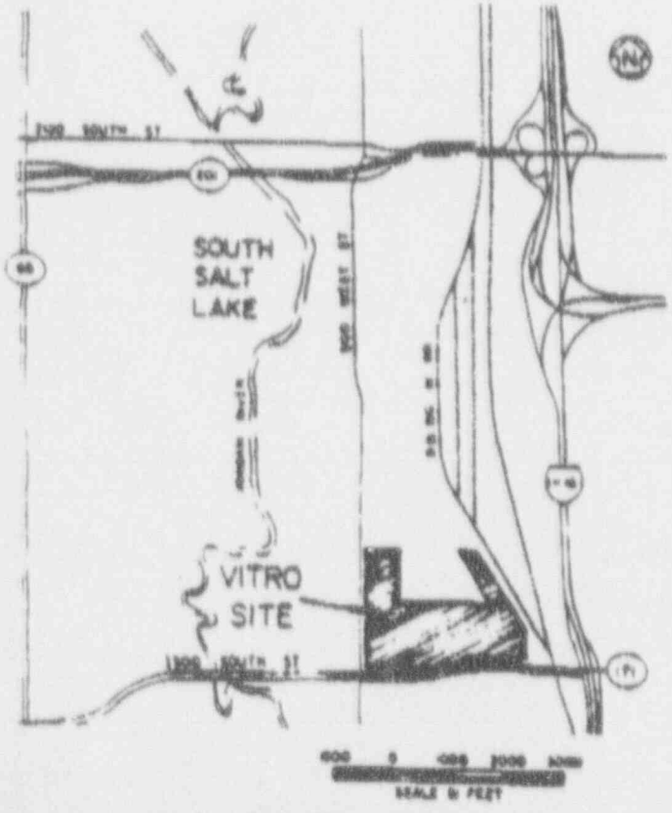
CLIVE

EPA Code #	Average Concentration	Range	Standard Deviation
CL001	0.26	0.10-0.50	.140
CL005	0.27	0.07-0.77	.199
CL010	0.29	0.09-0.80	.210
CL015	0.38	0.13-0.92	.226
CL999	0.27	0.08-0.57	.140

Table 2. NPDES Permit Requirements and December Water Treatment Plant Discharge Monitoring

Effluent Characteristics	Discharge Limitations 30-Daily Average	December Sample Measurement
Flow M^3/day (MGD)	N/A	.34 MGD
Total Suspended Solids, mg/L	20 mg/L	3 mg/l
Soluble Radium -226, pCi/L	3 pCi/L	0.5 pCi/L
Total Radium -226, pCi/L	10 pCi/L	0.5 pCi/L
Total Uranium, mg/L	2 mg/L	0.02 mg/L
Total Iron, mg/L	2 mg/L	0.04 mg/L
Total Copper, mg/L	0.15 mg/L	0.02 mg/L
COD, mg/L	100 mg/L	28 mg/L
Total Arsenic, mg/L	0.5 mg/L	0.003 mg/L
Total Cadmium, mg/L	0.03 mg/L	0.005 mg/L
Total Dissolved Solids, mg/L	N/A	2,840 mg/L





VICINITY MAP

FIGURE 1A

STATE AND SITE MAPS

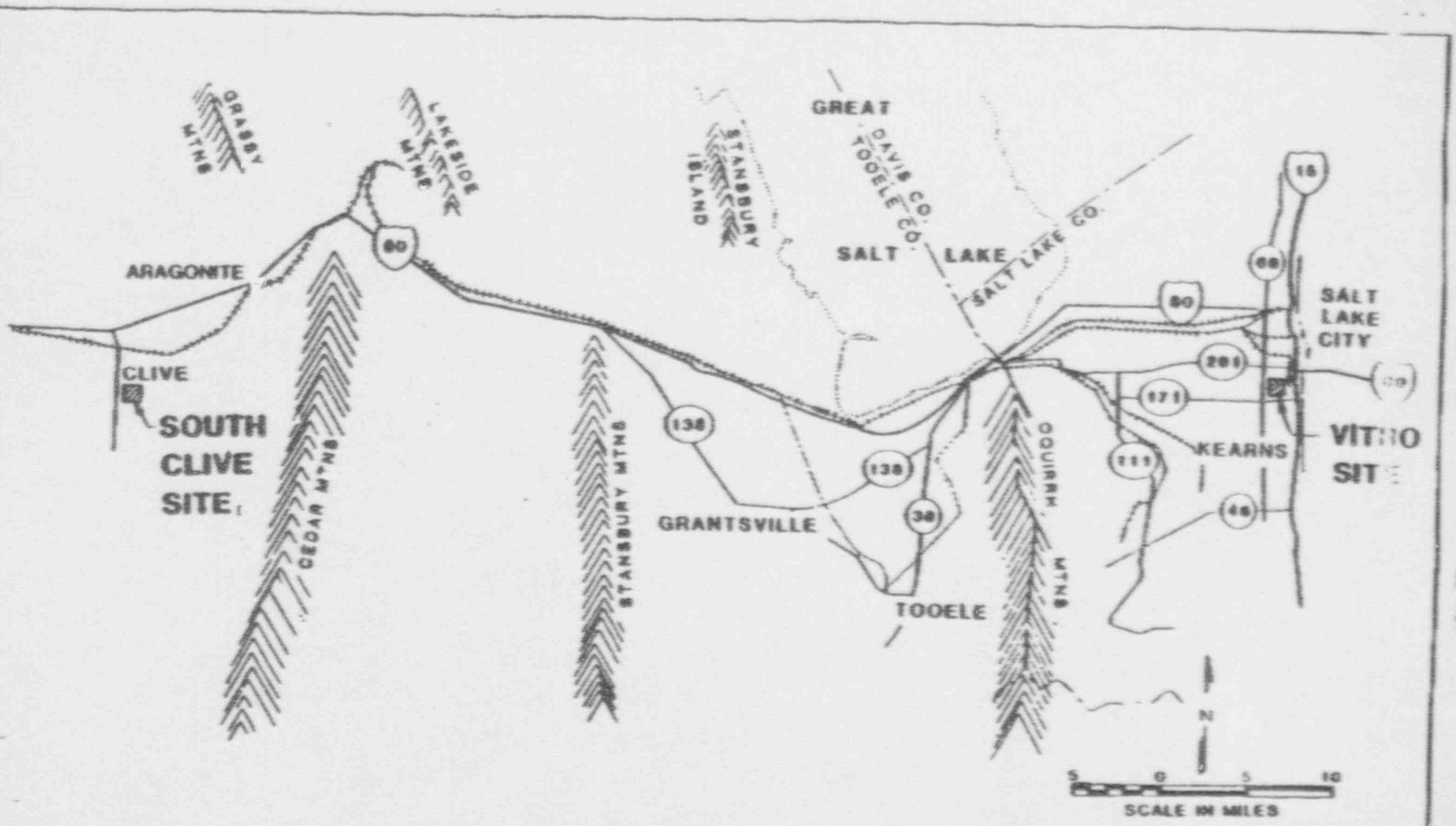


FIGURE 1B
SOUTH CLIVE VICINITY MAP

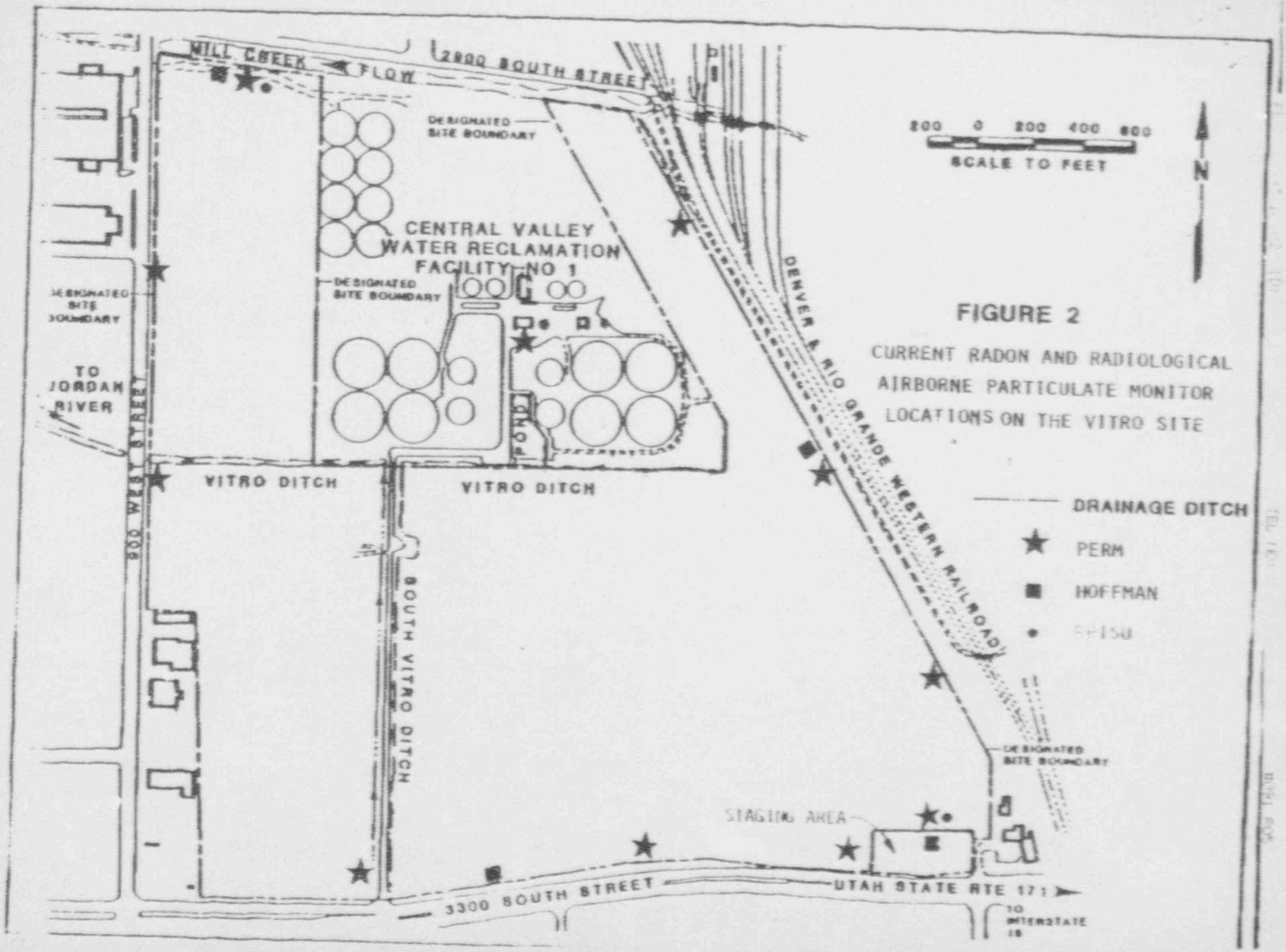


FIGURE 2

CURRENT RADON AND RADIOLOGICAL AIRBORNE PARTICULATE MONITOR LOCATIONS ON THE VITRO SITE

FIGURE 3

CURRENT PERM (PASSIVE ENVIRONMENTAL RADON MONITOR) LOCATIONS IN THE VITRO VICINITY

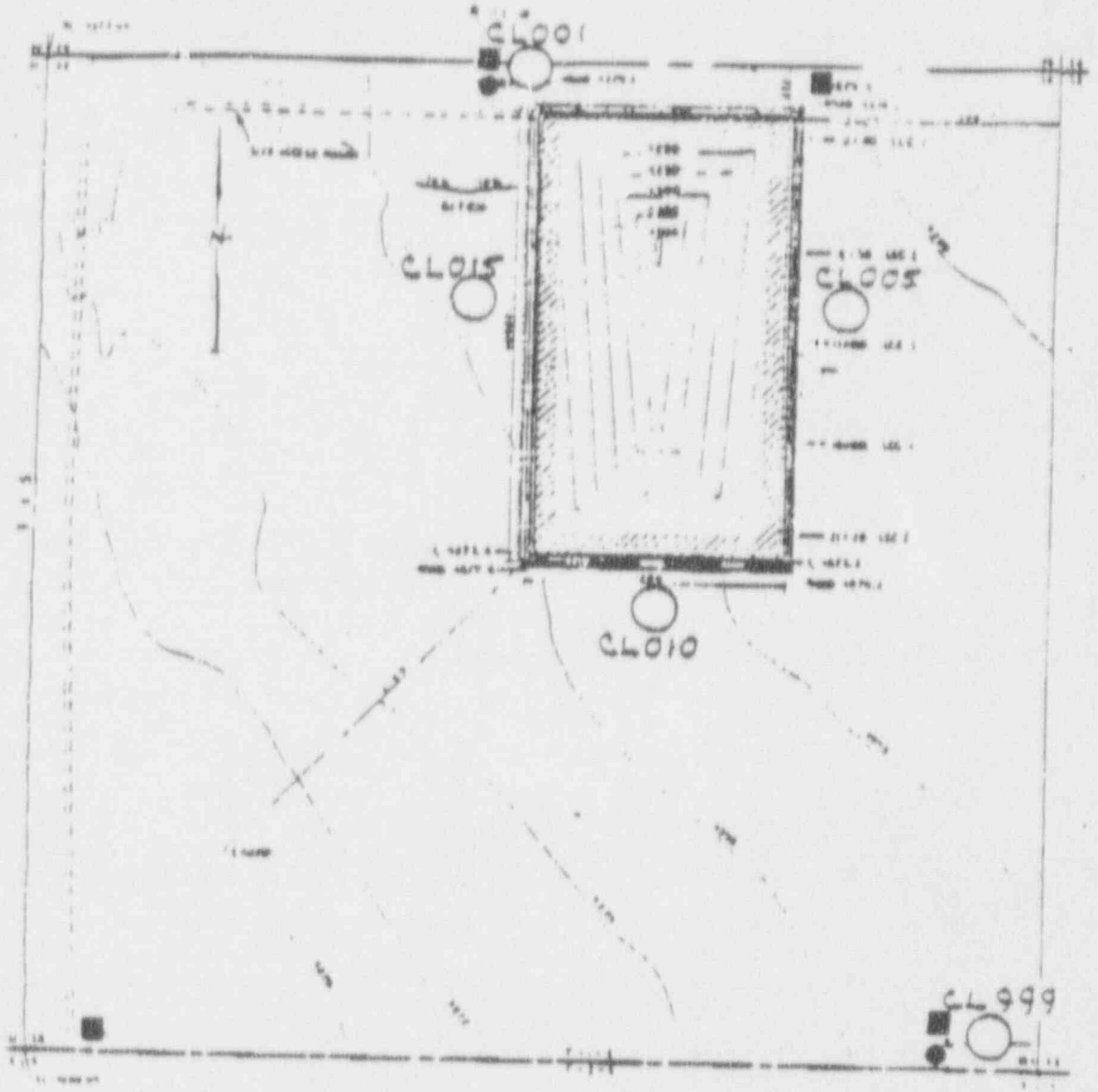


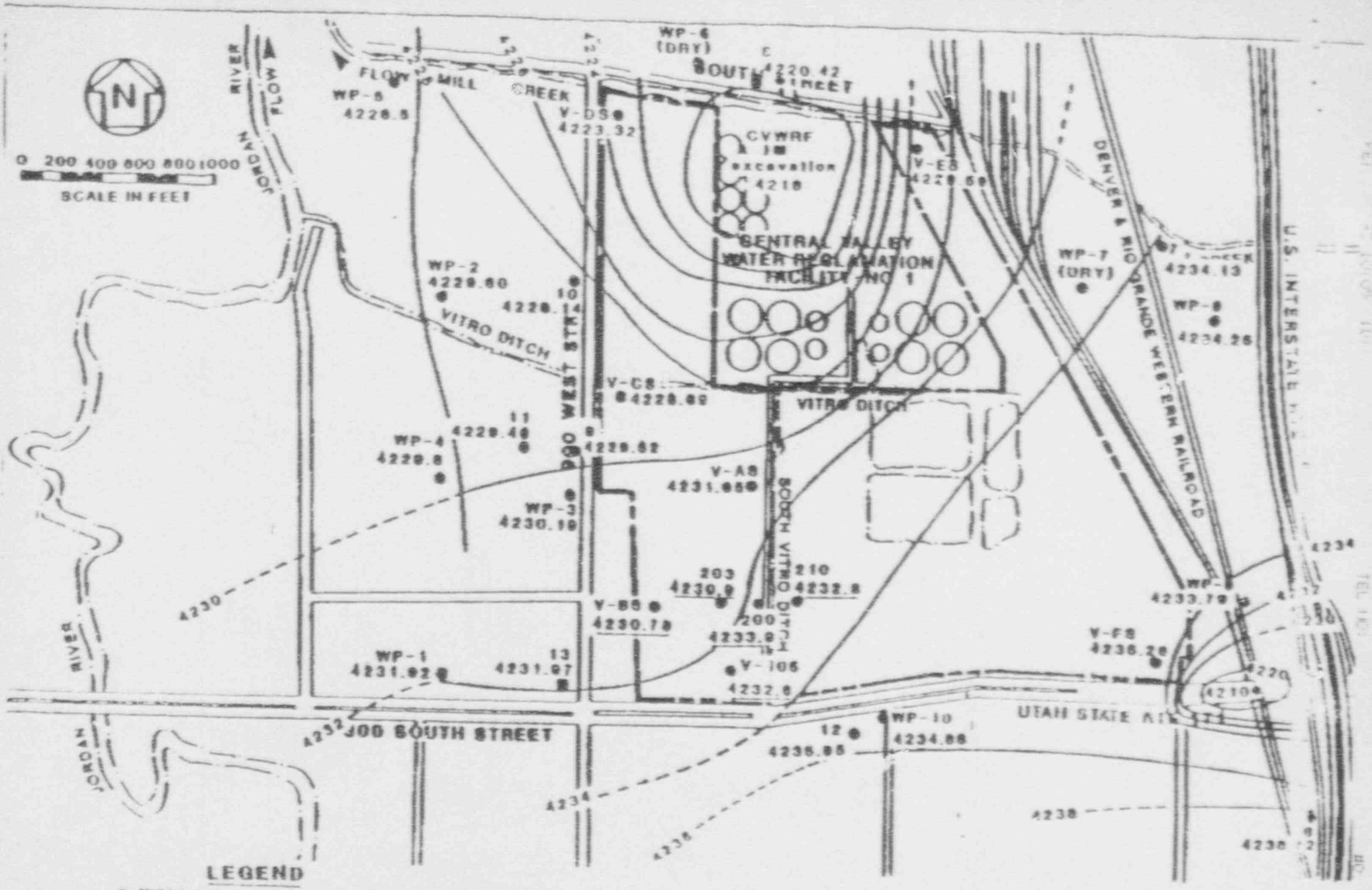
FIGURE 4

ENVIRONMENTAL MONITORING LOCATIONS AT CLIVE DISPOSAL SITE

○ Passive Environmental Radon Monitor

■ High Volume Air Sampler

● RPISU



LEGEND

- WELLS SHOWING MEASURED WATER LEVEL (UNDERLINED WHERE VERTICAL CONTROL IS LACKING)
- HIGHWAY DRAIN
- WATER TABLE SURFACE CONTOUR (DASHED WHERE EXTRAPOLATED)

FIGURE 5

WATER LEVELS IN THE UNCONFINED AQUIFER SOUTH SALT LAKE SITE, MEASURED SEPT. 1983

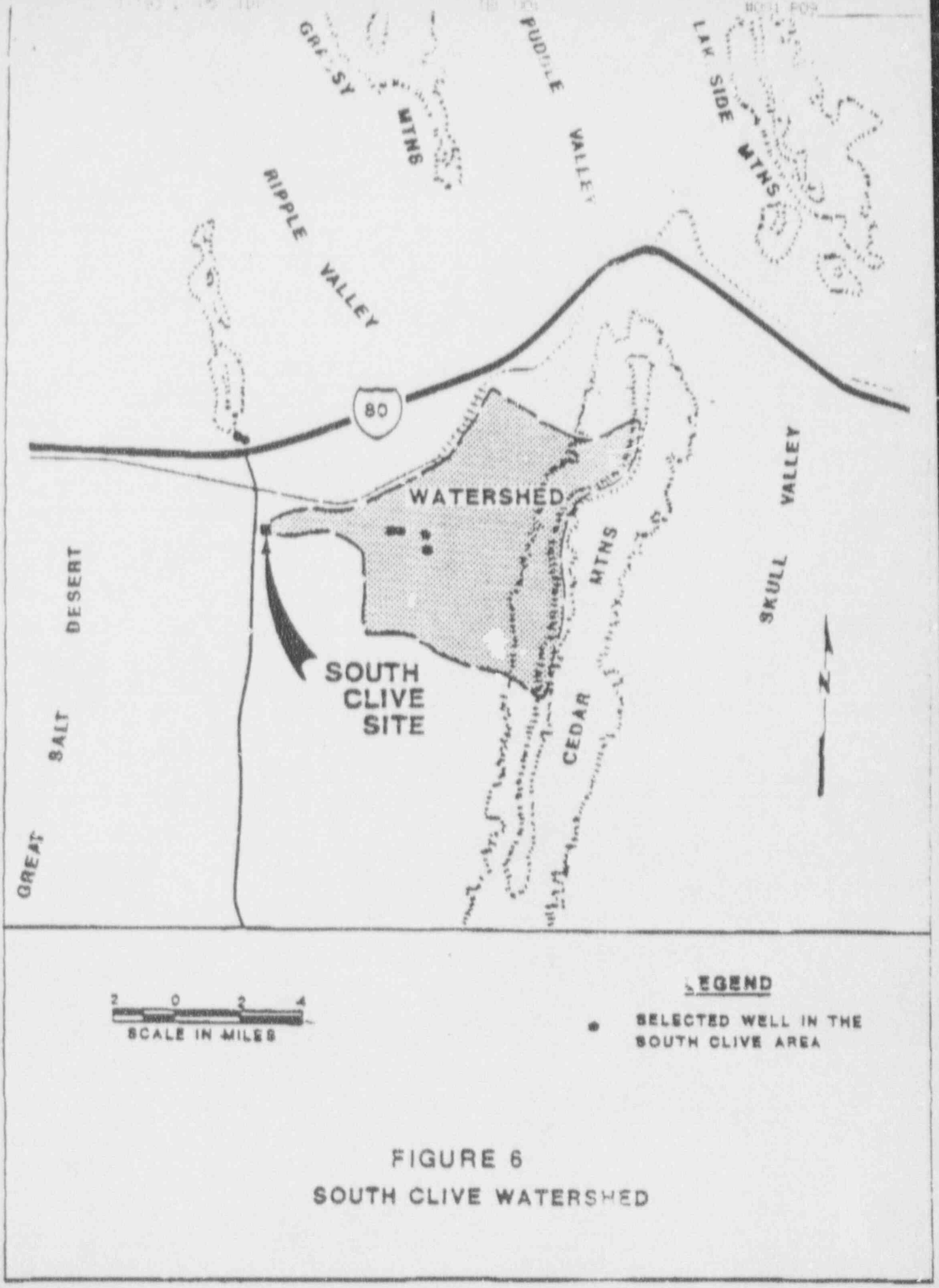


FIGURE 6

SOUTH CLIVE WATERSHED

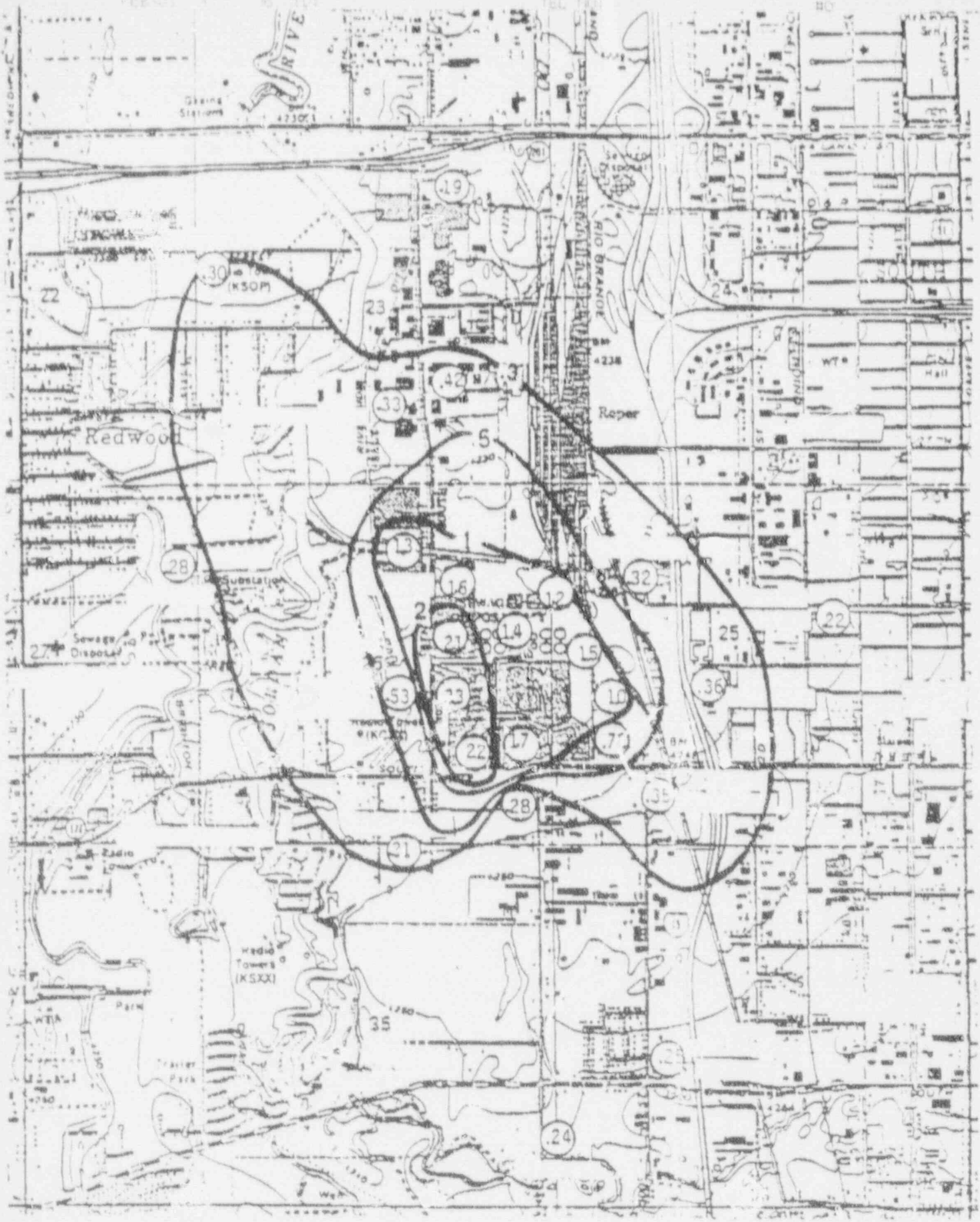


FIGURE 7

[illegible] DECEMBER [illegible]

LOCATION AND MEASUREMENT RESULTS, PERMS

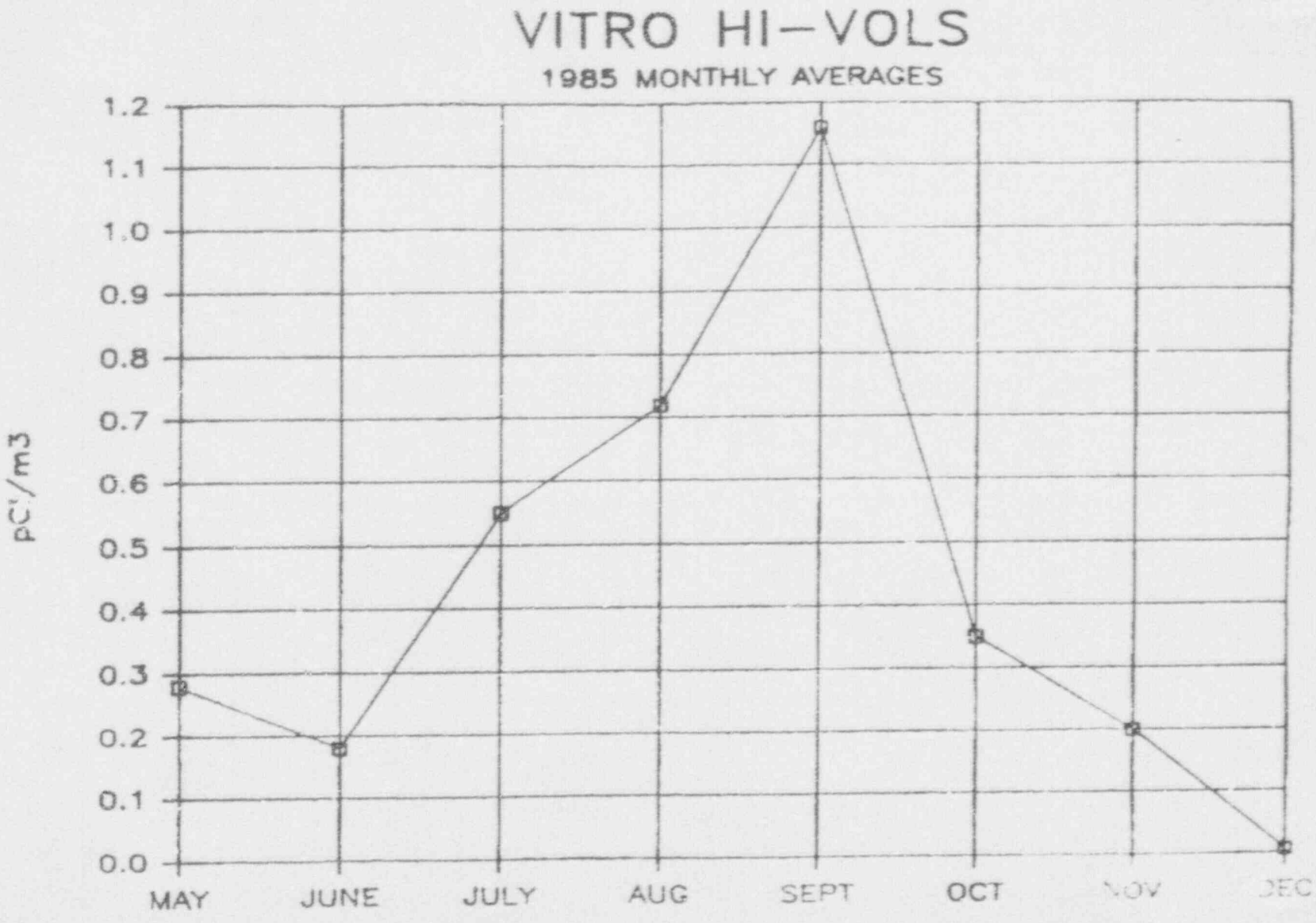


FIGURE 8

Air sampling results showing 1985 monthly average gross alpha concentrations in pCi/m3. The 10 CFR 20 standard of 2.0 pCi/m3 for radiation workers applies.

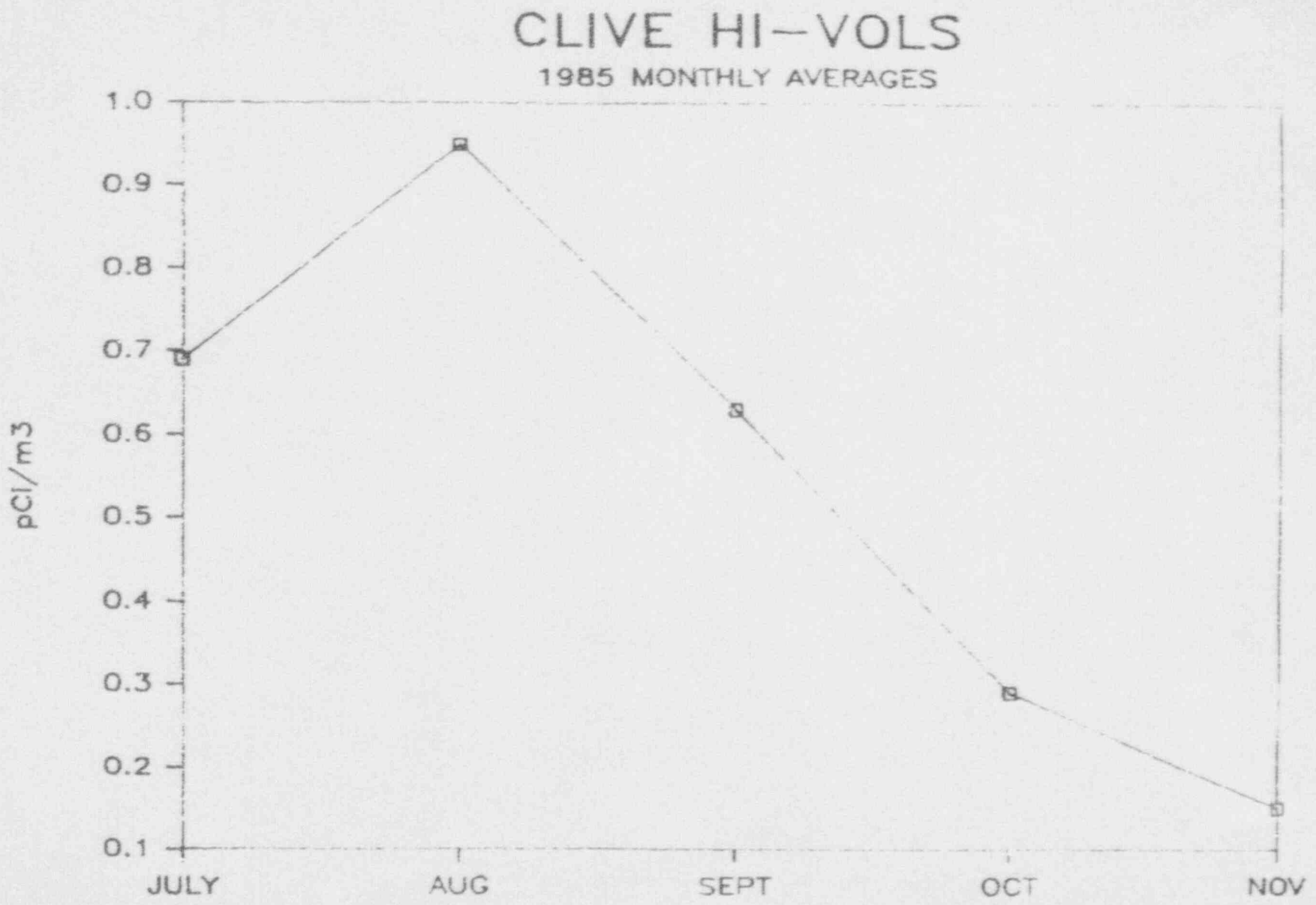


FIGURE 9

Air sampling results showing 1985 monthly average gross alpha concentrations in pCi/m3. The 10 CFR 20 standard of 2.6 pCi/m3 for radiation workers applies.

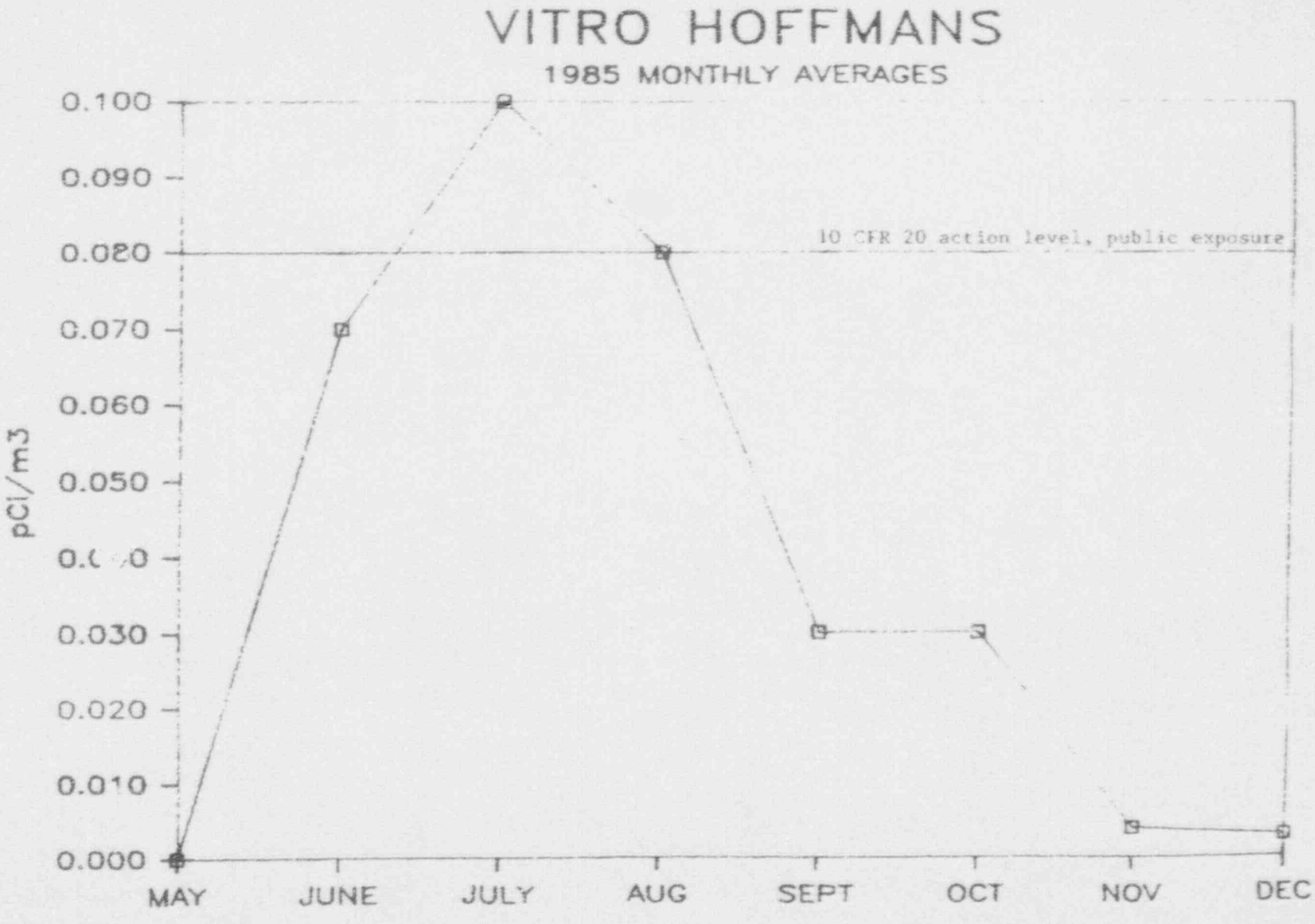


FIGURE 10

Air sampling results showing 1985 monthly average gross alpha concentrations in pCi/m3. The 10 CFR 20 standard of 0.08 pCi/m3 for the public applies.

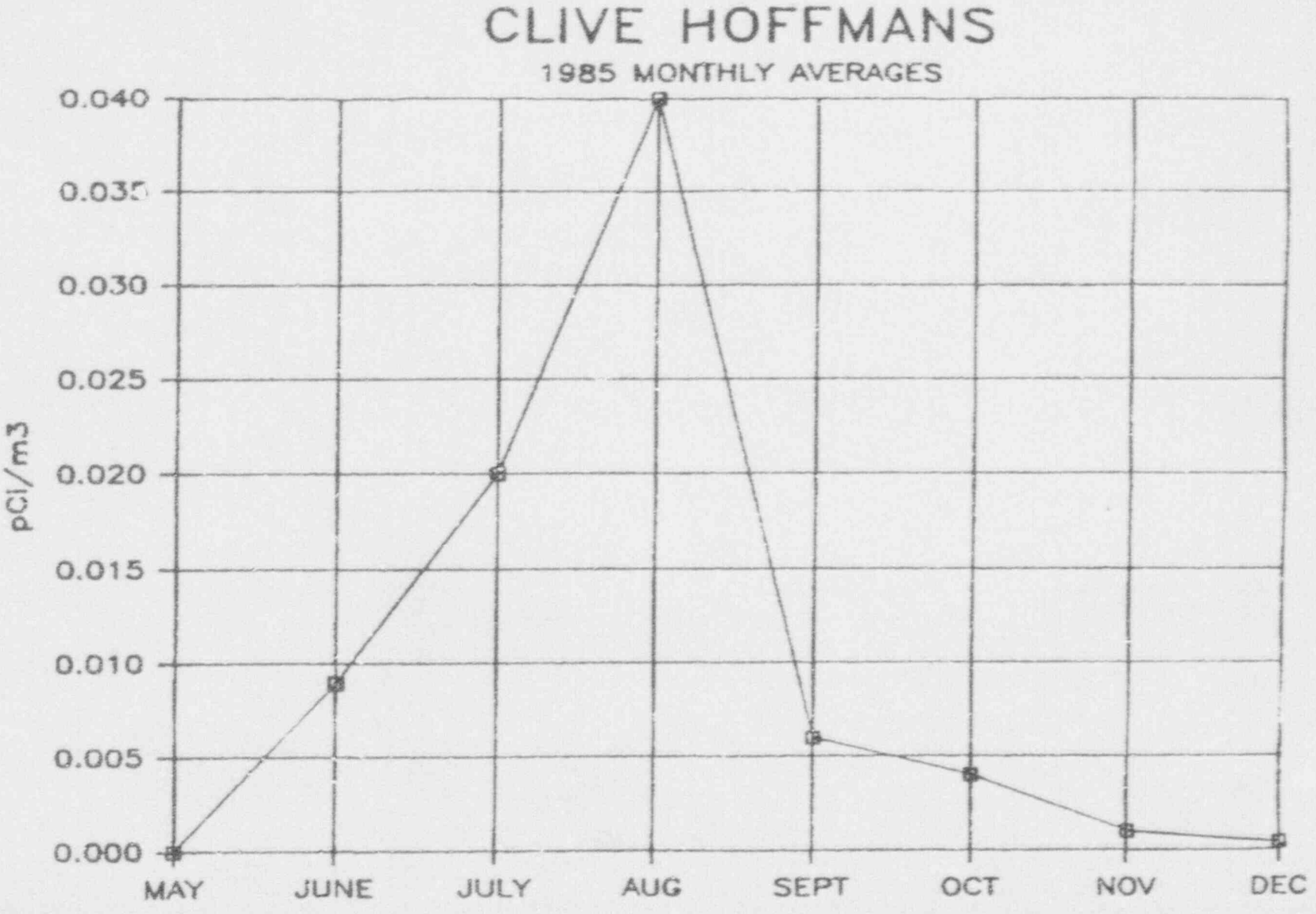


FIGURE 11

Air sampling results showing 1985 monthly average gross alpha concentrations in pCi/m3. The 10 CFR 20 standard of 0.08 pCi/m3 for the public's exposure applies.

ENCLOSURE 2

URANIUM MILL TAILINGS
REMEDIAL ACTION

PROJECT ANNUAL ENVIRONMENTAL MONITORING REPORT

CALENDAR YEAR 1986

Salt Lake City, Utah

Prepared by:

Utah Department of Health
Division of Environmental Health
Bureau of Radiation Control

recharged by upward flow from the "confined" aquifer and by surface infiltration. The lower system is recharged by the Wasatch Mountains to the east. The upper system discharges into surface water courses such as the north and south Vitro ditches, Millcreek and the Jordan River.

Clive - The water table below the Clive site ranged from 25-35 feet below ground surface with saturated conditions extending at least 230 feet below surface. The hydraulic gradient slopes gradually to the north-northeast. Groundwater recharge occurs from the Cedar Mountains to the east. Measured fluctuations in groundwater elevations are generally less than one foot.

III. ENVIRONMENTAL MONITORING METHODS AND RESULTS

A. Radon Monitoring

The State of Utah, Bureau of Radiation Control and the EPA started monitoring Radon-222 concentrations in air in April, 1985. Both Passive Environmental Radon Monitors (PERM's) and Radon Progeny Integrated Sampling Units (RPISU's) are used at both the Vitro and Clive sites. There are 26 PERM and 3 RPISU locations around the Vitro site, and 5 PERM and 2 RPISU locations around the Clive site. The PERM's measure ambient levels of Radon-222 and measure the active radon daughter concentrations. Samples are collected on a bi-weekly basis and shipped to EPA, Las Vegas for analysis. See Figures II. B2 for PERM and RPISU locations. Two Vitro PERM sites have duplicate PERMS for result comparisons. They are VT050 and VT080.

Background

Vitro - Prior to the beginning of any remedial action, the Monsanto Research Corp. monitored radon concentration in air at 36 PERM stations around the Vitro site. During this monitoring period the average background radon in air concentration in the Salt Lake Valley was determined by Monsanto to be 0.25 pCi/l and was approached a little more than 1 mile (1.6 km) from the site. Two PERM's currently in use are considered background for the Vitro site. They are VT998 and VT999.

Clive - A track etch detector placed at the Clive site by DOE, gave a monthly average of 0.31 pCi/l, for the quarter 12/81 - 2/82. PERM C1999 currently in use is considered background for the Clive site.

1986 Results

Figure III.A1 displays four isopleth maps showing the respective quarterly average radon concentrations for 1986 at the PERM locations in Salt Lake City. 10 CFR 20 limits the concentration of Radon-222 in air in unrestricted areas to 3 pCi/l in excess

of the natural background when averaged over 1 year. The corresponding limit for a restricted area is 30 pCi/l when averaged over 13 weeks. Table III.A2 and III.A3 summarize the PERM and RPISU measurements at the Vitro and Clive sites in 1986. Please refer to Figure II.B2 for location correlation.

TABLE III.A2

AVERAGE RADON CONCENTRATION (pCi/l) VALUES FROM THE VITRO AND CLIVE SITES - PERM's

EPA CODE #	JAN.-MARCH	APRIL-JUNE	JULY-SEPT.	OCT.-NOV.
VT001	1.283	0.824	0.559	0.393
*VT005/6	0.830	1.135	0.908	0.416
VT010	1.560	1.050	0.834	0.540
VT016	0.996	0.614	0.338	0.339
VT021	0.623	0.446	0.620	0.458
*VT025/6	0.532	0.681	0.790	0.495
VT030	1.348	0.983	0.354	0.304
VT035	1.041	1.889	2.675	0.828
*VT040/41	0.484	0.636	0.663	0.655
VT045	0.611	0.582	0.392	0.303
VT050	0.479	0.505	0.547	0.495
VT050	0.601	0.557	0.564	0.493
VT055	0.332	0.278	0.286	0.304
VT060	0.314	0.231	0.244	0.273
VT065	0.265	0.247	0.276	0.301
VT070	0.219	0.246	0.310	0.329
VT075	0.251	0.273	0.275	0.283
VT080	0.230	0.210	0.278	0.283
VTC)	0.248	0.256	0.277	0.407
VT085	0.259	0.214	0.317	0.346
VT090	0.230	0.212	0.274	0.350
VT095	0.250	0.291	0.261	0.378
VT100	0.250	0.210	0.237	0.281
VT105	0.210	0.203	0.213	0.277
VT110	0.283	0.192	0.203	0.265
VT115	0.782	0.742	0.676	0.606
VT998	0.182	0.188	0.250	0.226
VT999	0.324	0.230	0.220	0.309
CL001	0.324	0.357	0.451	0.576
CL005	0.206	0.296	0.408	1.172
CL010	0.369	0.574	0.852	1.128
CL015	0.430	0.867	1.411	1.672
CL999	0.230	0.260	0.352	0.536

NOTE: December results are not yet available
* Location of PERM was changed slightly during the first quarter

TABLE III.A3
AVERAGE RADON DAUGHTER CONCENTRATION
VITRO AND CLIVE SITES - RPISU's

EPA CODE #	JAN.-MARCH	APRIL-JUNE	JULY-SEPT.	OCT.-NOV.
VT016	.0027	.0017	.002	.002
VT021	.0007	.0015	.0015	.002
VT115	.018	.0016	.0019	.002
CL001	.0012	.0015	.002	.0033
CL999	.0015	.0010	.0015	.0023

NOTE: December results are not yet available
NOTE: VT = Vitro CL = Clive

B. Radiological Airborne Particulate Monitoring

Work areas and boundary areas are continuously sampled for airborne particulates at the Vitro and Clive sites.

Work area samples are collected with high volume vacuum air pumps (Hi-Q Environmental Products Company Model CF-900V-2C). These pumps are set-up in conjunction with daily construction operation where airborne particulate levels and worker exposure levels are expected to be highest (i.e. excavation, haul road, loading and unloading operations). Gas generators are used to power these vacuum air pumps and are placed downwind of the sampling unit so as not to influence sample results and to facilitate the mobility of sampling units to coincide with changes in work area locations.

Site boundary samples are collected by Hoffman high volume sampling units (General Metal Works, Inc.). Each site utilizes four Hoffman samplers which run on a continuous basis with the exception of Hoffman unit number nine (H9) located at the northeast end of the Clive disposal site. H9 runs only during train car rollover operations, as it is powered by the rollover generator which is shut down between dumping operations. Due to the close proximity of H9 to a work area (rollover operation), samples collected at this location indicate a significantly higher gross alpha concentration, but still fall well within gross alpha allowable limits on monthly average concentration calculations.

Of all the radionuclides in the uranium decay chain, Th^{230} is the isotope of most concern in airborne particulate concentrations. Since the Vitro site laboratory is not equipped to measure Th^{230} separately, only gross alpha measurements are made. Therefore, gross alpha concentrations in air standards

(for this UMTRA Project) have been established at 3 times the 10 CFR 20 Th^{230} concentration in air limit, (memorandum dated April 15, 1986, Blaine Howard, Certified Health Physicist, BRC). Ideally, a limit for gross alpha would be a weighed average of the limits of the separate isotopes in the sample. However, since the limit for Th^{230} is 1/15th of the limit for Ra-226 (the next most restrictive isotope in the tailings) only the ratio of Th^{230} to gross alpha is required to set an appropriate limit. This ratio will be different for different compositions of dust, but an average value specific to the Vitro uranium mill tailings can be used provided a sufficient safety factor is included.

To establish a realistic ratio between the gross alpha measurements and the Th^{230} concentrations, the Bureau sent 13 air filters to the EPA, Las Vegas Laboratory in 1986 for isotopic analysis. The results ranged in values from 3.2% to 12.9% with an average Th^{230} concentration equal to 7.6% of the gross alpha measurement determined by the normal counting procedure at the Vitro site.

Laboratory analyses are performed at the site Radiation Control trailer. Approximately 10% of the filters analyzed are sent to the State Health Laboratory for gross alpha comparison and metal analyses (arsenic, cadmium, chromium, lead, manganese, molybdenum and vanadium). Filters are also sent to EPA, Las Vegas for radiological analysis.

Calibration and Standards

A Mettler AE 50 scale is used to weigh filters. The weight before and after sampling is used to calculate particulate concentrations. The alpha counter used is a Ludlum Model 1000 scaler, with a Ludlum Model 43-1 alpha probe. A 30 minute background count on a clean sampling filter and a 10 minute standard count of a National Bureau of Standards (NBS) traceable Th^{230} source is taken daily to calculate the probe's counting efficiency.

Figures III.B1, III.B2, III.B3 and III.B4 are bar graphs displaying 1986 monthly gross alpha average concentration in air in units of pCi/m^3*. The differences in work area and boundary area exposure level scales are reflective of 10 CFR 20 Appendix B limits, Table 1 and Table 2, respectively. The 10 CFR 20 Th^{230} in air limits and the BRC gross alpha concentration in air tentative limit were never exceeded in monthly average concentrations during 1986.

* Absence of bar indicates that no samples were collected due to mechanical or electrical failure of sampling unit.

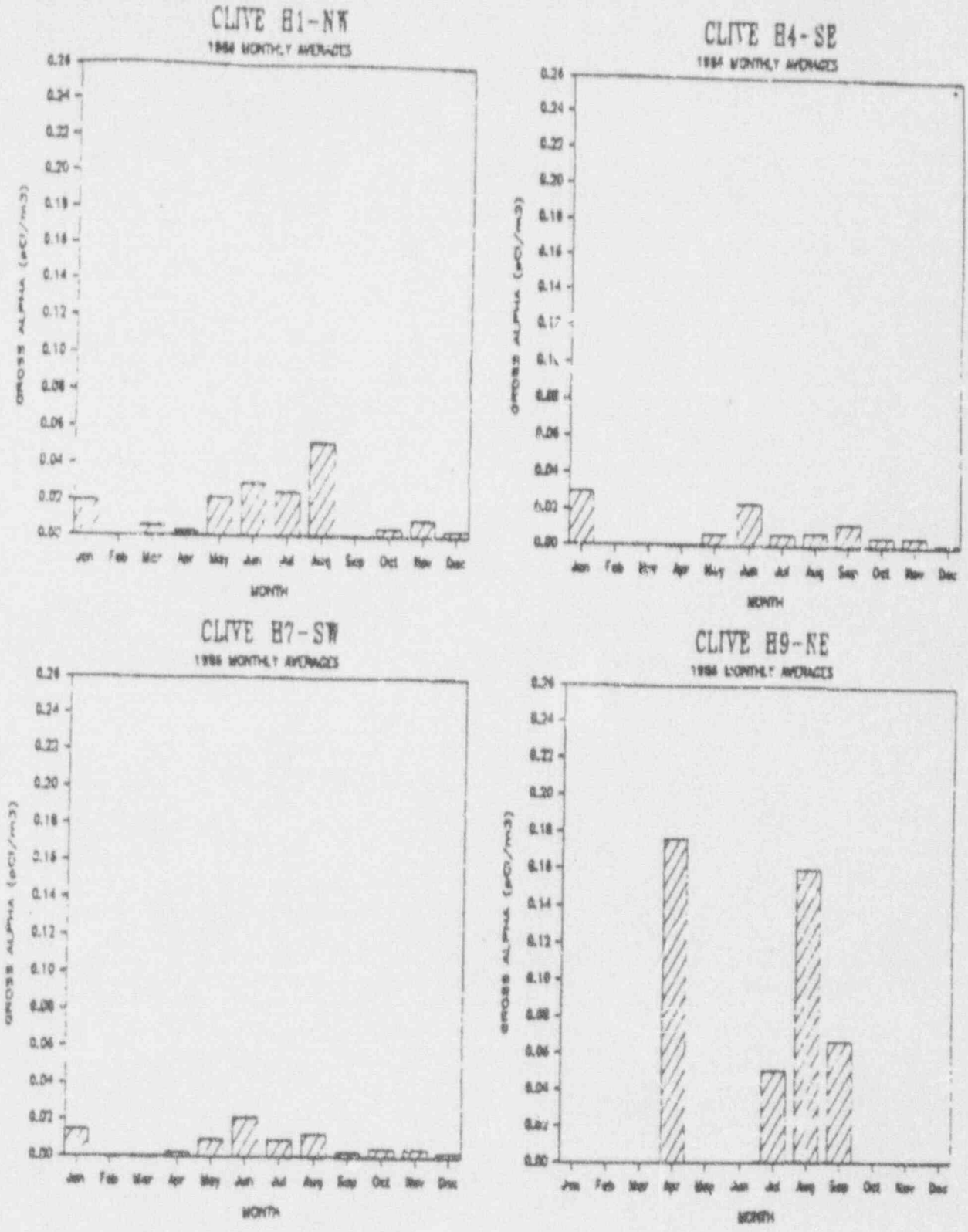


FIGURE III.B2

Air sampling results showing 1985 monthly average gross alpha concentrations in pCi/m^3. BRC limit of 0.24 pCi/m^3 for the public applies.

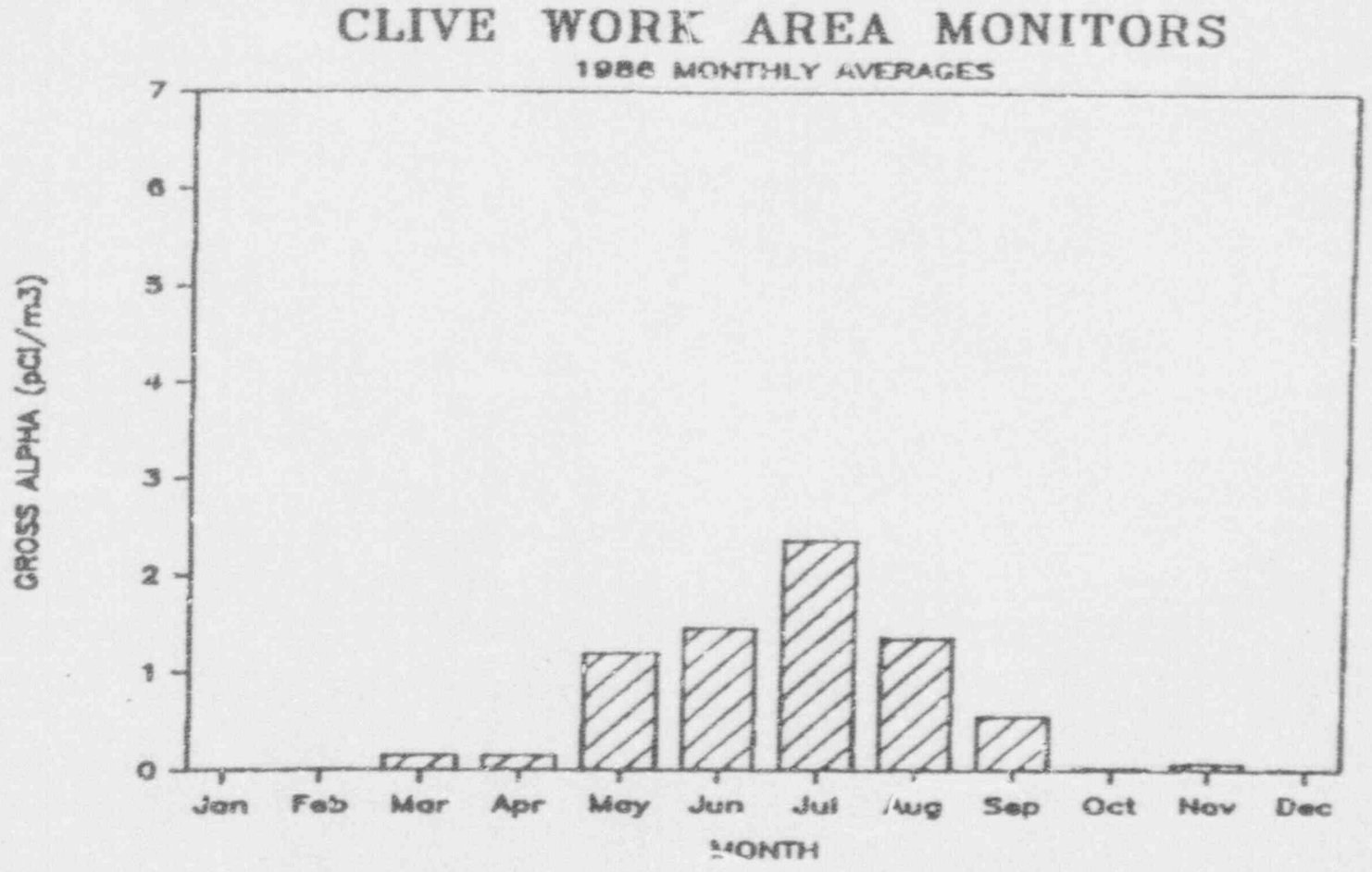


FIGURE III.B4

Air sampling results showing 1986 monthly average gross alpha concentrations in pCi/m³. BRC limit of 6.0 pCi/m³ for radiation workers applies.

C. Water Monitoring

Surface

Surface water samples are taken at various disturbed areas on the Vitro site. These grab samples are analyzed for gross alpha, uranium and radium-226 by the State Health Laboratory. Heavy metals analysis is also performed periodically. All sampling is performed by the Bureau of Radiation Vitro staff. Much effort has been made to minimize contaminated water from being discharged to unrestricted areas. Grab samples taken from the surface of the Vitro ditch exiting the site show compliance with standards set forth by the NPDES permit.

Well Monitoring

As part of the site characterization program groundwater wells (deep and shallow) were installed. Ten ground water monitoring wells in the Vitro vicinity, were selected for annual sampling. Selection of the wells were based on the physical condition of the wells and hydrological considerations including direction of groundwater movement with respect to the tailings pile. Sampling of the wells are carried out using EPA standard procedures.

Due to the two aquifer system, four wells (1, 2, 3, 5) were sampled in the deep confined aquifer and six wells (6B, 7A, 3, 9B, 11A, 12) were sampled in the shallow unconfined aquifer.

With respect to the groundwater flow (see Figure II.B4), four wells upgradient, three cross gradient wells and three downgradient wells were sampled. The location of the groundwater well's sampled around the Vitro site are shown in Figure III.C3.

Radiologic parameters were utilized as indicators of changes in groundwater contamination levels. A summary of radionuclide concentrations for the unconfined aquifer are shown in Tables III.C1 and III.C2. The results for groundwater monitoring are presented graphically in Figure III C.4* **.

Clive groundwater sampling will be done on a pre-operational and post-operational basis.

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* Absence of bar indicates that results were less than minimum detectable concentration (MDC).

** EPA National Interim (40 CFR 141, 143) drinking water standards apply.

Environmental Protection Agency in Denver and to the State of Utah Bureau of Water Pollution Control. Water samples were analyzed at the State of Utah Health Laboratory for parameters specified in the NPDES permit.

NPDES Permit Requirements and Monitoring Results

NPDES requires that the discharge not exceed 10% of the flow in Millcreek and that the pH of the dischcarge be between 6.5 and 9.0. Both of these requirements have always been met. The only NPDES requirement that has not always been met was one sample that exceeded the limit for suspended solids on November 7, 1986. All other results indicate compliance with NPDES. Other NPDES parameters and sampling results are summarized in Table III.C5.

IV. PERSONNEL MONITORING - METHODS AND RESULTS

A. External Gamma Exposures

All project personnel who worked for more than 3 months at either the Clive or Vitro site were issued thermoluminescent dosimeter (T.D) badges to monitor their external gamma exposure. A summary report for 1986 from the R.S. Landauer Co., giving individual results for 294 persons is summarized in TAble IV.A1. The average dose for 1986 was 50 mrem.

TABLE IV.A1

Dose*	Number of Persons	Percent of Total
Below Minimum Measurable Quantity	125	42.5
Less than 100 mrem	111	37.8
100 to 250 mrem	51	17.3
250 to 500 mrem	5**	1.7
500 to 750 mrem	2**	.7
TOTAL	294	100.0

B. Occupational Exposures

Occupational exposures during 1986 to radioactive particulates in air have been monitored during the working periods on a daily basis. Personnel pumps with 0.8 micron celluose filters were

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* The maximum permissible exposure for radiation workers is 5000 mrem

** The majority of the doses on these 7 badges was received while the badges were not worn and came from nuclear density gauges which were stored for a short time near the personnel lockers.

run for sampling both work area levels and individual exposures. The pumps were pre and post calibrated to determine the flowrate. The total volume is calculated as the product of the flowrate and run time of the sample. After a seven day waiting period which allows for the decay of Rn-222 daughter products, the filter is carefully removed from the cassette, the sample is alpha counted, and the gross alpha concentration is determined.

The results are presented as time weighted averages (TWA's) in Figure IV.B1. As mentioned in Part III Section B. of this report, the BRC has established a work area gross alpha concentration in air standard of 6.0 pCi/m^3 for this UMTRA project.

The monthly averages of Vitro samples indicate levels far below the 6.0 pCi/m^3 criteria. Four samples of the 178 collected at the Vitro site exceeded the 6.0 pCi/m^3 standard.

The results of samples taken at Clive indicate greater personnel exposure than at Vitro. The TWA's during the summer months of June, July, and August indicate average exposure levels between 66% and 90% of the criteria. Eighteen of the 159 samples at Clive exceeded the 6.0 pCi/m^3 criteria.

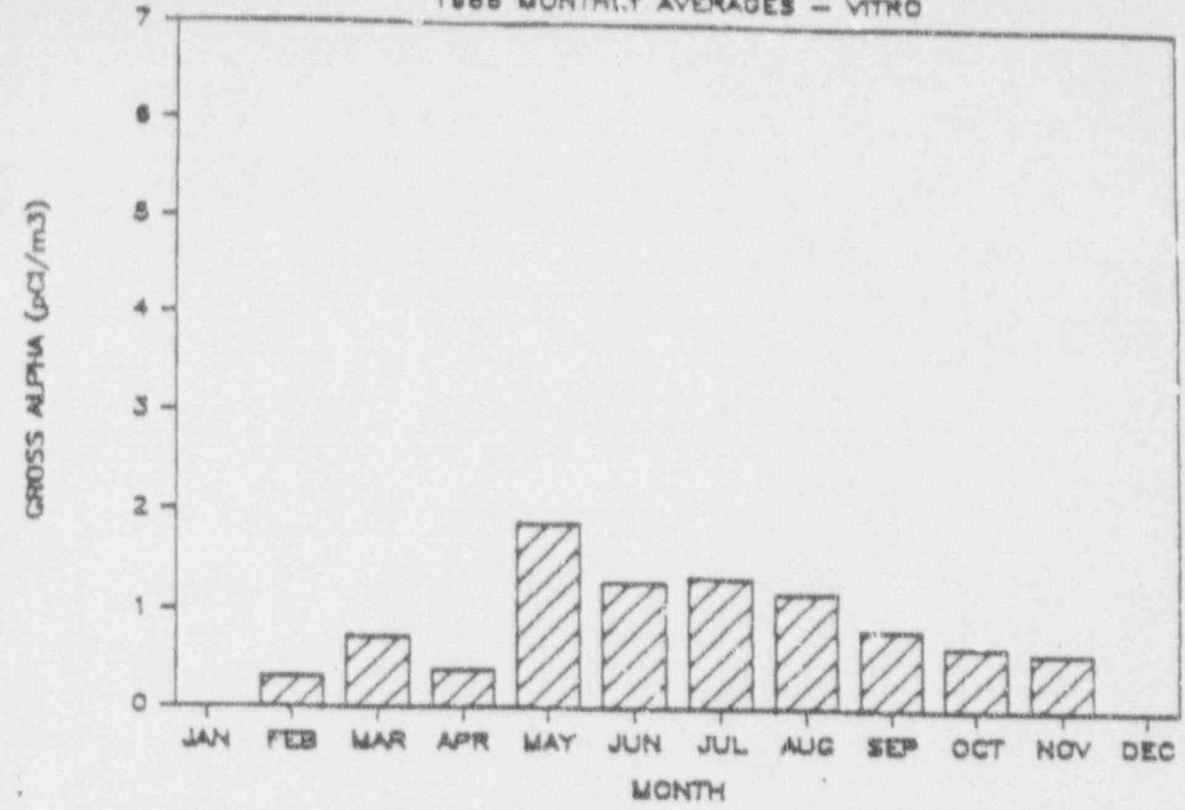
Although these results do not demonstrate a pattern of over exposure, they do demonstrate some higher than desirable levels of personnel exposure to radioactive particulates in air. Furthermore, they could have been greatly reduced by more aggressive efforts at dust suppression watering on the part of the contractor. The contractors inability to maintain dust levels at more reasonable and achievable levels has been well documented in the field records. This data also indicates the need to continue monitoring the personnel exposure to radioactive particulates, and maintain efforts to control airborne particulates. These measures will assess the compliance and assist the contractor in maintaining compliance with NRC standards.

C. INDUSTRIAL HYGIENE

During 1986 spot sampling to assess the contractor's compliance with OSHA personnel exposure limits (PEL's) for silica and other metals was performed. The metals data indicates no exposure problem at the Vitro or Clive sites. The greatest exposure sampled was less than 2% of the PEL for arsenic.

PERSONNEL AIR SAMPLER RESULTS

1988 MONTHLY AVERAGES – VITRO



PERSONNEL AIR SAMPLER RESULTS

1988 MONTHLY AVERAGES – CLIVE

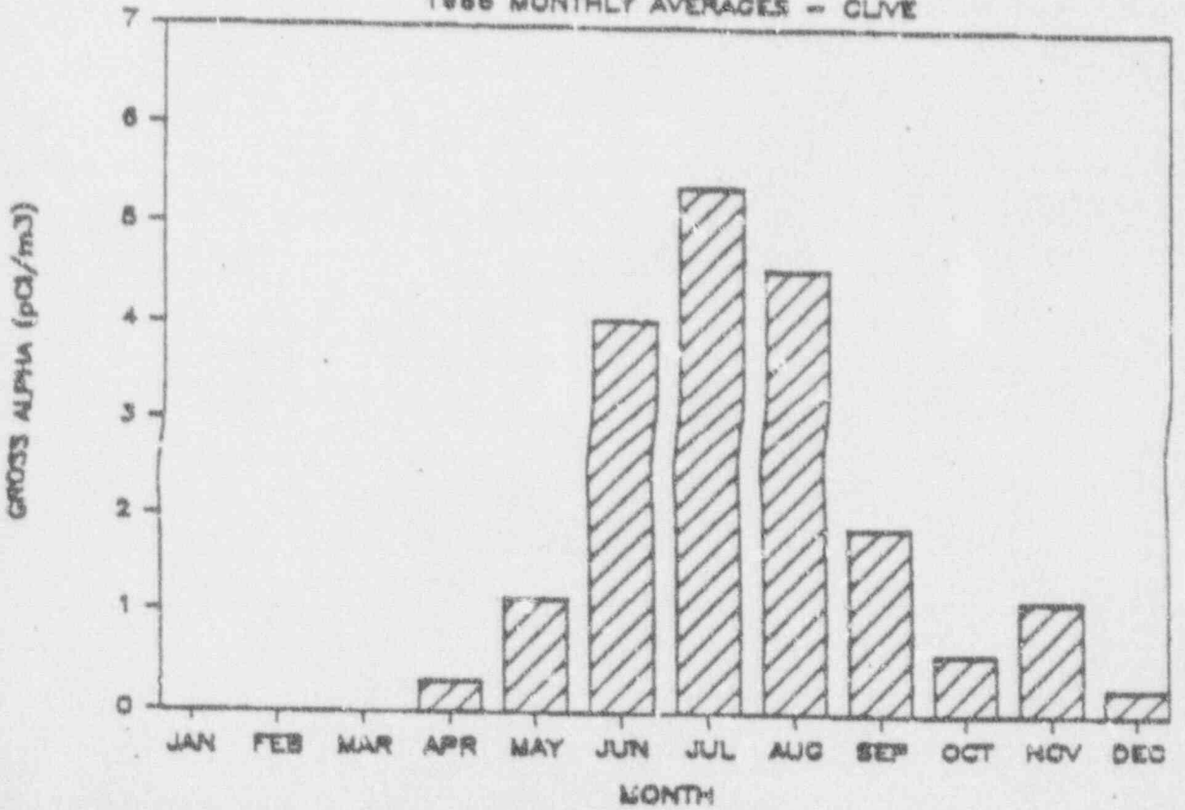


FIGURE IV-21

ENCLOSURE 3

URANIUM MILL TAILINGS
REMEDIAL ACTION

PROJECT ANNUAL ENVIRONMENTAL
MONITORING REPORT

CALENDAR YEAR 1987

Salt Lake City, Utah

Prepared by:

Utah Department of Health
Division of Environmental Health
Bureau of Radiation Control

Clive - A track etch detector placed at the Clive site by DOE, gave a monthly average of 0.31 pCi/l, for the quarter 12/81 - 2/82. PERM CL999 currently in use is considered background for the Clive site.

1987 Results

TABLE III.A1

Average Radon Concentration (pCi/l)
Values from the Vitro and Clive Sites - PERM's

EPA Code #	Jan-March	Apr-June	July-Sept	Oct-Dec
VT001	.293	.224	.273	.436
VT006	.343	.344	.443	.503
VT010	.281	.227	.312	.341
VT016	.247	.224	.251	.318
VT021	.249	.346	.475	.486
VT026	.292	.292	.390	.271
VT030	.190	.216	.255	.332
VT035	.220	.225	.260	.344
VT041	.258	.320	.389	.345
VT045	.191	.212	.312	.291
VT050	.274	.238	.399	.395
VT050	.223	.202	.318	.299
VT055	.226	.241	.333	.350
VT060	.207	.213	.201	.320
VT065	.230	.218	.273	.354
VT070	.206	.238	.347	.388
VT075	.165	.189	.270	.285
VT080	.230	.252	.364	.494
VT080	.235	.337	.392	.406
VT085	.171	.216	.253	.291
VT090	.272	.172	.244	.264
VT095	.253	.213	.342	.410
VT100	.262	.228	.330	.383
VT105	.193	.125	.265	.388
VT110	.203	.193	.205	.224
VT115	.364	.336	.482	.476
VT998	.204	.169	.240	.323
VT999	.215	.259	.343	.385
CL001	.423	.283	.402	.401
CL005	.385	.223	.531	.503
CL010	.441	.414	.567	.500
CL015	.789	.611	.744	.677
CL999	.323	.342	.387	.415

TABLE III.A2

Average Radon Daughter Concentration (pCi/l)
Vitro and Clive Sites - RPISU's

EPA Code #	Jan-March	Apr-June	July-Sept	Oct-Dec
VT01A	.0013	.0015	.0022	.0037
VT021	.0014	.0018	.0037	.0040
VT115	.0017	.0018	.0030	.0050
CL001	.0017	.0015	.0022	.0039
CL999	.0020	.0010	.0026	.0035

B. Radiological Airborne Particulate Monitoring

Boundary areas are continuously sampled for airborne particulates at the Vitro and Clive sites. Site boundary samples are collected by Hoffman high volume sampling units (General Metal Works, Inc.). The Vitro site had five Hoffman samplers and the Clive site has four which run on a continuous basis.

Of all the radionuclides in the uranium decay chain, Th^{230} is the isotope of most concern in airborne particulate concentrations. Since the Vitro site laboratory is not equipped to measure Th^{230} separately, only gross alpha measurements are made. Therefore, gross alpha concentrations in air standards (for this UMTRA Project) have been established at 3 times the 10 CFR 20 Th^{230} concentration in air limit, (memorandum dated April 15, 1986, Blaine Howard, Certified Health Physicist, BRC). Ideally, the limit for gross alpha would be a weighed average of the limits of the separate isotopes in the sample. However, since the limit for Th^{230} is 1/15th of the limit for Ra^{226} (the next most restrictive isotope in the tailings) only the ratio of Th^{230} to gross alpha is required to set an appropriate limit. This ratio will be different for different compositions of dust, but an average value specific to the Vitro uranium mill tailings can be used provided a sufficient safety factor is included.

To establish a realistic ratio between the gross alpha measurements and the Th^{230} concentrations, the Bureau sent thirteen air filters to the EPA Las Vegas Laboratory in 1987 for isotopic analysis. The results ranged in values from 3.2% to 12.9% with an average Th^{230} concentration equal to 7.6% of the gross alpha measurement determined by the normal counting procedure at the Vitro site.

Laboratory analyses are performed at the site Radiation Control trailer. Approximately 10% of the filters analyzed are sent to the State Health Laboratory for gross alpha comparison and metal analyses (arsenic, cadmium, chromium, lead, manganese, molybdenum, and vanadium). Filters are also sent to EPA Las Vegas for radiological analysis.

Calibration and Standards

A Mettler AE 50 scale is used to weigh filters. The weight before and after sampling is used to calculate particulate concentrations. The alpha counter used is a Ludlum Model 1000 scaler, with a Ludlum Model 43-1 alpha probe. A 30 minute background count on a clean sampling filter and a 10 minute standard count of a National Bureau of Standards (NBS) traceable Th^{230} source is taken daily to calculate the probe's counting efficiency.

Figures III.B1, III.B2, and III.B3 are bar graphs displaying 1987 monthly gross alpha average concentration in air in units of pCi/m^3*. The 10 CFR 20 Th^{230} in air limits and the BRC gross alpha concentration in air tentative limit were never exceeded in monthly average concentrations during 1987.

C. Water Monitoring

Surface

Surface water samples are taken at various disturbed areas on the Vitro site. These grab samples are analyzed for gross alpha, uranium and Ra^{226} by the State Health Laboratory. Heavy metals analysis is also performed periodically. All sampling is performed by the Bureau of Radiation Vitro staff. Much effort has been made to minimize contaminated water from being discharged to unrestricted areas. Grab samples taken from the surface of the Vitro ditch exiting the site show compliance with standards set forth by the NPDES permit.

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* Absence of bar indicates that no samples were collected due to mechanical or electrical failure of sampling unit.

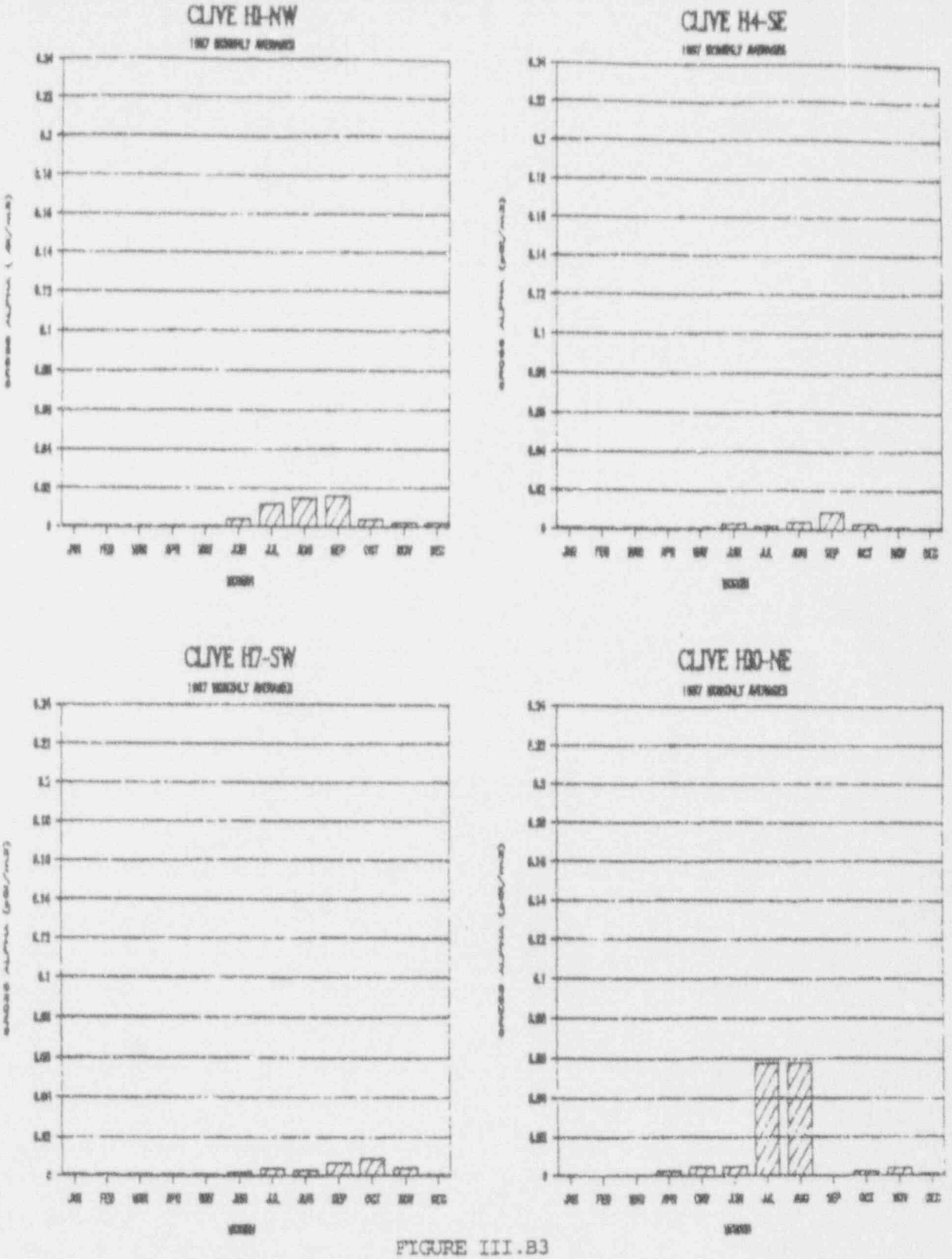

FIGURE III.B3

Air Sampling Results Showing 1987 Monthly Average Gross Alpha Concentrations in pCi/m^3. The BRC limit of 0.24 pCi/m^3 for Boundary Limits Apply.

Well Monitoring - Vitro

As part of the site characterization program groundwater wells (deep and shallow) are installed. Ten groundwater monitoring wells in the Vitro vicinity, were selected for annual sampling. Wells were not samples in 1984 or 1985 because the Vitro project did not begin in earnest until the late spring of 1985. Selection of the wells were based on the annual sampling done in 1986, and physical condition of the wells and hydrological considerations including direction of groundwater movement with respect to the tailings pile. Sampling of the wells are carried out using EPA standard procedures.

Due to the two aquifer systems, four wells (1, 2, 3, 5) were sampled in the deep confined aquifer and six wells (6B, 7A, 3, 9B, 11A, 12) were sampled in the shallow unconfined aquifer.

With respect to the groundwater flow (see Figure II.B4), four wells upgradient, three cross gradient wells and three downgradient wells were sampled. The location of the groundwater well's sampled around the Vitro site are shown in Figure III.C3.

Radiological parameters were utilized as indicators of changes in groundwater contamination levels. A summary of radionuclide concentrations for the unconfined aquifer are shown in Tables III.C1 and III.C2. The results for groundwater monitoring are presented graphically in Figure III.C4* **.

Well Monitoring - Clive

Groundwater samples from four wells (SC2, SC3, SC4 and SC5) were sampled for Ra^{226}, uranium and gross alpha in 1987. The location of the wells is shown in Figure III.C5* **. The results are shown in a bar graph, Figure III.C6. In 1982, the same wells were sampled four times over the course of a year. The 1982 results in the graph are averages of those four samples for each particular well and for each particular radionuclide. EPA standard methods were used in the 1987 sampling.

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* Absence of bar indicates the results were less than minimum detectable concentration (MDC).

** EPA National Interim (40 CFR 141, 143) drinking water standards apply.

TABLE III.C1

SUMMARY OF DOWNGRADIENT DATA 1983
UNCONFINED AQUIFER

Uranium	8.0 to 62 pCi/l
Ra^{226}	<MDC
Gross Alpha	63 to 600 pCi/l

SUMMARY OF DOWNGRADIENT DATA 1986
UNCONFINED AQUIFER

Uranium	55 to 134 pCi/l
Ra^{226}	<MDC
Gross Alpha	77 to 91 pCi/l

SUMMARY OF DOWNGRADIENT DATA 1987
UNCONFINED AQUIFER

Uranium	98 to 151 pCi/l
Ra^{226}	<0.2 pCi/l
Gross Alpha	82 to 125 pCi/l

TABLE III.C2

SUMMARY OF UPGRADIENT AND CROSS GRADIENT DATA 1983
UNCONFINED AQUIFER

Uranium	<2.0 to 11.4 pCi/l
Ra^{226}	<1.0 to 3.2 pCi/l
Gross Alpha	<2.0 to <300 pCi/l

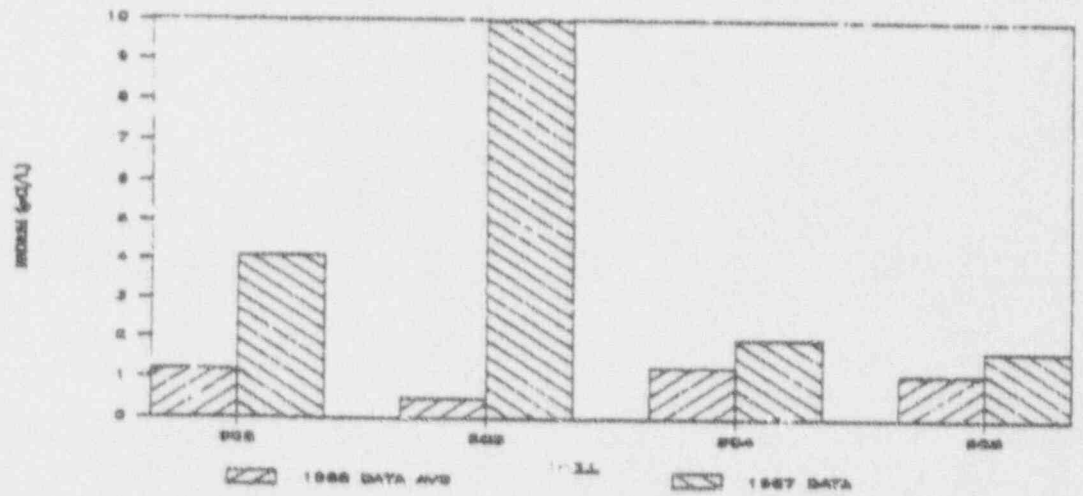
SUMMARY OF UPGRADIENT AND CROSS GRADIENT DATA 1986
UNCONFINED AQUIFER

Uranium	6.0 to 30.1 pCi/l
Ra^{226}	1.0 to 9.0 pCi/l
Gross Alpha	3.0 to 54 pCi/l

SUMMARY OF UPGRADIENT AND CROSS GRADIENT DATA 1987
UNCONFINED AQUIFER

Uranium	<1.0 to 21 pCi/l
Ra^{226}	<0.2 to 1 pCi/l
Gross Alpha	<1.0 to 21 pCi/l

CLIVE WELL MONITORING DATA



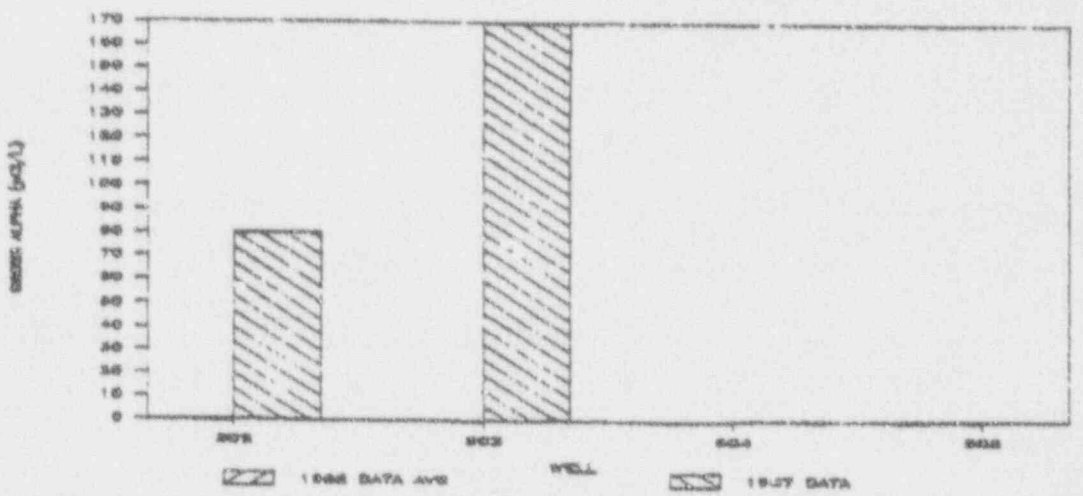


FIGURE III.C6

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