

70-687

CINTICHEM, INC.

P.O. BOX 816
TUXEDO, NEW YORK 10987 (914) 351-2131

October 22, 1997

Ms. Barbara Youngberg
NYS Dept. of Environmental Conservation
50 Wolf Road
Albany, NY 12233

Subject: Characterization Report for Union Carbide Spoils Area in Tuxedo, NY

Dear Ms. Youngberg:

Enclosed please find the referenced report. Based on our findings, this area now meets the criteria for unrestricted use.

If you have any comments or questions, please contact me at (914) 351-2236, or Mr. James McGovern at (914) 351-2131.

Very truly yours,

Joseph J. Adler
Joseph J. Adler
Manager, HSEA

Enclosure, as stated

cc: T. Dragoun, NRC C. Warren
E. Abelquist, ORISE L. Feigenbaum
R. Aldrich, NYS J. McGovern
T. Michaels, NRC J. Adler
D. Orlando, NRC L. Glander
Document Control Desk, NRC

K11101

bcc: F.C. Kentz, III
K. Magar

9710280005 971022
PDR ADOCK 07000687
C PDR



**CINTICHEM CHARACTERIZATION AND DOSE ASSESSMENT REPORT:
UNION CARBIDE SPOILS AREA**

1. INTRODUCTION

This report presents the final results of the sampling program that was performed in the vicinity of the "Union Carbide Spoils Area" (UCSA) located on the Cintichem site in Tuxedo, NY. Field sampling activities were conducted during the spring and summer of 1997. The data obtained was then used to assess the potential for exposure, if any, that could result from residual radioactivity (uranium ore residues) that are contained in this area.

The following two sections present the results of the UCSA characterization and dose assessment program. The characterization data indicates that the UCSA met the radiological criteria for unrestricted use in all areas except the "Hot Spot" area that had been identified previously. This Hot Spot has since been remediated to background levels. No radiation exposures in excess of natural background are expected to result from the UCSA.

2. UCSA CHARACTERIZATION PROGRAM RESULTS

Potentially affected soil within and around the suspect area of the UCSA was characterized by a sampling program conducted during the spring and summer of 1997. The characterization was performed in accordance with and as described by a sampling plan approved by the New York State Department of Environmental Conservation ¹.

A total of 25 boreholes were drilled in or around the northern section of the UCSA. Additionally, a background borehole was installed 86 meters east-southeast of the known UCSA Hot Spot. The locations of these boreholes are shown in Figure 1. Three of the borholes placed within the UCSA hit obstructions after a few feet. The other 22 boreholes were drilled completely through the expected thickness of the fill layer to the refusal on the original surface's boulder layer. The fill layer appeared to have a maximum thickness of 12 feet. Five of the UCSA boreholes plus the background borehole were sampled by split-spoon. This yielded 36 soil samples from the UCSA and one six-foot composite sample from the background borehole.

Nineteen composite samples of the soil cuttings were obtained from 19 of the 20 other boreholes that were installed. All 26 boreholes were gamma-logged at one-foot intervals with a sodium-iodide scintillation detector, yielding 155 gamma spectra. The soil sampling results from the five boreholes that were split-spoon sampled are presented in Table 1, A through E.

1 "Radiological Characterization Plan for Union Carbide Spoils Area," issued by Cintichem, Inc., dated January 22, 1997

The soil sampling results from the 19 boreholes from which composite samples were obtained are presented in Table 2. The soil sample result from the background borehole is presented in Table 3.

The soil concentrations of the principal long-lived radionuclides originally found within the known Hot Spot (i.e., Ra-226, U-238, U-235, and Th-232) were all found to be within the range of natural background found in the background borehole. The background concentrations (in pCi/gm) were found to be 3.75 for Ra-226, 5.13 for U-238, <0.22 for U-235, 1.78 for Th-232, and <0.047 for Cs-137 (a fallout background radionuclide). The maximum soil concentrations found within the five split-spoon sampled boreholes were 6.76 for Ra-226, 12.15 for U-238, 0.15 for U-235, 1.7 for Th-232, and 0.88 for Cs-137. The mean concentrations for the 36 soil samples were found to be 3.3 for Ra-226, 3.1 for U-238, 0.11 for U-235, 0.85 for Th-232, and 0.157 for Cs-137. These results are essentially no different than natural background, with the possible exception of the sample from Borehole No. 2 at the 720 to 719 foot elevation from which the maximum results for Ra-226, U-238, and Cs-137 were obtained.

Borehole No. 2 bordered the known Hot Spot on its northern side. The excavation and removal of this Hot Spot also included the soil layer surrounding this borehole. As such, the resulting maximums would now be 4.54 for Ra-226, 5.58 for U-238, 0.15 for U-235, 1.7 for Th-232, and 0.166 for Cs-137.

The soil concentration results for the 19 boreholes from which composite samples were obtained are also indistinguishable from that of the background borehole. The maximum concentrations found were (in pCi/gm) 4.17 for Ra-226, 6.18 for U-238, <0.14 for U-235, 1.7 for Th-232, and 0.039 for Cs-137. The mean concentrations for this group of samples were found to be 2.39 for Ra-226, 3.51 for U-238, ≤ 0.107 for U-235, 1.09 for Th-232, and 0.13 for Cs-137. The gamma logging results for the 155 one-foot intervals were also found to be indistinguishable from those obtained in the background borehole.

This data indicates that there are no deposits of uranium ore residue present in the UCSA other than that of the initial Hot Spot that was subsequently removed. Radionuclides of interest have only been found at levels similar to those of natural background. This is additionally supported by the degree of U-238 decay chain equilibrium (i.e., Ra-226 to U-238 ratio) that was found.

As can be seen from Table 4, the soil samples from the UCSA boreholes had mean Ra-226 : U-238 ratios of about 0.73. This is that same ratio found in the background borehole. Samples of soil from the known Hot Spot and uranium ore residues from Building No. 3 both had mean Ra-226 : U-238 ratios of about 1.33. This indicates that the radionuclides found in the boreholes do not originate from the uranium ore that was processed on site.

Soil from the known Hot Spot was completely excavated and removed. This resulted in a hole 10 to 12 feet in diameter and approximately 4 to 5 feet deep. This excavation was then surveyed and sampled. The bottom and sides of the excavation were scanned with a sodium-

iodide scintillation detector and a beta/alpha contamination frisker to locate any potentially elevated areas. None were found. The excavation was then soil sampled and surveyed for gamma exposure rate, with locations shown on Figure 2. Results are presented in Table 5. The soil concentrations found were consistent with those encountered for the remainder of the UCSA and background boreholes with mean concentrations (in pCi/gm) of 3.28 for Ra-226, 3.32 for U-238, 0.13 for U-235, 0.79 for Th-232, and 0.29 for Cs-137. Gross gamma exposure rates (background inclusive) were found to range from 8 to 13 μ Rem/hr at one meter above the surface, with a mean of 9.9 μ Rem/hr.

3. CONCLUSIONS

The UCSA, with the Hot Spot remediated, has been found to be at natural background levels for uranium ore residues. As such, no radiation exposures in excess of natural background are expected. This area meets the criteria for unrestricted use.

**TABLE 1
UCSA BOREHOLE SOIL SAMPLE DATA**

**Section 1-A
Borehole No. 2**

**Ground Level Elevation:
Grid Coordinate:**

**724 ft
395N, 72.5W**

	Depth Interval (feet)	Soil Concentration, pCi/gm				
		Ra-226	U-238	U-235	Th-232	Cs-137
	724-723	1.71	2.04	< 0.10	< 0.25	0.14
	723-722	0.83	1.50	< 0.08	0.69	< 0.113
	722-721	2.52	4.75	< 0.11	1.03	0.097
	721-720	4.07	6.01	< 0.16	< 0.77	0.23
NSR = No sample recovered	720-719	6.76	12.15	< 0.29	< 1.12	0.88
	719-718	NSR	NSR	NSR	NSR	NSR
	718-717	1.32	< 1.46	< 0.08	0.81	< 0.08
R = Refusal on bedrock or boulder	717-716	NSR	NSR	NSR	NSR	NSR
	716-715	2.56	2.57	< 0.12	1.10	0.021
	715-714	NSR	NSR	NSR	NSR	NSR
	714-713	NSR	NSR	NSR	NSR	NSR
	713-712	2.32	2.13	< 0.03	1.40	< 0.21
	712	R	R	R	R	R
	Mean	2.76	4.08	0.12	0.896	0.244
	S.D.	1.89	3.65	0.08	0.348	0.26

**Section 1-B
Borehole No. 4**

**Ground Level Elevation:
Grid Coordinate:**

**722 ft
402N, 80W**

	Depth Interval (feet)	Soil Concentration, pCi/gm				
		Ra-226	U-238	U-235	Th-232	Cs-137
	722-721	1.71	3.56	< 0.11	1.31	< 0.08
	721-720	2.35	3.94	< 0.11	0.79	< 0.08
	720-719	2.61	2.84	< 0.11	< 0.42	< 0.025
	719-718	1.62	< 1.69	< 0.04	0.64	< 0.088
NSR = No sample recovered	718-717	1.65	2.17	< 0.10	0.89	0.14
	717-716	NSR	NSR	NSR	NSR	NSR
	716-715	2.0	2.49	< 0.08	0.83	0.10
R = Refusal on bedrock or boulder	715-714	NSR	NSR	NSR	NSR	NSR
	714-713	NSR	NSR	NSR	NSR	NSR
	713-712	NSR	NSR	NSR	NSR	NSR
	712-711	NSR	NSR	NSR	NSR	NSR
	711-710	4.54	6.19	< 0.19	< 0.58	< 0.09
	710	R	R	R	R	R
	Mean	2.35	3.27	0.11	0.78	0.086
	S.D.	1.03	1.50	0.045	0.284	0.034

TABLE 1 Continued

**Section 1-C
Borehole No. 6**

**Ground Level Elevation: 723 ft
Grid Coordinate: 400N, 87W**

Depth Interval (feet)	<u>Soil Concentration, pCi/gm</u>				
	Ra-226	U-238	U-235	Th-232	Cs-137
723-722	2.10	2.88	< 0.11	1.35	< 0.078
722-721	1.65	1.54	< 0.08	0.81	0.18
721-720	2.70	4.19	< 0.11	0.83	< 0.10
720-719	< 1.22	< 1.89	< 0.11	1.08	0.19
719-718	2.75	5.58	< 0.14	1.11	< 0.14
718-717	1.2	1.78	< 0.08	0.54	0.17
717-716	2.22	3.06	< 0.11	< 0.29	< 0.09
716	R	R	R	R	R
Mean	1.98	2.99	0.11	0.86	0.135
S.D.	0.643	1.47	0.02	0.36	0.046

R = Refusal on bedrock or boulder

**Section 1-D
Borehole No. 8**

**Ground Level Elevation: 724 ft
Grid Coordinate: 394N, 85W**

Depth Interval (feet)	<u>Soil Concentration, pCi/gm</u>				
	Ra-226	U-238	U-235	Th-232	Cs-137
724-723	0.89	1.13	< 0.07	< 0.17	0.135
723-722	1.01	2.01	< 0.07	0.96	< 0.063
722-721	2.10	5.02	< 0.12	1.06	0.17
721-720	0.96	1.43	< 0.04	0.73	< 0.076
720-719	0.93	1.43	< 0.08	0.57	0.087
719-718	1.33	2.27	< 0.09	0.89	< 0.065
718-717	1.05	1.83	< 0.07	< 0.28	< 0.033
717-716	1.48	2.19	< 0.07	0.68	< 0.08
716-715	1.98	2.39	< 0.11	0.91	< 0.07
715-714	1.35	1.68	< 0.09	0.67	0.01
714	R	R	R	R	R
Mean	1.31	2.14	0.08	0.692	0.08
S.D.	0.435	1.09	0.023	0.29	0.046

R = Refusal on bedrock or boulder

TABLE 1 Continued

**Section 1-E
Borehole No. 15**

**Ground Level Elevation: 726 ft
Grid Coordinate: 387.5N, 92.5W**

Depth Interval (feet)	<u>Soil Concentration, pCi/gm</u>				
	Ra-226	U-238	U-235	Th-232	Cs-137
726-725	3.03	2.91	< 0.11	1.07	0.48
725-724	2.22	3.25	< 0.12	< 0.05	0.66
724-723	3.91	2.58	< 0.16	1.70	0.095
723-722	4.16	4.95	0.15	1.59	0.134
722	R	R	R	R	R
Mean	3.33	3.42	0.135	1.22	0.34
S.D.	0.885	1.05	0.024	0.55	0.27

R = Refusal on bedrock
or boulder

TABLE 2
UCSA BOREHOLE COMPOSITE SOIL SAMPLE RESULTS

Borehole ID No.	Grid Location	Ground Elevation (ft)	Bottom Elevation (ft)	pCi/gm				
				Ra-226	U-238	U-235	Th-232	Cs-137
1	394N, 75W	724	712	1.57	< 1.76	< 0.086	1.58	< 0.04
3	398N, 76W	721	714	3.27	4.91	< 0.14	1.7	0.27
5	(no sample recovered)							
7	397.5N, 90W	724	712	2.08	3.34	< 0.13	0.76	< 0.14
9	392.5N, 88W	724	716	2.64	5.48	< 0.11	1.3	< 0.06
10	395N, 83W	725	721	2.11	3.64	< 0.11	< 0.33	< 0.078
11	396N, 78W	724	715	3.52	6.18	< 0.13	0.58	0.19
12	392N, 78W	724	716	2.33	1.71	< 0.09	1.26	< 0.05
13	392N, 82W	724	717	1.80	2.84	< 0.12	1.35	0.17
14	392.5N, 92.5W	726	720	2.19	5.38	< 0.12	1.42	0.18
16	385N, 93W	726	720	1.73	3.02	< 0.08	1.45	< 0.08
17	384N, 89W	724	718	2.70	5.00	< 0.12	1.35	< 0.065
18	396.5N, 89W	724	721	1.20	1.68	< 0.065	0.53	0.39
19	385N, 86W	725	723	2.41	2.75	< 0.10	1.14	0.15
20	391N, 89W	725	724	3.50	4.56	< 0.11	1.36	< 0.065
21	395N, 88W	725	718	NSR	NSR	NSR	NSR	NSR
22	385N, 75W	727	718	1.42	2.09	< 0.08	1.38	0.11
23	366N, 134W	736	731	2.66	2.88	< 0.12	< 0.42	0.26
24	380N, 126W	735	729	1.76	2.35	< 0.097	< 0.14	< 0.079
25	368N, 116W	734	727	4.17	3.55	< 0.12	1.61	< 0.024
			Mean	2.39	3.51	0.107	1.09	0.13
			S.D.	0.808	1.42	0.02	0.49	0.097

TABLE 3
UCSA BACKGROUND BOREHOLE DATA *

Soil Concentration ** (pCi/gm)				
Ra-226	U-238	U-235	Th-232	Cs-137
3.75	5.13	< 0.22	1.78	< 0.047

* Located approximately 282 feet (800 meters) east-southeast of the USCA "Hot Spot", at grid coordinate 342N, 10W

** This borehole was sampled from ground level (730 ft) to a depth of 6 feet. The data represents a composite of the 0 to 6 foot borehole interval.

TABLE 4

COMPARISON OF URANIUM-238 DECAY CHAIN EQUILIBRIUMS
 FROM VARIOUS SOURCES

Sample Group	No. of Samples	Ra-226 to U-238		
		Range	Mean	Standard Deviation
Background Borehole	1	n/a	0.73	n/a
Boreholes: 2, 4, 6, 8 & 15 (split spoon sampled)	36	0.41 - 1.52	0.738	0.224
Boreholes: 1, 3, 7, 9, 10 - 14, 16 - 25 (single composite sample)	18	0.41 - 1.36	0.73	0.24
Pre-Remediation Hot Spot Area	3	1.24 - 1.47	1.33	0.12
Post-Remediation Hot Spot Area (Excavated)	9	0.60 - 1.31	0.973	0.255
Bldg 3 Exhaust Ventillation Debris	3	1.067 - 1.84	1.34	0.43

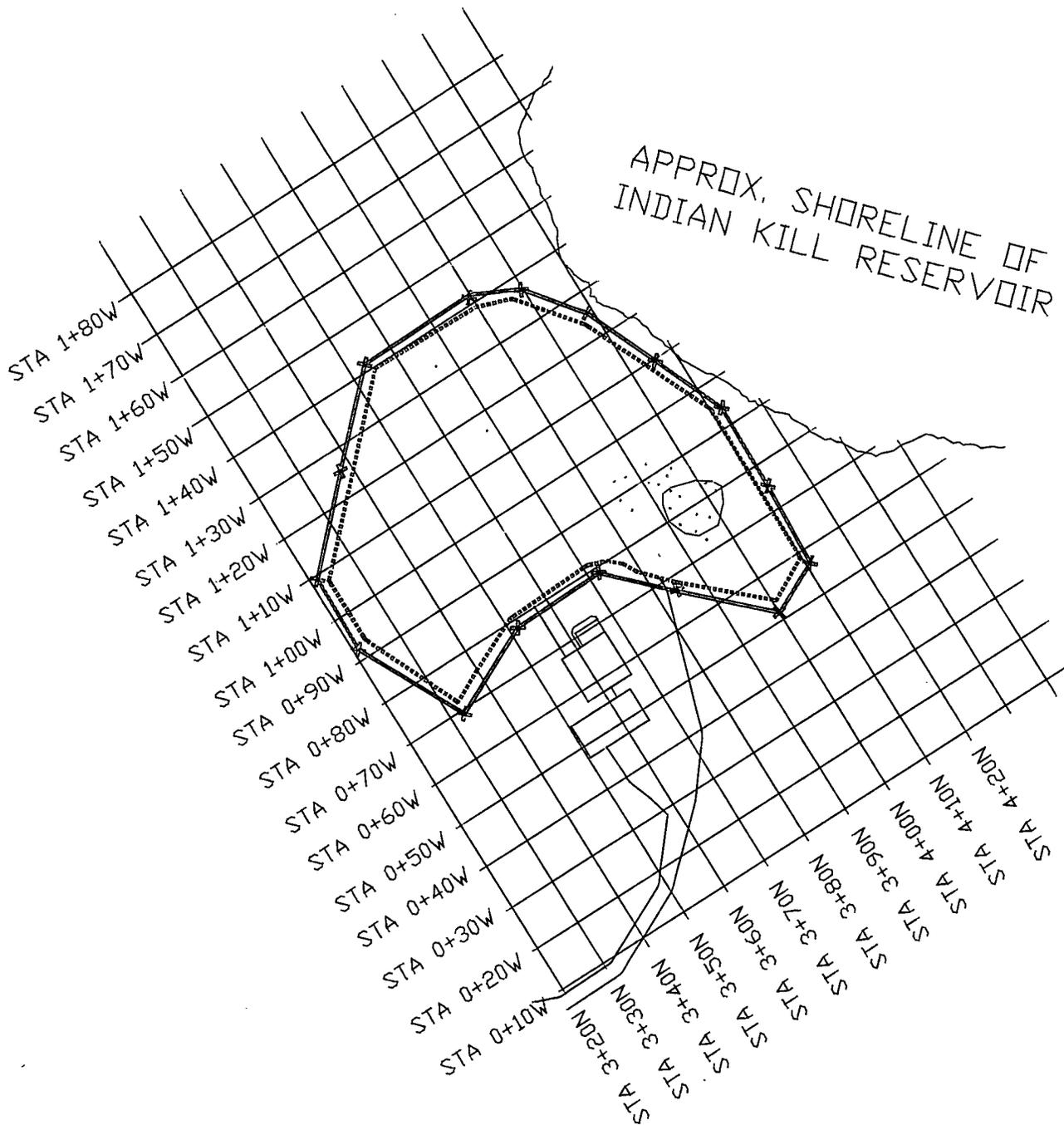
TABLE 5

UCSA SOIL SAMPLE AND DIRECT EXPOSURE RATE DATA
 FOLLOWING REMEDIATION OF HOT SPOT *

Sample Location	Gross Gamma Exposure Rate at 1 Meter (Rem/hr)	Soil Concentration, pCi/gm				
		Ra-226	U-238	U-235	Th-232	Cs-137
1	8	1.76	1.78	< 0.09	0.94	< 0.06
2	8	1.65	2.28	< 0.104	1.09	< 0.08
3	10	1.09	0.86	< 0.06	< 0.21	0.091
4	9	9.74	7.44	< 0.23	< 0.25	0.37
5	10	3.2	3.16	< 0.14	1.46	0.37
6	13	1.86	2.26	< 0.12	< 0.29	0.34
7	10	2.3	3.84	< 0.12	1.74	0.15
8	10	3.66	3.01	< 0.14	< 0.55	0.62
9	11	4.22	5.24	< 0.19	< 0.61	0.55
Mean	9.9	3.28	3.32	0.13	0.79	0.29
S.D.	1.54	2.63	1.99	0.05	0.55	0.21

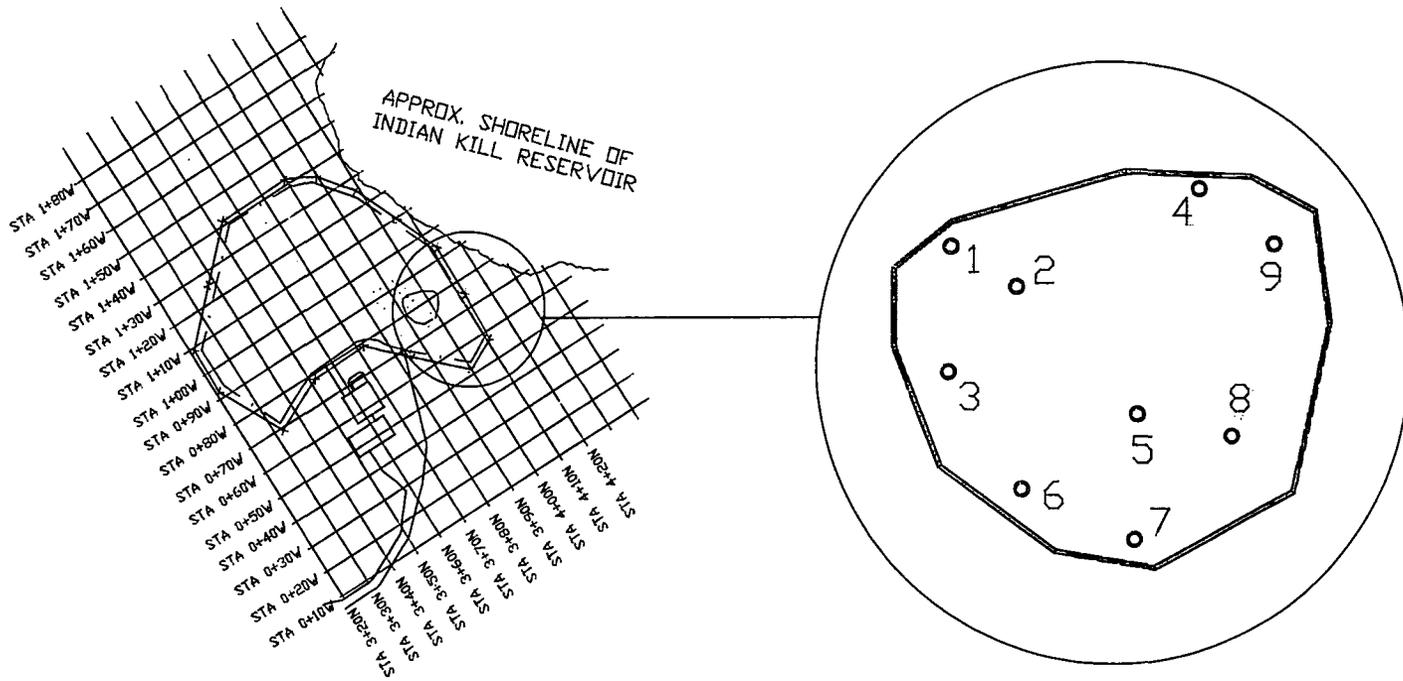
* This excavation removed the initial uranium ore contamination that was discovered in the UCSA. This is a 10 - 12 foot diameter excavation centered on or about grid coordinate 391N, 72W

FIGURE: 1 UCSA BORE SAMPLE LOCATIONS



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FIGURE: 2 UCSA FORMER HOT SPOT SAMPLE LOCATION



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