30-18276

JUN 17 1994

B. KOH & ASSOCIATES, INC.

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June 13, 1994

Mr. John Austin, Chief
Low-level Waste and Decommissioning Projects Branch
Division of Waste Management
US Nuclear Regulatory Commission
11555 Rockville Pike
Washington, DC 20555-001

Subject: Responses to NRC Comments on Northeast Ohio Regional Sewer District Responses dated February 24, 1994 - Site Characterization Plan

Dear Mr. Johnson:

On behalf of the Northeast Ohio Regional Sewer District (NEORSD), enclosed are the NEORSD responses to the latest round of NRC comments on the Site Characterization Plan, as provided in your letter dated May 18, 1994. A copy of these responses are also being provided to Mr. Gary Shear, NRC - Region III.

If you have any questions, please don't hesitate to give me a call at (716)592-3431.

Very Truly Yours,

Theodore G. Adams

Theodore G. Adams
Project Manager

Enclosure

cc: T. Lenhart, NEORSD-w/enclosure
R. Connelly, NEORSD-w/enclosure
G. Shear, NRC, Region III-w/enclosure
S. Nalluswami, NRC-w/enclosure
B. Koh, B. Koh and Associates, Inc.-w/enclosure

DA:94:106 NEORSD
Site Characterization Plan

21104

NH10

RESPONSES TO NRC COMMENTS ON NEORSD RESPONSES
DATED FEBRUARY 24, 1994

Northeast Ohio Regional Sewer District
Southerly Plant - Site Characterization Plan

Comment

Page 1 of 14 Responses

b. The issue regarding the confidence level for identifying "hot-spots" has not been adequately addressed. The intent of the earlier comment was that NEORSD should estimate the probability of missing "hot-spots" of a given concentration and size using the sampling program described in the plan and the preliminary results. The response provided by B. Koh and Associates, Inc. (BKA) does not discuss this particular aspect of the contamination situation.

Response: As will be shown in the Characterization report, sufficient sampling has been done to demonstrate that "hot spots" resulting from uneven or inconsistent deposition of the contaminant do not exist in either the North Fill or South Fill Areas. Rather, the contaminant is well mixed throughout the entire volume of deposited ash. Considering the amount of handling and processing of waste water, sludge and ash at the Easterly and Southerly Plants, it is not surprising that the contaminant would be distributed throughout the fill material deposited in the North and South Fill areas.

Individual samples have been collected that exceed the average value of the contaminated fill. In almost every case that has been examined, these more highly contaminated samples contained visible particles of metallic cobalt. The characterization report will show that the distribution of the samples, including the those that are more highly contaminated, is consistent with that ordinarily found in geological samples. Again this is to be expected based on the way in which the contaminant was introduced into the fill area.

In conclusion, B. Koh and Associates, Inc. is able to calculate, with the appropriate confidence levels, the average concentration of contamination in the fill areas but is unable to calculated the confidence level of missing a "hot spot." The reason the probability of missing a "hot spot" cannot be calculated is simply because there is no evidence that such a hot spot exists and hence, no way to model the situation.

Finally, a method to deal with the general question of hypothesized "hot spots" is contained in Appendix VII of NUREG 2082. The examples discussed in Appendix VII apply to a surface sampling program and are not directly applicable to the case at the Southerly Plant. If the NRC will provide guidance on how to apply this method to a situation involving a

contaminated volume of material, B. Koh and Associates, Inc. will use it for the Southerly case.

c. While calibration of the Bicron microrem meter with Cs-137 will not likely result in significant difference when measuring Co-60 gamma energies, the same probably cannot be said for the Ludlum microR meter, which utilizes a sodium iodide detector which is energy dependent. How is the energy dependence of NaI detectors to be accounted for during calibration? Also, provide the types of probes in addition to the instrument make and model number.

Response:

The energy dependence of NaI detectors (e.g. Ludlum Model 19 microR meter, 2" x 2" NaI probe and survey rate meter) was accounted for by cross calibrating the instruments with a pressurized ionization chamber (PIC). The types of probes and instrument make and model numbers used to support characterization are:

Instrument	Meter	Probe
Portable contamination monitor (beta/gamma)	Ludlum Model 3	Ludlum Model 44-9
Exposure rate measurement	Ludlum Model 19 MicroR meter	n/a
	Bicron MicroRem meter	n/a
Scaler (alpha/beta/gamma) air sampler and contamination counting	Ludlum Model 2200	Eberline HP-210

Page 2 of 14 (Item 1) and Page 5 of 14 (Item 7) of Responses

The responses to these two comments appear to be in conflict. Please clarify. If NEORSD is not planning on conducting characterization of Imhoffs, aeration tanks, or the west incinerator bank at this time, please justify.

Response:

As part of the investigation of whether past incineration of the Co-60 contaminated sludge might have contaminated other incinerator related systems, equipment or auxiliary buildings, the NEORSD surveyed and sampled Incinerators 1 and 4, the incinerator building roof, vent roof, the auxiliary building roof and four fume tanks.

The characterization of these buildings, equipment and systems will be included for completeness in the NEORSD Site Characterization Report. The NEORSD is not planning on conducting additional characterization of the Imhoff Tanks or the berm located north/northwest of the Incinerator Building and steam plant. These areas were comprehensively surveyed and characterized by ORISE and NRC Region III representatives during September 1991 and March and August, 1992 (ORISE, August 1992, NRC, October 1992).

The results of walkover scans, surface and subsurface, soil sampling and analysis, and exposure rate measurements performed by ORISE and the NRC from these areas revealed:

1) The presence of low level quantities of Co-60 in the berm (less than 5.2 pCi/g) and direct radiation measurements at one meter from the surface at natural background levels and

2) No Co-60 detected in soil in the Imhoff tank area and microR/hr levels at background.

Therefore, the NEORSD believes that these areas have been adequately characterized by ORISE and the NRC and no further characterization is necessary. Results of the walkovers, scans, exposure rate measurements, soil sampling and analysis contained in the ORISE and NRC reports will be presented in the NEORSD Site Characterization Report.

With respect to the aeration tanks, ORISE and NRC Region III representatives performed walkover scan of the area using 3" x 3" NaI (Tl) gamma scintillation detectors with rate meters coupled with audible indicators during November 1993. Results of the walkover indicated radiation readings within background levels.

Similar to the Imhoff tanks, the ash contained in the aeration tanks is restricted within the concrete structure providing containment on all three sides. The top cover is comprised

of clay and topsoil/vegetation. Therefore, the NEORSD believes there is no benefit in conducting additional characterization of the aeration tank. The NRC walkover scan of the aeration tank will be incorporated in the NEORSD Site Characterization Report.

Page 6 of 14 of Responses, Item 10

The west boundary for the North Fill Area is not provided. The last word should be "west" instead of "east" on the third line of para 1 Section 3.2.2, Page 3-4, of the Site Characterization Plan.

Response:

The second sentence of para 2 of Section 3.2.2 will be revised to read "The North Fill Area is bounded on the south by the SWTP, on the west by the SWTP and East 49th Street, on the east by Interstate Route 77, and on the north by the Penn Central Railroad Spur and related lowlands."

Page 11 of 14 of Responses, Item 23

b. It is not convincing that monitoring wells are not needed around Lagoons A, B, and C. Please provide results of samples collected in clay liner indicating that there was no evidence of Co-60 migration.

Response:

As part of the Final Radiological Survey effort, one foot subsurface samples were obtained using a split spoon sampler from the clay liners of the three Lagoons (A, B, and C). The first 6 inches of clay liner samples was considered a surface sample. The last 6 inches of the clay liner sample was considered subsurface. Data from Tables C-2 through C-7 (Attachment 2) from the Final Radiological Survey Report, March 1994 demonstrate that Co-60 has not migrated into or through the clay liner and surrounding areas. Therefore, monitoring wells are not needed around Lagoons A, B, and C.

We understand "future site characterization efforts" are those NEORSD/SP is proposing to do at the Southerly Plant.

Response:

At the present time there are no future site characterization efforts proposed for the South Fill Area, North Fill Area or other locations including the Imhoff Tanks, Aeration Tanks and the west bank located northwest of the incinerator building (See response to Page 6 of 14, item 10). If, however, any additional site characterization activities are required, they will be conducted under the new 10 CFR Part 20 requirements.

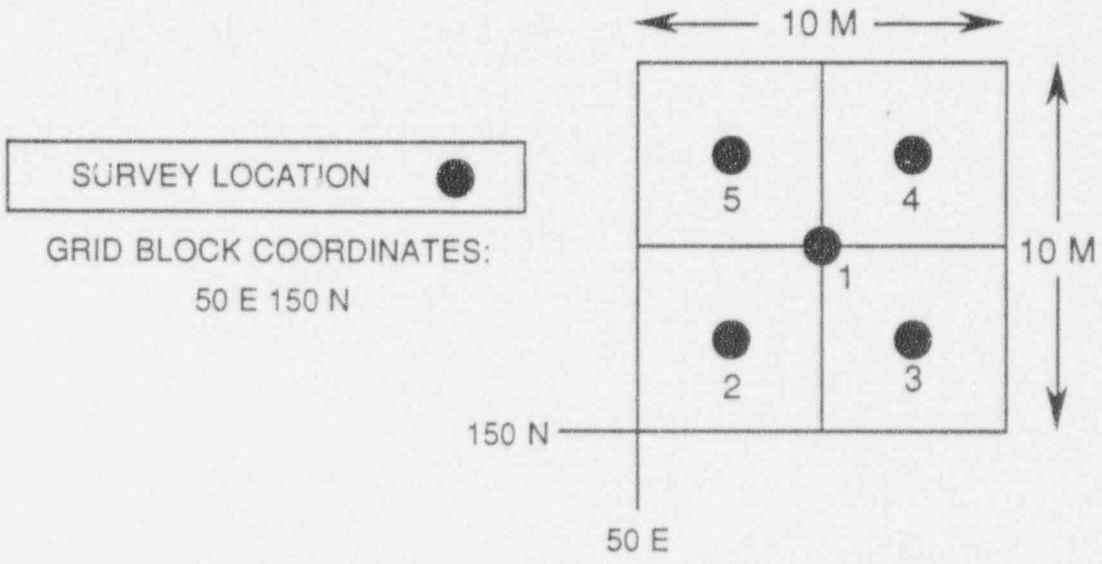
FIGURE C-2

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

LAGOON A
SOIL SAMPLING AND RADIATION SURVEY PATTERN
AND
GRID BLOCK IDENTIFICATION CONVENTION

SURVEYS



SAMPLES

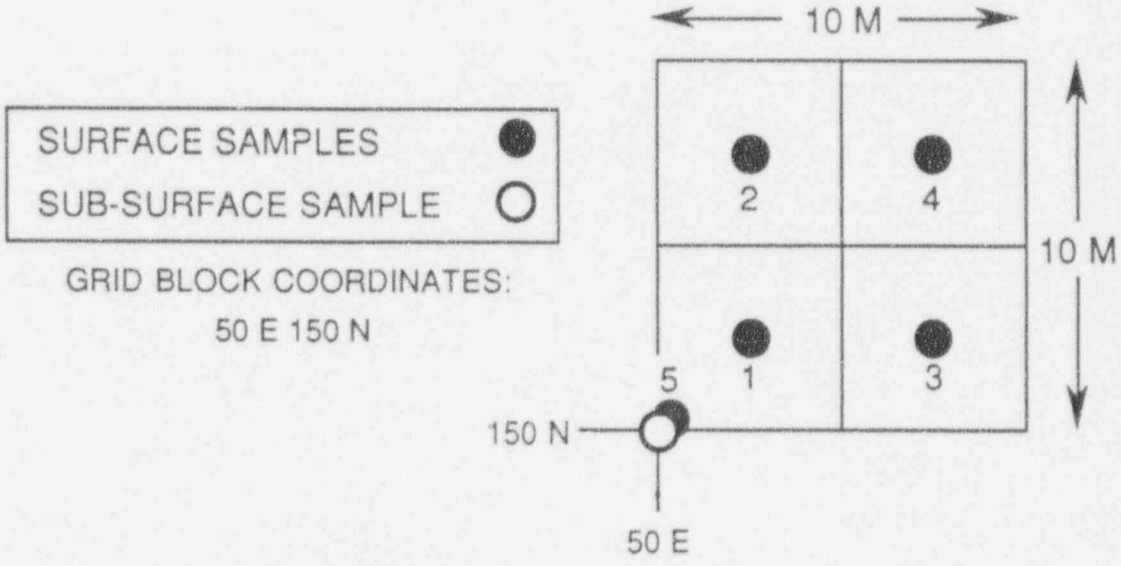


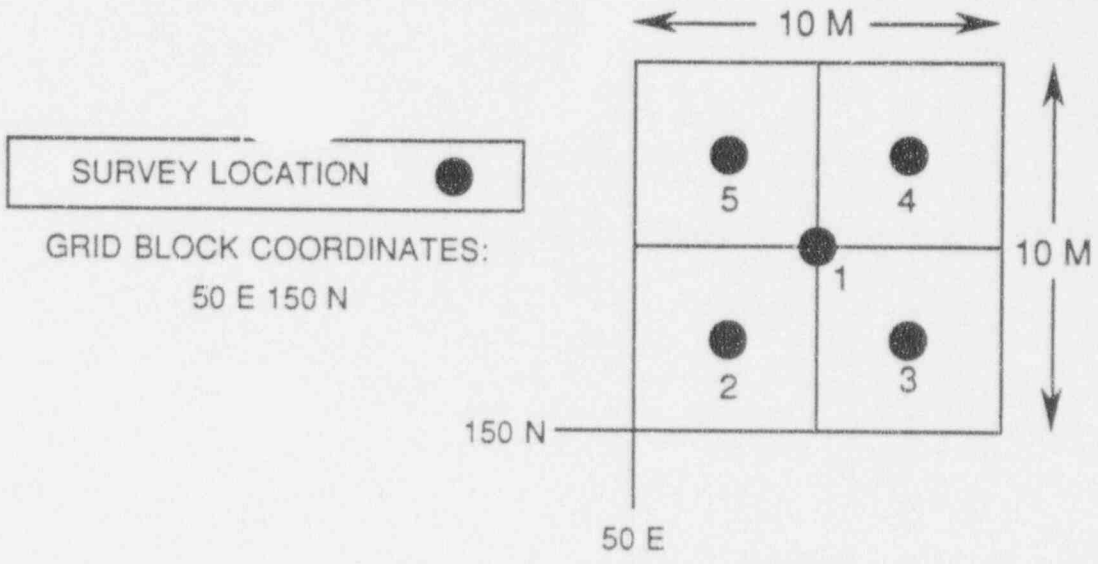
FIGURE C-3

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

LAGOON B
SOIL SAMPLING AND RADIATION SURVEY PATTERN
AND
GRID BLOCK IDENTIFICATION CONVENTION

SURVEYS



SAMPLES

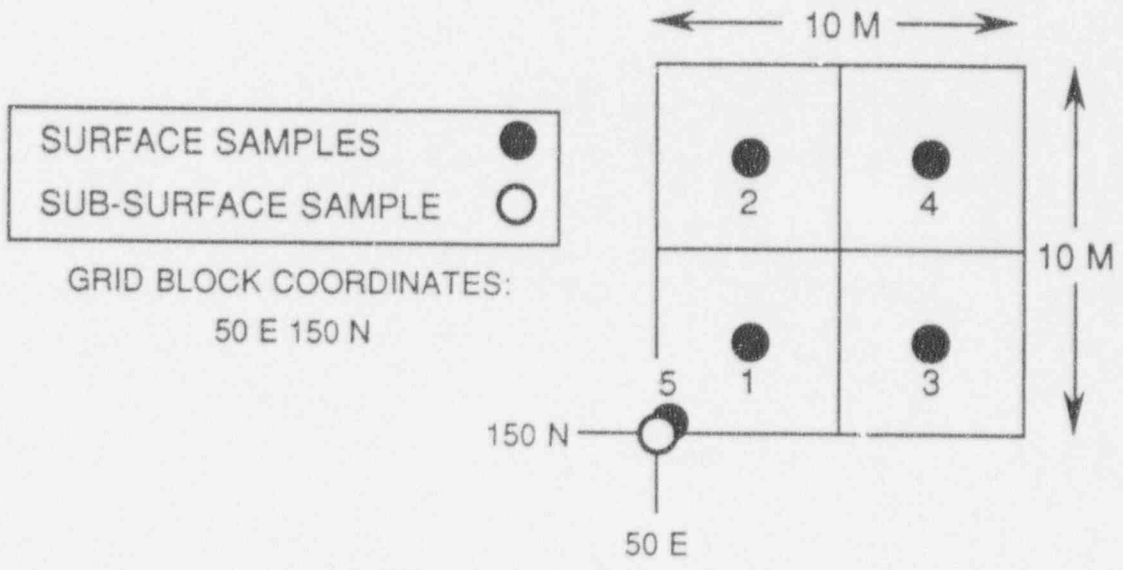


FIGURE C-4

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

LAGOON C
SOIL SAMPLING AND RADIATION SURVEY PATTERN
AND
GRID BLOCK IDENTIFICATION CONVENTION

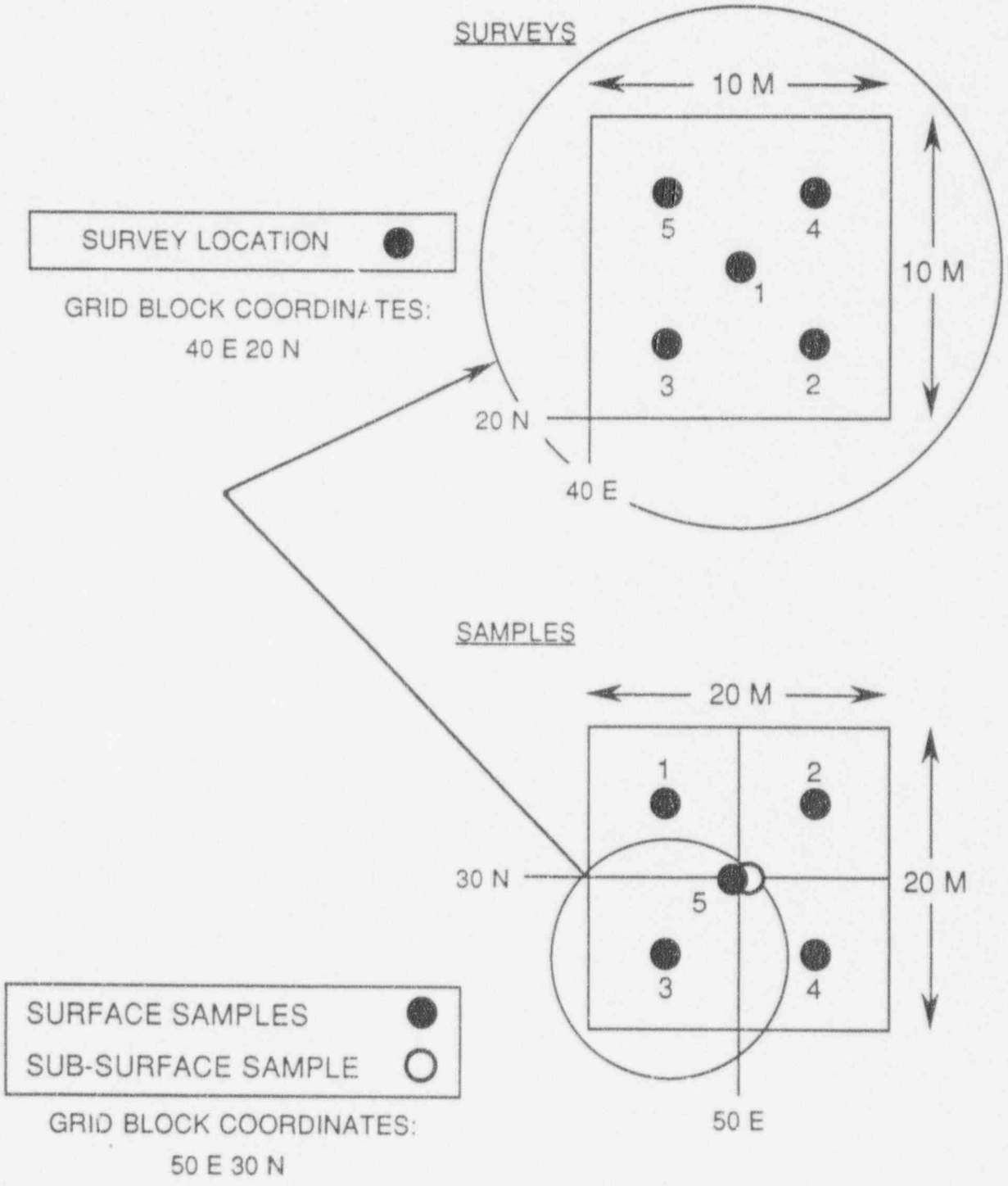


TABLE C-5

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON A

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF.	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
A 001		80	290	<0.257 (C)						<0.257	24	ACC	<0.257	8	ACC
A 002	01	90	290	<0.161 (C)				<0.422	<0.316	<0.422	24	ACC	<0.213	8	ACC
A 003		80	280	<0.297 (C)						<0.297	24	ACC	<0.297	8	ACC
A 004		90	280	<0.305 (C)						<0.305	24	ACC	<0.305	8	ACC
A 005		100	280	<0.199 (C)						<0.199	24	ACC	<0.199	8	ACC
A 006		110	280	<0.171 (C)						<0.171	24	ACC	<0.171	8	ACC
A 007		80	270	1.250 (C)						1.250	24	ACC	1.250	8	ACC
A 008	02	90	270	<0.417 (C)				<0.542	<0.236	<0.542	24	ACC	<0.442	8	ACC
A 009		100	270	<0.334 (C)						<0.334	24	ACC	<0.334	8	ACC
A 010	03	110	270	<0.269 (C)				<0.405	<0.290	<0.405	24	ACC	<0.296	8	ACC
A 011		70	260	<0.300 (C)						<0.300	24	ACC	<0.300	8	ACC
A 012		80	260	<0.337 (C)						<0.337	24	ACC	<0.337	8	ACC
A 013		90	260	<0.121 (C)						<0.121	24	ACC	<0.121	8	ACC
A 014		100	260	<0.355 (C)						<0.355	24	ACC	<0.355	8	ACC
A 015		110	260	<0.383 (C)						<0.383	24	ACC	<0.383	8	ACC
A 016		120	260	<0.334 (C)						<0.334	24	ACC	<0.334	8	ACC
A 017		70	250	<0.222 (C)						<0.222	24	ACC	<0.222	8	ACC
A 018		80	250	<0.225 (C)						<0.225	24	ACC	<0.225	8	ACC
A 019	04	90	250	<0.441 (C)				<0.183	<0.184	<0.441	24	ACC	<0.389	8	ACC
A 020		100	250	<0.310 (C)						<0.310	24	ACC	<0.310	8	ACC
A 021	05	110	250	<0.377 (C)				<0.208	<1.010	<1.010	24	ACC	<0.343	8	ACC
A 022		120	250	<0.219 (C)						<0.219	24	ACC	<0.219	8	ACC
A 023	06	130	250	<0.415 (C)				<0.111	<0.240	<0.415	24	ACC	<0.354	8	ACC
A 024		70	240	<0.151 (C)						<0.151	24	ACC	<0.151	8	ACC
A 025		80	240	0.807 (C)						0.807	24	ACC	0.807	8	ACC
A 026		90	240	2.760	2.270	<0.577	0.939			2.760	24	ACC	1.637	8	ACC
A 027		100	240	<0.518 (C)						<0.518	24	ACC	<0.518	8	ACC
A 028		110	240	<0.463 (C)						<0.463	24	ACC	<0.463	8	ACC
A 029		120	240	<0.298 (C)						<0.298	24	ACC	<0.298	8	ACC
A 030		130	240	<0.187 (C)						<0.187	24	ACC	<0.187	8	ACC

TABLE C-5

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON A
ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF.	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
A 031	07	70	230	<0.199 (C)				<0.341	<0.182	<0.341	24	ACC	<0.227	8	ACC
A 032		80	230	0.916 (C)						0.916	24	ACC	0.916	8	ACC
A 033	08	90	230	<0.293	<0.942	<0.454	0.726	1.260	<0.265	1.260	24	ACC	<0.679	8	ACC
(SEE NOTE 2)				<0.361	<0.553	<0.844									
A 034		100	230	1.320 (C)						1.320	24	ACC	1.320	8	ACC
A 035	09	110	230	1.220 (C)				<0.661	<0.469	1.220	24	ACC	1.108	8	ACC
A 036		120	230	<0.524 (C)						<0.524	24	ACC	<0.524	8	ACC
A 037	10	130	230	<0.209 (C)				<0.257	<0.137	<0.257	24	ACC	<0.219	8	ACC
A 038		140	230	<0.203 (C)						<0.203	24	ACC	<0.203	8	ACC
	11	150	230					<0.399	<0.229	<0.399	24	ACC	<0.399	8	ACC
A 039		70	220	<0.244 (C)						<0.244	24	ACC	<0.244	8	ACC
A 040		80	220	1.150 (C)						1.150	24	ACC	1.150	8	ACC
A 041		90	220	1.470 (C)						1.470	24	ACC	1.470	8	ACC
A 042		100	220	<0 234 (C)						<0.234	24	ACC	<0.234	8	ACC
A 043		110	220	<0.551 (C)						<0.551	24	ACC	<0.551	8	ACC
A 044		120	220	<0.267 (C)						<0.267	24	ACC	<0.267	8	ACC
A 045		130	220	<0.288 (C)						<0.288	24	ACC	<0.288	8	ACC
A 046		140	220	<0.189 (C)						<0.189	24	ACC	<0.189	8	ACC
A 047		150	220	<0.113 (C)						<0.113	24	ACC	<0.113	8	ACC
A 048	12	70	210	<0.243 (C)				<0.359	<0.212	<0.359	24	ACC	<0.266	8	ACC
A 049		80	210	1.270 (C)						1.270	24	ACC	1.270	8	ACC
A 050	13	90	210	1.300 (C)				<0.447	<0.409	1.300	24	ACC	1.129	8	ACC
A 051		100	210	5.480	2.810	0.654	0.559			5.480	24	ACC	2.376	8	ACC
A 052	14	110	210	<0.679 (C)				<0.332	<0.811	<0.811	24	ACC	<0.610	8	ACC
A 053		120	210	<0.516 (C)						<0.516	24	ACC	<0.516	8	ACC
A 054	15	130	210	<0.404 (C)				<0.537	<0.471	<0.537	24	ACC	<0.431	8	ACC
A 055		140	210	<0.276 (C)						<0.276	24	ACC	<0.276	8	ACC
A 056	16	150	210	<0.138 (C)				<0.214	<0.046	<0.214	24	ACC	<0.153	8	ACC
A 057		60	200	<0.156 (C)						<0.156	24	ACC	<0.156	8	ACC

TABLE C-5

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON A

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF.	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
A 058		70	200	<0.343 (C)						<0.343	24	ACC	<0.343	8	ACC
A 059		80	200	1.090 (C)						1.090	24	ACC	1.090	8	ACC
A 060		90	200	1.500 (C)						1.500	24	ACC	1.500	8	ACC
A 061		100	200	4.180	3.330	<0.668	2.010			4.180	24	ACC	2.547	8	ACC
A 062		110	200	1.460 (C)						1.460	24	ACC	1.460	8	ACC
A 063		120	200	<0.508 (C)						<0.508	24	ACC	<0.508	8	ACC
A 064		130	200	<0.449 (C)						<0.449	24	ACC	<0.449	8	ACC
A 065		140	200	<0.335 (C)						<0.335	24	ACC	<0.335	8	ACC
A 066		150	200	<0.158 (C)						<0.158	24	ACC	<0.158	8	ACC
A 067		160	200	<0.179 (C)						<0.179	24	ACC	<0.179	8	ACC
A 068		60	190	0.635 (C)						0.635	24	ACC	0.635	8	ACC
A 069	17	70	190	<0.216 (C)				<0.397	<0.264	<0.397	24	ACC	<0.332	8	ACC
A 070		80	190	0.607 (C)						0.607	24	ACC	0.607	8	ACC
A 071	18	90	190	1.280 (C)				<1.130	<0.313	1.280	24	ACC	1.250	8	ACC
A 072		100	190	0.999 (C)						0.999	24	ACC	0.999	8	ACC
A 073	19	110	190	<0.517 (C)				<0.227	<0.129	<0.517	24	ACC	<0.459	8	ACC
A 074		120	190	<0.481 (C)						<0.481	24	ACC	<0.481	8	ACC
A 075	20	130	190	<0.462 (C)				<0.349	<0.195	<0.462	24	ACC	<0.439	8	ACC
A 076		140	190	<0.432 (C)						<0.432	24	ACC	<0.432	8	ACC
A 077	21	150	190	<0.214 (C)				<0.245	<0.162	<0.245	24	ACC	<0.220	8	ACC
A 078		160	190	<0.144 (C)						<0.144	24	ACC	<0.144	8	ACC
	22	170	190					<0.317	<0.250	<0.317	24	ACC	<0.317	8	ACC
A 079		60	180	<0.202 (C)						<0.202	24	ACC	<0.202	8	ACC
A 080		70	180	<0.371 (C)						<0.371	24	ACC	<0.371	8	ACC
A 081		80	180	1.230 (C)						1.230	24	ACC	1.230	8	ACC
A 082		90	180	<0.552 (C)						<0.552	24	ACC	<0.552	8	ACC
A 083		100	180	0.698 (C)						0.698	24	ACC	0.698	8	ACC
A 084		110	180	<0.450 (C)						<0.450	24	ACC	<0.450	8	ACC
A 085		120	180	<0.499 (C)						<0.499	24	ACC	<0.[illegible]9	8	ACC
A 086		130	180	<0.329 (C)						<0.329	24	ACC	<0.329	8	ACC

TABLE C-5

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON A
ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF.	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
A 087		140	180	<0.303 (C)						<0.303	24	ACC	<0.303	8	ACC
A 088		150	180	<0.169 (C)						<0.169	24	ACC	<0.169	8	ACC
A 089		160	180	<0.238 (C)						<0.238	24	ACC	<0.238	8	ACC
A 090		170	180	<0.170 (C)						<0.170	24	ACC	<0.170	8	ACC
A 091		60	170	<0.170 (C)						<0.170	24	ACC	<0.170	8	ACC
A 092	23	70	170	<0.394 (C)				<0.200	<0.304	<0.394	24	ACC	<0.355	8	ACC
A 093		80	170	<0.416 (C)						<0.416	24	ACC	<0.416	8	ACC
A 094	24	90	170	<0.529 (C)				<0.352	<0.187	<0.529	24	ACC	<0.494	8	ACC
A 095		100	170	<0.562 (C)						<0.562	24	ACC	<0.562	8	ACC
A 096	25	110	170	<0.463 (C)				<0.437	<0.163	<0.463	24	ACC	<0.458	8	ACC
A 097		120	170	0.690 (C)						0.690	24	ACC	0.690	8	ACC
A 098	26	130	170	<0.389 (C)				<0.116	<0.294	<0.389	24	ACC	<0.334	8	ACC
A 099		140	170	<0.379 (C)						<0.379	24	ACC	<0.379	8	ACC
A 100	27	150	170	<0.183 (C)				<0.122	<0.213	<0.213	24	ACC	<0.171	8	ACC
A 101		160	170	<0.305 (C)						<0.305	24	ACC	<0.305	8	ACC
A 102	28	170	170	<0.128 (C)				<0.379	<0.191	<0.379	24	ACC	<0.178	8	ACC
A 103		180	170	<0.121 (C)						<0.121	24	ACC	<0.121	8	ACC
A 104		60	160	<0.221 (C)						<0.221	24	ACC	<0.221	8	ACC
A 105		70	160	<0.294 (C)						<0.294	24	ACC	<0.294	8	ACC
A 106		80	160	<0.367 (C)						<0.367	24	ACC	<0.367	8	ACC
A 107		90	160	<0.504 (C)						<0.504	24	ACC	<0.504	8	ACC
A 108		100	160	<0.580 (C)						<0.580	24	ACC	<0.580	8	ACC
A 109		110	160	<0.566 (C)						<0.566	24	ACC	<0.566	8	ACC
A 110		120	160	<0.557 (C)						<0.557	24	ACC	<0.557	8	ACC
A 111		130	160	<0.491 (C)						<0.491	24	ACC	<0.491	8	ACC
A 112		140	160	<0.217 (C)						<0.217	24	ACC	<0.217	8	ACC
A 113		150	160	<0.194 (C)						<0.194	24	ACC	<0.194	8	ACC
A 114		160	160	<0.246 (C)						<0.246	24	ACC	<0.246	8	ACC
A 115		170	160	<0.150 (C)						<0.150	24	ACC	<0.150	8	ACC
A 116		180	160	<0.224 (C)						<0.224	24	ACC	<0.224	8	ACC

TABLE C-5

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON A
ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF.	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
A 117		60	150	<0.275 (C)						<0.275	24	ACC	<0.275	8	ACC
A 118	29	70	150	<0.251 (C)				<0.055	<0.236	<0.251	24	ACC	<0.212	8	ACC
A 119		80	150	<0.180 (C)						<0.180	24	ACC	<0.180	8	ACC
A 120	30	90	150	<0.321 (C)				<0.243	2.130	2.130	24	ACC	<0.305	8	ACC
A 121		100	150	<0.293 (C)						<0.293	24	ACC	<0.293	8	ACC
A 122	31	110	150	<0.332 (C)				<0.197	<0.271	<0.332	24	ACC	<0.305	8	ACC
A 123		120	150	<0.408 (C)						<0.408	24	ACC	<0.408	8	ACC
A 124	32	130	150	<0.296 (C)				<0.220	<0.179	<0.296	24	ACC	<0.281	8	ACC
A 125		140	150	<0.228 (C)						<0.228	24	ACC	<0.228	8	ACC
A 126	33	150	150	<0.328 (C)				<0.157	<0.176	<0.328	24	ACC	<0.294	8	ACC
A 127		160	150	<0.267 (C)						<0.267	24	ACC	<0.267	8	ACC
A 128	34	170	150	<0.182 (C)				<0.188	<0.197	<0.197	24	ACC	<0.183	8	ACC
A 129		180	150	<0.190 (C)						<0.190	24	ACC	<0.190	8	ACC
A 130	35	190	150	<0.221 (C)				<0.236	<0.150	<0.236	24	ACC	<0.224	8	ACC
A 131		80	140	<0.166 (C)						<0.166	24	ACC	<0.166	8	ACC
A 132		90	140	<0.285 (C)						<0.285	24	ACC	<0.285	8	ACC
A 133		100	140	<0.239 (C)						<0.239	24	ACC	<0.239	8	ACC
A 134		110	140	<0.202 (C)						<0.202	24	ACC	<0.202	8	ACC
A 135		120	140	<0.190 (C)						<0.190	24	ACC	<0.190	8	ACC
A 136		130	140	<0.166 (C)						<0.166	24	ACC	<0.166	8	ACC
A 137		140	140	<0.227 (C)						<0.227	24	ACC	<0.227	8	ACC
A 138		150	140	<0.172 (C)						<0.172	24	ACC	<0.172	8	ACC
A 139		160	140	<0.168 (C)						<0.168	24	ACC	<0.168	8	ACC
A 140		170	140	<0.163 (C)						<0.163	24	ACC	<0.163	8	ACC
A 141		180	140	<0.139 (C)						<0.139	24	ACC	<0.139	8	ACC
A 142		190	140	<0.137 (C)						<0.137	24	ACC	<0.137	8	ACC
A 143		140	130	<0.207 (C)						<0.207	24	ACC	<0.207	8	ACC
A 144		150	130	<0.145 (C)						<0.145	24	ACC	<0.145	8	ACC

TABLE C-5

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON A
ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF.	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
A 145		160	130	<0.182 (C)						<0.182	24	ACC	<0.182	8	ACC
A 146		170	130	<0.152 (C)						<0.152	24	ACC	<0.152	8	ACC
A 147		180	130	<0.183 (C)						<0.183	24	ACC	<0.183	8	ACC
A 148	36	190	130	<0.179 (C)				<0.218	<0.047	<0.218	24	ACC	<0.187	8	ACC
							SAMPLE DEPTH:	0" - 6"	6" - 12"						
							AVERAGE pCi/gm:	<0.346	<0.321						

NOTE 1: SAMPLES 1 THROUGH 4 ARE FROM COMPOSITE (C) SAMPLES, EXCEPT WHERE THE COMPOSITE RESULT, INCLUDING ANALYTICAL UNCERTAINTY, WAS >2 pCi/gm, IN WHICH CASE ALL FOUR SAMPLES FROM THE GRID BLOCK WERE ANALYZED.
THE 5th SURFACE SAMPLE WAS TAKEN AT THE SAME LOCATION AS THE SUB-SURFACE SAMPLE. GRID BLOCK AVERAGES FOR BLOCKS WITH 5 SAMPLES ARE WEIGHTED TO ACCOUNT FOR THE 4 SAMPLE COMPOSITES.

NOTE 2: THE COMPOSITE RESULT FOR GRID BLOCK 033 WAS 10 pCi/gm. WHEN THE INDIVIDUAL SAMPLES WERE ANALYZED, ONE HAD A VALUE OF 34.1 pCi/gm, EXCEEDING THE LOCAL LIMIT OF 24. THE GRID BLOCK WAS REMEDIATED, AND RESAMPLED. THE RESULTS OF THAT RESAMPLING ARE SHOWN HERE.

NOTE 3: TO AVOID OVERSTATEMENT OF THE OVERALL SURFACE AVERAGE DUE TO THE ADDITIONAL ANALYSES FROM HIGHER CONCENTRATION AREAS, THE AVERAGE IS CALCULATED FROM THE GRID BLOCK AVERAGES, RATHER THAN FROM THE INDIVIDUAL ANALYSES

SURVEY UNIT EVALUATION: LAGOON A SOIL ANALYSIS

				pCi Co-60/gm		
	$\overline{X}$	n	S_x	μ_a	LIMIT	DISPOSITION
MAX. SUB-SURFACE AVERAGE AT 95% CONFIDENCE	0.321	36	0.361	0.423	8	ACCEPT
MAX. SURFACE AVERAGE AT 95% CONFIDENCE	0.435	199	0.642	0.511	8	ACCEPT

$$\overline{X} = \frac{1}{n_s}\sum_{i=1}^{n_s} X_i$$
Average (NOTE 3)

$$S_x = \sqrt{\frac{\sum_{i=1}^{n} (\overline{x} - x_i)^2}{n-1}}$$
Standard deviation

$$\mu_a = \overline{X} + t_{1-\alpha,df}\frac{S_x}{\sqrt{n}}$$
95% Confidence level

TABLE C-6

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON B

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF. (SEE NOTE 2)	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
B 001		50	130	<0.412 (C)						<0.412	24	ACC	<0.412	8	ACC
B 002	01	60	130	<0.299 (C)				<0.078	<0.286	<0.299	24	ACC	<0.255	8	ACC
B 003		70	130	<0.139 (C)						<0.139	24	ACC	<0.139	8	ACC
B 004	02	80	130	<0.145 (C)				<0.132	<0.198	<0.198	24	ACC	<0.142	8	ACC
B 005		90	130	<0.232 (C)						<0.232	24	ACC	<0.232	8	ACC
B 006	03	100	130	<0.175 (C)				<0.287	<0.056	<0.287	24	ACC	<0.197	8	ACC
B 007		110	130	<0.197 (C)						<0.197	24	ACC	<0.197	8	ACC
	04	120	130					<0.211	<0.220	<0.220	25	ACC	<0.211	8	ACC
B 008		50	120	0.792 (C)						0.792	24	ACC	0.792	8	ACC
B 009		60	120	<0.211 (C)						<0.211	24	ACC	<0.211	8	ACC
B 010		70	120	<0.384 (C)						<0.384	24	ACC	<0.384	8	ACC
B 011		80	120	<0.462 (C)						<0.462	24	ACC	<0.462	8	ACC
B 012		90	120	<0.174 (C)						<0.174	24	ACC	<0.174	8	ACC
B 013		100	120	<0.215 (C)						<0.215	24	ACC	<0.215	8	ACC
B 014		110	120	<0.257 (C)						<0.257	24	ACC	<0.257	8	ACC
B 015		120	120	<0.309 (C)						<0.309	24	ACC	<0.309	8	ACC
B 016		130	120	<0.329 (C)						<0.329	24	ACC	<0.329	8	ACC
B 017		140	120	<0.342 (C)						<0.342	24	ACC	<0.342	8	ACC
B 018		150	120	<0.213 (C)						<0.213	24	ACC	<0.213	8	ACC
B 019		160	120	<0.250 (C)						<0.250	24	ACC	<0.250	8	ACC
B 020		170	120	0.449 (C)						0.449	24	ACC	0.449	8	ACC
B 021		50	110	<0.311 (C)						<0.311	24	ACC	<0.311	8	ACC
B 022	05	60	110	<0.195 (C)				<0.469	<0.410	<0.469	24	ACC	<0.250	8	ACC
B 023		70	110	<0.294 (C)						<0.294	24	ACC	<0.294	8	ACC
B 024	06	80	110	<0.299 (C)				<0.325	<0.208	<0.325	24	ACC	<0.304	8	ACC
B 025		90	110	<0.539 (C)						<0.539	24	ACC	<0.539	8	ACC
B 026	07	100	110	<0.382 (C)				<0.347	<0.262	0.382	24	ACC	<0.375	8	ACC
B 027		110	110	<0.644	<0.285	<0.516	<0.317			<0.644	24	ACC	<0.441	8	ACC
B 028	08	120	110	2.200	1.020	<0.306	<0.325	<0.387	<0.159	<2.200	24	ACC	0.848	8	ACC
B 029		130	110	0.985 (C)						0.985	24	ACC	0.985	8	ACC
B 030	09	140	110	0.707 (C)				<0.677	<0.568	0.707	24	ACC	<0.751	8	ACC
B 030(A)				1.000											
B 031		150	110	0.359 (C)						0.359	24	ACC	0.359	8	ACC
B 032	10	160	110	0.336 (C)				<0.368	<0.192	<0.368	24	ACC	<0.342	8	ACC

TABLE C-6

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON B

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF. (SEE	SUB-	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
NOTE 2)	SURF	E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
B 033		170	110	<0.204 (C)						<0.204	25	ACC	<0.204	9	ACC
B 034	11	180	110	<0.203 (C)				<0.164	<0.218	<0.218	24	ACC	<0.195	8	ACC
B 035		190	110	<0.181 (C)						<0.181	24	ACC	<0.181	8	ACC
B 036	12	200	110	<0.255 (C				<0.178	<0.209	<0.255	24	ACC	<0.240	8	ACC
B 037		210	110	<0.298 (C)						<0.298	24	ACC	<0.298	8	ACC
	13	220	110					<0.069	<0.137	<0.137	25	ACC	<0.069	8	ACC
B 038		50	100	<0.203 (C)						<0.203	24	ACC	<0.203	8	ACC
B 039		60	100	<0.230 (C)						<0.230	24	ACC	<0.230	8	ACC
B 040		70	100	<0.275 (C)						<0.275	25	ACC	<0.275	8	ACC
B 041		80	100	<0.382 (C)						<0.382	26	ACC	<0.382	8	ACC
B 042		90	100	<0.293 (C)						<0.293	24	ACC	<0.293	8	ACC
B 043		100	100	<0.467 (C)						<0.467	24	ACC	<0.467	8	ACC
B 044		110	100	0.828 (C)						0.828	24	ACC	0.828	8	ACC
B 045		120	100	<0.465 (C)						<0.465	24	ACC	<0.465	8	ACC
B 046		130	100	1.450 (C)						1.450	24	ACC	1.450	8	ACC
B 047		140	100	11.700	<0.339	10.100	2.960			11.700	24	ACC	<3.839	8	ACC
B 047(A)				1.170	0.747	<0.348	3.350					ACC			
B 048		150	100	1.510 (C)						1.510	24	ACC	1.510	8	ACC
B 049		160	100	1.560 (C)						1.560	24	ACC	1.560	8	ACC
B 050		170	100	0.812 (C)						0.812	24	ACC	0.812	8	ACC
B 051		180	100	1.420 (C)						1.420	24	ACC	1.420	8	ACC
B 052		190	100	0.883 (C)						0.883	24	ACC	0.883	8	ACC
B 053		200	100	0.480 (C)						0.480	24	ACC	0.480	8	ACC
B 054		210	100	0.671 (C)						0.671	24	ACC	0.671	8	ACC
B 055		220	100	0.484 (C)						0.484	24	ACC	0.484	8	ACC
B 056		50	90	<0.383 (C)						<0.383	24	ACC	<0.383	8	ACC
B 057	14	60	90	<0.269 (C)				<0.299	<0.270	<0.299	24	ACC	<0.275	8	ACC
B 058		70	90	<0.328 (C)						<0.328	24	ACC	<0.328	8	ACC
B 059	15	80	90	<0.332 (C)				<0.351	<0.226	<0.351	24	ACC	<0.336	8	ACC
B 060		90	90	<0.191 (C)						<0.191	24	ACC	<0.191	8	ACC
B 061	16	100	90	0.685 (C)				<0.526	<0.276	0.685	24	ACC	<0.653	8	ACC
B 062		110	90	<0.502 (C)						<0.502	24	ACC	<0.502	8	ACC
B 063	17	120	90	0.481 (C)				<0.418	<0.299	0.481	24	ACC	<0.468	8	ACC
B 064		130	90	1.170 (C)						1.170	24	ACC	1.170	8	ACC

TABLE C-6

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON B
ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF. (SEE NOTE 2)	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
B 064(A)				0.931											
B 065	18	140	90	1.200 (C)				<0.392	<0.286	1.200	24	ACC	0.991	8	ACC
B 065(A)				0.756											
B 066		150	90	1.440	0.651	5.180	2.110			5.180	24	ACC	2.198	8	ACC
B 066(A)				1.610											
B 067	19	160	90	1.490 (C)				<0.372	<0.371	1.490	24	ACC	<1.266	8	ACC
B 068		170	90	1.030 (C)						1.030	24	ACC	1.030	8	ACC
B 069	20	180	90	1.420 (C)				<0.383	<0.275	1.420	24	ACC	<1.213	8	ACC
B 070		190	90	<0.641 (C)						<0.641	24	ACC	<0.641	8	ACC
B 071	21	200	90	1.070 (C)				<0.222	<0.276	1.070	24	ACC	<0.900	8	ACC
B 072		210	90	0.899 (C)						0.899	24	ACC	0.899	8	ACC
B 073	22	220	90	<0.287 (C)				<0.253	<0.242	<0.287	24	ACC	<0.280	8	ACC
B 074		230	90	<0.174 (C)						<0.174	24	ACC	<0.174	8	ACC
B 075		40	80	<0.299 (C)						<0.299	24	ACC	<0.299	8	ACC
B 076		50	80	<0.408 (C)						<0.408	24	ACC	<0.408	8	ACC
B 077		60	80	<0.335 (C)						<0.335	24	ACC	<0.335	8	ACC
B 078		70	80	<0.102 (C)						<0.102	24	ACC	<0.102	8	ACC
B 079		80	80	<0.309 (C)						<0.309	24	ACC	<0.309	8	ACC
B 080		90	80	<0.313 (C)						<0.313	24	ACC	<0.313	8	ACC
B 081		100	80	0.565 (C)						0.565	24	ACC	0.565	8	ACC
B 082		110	80	0.810 (C)						0.810	24	ACC	0.810	8	ACC
B 083		120	80	<0.210 (C)						<0.210	24	ACC	<0.210	8	ACC
B 084		130	80	<0.375 (C)						<0.375	24	ACC	<0.375	8	ACC
B 085		140	80	0.949 (C)						0.949	24	ACC	0.949	8	ACC
B 086		150	80	2.530	2.150	9.030	3.340			9.030	24	ACC	<3.407	8	ACC
B 086(A)				0.334	6.350	16.900	2.420								
B 086(A)				2.660											
B 086(B)				<0.442	<0.294	2.690	<0.315								
B 086(B)				<0.266	1.390										
B 087		160	80	<0.841	3.120	3.260	2.450			3.260	24	ACC	<2.418	8	ACC
B 088		170	80	4.360	1.820	3.590	1.070			4.360	24	ACC	2.710	8	ACC
B 089		180	80	1.930	2.390	2.000	3.920			3.920	24	ACC	2.560	8	ACC
B 090		190	80	2.500	1.930	2.200	<0.391			2.500	24	ACC	<1.755	8	ACC
B 091		200	80	1.110 (C)						1.110	24	ACC	1.110	8	ACC

TABLE C-6

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON B

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF. (SEE NOTE 2)	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
B 092		210	80	1.210 (C)						1.210	24	ACC	1.210	8	ACC
B 093		220	80	<0.480 (C)						<0.480	24	ACC	<0.480	8	ACC
B 094		230	80	<0.220 (C)						<0.220	24	ACC	<0.220	8	ACC
B 095		40	70	<0.413 (C)						<0.413	24	ACC	<0.413	8	ACC
B 096		50	70	<0.243 (C)						<0.243	24	ACC	<0.243	8	ACC
B 097	23	60	70	<0.349 (C)				<0.120	<0.214	<0.349	24	ACC	<0.303	8	ACC
B 098		70	70	<0.218 (C)						<0.218	24	ACC	<0.218	8	ACC
B 099	24	80	70	<0.242 (C)				<0.247	<0.163	<0.247	24	ACC	<0.243	8	ACC
B 100		90	70	<0.339 (C)						<0.339	24	ACC	<0.339	8	ACC
B 101	25	100	70	0.516 (C)				<0.210	<0.225	0.516	24	ACC	<0.455	8	ACC
B 102		110	70	<0.551 (C)						<0.551	24	ACC	<0.551	8	ACC
B 103	26	120	70	0.915 (C)				<1.520	<0.346	1.520	24	ACC	1.036	8	ACC
B 104		130	70	2.030	3.710	2.450	2.810			3.710	24	ACC	2.750	8	ACC
B 105	27	140	70	1.180 (C)				<0.545	<0.306	1.180	24	ACC	<1.053	8	ACC
B 106		150	70	2.640	1.820	3.830	2.750			3.830	24	ACC	<3.711	8	ACC
B 106(A)				5.520	4.160	8.880	4.060								
B 106(B)				3.030	<0.423										
B 107	28	160	70	2.200	11.200	3.780	3.850	<1.130	<0.274	11.200	24	ACC	3.988	8	ACC
B 107(A)				9.890	2.300	3.340	3.190								
B 107(B)				2.270	0.717										
B 108		170	70	3.720	1.980	5.040	6.790			6.790	24	ACC	<3.343	8	ACC
B 108(A)				5.040	1.100	2.470	<0.600								
B 109	29	180	70	1.070 (C)				<0.389	<0.297	1.070	24	ACC	<0.934	8	ACC
B 110		190	70	1.330	2.530	3.700	<0.443			3.700	24	ACC	<2.001	8	ACC
B 111	30	200	70	5.610	1.810	0.614	<0.322	<0.351	<0.182	5.610	24	ACC	<1.741	8	ACC
B 112		210	70	1.770 (C)						1.770	24	ACC	1.770	8	ACC
B 113	31	220	70	1.300 (C)				<0.553	<0.197	1.300	24	ACC	<1.151	8	ACC
B 114		230	70	0.651 (C)						0.651	24	ACC	0.651	8	ACC
	32	240	70					<0.260	<0.156	<0.260	25	ACC	<0.260	8	ACC
B 115		60	60	<0.218 (C)						<0.218	24	ACC	<0.218	8	ACC
B 116		70	60	<0.628 (C)						<0.628	24	ACC	<0.628	8	ACC
B 117		80	60	<0.207 (C)						<0.207	24	ACC	<0.207	8	ACC
B 118		90	60	<0.391 (C)						<0.391	24	ACC	<0.391	8	ACC
B 119		100	60	0.838 (C)						0.838	24	ACC	0.838	8	ACC

TABLE C-6

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON B

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF. (SEE NOTE 2)	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
B 120		110	60	<0.321	0.827	<0.146	2.510			2.510	24	ACC	<0.951	8	ACC
B 121		120	60	<0.442 (C)						<0.442	24	ACC	<0.442	8	ACC
B 122		130	60	<0.307 (C)						<0.307	24	ACC	<0.307	8	ACC
B 123		140	60	4.910	3.310	2.960	0.911			4.910	24	ACC	3.023	8	ACC
B 124		150	60	<0.467 (C)						<0.467	24	ACC	<1.300	8	ACC
B 124(A)				4.630											
B 125		160	60	1.720 (C)						1.720	24	ACC	1.686	8	ACC
B 125(A)				1.550											
B 126		170	60	4.820	3.460	1.500	2.980			4.820	24	ACC	3.190	8	ACC
B 127		180	60	<0.481	1.190	1.690	2.070			2.070	24	ACC	<1.358	8	ACC
B 128		190	60	<0.420	1.050	<0.324	<0.371			1.050	24	ACC	<0.541	8	ACC
B 129		200	60	0.742 (C)						0.742	24	ACC	0.742	8	ACC
B 130		210	60	0.291 (C)						0.291	24	ACC	0.291	8	ACC
B 131		220	60	1.780 (C)						1.780	24	ACC	1.780	8	ACC
B 132		230	60	0.518 (C)						0.518	24	ACC	0.518	8	ACC
B 133		110	50	<0.297 (C)						<0.297	24	ACC	<0.297	8	ACC
B 134		120	50	<0.300 (C)						<0.300	24	ACC	<0.300	8	ACC
B 135		130	50	<0.265 (C)						<0.265	24	ACC	<0.265	8	ACC
B 136		140	50	1.170 (C)						1.170	24	ACC	1.170	8	ACC
B 137		150	50	1.630 (C)						1.630	24	ACC	1.630	8	ACC
B 138	33	160	50	<0.312	0.889	2.740	7.500	<0.221	<0.183	7.500	24	ACC	<2.332	8	ACC
B 139		170	50	1.690	2.600	<0.311	1.040			2.600	24	ACC	<1.410	8	ACC
B 140	34	180	50	1.640 (C)				<0.430	<0.442	1.640	24	ACC	<1.398	8	ACC
B 141		190	50	1.010 (C)						1.010	24	ACC	1.010	8	ACC
B 142	35	200	50	1.430 (C)				<0.373	<0.187	1.430	24	ACC	<1.219	8	ACC
B 143		210	50	1.060 (C)						1.060	24	ACC	1.060	8	ACC
B 144	36	220	50	0.448 (C)				<0.314	<0.361	0.448	25	ACC	<0.421	9	ACC
B 145		230	50	<0.281 (C)						<0.281	26	ACC	<0.281	10	ACC
	37	240	50					<0.277	<0.222	<0.277	25	ACC	<0.055	8	ACC
B 146		170	40	<0.245 (C)						<0.245	27	ACC	<0.245	11	ACC
B 147		180	40	0.345 (C)						0.345	28	ACC	0.345	12	ACC
B 148		190	40	1.140 (C)						1.140	24	ACC	1.140	8	ACC
B 149		200	40	0.390 (C)						0.390	24	ACC	0.390	8	ACC

TABLE C-6

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON B

ANALYSIS: SOIL/GAMMA SPECTROMETRY

GRID BLOCK ID				DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
SURF. (SEE NOTE 2)	SUB-SURF	COORDINATES		SURFACE (SEE NOTE 1)					SUB-SURF.	MAXIMUM			SURFACE AVERAGE		
		E	N	1	2	3	4	5	6" - 12"	VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
B 150		210	40	<0.421 (C)						<0.421	24	ACC	<0.421	8	ACC
B 151		220	40	<0.247 (C)						<0.247	24	ACC	<0.247	8	ACC
B 152	36	230	40	<0.328 (C)						<0.328	24	ACC	<0.328	8	ACC
								SAMPLE DEPTH:	0" - 6"	6" - 12"					
								AVERAGE pCi/gm:	<0.374	<0.254					

NOTE 1: SAMPLES 1 THROUGH 4 ARE FROM COMPOSITE (C) SAMPLES, EXCEPT WHERE THE COMPOSITE RESULT, INCLUDING ANALYTICAL ERROR, WAS >2 pCi/gm, IN WHICH CASE ALL FOUR SAMPLES FROM THE GRID BLOCK WERE ANALYZED.
THE 5th SURFACE SAMPLE WAS TAKEN AT THE SAME LOCATION AS THE SUB-SURFACE SAMPLE. GRID BLOCK AVERAGES FOR BLOCKS WITH 5 SAMPLES ARE WEIGHTED TO ACCOUNT FOR THE 4 SAMPLE COMPOSITES.

NOTE 2: (A) SAMPLES WERE COLLECTED AND ANALYZED AS A RESULT OF HIGHER THAN EXPECTED RESULTS FROM ANALYSIS OF THE ORIGINAL 4 SAMPLES.
(B) SAMPLES WERE COLLECTED AND ANALYZED AS A RESULT OF HIGHER THAN EXPECTED RESULTS FROM ANALYSIS OF THE PREVIOUS SAMPLES.

NOTE 3: TO AVOID OVERSTATEMENT OF THE OVERALL SURFACE AVERAGE DUE TO THE ADDITIONAL ANALYSES FROM HIGHER CONCENTRATION AREAS, THE AVERAGE IS CALCULATED FROM THE GRID BLOCK AVERAGES, RATHER THAN FROM THE INDIVIDUAL ANALYSES

SURVEY UNIT EVALUATION: LAGOON A SOIL ANALYSIS

				pCi Co-60/gm		
	$\overline{X}$	n	S_x	μ_a	LIMIT	DISPOSITION
MAX. SUB-SURFACE AVERAGE AT 95% CONFIDENCE	0.254	37	0.094	0.280	8	ACCEPT
MAX. SURFACE AVERAGE AT 95% CONFIDENCE	0.804	292	2.053	1.003	8	ACCEPT

$$\overline{X} = \frac{1}{n_s}\sum_{i=1}^{n_s} X_i$$

Average (NOTE 3)

$$S_x = \sqrt{\frac{\sum_{i=1}^{n}(\overline{x} - x_i)^2}{n-1}}$$

Standard deviation

$$\mu_a = \overline{X} + t_{1-\alpha,df}\frac{S_x}{\sqrt{n}}$$

95% Confidence level

TABLE C-7

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON C

ANALYSIS: SOIL/GAMMA SPECTROMETRY

20 M X 20 M GRID BLOCK INFORMATION							DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
No.	COORDINATES		INCLUDED 10 M X 10 M GRID CELLS				SURFACE					SUB SURF.	MAXIMUM			SURFACE AVERAGE		
							10 M X 10 M GRID CELLS				CENTER							
	E	N/S	1	2	3	4	1	2	3	4	5		VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
01	50	50 N	001	002	006	007	<0.355	0.666	0.378	<0.590	<0.464	<0.199	0.666	24	ACC	<0.491	8	ACC
02	70	50 N	003	004	008	009	<0.230	<0.346	0.891	<0.394	<0.214	<0.197	0.891	24	ACC	<0.415	8	ACC
03	90	50 N	--	005	010	011	--	<0.226	<0.561	0.379	<0.345	<0.314	<0.561	24	ACC	<0.378	8	ACC
04	50	30 N	017	018	035	036	<0.217	<0.188	<0.447	<0.420	<0.743	<0.241	<0.743	24	ACC	<0.403	8	ACC
05	70	30 N	019	020	037	038	0.501	<0.610	<0.417	<0.982	<0.236	<0.087	<0.982	24	ACC	<0.549	8	ACC
06	90	30 N	021	022	039	040	<0.768	<0.229	<0.361	--	<0.243	<0.747	<0.768	24	ACC	<0.400	8	ACC
07	110	30 N	023	024	041	042	<0.260	2.410	1.950	2.360	<0.395	<0.183	2.410	24	ACC	<1.475	8	ACC
08	130	30 N	025	026	043	044	<0.190	<0.296	2.050	0.861	3.320	2.270	3.320	24	ACC	<1.343	8	ACC
09	150	30 N	027	028	045	046	<0.458	<0.307	1.490	1.070	0.878	<0.252	1.490	24	ACC	<0.841	8	ACC
10	170	30 N	029	030	047	048	<0.262	<0.356	<0.311	<0.045	<0.434	<0.169	<0.434	24	ACC	<0.282	8	ACC
11	190	30 N	031	032	049	050	<0.099	<0.236	<0.899	0.513	<0.150	<0.062	<0.899	24	ACC	<0.379	8	ACC
12	210	30 N	033	034	051	052	<0.659	<0.235	<0.220	<0.282	<0.249	<0.171	<0.659	24	ACC	<0.329	8	ACC
13	50	10 N	055	056	075	076	<0.532	1.240	<0.513	<0.695	<0.397	<1.550	1.240	24	ACC	<0.675	8	ACC
14	70	10 N	057	058	077	078	<0.366	<0.242	<0.388	1.180	<0.346	<0.159	1.180	24	ACC	<0.504	8	ACC
15	90	10 N	059	060	079	080	<0.326	--	<0.683	0.707	<0.214	<0.288	0.707	24	ACC	<0.483	8	ACC
16	110	10 N	061	062	081	082	2.680	<1.220	2.360	<0.451	2.830	<1.210	2.830	24	ACC	<1.908	8	ACC
17	130	10 N	063	064	083	084	<0.768	<0.455	<0.445	0.722	0.478	<0.224	<0.768	24	ACC	<0.574	8	ACC
18	150	10 N	065	066	085	086	0.521	1.050	<0.434	<0.336	<0.371	<0.163	1.050	24	ACC	<0.542	8	ACC
19	170	10 N	067	068	087	088	0.997	<0.437	<0.411	0.692	<0.273	<0.259	0.997	24	ACC	<0.562	8	ACC
20	190	10 N	069	070	089	090	<0.147	<0.327	9.280	1.350	0.585	<0.215	9.280	24	ACC	<2.338	8	ACC
21	210	10 N	071	072	091	092	1.170	<0.302	1.320	<0.343	<0.828	<1.260	1.320	24	ACC	<0.793	8	ACC
22	230	20 N	053	054	073	074	0.757	<0.342	1.030	<0.174	<0.220	<0.152	1.030	24	ACC	<0.505	8	ACC
23	50	10 S	094	095	112	113	<0.701	2.020	<0.336	<0.461	<0.323	<0.490	2.020	24	ACC	<0.768	8	ACC
24	70	10 S	096	097	114	115	2.020	<0.705	1.400	0.734	<0.295	<0.210	2.020	24	ACC	<1.031	8	ACC
25	90	10 S	098	099	116	117	<0.122	<1.320	1.310	<0.858	<0.563	<0.464	<1.320	24	ACC	<0.835	8	ACC
26	110	10 S	100	101	118	119	1.650	1.080	0.698	<0.689	<0.318	<0.079	1.650	24	ACC	<0.887	8	ACC
27	130	10 S	102	103	120	121	0.785	1.340	<0.461	0.491	<0.695	<0.273	1.340	24	ACC	<0.754	8	ACC
28	150	10 S	104	105	122	123	0.662	<0.300	<0.465	1.730	<0.565	<0.065	1.730	24	ACC	<0.744	8	ACC
29	170	10 S	106	107	124	125	1.100	<0.282	<0.239	<0.234	<0.770	<0.197	1.100	24	ACC	<0.525	8	ACC
30	190	10 S	108	109	126	127	0.405	0.879	0.673	0.697	<0.227	<0.391	0.879	24	ACC	<0.576	8	ACC
31	210	10 S	110	111	128	129	<0.165	<0.269	<0.163	<0.548	<0.158	<0.192	<0.548	24	ACC	<0.261	8	ACC
32	70	30 S	130	131	--	--	<0.356	<0.326	--	--	<0.297	<0.242	<0.356	24	ACC	<0.326	8	ACC

TABLE C-7

FINAL SURVEY DATA

ASH LAGOON REMEDIATION PROJECT
NORTHEAST OHIO REGIONAL SEWER DISTRICT

SURVEY UNIT: LAGOON C

ANALYSIS: SOIL/GAMMA SPECTROMETRY

20 M X 20 M GRID BLOCK INFORMATION							DATA (pCi Co-60/gm)						SAMPLE EVALUATION RESULTS (pCi Co-60/gm)					
No.	COORDINATES		INCLUDED 10 M X 10 M GRID CELLS				SURFACE 10 M X 10 M GRID CELLS				CENTER	SUB SURF.	MAXIMUM			SURFACE AVERAGE		
	E	N/S	1	2	3	4	1	2	3	4	5		VALUE	LIMIT	DISP.	VALUE	LIMIT	DISP.
33	90	30 S	132	133	144	145	<0.260	<0.748	<0.527	3.490	<0.222	<0.132	3.490	24	ACC	<1.049	8	ACC
34	110	30 S	134	135	146	147	0.590	<0.958	<0.356	<0.275	<0.299	<0.390	<0.958	24	ACC	<0.496	8	ACC
35	130	30 S	136	137	148	149	<0.945	0.722	<0.374	<0.316	<0.263	<0.163	<0.945	24	ACC	<0.524	8	ACC
36	150	30 S	138	139	150	151	<0.262	1.480	<0.890	0.533	<0.275	<0.062	1.480	24	ACC	<0.688	8	ACC
37	170	30 S	140	141	152	153	1.620	1.000	0.631	0.420	<0.263	<0.181	1.620	24	ACC	0.787	8	ACC
INDIVIDUAL LAGOON PERIMETER 10 M X 10 M GRID CELLS NOT IN ANY 20 M X 20 M GRID BLOCK																		
	100 - 130	40 N	012	013	014	015	0.489	<0.157	<0.231	<0.754								
	140	40 N	016				<0.370						<0.754	24	ACC	<0.400	8	ACC
	220	0	093				<0.310						<0.310	24	ACC	<0.310	8	ACC
	180 - 190	20 S	142	143			<0.251	<0.410					<0.410	24	ACC	<0.331	8	ACC
	30	0 - 130 N	154	155	156		<0.279	<0.420	1.980				1.980	24	ACC	<0.893	8	ACC
									SAMPLE DEPTH:		0" - 6"	6" - 12"						
									AVERAGE pCi/gm:		<0.534	<0.376						

SURVEY UNIT EVALUATION: LAGOON C SOIL ANALYSIS

				pCi Co-60/gm		
	$\overline{X}$	n	S_x	μ_a	LIMIT	DISPOSITION
MAX. SUB-SURFACE AVERAGE AT 95% CONFIDENCE	0.376	37	0.465	0.505	8	ACCEPT
MAX. SURFACE AVERAGE AT 95% CONFIDENCE	0.711	191	0.857	0.814	8	ACCEPT

$$\overline{x} = \frac{1}{n_s}\sum_{i=1}^{n_s} x_i$$

Average

$$S_x = \sqrt{\frac{\sum_{i=1}^{n} (\overline{x} - x_i)^2}{n-1}}$$

Standard deviation

$$\mu_a = \overline{X} + t_{1-\alpha,df}\frac{S_x}{\sqrt{n}}$$

95% Confidence level