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**An Environmental Radiological  
Survey of the Intermediate-Level  
Waste System Pipeline**

W. F. Ohnesorge <sup>36</sup>  
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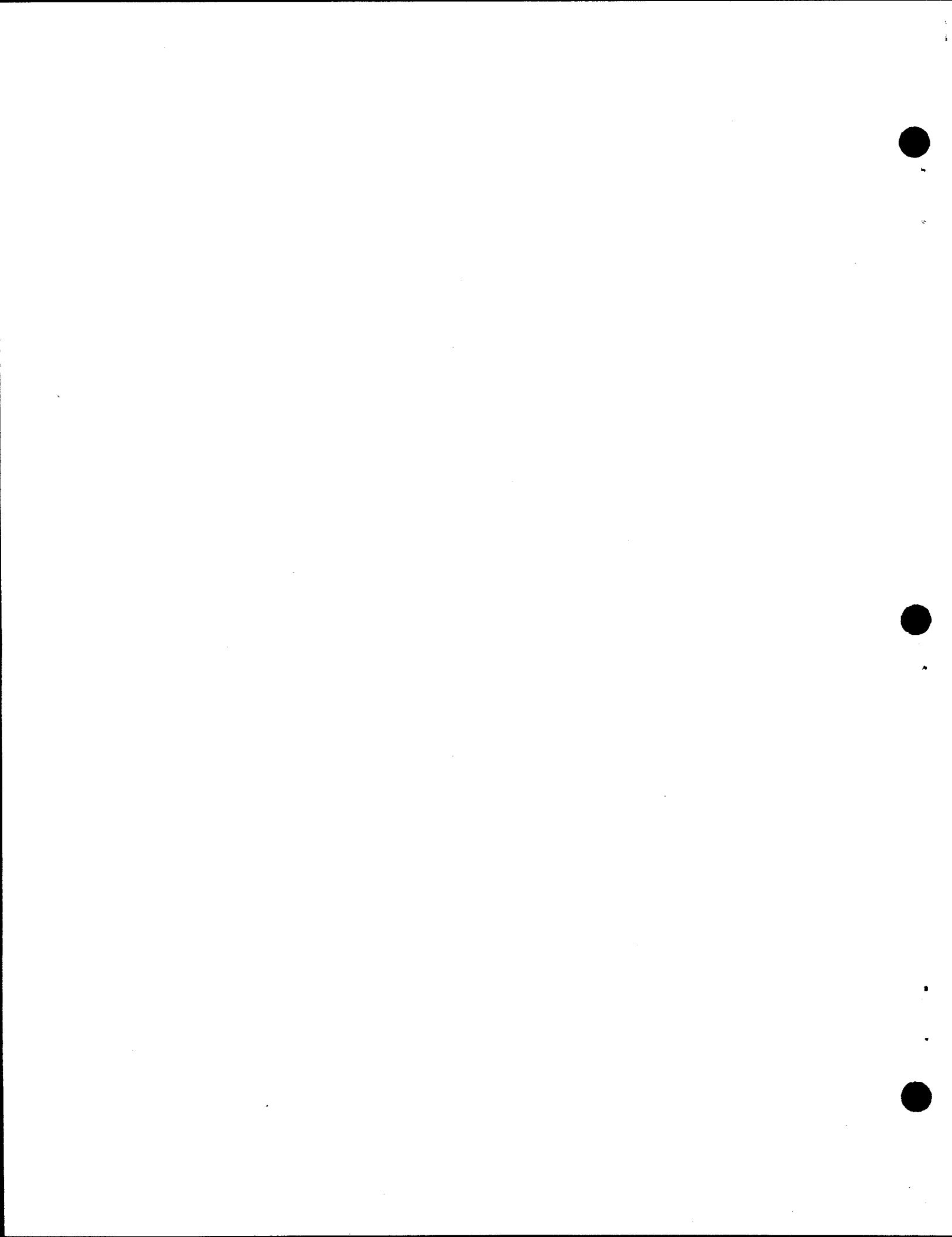
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Intermediate-Level Waste System Pipeline

W. F. Ohnesorge      D. W. Parsons  
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Department of Environmental Management  
Industrial Safety and Applied  
Health Physics Division

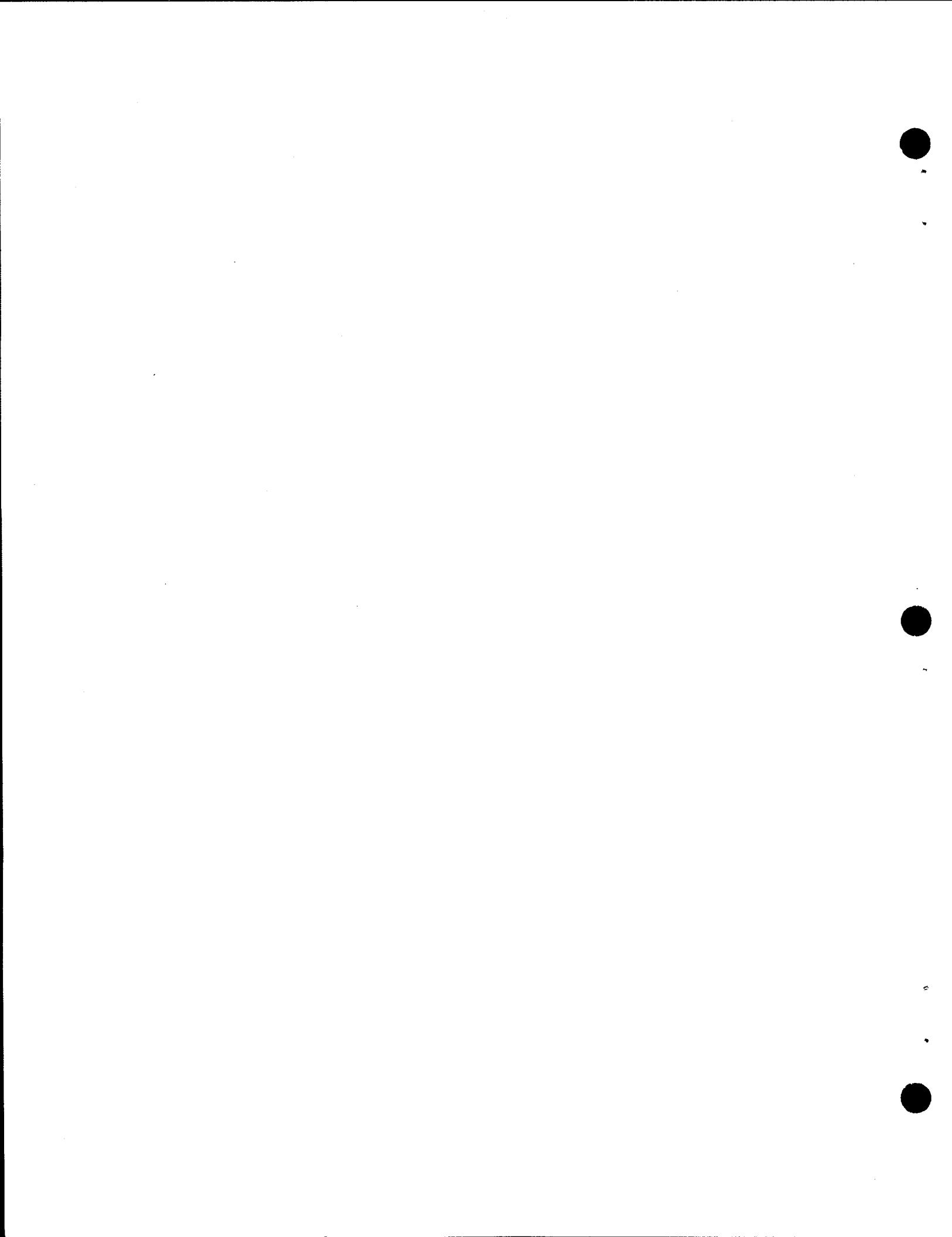
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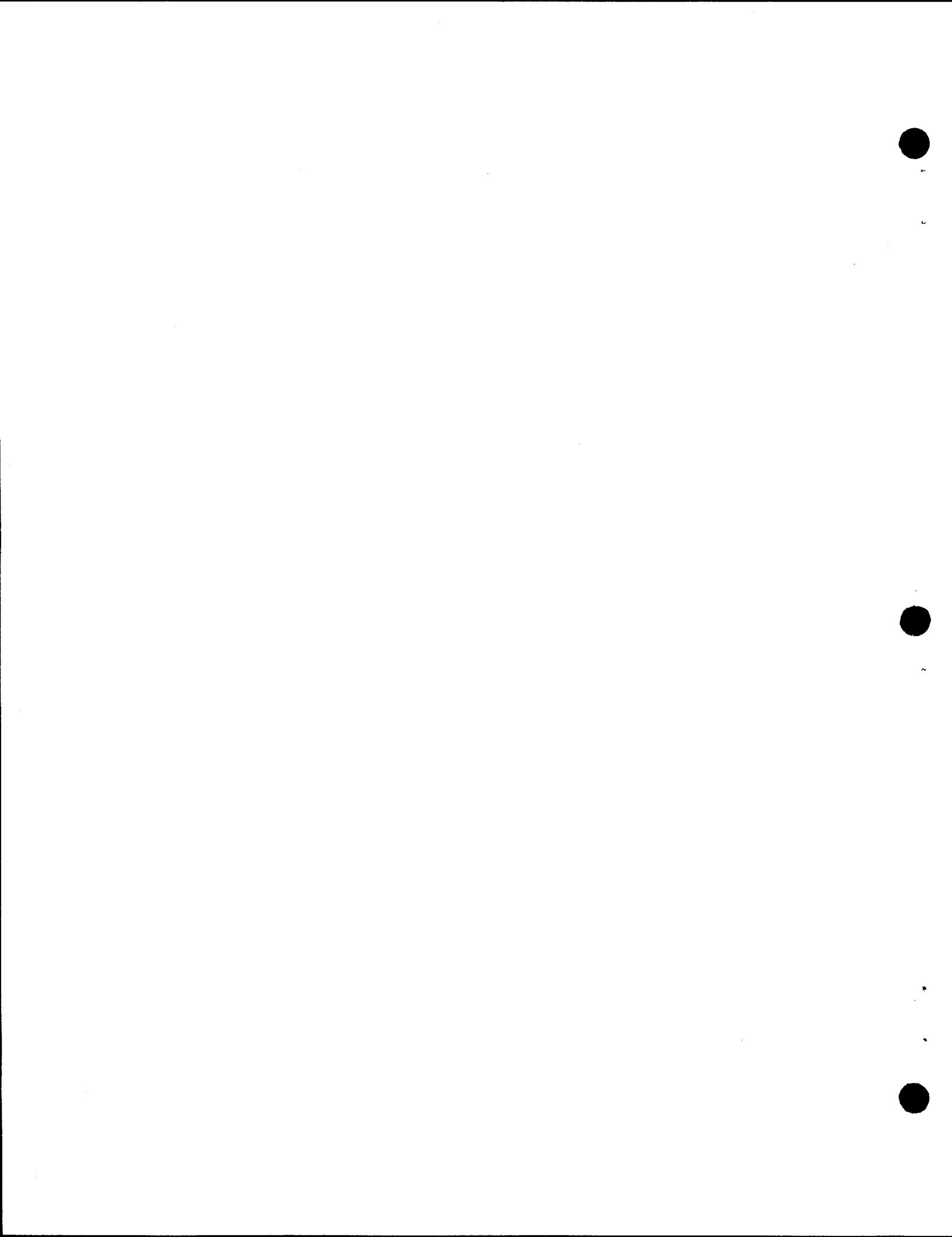
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AN ENVIRONMENTAL RADIOLOGICAL SURVEY OF THE  
INTERMEDIATE-LEVEL WASTE SYSTEM PIPELINE

W. F. Ohnesorge      D. W. Parsons  
T. W. Oakes      J. L. Malone

HIGHLIGHTS

This publication gives the results of a February 1979 radiation survey of the intermediate-level waste system pipeline. Survey techniques and recommendations for health physics monitoring during cleanup are included.

INTRODUCTION

The intermediate-level waste (ILW) pipeline was used to transfer liquid radioactive waste from the Oak Ridge National Laboratory (ORNL) area to the original hydrofracture facility and to the seepage pits and trenches. A history of the pits and trenches gives some insight to the amount of materials handled by these lines.<sup>1</sup> These pits and trenches were in use from 1951 to 1966. Approximately  $1.9 \times 10^{16}$  Bq ( $5 \times 10^5$  Ci) went to pits 2, 3, and 4;  $1.1 \times 10^{16}$  Bq ( $3 \times 10^5$  Ci) to trench 5; and  $1.0 \times 10^{16}$  Bq ( $2.8 \times 10^5$  Ci) to trench 7. Pit 1 and trench 6 were in operation for only a short time because of breakthrough of activity. A preliminary radionuclide inventory of trench 7 indicated the following activities [becquerels (curies)]:  $^{137}\text{Cs}$ ,  $5.6 \times 10^{15}$  ( $1.5 \times 10^5$ );  $^{90}\text{Sr}$ ,  $1.2 \times 10^{15}$  ( $3.2 \times 10^4$ );  $^{60}\text{Co}$ ,  $6.3 \times 10^{12}$  ( $1.7 \times 10^2$ );  $^{237}\text{Pu}$ ,  $3.4 \times 10^{11}$  (9.2); and  $^{233}\text{U}$ ,  $1.2 \times 10^{11}$  (3.2). Small amounts [less than  $3.7 \times 10^{10}$  Bq (1 Ci) each] of various additional alpha-emitting nuclides were also on the inventory.

Between February 7 and February 9, 1979, members of the Department of Environmental Management conducted radiation surveys of the ILW system pipeline between the original hydrofracture site and ORNL. The pipe system surveyed included branches to waste pits 2 and 3 and waste trenches 5 and 7 (Fig. 1). Survey point 1 was located at the hydrofracture site, and the final survey point, 784, was at a manhole cover near the intersection of Lagoon Road and Melton Drive. Figure 2 shows a contour map

of the survey area. Figures 3 through 7 show the individual survey points. A resurvey was made in areas where leaks were detected in the pipe. Figures 8 and 9 and Table 1 show survey results in the areas where leaks occurred.

The readings during the initial survey were taken at 3.0-m (10-ft) intervals 1 m (3.3 ft) above the ground and at the ground surface. Three sets of simultaneous readings were taken. One set of readings was taken over the center of the pipeline, and the other readings were taken 1.5 m (5 ft) to the left and to the right of the line. (Left and right is as seen by an individual standing over the pipeline facing in the direction of higher-numbered survey points.)

#### SURVEY INSTRUMENTS AND DOSIMETERS

Readings (Table 2) were taken with portable survey meters that had a 30-mg/cm<sup>2</sup> stainless steel window Geiger-Mueller (GM) tube and an aluminum beta shield (ORNL Q-2092A). The beta shields were closed during the survey. These survey meters were calibrated with a <sup>226</sup>Ra source and adjusted so they indicated 2700 counts per minute in a 0.01-mSv/h (1-mR/h) field.

Readings in the areas where leaks occurred (Figs. 8 and 9) were taken with a portable ion-chamber survey meter (ORNL standard model "cutie pie"). These readings included beta radiation and were higher than those taken with the beta-shielded GM tubes.

In addition to the cutie pie meter survey of the leak areas, a thermoluminescent-dosimeter (TLD) survey was made (Table 1). The TLDs, placed in plastic bottles on stakes 1 m (3.3 ft) above the ground, were left in place for approximately 5 d.

#### DISCUSSION OF SURVEY RESULTS

Table 2 shows the results of the GM survey. The elevated readings near the hydrofracture site were probably caused by general background

radiation and not by a pipe leak. The two areas (identified on Figs. 3 and 4 as special areas nos. 1 and 2) where leaks occurred were located at survey locations 67 to 72 (pipe leak 2 in Fig. 1) and locations 193 and 204 (pipe leak 1 in Fig. 1). The readings taken in these contaminated areas at ground level were sometimes less than those taken at 1 m (3.3 ft) above the ground at the same location. This was probably because of shielding by uneven terrain and an uneven distribution of radionuclides at the surface.

The only other elevated readings in addition to those in the contaminated areas were found in survey areas where the line was exposed, such as at creek crossings. The final elevated reading, survey point 784, was obtained at a manhole cover for the line.

Figures 8 and 9 show the areas where the leaks occurred. The readings shown on these figures were taken with a cutie pie survey meter at 1 m (3.3 ft) above the ground. A stake with a flag was placed to mark each measurement point in the leak areas.

The dosimeter location numbers (Table 1) correspond to the survey point numbers (Figs. 8 and 9). The TLD readings were lower than the cutie pie meter readings because of the beta shielding by the plastic bottles that contained the TLDs.

#### CONCLUSION

The measured gamma rates at the leak sites would indicate a contamination level on the order of 37 to 190 kBq/cm<sup>2</sup> (1- to 5- $\mu$ Ci/cm<sup>2</sup>) gamma activity if the contamination were all on the surface. Because the activity is mixed in the soil and would vary greatly with location, giving an accurate estimate of specific activity in microcuries per cubic centimeter would be difficult. However, it would be sufficient for planning purposes to say that on the order of 37 to 370 kBq/cm<sup>3</sup> (1 to 10  $\mu$ Ci/cm<sup>3</sup>) of beta-gamma activity might be expected in the top layers of soil and that greater amounts could be expected at greater depths (near the pipe) in some locations. These levels of activity would require the services of personnel from the Department of Health Physics of the Industrial Safety and Applied Health Physics Division for planning and executing a cleanup operation.

## REFERENCE

1. C. R. Olsen et al., unpublished data, 1981.

ORNL DWG 74-8966R

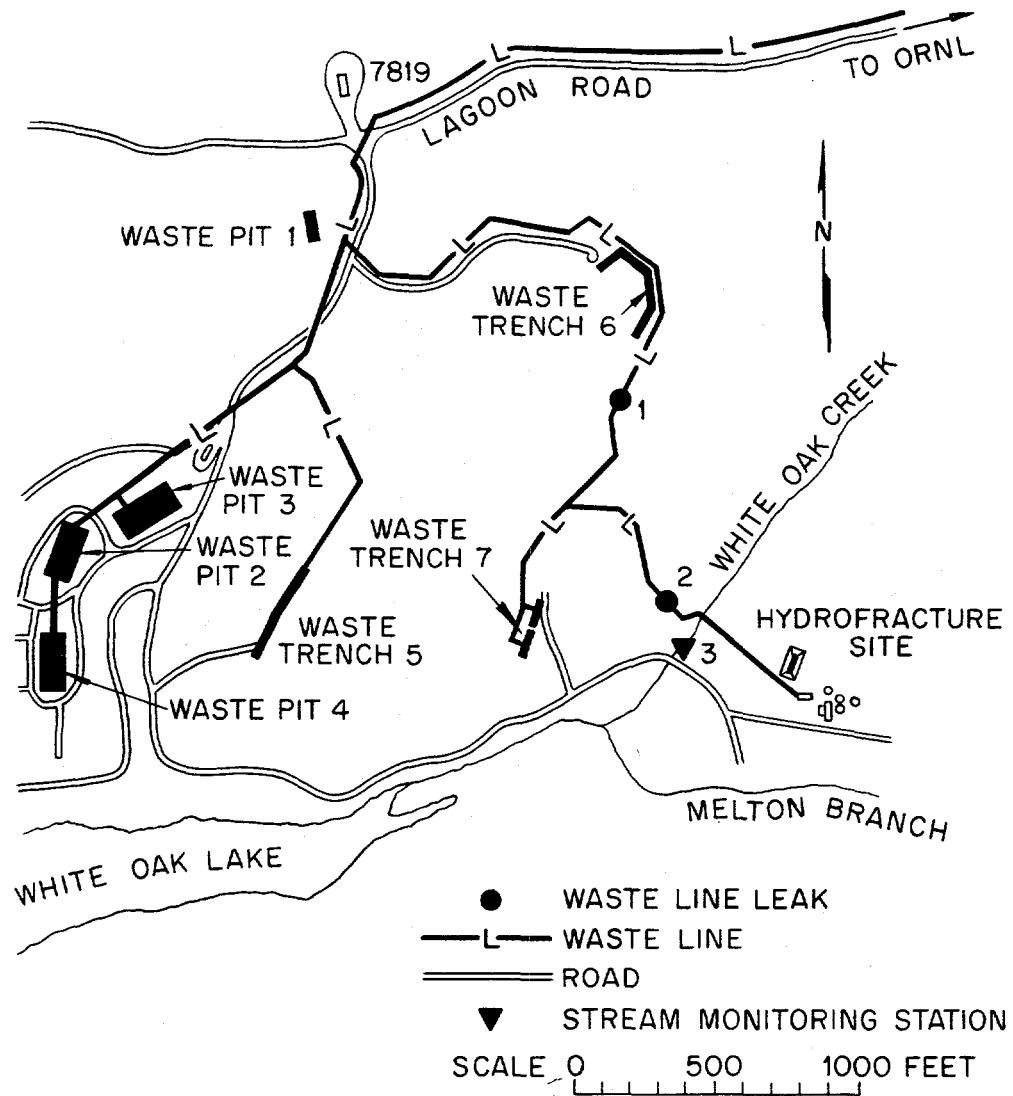


Fig. 1. Location of waste line leaks on transfer line between ORNL and hydrofracture site. (To convert the scale to meters divide by 3.3.)

ORNL-LR-DWG 24800R

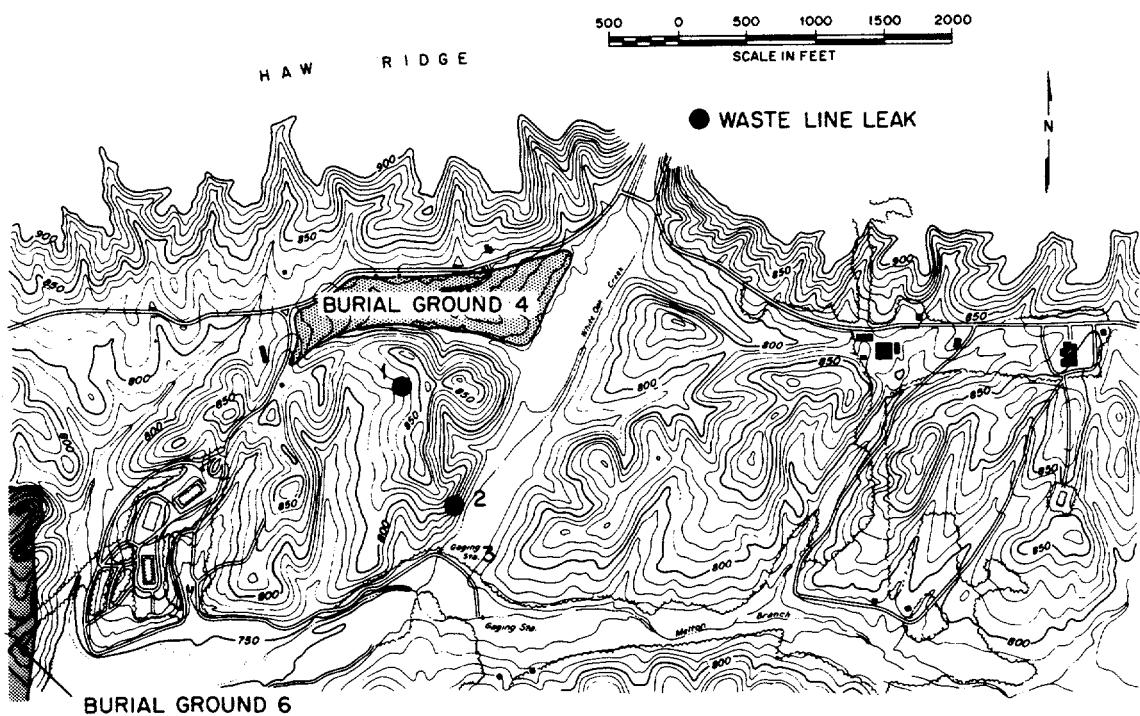


Fig. 2. Location of waste line leaks. (All distances are in feet; to convert to meters, divide distances by 3.3.)

ORNL-DWG 81-11568

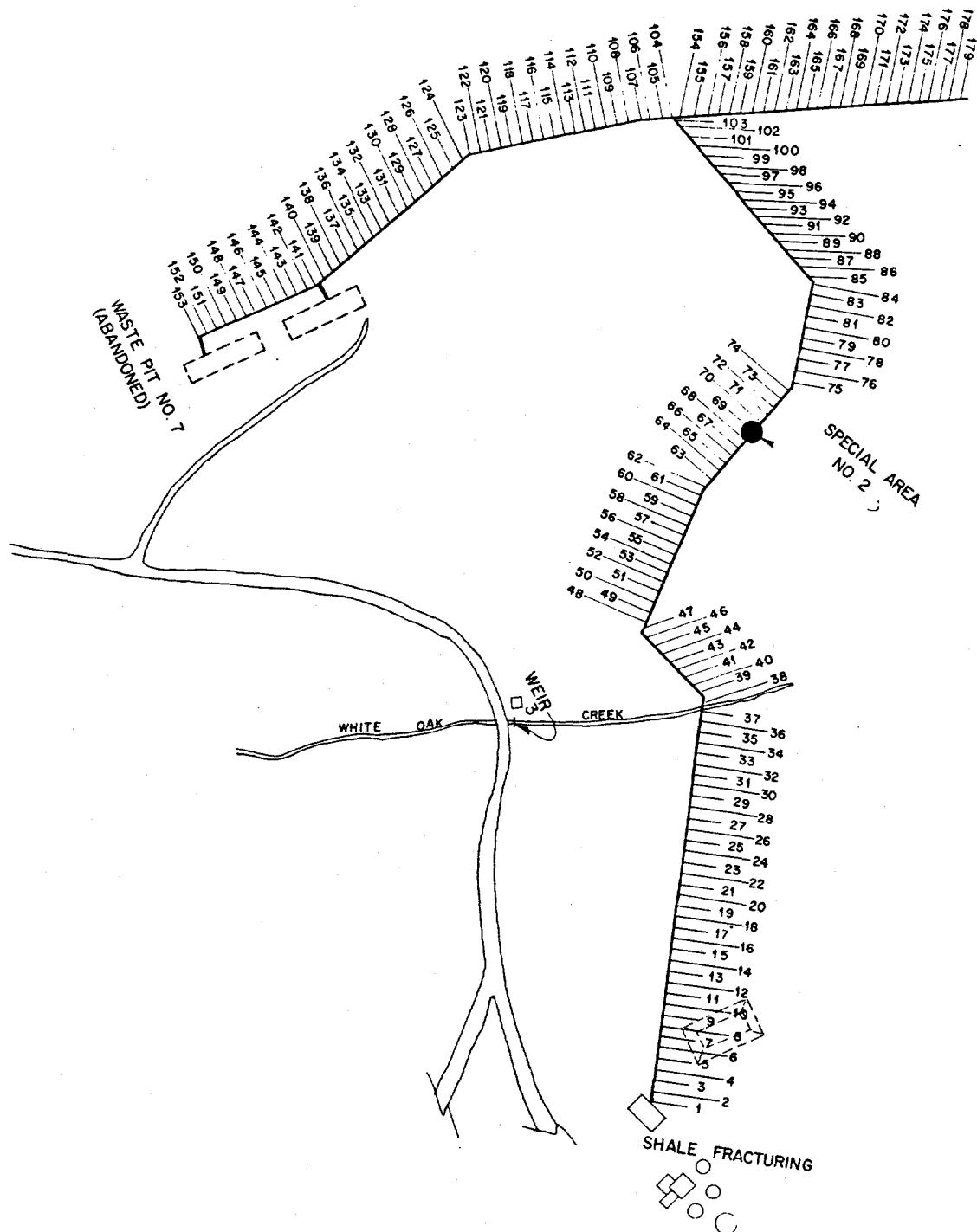


Fig. 3. Location of sampling points 1-179.

ORNL-DWG 81-11569

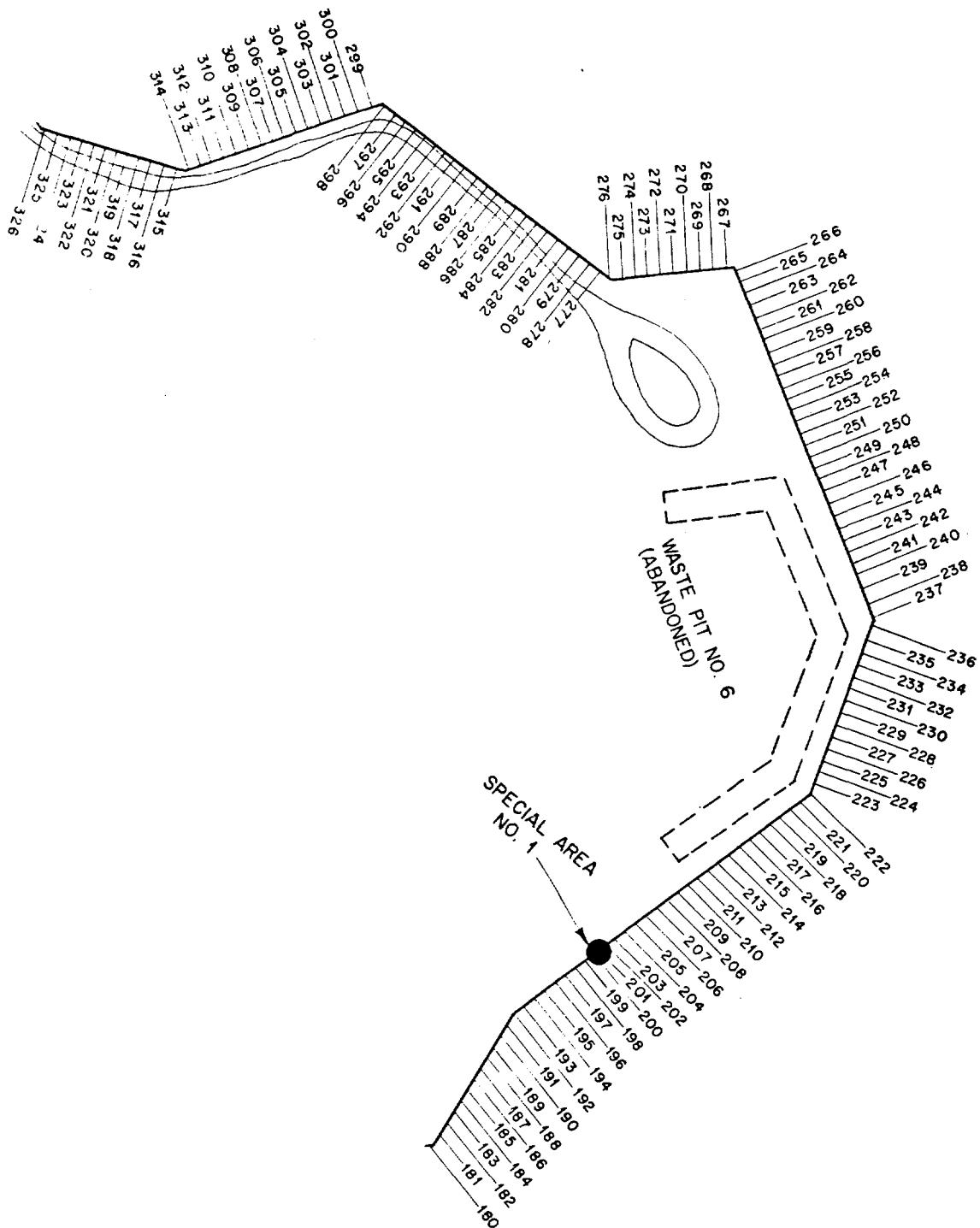


Fig. 4. Location of sampling points 180-326.

ORNL-DWG 81-11570

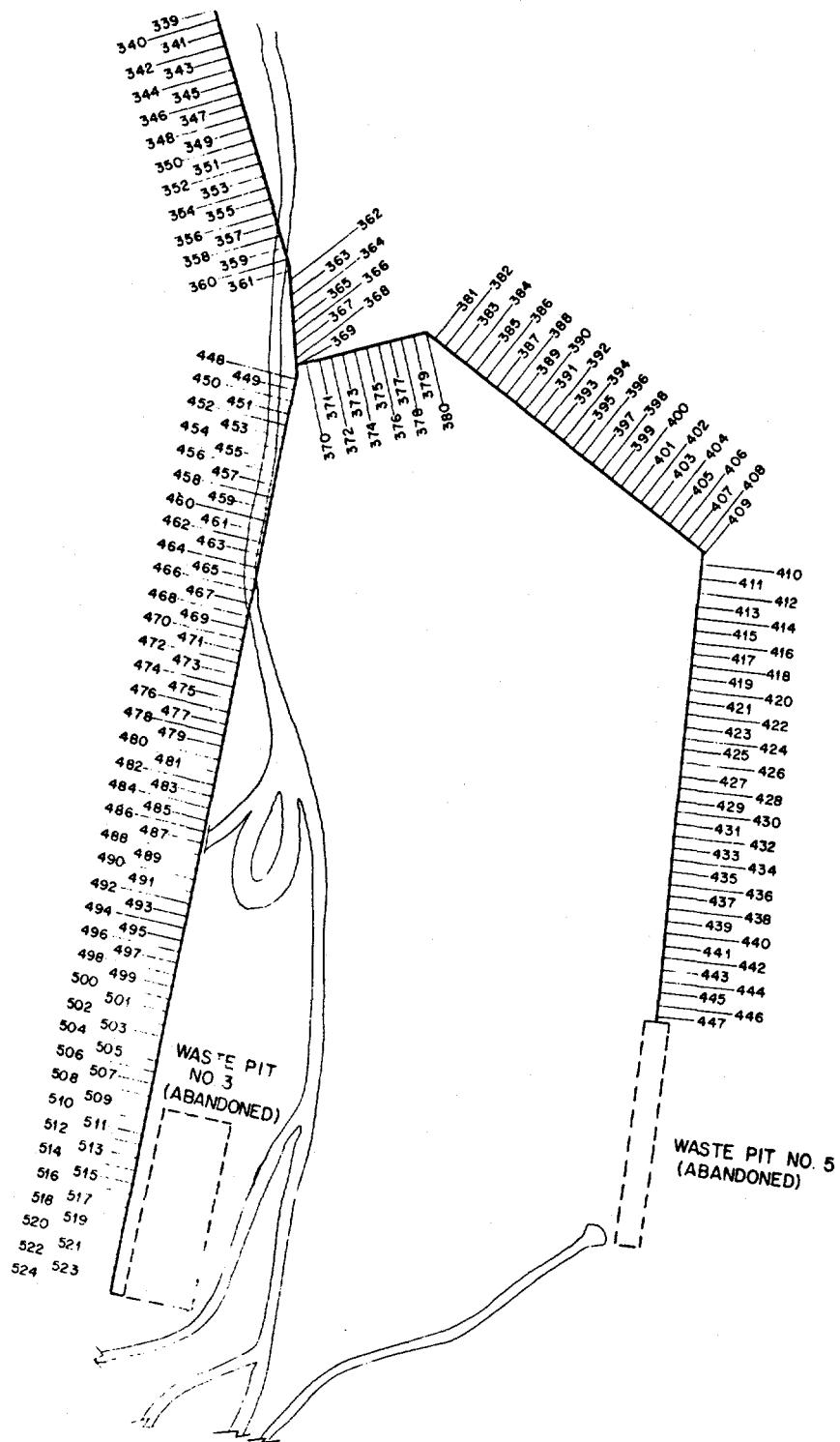


Fig. 5. Location of sampling points 339-524.

ORNL-DWG 81-11571

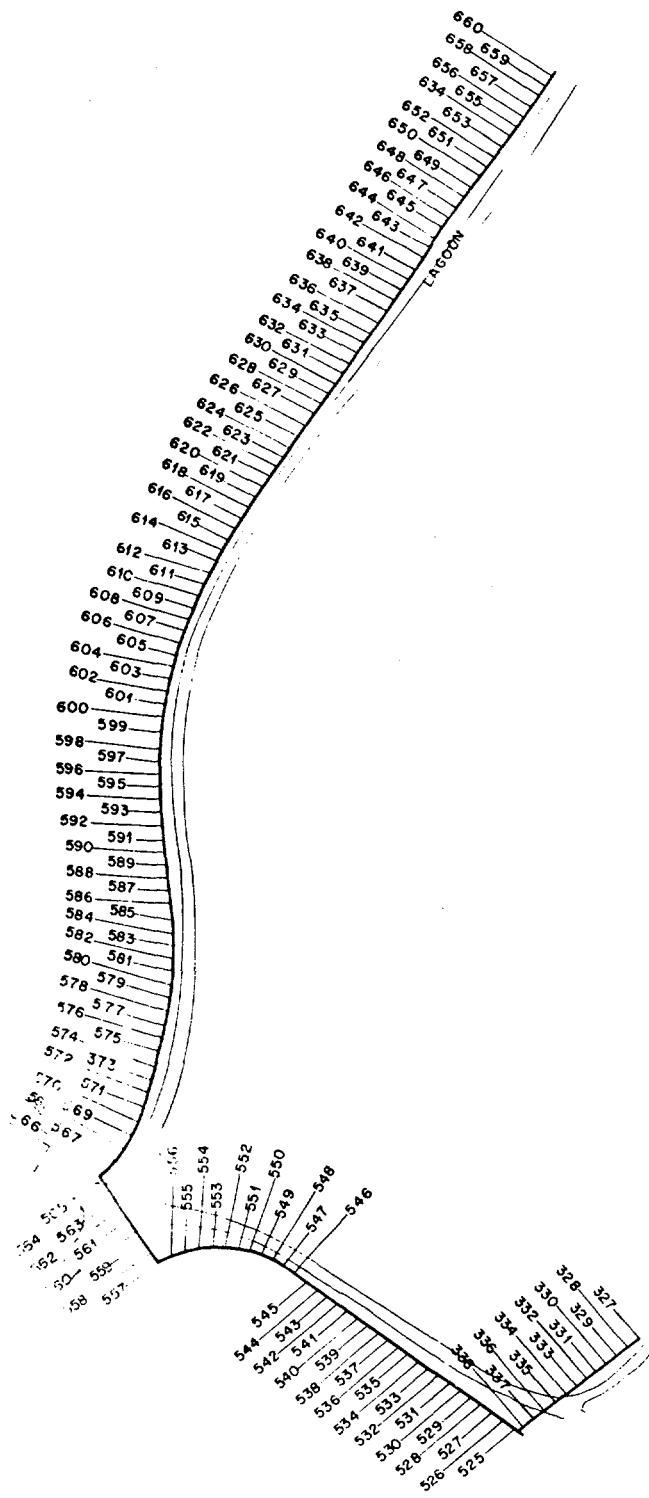


Fig. 6. Location of sampling points 327-338 and 525-660.

ORNL-DWG 81-11567

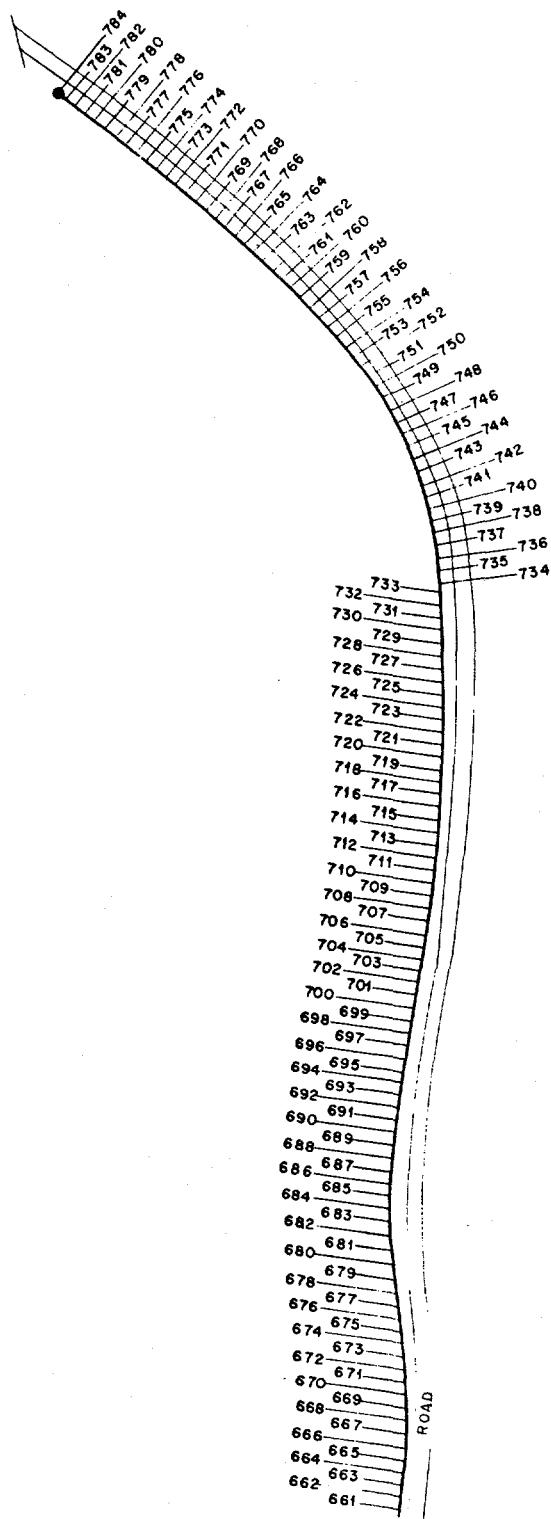


Fig. 7. Location of sampling points 661-784.

ORNL-DWG 81-11566

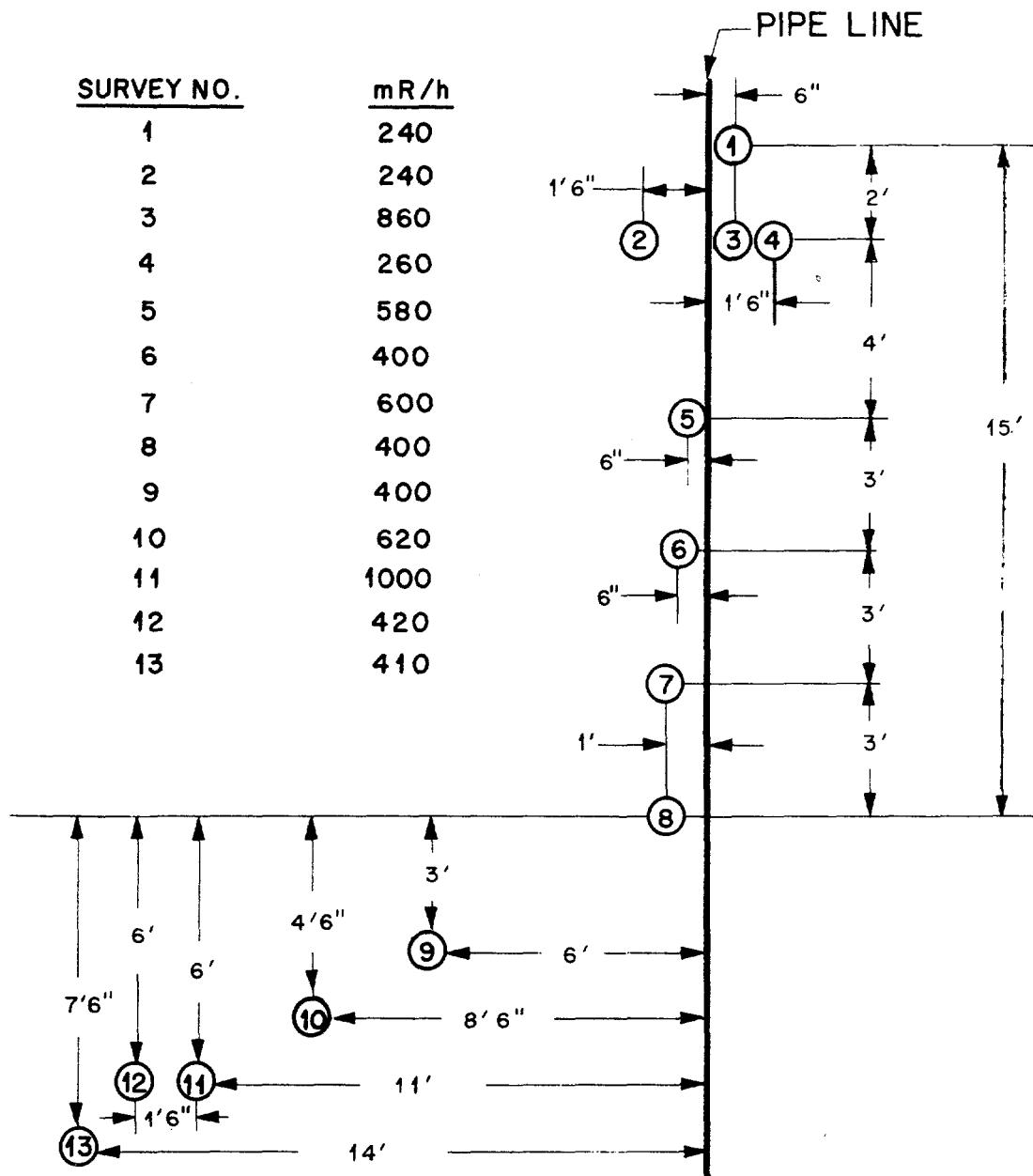
SPECIAL AREA NO. 1

Fig. 8. "Cutie pie" survey locations and results - special area 1.  
 (To convert mR/h to mSv/h, multiply by 0.01: to convert feet to meters,  
 divide by 3.3.)

ORNL-DWG 81-11565

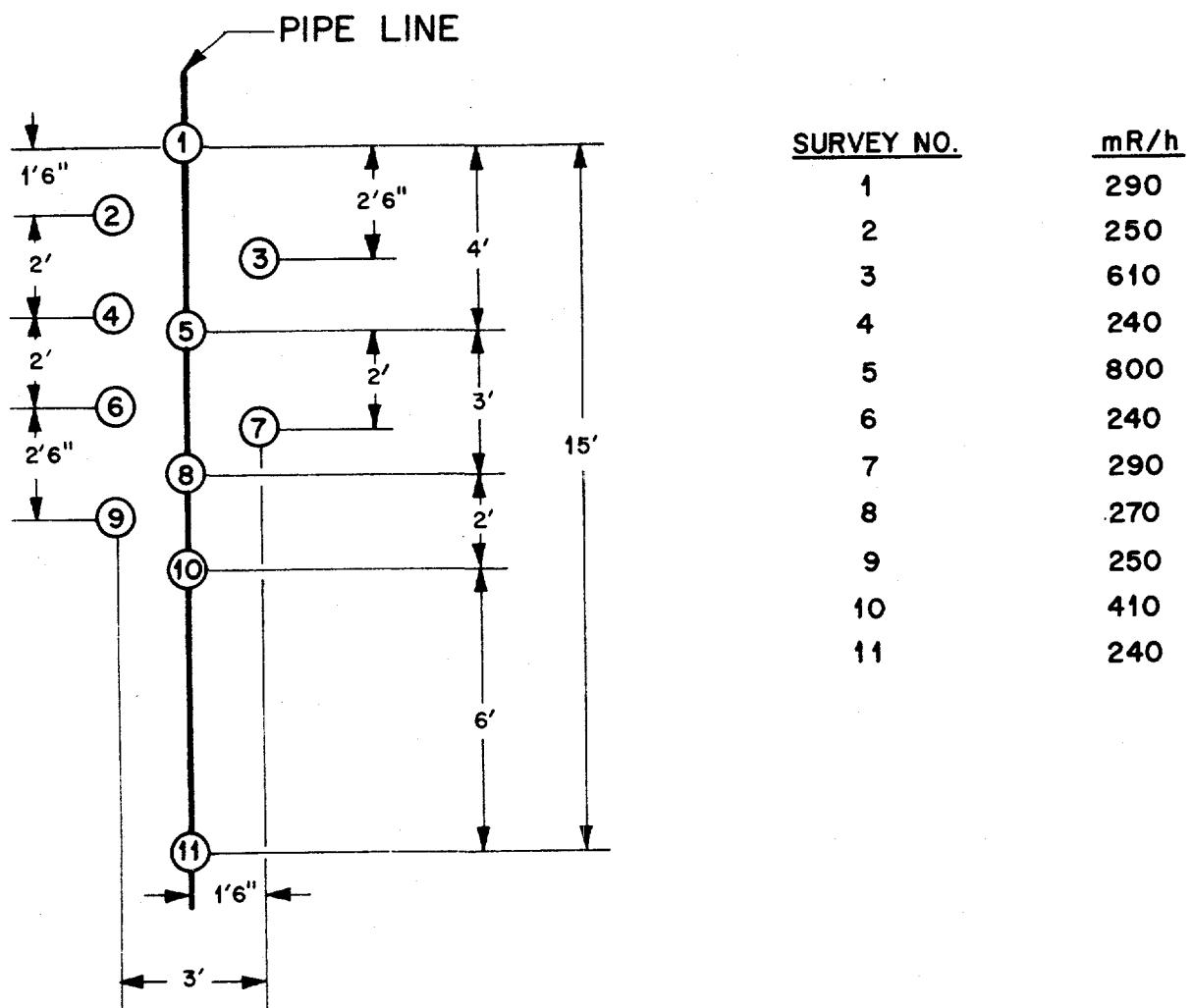
SPECIAL AREA NO. 2

Fig. 9. "Cutie pie" survey locations and results - special area 2.  
(To convert mR/h to mSv/h, multiply by 0.01.)

Table 1. Results of thermoluminescent-dosimeter survey  
of two special areas

Area 1			Area 2		
Survey point	Dose rate		Survey point	Dose rate	
	mSv/h	mR/h		mSv/h	mR/h
1	0.81	82	1	1.40	140
2	1.0	100	2	0.80	80
3	1.9	190	3	0.90	90
4	0.9	90	4	0.99	99
5	0.2	120	5	0.68	68
6	0.1	100	6	0.81	81
7	0.97	97	7	0.89	89
8	$\alpha$	$\alpha$	8	1.31	130
9	0.97	97	9	2.6	260
10	2.00	200	10	0.72	72
11	$\alpha$	$\alpha$	11	$\alpha$	$\alpha$
12	$\alpha$	$\alpha$			
13	2.10	210			

$\alpha$  No dosimeter.

Table 2. Counts per minute at indicated locations along intermediate-level waste system pipeline

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
1	2,000	2,500	2,700	2,700	2,700	2,700
2	2,200	1,500	2,000	2,000	2,200	2,200
3	1,500	1,500	2,000	1,500	1,500	1,600
4	1,500	1,300	1,700	1,500	1,400	1,400
5	1,500	1,300	1,500	1,500	1,100	1,400
6	1,200	1,300	1,500	1,000	1,000	1,200
7	1,000	1,000	1,400	800	1,000	1,100
8	1,000	800	1,000	800	1,000	1,000
9	700	700	1,000	1,000	900	900
10	900	700	800	800	800	700
11	500	700	700	700	700	700
12	600	600	800	600	600	500
13	800	500	600	500	600	600
14	500	700	500	500	500	500
15	600	600	600	600	500	600
16	500	400	600	500	500	500
17	600	500	600	500	500	500
18	500	400	400	500	400	500
19	500	500	600	400	600	500
20	600	600	400	500	500	500
21	500	500	600	500	500	500
22	500	600	500	500	500	500
23	700	600	800	600	500	600
24	700	700	600	700	600	600
25	900	800	800	800	700	700
26	900	1,100	900	900	900	1,000
27	1,000	1,000	900	1,000	800	1,000
28	1,200	1,000	800	1,100	900	1,000
29	1,300	1,200	1,000	1,200	1,300	1,200
30	1,700	1,500	1,500	1,500	1,400	1,400

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
31	1,600	1,400	1,300	1,300	1,100	1,300
32	1,500	1,500	1,500	1,500	1,600	1,400
33	1,700	1,500	1,500	1,500	1,700	1,500
34	1,700	1,700	1,600	1,500	1,700	1,800
35	2,000	2,000	1,800	1,800	2,100	2,100
36	2,000	1,800	1,800	2,000	1,700	1,700
37	2,200	2,000	4,500	2,500	2,200	2,000
38	1,500	2,300	10,000	3,000	1,200	1,500
39	2,000	2,000	4,000	2,000	1,800	1,400
40	2,300	2,000	2,000	1,600	3,500	2,200
41	1,000	700	700	700	700	700
42	1,000	1,100	600	700	600	700
43	700	700	500	700	500	600
44	600	700	600	600	600	700
45	600	700	500	500	600	600
46	600	500	600	600	600	500
47	600	500	500	500	500	500
48	500	400	500	400	500	500
49	500	500	500	500	500	500
50	400	400	500	500	500	400
51	500	500	400	500	500	500
52	400	400	400	400	500	400
53	500	500	200	300	500	400
54	500	500	500	500	400	500
55	600	500	600	600	500	600
56	700	700	500	500	700	600
57	500	800	800	600	600	700
58	600	700	700	800	700	900
59	900	1,100	1,100	1,500	700	900
60	1,300	1,600	1,200	1,400	700	900

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
61	4,500	3,100	2,000	3,000	1,200	2,200
62	2,700	2,500	9,000	3,500	2,400	2,700
63	1,000	2,000	3,300	4,300	9,000	6,000
64	1,100	1,600	4,700	7,000	110,000	50,000
65	1,000	1,500	1,300	1,800	1,700	3,000
66	1,200	2,200	2,500	3,500	3,700	4,000
67	1,500	7,000	20,000	10,000	3,000	8,000
68	30,000	33,000	150,000	70,000	2,500	16,000
69	100,000	150,000	200,000	210,000	4,000	32,000
70	257,000	257,000	Off scale	360,000	6,000	42,000
71	3,000	11,000	5,000	23,000	3,500	15,000
72	1,500	3,000	13,000	3,500	1,900	2,200
73	1,000	1,000	1,000	1,900	1,000	1,000
74	1,000	900	700	1,200	700	900
75	800	600	600	1,000	700	700
76	600	600	600	600	600	600
77	500	400	500	400	500	500
78	500	300	500	400	400	500
79	500	300	300	400	400	400
80	500	400	300	400	400	400
81	300	200	300	300	300	300
82	200	200	200	300	300	300
83	300	200	300	300	200	200
84	200	200	200	200	200	300
85	200	100	200	200	300	200
86	200	200	200	200	200	200
87	200	200	100	100	200	200
88	200	200	200	200	200	200
89	200	200	200	200	200	300
90	200	200	300	100	200	200

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
91	200	100	200	100	200	200
92	200	200	200	200	200	200
93	100	100	100	200	200	100
94	200	200	100	100	200	200
95	200	200	100	100	200	200
96	100	200	200	100	200	200
97	100	200	200	100	200	100
98	200	200	100	100	200	200
99	100	100	100	100	200	200
100	100	100	200	100	100	100
101	100	100	100	100	100	100
102	100	100	200	100	100	200
103	100	100	100	100	100	200
104	200	200	200	100	100	200
105	200	200	200	300	200	500
106	200	400	200	700	3,200	2,200
107	100	100	100	300	300	500
108	200	300	200	200	200	200
109	100	200	100	100	100	200
110	100	100	100	100	200	200
111	200	100	200	100	200	200
112	100	200	100	100	100	200
113	200	100	200	100	100	100
114	200	100	200	100	200	100
115	200	100	200	100	100	200
116	300	100	100	100	200	300
117	100	100	100	100	100	200
118	200	100	100	100	200	100
119	200	200	200	100	200	200
120	200	200	100	100	200	200

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
121	100	200	100	200	15,000	900
122	200	200	100	200	200	100
123	200	200	100	100	200	200
124	200	200	100	200	300	200
125	200	200	200	100	200	200
126	200	100	200	200	200	300
127	100	200	100	200	200	300
128	300	300	300	100	100	200
129	300	300	200	300	300	300
130	200	200	200	300	200	300
131	300	300	200	300	300	300
132	300	100	300	300	300	200
133	200	200	300	200	200	200
134	200	200	200	200	300	300
135	300	300	350	350	400	400
136	400	510	400	450	310	400
137	700	500	700	500	1,000	500
138	500	500	300	500	500	500
139	600	400	500	300	400	300
140	200	300	200	300	220	330
141	300	300	300	200	360	1,200
142	300	500	300	500	700	700
143	500	500	500	500	500	700
144	1,000	800	600	700	500	500
145	500	600	200	200	300	200
146	200	200	200	300	400	400
147	200	200	200	200	100	300
148	200	200	100	200	200	170
149	200	200	100	100	220	220
150	200	200	200	200	200	200

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
151	200	200	200	200	200	200
152	200	100	250	200	240	210
153	100	200	200	200	190	220
154	150	150	130	150	140	150
155	130	160	180	150	100	140
156	100	100	130	130	130	140
157	150	140	150	130	150	140
158	130	130	160	130	140	100
159	150	140	180	160	110	130
160	100	130	110	100	140	140
161	100	80	90	100	90	90
162	150	150	150	130	100	90
163	130	120	100	150	150	140
164	100	120	120	120	120	120
165	100	80	150	140	120	110
166	150	130	100	130	90	90
167	130	150	130	100	100	100
168	100	130	100	130	120	150
169	150	130	100	130	140	130
170	200	140	130	120	100	110
171	140	120	100	100	120	120
172	140	100	150	150	130	150
173	150	130	100	130	80	100
174	150	210	130	130	150	120
175	100	140	100	100	190	170
176	150	140	130	140	140	140
177	130	200	130	160	90	90
178	130	160	130	130	140	120
179	150	200	150	130	130	130
180	140	140	200	200	160	180

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
181	150	200	180	180	170	140
182	200	230	230	280	190	210
183	250	230	200	230	240	230
184	300	300	280	330	200	230
185	270	270	280	380	250	300
186	260	300	260	300	270	260
187	300	300	350	300	260	350
188	340	450	390	450	350	430
189	400	500	500	600	450	450
190	500	600	500	700	500	450
191	600	700	500	700	500	600
192	700	1,000	700	600	600	700
193	1,000	1,100	1,000	1,200	1,000	900
194	1,100	1,500	1,000	1,300	1,000	1,100
195	1,400	1,800	1,300	1,800	1,200	1,400
196	1,700	2,500	1,800	2,300	1,700	1,700
197	2,300	3,000	2,300	3,000	2,100	2,500
198	2,500	4,800	2,500	4,700	2,500	3,800
199	3,500	8,000	3,000	7,000	3,500	6,000
200	12,000	80,000	7,000	31,000	5,000	20,000
201	380,000	200,000	50,000	140,000	6,000	26,000
202	500,000	350,000	80,000	230,000	15,000	35,000
203	10,000	13,000	30,000	70,000	7,000	22,000
204	2,000	2,000	1,050	4,000	1,300	2,000
205	1,000	1,000	1,000	1,000	900	1,500
206	700	500	800	700	800	700
207	600	500	600	500	500	700
208	500	400	500	600	500	600
209	400	300	400	400	400	500
210	350	280	400	400	300	360

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
211	350	230	400	300	320	350
212	260	230	280	300	270	350
213	300	260	350	250	270	240
214	220	250	250	250	270	240
215	250	200	280	250	200	240
216	200	180	260	250	240	200
217	150	170	200	200	210	190
218	150	180	160	150	150	170
219	170	150	130	150	100	100
220	170	200	180	160	120	120
221	150	150	150	150	140	150
222	200	160	170	100	170	180
223	150	160	150	150	170	120
224	130	120	130	110	150	160
225	150	120	130	130	130	150
226	130	120	140	130	70	90
227	140	150	100	120	70	150
228	100	150	150	130	130	120
229	140	110	130	130	90	100
230	120	80	120	100	80	110
231	80	80	110	90	100	130
232	130	90	130	110	80	90
233	110	100	80	100	100	100
234	150	120	110	110	100	110
235	320	150	150	150	80	80
236	100	100	100	100	100	100
237	100	80	80	120	80	140
238	80	60	130	70	110	110
239	150	100	140	100	110	100
240	100	120	140	130	140	120

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
241	90	150	150	150	140	120
242	130	140	130	130	220	200
243	70	70	200	200	360	320
244	100	80	130	120	110	110
245	200	150	200	300	100	100
246	150	150	300	250	100	120
247	100	60	150	130	100	110
248	100	80	30	60	100	90
249	100	120	100	130	90	70
250	100	90	100	80	80	90
251	120	100	110	80	100	100
252	100	90	60	100	70	100
253	80	150	50	40	80	90
254	50	90	100	90	80	100
255	60	80	60	70	60	90
256	80	80	90	80	60	70
257	80	70	70	60	80	80
258	70	70	100	70	60	80
259	40	70	80	70	40	50
260	60	90	100	60	60	50
261	70	70	100	70	70	70
262	80	60	110	60	60	60
263	30	40	60	40	50	70
264	70	70	70	60	60	50
265	50	50	80	50	60	60
266	60	80	80	80	80	70
267	80	40	80	70	50	50
268	40	60	60	70	80	90
269	80	60	50	60	50	50
270	60	70	50	40	50	70

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
271	100	100	60	70	50	50
272	80	40	80	60	40	40
273	50	40	40	50	60	60
274	60	40	60	70	40	40
275	50	60	60	50	30	30
276	70	40	70	50	50	60
277	80	40	50	30	50	60
278	50	70	50	60	40	50
279	60	40	20	10	60	70
280	60	50	50	60	30	70
281	90	80	90	50	50	50
282	70	40	40	20	60	80
283	60	70	80	80	40	40
284	50	80	80	60	50	50
285	60	40	60	70	60	70
286	60	50	40	50	50	50
287	60	60	60	60	60	60
288	50	60	60	50	50	40
289	40	70	60	60	60	60
290	50	60	50	60	40	40
291	50	50	70	60	50	70
292	50	50	40	30	50	40
293	60	50	50	40	70	50
294	60	70	70	50	80	70
295	70	50	50	30	90	70
296	60	70	40	60	50	50
297	70	40	50	80	50	50
298	50	60	70	70	50	50
299	60	50	80	60	50	50
300	50	60	50	40	60	50

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
301	50	50	50	60	50	50
302	50	60	60	40	50	40
303	30	60	60	60	60	60
304	40	60	50	60	70	70
305	60	80	70	70	70	70
306	60	80	60	80	60	60
307	70	40	70	50	60	50
308	50	40	50	40	50	50
309	70	80	80	50	60	50
310	60	50	60	70	50	60
311	80	40	70	70	50	50
312	60	70	70	60	80	80
313	60	50	50	50	70	70
314	50	70	80	70	70	80
315	50	70	80	60	60	60
316	70	60	70	70	80	80
317	50	60	80	80	60	60
318	60	50	60	60	50	60
319	40	50	50	40	80	60
320	60	70	80	60	50	80
321	70	80	80	70	40	60
322	60	80	80	100	50	60
323	70	50	70	70	60	70
324	70	100	100	90	70	60
325	60	80	70	80	100	100
326	100	130	70	70	100	90
327	100	130	100	100	80	80
328	150	150	100	180	90	90
329	160	170	70	100	100	130
330	70	100	100	90	70	90

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
331	120	120	100	130	80	100
332	90	100	80	80	70	70
333	100	70	80	90	90	100
334	100	130	80	80	120	110
335	80	80	80	80	90	120
336	80	90	100	110	100	90
337	150	150	150	130	80	100
338	100	100	150	160	150	150
339	160	160	110	80	100	140
340	160	170	100	120	160	130
341	200	150	110	100	150	120
342	160	160	130	150	110	140
343	170	230	200	170	160	170
344	250	240	200	200	150	150
345	200	250	180	250	170	200
346	120	150	150	200	150	200
347	160	180	180	180	130	90
348	150	110	130	150	110	110
349	130	130	130	100	90	100
350	130	100	80	130	90	80
351	100	100	90	80	50	100
352	120	80	70	80	100	90
353	80	70	80	80	80	90
354	50	100	80	80	90	100
355	90	80	90	80	70	100
356	50	70	90	90	80	80
357	60	100	70	60	120	90
358	120	100	120	100	100	100
359	100	150	350	250	70	80
360	1,500	6,000	40,000	20,000	300	470

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
361	300	170	150	160	150	160
362	120	100	100	100	80	70
363	70	50	80	70	100	90
364	60	70	100	80	100	60
365	100	50	50	60	70	60
366	70	100	70	40	70	70
367	60	70	80	70	80	80
368	90	70	100	100	60	60
369	2,000	1,500	370	400	100	200
370	100	120	250	200	120	100
371	350	250	100	130	140	130
372	260	200	80	80	100	80
373	260	180	80	80	100	60
374	250	180	80	80	100	70
375	100	50	50	80	100	60
376	50	70	70	50	60	70
377	40	80	50	80	80	60
378	100	120	80	70	90	100
379	100	80	70	80	50	50
380	250	1,050	250	1,020	140	180
381	800	1,000	250	400	100	150
382	100	80	100	60	70	50
383	80	100	60	50	80	80
384	90	50	50	60	60	60
385	80	60	60	70	50	50
386	70	70	60	70	60	60
387	70	70	50	100	60	60
388	50	50	80	80	40	40
389	70	70	80	60	70	80
390	70	100	100	70	40	60

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
391	100	60	80	100	50	50
392	100	60	60	50	50	50
393	50	60	50	60	20	60
394	60	60	40	60	70	80
395	80	50	90	80	50	80
396	60	80	100	80	60	60
397	50	60	50	100	60	60
398	40	40	50	40	60	80
399	80	50	50	90	70	70
400	70	100	50	40	40	60
401	100	100	80	50	40	50
402	60	50	80	70	60	50
403	70	70	50	50	60	60
404	50	100	100	90	70	100
405	90	100	100	100	60	60
406	50	80	90	90	60	50
407	80	80	110	80	40	50
408	70	50	60	50	70	70
409	50	100	120	110	90	120
410	60	100	130	90	70	50
411	50	50	30	50	40	40
412	70	60	100	80	40	50
413	60	70	60	40	50	40
414	70	60	80	60	50	40
415	100	90	60	50	40	50
416	100	100	100	100	70	60
417	100	80	50	50	50	50
418	70	70	80	100	50	50
420	100	100	80	80	60	50

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
421	70	90	60	60	60	80
422	40	110	130	110	80	60
423	150	120	100	110	90	90
424	60	70	130	100	100	80
425	100	130	200	170	70	90
426	120	100	100	100	80	80
427	180	160	60	70	60	70
428	100	100	70	70	70	80
429	100	110	100	80	100	70
430	110	90	60	90	50	40
431	60	50	100	100	50	50
432	50	70	70	90	80	60
433	70	80	80	80	90	70
434	100	70	50	70	80	60
435	100	80	90	90	80	80
436	100	100	120	100	60	70
437	70	70	70	50	50	60
438	100	60	50	50	80	90
439	50	70	70	70	70	70
440	70	60	80	80	90	80
441	60	100	100	60	80	90
442	60	70	70	80	50	70
443	190	200	100	100	70	70
444	300	150	120	110	90	70
445	150	120	80	80	80	80
446	120	140	100	80	90	70
447	100	100	80	150	70	70
448	150	100	120	100	70	70
449	100	70	60	70	60	70
450	60	50	60	100	70	70

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
451	70	90	80	50	40	60
452	50	50	50	50	60	60
453	100	70	60	60	50	40
454	70	70	30	60	50	60
455	100	70	80	80	50	60
456	70	70	60	80	60	60
457	50	70	80	80	80	70
458	60	40	50	50	50	70
459	70	50	70	70	60	60
460	70	70	60	60	50	60
461	60	70	50	60	50	60
462	50	70	30	50	70	80
463	60	40	60	60	40	50
464	50	60	50	30	60	80
465	50	100	60	80	60	60
466	60	80	70	80	60	50
467	40	100	80	70	40	60
468	50	60	60	40	50	50
469	50	40	70	80	80	80
470	50	60	50	50	90	80
471	70	70	50	60	70	70
472	70	70	80	70	70	60
473	70	100	70	70	80	50
474	100	40	80	80	100	70
475	70	100	100	100	70	70
476	70	70	50	60	80	70
477	100	100	100	100	60	80
478	100	100	140	150	70	100
479	100	100	150	100	80	70
480	90	100	150	80	140	130

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
481	80	100	100	90	150	150
482	70	50	60	70	120	120
483	40	50	70	80	80	60
484	100	100	100	90	90	80
485	70	70	150	130	110	90
486	100	80	110	120	100	120
487	70	100	400	200	100	90
488	60	100	150	120	150	130
489	50	60	60	80	60	70
490	130	50	50	50	100	110
491	100	100	80	80	110	90
492	80	100	50	80	70	100
493	100	120	80	120	110	140
494	120	150	280	300	100	150
495	70	100	150	100	230	120
496	60	80	80	80	110	110
497	80	90	110	120	90	80
498	60	100	100	80	50	70
499	50	90	100	100	100	100
500	150	150	150	130	130	140
501	170	150	120	80	90	100
502	50	100	100	80	140	140
503	160	250	160	160	120	130
504	120	100	130	150	230	200
505	100	90	130	100	180	170
506	100	100	90	150	170	190
507	100	100	150	100	160	130
508	150	190	1,050	300	200	190
509	100	100	200	200	140	150
510	120	150	180	180	160	170

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
511	150	170	160	150	190	190
512	550	520	200	180	180	190
513	250	300	250	250	250	250
514	150	200	300	250	220	220
515	130	120	220	180	200	160
516	180	180	130	150	140	190
517	350	300	800	500	170	250
518	200	150	300	280	250	200
519	100	100	120	120	130	110
520	200	150	130	130	130	150
521	140	150	120	100	100	110
522	200	150	200	190	150	150
523	300	250	600	200	170	200
524	200	150	150	120	140	140
525	100	100	120	120	130	130
526	60	140	110	90	80	80
527	100	110	90	90	70	70
528	100	110	100	100	90	100
529	100	60	100	120	90	100
530	120	80	70	90	60	70
531	100	90	100	90	70	60
532	100	80	110	80	60	50
533	90	50	70	70	70	80
534	80	80	80	80	70	70
535	100	80	80	50	70	70
536	70	80	70	80	70	60
537	80	70	80	80	80	80
538	60	70	70	70	80	80
539	60	60	100	80	60	50
540	80	80	60	50	120	100

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
541	70	80	60	60	70	50
542	80	70	40	40	70	50
543	60	70	50	40	40	40
544	70	70	70	50	60	50
545	30	40	50	70	80	70
546	60	60	60	50	70	80
547	70	80	70	60	100	70
548	80	70	60	60	60	60
549	70	70	50	50	60	50
550	70	70	70	70	60	50
551	60	110	80	50	60	50
552	50	70	40	60	50	50
553	60	60	50	50	50	60
554	60	100	90	60	50	50
555	60	70	50	60	60	60
556	60	60	60	80	50	70
557	60	50	70	100	70	70
558	70	70	50	60	70	70
559	50	50	30	50	60	60
560	60	60	70	70	50	40
561	70	50	60	50	50	50
562	70	70	20	50	60	70
563	120	100	50	20	50	80
564	90	100	90	90	50	60
565	60	100	50	50	90	60
566	70	100	90	100	70	70
567	100	120	50	40	50	50
568	100	100	70	50	50	50
569	120	100	40	60	50	80
570	70	50	50	50	50	40

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
571	60	80	70	70	50	50
572	60	80	60	70	50	50
573	100	120	50	50	50	50
574	100	100	40	40	60	40
575	70	90	50	50	50	60
576	90	80	30	20	60	50
577	80	70	50	70	50	60
578	70	70	60	60	40	50
579	80	100	50	40	50	40
580	100	60	70	50	60	50
581	40	90	30	20	50	50
582	100	80	30	30	30	30
583	70	70	30	30	40	30
584	70	90	40	30	50	40
585	60	80	50	50	20	10
586	40	100	30	40	50	50
587	100	90	30	40	50	40
588	70	70	30	40	40	40
589	70	100	20	50	50	50
590	70	80	20	30	20	30
591	120	90	40	30	40	20
592	40	50	50	30	30	30
593	50	70	30	20	30	30
594	50	50	50	70	50	40
595	40	50	40	30	40	50
596	40	70	30	20	50	40
597	60	70	30	40	40	40
598	80	50	40	20	50	50
599	60	70	30	30	60	60
600	50	60	10	20	60	60

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
601	50	70	20	50	40	40
602	50	80	30	20	40	40
603	60	50	30	40	50	40
604	70	50	20	50	50	40
605	60	60	50	30	30	40
606	70	60	30	30	50	60
607	70	50	40	50	40	40
608	100	80	40	30	30	30
609	60	60	20	30	40	40
610	50	80	30	50	30	40
611	40	60	30	60	60	50
612	60	60	70	50	20	20
613	70	70	40	40	50	40
614	50	50	50	40	50	40
615	70	70	60	60	40	40
616	60	60	30	50	30	20
617	50	70	50	60	40	40
618	70	60	40	40	60	70
619	50	40	50	50	50	50
620	30	50	40	50	50	40
621	30	60	30	40	40	40
622	50	50	40	40	40	50
623	70	50	40	30	50	50
624	70	50	70	70	40	40
625	60	60	60	50	50	40
626	30	60	30	30	70	60
627	50	30	50	40	30	50
628	30	40	50	40	40	40
629	40	50	50	50	50	60
630	40	50	40	50	50	30

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
631	30	70	70	70	30	30
632	60	70	50	30	50	40
633	70	70	30	20	30	40
634	70	70	50	30	50	60
635	30	50	50	40	40	50
636	50	20	50	60	40	50
637	50	50	40	30	50	40
638	70	70	40	30	30	30
639	60	70	30	40	30	40
640	60	60	50	50	70	60
641	60	50	60	40	40	40
642	50	60	50	80	30	60
643	60	60	50	50	50	50
644	40	60	50	60	50	50
645	60	60	60	70	40	30
646	60	60	50	50	40	30
647	50	60	60	50	40	40
648	40	60	60	70	40	40
649	70	70	80	80	50	40
650	100	60	70	50	40	50
651	70	50	30	50	50	40
652	40	60	50	90	50	60
653	50	50	50	50	50	40
654	50	60	60	50	50	60
655	50	60	50	50	40	50
656	60	60	50	60	60	30
657	50	40	50	50	30	40
658	50	50	50	70	60	60
659	70	60	70	100	60	60
660	70	70	60	100	60	60
661	50	50	100	120	70	80

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
662	70	70	50	70	90	70
663	50	100	50	100	70	80
664	50	80	100	100	50	80
665	60	100	80	80	70	60
666	60	40	60	50	50	50
667	60	70	80	70	50	60
668	60	60	70	70	70	70
669	60	70	70	80	50	50
670	60	60	90	80	50	50
671	50	60	60	90	60	50
672	80	70	90	60	50	70
673	50	80	80	70	70	80
674	50	50	70	60	70	60
675	70	60	60	60	80	80
676	70	80	90	80	60	60
677	110	110	120	120	60	70
678	70	100	70	50	70	70
679	90	70	90	70	70	70
680	60	70	60	60	90	70
681	80	110	50	80	50	60
682	80	90	90	70	90	90
683	100	100	110	100	80	70
684	100	100	100	100	80	90
685	100	90	130	100	100	80
686	100	110	70	70	70	70
687	80	60	130	130	90	120
688	60	60	100	70	100	80
689	60	80	70	80	80	90
690	70	70	100	100	70	80
691	140	130	130	130	90	100
692	70	70	120	120	100	90

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
693	80	80	80	100	70	70
694	60	80	100	110	100	90
695	60	100	130	100	100	80
696	60	100	120	100	100	80
697	100	80	110	110	90	100
698	80	60	150	120	90	130
699	80	100	100	100	100	100
700	140	60	90	70	90	120
701	80	80	60	90	110	80
702	110	90	120	120	80	100
703	120	100	110	90	100	100
704	100	100	120	130	90	90
705	100	110	90	100	100	110
706	90	120	100	120	130	100
707	80	130	100	140	100	100
708	150	120	150	130	90	110
709	100	120	120	150	90	140
710	150	130	150	140	140	130
711	90	140	120	140	120	130
712	100	100	120	150	160	120
713	150	100	150	160	120	140
714	110	140	130	140	120	140
715	110	150	150	130	100	150
716	120	100	120	160	170	150
717	130	130	160	130	160	150
718	130	160	130	150	130	170
719	150	150	100	120	100	90
720	120	140	90	140	130	150
721	160	120	160	160	140	150
722	150	160	160	160	150	120
723	140	120	120	150	160	170

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
724	100	150	160	170	130	170
725	130	130	140	150	130	150
726	160	170	200	170	170	180
727	160	170	170	170	150	150
728	150	140	150	150	130	160
729	120	90	180	200	180	150
730	160	210	150	210	180	190
731	150	150	180	180	180	180
732	150	150	180	200	180	190
733	180	160	200	190	200	220
734	170	200	200	230	200	230
735	140	200	200	170	210	230
736	200	200	170	180	190	220
737	220	200	190	270	200	220
738	200	210	250	210	250	230
739	150	180	200	270	200	210
740	160	150	250	200	180	200
741	170	120	170	250	230	240
742	180	150	210	200	210	220
743	230	200	200	200	190	220
744	210	250	250	230	250	200
745	160	230	250	250	250	220
746	200	190	210	230	200	240
747	200	160	290	260	200	240
748	250	220	230	270	230	210
749	210	210	250	220	200	230
750	270	300	260	260	250	260
751	160	250	240	280	190	150
752	250	220	230	260	280	290
753	200	250	250	240	220	260
754	210	210	280	300	230	260

Table 2. (continued)

Location	Left		Center		Right	
	Ground	Meter	Ground	Meter	Ground	Meter
755	230	220	250	280	300	280
756	260	300	250	290	250	290
757	250	250	220	220	250	270
758	230	250	200	250	300	290
759	250	260	230	280	190	250
760	250	230	210	220	240	310
761	180	300	230	300	320	350
762	260	230	300	250	200	230
763	300	300	300	300	290	300
764	300	260	210	260	300	270
765	220	250	300	300	330	320
766	240	300	350	300	300	260
767	230	250	270	310	260	290
768	200	300	280	300	220	280
769	200	260	260	250	300	320
770	300	260	250	250	300	270
771	200	250	200	190	280	270
772	250	250	150	220	270	280
773	220	250	260	310	250	290
774	240	200	250	250	240	250
775	230	250	200	210	230	210
776	200	250	200	250	200	200
777	180	210	220	220	200	230
778	250	180	200	180	240	190
779	160	220	240	250	200	190
780	180	180	220	200	180	230
781	200	200	250	240	190	200
782	210	150	210	190	200	200
783	200	180	200	180	150	160
784	300	450	350	4,000	220	290

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