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Title

UNC ENVIRONMENTAL SURVEILLANCE REPORT
FOR THE 100 AREAS -- FY 1984

Author

E. M. Greager

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UNC ENVIRONMENTAL SURVEILLANCE REPORT FOR THE 100 AREAS -- FY 1984

Prepared By: ______________________ Date: 12/11/84
E. M. Greager,
Senior Environmental Engineer

Reviewed By: ______________________ Date: 12/15/84
J. J. Dorian, Manager
Environmental Control

Approved By: ______________________ Date: [illegible]
D.F. Brendel, Manager
Environmental and Occupational Safety

SUMMARY

The UNC Environmental Surveillance Program for the 100 Areas provides monitoring to assist in evaluating the environmental impact of 100-N Reactor facilities, the shutdown reactor facilities, and burial grounds in the retired 100 Areas. The major objectives of the program are to monitor radionuclide concentrations in radiological release pathways, maintenance of a data base for trend analyses, sampling and data for accidental release analyses, and demonstration of compliance with applicable regulations.

The surveillance program consists of sampling and monitoring of several environmental parameters. At 100-N Area, samples of ambient air, groundwater, vegetation, soil, and sediment are collected and analyzed along with direct radiation measurements around the 1301-N Facility and along the river shoreline. At the retired 100 Areas, soil and vegetation samples are collected and analyzed. In addition, groundwater samples are collected and analyzed from several monitoring wells at 100-K Area. Special samples to monitor the potential biotransport of radionuclides may also be included in the surveillance program.

Based on the sampling performed for the environmental surveillance program, 100 Area facilities are in compliance with applicable regulations and there is no significant adverse environmental impact from past or present reactor operations.

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1.0 ENVIRONMENTAL SURVEILLANCE PROGRAM

1.1 Purpose of the Program

The UNC Environmental Surveillance Program for the 100 Areas provides monitoring to assist in evaluating the environmental impact of 100-N Reactor facilities, retired 100 Area facilities, and 100 Area burial grounds on the immediately surrounding environment. The program is designed to evaluate trends in releases to various pathways to the environs from reactor facilities. The major objectives of this program are:

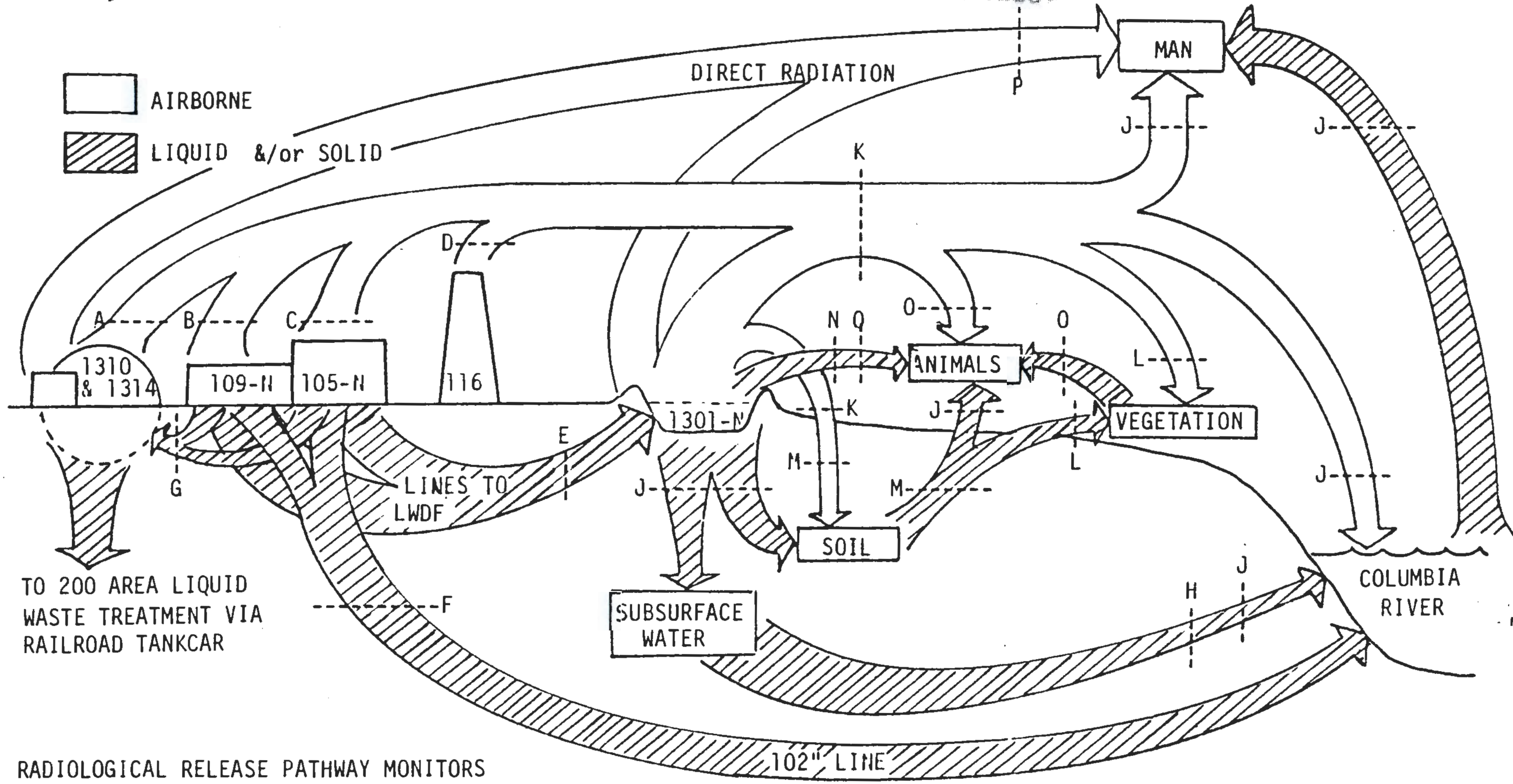
- Detection of radionclide concentrations in identified radiological release pathways.
- Detection and evaluation of changes in the radionuclide concentrations discharged to or existing in the immediate environment. This will serve as a means of detecting system changes or failures, so that appropriate actions may be taken.
- Maintenance of a data base for trend analyses in order to provide the capability for evaluation and response to changes in radioactive material releases from any off-normal or accident condition.
- Provide samples and data to be used for "after-the-fact" accidental release analyses.
- Demonstrate compliance with applicable regulations.

The evaluation of the population dose resulting from the operation of N Reactor is the responsiblility of the Battelle Pacific Northwest Laboratory (PNL). UNC Nuclear Industries supplies radionuclide discharge data to PNL for use in the preparation of these analyses.

In order to establish monitoring requirements, the radiological release pathways from 100-N Area facilities to the immediate environment were analyzed and a flow diagram produced (Figure 1.1). This pathway diagram was used as the basis for the monitoring at 100-N Area in the surveillance program. Similar types of pathway analyses were performed to determine the scope of environmental monitoring in the retired 100 Areas.

The UNC Environmental Surveillance Program for the 100 Areas is summarized in Table 1.1. In addition, special samples to monitor the potential biotransport of radionuclides may also be collected and included in the surveillance program.

The surveillance program for the 100 Areas is continually improved and upgraded. Sampling procedures, techniques, and frequencies are subject to change as more experience is gained in surveillance of the 100 Area environs.



RADIOLOGICAL RELEASE PATHWAY MONITORS
(INDICATED BY DASHED LINES):

EFFLUENT RADIOANALYTICAL PROGRAM

- A AIRBORNE SAMPLER ON TANK VENTS
- B CONTINUOUS SAMPLING SYSTEM
- C CONTINUOUS SAMPLING SYSTEM
- D CONTINUOUS SAMPLING SYSTEM
- E FLOW PROPORTIONAL COMPOSITE SAMPLER
- F CONTINUOUS LARGE VOLUME SAMPLER
- G SAMPLE ANALYSIS DURING STORAGE & SHIPMENT
- H MULTIPLE CONTINUOUS COMPOSITE SAMPLERS

ENVIRONMENTAL SURVEILLANCE PROGRAM

- J PNL ENVIRONMENTAL PROGRAM
- K CONTINUOUS AIR SAMPLERS
- L VEGETATION SAMPLING
- M SOIL SAMPLING
- N WIRE MESH TRENCH COVER
- O 100-N AREA PERIMETER FENCE
- P TLDs AND DIRECT RADIATION MEASUREMENT

Figure 1.1. Major Radiological Release Pathways Between 100-N Facilities and the Environs

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Table 1.1. Summary of the UNC Environmental Surveillance Program for the 100 Area.

Type Sample	Sampling Method	Number of Sample Locations	Sampling Frequency	Type Analysis
Air Samples	Low volume continuous sampler with particulate filtration and charcoal filter. (100-N Area only)	4	Monthly	Particulate - Gross alpha and beta and major gamma emitters Charcoal - major gamma emitters.
Ground Water Samples	Sample provided to UNC by PNL. (100-N and 100-K Areas)	31	Quarterly	Major gamma emitters.
Soil Samples	Surface soil, approximately 100 cc (All 100 Areas)	32	Annually	Major gamma emmitters. Sr and Pu.
LWDF Sediment	Dip samples of 25 cc of LWDF bottom sediment. (100-N Area only)	9	Annually	Major gamma emitters. Sr and Pu.
Vegetation Samples	One pound (500 g) sample of vegetation, collected and dried. (all 100 Areas)	32	Annually	Major gamma emitters. Sr and Pu.
Gamma Radiation, 100-N	CaF_2:Mn (TLD-400) Dosimeters (100-N only)	30	Monthly	---
Gamma Radiation, 1301-N LWDF	Integrated count using hand-held survey instrument (100-N Area only)	27	Annually	---
Gamma Radiation, 1325-N LWDF	Integrated count using hand-held survey instrument (100-N Area only)	19	Annually	---
Gamma Radiation River Shoreline	Same as above (100-N Area only)	50	Annually	---

1.2 Surveillance Program Procedures

Consistency in sample collection techniques is important in comparing different sets of data and validating trend analyses. Specific sample collection, preparation, and analysis procedures are described in Appendix A.

PNL is responsible for the environmental surveillance program for the Hanford Site. It is UNC policy to mimic the PNL sample collection, preparation, and analytical procedure as much as possible to allow maximum comparison of the analytical results between the two surveillance programs.

Measurements in the UNC radioanalytical lab are limited to gamma scans of samples containing varying and unknown concentrations of fission and activation products. To perform the analyses, four high purity intrinsic germanium detectors are used. Sample analysis procedures have been established by UNC and documented in Section 2.0 of UNI-M-76 REV2, "Effluent Radioanalytical Program". Strontium and plutonium analyses are performed by the U.S. Testing Company.

The precision and accurancy of radioanalytical instrumentation is maintained thru a laboratory Quality Control Program. The procedures for this Quality Control Program are included in Section 5.0 of UNI-M-76, REV2.

2.0 AIR SAMPLING

Environmental air sampling is conducted as a means of evaluating radionuclide discharges which could result in radiation exposures to N Reactor personnel and trend changes which could be an indication of variations in either the input to a facility or in the functioning of some part of the facility.

A "sampling train", consisting of collection devices, an air mover, and an air flow system is used. The collection device is a standard cartridge sampler (UNC Print H-1-39022). This cartridge contains a 1 cfm orifice, particulate filtration, and a charcoal absorber for halogens. A continuous duty, low volume air pump is installed, along with the cartridge, in a weatherproof enclosure.

Four continuous air sampling stations monitor 100-N Area as shown in Figure 2.1. Samples are collected monthly and analyzed for gamma emitters. The particulate filter is also analyzed for gross alpha and beta. Radionuclide concentrations detected in the air samples are listed in Table 2.1

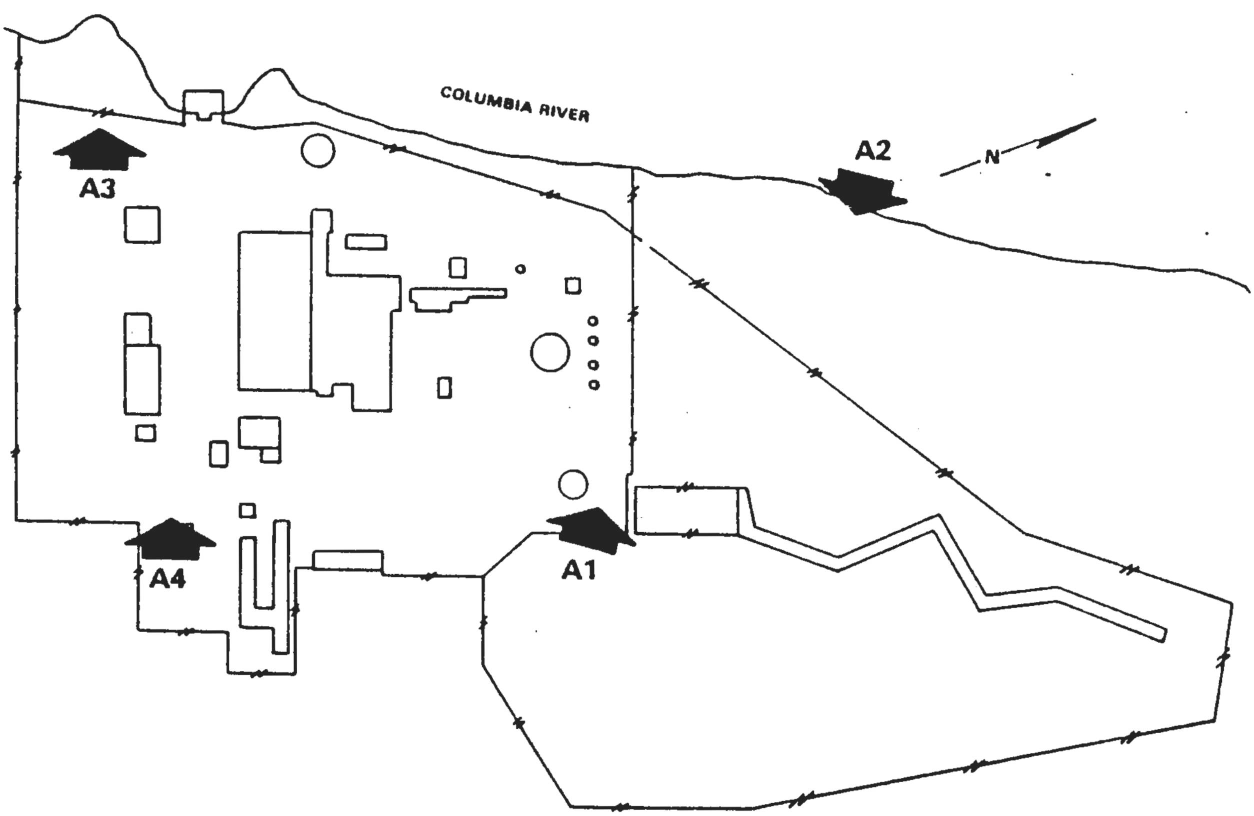

Figure 2.1. Continuous Air Sampling Locations at 100-N Area.

Table 2.1. Radionuclide Concentrations Detected in Air Samples at 100-N Area. Concentrations are in pCi/L.

	Particulate Filter Samples	Mn-54	Fe-59	Co-60	Nb-95	Ru-103	Ce-141	Ce-144
A1	Maximum	1.9E-4	1.0E-4	8.4E-4	8.2E-5	4.1E-5	5.6E-5	6.9E-5
	Average*	6.1E-5	---	1.7E-4	4.8E-5	2.7E-5	3.8E-5	6.3E-5
	No. of detectable results	6	1	9	4	2	2	2
A2	Maximum	ND	ND	2.6E-4	ND	ND	1.4E-5	ND
	Average*	---	---	7.1E-5	---	---	---	---
	No. of detectable results	---	---	5	---	---	1	---
A4	Maximum	ND	ND	5.5E-5	ND	ND	ND	ND
	Average	---	---	4.1E-5	---	---	---	---
	No. of detectable results	---	---	4	---	---	---	---

	Charcoal Cartridge Samples	As-76	I-131**
A1	Maximum	2.3E-3	6.7E-4
	Average	---	2.7E-4
	No. of detectable results	1	5
A2	Maximum	ND	< 1.2E-4
	Average	---	< 5.8E-5
	No. of detectable results	---	0
A4	Maximum	ND	< 4.6E-4
	Average	---	< 1.5E-4
	No. of detectable results	---	0

ND = Not Detected

* = average based on detectable results (13 sampling periods during the year are completed)

** Concentrations of I-131 at stations A2 and A4 were calculated, even though there were no detectable results, as a point of interest.

NOTE: Sample station A3 was out-of-service during FY 1984

3.0 GROUND WATER SAMPLING

Ground water sampling is performed at 100-N Area to monitor the movement of radionuclides between the 1301-N Liquid Waste Disposal Facility (LWDF), the 1325-N LWDF, and the riverbank springs. This monitoring aids in determining the effectiveness of the soil column for entrapping radionuclides. At 100-N and 100-K Areas, groundwater monitoring is also used to help determine the integrity of underground piping, basins, tanks, and other structures holding radioactive liquids.

Twenty-seven groundwater monitoring wells at 100-N Area and four wells at 100-K Area are sampled by PNL (Figures 3.1 and 3.2). These wells are sampled once every quarter and analyzed by PNL for beta emitters and tritium. Semi-annually, the samples are analyzed by PNL for strontium and gamma emitters.

Each quarter, PNL provides a one gallon sample of water from each well to UNC. These quarterly samples are analyzed for concentrations of gamma-emitting radionuclides. Detectable concentrations of radionuclides in the groundwater samples are listed in Table 3.1.

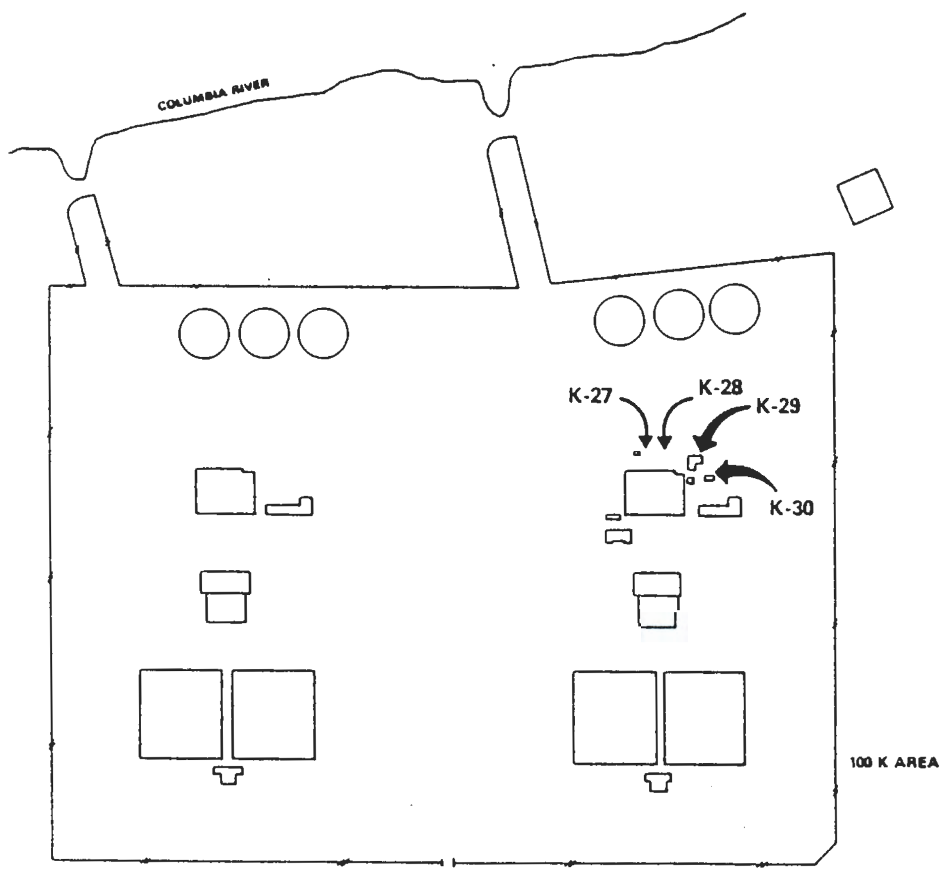

Figure 3.1. Location of Groundwater Monitoring Wells at 100-K Area.

Figure 3.2. Location of Groundwater Monitoring Wells at 100-N Area.

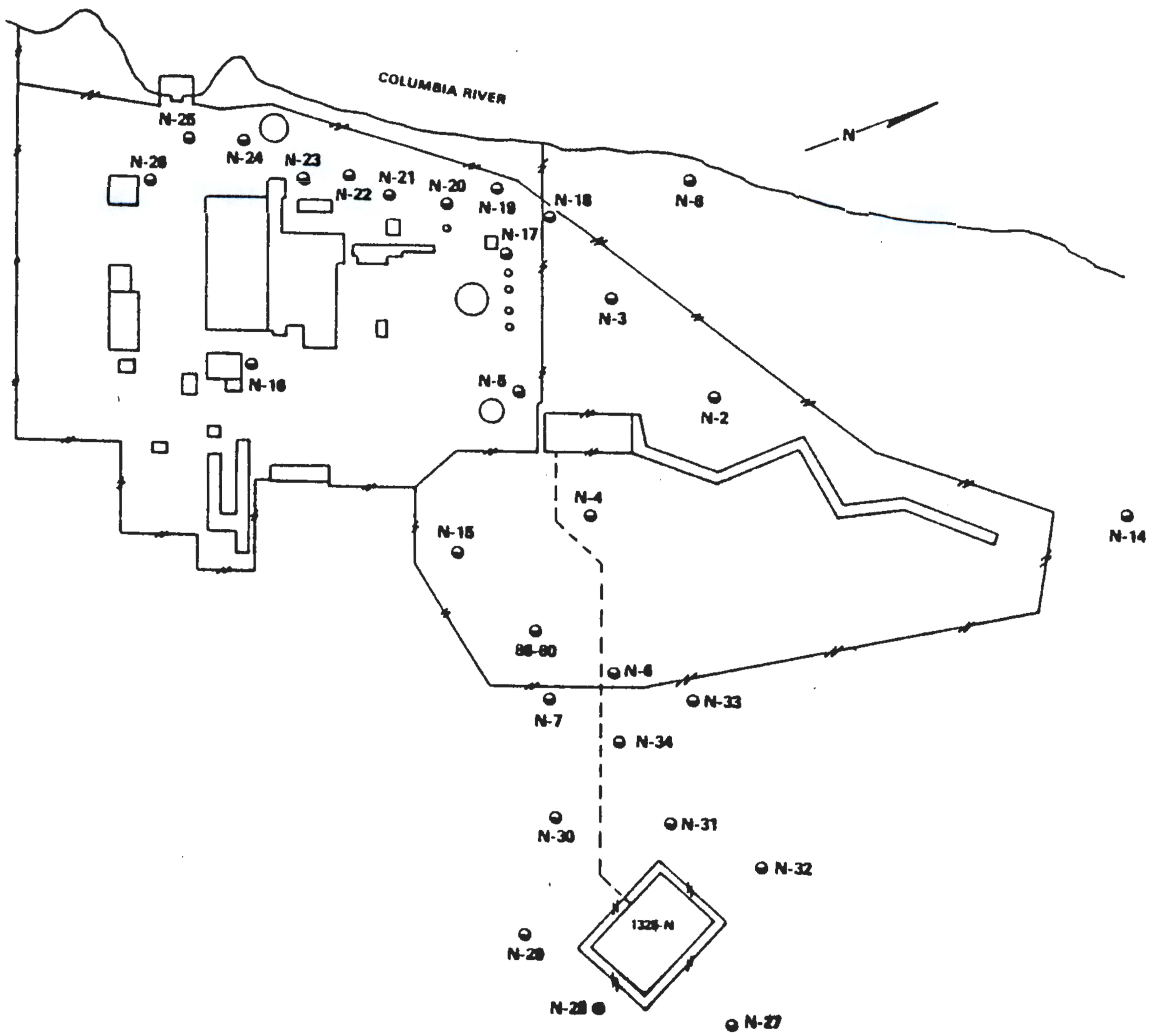

Table 3.1. Radionuclide Concentrations Detected in Ground Water Samples Collected at 100-N and 100-K Areas. Concentrations are in pCi/L.

Well		Mn-54	Co-60	Mo-99	Ru-103	Ru-106	Sb-124	Sb-125	I-131
N-2	Max.	ND	240	ND	370	470	25	330	5,100
	Avg.	---	170	---	230	250	17	240	1,800
N-3	Max.	ND	90	ND	68	100	ND	97	370
	Avg.	---	89	---	48	81	---	77	230
N-4	Max.	ND	56	ND	ND	ND	ND	27	ND
	Avg.	---	41	---	---	---	---	17	---
N-5	Max.	ND	90	ND	15	60	ND	88	ND
	Avg.	---	69	---	13	*	---	68	---
N-6	Max.	ND	58	4,600	100	100	29	99	12,000
	Avg.	---	49	*	66	71	*	82	6,400
N-7	Max.	6.3	210	13,000	74	130	42	170	18,000
	Avg.	4.7	130	*	55	94	27	110	6,200
N-14	Max.	ND	160	ND	80	140	ND	150	460
	Avg.	---	100	---	52	120	---	120	160
N-15	Max.	ND	55	ND	22	37	ND	25	ND
	Avg.	---	36	---	18	*	---	22	---
N-16	Max.	ND	67	ND	ND	ND	ND	ND	ND
	Avg.	---	28	---	---	---	---	---	---
N-17	Max.	ND	37	ND	9.2	ND	ND	ND	ND
	Avg.	---	25	---	*	---	---	---	---
N-18	Max.	ND	30	ND	ND	ND	ND	18	ND
	Avg.	---	15	---	---	---	---	13	---
N-19	Max.	4.8	140	ND	5.7	ND	ND	85	380
	Avg.	*	94	---	*	---	---	39	*
N-20	Max.	ND	100	ND	18	ND	ND	22	100
	Avg.	---	61	---	12	---	---	16	66
N-21	Max.	ND	25	ND	5.9	ND	ND	ND	ND
	Avg.	---	20	---	*	---	---	---	---
N-22	Max.	4.2	21	ND	ND	ND	ND	ND	ND
	Avg.	*	18	---	---	---	---	---	---

Table 3.1 (Cont'd)

Well		Mn-54	Co-60	Mo-99	Ru-103	Ru-106	Sb-124	Sb-125	I-131
N-23	Max.	3.2	35	ND	8.1	ND	ND	5.1	25
	Avg.	*	24	---	*	---	---	*	*
N-24	Max.	ND	100	ND	22	68	ND	110	ND
	Avg.	---	44	---	19	64	---	94	---
N-25	Max.	ND	8.8	ND	ND	ND	ND	ND	ND
	Avg.	---	*	---	---	---	---	---	---
N-26	Max.	ND	21	ND	ND	ND	ND	ND	ND
	Avg.	---	9.2	---	---	---	---	---	---
N-27	Max.	12	520	1,700	330	340	97	170	16,000
	Avg.	*	230	*	210	240	45	120	7,800
N-28	Max.	21	260	9,200	260	300	25	180	20,000
	Avg.	*	140	*	180	150	23	110	8,800
N-29	Max.	ND	580	ND	470	480	110	280	28,000
	Avg.	---	320	---	280	280	47	160	13,000
N-30	Max.	18	280	52,000	190	200	77	140	31,000
	Avg.	*	130	*	110	110	67	85	11,000
N-31	Max.	8.0	250	14,000	220	170	36	140	21,000
	Avg.	*	150	*	140	140	34	110	7,800
N-32	Max.	ND	240	ND	120	210	23	60	1,400
	Avg.	---	160	---	100	160	*	59	940
N-33	Max.	9.7	280	3,300	110	200	12	150	11,000
	AVg.	*	140	*	90	130	*	120	3,200
N-34	Max.	9.7	290	ND	190	150	48	98	1,600
	Avg.	*	190	---	120	130	*	81	640
K-27	Max.	ND	12	ND	ND	ND	ND	530	ND
	Avg.	---	9.7	---	---	---	---	520	---
K-28	Max.	ND	13	ND	ND	ND	ND	54	ND
	Avg.	---	11	---	---	---	---	40	---
K-29	Max.	ND	22	ND	ND	ND	ND	ND	ND
	Avg.	---	10	---	---	---	---	---	---
K-30	Max.	ND	16	ND	ND	ND	ND	ND	ND
	Avg.	---	11	---	---	---	---	---	---

ND = Not Detected
* = only one sample with detectable results

Table 3.1 (Cont'd)

NOTE: Other radionuclides were also detected in ground water as follows:

Well No.	Cr-51	Co-58	Nb-95	Zr-95	Cs-134	Cs-137
N-2	ND	6.5	ND	ND	ND	ND
N-7	ND	ND	ND	ND	ND	7.4
N-22	ND	ND	ND	ND	ND	6.9
N-27	ND	ND	16	ND	140	ND
N-28	63	ND	5.1	ND	ND	ND
N-29	370	19	ND	ND	12	ND
N-30	ND	ND	26	21	ND	ND
N-31	ND	ND	ND	6.9	ND	ND
N-33	80	ND	ND	ND	ND	ND
N-34	120	14	ND	ND	ND	ND

4.0 SOIL SAMPLING

Soil sampling provides a means to evaluate radionuclides which settle out of the air, are absorbed from liquid releases to the soil, or spread due to the burial of radioactive solid waste. Soil samples were collected once during 1984 at each of the 100 Areas. Sample locations are indicated on Figures 4.1 - 4.6. Soil sampling locations were selected to maximize the potential for detecting radionuclides from either airborne deposition, past leakage or disposal of radioactive liquid effluents, or past disposal of radioactive solid waste.

Soil samples consisted of surface soil (top 2.5 cm) collected with a small trowel. Approximately 100 cc of soil was collected at each location. Radionuclide concentrations detected in these soil samples are listed in Table 4.1.

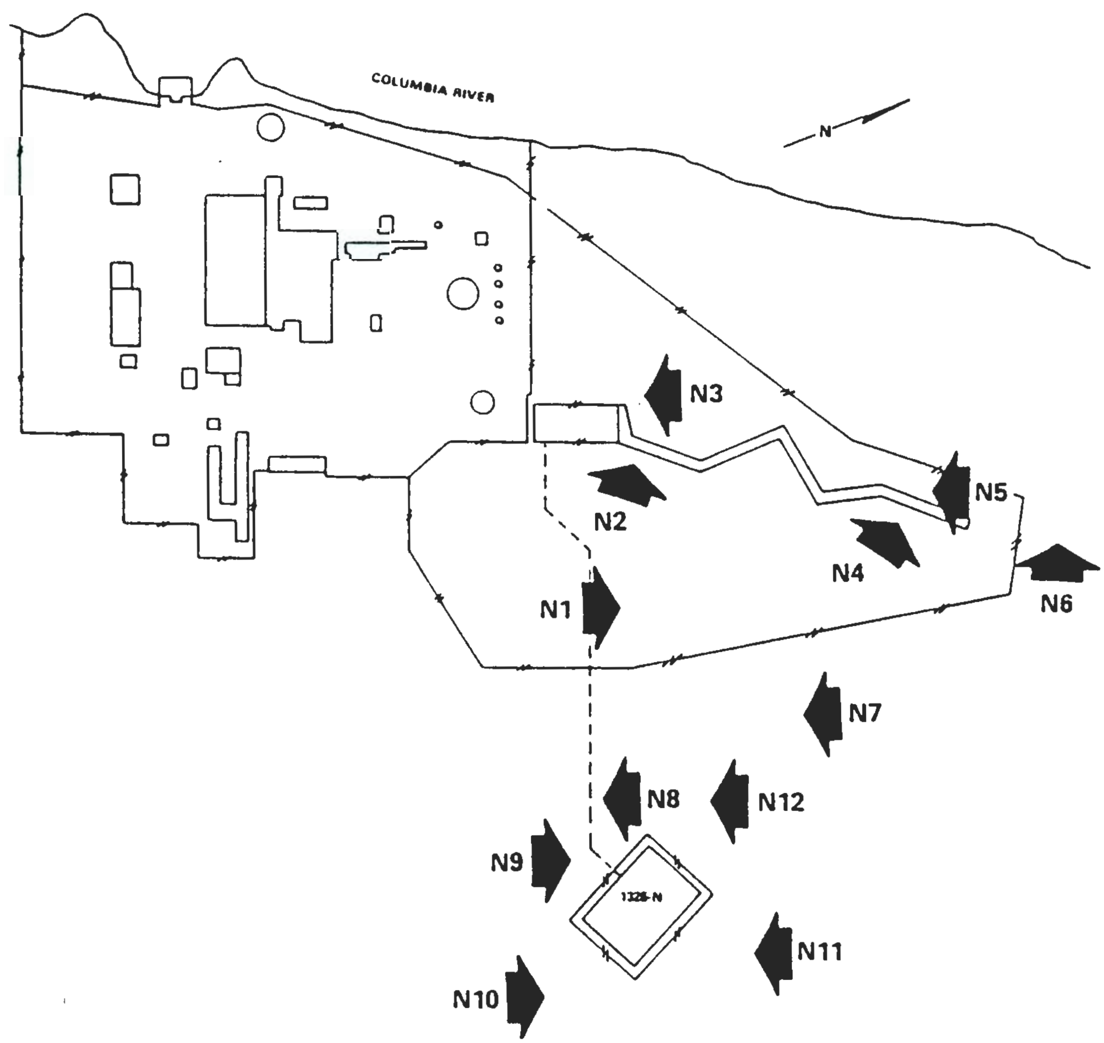

Figure 4.1. Soil and Vegetation Sampling Locations at 100-N Area.

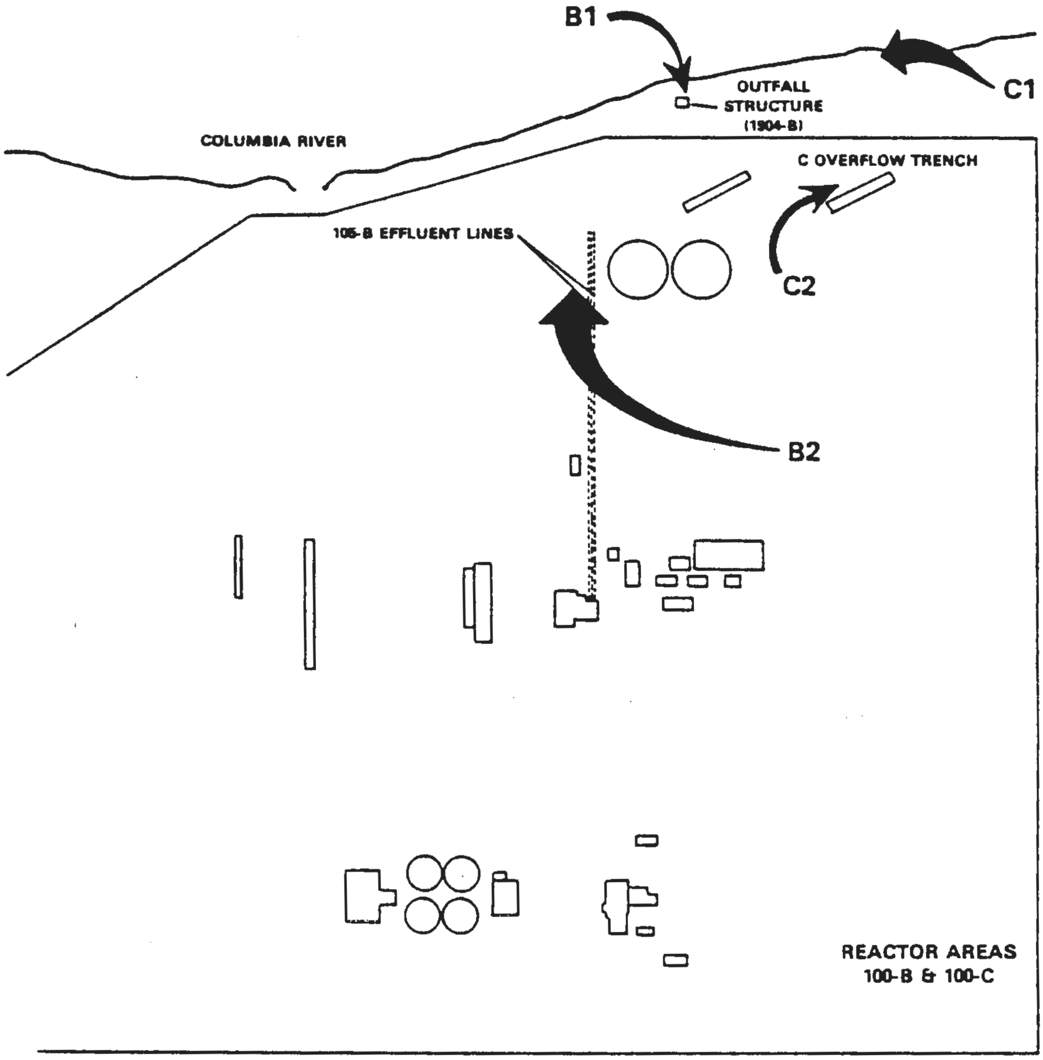

Figure 4.2. Soil and Vegetation Sampling Locations at the Retired 100-B/C Area.

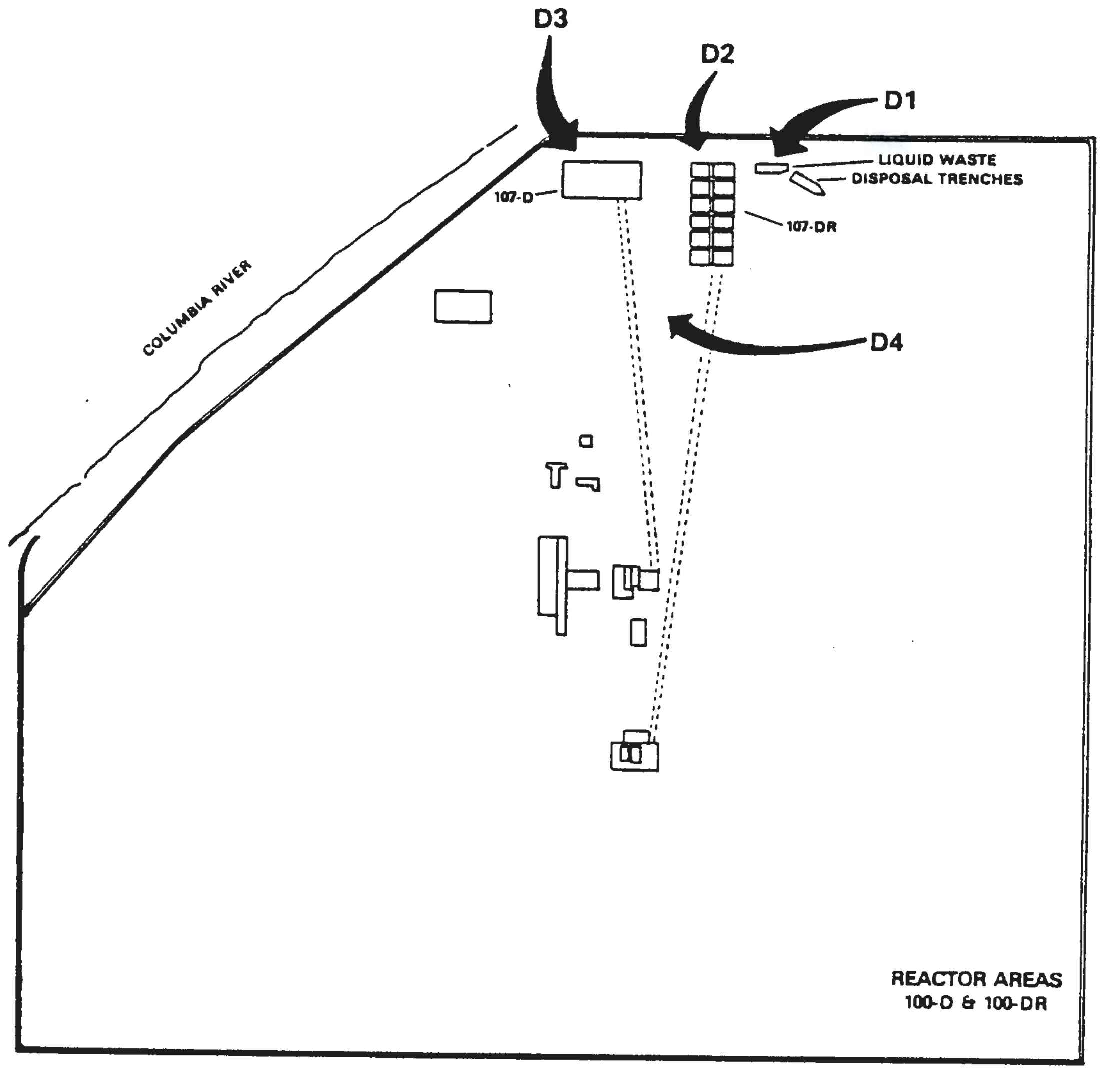

Figure 4.3. Soil and Vegetation Sampling Locations at the Retired 100-D/DR Area.

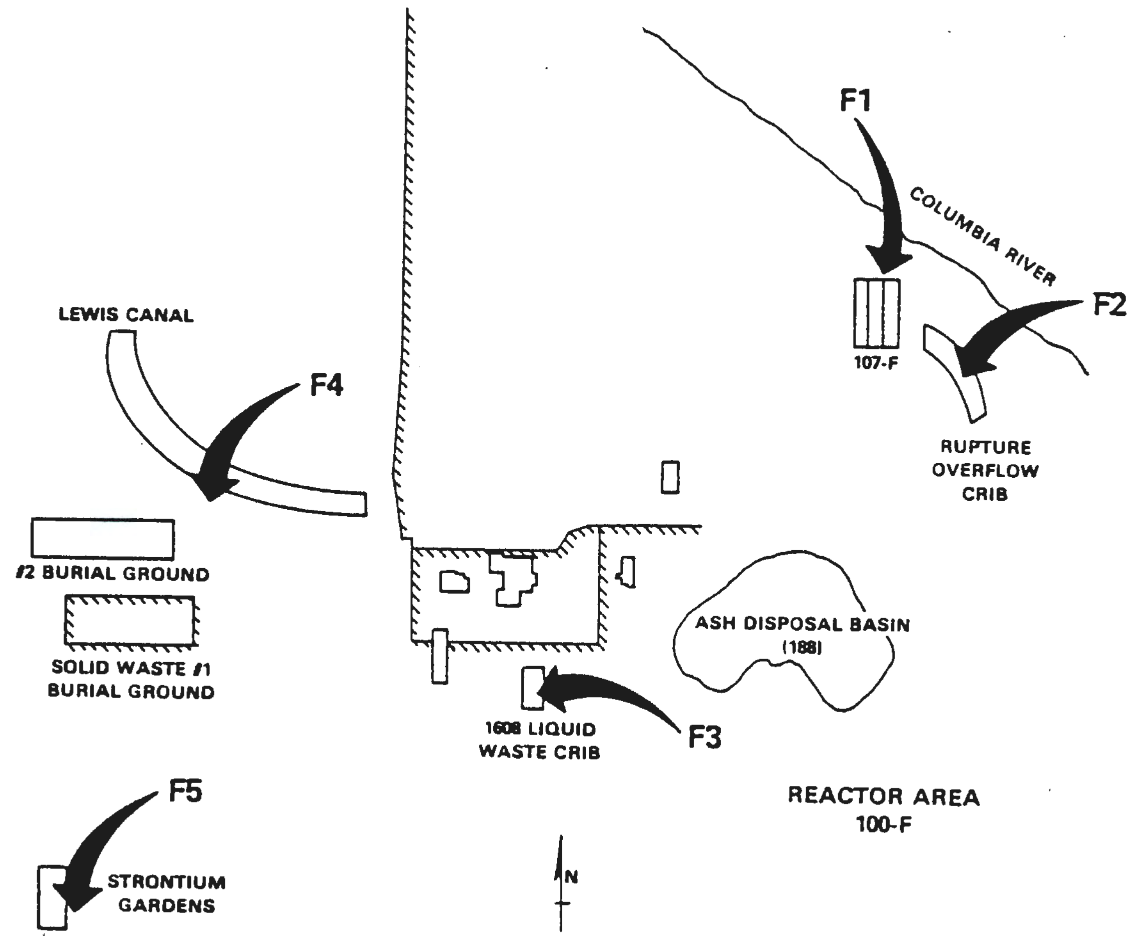

Figure 4.4. Soil and Vegetation Sampling Locations at the Retired 100-F Area.

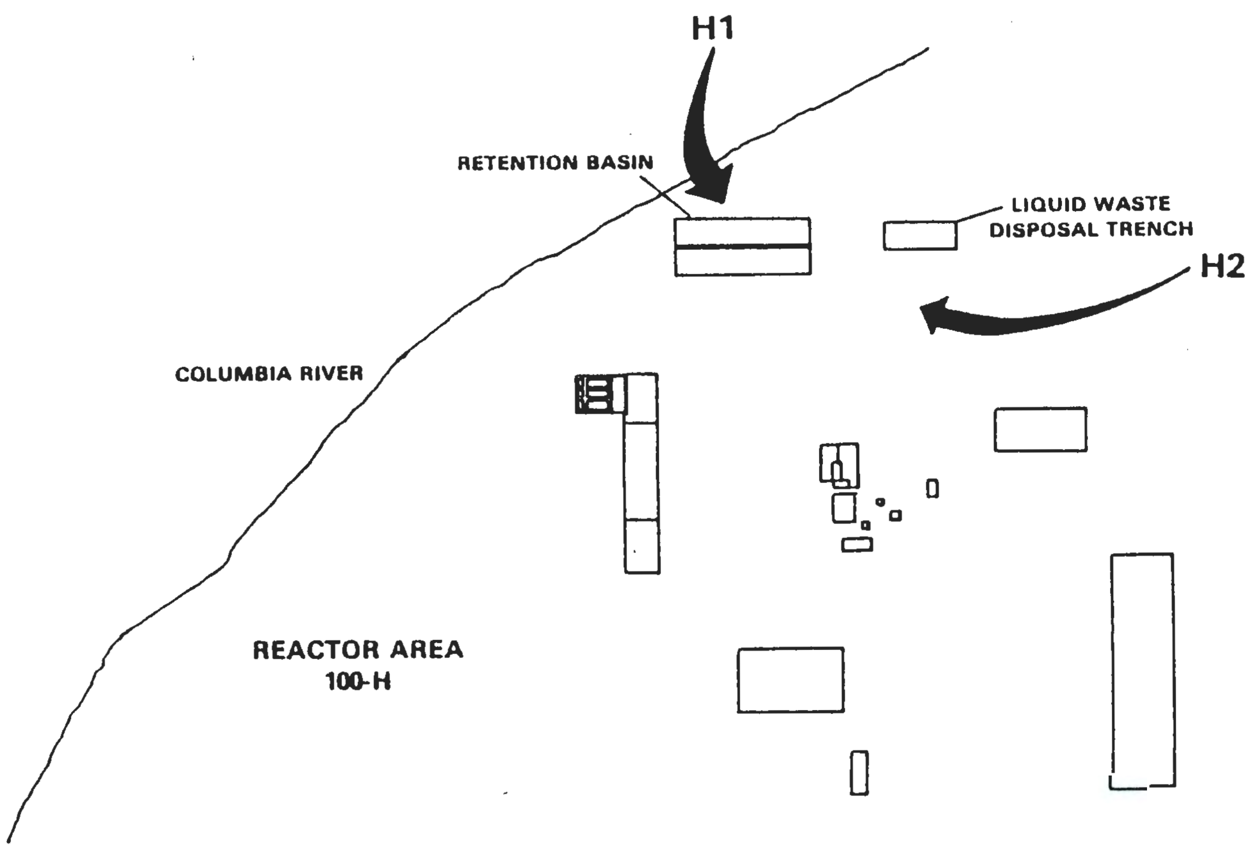

Figure 4.5. Soil and Vegetation Sampling Locations at the Retired 100-H Area.

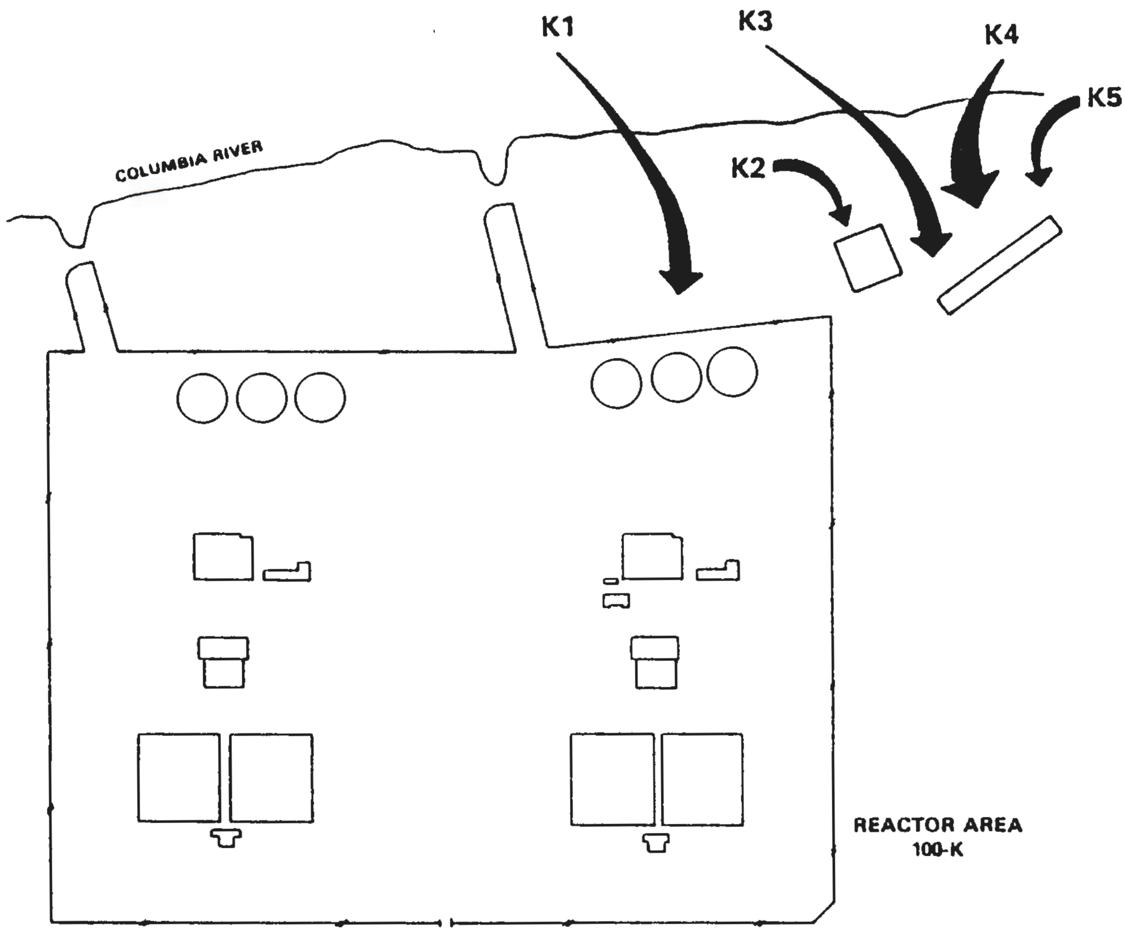

Figure 4.6. Soil and Vegetation Sampling Locations at the Retired 100-K Area.

Table 4.1. Radionuclide Concentrations Detected in Soil Samples Collected in the 100 Areas. Concentrations are in pCi/g (dry weight).

Sample Location	Mn-54	Co-60	Sr-90	Cs-137	Eu-152	Eu-154	Pu-238	Pu-239/240
N1	ND	2.4	0.19	0.63	ND	ND	8.4E-4	6.4E-3
N2	0.27	5.5	0.43	ND	ND	0.35	1.4E-2	6.7E-2
N3	0.15	1.8	0.21	ND	ND	ND	1.4E-3	5.6E-3
N4	0.19	3.8	0.15	2.5	ND	0.35	1.1E-3	4.9E-3
N5	0.12	0.59	0.05	0.14	ND	ND	8.1E-5	7.1E-4
N6	ND	0.35	0.55	0.55	ND	ND	5.4E-4	5.3E-3
N7	ND	0.52	0.04	0.19	ND	ND	1.7E-4	1.4E-3
N8	ND	2.1	0.21	1.3	ND	ND	3.7E-4	1.7E-2
N9	ND	1.0	0.21	0.43	ND	ND	6.1E-3	3.8E-2
N10	ND	0.62	0.06	0.41	ND	ND	8.4E-4	6.4E-3
N11	ND	0.76	0.53	0.43	ND	ND	6.8E-4	5.6E-3
N12	ND	0.79	0.38	1.0	ND	ND	1.0E-3	2.5E-2
B1	ND	0.45	0.12	0.72	0.87	ND	4.3E-4	6.6E-3
B2	ND	0.82	0.65	4.0	2.4	ND	1.2E-3	3.0E-2
C1	ND	0.71	0.28	2.5	3.0	0.93	1.0E-3	4.6E-2
C2	ND	0.17	0.22	0.38	0.55	ND	1.5E-3	1.4E-2
D1	ND	0.19	0.07	0.16	0.13	ND	2.1E-5	4.0E-3
D2	ND	0.30	0.25	0.15	0.28	ND	2.6E-4	3.1E-2
D3	ND	0.21	0.10	0.09	ND	ND	3.3E-4	1.7E-3
D4	ND	0.16	0.15	0.23	0.25	ND	ND	2.4E-3
F1	ND	0.16	0.35	0.11	0.24	0.20	3.5E-4	2.9E-3
F2	ND	0.31	0.42	0.26	1.9	0.60	4.0E-4	7.1E-3
F3	ND	4.6	0.59	2.1	17	4.0	1.3E-3	3.7E-2
F4	ND	0.10	0.06	0.15	ND	ND	3.6E-4	1.6E-3
F5	ND	0.24	0.77	0.88	ND	ND	7.3E-5	3.8E-3
H1	ND	0.26	0.21	0.42	0.25	0.37	2.8E-4	7.1E-3
H2	ND	0.47	0.26	2.9	4.4	0.55	1.1E-3	2.3E-2
K1	ND	9.5	3.2	6.5	41	7.9		
K2	ND	3.5	0.32	39	11	2.2	3.0E-3	9.9E-2
K3	ND	0.15	0.58	0.73	ND	ND	3.4E-4	1.7E-2
K4	ND	ND	0.05	ND	ND	ND	4.5E-4	7.1E-4
K5	ND	0.15	0.04	0.07	ND	ND	3.4E-5	1.7E-4

ND = Not Detected

In addition to the radionuclides listed above, Eu-155 was detected in the following concentrations (pCi/g) at the following locations: 0.17 at N11, 0.16 at C2, 0.08 at D1, 0.13 at D2, 017 at D4, and 0.65 at K1. Also, 0.11 pCi/g of Cs-134 was detected in sample N4.

5.0 LWDF SEDIMENT SAMPLING

Sediment samples from the 1301-N LWDF were collected once during 1984 at the locations indicated in Figure 5.1. Sediment samples were obtained by attaching a small jar to the end of a long pole and using this device as a scoop. Approximately 25 cc of sediment is collected. Sediment gathered by the scoop is transferred to a 200 mL jar and the scoop is then rinsed with the water in the LWDF.

Radionuclide concentrations detected in LWDF sediment samples are listed in Table 5.1. A comparison of the average concentrations of several radionuclides found in LWDF sediment samples over the past several years is included in Table 5.2.

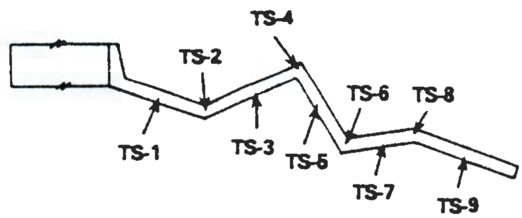

Figure 5.1. 1301-N LWDF Sediment Sampling Locations.

Table 5.1. Radionuclide Concentrations Detected in 1301-N LWDF Sediment Samples. Concentrations are in pCi/g (dry weight).

Sample Location	Mn-54	Co-60	Cs-137
TS-1	$<7.9x10^5$	$5.3x10^7$	$3.1x10^6$
TS-2	$4.7x10^5$	$2.2x10^7$	$9.6x10^5$
TS-3	$5.2x10^5$	$3.2x10^7$	$8.2x10^5$
TS-4	$1.3x10^6$	$1.6x10^7$	$7.5x10^5$
TS-5	$<1.9x10^5$	$8.3x10^6$	$1.3x10^6$
TS-6	$3.5x10^5$	$2.3x10^7$	$7.5x10^5$
TS-7	$3.2x10^6$	$1.6x10^7$	$9.8x10^5$
TS-8	$7.5x10^5$	$1.6x10^7$	$7.3x10^5$
TS-9	$1.1x10^6$	$1.5x10^7$	$1.3x10^6$
Avg.	$9.6x10^5$	$2.2x10^7$	$1.2x10^6$

In addition to the radionuclides listed above, sample TS-5 contained $1.5x10^5$ pCi/g of Eu-154 and sample TS-7 contained $8.7x10^5$ pCi/g of Ce-144.

ND = Not Detected

NOTE: Sr-90 and Pu-239/240 analytical results were not available at time of publication. These results will be distributed at a later date.

Table 5.2. Comparison of Average Concentrations (pCi/g - dry wt.) of Selected Radionuclides in 1301-N LWDF Sediment Samples Since 1975.

Year	Co-60	Cs-137	Sr-90	Pu-239/240
1975	5.2×10^6	1.1×10^6	2.4×10^3	9.8×10^2
1976	2.0×10^6	1.8×10^5	2.7×10^4	3.7×10^3
1977	7.1×10^5	7.9×10^4	2.1×10^4	4.6×10^3
1978	5.2×10^6	2.2×10^5	2.5×10^4	5.2×10^3
1979	2.6×10^7	8.1×10^5	4.2×10^4	6.2×10^3
1980	6.4×10^6	2.8×10^5	1.1×10^5	4.0×10^4
1981	9.1×10^6	4.5×10^5	1.5×10^5	1.8×10^4
1982	1.5×10^7	6.6×10^5	1.6×10^5	4.2×10^5
1983	1.2×10^7	6.2×10^5	2.8×10^4	7.8×10^3
1984	2.2×10^7	1.2×10^6	Not Yet Available	

6.0 VEGETATION SAMPLING

Radionuclides can concentrate in plants by surface deposition, root uptake, and translocation from other parts of the plant. Since herbivorous animals in the 100 Areas may utilize potentially contaminated vegetation as a food source, it is important to analyze vegetation samples to assess the potential for biotransport of radionuclides upward through higher trophic levels.

Vegetation samples were collected once during 1984 in all of the 100 Areas at the same locations as the soil samples (refer to Figures 4.1 - 4.6). Vegetation sampling locations were selected to maximize the potential for detecting radionuclides in the vegetation from either airborne deposition or root uptake of underground radioactive liquid. Vegetation samples consisted of the growing parts of the plants (except cheatgrass) that were dominant at a particular location. Whenever possible, perennial shrubs were collected in order to compare as closely as possible to the PNL Environmental Surveillance Program. Concentrations of radionuclides detected in the vegetation samples are listed in Table 6.1.

Table 6.1. Concentrations of Radionuclides Detected in 100 Area Vegetation Samples. Concentrations are in pCi/g (dry weight).

Sample Location	Mn-54	Co-60	Sr-90	Cs-137	Pu-238	Pu-234/240
N1	0.28	1.1	0.18	0.09	2.1E-5	6.7E-4
N2	0.75	2.4	0.13	0.12	1.6E-4	1.6E-3
N3	0.12	0.42	0.09	0.04	6.1E-5	9.0E-4
N4	0.15	0.59	ND	0.08	5.6E-4	7.9E-4
N5	0.13	0.48	0.09	ND	2.8E-5	2.8E-4
N6	0.10	0.35	0.08	ND	2.3E-4	2.2E-4
N7	0.15	0.74	0.07	ND	1.3E-4	4.5E-4
N8	0.16	0.51	0.07	ND	3.9E-4	8.5E-4
N9	0.06	0.29	0.12	ND	3.6E-4	2.4E-3
N10	0.14	0.69	0.09	ND	4.2E-4	3.6E-3
N11	0.24	0.41	0.11	0.09	1.1E-4	1.2E-3
N12	0.09	0.22	0.03	ND	3.9E-5	3.3E-4
B1	ND	0.30	0.08	0.12	ND	4.7E-4
B2	ND	0.09	0.67	ND	2.0E-4	4.5E-4
C1	ND	0.05	4.9	0.09	3.3E-4	1.3E-3
C2	ND	0.07	0.04	0.05	1.9E-4	1.9E-4
D1	ND	0.19	0.06	ND	5.1E-3	ND
D2	ND	0.22	0.24	1.2	1.6E-5	2.2E-4
D3	ND	0.30	0.19	0.11	ND	6.7E-4
D4	ND	0.13	0.61	3.8	3.9E-4	8.4E-4
F1	ND	0.17	0.36	0.09	3.6E-4	2.9E-4
F2	ND	9.6	0.34	72	5.2E-4	8.3E-3
F3	ND	0.98	17	5.5	1.2E-5	9.1E-4
F4	ND	0.10	0.08	ND	3.5E-5	3.0E-4
F5	ND	0.18	20	1.7	1.5E-3	9.7E-3
H1	ND	0.12	0.53	0.12	3.7E-4	1.0E-3
H2	ND	0.23	3.5	0.13	2.4E-5	2.4E-3
K1	ND	0.12	0.38	ND	1.4E-4	2.8E-4
K2	ND	0.08	0.41	ND	6.0E-5	3.6E-4
K3	ND	0.19	2.8	0.10	1.0E-4	2.1E-4
K4	ND	0.22	1.5	0.15	1.0E-3	1.4E-3
K5	ND	0.28	1.4	ND	1.3E-4	1.2E-3

ND = Not Detected

In addition to the radionuclides listed above, the following radionuclide concentrations, in pCi/g, were detected in the samples identified in parenthesis:

Fe-59 0.21 (N12)
Nb-95 0.16 (N1), 0.25 (N2), 0.26 (N8), 0.18 (N10)
Zr-95 0.11 (N1), 0.16 (N8), 0.21 (N10)
Ce-144 0.13 (N2)
Eu-152 18 (F2), 0.44 (F3)
Eu-154 0.07 (N4), 0.22 (N11), 0.14 (D3), 14 (F2)

7.0 DIRECT RADIATION MEASUREMENT

7.1 1301-N and 1325-N Grid Survey

A grid network of radiation survey locations is established around the 1301-N LWDF and the 1325-N LWDF (Figures 7.1 and 7.2). Surveys were taken at intersecting points of the grids shown in the figures. A direct reading count rate integrating instrument (an Eberline HP-210 probe with an Eberline Scaler) was used to measure activity and a μR meter (Ludlum Model 12S) is used to measure the dose rate at each location. Data collected is presented in Tables 7.1 and 7.2.

Measurements were made at a height of one meter. To obtain an activity count rate, counts were made for one minute. Direct radiation surveys of the 1301-N and 1325-N grids are performed annually. The 1301-N grid survey was performed on August 22, 1984 and the 1325-N grid survey was conducted on August 29, 1984. During both surveys, N Reactor was shut down and the flow rate to the 1301-N LWDF was approximately 3000 gpm. The 1310-N Chemical Waste Tank and the 1314-N Waste Load-out Station Tank were both empty.

Figure 7.1. Grid Used for Radiation Survey Around the 1301-N Facility.

Table 7.1. Data from 1301-N Grid Survey in Counts per Minute and μR per hour.

Grid Point	CPM	μR/hr
A1	875	600
A2	355	400
A3	145	230
A4	95	150
A5	80	110
B3	570	650
B4	155	400
B5	175	300
B6	140	175
B7	120	120
C1	390	400
C2	335	350
C3	270	400
C4	190	350
C5	135	230
C8	140	200
C9	130	90
D1	110	160
D2	125	140
D3	165	120
D4	100	140
D5	100	120
D6	230	150
D7	105	140
D8	140	130
D9	145	120

Table 7.2. Data from 1325-N Grid Survey in Counts per Minute and μR per hour.

Grid Point	CPM	μR/hr
W1	70	15
W2	100	25
W3	100	45
W4	70	60
W5	75	35
X1	70	15
X2	45	35
X3	4600	400
X5	120	50
Y1	100	20
Y2	140	30
Y3	9000	100
Y4	2800	450
Y5	80	50
Z1	65	15
Z2	90	25
Z3	55	25
Z4	100	30
Z5	120	25

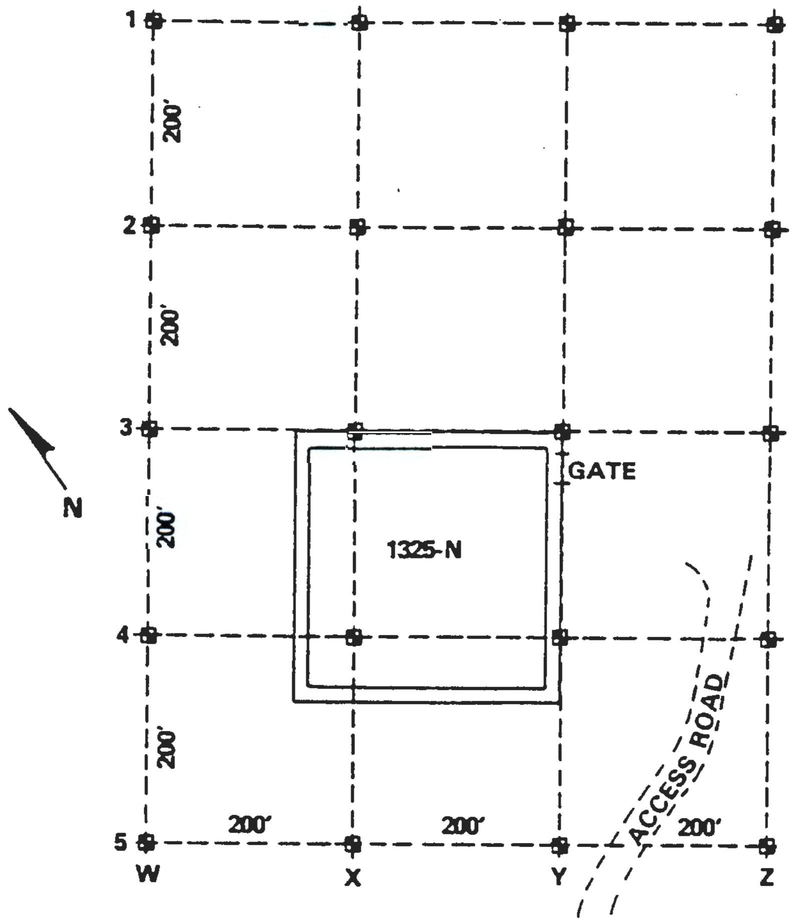

Figure 7.2 Grid Used for Radiation Survey Around the 1325-N Facility.

7.2 Environmental Dosimeters

External radiation dose information is collected at 100-N Area using CaF_2:Mn (TLD-400) thermoluminescent dosimeters. The dosimeters used are delivered and picked up monthly by PNL where they are read, calibrated, and annealed.

Locations of the environmental dosimeters at 100-N Area are depicted in Figure 7.3. This drawing also shows the area of river shoreline that was surveyed in the annual shoreline survey.

The data collected from the 100-N Area environmental dosimeters are presented in Table 7.3. Included is the average dose rate, continuous occupancy dose, and the dose to workers. The dose to workers is defined as the dose to a person that spends 40 hours per week and 52 weeks per year at the site of a specific environmental dosimeter.

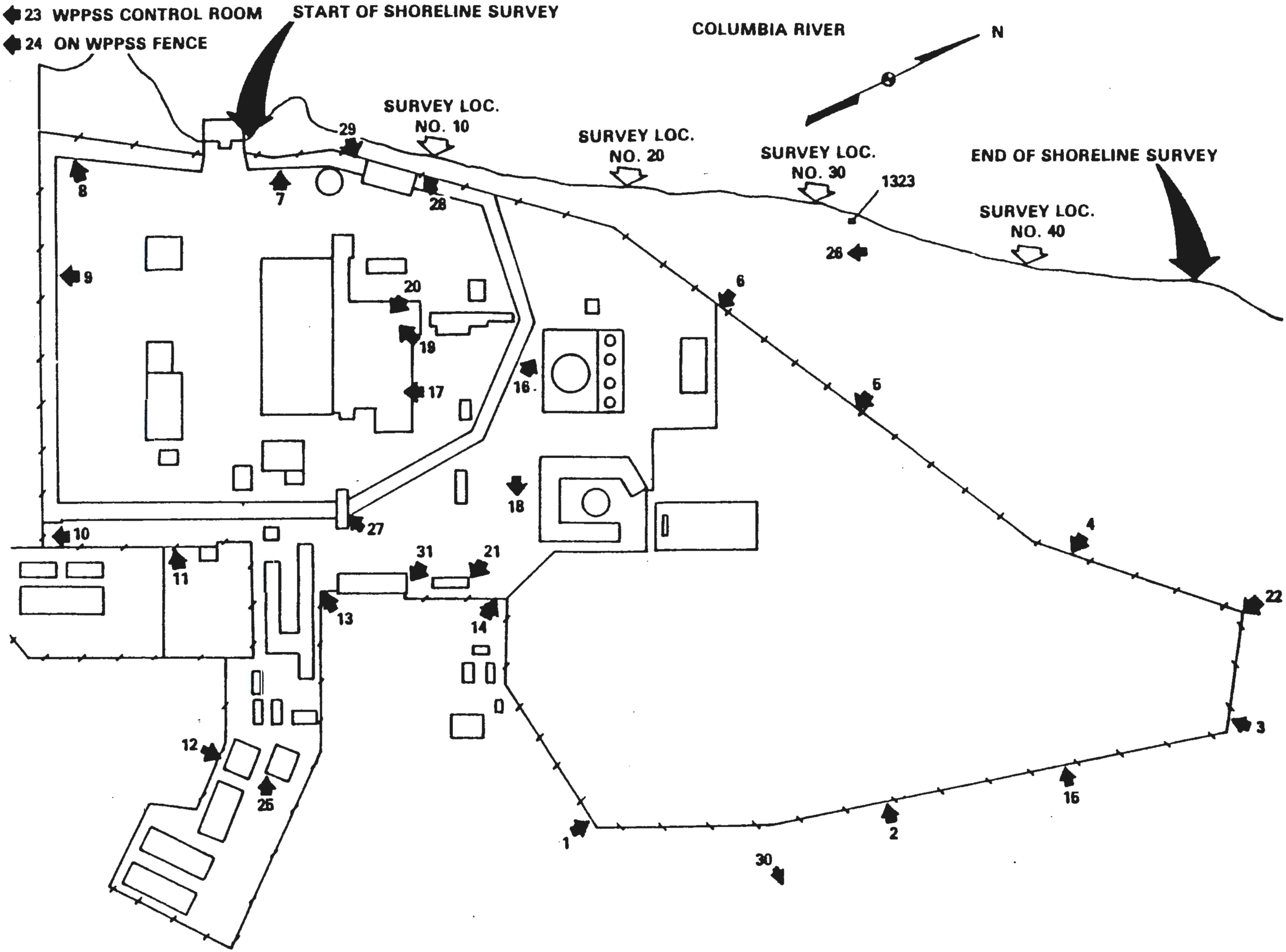

Figure 7.3. **LOCATIONS OF ENVIRONMENTAL DOSIMETERS AND SHORELINE SURVEY.**

TABLE 7.3. Dose Rates (mrad/hr) Detected From 100-N Area Environmental Dosimeters.

ENVIRONMENTAL TLD READINGS FISCAL YEAR 1984

AUGUST 1983 - AUGUST 1984

(mRad/hr)

TLD LOCATION ON	OFF	PER.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
08/26/83	09/23/83	1	.020	.017	.011	.017	.031	.048	.100		.008	.007	.006	.008	.013	.053	.016
09/23/83	10/21/83	2	.039	.069	.038	.155	.083	.065	.085	.008	.009	.009	.009	.011	.016	.067	.067
10/21/83	11/18/83	3	.067	.155	.164	.396	.179	.112	.108	.011	.012	.011	.012	.014	.018	.101	.082
11/18/83	12/16/83	4	.030	.056	.063	.139	.073	.049	.104	.006	.005	.005	.006	.006	.009	.061	.035
12/16/83	01/13/84	5	.053	.153	.086	.492	.164	.092	.104	.009	.008	.009	.012	.011	.016	.176	.091
01/13/84	02/10/84	6	.046	.023	.079	.372	.135	.078	.103	.005	.004	.005	.006	.008	.011	.069	.144
02/10/84	03/09/84	7	.029	.052	.031	.123	.054	.044	.105	.005	.005	.005	.005	.006	.008	.046	.054
03/09/84	04/06/84	8	.031	.052	.023	.062	.049	.052	.124	.009	.007	.006	.007	.011	.012	.047	.039
04/06/84	05/11/84	9	.021	.039	.028	.098	.047	.056	.114	.004	.004	.018		.007	.017	.045	.043
05/11/84	06/01/84	10	.015	.021	.016	.056	.036	.041	.122	.004	.004	.008	.025	.003	.009	.036	.027
06/01/84	06/29/84	11	.016	.029	.020	.069	.038	.036	.108	.006	.005	.005	.006	.004	.009	.035	.035
06/29/84	07/27/84	12	.027	.038	.021	.062	.040	.043	.131	.011	.016	.008	.009	.006	.013	.044	.036
07/27/84	08/24/84	13	.021	.024	.015	.029	.032	.033	.119	.008	.009	.007	.010	.006	.014	.044	.024
Average Dose Rate (mRad/hr)			.032	.056	.046	.16	.074	.058	.11	.012	.007	.008	.009	.008	.013	.063	.053
Continuous Occupancy Dose, mRad/yr			280	490	400	1400	650	510	960	110	63	70	79	70	110	550	460
Dose Rate to Workers mRad/yr			66	120	96	330	150	120	230	25	15	17	19	17	27	130	110

TLD LOCATION ON	OFF	PER.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
08/26/83	09/23/83	1	.049	.005		.011	.016	.053	.010	.006	.005	.006	.009	.011	.006	.013	.015	
09/23/83	10/21/83	2	.061	.006	.077	.011	.006	.066	.047	.006	.004	.007	.026	.012		.014	.016	
10/21/83	11/18/83	3	.084	.006	.116	.011	.007	.089	.114	.004	.006	.008	.051	.013		.017	.017	
11/18/83	12/16/83	4	.040	.003	.072	.009	.004	.057	.047	.003	.004	.004	.021	.010	.062	.477	.025	
12/16/83	01/13/84	5	.082	.008	.095	.006	.006	.068	.118	.005	.008	.009	.051	.009	.090	.439	.019	
01/13/84	02/10/84	6	.059	.003	.083	.006	.003	.058	.105	.002	.004	.005	.044	.006	.100	.462	.042	
02/10/84	03/09/84	7	.040	.003	.047	.006	.003	.038	.039	.002	.004	.004	.017	.007	.051	.421	.160	
03/09/84	04/06/84	8	.058	.007	.060	.011	.008	.049	.024	.002	.006	.008	.012	.008	.056	.514	.341	.034
04/06/84	05/11/84	9	.044	.004	.050	.006	.003	.042	.034	.004	.003	.006	.016	.009	.045	.462	.014	.033
05/11/84	06/01/84	10	.039	.005	.038	.008	.005	.032	.021	.004	.005	.004	.011	.008	.039	.484	.008	.027
06/01/84	06/29/84	11	.039	.005	.043	.010	.006	.036	.026	.005	.004	.004	.012	.009	.046	.488	.016	.032
06/29/84	07/27/84	12	.084	.008	.057	.009	.006	.044	.026	.008	.004	.007	.011	.009	.327	.469	.113	.037
07/27/84	08/24/84	13	.071	.007	.049	.009	.006	.036	.016	.009	.005	.006	.010	.009	.238	.473	.031	.035
Average Dose Rate (mRad/hr)			.058	.005	.066	.009	.006	.051	.048	.005	.005	.006	.022	.009	.096	.36	.063	.033
Continuous Occupancy Dose, mRad/yr			510	44	560	79	53	450	420	44	44	53	190	79	840	3200	650	290
Dose Rate to Workers mRad/yr			120	10	140	19	13	110	100	10	10	13	46	19	200	760	130	69

7.3 Shoreline Survey

An Eberline HP-210 probe with an Eberline Scaler and a Ludlum Model 12S μR meter were used to conduct the annual Columbia River shoreline radiation survey which began just downstream of the 181-N building and ended approximately 1000 feet downstream from the 1323-N sample shack. The measurements were made approximately every 50 feet along the high water mark of shoreline and were taken one meter above ground and in the same manner as the grid surveys. Data collected during the shoreline survey is presented in Table 7.4.

The shoreline survey is performed annually. This survey was conducted on June 16, 1984. At that time the reactor was shut down and the 1301-N LWDF flow rate was approximately 1500 gpm. The average Columbia River flow rate on this day was 164,000 cfs. The 1310-N Chemical Waste Tank and the 1314-N Waste Load-out Station Tank were both empty.

Table 7.4 Radiation Data from the 100-N Area Shoreline Survey in Counts per Minute and μR per Hour.

Location	CPM	μR/hr	Location	CPM	μR/hr
1	90	40	26	90	85
2	110	50	27	80	75
3	95	50	28	65	65
4	135	60	29	60	60
5	155	80	30	95	50
6	100	60	31	125	40
7	145	60	32	95	40
8	85	40	33	85	40
9	65	40	34	85	40
10	145	40	35	140	35
11	105	30	36	215	35
12	85	40	37	435	40
13	75	40	38	150	35
14	135	40	39	215	35
15	55	45	40	250	35
16	80	50	41	185	35
17	125	60	42	115	35
18	80	65	43	145	30
19	40	80	44	180	30
20	95	80	45	85	30
21	95	100	46	110	30
22	130	110	47	70	30
23	70	110	48	125	30
24	110	105	49	125	30
25	60	100	50	90	30

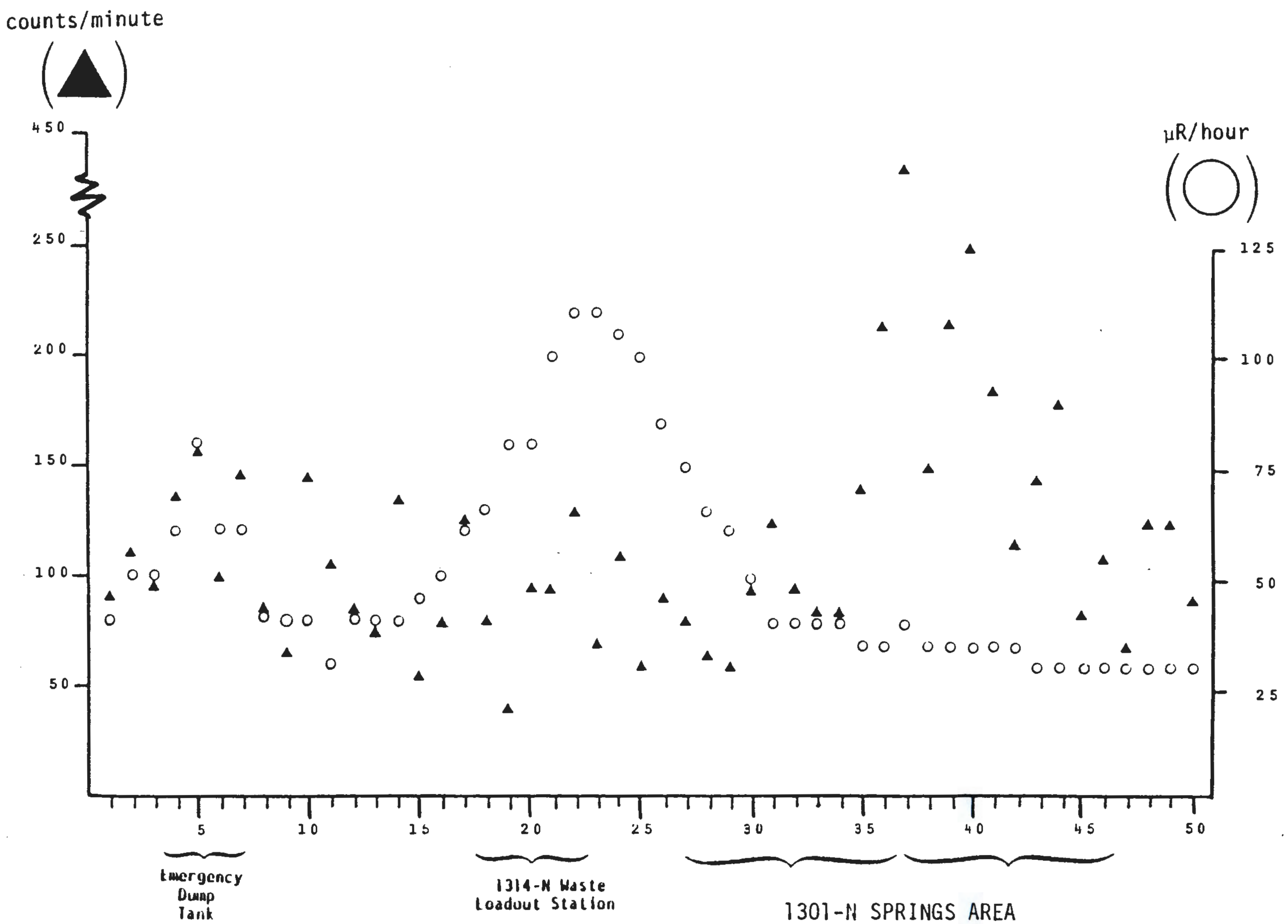

Figure 7.4. Dose Rates and Activity Levels Detected During the Shoreline Survey.

8.0 SPECIAL ENVIRONMENTAL SAMPLES

As part of the Environmental Surveillance Program for the 100 Areas, the results of special environmental samples or studies of the 100 Area environs are included in the annual surveillance report. These special samples are listed in the following subsections.

8.1 Thesis Work

As a thesis in partial fulfullment of the requirements for the degree of Master of Science from the Washington State University Program in Biology, a study was completed to compare the relative availability of radionuclides to plants before and after liquid radioactive waste has passed through the soil. Plants irrigated with low-level liquid radioactive waste were compared to plants irrgated with the same water after it had passed through a long natural soil column. By measuring the radionuclide uptake of the plants, a ratio of radionuclide uptake was calculated to estimate changes in the availability of radionuclides to plants.

The study sites used were the 1301-N LWDF and the 1301-N riverbank springs. Water discharged to the 1301-N LWDF percolates through the underlying soil and some of this liquid emerges at the riverbank springs (Rokkan, 1984). Water discharged to the LWDF and emerging from the springs, along with Columbia River water for the control group, was used to irrigate Roma tomato plants. A total of 24 plants were divided into three treatment groups and grown for 92 days in 10 gallon containers. Conclusions of the study are listed below (Greager, 1984).

The soil is effective in removing all or a portion of most of the radionuclides discharged to the waste disposal facility before the waste stream emerges at the river bank springs. Only those radionuclides in mobile chemical forms migrate through the soil with ground water to the river bank springs.

Tomato plants irrigated with water from the LWDF and springs exhibited statistically significant differences in the total uptake of radionuclides. These differences were a function of the different radionuclide concentrations present in the separate irrigation supplies.

Ratios of radionuclide concentrations in tomato plants to the concentration in the applicable irrigation supply showed there was no statistically significant difference in the uptake of radionuclides grown with either LWDF or springs water. It appears there is no change in the availability of radionuclides to tomato plants due to the passage of low-level liquid radioactive waste through soil.

The physicochemical composition of a radionuclide changes as it moves through soil since certain chemical forms are more mobile than others. Particulate and cationic forms are more easily sorbed by the soil while anionic and nonionic chemical species migrate more easily with ground water. These chemical changes do not appear to have any effect on the availability of the radionuclide to plants.

Radionuclides appear to be distributed differently in different plant compartments. Lower radionuclide concentrations and a lower rate of radionuclide uptake in tomato fruit indicate that radionuclides are more strongly excluded from this part of the plant. Since the fruit is the part of the plant most likely to be consumed by humans, it is important to consider this differential radionuclide uptake in pathway analysis calculations.

8.2 Strontium and Plutonium Concentrations in 100-Area Soil and Vegetation Samples

Soil and vegetation samples collected during FY 1983 for the Environmental Surveillance Program were analyzed for Sr-90, Pu-238, and Pu-239/240 concentrations. Due to a slow turn around time at the U.S. Testing Company, these results were not included in the past annual environmental surveillance report. The following tables present the strontium and plutonium concentrations that have been detected. Vegetation and soil sampling locations were the same in 1983 and 1984, so that sampling locations are pictured in Figures 4.1 through 4.6 of this report. The exception to this is that sampling locations N9, N10, N11, and N12 were added in 1984.

Table 8.1. Sr-90, Pu-238, and Pu-239/240 Concentrations Detected in 100-N Area Soil Samples Collected in 1982. Concentrations are in pCi/g (dry wt.).

Sample Location	Sr-90	Pu-238	Pu-239/240
N1	1.6 E-1	9.5 E-4	7.8 E-3
N2	3.8 E0	2.4 E-2	1.4 E-1
N3	1.9 E0	5.1 E-3	2.9 E-2
N4	3.1 E-1	1.1 E-3	1.2 E-2
N5	4.2 E-1	4.1 E-3	2.7 E-2
N6	1.1 E-1	5.5 E-4	5.5 E-3
N7	1.5 E-1	5.9 E-4	5.1 E-3
N8	6.0 E-1	3.0 E-3	1.5 E-2
B1	3.7 E-1	1.6 E-4	8.9 E-3
B2	1.5 E0	1.5 E-3	5.3 E-2
C1	3.4 E-1	6.8 E-4	1.7 E-2
C2	2.9 E-1	9.3 E-4	2.4 E-2
D1	5.4 E-2	3.4 E-4	2.9 E-3
D2	5.3 E-1	5.1 E-3	1.0 E-1
D3	4.8 E-2	3.7 E-5	6.2 E-3
D4	8.4 E-2	1.6 E-4	2.5 E-3
F1	6.2 E-2	7.5 E-4	1.8 E-2
F2	8.7 E-1	6.0 E-4	7.3 E-3
F3	9.2 E-1	2.3 E-3	4.2 E-2
F4	3.7 E-2	7.6 E-3	2.1 E-3
F5	2.2 E0	4.9 E-4	4.9 E-3
H1	5.6 E-1	5.9 E-4	2.1 E-2
H2	2.6 E-1	5.0 E-4	6.3 E-3
K1	1.3 E+1	6.6 E-2	1.8 E0
K2	1.8 E-1	1.8 E-4	2.8 E-3
K3	8.1 E-1	8.8 E-4	2.7 E-2
K4	5.0 E-2	4.6 E-4	9.4 E-3
K5	4.9 E-2	1.4 E-4	5.3 E-3

Table 8.2. Sr-90 and Plutonium Concentrations Detected in 100 Area Vegetation Samples Collected in 1982. Concentrations are in pCi/g (dry wt.).

Sample Location	Sr-90	Pu-238	Pu-239/240
N1	2.6 E-1	5.1 E-4	5.6 E-3
N2	1.7 E-1	2.9 E-4	4.0 E-3
N3	1.8 E+1	6.5 E-4	3.4 E-3
N4	5.2 E-1	3.4 E-4	6.7 E-4
N5	2.6 E-1	1.1 E-3	2.1 E-3
N6	4.3 E-1	1.2 E-3	2.8 E-3
N7	2.7 E-2	1.8 E-4	6.0 E-5
N8	7.2 E-1	4.9 E-3	2.3 E-2
B1	1.3 E0	2.0 E-4	5.0 E-4
B2	1.4 E0	3.4 E-3	2.5 E-2
C1	9.4 E0	1.0 E-4	9.9 E-4
C2	4.7 E-2	2.9 E-3	4.2 E-4
D1	3.8 E-1	9.7 E-5	5.5 E-4
D2	1.7 E-1	1.3 E-3	2.2 E-2
D3	4.4 E-1	4.0 E-4	8.0 E-4
D4	1.7 E-1	2.6 E-5	4.1 E-3
F1	4.7 E-1	1.3 E-3	2.4 E-2
F2	6.8 E-1	1.5 E-4	1.5 E-4
F3	4.4 E+1	3.8 E-5	1.5 E-4
F4	3.6 E-1	1.6 E-4	6.2 E-5
F5	4.8 E-1	9.6 E-4	1.6 E-3
H1	7.7 E-1	3.8 E-4	1.2 E-3
H2	1.2 E-1	4.0 E-3	3.9 E-4
K1	1.9 E-1	1.1 E-4	2.3 E-4
K2	4.2 E0	4.1 E-5	8.2 E-5
K3	1.5 E-1	7.9 E-5	4.0 E-4
K4	5.7 E0	1.4 E-4	5.3 E-4
K5	2.6 E0	3.1 E-4	3.2 E-3

Table 8.3. Sr-90 and Plutonium Concentrations Detected in 100-N Area Trench Sediment Samples Collected in 1983. Concentrations are in pCi/g (dry wt.).

Sample Location	Sr-90	Pu-238	Pu-239/240
TS-1	4.6 E4	2.4 E3	1.2 E4
TS-2	4.6 E4	3.0 E3	1.3 E4
TS-3	2.9 E4	1.8 E3	1.0 E4
TS-4	2.6 E4	1.5 E3	7.5 E3
TS-5	1.3 E4	5.6 E2	3.0 E3
TS-6	4.6 E4	2.0 E3	9.8 E3
TS-7	2.7 E4	1.1 E3	6.2 E3
TS-8	1.3 E4	8.3 E2	4.6 E3
TS-9	8.7 E3	9.2 E2	4.3 E3
Average	2.8 E4	1.6 E3	7.8 E3

Table 8.4. Sr-90 and Plutonium Concentrations in Riverbanks Springs Vegetation Collected in 1983. Concentrations are in pCi/g (dry wt.). These vegetation samples were not collected in 1984. For sample locations, refer to the 1983 report (Greager, 1983).

Sample Location	Sr-90	Pu-238	Pu-239/240
SV-1	1.4 E+2	1.6 E-4	3.3 E-3
SV-2	5.0 E+2	9.0 E-4	4.0 E-3
SV-3	4.7 E+2	2.0 E-4	2.8 E-3
SV-4	2.0 E+2	9.0 E-4	2.2 E-2

9.0 REFERENCES

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APPENDIX A

ENVIRONMENTAL SURVEILLANCE PROGRAM

SAMPLE COLLECTION AND PREPARATION PROCEDURES

The following procedures are to be used for collecting and preparing the samples required in the UNC Environmental Surveillance Program. There are several different types of samples collected, including:

1) Cartridges from the Continuous Air Monitors,
2) Groundwater Samples,
3) Soil Samples,
4) Trench Sediment Samples,
5) Vegetation Samples,
6) TLDs, and
7) Direct Gamma Surveys.

Battelle Pacific Northwest Laboratories (PNL) is responsible for the environmental surveillance program for the Hanford Site. It is UNC policy to mimic the PNL sample collecton, preparation, and analytical procedures as much as possible to allow maximum comparison of the analytical results between the two surveillance programs.

Site maps showing the sample collection locations are presented directly after the narrative portion which describes the methods for sample collection and preparation.

AIRBORNE CARTRIDGE SAMPLES

Four continuous air sampling stations are set up to monitor 100-N Area. Each sampling station consists of a continuous duty, low volume air pump and a sample cartridge in a weatherproof enclosure.

The removable quick-disconnect stainless steel sample cartridge contains:

1) One paper filter (42.5 mm diameter),
2) A 1-inch deep charcoal bed (35 g activated charcoal GE 602),
3) A 2-inch deep charcoal bed (70 g charcoal GE 618), and
4) A 1 CFM critical orifice.

Safety: Keep clear of moving parts of pumps. Watch for spiders and snakes. Standard laboratory safety rules.

Special Tools or Equipment: Quick-disconnect stainless steel sample cartridge.

Prerequisites: Continuous air pump must be operating. If pump is not operating, notify Environmental Control.

Sample Collection: Sample cartridges are collected and replaced every four weeks. For guidance on packing the sample cartridges, refer to UNI-M-3, "Radiation Practices Manual," Section 2.7. Be sure samples are labelled correctly.

Sample Type: Airborne cartridge sample (charcoal and particulate).

Sample Preparation: Refer to UNI-M-76 REV 1, Section 2.14.

Sample Volume: The volume for a 28 day sample @ 1 cfm equals 1.14×10^6 litres - - the total sample volume can be adjusted by multiplying 1696.43 litres times the hours the sample was run (28 days = 672 hrs).

Gamma Analysis:

Sequence File:
- 40 (charcoal Det. #3 and RM Analyzer)
- 50 (filter Det. #3 and RM Analyzer)
- 80 (filter Det. #1)

Count Time: 60 minutes for both charcoal and filter

VEGETATION SAMPLES

Vegetation samples are collected annually from the 100 Areas, including the 1301-N Riverbank Springs. Approximately 38 samples are collected each year.

Safety: Watch for spiders and snakes. Standard laboratory safety rules. RWP N-22 applies to certain 100-N Area sampling locations.

Special Tools or Equipment: Plastic and paper bags. Clippers to collect vegetation.

Prerequisites: Collect vegetation samples annually in June to allow sufficient time for new growth. EXCEPTION: collect riverbank springs vegetation annually in August to take advantage of low river flow.

Sample Collection:

(1) At all sample locations, if possible, the new growth of perennial vegetation (such as rabbitbrush or sagebrush) should be collected.

(2) In sample areas where no perennial vegetation occurs, the dominant vegetation should be collected.

(3) About one pound of vegetation should be collected.

(4) Special requirements for riverbank springs:

   (a) Collect one sample from each zone as marked on the map.

   (b) Collect the wide-blade grass (reed canarygrass) present along the springs -- attempt to collect grass growing above a visible spring.

Sample Type: Approximately one pound of vegetation in plastic bags.

Sample Preparation: The vegetation should be transferred to paper bags to speed the drying process. Be sure and label the paper bags with the sample identification number. After the vegetation has dried for 2-3 weeks, place the vegetation in a 4 litre Marinelli beaker. After weighing the sample, place the beaker in a plastic bag and seal the bag with tape, leaving room for the Marinelli to fit over the detector.

Sample Volume: Measure and record the weight of the dry vegetation in grams (net weight).

Gamma Analysis: Sequence File: 60 (Det. #3 and RM Analyzer)

Count Time: 8 hours

Follow-up: All vegetation samples should be sent to U.S. Testing for Sr-90 and Pu-239/240 analysis.

SOIL SAMPLES

Soil samples are collected annually from the 100 Areas. Approximately 30 samples are collected each year.

Safety: Watch for spiders and snakes. Standard laboratory safety rules. RWP N-22 applies to certain 100-N Area sampling locations.

Special Tools or Equipment: Petri dish, small digging tool (small shovel, large spoon, or large putty knife will work), 200 cc plastic jars.

Prerequisites: Soil samples should be collected once per year during May or June.

Sample Collection:

(1) To collect the soil samples, a petri dish and small digging tool (small shovel, large spoon, large putty knife, etc.) will be needed.

(2) Twist one half of the petri dish (the open side) into the ground and dig the soil out from around the petri dish.

(3) Remove the petri dish and skin off approximately the top centimetre of soil from the mound formed by the petri dish.

(4) Enough soil should be collected to fill a 200 cc jar at least 50% full.

(5) In areas where the soil is too rocky to use the petri dish, surface soil limited to the top centimetre should be removed without using the petri dish.

(6) Be sure and label soil samples correctly.

Sample Type: At least 100 cc of soil in 200 cc jars.

Sample Preparation: Make sure the soil is dry -- if the soil is not dry, remove the lid and allow the soil to dry for a few days. After weighing the sample, heat seal the 200 cc jar in a plastic bag.

Sample Volume: Measure and record the weight of the dry soil in grams (this is net weight -- the weight of the sample container must be subtracted).

Gamma Analysis:

Sequence File: 10 (Det. #3)
40 (RM Analyzer)

Count Time: 8 hours

Follow-up: All soil samples should be sent to U.S. Testing for Sr-90 and Pu-239/240 analysis.

TRENCH SEDIMENT SAMPLES

Trench sediment samples are collected annually from nine locations in the 1301-N trench. These samples are highly radioactively contaminated and should be handled with care.

<u>Safety:</u> Watch for spiders and snakes. Standard laboratory safety rules. RWP N-22 applies -- single SWP clothing must be worn while collecting samples.

<u>Special Tools or Equipment:</u> Sediment core sampler or a long pole with a scoop on the end, 200 cc jars.

<u>Prerequisites:</u> Sediment samples should be collected once per year during May or June.

<u>Sample Collection:</u> Manholes are provided in the trench cover at the sample locations. Samples may be obtained by either using the core sampler (contact Environmental Control) or a long pole with a scoop on the end. Only a small amount of sediment should be collected (~25 cc). To avoid radiation exposure problems, do not collect more sediment than necessary. Be sure and label the sediment samples correctly.

<u>Sample Type:</u> Approximately 25 cc of sediment in a 200 cc jar.

<u>Sample Preparation:</u> The lids of the jars should be removed and the uncovered jars placed under the radiation hood in Room 50. The jars should be left under the hood until the sediment is dry. After weighing the sample, heat seal the 200 cc jar in a plastic bag.

<u>Sample Volume:</u> Measure and record the weight of the dry sediment in grams (net weight).

<u>Gamma Analysis:</u> Sequence File: 90 (Det. #3)

Count Time: 2 minutes

<u>Follow-up:</u> All trench sediment samples should be sent to U.S. Testing for Sr-90 and Pu-239/240 analysis.

GROUNDWATER SAMPLES

Groundwater samples are collected once every quarter at approximately 22 different monitoring wells at 100-N Area and four wells at 100-K Area.

Safety: Standard laboratory safety rules.

Special Tools or Equipment: Filters -- sharkskin and 45 μ size.

Prerequisites: None, other than the samples collected by PNL.

Sample Collection: The samples are collected by PNL once each quarter when they collect samples from the same wells for the Hanford Groundwater Monitoring Program.

Sample Type: One gallon liquid samples.

Sample Preparation: The samples must be filtered before counting. Funnel filter the groundwater through sharkskin and then filter the water again using a 0.45 μ size filter (this is the same size that PNL uses). Filters may be discarded. The filtered groundwater should be placed in a four litre Marinelli beaker. Refer to UNI-M-76 REV 1, Section 2.4 for further instructions on preparing liquid Marinelli samples.

Sample Volume: 4 litres.

Gamma Analysis: Sequence File: 10 (Det. #3)
20 (Det. #2)
90 (RM Analyzer)

Count Time: 8 hours

ENVIRONMENTAL DOSIMETERS

External radiation dose information is collected at 100-N Area using CaF_2:Mn (TLD-400) thermoluminescent dosimeters. The dosimeters used are delivered and picked up monthly by PNL where they are read, calibrated, and annealed.

100-N Area personnel should replace the dosimeters once every four weeks. TLDs should be placed at a height of approximately 1 metre. The new TLDs can be found in the lead brick "cave" maintained by Environmental Control (currently in Larry Diediker's office). After replacing the TLDs at all locations, the old TLDs should be returned to the lead brick cave.

Safety: Watch for spiders and snakes. RWP N-22 applies to some TLD locations.

Special Tools or Equipment: TLDs

Prerequisites: New TLDs must be available as replacements.

1301-N GRID SURVEY

A grid network of radiation survey locations is established adjacent to the 1301-N crib and trench. The survey locations are marked with an identification tag attached to a metal pole.

A direct reading count rate integrating instrument (an Eberline HP-210 probe with an Eberline Scaler) is used to measure activity and a μR meter (Ludlum Model 12S) is used to measure the dose rate at each location. All measurements are made at a height of approximately one metre. To obtain a count rate per minute, count at each survey location for two minutes and record one-half of the result.

Along with the information collected using the instruments, the following information should be recorded:

1) Reactor power level
2) Crib flow rate
3) Level of decontamination wastes in 1310-N tank
4) Level of decontamination wastes in the 1314-N tank
5) Status of wastes and level in the Emergency Dump Tank

The above information can be obtained from the 105-N Control Room or the Room 50 weekly analysis logbook.

Safety: Watch for spiders and snakes. RWP N-22 applies to the grid survey.

Special Tools or Equipment: Eberline HP-210 probe with Eberline Scaler, Ludlum Model 12 S μR meter..

Prerequisites: The grid survey should be conducted once per year during August, preferably during reactor operation. Results of the survey shall be sent promptly to Environmental Control.

SHORELINE SURVEY

A Columbia River shoreline radiation survey at 100-N Area covers the area beginning just downstream of the 181-N Building and ending about 1000 feet downstream of the 1323-N sample shed. Measurements are made approximately every 50 feet along the high water mark of the shoreline at a height of approximately one metre.

As in the grid survey, a direct reading count rate integrating instrument (an Eberline HP-210 probe with an Eberline Scaler) is used to measure activity and a μR meter (Ludlum Model 12S) is used to measure the dose rate at each location. To obtain a count rate per minute, count at each survey location for two minutes and record one-half of the result.

Along with the information collected using the instruments, the following information should be recorded:

1) Reactor power level
2) Crib flow rate
3) Level of decontamination wastes in 1310-N tank
4) Level of decontamination wastes in 1314-N tank
5) Status of wastes and level in the Emergency Dump Tank

The above information can be obtained from the 105-N Control Room or the Room 50 weekly analysis logbook.

Safety: Watch for spiders and snakes. Watch for slipping hazards along shoreline.

Special Tools or Equipment: Eberline HP-210 probe with Eberline Scaler, Ludlum Model 12 S μR meter.

Prerequisites: The shoreline survey should be conducted once per year during August, preferably during reactor operation. Results of the survey shall be sent promptly to Environmental Control.