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Calendar Year 1988

C. J. Perkins

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Calendar Year 1988

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WESTINGHOUSE HANFORD COMPANY ENVIRONMENTAL SURVEILLANCE ANNUAL REPORT--100 AREAS CALENDAR YEAR 1988

C. J. PERKINS

ABSTRACT

Near-field environmental surveillance of the Hanford 100 Areas is performed by Westinghouse Hanford Company (Westinghouse Hanford) to assess and control the impacts of operations. This involves sampling and analysis from the major environmental pathways of exposure to onsite workers.

Results from the Westinghouse Hanford Environmental Surveillance Program for the Hanford 100 Areas are presented in this report. The environmental surveillance program provides sampling and monitoring of several parameters to evaluate the environmental impact of 100-N Area Reactor Facilities and the shutdown reactor facilities and burial grounds in the retired 100 Areas. Discharges to the environment are reported in annual effluent release reports.

At 100-N Area, samples of ambient air, groundwater, vegetation, and surface soil were collected and analyzed. Direct radiation levels were also monitored at several locations. Samples of ambient air, vegetation, surface soil, and sediment were collected to monitor the environmental impact of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs). Direct radiation surveys were conducted for each LWDF and along the Columbia River shoreline.

At the retired 100 Areas, vegetation and surface soil samples were collected and analyzed. In addition, samples from groundwater monitoring wells located at 100-K Area were collected and analyzed. The results are provided in this report.

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EXECUTIVE SUMMARY

Near-field environmental surveillance of the Hanford 100 Areas is performed by Westinghouse Hanford Company (Westinghouse Hanford) to assess and control the impacts of operations. This involves sampling and analysis from the major environmental pathways of exposure to onsite workers.

Results from the Westinghouse Hanford Environmental Surveillance Program for the Hanford 100 Areas are presented in this report. The environmental surveillance program provides sampling and monitoring of several parameters to evaluate the environmental impact of 100-N Area Reactor Facilities and the shutdown reactor facilities and burial grounds in the retired 100 Areas. Discharges to the environment are reported in annual effluent release reports.

At 100-N Area, samples of ambient air, groundwater, vegetation, and surface soil were collected and analyzed. Direct radiation levels were also monitored at several locations. Samples of ambient air, vegetation, surface soil, and sediment were collected to monitor the environmental impact of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs). Direct radiation surveys were conducted for each LWDF and along the Columbia River shoreline.

At the retired 100 Areas, vegetation and surface soil samples were collected and analyzed. In addition, samples from groundwater monitoring wells located at 100-K Area were collected and analyzed. The results provided in this report are summarized by the following highlights.

REGULATORY CONTROLS

The Radiation dose to workers and the offsite population is regulated by a tiered system of controls. The U.S. Department of Energy (DOE) has established the occupational dose limit at 5,000 mrem/yr. The effective dose equivalent limits for any member of the public were set by the DOE at 500 mrem/yr for occasional annual exposures and at 100 mrem/yr for continuous exposures. An administrative action level of 25 mrem/yr (to the maximum individual member of the public) has been identified by the DOE to ensure that these dose limits are not exceeded.

Derived concentration guidelines (DCGs) corresponding to the 100 mrem/yr effective dose equivalent standard are used for comparison purposes only in this report. It should be noted that the DCGs are applicable at the point of actual exposure to members of the public and are, therefore, not applicable onsite.

GENERAL

The N Reactor was placed in a "standdown" mode on January 7, 1987, and did not operate during calendar year 1988.

AMBIENT AIR MONITORING

Environmental samples of ambient air collected near 100-N Area indicated that the concentrations of airborne radionuclides were less than the DCG and that there was no significant release to the environment. The only radionuclide detectable during 1988 was ^{60}Co.

GROUNDWATER

Radionuclide concentrations in the groundwater exceeded the DCG for ^{90}Sr in monitoring sites near the 1301-N and 1325-N LWDFs during the reporting period. Concentrations of ^{90}Sr also exceeded the DCG at the N Springs. Groundwater tritium concentrations generally stabilized, compared to 1987 in the 100-N and 100-K Areas, and did not exceed the DCG at any time during the reporting period. Iodine-131 concentrations decreased to below detection limits in all 100-N and 100-K monitoring wells in 1988.

SOIL AND VEGETATION

Environmental samples of surface soil and vegetation collected at 100-N Area indicated near-background levels of radionuclides in the immediate environment. Trend analysis revealed generally stable radionuclide concentrations in soil and vegetation samples since 1980. Five additional, downstream vegetation sampling locations were added along the N Springs shoreline in 1988. Generally, these samples contained above-background levels of ^{90}Sr. Residual concentrations of radionuclides released to the 1301-N LWDF were detected in the surface soil and vegetation adjacent to the facility. Since September 1985, the 1301-N LWDF has not received 100-N Reactor liquid effluent. Facility closure plans are being evaluated that will include biotransport and intrusion barriers.

Environmental samples of surface soil and vegetation collected near the retired 100 Area reactor facilities indicated no significant release or biotransport of radionuclides to the immediate environment. Trend analysis, again, revealed generally stable radionuclide concentration in soil and vegetation samples since 1981.

EXTERNAL RADIATION

External radiation levels were highest in radiologically controlled areas near the 1301-N and 1325-N LWDFs. Dose rates at thermoluminescent dosimeter (TLD) locations near the 1301-NLWDF were generally lower than the levels observed in 1986 and 1987. Activities conducted in support of the "laying-up" of N Reactor created a slightly increasing trend in dose rates at TLD locations near the 1304-N Emergency Dump Tank. A short-term increase of activity associated with rail car shipments of irradiated fuel to PUREX during July through September led to a slight increase in environmental dose rates at the nearby TLD locations.

RADIOLOGICAL SURVEYS

Direct radiation levels measured near the 1301-N LWDF and along the Columbia River shoreline were again higher than in years prior to 1986. The 1301-N LWDF is no longer receiving liquid effluent from N Reactor. The absence of shielding (water) resulted in the increased direct radiation levels.

Direct radiation levels measured near the 1325-N LWDF were significantly higher than in previous annual surveys. The 1325-N LWDF began receiving liquid effluent in September 1985. The increased radionuclide inventory in the facility, along with lower water levels during the low-flow conditions of the 1987 standdown of N Reactor, resulted in the increased direct radiation levels.

LIQUID WASTE DISPOSAL FACILITIES

Sediment samples collected from the 1325-N LWDF crib contained activation and fission products discharged from N Reactor. Discharges to the 1301-N LWDF were discontinued in September 1985; therefore, 1301-N sediment samples were not collected. Residual radionuclide levels will decline as the radionuclides decay.

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1.0 INTRODUCTION

1.1 BACKGROUND

Westinghouse Hanford Company (Westinghouse Hanford), as a prime contractor to the U.S. Department of Energy (DOE) at the Hanford Site, manages the operation of the N Reactor and the storage of spent fuel at 100-K Area and maintains the retired reactor facilities at 100-B/C, -D/DR, -F, -KE/KW, and -H Areas.

The Hanford Site is located within the Pasco Basin in south-central Washington State, approximately 170 mi southeast of Seattle and 125 mi southwest of Spokane. The 100 Areas are located in the north-central part of the Hanford Site, along the southern (right) bank of the Columbia River (see Figure 1-1).

1.2 SCOPE OF THE ENVIRONMENTAL SURVEILLANCE PROGRAM

The Westinghouse Hanford Environmental Surveillance Program for the 100 Areas provides monitoring of specific environmental media. The information is used to assist in evaluating the environmental impact of 100-N Area reactor facilities and the shutdown reactor facilities in the retired 100 Areas (see "Site Characteristics"). The major objectives of the monitoring program are as follows:

- Detect radionuclides in identified radiological release pathways
- Detect and evaluate changes in radionuclide concentrations discharged or existing in the immediate environment
- Maintain a data base for trend analyses
- Provide data for after-the-fact release analyses
- Demonstrate compliance with applicable regulations.

This document is used by Westinghouse Hanford to evaluate facility operation and management practices. The report does not include estimates of radiation doses to the public resulting from the operation of 100 Area facilities. Reports of population dose commitments and other environmental information for the Hanford Site are prepared and issued by Battelle's Pacific Northwest Laboratory (PNL). Westinghouse Hanford provides radionuclide release information to PNL for the preparation of such documents.

1.3 REGULATORY BASIS

Radiation standards and regulations for protection of the worker and the environment are contained in DOE Order 5480.1B, "Environment, Safety, and Health Programs for DOE Operations" (DOE 1986a). In 1985, DOE issued a memorandum (DOE 1985) that revised the radiation protection standards for protection of the public in the vicinity of DOE facilities. This memorandum became effective on July 1, 1985, and incorporated the radiation dose calculation methodology recommended

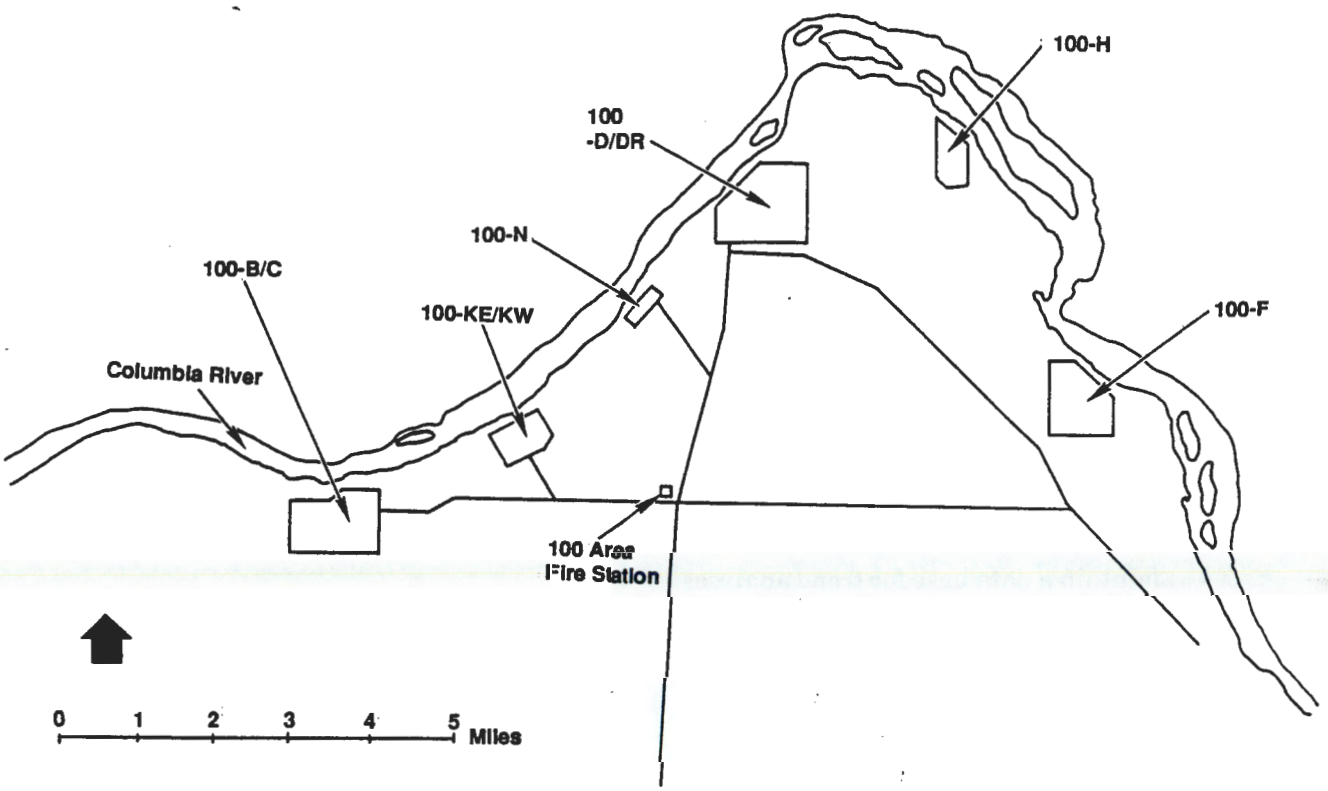

Figure 1-1. Map of the 100 Areas.

by the International Commission on Radiological Protection (ICRP) in Publications 26 and 30 (ICRP 1977, 1979). The memorandum established the maximum allowable radiation dose to the public at 500 mrem/yr for occasional annual doses and at 100 mrem/yr for doses expected to last longer than 5 yr. The radiation dose from airborne effluents is limited to 25 mrem/yr whole body dose equivalent and 75 mrem/yr to any organ.

Derived concentration guides (DCGs) corresponding to the 100-mrem/yr effective dose equivalent standard are used as comparisons in this report. It should be noted that the DCGs are applicable at the point of actual exposure to members of the public and are, therefore, not directly applicable onsite. In keeping with Westinghouse Hanford's philosophy to keep doses to workers as low as reasonably achievable (ALARA), the DCGs are compared to onsite data.

1.4 FACILITY DESCRIPTIONS

1.4.1 100-N Area Facilities

1. 105-N Reactor--The N Reactor is a graphite-moderated, pressurized light-water cooled reactor that uses slightly enriched uranium fuel in the production of special nuclear materials (SNM) and byproduct steam for use by the Washington Public Power Supply System (Supply System) in the generation of electric power. N Reactor has been placed in a "standdown" mode since January 7, 1987.

2. Liquid Waste Disposal Facilities--Two liquid waste disposal facilities (LWDF), 1301-N and 1325-N, have been used to receive and treat N Reactor liquid wastes containing low-level fission and activation products. The 1301-N LWDF was permanently retired from service in September 1985. The 1325-N LWDF is now the only LWDF receiving radioactive liquid waste discharges.

   The LWDF, also referred to as crib and trench, allows influent to percolate downward into an engineered soil column, where a high percentage of radionuclides contained in the influent is removed by adsorption, filtration, and ion exchange.

3. 1314-N Liquid Waste Loadout Facility--The 1314-N Facility receives the radioactive liquid waste from the 1310-N Facility and the 107-N Facility and transfers it into a railway tank car which carries the liquid to the 200 West Area Tank Farms for processing and disposal (see WHC-EP-0145, Section 1.4.2).

4. 1310-N Radioactive Chemical Waste Storage Facility--The 1310-N Facility is used to temporarily store radioactive waste solution used in the internal decontamination of the N Reactor. After cooling and neutralization, the solution is subsequently transferred through underground piping to the 1314-N Liquid Waste Loadout Facility.

5. 107-N Fuel Storage Basin Recirculation Facility--The 107-N Facility provides for N Reactor's irradiated fuel storage basin water recirculation and necessary filtration and demineralization to reduce radioactive effluent discharges to the 1325-N LWDF. Ion exchange system regeneration effluent and sand filter backwash water are transferred through underground piping to the 1314-N Liquid Waste Loadout Facility.

6. 1304-N Emergency Dump Tank--The 1304-N Emergency Dump Tank (EDT) is a 1,300,000 gal-capacity steel-walled vessel. In the extremely unlikely event that the thermally hot, pressurized reactor primary coolant system must be rapidly dumped, this tank would provide the necessary quenching to prevent the coolant from flashing to steam. A constant volume of 680,000 gal of unheated water is maintained in the tank. Because of small leakage in the primary coolant system dump valves, the quench water normally contains a small inventory of radioactive materials.

7. 166-N Fuel Oil Storage Facility--The 166-N facility is an above-ground 1,135,000 gal-capacity storage tank. The tank is surrounded by an earthen berm capable of retaining approximately 2,300,000 gal. The fuel oil transfer piping is protected against corrosion. Fuel oil is used at the 100-N Area for the boiler system.

8. 1715-N Diesel Oil Storage Facility--The 1715-N facility consists of four above-ground 105,000 gal-capacity storage tanks. The tanks are located within an earthen berm capable of retaining approximately 730,000 gal. All underground diesel oil transfer piping is protected against corrosion. Diesel oil is used at the 100-N Area to ignite the boiler systems and to fuel the diesel-driven, emergency cooling system pumps.

1.4.2 Retired 100 Area Facilities

1. 105-K East and West Fuel Storage Basins--These fuel storage basins, located in the retired 100 Areas, are 2 mi upstream of N Reactor. Irradiated N Reactor fuel elements are stored in these basins awaiting transfer to the Plutonium Uranium Extraction (PUREX) Plant, located in the 200 East Area. (See WHC-EP-0145, Section 1.4.1.)

2. 100-B, -C, -D, -DR, -F, -H, -KE, and -KW Retired Reactor Sites--These eight retired reactors are located along the Columbia River in the northern-most portion of the Hanford Site (see Figure 1-1). Several permanently deactivated liquid and solid waste disposal sites and burial grounds are associated with each facility. Characterization of the remaining radioactivity in these facilities was completed and was reported in 1978 (UNI-946, "Radiological Characterization of the Retired 100 Areas").

1.5 100 AREAS ENVIRONMENTAL SURVEILLANCE PROGRAM

1.5.1 100-N Area

Environmental surveillance at 100-N Area is conducted primarily to monitor and document radionuclides detected in environmental media located near the 100-N Area facilities. The sampling program is designed to monitor the major radiological release pathways of N Reactor. The major release pathways of N Reactor are identified in Figure 1-2.

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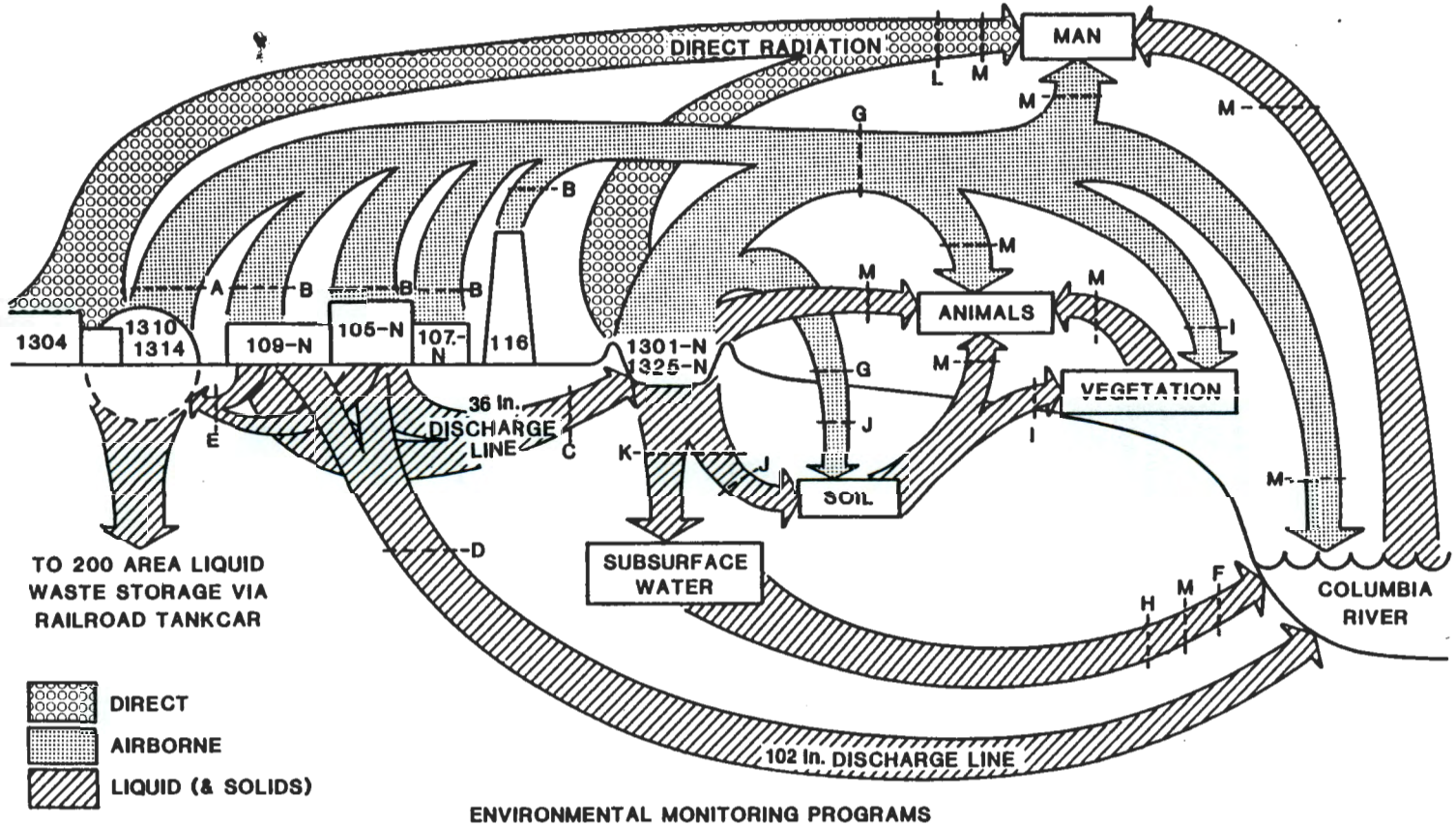


ENVIRONMENTAL MONITORING PROGRAMS

EFFLUENT RELEASE PROGRAM

- A Air sampler on tank vents.
- B Continuous air samplers
- C Flow proportional liquid sampler
- D Continuous large volume liquid sampler
- E Liquid samples during storage and shipment
- F Continuous Composite liquid sampler

ENVIRONMENTAL SURVEILLANCE PROGRAM

- G Continuous air samples
- H Ground water samples
- I Vegetation samples
- J Soil samples
- K Sediment samples
- L Direct radiation measurements
- M PNL Environmental Program

Figure 1-2. Major Radiological Release Pathways Related to 100-N Area Facilities.

As a result of release pathway analyses, two basic monitoring programs have been implemented at 100-N Area. Routine effluent releases are monitored and reported separately as a part of the Effluent Release Program. Environmental media associated with N Reactor release pathways are monitored as part of the Environmental Surveillance Program. These two programs, along with portions of the PNL Environmental Surveillance Program, ensure that all environmental release pathways are monitored at one or more points.

The Environmental Surveillance sampling for 100-N Area is summarized in Table 1-1. Sampling methods, frequencies, and analyses are based on characteristics of the environmental parameter being sampled.

Table 1-1. Summary of the Westinghouse Hanford Company Environmental Surveillance Program for the 100-N Area.

Sample	Sampling method	Number of sample locations	Frequency	Analyses
Air	Low-volume continuous sampler with particle filter and charcoal bed	4	Every 4 wk	Gamma-emitting radionuclides
Groundwater	Well samples (4-L) provided by PNL	32	Quarterly	Gamma-emitting radionuclides, strontium, and tritium
Groundwater	Well sample (1-qt)	11	Dependent on well	Oil and grease
Surface soil	Composite sample of about 150 g dry weight	12	Annually	Gamma-emitting radionuclides, strontium, and plutonium
Vegetation	Composite sample of about 500 g dry weight	20	Annually	Gamma-emitting radionuclides, strontium, and plutonium
Direct radiation	TLD-400 Dosimeters (CaF_2:Mn matrix)	41	Every 4 wk	Dose rate and integrated dose
Direct radiation (Columbia River shoreline)	Dose rate using hand-held survey instrument	94	Annually	Dose rate

PST88-3230-1

The sampling program for the 1301-N and 1325-N LWDFs is summarized in Table 1-2. Sampling methods, frequencies, and analyses are based on characteristics of the parameter being sampled.

1.5.2 Retired 100 Areas

Environmental surveillance in the retired 100 Areas is conducted to monitor radionuclides detected in environmental media located near the retired reactor facilities and 100 Area burial grounds. The program consists primarily of soil and vegetation sampling in each of the retired areas. Groundwater sampling is also conducted at 100-K Area.

Table 1-2. Summary of the Westinghouse Hanford Company Liquid Waste Disposal Facilities (LWDF) Sampling Program.

Sample	Sampling method	Number of sample locations	Frequency	Analyses
Air	Low-volume continuous sampler with particle filter and charcoal bed	1	Every 4 wk	Gamma-emitting radionuclides
Surface soil	Composite sample of about 150 g dry weight	5	Annually	Gamma-emitting radionuclides, strontium, and plutonium
Vegetation	Composite sample of about 500 g dry weight	5	Annually	Gamma-emitting radionuclides, strontium, and plutonium
1325-N LWDF sediment	Dip samples of bottom sediment	12	Annually	Gamma-emitting radionuclides and strontium
Direct radiation	Dose rates using hand-held survey instrument	80	Annually	Dose rate

NOTE: The monitoring parameters listed in Table 1-2 for the LWDF sampling program will be included in their respective sections, as listed in the contents. The exception to this listing will be the LWDF sediment sampling discussion in Chapter 6.0. PST88-3230-2

The sampling program for the retired 100 Areas is summarized in Table 1-3. Sampling methods, frequencies, and analyses are based on characteristics of the environmental parameter being sampled.

Table 1-3. Summary of the Westinghouse Hanford Company Environmental Surveillance Program for the Retired 100 Areas.

Sample	Sampling method	Number of sample locations	Frequency	Analyses
Surface soil	Composite sample of about 150 g dry weight	20	Annually	Gamma-emitting radionuclides, strontium, and plutonium
Vegetation	Composite sample of about 500 g dry weight	20	Annually	Gamma-emitting radionuclides, strontium, and plutonium
Groundwater	Well samples (4-L) provided by PNL*	4	Quarterly	Gamma-emitting radionuclides and tritium

NOTE: The monitoring parameters listed in Table 1-3 for the retired 100 Areas sampling program will be included in their respective sections, as listed in the Contents.
*Pacific Northwest Laboratory. PST88-3230-3

Surface soil and vegetation samples provide a means of evaluating the distribution of radionuclides from current and past releases to the environment.

The sampling techniques used for the retired 100 Areas samples were identical to those used at 100-N Area. Soil samples consisting of 150 g each were collected from the top 2.5 cm of the soil surface. Vegetation samples of 500 g each were collected from the growing portions of perennial vegetation. Gray rabbitbrush (Chrysothamnus nauseosus) was the predominant species sampled.

Duplicate samples of both media were collected. One of each duplicate sample was analyzed for gamma-emitting radionuclides at the 100-N Westinghouse Hanford radioanalytical laboratory. The remaining duplicate samples were analyzed for strontium and plutonium by the U.S. Testing Company Inc. (UST). Groundwater is routinely sampled from four wells located near the 105-KE Reactor Building. These samples are collected to detect potential leakage from the 105-KE Reactor Fuel Storage Basin.

1.6 SUMMARY OF DECOMMISSIONING ACTIVITIES

The environmental impact of decommissioning the retired 100 Area reactor ancillary facilities is mostly beneficial, since decommissioning will remove or stabilize potentially contaminated structures; however, activities conducted to dismantle and decommission the retired 100 Area facilities may disturb radionuclides contained in or on the structures. These disturbances could potentially release radioactivity to the immediate environment. All facilities are surveyed for radioactive contamination before demolition. Contaminated facilities are fully characterized and decontaminated when necessary to ensure that a future resident would receive less than 25 mrem/yr from buried residual radioactive materials.

The following information provides a brief description of major decommissioning activities completed during the reporting period. Several 100 Area retired facilities underwent various stages of decommissioning. In 1988, decommissioning activities included demolishing the 117-C Filter Building, and demolishing and cleaning up the remaining foundations and concrete slabs at 184-B and -D Powerhouses and the 1717-F Maintenance Shops. Following this work, the sites were backfilled and restored to the natural contour of the surrounding land. Cleanup of the 183-H Solar Basins progressed to removing the accumulated sludge in the bottoms of the basins.

Ground disposal facilities in the 100 Areas were sprayed for weed control between November 1986 and February 1987. About 990 lb of Krovar and 300 lb of Arsenal were applied (the two were not mixed) to the various retired disposal facilities to minimize potential biotransport of residual radionuclides.

2.0 AMBIENT AIR MONITORING

Air sampling provides a means of monitoring radionuclides released to the air from N Reactor facilities. The 100-N Area environmental air sampling stations are shown in Figure 2-1. Tables C-1 through C-5 list the radionuclide concentrations detected in the 100-N Area air samples for the reporting period.

Air samples were collected with continuously operating low-volume sample pumps. Ambient air was drawn through a 1 ft^3/min orifice into a stainless steel sample cartridge containing a 47-mm millipore filter and a bed of activated charcoal to collect halogens. The sample cartridges were changed approximately every 4 wk and analyzed for gamma-emitting radionuclides at the Westinghouse Hanford radioanalytical laboratory located in the 105-N Reactor Building.

In previous years, comparative data of airborne concentrations of ^{131}I were presented in this report to provide simplified trend analysis of this contaminant. However, with the shutdown of N Reactor in January 1987, ^{131}I concentrations in the air have been reduced to below detection limits and continued trend charting of this radionuclide is no longer warranted. Until such time as analysis results dictate otherwise, only ^{60}Co results will be presented in graph form for this report. The airborne concentrations of radionuclides of concern will continue to be reported in tabular form in the Appendix.

Average radionuclide concentrations detected in 100-N Area air samples are listed in Table C-1. All averages calculated from two or more values include the standard deviation to indicate the distribution of the data. Minimum and maximum concentrations are also shown to indicate the sample range. All radionuclide concentrations were well below the DOE DCG.

The DCGs are shown for comparison at the bottom of the table. These concentration guides are applicable at the point of actual exposure to members of the public. The radionuclides identified in the 100-N Area ambient air samples are near or below the level of detection. Average concentrations of ^{60}Co detected in 100-N Area air samples from 1982 to 1988 are presented in Figure 2-2. Ambient air monitoring is conducted for the 1301-N LWDF at a location near the inlet end of the facility (station A1).

Cobalt-60 concentrations near the 1301-N Facility fell below historical average levels and were well below the significantly increased levels detected in 1987. The 1987 spike was attributable to the disturbances to the crib surface and sub-surface during excavation activities which occurred in late 1987. Average concentrations of ^{60}Co detected near the 1301-N Facility from 1982 to 1988 are presented in Figure 2-3.

In July 1988, the boulder surface of the crib portion of the 1301-N LWDF was covered with several feet of clean soil to prevent possible resuspension and animal transport of contaminants. However, since airborne contaminant levels at 100-N for all radionuclides were near or below minimum detection limits prior to this work, no significant decrease in concentration levels was discernable.

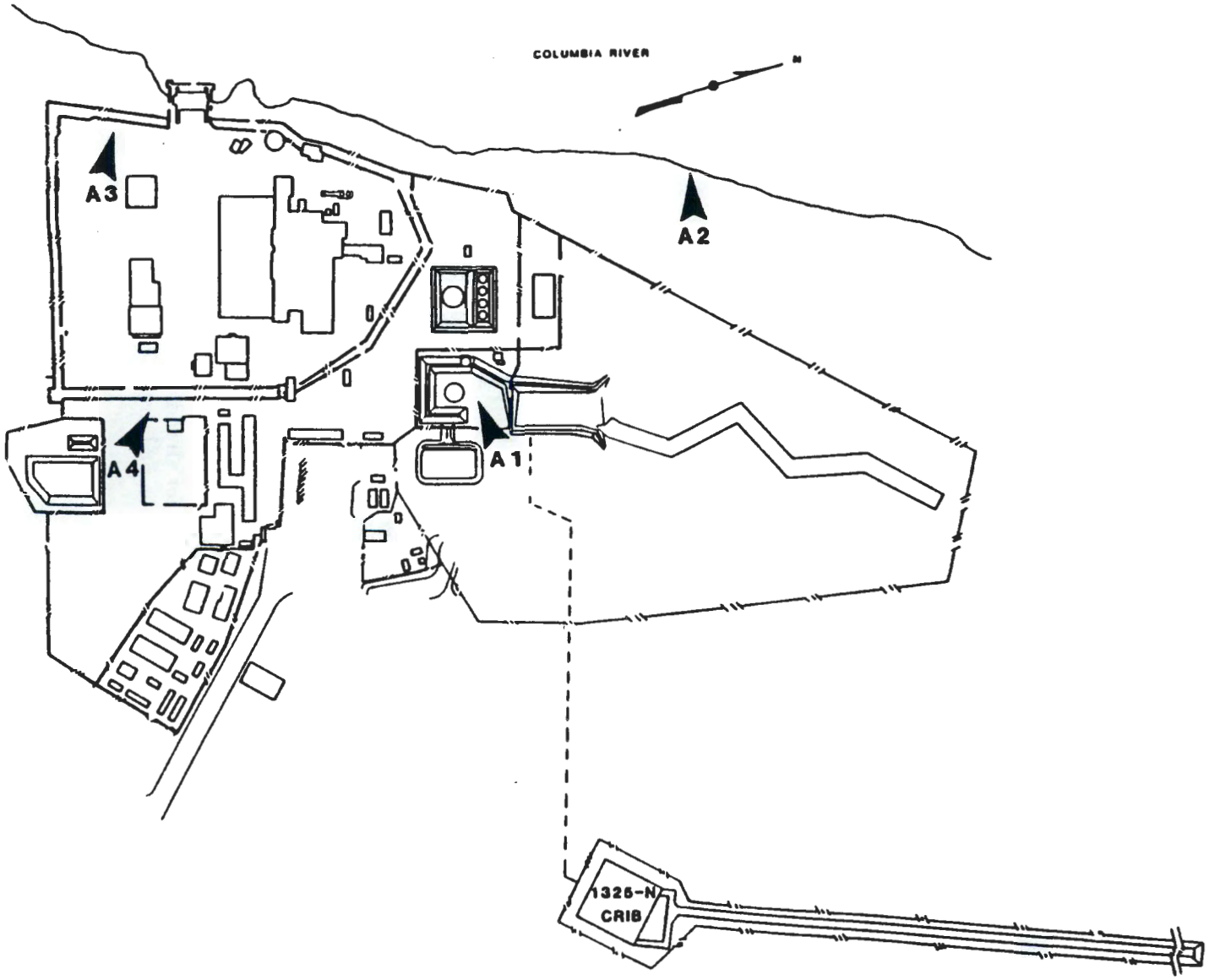


Figure 2-1. Ambient Air Sampling Locations at 100-N Area.

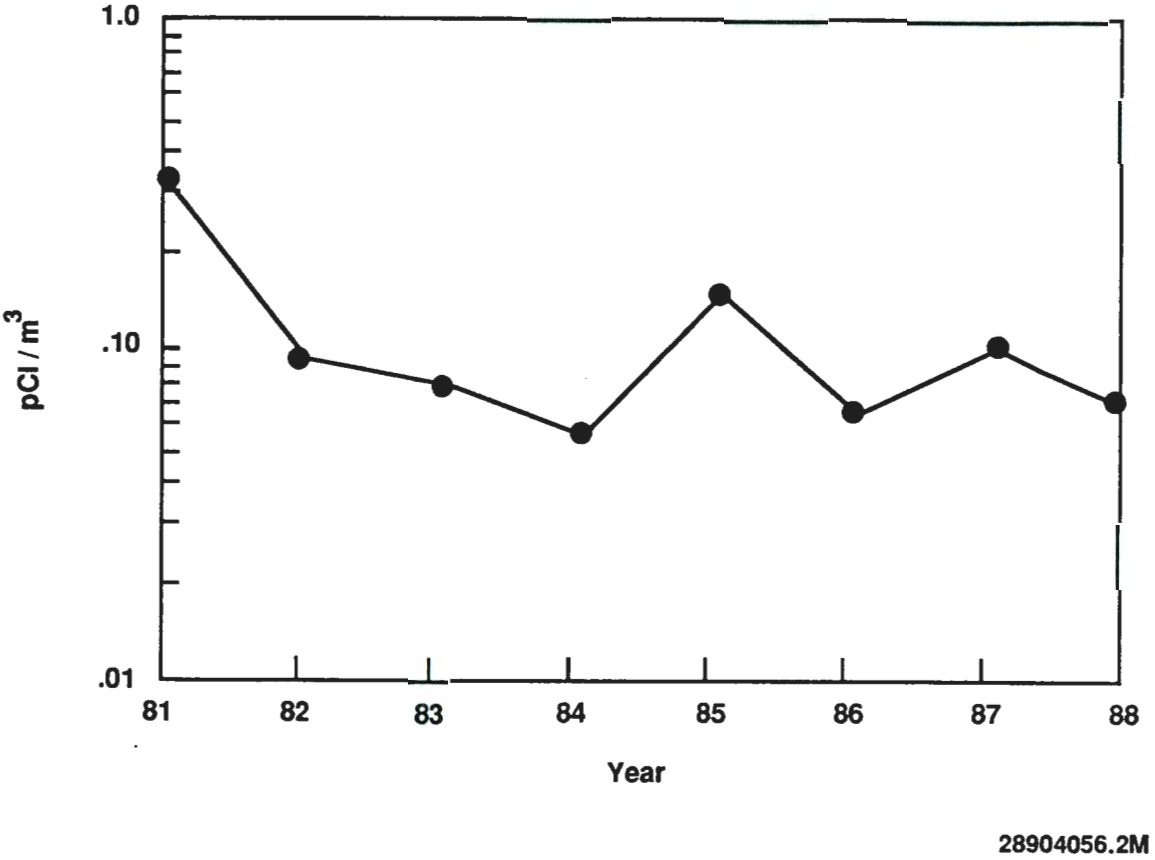
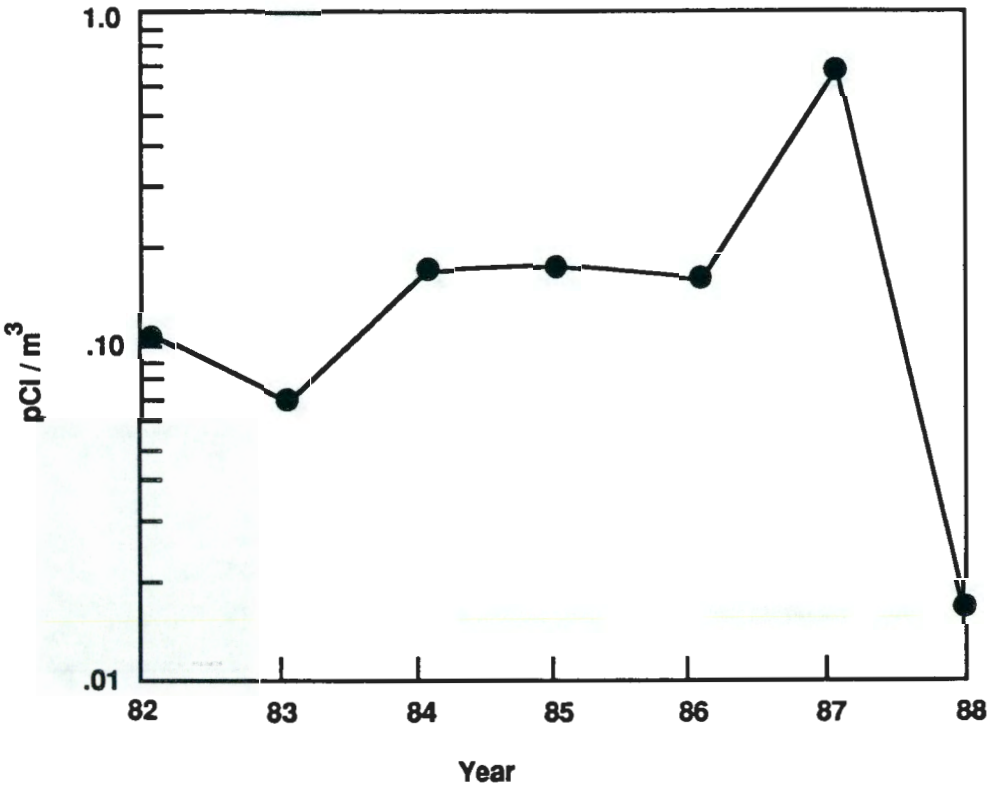


Figure 2-2. Average Concentrations of ^{60}Co Detected in 100-N Area Ambient Air from 1981 to 1988.



28904056.1M

Figure 2-3. Average Concentrations of ^{60}Co Detected in 1301-N Air Samples from 1982 to 1988.

3.0 GROUNDWATER MONITORING

3.1 RADIOLOGICAL GROUNDWATER SAMPLING--100-N AREA

The 100-N Area groundwater sampling is performed to monitor radionuclide concentrations in the groundwater beneath the 1301-N LWDF, the 1325-N LWDF, and other 100-N Area facilities. Groundwater samples are also collected to monitor the integrity of underground piping, basins, and tanks. The locations of the groundwater sampling wells are shown in Figure 3-1. Samples of groundwater (4-L) were collected by PNL and analyzed for gamma-emitting radionuclides at the 100-N, Westinghouse Hanford radioanalytical laboratory. Duplicate samples collected by PNL were analyzed for tritium and $^{89,90}Sr$ by UST. Radionuclide concentrations detected in the quarterly groundwater samples are presented in Tables D-1 through D-8. The samples contain radionuclides attributable to liquid effluents discharged to the 1325-N LWDF (Rokkan 1986). Radionuclides that either do not decay or are not retained in the soil column beneath the LWDFs are ultimately released to the Columbia River via the N Springs shoreline. This discharge is monitored at well N-8T. The entire length (about 2 mi) of the shoreline between 100-N and 100-D/DR Areas also is characterized annually. Detailed discussions of these sampling results are reported in annual effluent release reports and N Springs characterization reports, respectively. The only radionuclide with concentrations above the DCG at the N Springs is ^{90}Sr.

The average concentrations of ^{60}Co, ^{90}Sr, and ^{131}I detected in well N-2 from 1981 to 1988 are presented in Figure 3-2. These radionuclides are useful as indicators of groundwater contamination and migration. Figure 3-3 shows average concentrations of the same radionuclides detected in well N-33 from 1985 through 1988. These two wells were selected for comparison because of their positions relative to the 1301-N and 1325-N LWDFs.

Concentrations of ^{60}Co, ^{90}Sr, and ^{131}I all decreased in well N-2 for the reporting period. This is to be expected since liquid effluent is no longer discharged to the 1301-N LWDF. Rather, the 1325-N LWDF has been receiving this effluent since September 1985. The trend depicted in well N-33 showed a reversal of the increase seen in 1987. These reduced values are attributable to the decreased liquid effluent discharged to the 1325-N LWDF associated with the continued standdown status of N Reactor. Average ^{90}Sr concentrations in well N-33 remained below the DCG in 1988, and ^{131}I concentrations were below analytical detection limits. Cobalt-60 concentrations decreased during the reporting period, with the 1988 average value falling below the historic range of well N-33.

3.2 OIL AND GREASE SAMPLING--100-N AREA

Samples of groundwater (1 qt) were collected on a variable frequency from several oil detection wells. After organoleptic inspection, the samples were sent to the Hanford Environmental Health Foundation (HEHF) and analyzed for oil and grease. These data are used to monitor the integrity of underground oil transfer lines and oil storage tanks at 100-N Area.

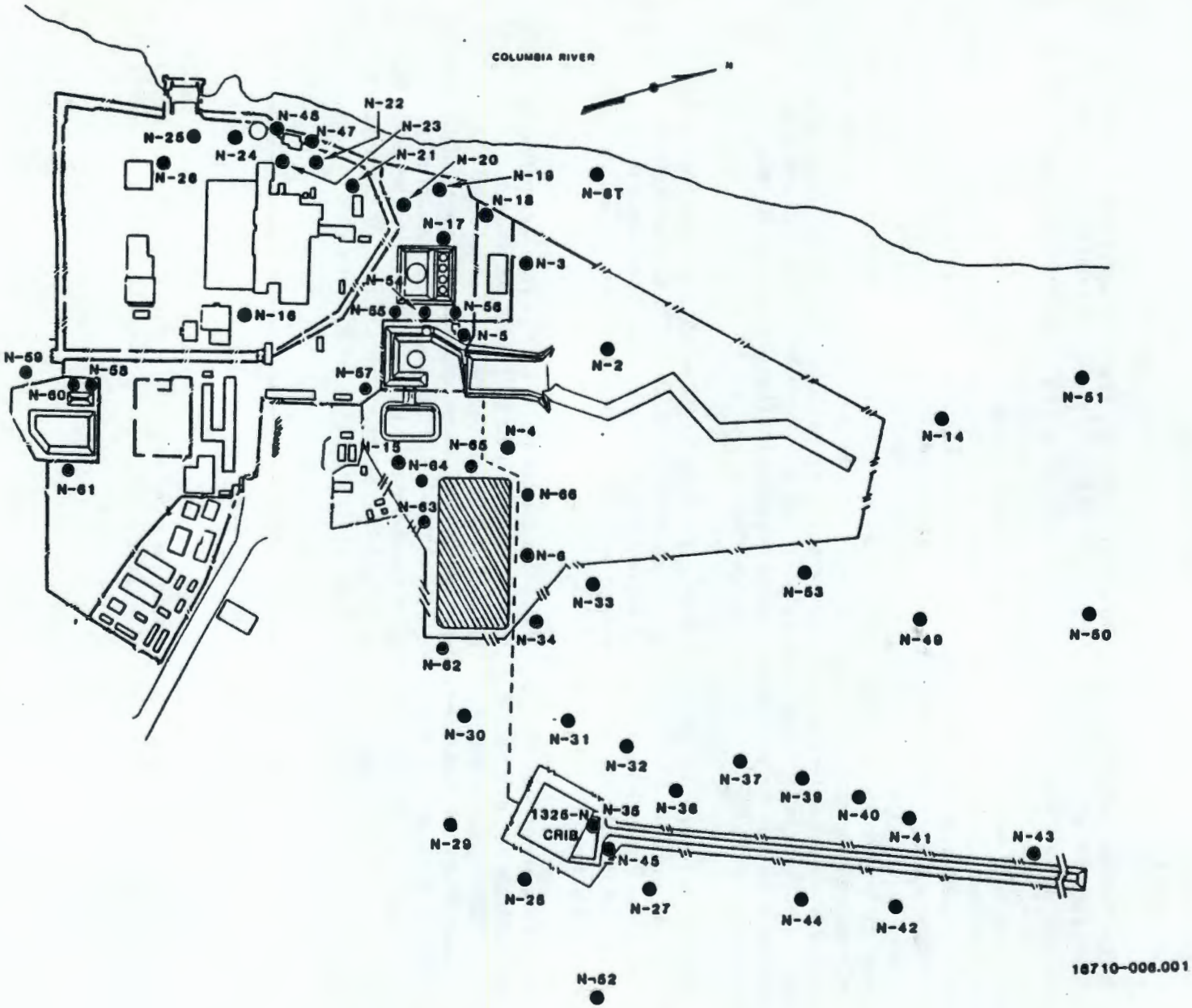
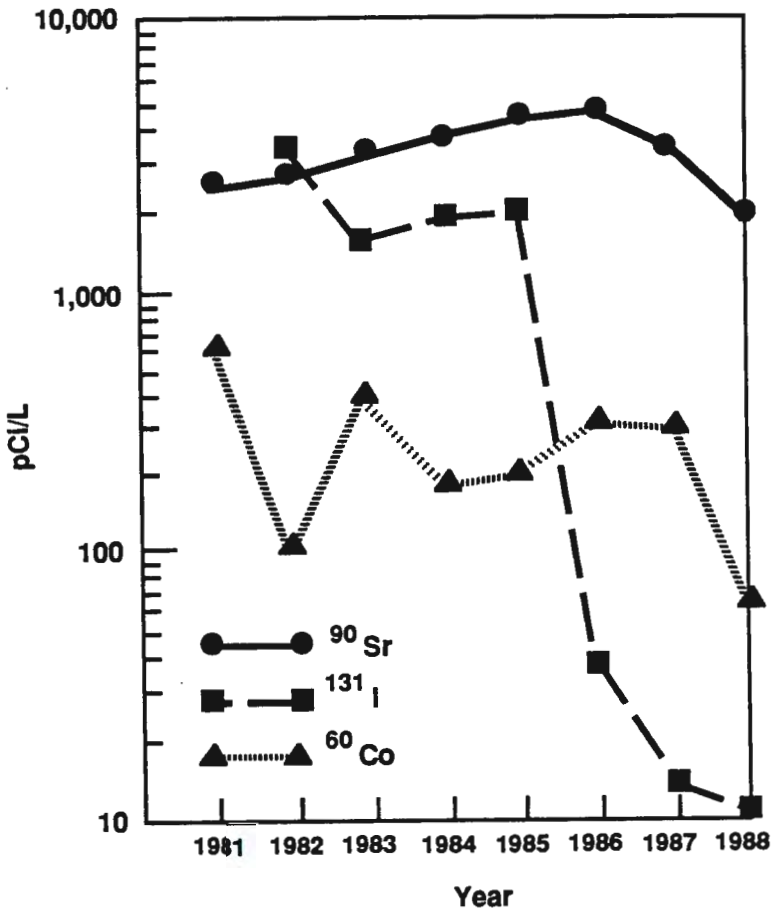
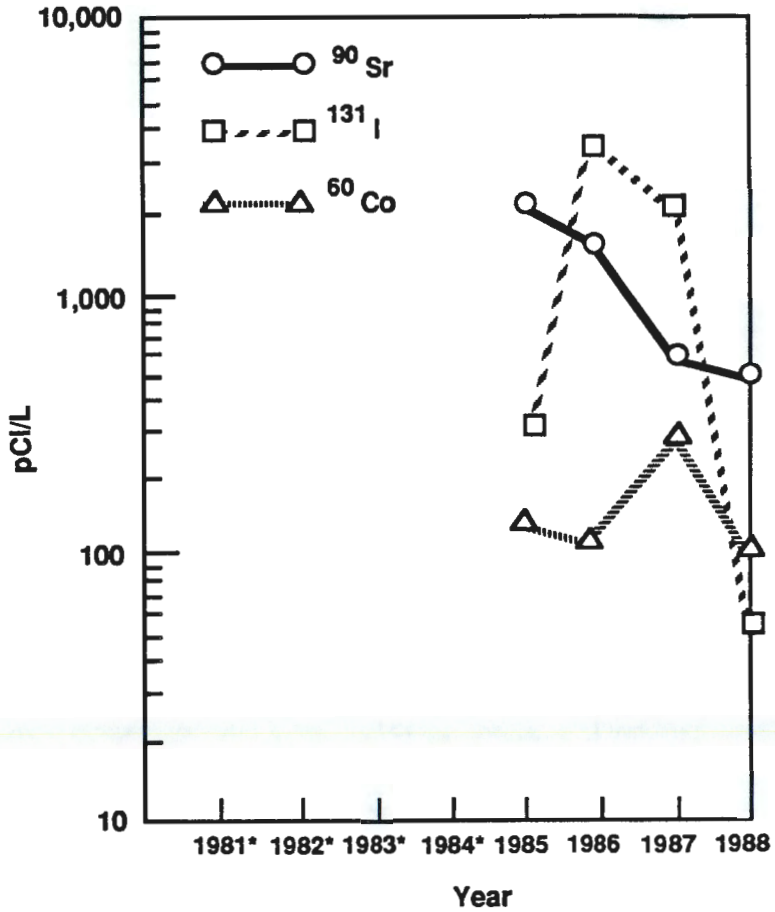


Figure 3-1. Location of Groundwater Wells at 100-N Area.



28904056.4M

Figure 3-2. Average Concentration of ^{60}Co, ^{90}Sr, and ^{131}I Detected in Well N-2 from 1981 to 1988.



* Well N-33 was not in use preceding 1985.

28904056.3M

Figure 3-3. Average Concentration of ^{60}Co, ^{90}Sr, and ^{131}I Detected in Well N-33 from 1985 to 1988.

Average oil and grease concentrations detected in 100-N Area groundwater samples are presented in Table 3-1. The lower limit of detection is 1 mg/L. Most samples contained concentrations of oil and grease less than or near the level of detection. Table D-9 lists the oil and grease concentrations detected in 100-N Area groundwater monitoring wells.

Table 3-1. Oil and Grease Concentrations Detected in 100-N Area Groundwater (mg/L).

Well*	Number of samples	Maximum	Minimum	Average	Standard deviation
N-16	10	13.8	<1.0	2.3	3.8
N-17	12	9.8	<1.0	1.8	2.4
N-18	12	6.6	<1.0	2.1	1.8
N-19	9	1.0	<1.0	1.0	0.0
N-20	9	1.4	<1.0	1.0	0.1
N-21	10	3.5	<1.0	1.3	0.8
N-22	5	<1.0	<1.0	<1.0	0.0
N-23	19	1.7	<1.0	1.0	0.2
N-24	20	1.2	<1.0	1.0	0.0
N-25	29	2.8	<1.0	1.1	0.4
N-26	19	5.6	<1.0	1.3	1.0

*Locations identified in Figure 3-1. PST88-3230-3-1

3.3 RADIOLOGICAL GROUNDWATER SAMPLING--100-K AREA

A leak was detected in the 105-KE Reactor Fuel Storage Basin during the 1970's. The leak was repaired in 1980 and water levels in the basin are now continuously monitored and reveal no detectable leakage. In addition, Westinghouse Hanford samples four groundwater wells located near the 105-KE Reactor Building to provide detection of leakage from the storage basin.

Samples (4-L) were collected and analyzed for gamma-emitting radionuclides at the Westinghouse Hanford radioanalytical laboratory. Duplicate samples collected by PNL were analyzed for tritium by UST. The sampling locations are shown on Figure 3-4. Radionuclide concentrations detected in the 100-K Area groundwater samples are presented in Tables D-1 through D-8. The concentrations of ^{125}Sb detected in samples from wells K-27 and K-28 indicate residual contamination from past leaks of basin storage water.

Average radionuclide concentrations detected in well K-27 from 1982 through 1988 are presented in Table D-10. The data indicate that concentrations of ^{125}Sb (2.7-yr half-life) in well K-27 have stabilized.

Tritium concentrations detected in well K-30 have exceeded those of any other 100 Area groundwater monitoring well since 1982. The range of tritium concentrations at this well is large for this period, with the 1988 results showing a slight increase. The 1988 concentration average was 50% of the DCG for tritium (2.0 E+06 pCi/L).

The most probable source of tritium in well K-30 is from the nearby 115-KE crib (see Figure 3-4) which received significant amounts of tritium from the dryer room condensate in the 100-KE Reactor (operated from 1955 to 1971). Well K-30 is located about 200 ft down gradient from the 115-KE crib. Table 3-2 lists average tritium concentrations in each of these 100-K Area wells from 1982 through 1988.

Table 3-2. Tritium Concentrations Detected in 100-KE Area Groundwater (pCi/L) from 1982 through 1988.

Year	Well*			
	K-27	K-28	K-29	K-30
1982	4.5 E+03	3.4 E+03	8.5 E+03	8.8 E+05
1983	3.1 E+03	2.1 E+03	2.0 E+04	6.8 E+05
1984	3.0 E+03	2.5 E+03	4.9 E+04	4.3 E+05
1985	1.8 E+03	3.6 E+03	4.9 E+04	4.2 E+05
1986	1.5 E+03	3.1 E+03	3.7 E+04	6.4 E+05
1987	1.5 E+03	4.2 E+03	9.9 E+03	8.3 E+05
1988	2.3 E+03	3.2 E+03	1.4 E+04	1.2 E+06

NOTE: DCG = 2.0 E+06 pCi/L.
*Locations identified in Figure 3-4. PST88-3230-3-2

3.4 RESOURCE CONSERVATION AND RECOVERY ACT GROUNDWATER MONITORING--100-N AREA

The Resource Conservation and Recovery Act (RCRA) groundwater monitoring program is administered in the 100 Areas by PNL. The results of this monitoring program are published quarterly.

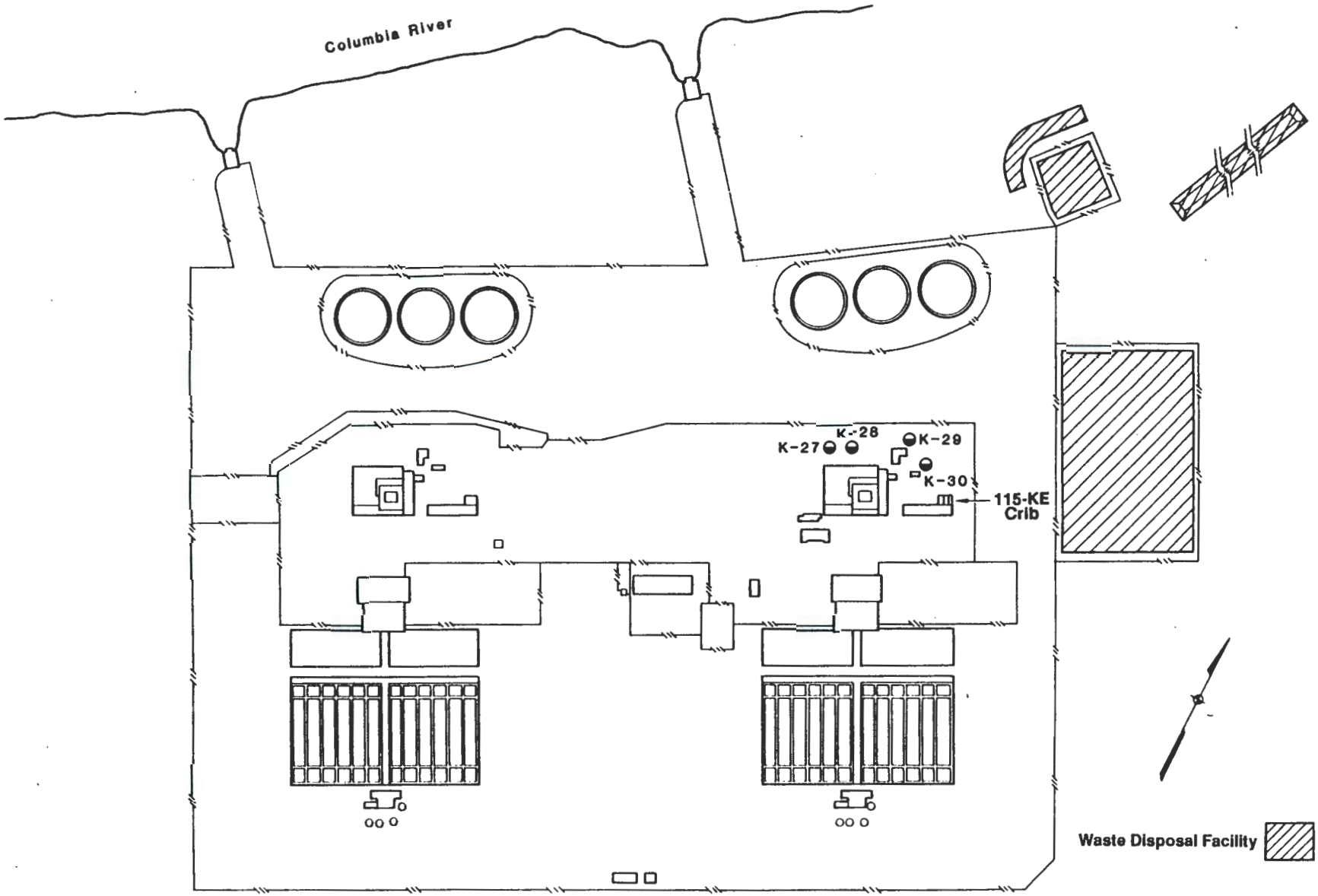


Figure 3-4. Location of Groundwater Wells at 100-K Area.

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4.0 SOIL AND VEGETATION MONITORING

4.1 SOIL SAMPLING

Surface soil samples provide a means of evaluating the environmental distribution of radionuclides from releases to the air or liquid releases to the soil.

Surface soil was sampled at each of the locations shown in Figure 4-1. Duplicate samples of about 150 g each were collected from the top 2.5 cm of the soil surface. A duplicate of each sample was sent to UST for strontium and plutonium analysis. The remaining sample was analyzed for gamma-emitting radionuclides at the 100-N, Westinghouse Hanford radioanalytical laboratory.

Construction of various new facilities at 100-N Area during calendar year 1987 caused two soil and vegetation sampling locations to be either inaccessible or permanently destroyed. Alternate locations were reestablished in 1988.

4.1.1 100-N Area

Five of the surface soil samples (N1 through N5) were collected at locations near the 1301-N LWDF. Radionuclides contained in the LWDF effluent were detected in the samples. As the data indicate, the concentrations show a large degree of variance depending on sample location. In general, the samples collected nearer the 1301-N crib portion of the facility contained relatively higher concentrations of the contaminants. Average radionuclide concentrations detected in 100-N Area surface soil from 1980 through 1988 in locations near the 1301-N LWDF (sites N1 through N5) are presented in Table 4-1. Average radionuclide concentrations detected in 100-N Area surface soil from 1980 through 1988 in locations N6 through N12 are presented in Table 4-2.

Radionuclide concentrations detected in 100-N Area surface soil are presented in Tables E-1 and E-2. Average radionuclide concentrations for the Hanford Site and offsite, as reported by PNL for 1987, are included for comparison. The 100-N values are comparable to Hanford Site averages.

4.1.2 Retired 100 Areas

Environmental surveillance in the retired 100 Areas is conducted to monitor radionuclides detected in environmental media located near the retired reactor sites and waste disposal facilities. The program consists primarily of soil and vegetation sampling in each of the retired areas. Sample locations were chosen immediately adjacent to retired waste disposal facilities in a manner to maximize the potential for detecting contamination. Environmental samples of surface soil collected near the retired 100 Area reactor facilities indicated no elevated levels of radionuclides when compared to the Hanford Site average concentrations. Surface soil and vegetation sampling locations for the retired 100 Areas are presented in Figures 4-2 through 4-6.

Average radionuclide concentrations detected in surface soil samples for each of the retired 100 Areas from 1980 through 1988 are presented in Tables 4-3 through 4-7. The results of the 1988 surface soil analyses for each sample location in the retired 100 Areas are presented in Tables E-3 through E-7.

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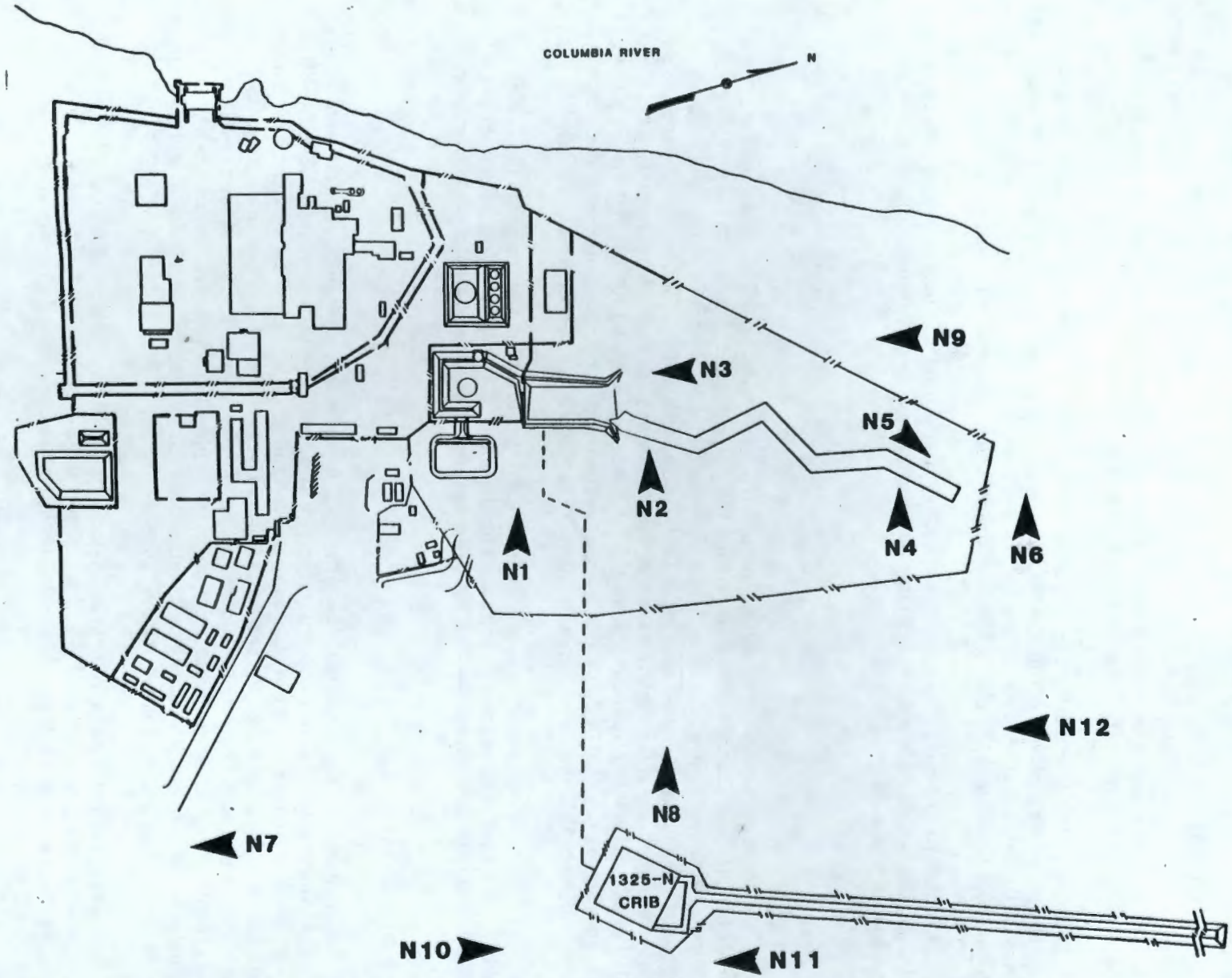

Figure 4-1. Surface Soil Sampling Locations at 100-N Area.

Table 4-1. Average Radionuclide Concentrations (pCi/g) Detected in Soil Samples Near the 1301-N Liquid Waste Disposal Facility from 1980 through 1988.

Year	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	2.5 E+00	1.3 E+01	3.5 E-01	4.1 E+00	NR	2.5 E-02
1981	6.6 E+00	4.0 E+00	7.0 E-01	6.1 E+00	NR	4.4 E-02
1982	6.6 E-01	6.3 E+00	2.7 E-01	2.7 E+00	NR	1.8 E-02
1983	4.1 E-01	5.4 E+00	1.3 E+00	3.8 E+00	NR	4.3 E-02
1984	1.8 E-01	2.8 E+00	2.1 E-01	1.1 E+00	NR	1.7 E-02
1985	1.5 E+00	1.3 E+01	6.5 E-01	3.9 E+00	NR	3.2 E-02
1986	1.6 E-01	4.5 E+00	2.2 E-01	2.5 E+00	NR	1.7 E-02
1987	3.2 E-01	5.1 E+00	3.4 E-01	1.6 E+00	5.4 E-03	2.2 E-02
1988	1.4 E-01	7.8 E+00	3.5 E-01	2.0 E+00	2.3 E-03	1.7 E-02

NR = Not reported. PST88-3230-4

NOTE: Table E-1 lists the results of the 1988 analysis of 1301-N LWDF surface soil samples.

Table 4-2. Average Radionuclide Concentrations (pCi/g) Detected in 100-N Area Surface Soil Samples from 1980 through 1988.

Year	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	2.4 E-01	8.5 E-01	1.8 E-01	5.0 E-01	NR	1.8 E-02
1981	1.6 E-01	1.3 E+00	2.1 E-01	1.0 E+00	NR	1.1 E-02
1982	1.3 E-01	1.6 E+00	9.9 E-02	3.4 E-01	NR	5.0 E-03
1983	2.1 E-01	2.7 E+00	2.9 E-01	4.4 E-01	NR	8.5 E-03
1984	NR	8.8 E-01	2.8 E-01	6.2 E-01	NR	1.4 E-02
1985	1.2 E-01	1.2 E+00	1.3 E-01	5.2 E-01	NR	1.3 E-02
1986	1.1 E-01	4.1 E-01	8.3 E-02	5.0 E-01	NR	8.2 E-03
1987	9.1 E-02	4.1 E-01	1.1 E-01	3.9 E-01	1.1 E-03	6.7 E-03
1988	6.7 E-02	3.4 E-01	1.6 E-01	3.9 E-01	4.5 E-04	9.5 E-03

NR = Not reported. PST88-3230-5

NOTE: Table E-1 lists the results of the 1988 analysis of 1301-N LWDF surface soil samples.

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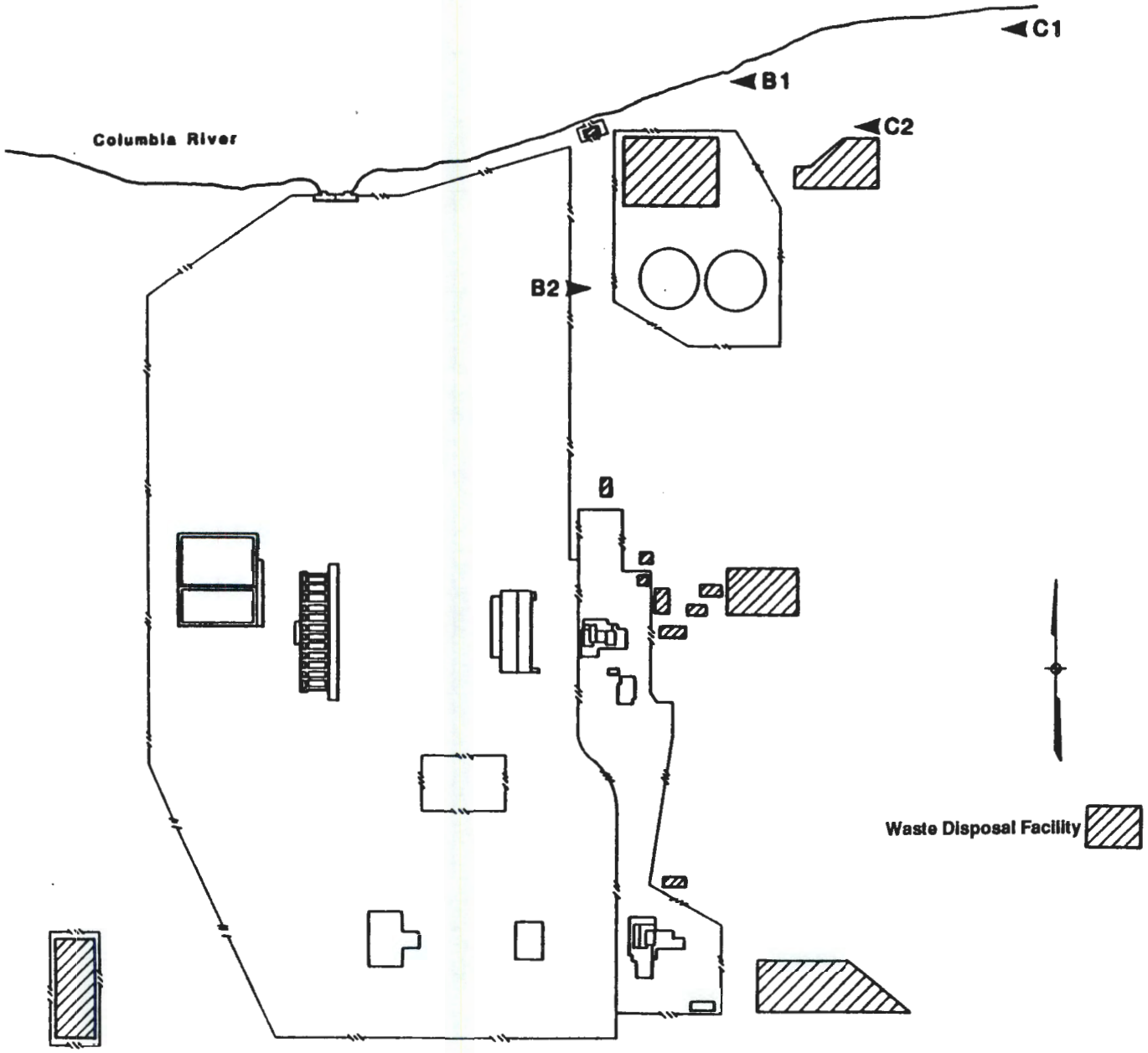

Figure 4-2. Soil and Vegetation Sampling Locations at 100-B/C Area.

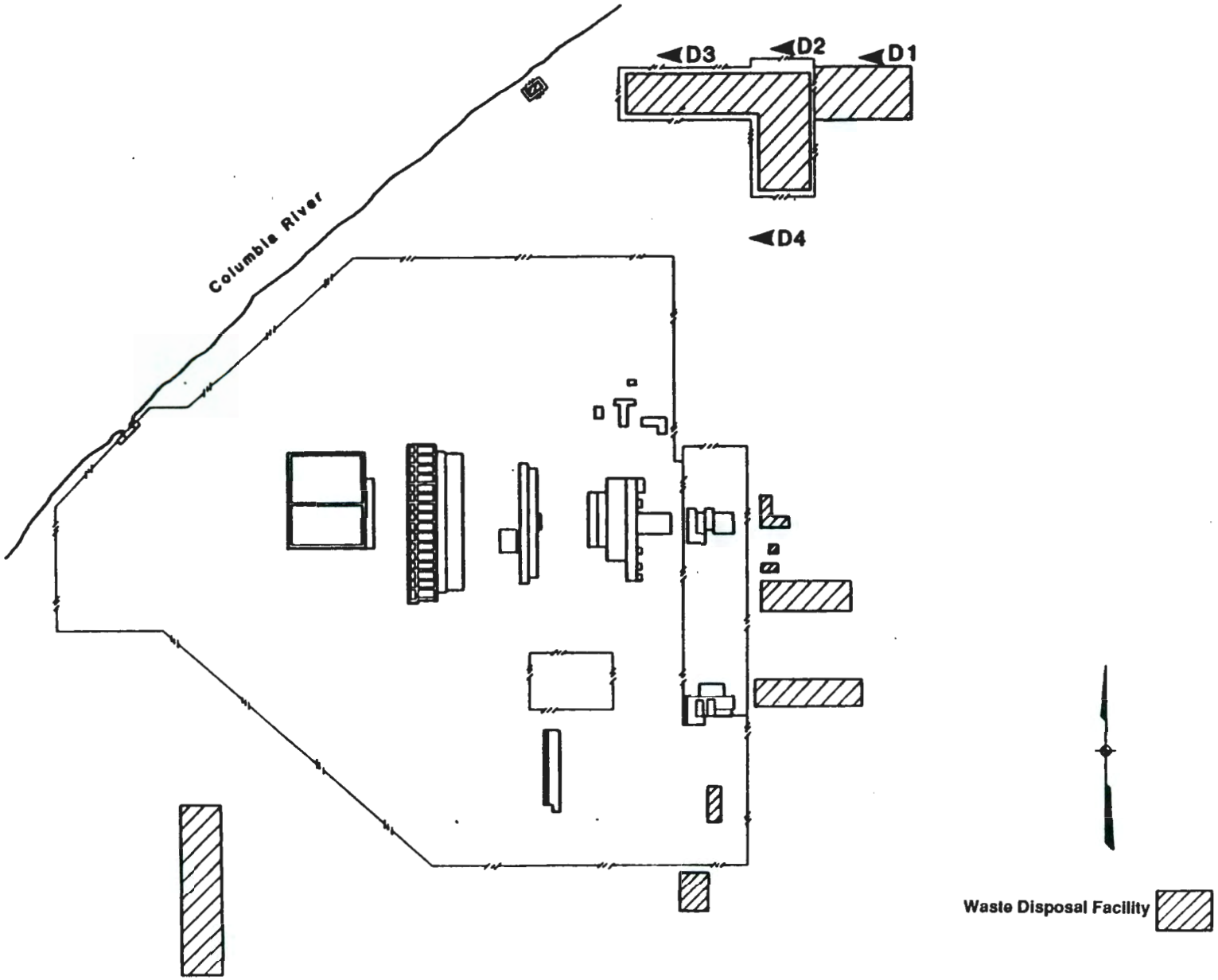

Figure 4-3. Soil and Vegetation Sampling Locations at 100-D/DR Area.

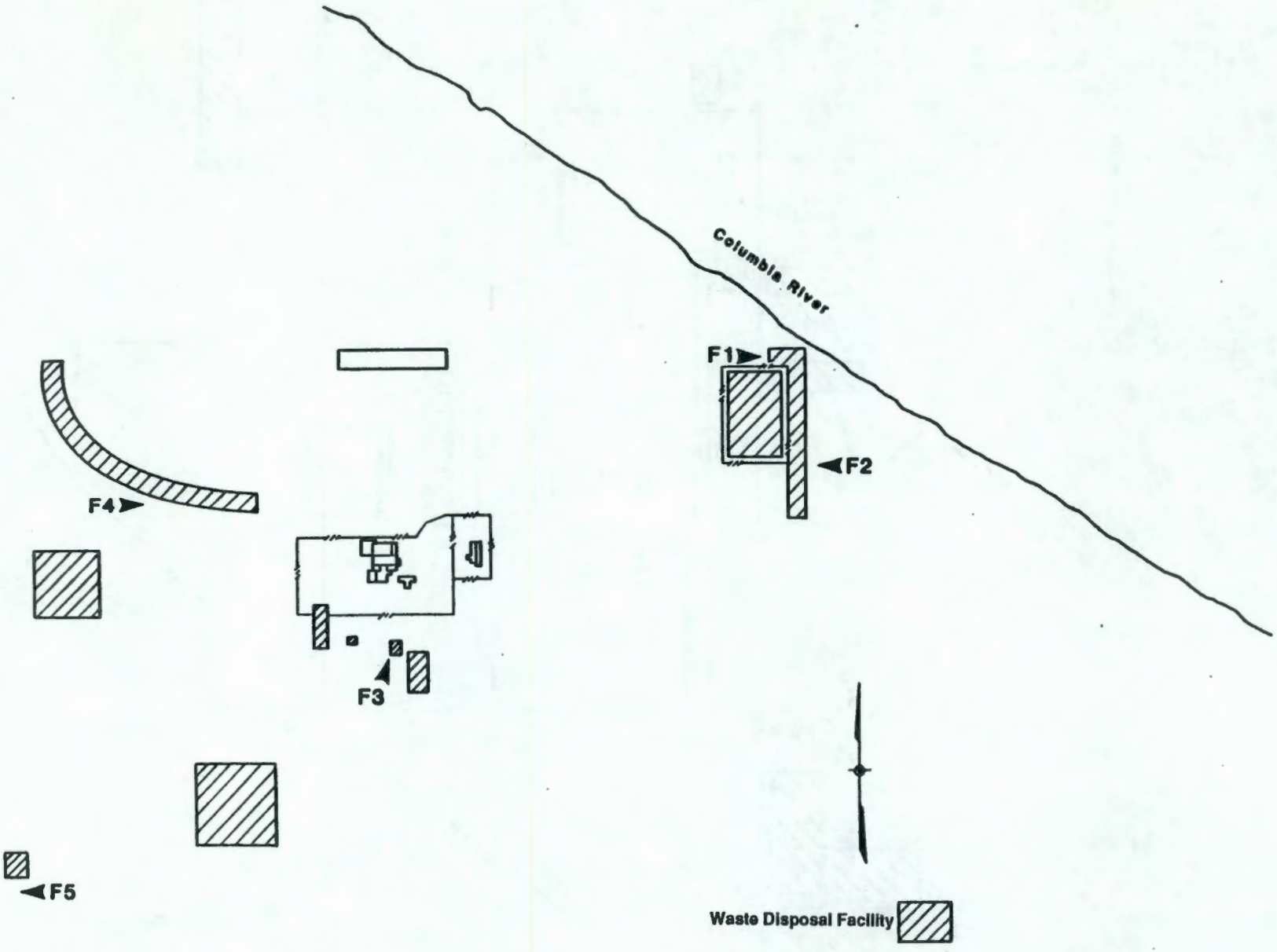

Figure 4-4. Soil and Vegetation Sampling Locations at 100-F Area.

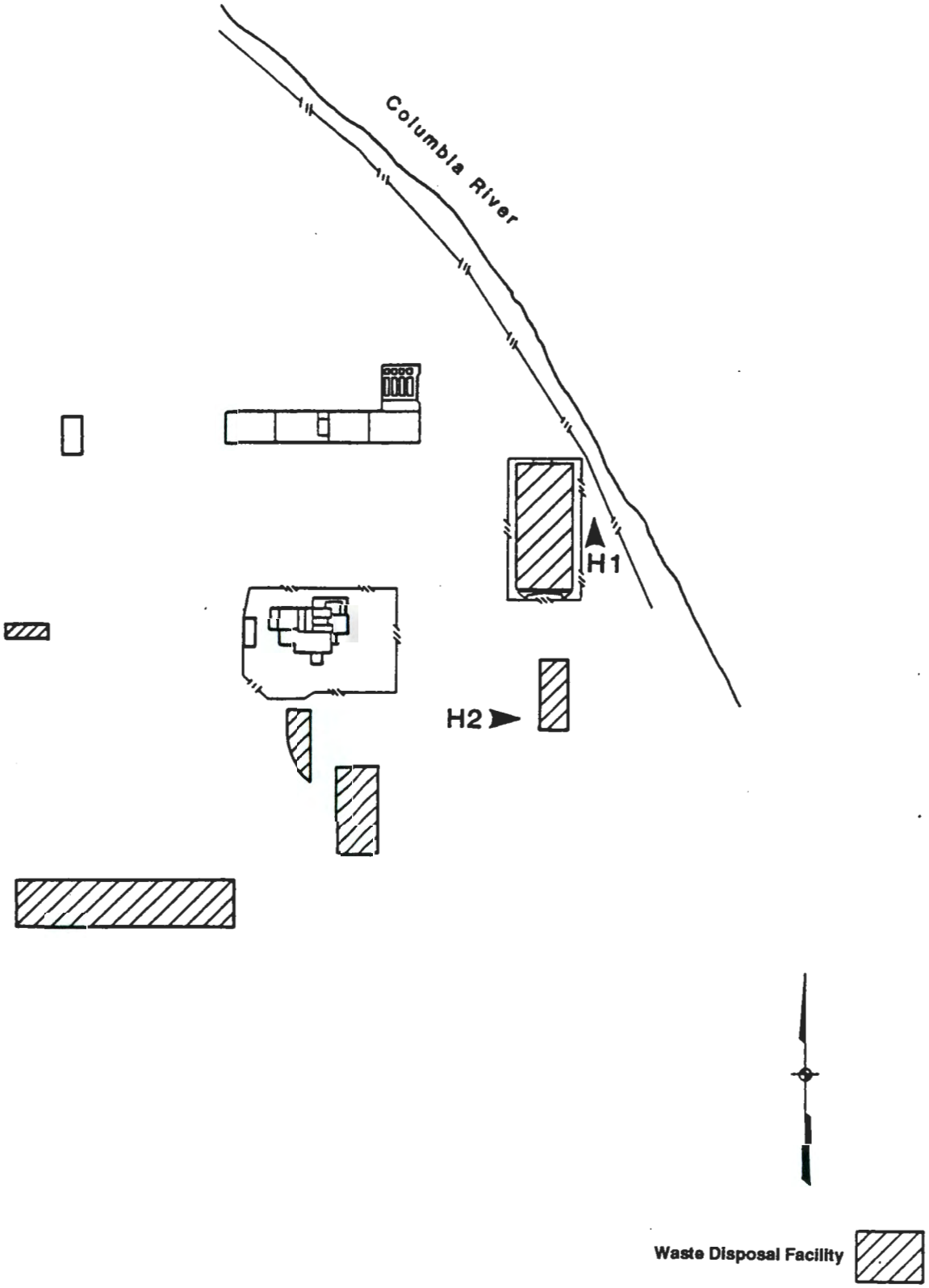

Figure 4-5. Soil and Vegetation Sampling Locations at 100-H Area.

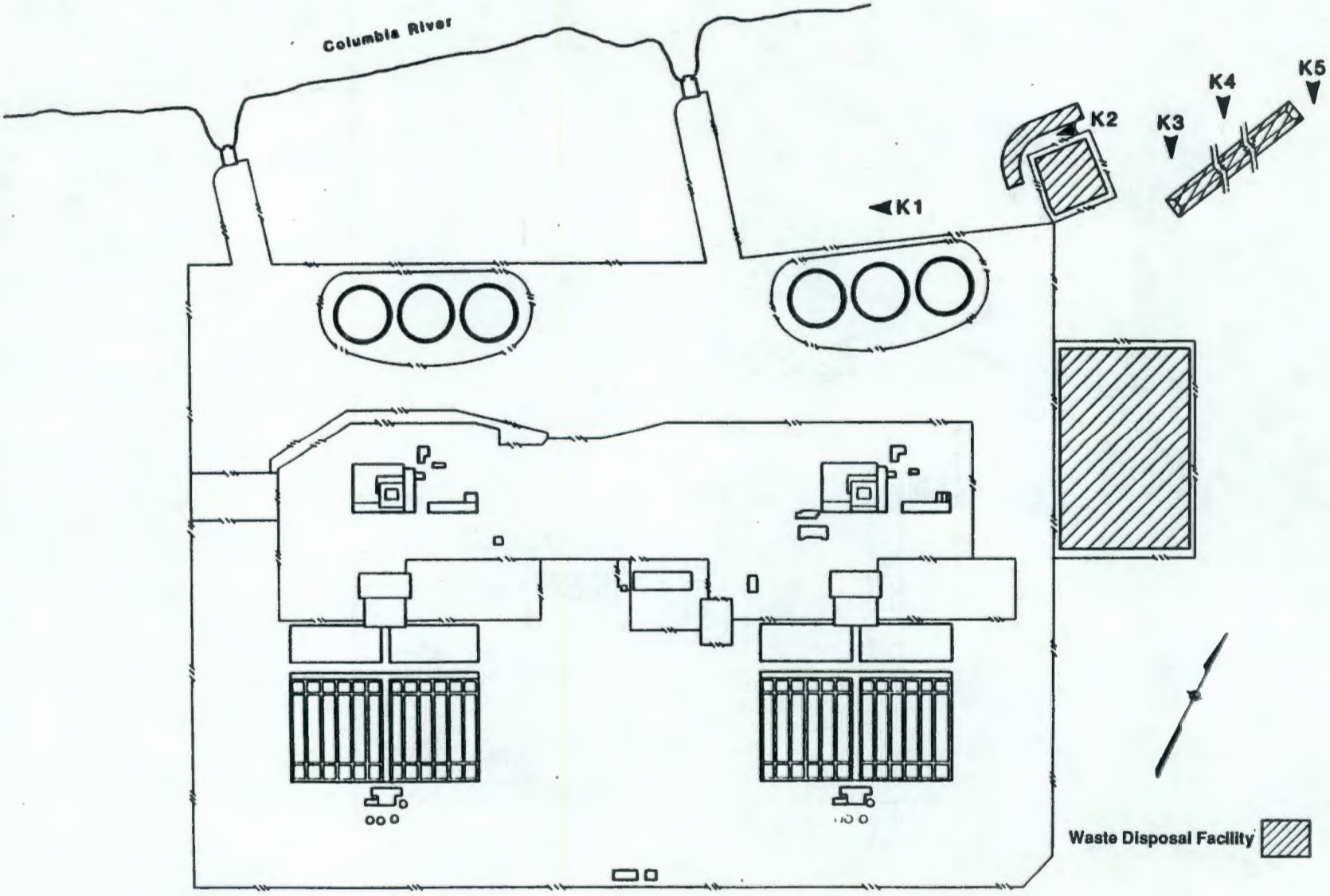

Figure 4-6. Soil and Vegetation Sampling Locations at 100-K Area.

Table 4-3. Average Radionuclide Concentrations (pCi/g) Detected in 100-B/C Area Surface Soil Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	5.7 E-01	NR	1.2 E+00	NR	NR
1982	8.2 E-01	NR	1.3 E+00	NR	NR
1983	4.2 E-01	NR	1.5 E+00	NR	NR
1984	5.4 E-01	3.2 E-01	1.9 E+00	1.0 E-03	2.4 E-02
1985	2.7 E-01	2.4 E-02	4.5 E-01	2.9 E-04	8.8 E-04
1986	1.8 E-01	1.2 E-01	6.4 E-01	5.5 E-04	8.3 E-03
1987	2.6 E-01	1.1 E-01	9.2 E-01	6.2 E-04	1.4 E-02
1988	2.7 E-01	3.9 E-01	9.5 E-01	6.2 E-04	3.0 E-02

NR = Not reported. PST88-3230-6

NOTE: Table E-3 lists the results of the 1988 analysis of 100-B/C Area surface soil samples.

Table 4-4. Average Radionuclide Concentrations (pCi/g) Detected in 100-D/DR Area Surface Soil Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	3.6 E-01	NR	4.0 E-01	NR	NR
1982	4.9 E-01	NR	3.2 E-01	NR	NR
1983	4.2 E-01	NR	1.7 E-01	NR	NR
1984	2.2 E-01	1.4 E-01	1.6 E-01	1.4 E-04	9.8 E-03
1985	2.4 E-01	5.6 E-02	2.7 E-01	2.1 E-04	3.0 E-03
1986	2.6 E-01	7.3 E-02	8.7 E-01	3.2 E-04	5.8 E-03
1987	2.8 E-01	2.0 E-01	1.1 E+00	1.6 E-03	1.8 E-02
1988	1.9 E-01	1.5 E-01	9.3 E-01	6.2 E-04	8.2 E-03

NR = Not reported. PST88-3230-7

NOTE: Table E-4 lists the results of the 1988 analysis of 100-D/DR Area surface soil samples.

Table 4-5. Average Radionuclide Concentrations (pCi/g) Detected in 100-F Area Surface Soil Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	2.9 E-01	NR	6.0 E-01	NR	NR
1982	1.4 E+00	NR	1.7 E+00	NR	NR
1983	2.7 E-01	NR	8.6 E-01	NR	NR
1984	1.1 E+00	4.4 E-01	7.0 E-01	5.0 E-04	1.0 E-02
1985	3.0 E-01	2.9 E-01	8.3 E-01	6.5 E-04	9.8 E-03
1986	2.3 E-01	2.7 E-01	7.4 E-01	3.8 E-04	1.1 E-02
1987	1.9 E-01	2.4 E-01	5.5 E-01	6.4 E-04	9.3 E-03
1988	1.7 E-01	1.6 E-01	6.2 E-01	1.3 E-03	1.4 E-02

NR = Not reported. PST88-3230-8
NOTE: Table E-5 lists the results of the 1988 analysis of 100-F Area surface soil samples.

Table 4-6. Average Radionuclide Concentrations (pCi/g) Detected in 100-H Area Surface Soil Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	1.5 E-01	NR	9.0 E-02	NR	NR
1982	1.8 E-01	NR	3.4 E-01	NR	NR
1983	1.6 E-01	NR	4.7 E-01	NR	NR
1984	3.7 E-01	2.4 E-01	1.7 E+00	6.9 E-04	1.5 E-02
1985	1.4 E-01	9.8 E-02	2.3 E-01	1.9 E-04	5.7 E-03
1986	1.8 E-01	7.1 E-02	8.9 E-01	6.1 E-04	1.0 E-02
1987	2.8 E-01	1.9 E-01	2.0 E+00	8.5 E-04	3.1 E-02
1988	1.6 E-01	7.5 E-02	3.6 E-01	6.1 E-04	6.6 E-03

NR = Not reported. PST88-3230-9
NOTE: Table E-6 lists the results of the 1988 analysis of 100-H Area surface soil samples.

Table 4-7. Average Radionuclide Concentrations (pCi/g) Detected in 100-K Area Surface Soil Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	8.3 E-01	NR	4.4 E+00	NR	NR
1982	2.6 E+01	NR	8.8 E-01	NR	NR
1983	5.5 E+01	NR	5.3 E+01	NR	NR
1984	3.3 E+00	8.4 E-01	1.2 E+01	9.6 E-04	2.9 E-02
1985	7.4 E-01	2.9 E-01	1.1 E+00	1.4 E-03	3.2 E-02
1986	1.0 E+00	1.8 E-01	1.1 E+00	9.1 E-04	2.3 E-02
1987	1.2 E+00	4.3 E-01	1.3 E+00	2.7 E-03	5.5 E-02
1988	3.9 E-01	2.3 E-01	7.3 E-01	7.1 E-04	1.9 E-02

NR = Not reported. PST88-3230-10
NOTE: Table E-7 lists the results of the 1988 analysis of 100-K Area surface soil samples.

4.2 VEGETATION SAMPLING

Vegetation samples provide a means of evaluating the distribution of radionuclides deposited on vegetation from airborne releases or the uptake of radionuclides from the soil. Duplicate samples of green vegetation (about 500 g each) were collected from available perennial shrubs at the same locations from which surface soil samples were obtained (Figure 4-1). The vegetation consisted of gray rabbitbrush (Chrysothamnus nauseosus). Strontium and plutonium analyses were conducted by UST; gamma analyses were conducted at the 100-N, Westinghouse Hanford radioanalytical laboratory.

4.2.1 100-N Area

Five of the vegetation samples (N1 through N5) were collected at locations near the 1301-N LWDF. Radionuclide concentrations detected in vegetation samples collected near the 1301-N LWDF are listed in Table E-8. Average radionuclide concentrations detected in the vegetation from 1980 through 1988 are presented in Table 4-8. The concentrations can be attributed to uptake of the radionuclides from the contaminated soil near the 1301-N LWDF.

Radionuclide concentrations detected in the 100-N Area vegetation samples outside the 1301-N LWDF area are presented in Table E-9. Concentrations in 100-N Area vegetation samples were comparable to those reported for the Hanford Site average. Average radionuclide concentrations detected in 100-N Area vegetation from 1980 through 1988, from sampling sites N6 through N12, are presented in Table 4-9.

Vegetation samples were also collected from eight locations in the 100-N Area along the Columbia River shoreline (Figure 4-7). This portion of the shoreline, N Springs, contains small springs affected by underground drainage from the 1301-N and 1325-N LWDF effluent (see explanation in Groundwater Monitoring section). Wildrye (Elymus sp.) growing near the N Springs was sampled. The plants were growing through the cover of boulders along the shoreline. The samples were collected and analyzed using the methods described previously.

Table 4-8. Average Radionuclide Concentrations (pCi/g) Detected in Vegetation Samples Near the 1301-N Liquid Waste Disposal Facility from 1980 through 1988.

Year	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	1.4 E+00	4.0 E+00	NR	1.1 E+00	NR	NR
1981	2.5 E+00	1.2 E+01	1.8 E+00	1.8 E+00	NR	7.1 E-03
1982	4.6 E-01	1.6 E+00	1.2 E-01	2.6 E-01	NR	2.6 E-03
1983	4.5 E-01	1.9 E+00	6.0 E-01	3.9 E-01	NR	3.2 E-03
1984	2.9 E-01	1.0 E+00	1.2 E-01	8.3 E-02	NR	8.5 E-04
1985	5.9 E-01	1.7 E+00	1.9 E+00	1.0 E-01	NR	1.5 E-03
1986	6.8 E-01	3.5 E+00	7.3 E-02	6.5 E-01	NR	2.6 E-03
1987	4.9 E-01	2.8 E+00	6.3 E-02	2.0 E-01	1.2 E-03	5.6 E-03
1988	1.5 E-01	2.0 E+00	1.2 E-01	1.3 E-01	4.3 E-04	1.7 E-03

NR = Not reported. PST88-3230-11

NOTE: Table E-8 lists the results of the analysis of 1301-N LWDF vegetation samples.

Table 4-9. Average Radionuclide Concentrations (pCi/g) Detected in 100-N Area Vegetation Samples from 1980 through 1988.

Year	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	4.8 E-01	1.0 E+00	NR	2.8 E-01	NR	NR
1981	1.8 E+00	2.5 E+01	5.8 E-01	7.1 E-01	NR	2.1 E-02
1982	4.9 E-01	1.5 E+00	2.0 E-01	1.3 E-01	NR	7.8 E-03
1983	3.6 E-01	1.0 E+00	2.9 E-01	9.0 E-02	NR	8.6 E-03
1984	1.3 E-01	4.6 E-01	8.1 E-02	9.0 E-02	NR	1.3 E-03
1985	3.6 E-01	1.4 E+00	5.1 E-02	1.6 E-01	NR	8.7 E-04
1986	2.6 E-01	9.5 E-01	2.2 E-01	7.9 E-01	NR	1.1 E-03
1987	1.1 E-01	7.0 E-01	2.6 E-01	9.4 E-02	1.3 E-04	5.8 E-04
1988	1.3 E-01	8.0 E-01	2.5 E-01	1.6 E-01	1.7 E-04	6.6 E-04

NR = Not reported. PST88-3230-12

NOTE: Table E-9 lists the results of the analysis of 100-N Area vegetation samples.

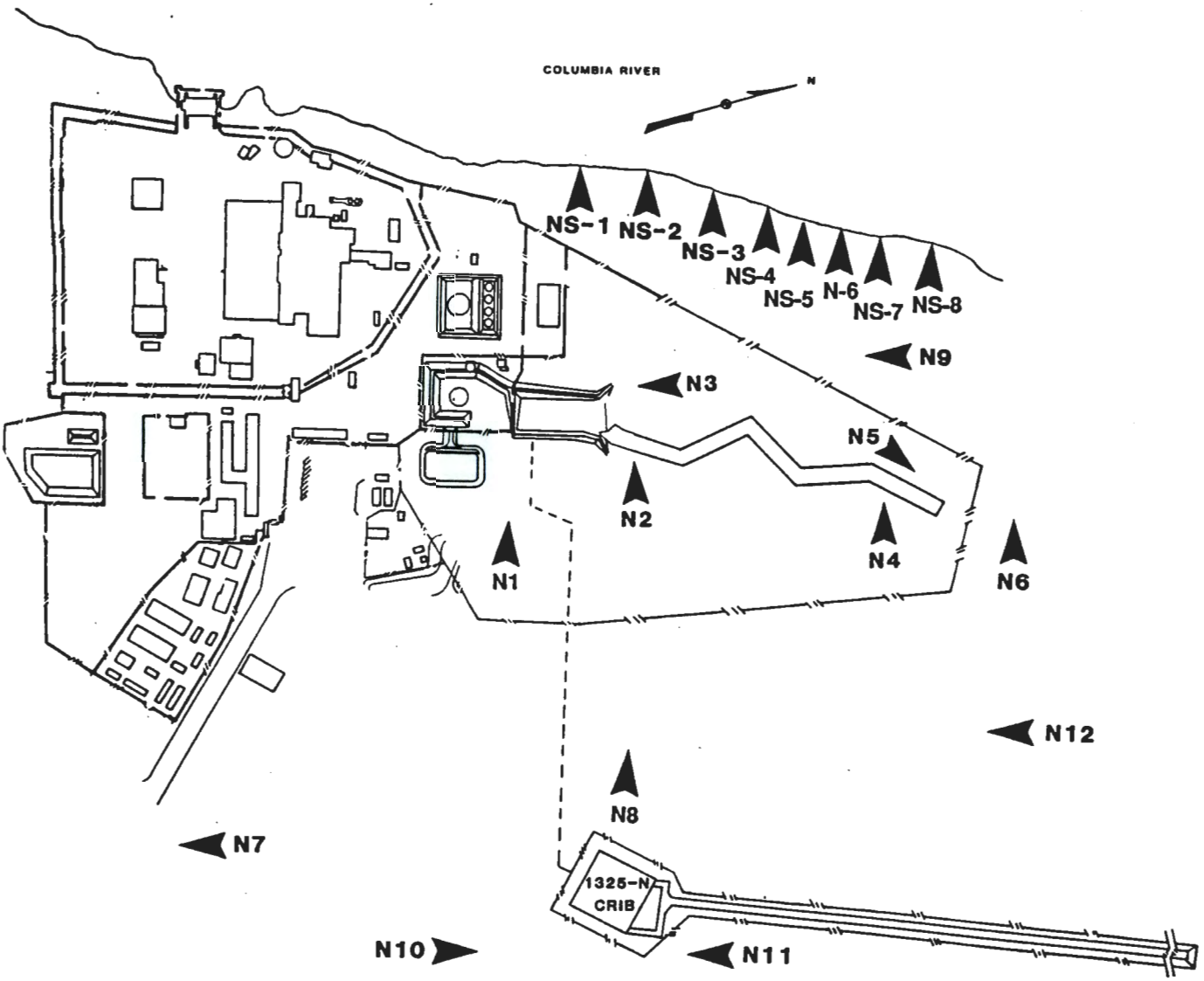

Figure 4-7. Vegetation Sampling Locations at 100-N Area.

Radionuclide concentrations detected in the N Springs vegetation samples are presented in Table E-10. The average radionuclide concentrations detected on the Hanford Site are again shown for comparison. The N Springs samples contained above-background concentrations of ^{90}Sr, with the highest concentrations detected in the samples collected from the shoreline area in the most direct groundwater migration path from the LWDFs (i.e., NS-1, -2, -3 locations). Growing plants will assimilate available strontium and cesium from the soil (Kathren 1984). Although liquid effluent discharged to the 1325-N LWDF has decreased since N Reactor was placed in standdown status, residual ^{90}Sr in the 1301-N LWDF soil column continues to influence the shoreline vegetation. Average radionuclide concentrations detected in N Springs vegetation from 1980 through 1988 are presented in Table 4-10. The concentrations of ^{90}Sr detected in 1988 were similar to levels reported in 1987.

Table 4-10. Radionuclide Concentrations (pCi/g) Detected in N Springs Vegetation Samples from 1980 through 1988.

Year	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	1.5 E-01	5.6 E+00	NR	4.4 E-01	NR	NR
1981	NR	3.3 E+00	2.0 E+02	NR	NR	3.7 E-03
1982	1.5 E-01	2.8 E+00	4.8 E+02	NR	NR	8.3 E-03
1983	7.0 E-02	3.0 E+00	3.3 E+02	4.0 E-02	NR	8.0 E-03
1984	NR	NR	NR	NR	NR	NR
1985	7.6 E-02	1.2 E+00	4.2 E+02	1.7 E-01	NR	4.4 E-04
1986	1.6 E-01	1.1 E+00	2.2 E+02	2.1 E-01	NR	4.2 E-04
1987	2.0 E-01	9.0 E-01	2.9 E+02	1.1 E-01	<1.3 E-04	7.6 E-04
1988	2.4 E-01	1.4 E+00	1.2 E+02	2.0 E-01	8.5 E-05	2.0 E-04

NR = Not reported. PST88-3230-13

NOTE: Table E-10 lists the results of the analysis of N-Springs vegetation samples.

4.2.2 Retired 100 Areas

Vegetation sampling locations in the retired 100 Areas coincide with the surface soil locations shown in Figures 4-2 through 4-6. Average radionuclide concentrations detected in vegetation samples for each of the retired 100 Areas from 1980 through 1988 are presented in Tables 4-11 through 4-15. The results of the 1988 vegetation sample analysis for each sample location in the retired 100 Areas are presented in Tables E-11 through E-15. Environmental samples of vegetation collected near the retired 100 Area reactor facilities indicated no elevated levels of radionuclides when compared to the Hanford Site average concentrations.

Table 4-11. Average Radionuclide Concentrations (pCi/g) Detected in 100-B/C Vegetation Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	3.6 E+00	NR	3.6 E-01	NR	NR
1982	1.9 E-01	NR	1.1 E-01	NR	NR
1983	1.8 E-01	NR	8.0 E-02	NR	NR
1984	1.3 E-01	1.4 E+00	8.7 E-02	2.4 E-04	6.0 E-04
1985	4.6 E-01	1.4 E+00	1.2 E-01	2.5 E-04	1.0 E-03
1986	2.5 E-01	2.0 E-01	2.8 E+00	2.5 E-05	6.2 E-04
1987	1.5 E-01	2.3 E-01	1.0 E-01	4.6 E-04	6.5 E-04
1988	3.5 E-01	2.6 E-01	2.1 E-01	1.4 E-04	3.1 E-04

NR = Not reported. PST88-3230-14
NOTE: Table E-11 lists the results of the analysis of 100-B/C Area vegetation samples.

Table 4-12. Average Radionuclide Concentrations (pCi/g) Detected in 100-D/DR Area Vegetation Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	1.2 E+00	NR	1.6 E-01	NR	NR
1982	1.1 E-01	NR	2.7 E+00	NR	NR
1983	9.5 E-02	NR	1.4 E-01	NR	NR
1984	2.1 E-01	2.8 E-01	1.7 E+00	1.8 E-03	5.8 E-04
1985	2.4 E-01	6.9 E-02	6.8 E-01	1.2 E-04	7.0 E-04
1986	2.7 E-01	1.5 E-01	1.7 E+00	0.0 E+00	3.1 E-04
1987	2.5 E-01	9.5 E-02	6.3 E-01	1.6 E-04	2.8 E-04
1988	2.8 E-01	1.8 E-01	9.6 E-02	3.8 E-05	1.9 E-04

NR = Not reported. PST88-3230-15
NOTE: Table E-12 lists the results of the analysis of 100-D/DR Area vegetation samples.

Table 4-13. Average Radionuclide Concentrations (pCi/g) Detected in 100-F Area Vegetation Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	9.2 E-01	NR	2.2 E+00	NR	NR
1982	1.6 E-01	NR	7.9 E-01	NR	NR
1983	2.8 E-01	NR	1.0 E+00	NR	NR
1984	2.2 E+00	7.6 E+00	2.0 E+01	4.9 E-04	3.9 E-03
1985	3.3 E-01	1.4 E+00	5.8 E-01	4.9 E-05	5.3 E-04
1986	1.7 E-01	9.3 E-02	1.1 E+00	8.3 E-05	1.2 E-04
1987	2.4 E-01	1.8 E-01	1.9 E-01	3.8 E-04	1.7 E-04
1988	9.9 E-01	8.9 E-02	3.1 E-01	3.3 E-05	1.1 E-04

NR = Not reported. PST88-3230-16

NOTE: Table E-13 lists the results of the analysis of 100-F Area vegetation samples.

Table 4-14. Average Radionuclide Concentrations (pCi/g) Detected in 100-H Area Vegetation Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	6.8 -01	NR	1.5 E-01	NR	NR
1982	NR	NR	NR	NR	NR
1983	1.3 E-01	NR	9.0 E-02	NR	NR
1984	1.8 E-01	2.0 E+00	1.3 E-01	2.0 E-04	1.7 E-03
1985	2.0 E-01	6.0 E-02	4.5 E-02	1.0 E-04	5.1 E-04
1986	2.2 E-01	5.3 E-01	1.3 E+00	1.3 E-04	4.4 E-05
1987	2.6 E-01	2.6 E-01	1.0 E-01	3.5 E-05	2.7 E-04
1988	9.0 E-01	3.9 E-01	1.5 E-01	2.0 E-04	1.5 E-04

NR = Not reported. PST88-3230-17

NOTE: Table E-14 lists the results of the analysis of 100-H Area vegetation samples.

9 2 1 2 4 9 5 1 9 4 0

Table 4-15. Average Radionuclide Concentrations (pCi/g) Detected in 100-K Area Vegetation Samples from 1981 through 1988.

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1981	1.2 E+00	NR	1.0 E-01	NR	NR
1982	2.4 E-01	NR	9.7 E-01	NR	NR
1983	1.5 E-01	NR	2.5 E-01	NR	NR
1984	1.8 E-01	1.3 E+00	1.3 E-01	2.9 E-04	6.9 E-04
1985	4.6 E-01	3.9 E-01	1.3 E-01	1.9 E-04	7.1 E-04
1986	2.8 E-01	4.0 E-01	1.5 E+00	2.5 E-04	7.9 E-04
1987	2.3 E-01	1.3 E+00	1.1 E-01	1.9 E-04	2.2 E-04
1988	4.9 E-01	1.2 E+00	1.8 E-01	5.2 E-05	3.8 E-04

NR = Not reported. PST88-3230-18

NOTE: Table E-15 lists the results of the analysis of the 1988 100-K Area vegetation samples.

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5.0 EXTERNAL RADIATION MONITORING

Environmental TLDs are used to measure direct radiation and evaluate environmental dose rates at several locations at 100-N Area.

The environmental TLDs (CaF_2:Mn matrix) are delivered, calibrated, and read every 4 wk by PNL. The locations of the environmental TLDs at 100-N Area are shown in Figure 5-1. The average dose rate in mrem/h, extrapolated dose rate per work year for each of the TLD locations, and the ALARA occupational exposure guideline for comparison are presented in Table F-1.

The dose per work year is defined as the accumulated dose over a period of 40 h/wk and 52 wk/yr at the site of a specific environmental dosimeter. The value is used only to indicate the significance of background radiation levels. It does not show actual occupational exposure as workers rarely spend large amounts of time at most of these locations, especially inside established radiation zones. In October 1986, five TLD locations were added to the 100-N Area external radiation monitoring program. These sites, numbers 37 through 41, were included to assess dose rates to workers housed in offices located near the 1301-N LWDF. The 1988 results indicate that, as in 1987, the ALARA exposure guidelines for nonradiation zone workers (240 mrem/yr) were not exceeded and there is an apparent, overall decreasing trend in dose rates at these locations.

Dose rates measured at TLD locations near the 1310-N Radioactive Chemical Waste Storage Facility (TLD locations 14, 16, 18, 21, and 31) which were elevated in 1987 due to an internal decontamination of the N Reactor primary coolant piping, decreased in 1988 to levels that are consistent with previous measurements observed when the facility was idle.

Direct radiation levels were higher near facilities that contained or received liquid effluent from N Reactor. These facilities include the 1304-N Emergency Dump Tank, the 1301-N LWDF, and the 1325-N LWDF. The environmental dose rates detected near the 1301-N LWDF were, as in 1986 and 1987, higher than in previous years. This is due primarily to the fact that as of September 19, 1985, the facility is no longer being used and no longer contains water. The water contained by the facility during operation shielded direct radiation to levels similar to those in 1985. There was, however, a 19% overall decrease in dose rates observed in 1988 compared to 1987, and a 29% decrease in 1988 compared to 1986 levels. This decrease for 1988 may be attributable to the continued decay of the shorter lived radionuclides resident in the facility. The installment in July of several feet of clean soil to the crib portion of the 1301-N LWDF revealed no significant dose-rate reductions at any of the affected TLD locations following completion of the project. Most likely, the dose-rates associated with the unaffected trench portion of the 1301-N continued to contribute to the overall radiation levels measured at this facility. Plans for permanent closure and stabilization of the 1301-N LWDF are being developed and reviewed. The environmental dose rates detected near the 1325-N LWDF were also higher than in previous years. Liquid effluents from N Reactor were discharged to the 1325-N when the 1301-N LWDF was retired. The N Reactor was subsequently placed in standdown status in January 1987. Effluent discharged to the 1325-N, which would provide shielding from direct radiation under normal operating conditions, decreased substantially, due to lower flow rates, following the initiation of standdown. The increase in radionuclide inventory in the 1325-N LWDF, coupled with lack of shielding water, explains the increased dose rates measured at the affected TLD locations.

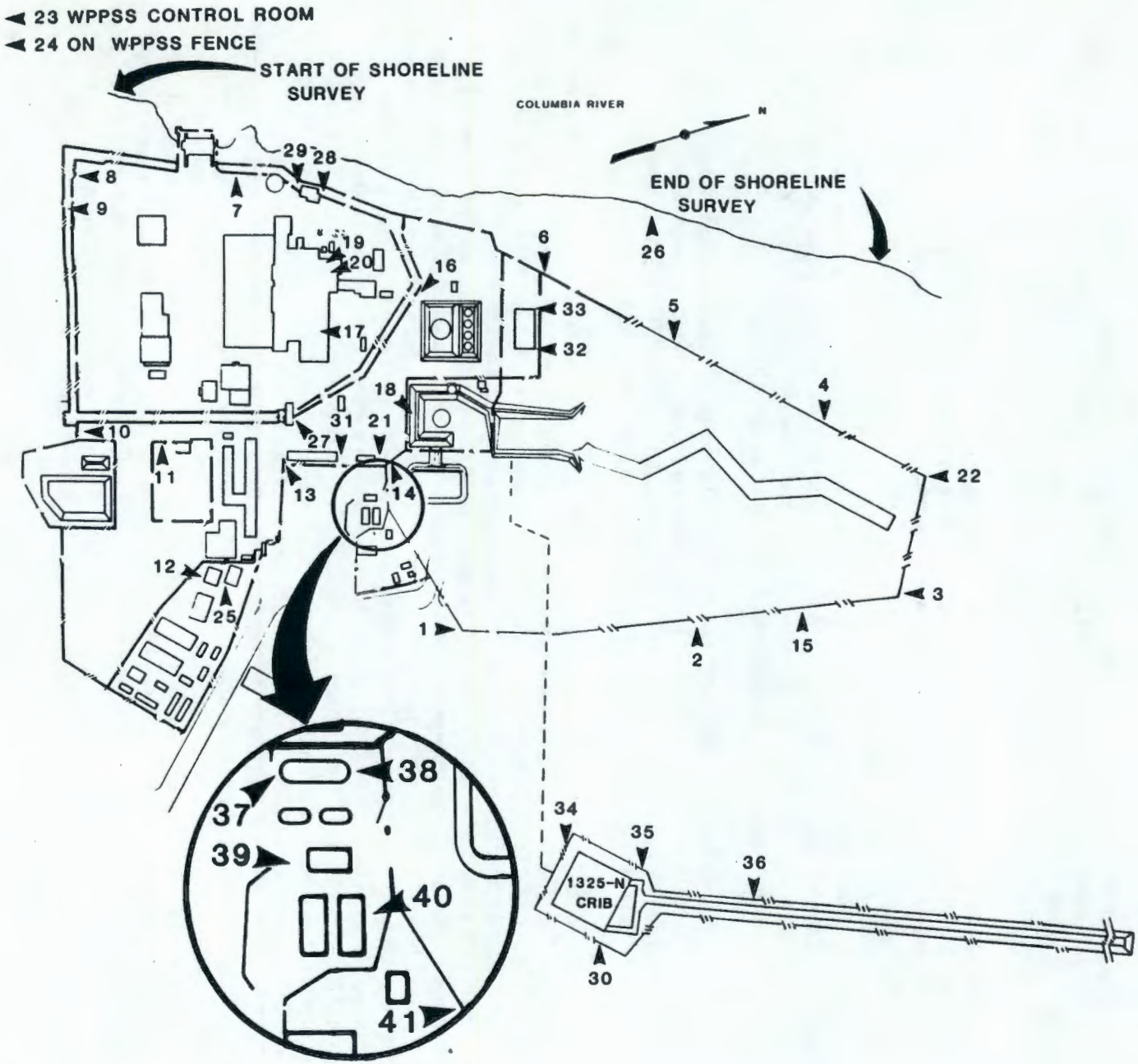

Figure 5-1. Location of Environmental Dosimeters and the Columbia Shoreline Survey at 100-N Area.

A slightly increasing trend in dose rates was observed at TLD location 7 in the latter part of 1988. This increase is attributed to the removal of the quench water normally contained in the 1304-N Emergency Dump Tank. This water, which would provide shielding from direct radiation associated with the residual internal surface contamination of the vessel, was drained as part of the ongoing "lay-up" of N Reactor.

A short-term increase in dose rates at TLD location 28 was observed from mid-July through mid-September. This increase was due to increased rail transport of irradiated fuel elements to PUREX during this time. Dose-rates decreased immediately once the rail transport activities were concluded.

A table of the monthly dose rate measurements for each environmental TLD location is included in Table B-2.

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6.0 LIQUID WASTE DISPOSAL FACILITY MONITORING

Environmental surveillance of the 1301-N and 1325-N LWDFs is performed to monitor and document the environmental impact associated with these disposal facilities. Several parameters including ambient air, vegetation, surface soil, and bottom sediments are sampled and analyzed. Ambient environmental dose rates are also monitored annually. Ambient air, vegetation, surface soil, and external radiation monitoring for the LWDFs have been included in their respective sections previous to this. The following section, Radiological Surveys, will address the annual ambient environmental dose rate surveys associated with LWDF monitoring. This section, LWDF monitoring, will discuss the sampling and analysis of the 1325-N LWDF bottom sediments.

The 1325-N LWDF receives liquid effluent from N Reactor. The liquid effluent is discharged to a soil column that retains the radionuclides as the effluent percolates through the subsoil. Samples of surface sediment were obtained from the bottom of the 1325-N LWDF on July 13, 1988. The samples, about 10 g each, were collected by means of several sampling ports located in the cover over the disposal facility (Figure 6-1). At the time of sampling, the 1325-N facility was receiving liquid effluent from N Reactor. The samples were analyzed for gamma-emitting radionuclides at the 100-N, Westinghouse Hanford radioanalytical lab. The samples were then shipped to UST for $^{89,90}Sr$ and plutonium analyses.

Comparison of radionuclide concentrations detected in the 1325-N sediments from 1985 to 1988 are presented in Table 6-1. Radionuclide concentrations detected in sediments sampled from the 1325-N LWDF crib are presented in Table G-1.

Use of the 1301-N LWDF was discontinued on September 19, 1985. Emphasis on LWDF sediment sampling subsequently shifted to the 1325-N LWDF. As the radionuclides contained in the 1301-N LWDF decay, concentrations will decrease. Stabilization and permanent closure of the facility are being studied at this time.

Table 6-1. Average Radionuclide Concentrations (pCi/g) Detected in 1325-N Liquid Waste Disposal Facility Sediment Since 1985.

Year	^{60}Co	^{90}Sr	^{137}Cs	$^{239,240}Pu$
1985	8.3 E+05	5.4 E+04	3.7 E+04	1.3 E+04
1986	2.8 E+06	5.9 E+03	9.3 E+04	NR
1987	8.7 E+05	9.7 E+04	2.3 E+04	3.3 E+04
1988	1.3 E+06	2.3 E+04	5.1 E+04	1.4 E+04

NR = Not reported. PST88-3230-19

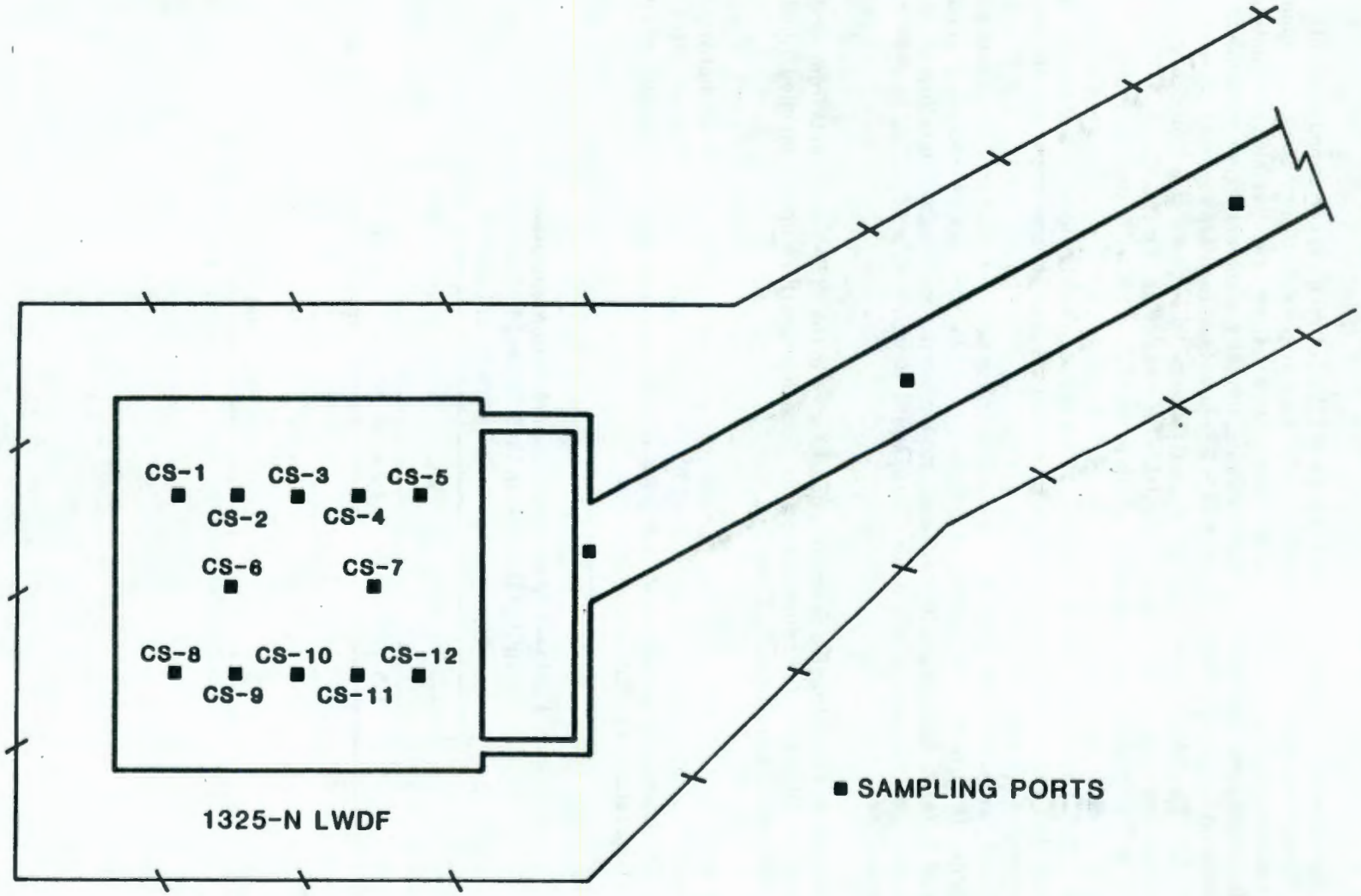

Figure 6-1. Sediment Sampling Locations for the 1325-N Liquid Waste Disposal Facility.

7.0 RADIOLOGICAL SURVEYS

7.1 INTRODUCTION

Direct radiation levels are measured annually along the 100-N Area portion of the Columbia River shoreline. Annual environmental radiation surveys are also conducted at intersecting points of survey grids established around the 1301-N and 1325-N LWDFs to monitor direct radiation levels associated with the disposal facilities.

Each of the surveys relied on the use of a Bicron Model 5045 portable micro-R meter. The meter was calibrated by PNL to a ^{137}Cs source and the readings were taken at a height of 1 m at 50-ft intervals. The micro-R readings obtained for these surveys reflect relative (to each other) dose rates only, and do not indicate actual whole body penetrating dose rates, as this type of instrument is overly sensitive to nonpenetrating radiation sources.

7.2 COLUMBIA RIVER SHORELINE SURVEY

On August 18, 1988, relative dose rates were measured along the Columbia River shoreline starting near the 005 outfall and proceeding downstream past the N Springs (refer to Figure 5-1). A graphic representation of the shoreline survey data is presented in Figure 7-1. The locations of the 100-N Area facilities that potentially contribute to dose rates measured near the river shoreline are shown. At the time of the survey, N Reactor was shut down. The 1304-N Emergency Dump Tank contained low-level activity quench water. Two rail cars containing irradiated fuel awaiting shipment to PUREX were located near the 1314-N Facility. The dose rates (at 1 m) from these rail cars were 8 mrem/h and 22 mrem/h. Flow to the 1325-N LWDF was about 200 gal/min. The 1310-N Radioactive Chemical Waste Storage Facility was empty.

Relative environmental dose rates detected along the Columbia River Shoreline opposite the 1301-N LWDF were similar to 1986 and 1987. As of September 19, 1985, this facility was no longer used and no longer contained water that, during operation, shielded direct radiation levels. Relative dose rates detected between the 1314-N Facility and the upstream (west) perimeter fence were approximately 170% higher than the 1987 levels. This is attributable to the irradiated fuel contained in the nearby rail cars. Increased shipping activities were conducted from mid-July through mid-September of 1988. This also produced elevated dose-rate measurements during this period at the nearby TLD location (see Section 5.0). The readings at each location obtained during this survey are presented in Table H-1.

7.3 LIQUID WASTE DISPOSAL FACILITY RADIATION SURVEYS

7.3.1 Introduction

The 1301-N and 1325-N LWDFs are secured facilities posted as radiation zones. Due to the potential for radionuclide contamination and direct radiation exposure, the facilities are surrounded by a security fence. Only trained personnel are allowed access to the disposal facilities. Even then, workers do not spend large amounts of time in these areas.

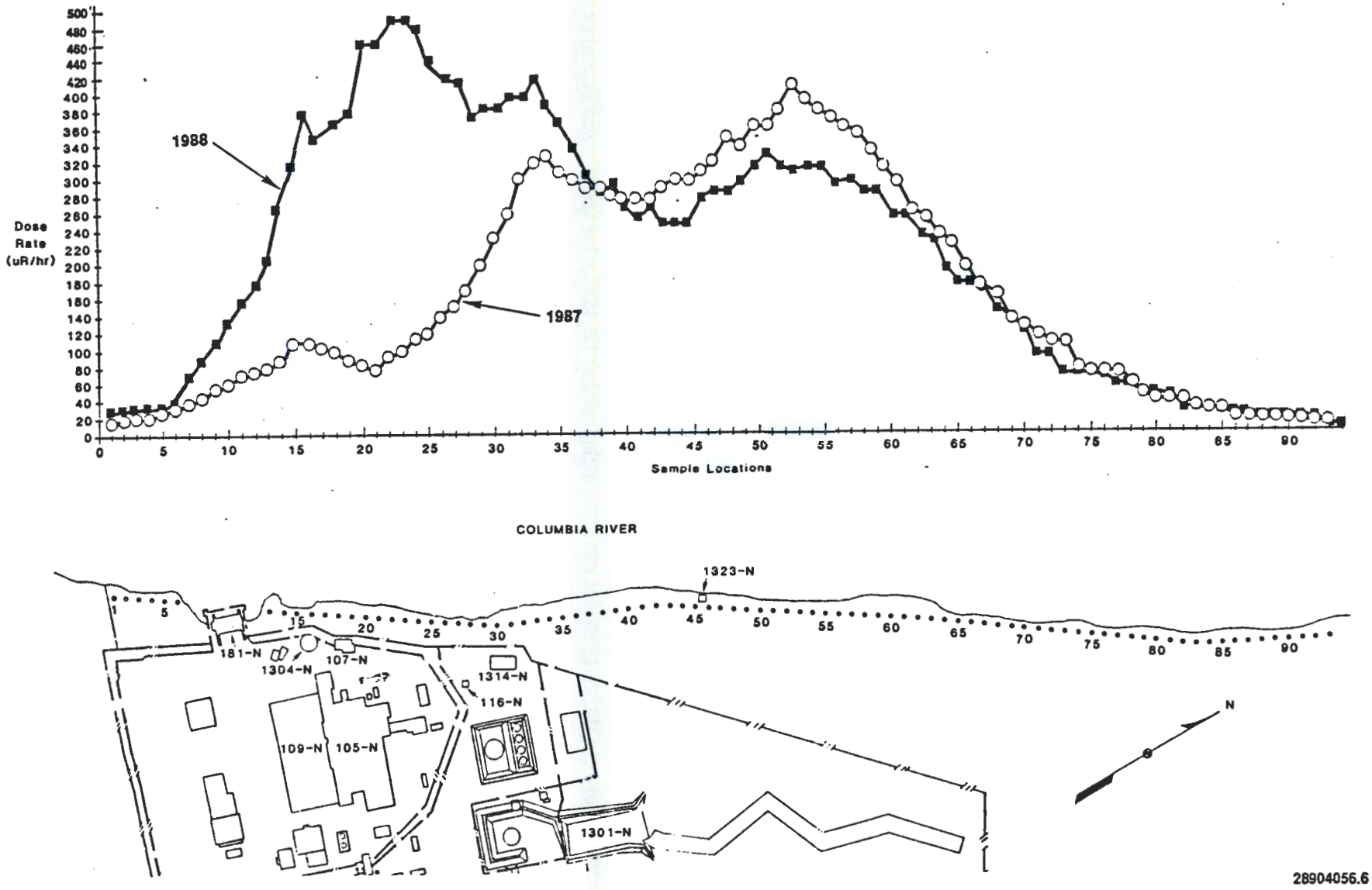

Figure 7-1. Environmental Dose Rates Detected at Survey Points along the Columbia River Shoreline.

For convenience of reference, the 1987 LWDF survey results are included in Figures H-1 and H-2. The methods and equipment used for the annual dose rate surveys conducted at the 1301-N and 1325-N LWDFs were identical to those described for the annual Columbia River shoreline survey.

7.3.2 1301-N Liquid Waste Disposal Facility Survey Results

Figure 7-2 shows the relative environmental dose rates detected around the 1301-N LWDF on August 17, 1988. N Reactor was not operating at the time of the survey. The 1325-N LWDF was receiving liquid effluent from the N Reactor at a rate of about 200 gal/min. The 1310-N Radioactive Chemical Treatment Facility was empty. Two rail cars, containing irradiated fuel, were located at the 1314-N Facility.

The data indicate that the areas near the "box weir" (inlet) portion of the 1301-N LWDF and the first leg of the 1301-N trench have the highest background dose rates. The absence of water from the LWDF is the major factor contributing to the dose rates. During operation, water levels in the crib shielded much of the radiation emitted by the contaminated sediments.

Also, an overall decrease in the relative dose-rates measured at this facility was indicated in 1988. The continued decay of the radionuclide inventory contained in 1301-N is the apparent cause of this reduction.

A project that added several feet of clean soil to the uncovered boulders on the 1310-N crib may have caused a slight shielding affect, although data acquired from the TLD locations at this facility do not indicate a discernable trend.

Survey locations away from the inlet portion of the 1301-N showed mostly a slightly reduced dose rate in the 1988 measurements.

7.3.3 Liquid Waste Disposal Facility

The relative environmental dose rates detected around the 1325-N LWDF on August 17, 1988 are presented in Figure 7-3. The N Reactor was not operating at the time and the 1325-N was receiving about 200 gal/min of liquid effluent from N Reactor. The 1310-N Radioactive Chemical Waste Storage Facility was empty. The 1301-N LWDF did not contain liquid effluent.

In 1988, the 1325-N LWDF showed an ~10% increase in relative dose rates over the 1987 survey. Both the 1988 and 1987 surveys are ~ 180% to 190% higher than the 1986 survey. Radionuclide inventory in the 1325-N LWDF increased during CY 1986 after the 1301-N LWDF was retired. Liquid effluent, discharged to the facility after standdown was initiated, decreased significantly. This effluent would normally provide some degree of shielding from direct radiation. The increased radionuclide loading and subsequent reduction of shielding liquid led to the increased relative environmental dose rates observed at 1325-N LWDF during the 1988 and 1987 surveys.

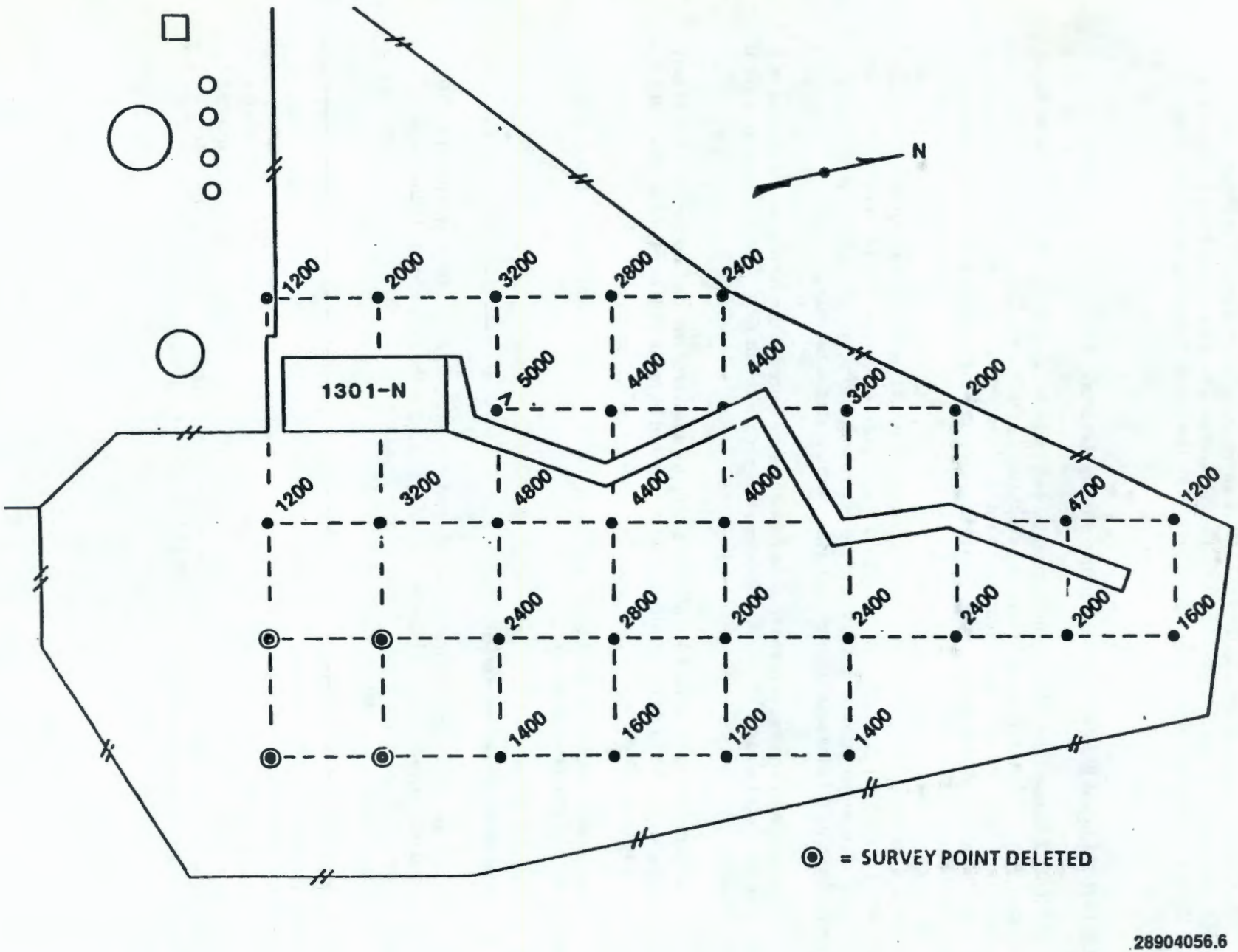

Figure 7-2. Environmental Dose Rates (μrem/h) Measured at Survey Points Around the 1301-N Liquid Waste Disposal Facility in 1988.

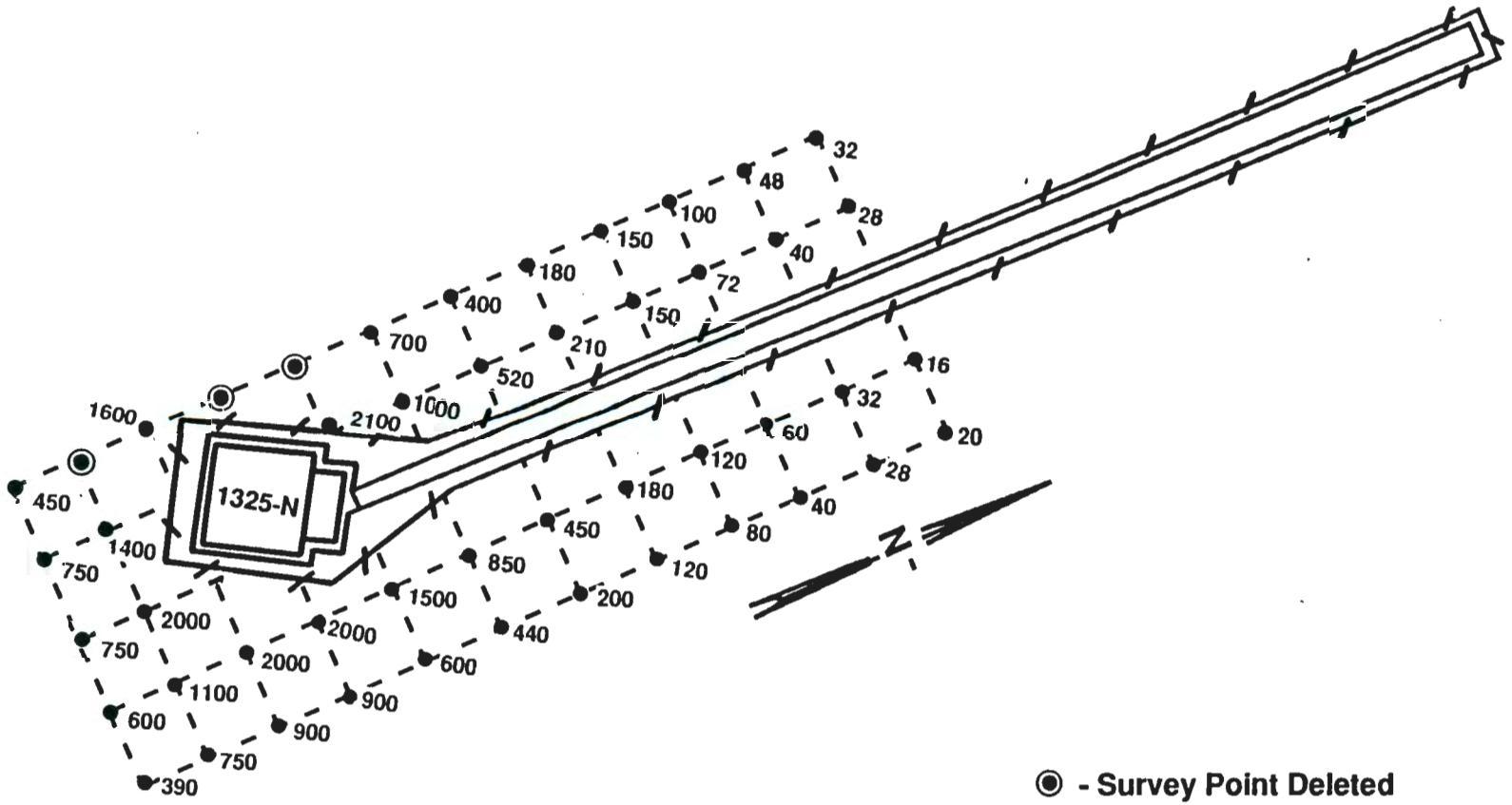

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Figure 7-3. Environmental Dose Rates (µrem/h) Measured at Survey Points Around the 1325-N Liquid Waste Disposal Facility in 1988.

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APPENDIX A

QUALITY ASSURANCE

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INTRODUCTION

The Westinghouse Hanford Company (Westinghouse Hanford) Surveillance Program for the 100 Areas provides monitoring to assist in evaluating the environmental impact of N Reactor facilities, the retired 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, maintain a database for trend analyses, provide data for accidental release analyses, and demonstrate compliance with applicable regulations.

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 and 1325-N Liquid Waste Disposal Facilities (LWDF) and along the river shoreline. At the retired 100 Areas, soil, vegetation, and groundwater samples are collected and analyzed. Special samples to monitor the potential biotransport of radionuclides may also be included in the surveillance program.

Procedures and guidelines are used to ensure that near-field environmental monitoring techniques and analyses are conducted within established limits of acceptance. The essential components of these manuals as they apply to the 100 Areas environmental surveillance Quality Assurance (QA) program are briefly outlined below.

DOCUMENTATION

Record keeping is a vital requirement of the 100 Areas near-field environmental monitoring program. Each phase of the program is documented to ensure regulatory compliance, accurate trend analysis, and optimal monitoring procedures. Pertinent documentation includes the following:

- Sampling Logs--Records of all environmental samples collected by Operational Health Physics (OHP) and N Reactor Operations (NRO) personnel are kept in these log books.

- Data Records--All analytical data received by 100 Areas Environmental Protection (EP) from the radioanalytical laboratories are recorded on magnetic media and on hard-copy printouts.

- Environmental Surveillance Requirements--The procedures and reporting guidelines for these requirements are provided in various company manuals.

- Chain of Custody Log--This log records custody of the environmental samples from collection through disposal.

Various reports are generated to document, control, and report the condition of, and impact to, the near-field environment. These reports include the following.

- Annual Environmental Release Report--This report covers atmospheric and liquid releases of radionuclides and chemical from the 100 and 300 Areas facilities.

- Environmental Surveillance Report for the 100 Areas--This annual report summarizes sampling and monitoring completed during the previous year to fulfill the requirements of the Westinghouse Hanford 100 Areas, Environmental Surveillance Program.

- N Area Radioactive Release Summary Report--This quarterly report shows the total amounts of "indicator" radionuclides released to the environment for both the current month and calendar year to date.

- Westinghouse Hanford Release Report for the Hanford Site--This monthly report shows the total amounts of potentially hazardous materials released from Westinghouse Hanford facilities for the previous month. Unplanned releases and spills to the environment are included in this report.

- National Pollutant Discharge Elimination System (NPDES) Effluent Monitoring Report--The NPDES Effluent Monitoring Report summarizes the sampling data required by the NPDES Permit. The U.S. Department of Energy (DOE) transmits the report to the Environmental Protection Agency as required by NPDES regulations.

- Annual 100 Area Inactive Burial Site and Retention Basin Surveillance and Maintenance Report--The report summarizes maintenance and surveillance activities conducted for the retired 100 Areas burial sites and retention basins. The report allows Environmental Protection to evaluate the effectiveness of the surveillance and maintenance effort.

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DATA ANALYSIS

Environmental data are reviewed to determine compliance with applicable Federal, State, local, and Westinghouse Hanford guides. The data are analyzed both graphically and by standard statistical tests to determine trends and impacts on the environment. Newly acquired data are compared with historical data and natural background levels. Routine environmental data are stored on both magnetic media (i.e., in a microcomputer environment) and on hard-copy printouts.

TRAINING

To ensure quality and consistency in sample collection and handling, all personnel performing such work receive formal training. The OHP personnel involved in sample analyses receive formal initial, and annual followup training in the operation of the radioanalytical laboratory equipment located in the 105-N Building.

SAMPLE FREQUENCY

The sampling schedules and types are established by 100 Areas Environmental Protection on the basis of detailed review of each effluent stream to ensure that all samples accurately represent the types and concentrations of radionuclides that are being discharged in that effluent stream. The routine monitoring schedule is provided in the applicable company manual. A brief description of the sampling program is presented below.

1. Ambient air sample filters are collected weekly.

2. Liquid effluent samples are composited and collected weekly.

3. Environmental thermoluminescent dosimeters (TLD) are exchanged monthly.

4. Groundwater samples for radiological analysis are collected quarterly. Samples from oil and grease monitoring wells are collected on a location-dependent frequency.

5. Radiological surveys of the LWDFs and Columbia River shoreline are performed annually.

6. The soil, vegetation and 1325-N LWDF sediment samples are collected annually.

ANALYTICAL PROCEDURES

Three laboratories provide analytical support to the 100 Areas Environmental Surveillance Program: the U.S. Testing (UST), the Radiation Standards and Engineering Laboratory at Pacific Northwest Laboratory (PNL), and the 100-N, Westinghouse Hanford Analytical Laboratory. The environmental samples are analyzed in accordance with prescribed procedures and quality control guides.

Radioanalyses conducted at the 100-N, Westinghouse Hanford radioanalytical laboratory are limited to the detection of gamma-emitting radionuclides. Other analyses, such as gross alpha-beta, tritium, strontium, and plutonium determinations are performed by either UST or PNL, depending on sample type. The PNL also provides TLD calibration, annealing and analyses.

Historically, the radioanalytical program at 105-N has provided reliable and accurate analyses of gamma-emitting radionuclides. The laboratory has consistently performed well on Environmental Protection Agency inter-laboratory comparisons. The quality control program for the laboratory is documented in the applicable company manual. Quality control for the UST laboratory is overseen by PNL.

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APPENDIX B

GLOSSARY OF TERMS

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ACRONYMS

ALARA	as low as reasonably achievable
DCG	derived concentration guide
DOE	U.S.Department of Energy
EDB	emergency dump basin
EDT	emergency dump tank
EP	Environmental Protection
HEHF	Hanford Environmental Health Foundation
ICRP	International Commission on Radiological Protection
LWDF	liquid waste disposal facility
NPDES	national pollutant discharge elimination system
NRO	N Reactor Operations
OHP	Operational Health Physics
PNL	Pacific Northwest Laboratory
PUREX	Plutonium Uranium Extraction (Plant)
SNM	special nuclear material
Supply System	Washington Public Power Supply System
TLD	thermoluminescent dosimeter
UST	U.S. Testing Company, Inc.
Westinghouse Hanford	Westinghouse Hanford Company

DEFINITIONS

Biological transport--Concerns one or more of the following processes:

- Movement of subsurface radioactivity to the surface by physiological plant processes
- Dispersion of such plants by the wind
- Contaminated urine and feces deposited by animals that have gained access to and ingested radioactivity
- Contaminated animals themselves that have ingested radioactivity directly or ingested other contaminated animals or plants
- Physical displacement of radioactivity by burrowing animals
- Nests built using contaminated materials.

Background radiation--Refers to regional levels of radioactivity produced by sources other than those of specific interest (e.g., the nuclear activities at the Hanford Site).

Biota--The plant and animal life of a specific region.

Chemical processing--Chemical treatment of material to selectively separate desired components. At the Hanford Site, plutonium, uranium, and fission products are chemically separated from irradiated fuels.

Controlled area--An area where access is controlled to protect individuals from extra exposure to radiation and radioactive materials.

Crib--A subsurface low-level liquid-waste disposal site that allows liquid waste to percolate into surrounding soil.

Decommissioning--The process of removing a facility or area from operation, often involving decontamination and/or disposal, plus incorporating appropriate controls and safeguards.

Decontamination--The removal of radioactivity from a surface or from within another material.

Environmental surveillance--A survey and sampling program designed to determine radiological impact due to site operations.

Groundwater--Water that exists below ground surface (i.e., within the zone of saturation).

Less than detectable--An analytical term for a radionuclide concentration in a sample that is lower than the minimum detection capabilities of that analytical equipment or process.

Quality assurance--A program designed to maintain the quality of the results of a program within established limits of acceptance.

Radiation survey--Evaluation of an area or object with portable instruments to identify radioactive materials and radiation fields present.

Radiological Control Area--An area where access is controlled to protect individuals from exposure to radiation and/or radioactive materials. In the Separations Area, control areas include, but are not limited to, areas posted as Radiation Area, Surface Contamination, and Underground Radioactive Materials--all describing the radiological condition of the area within.

Retired waste site--A waste site that is isolated and no longer available to receive waste in any form.

Surface contamination--A radiological control status that refers to radioactivity on the surface of the ground that exceeds the Soil Contamination Standard.

Thermoluminescent dosimeter--A chip or series of chips used for measuring external gamma radiation. It consists of a material capable of absorbing energy imparted by ionizing radiation, then emitting light as a result of thermal stimulation. A measure of that light is proportional to the radioactivity absorbed.

Water table--The upper boundary of an unconfined aquifer below which saturated groundwater occurs.

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APPENDIX C

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Table C-1. Concentrations of Radionuclides Detected in 100-N Area Air Samples (pCi/m^3).

Sample Location[a]	Number of Samples		^{54}Mn	^{60}Co	^{103}Ru	^{131}I	^{137}Cs
A-1	9	Maximum	<7.5 E-02	1.7 E-01	<5.4 E-02	<5.8 E-02	<7.5 E-02
		Minimum	<5.6 E-03	3.0 E-02	<5.4 E-03	<6.2 E-03	<6.8 E-03
		Average	<2.1 E-02	7.1 E-02	<1.7 E-02	<1.8 E-02	<2.1 E-02
		Stan. Dev.	1.9 E-02	4.4 E-02	1.3 E-02	1.4 E-02	1.9 E-02
A-2	13	Maximum	<2.2 E-02	2.2 E-01	<2.1 E-02	<2.1 E-02	<2.9 E-02
		Minimum	<8.9 E-03	1.8 E-02	<1.1 E-02	<1.0 E-02	<6.5 E-03
		Average	<1.5 E-02	6.0 E-02	<1.3 E-02	<1.4 E-02	<1.6 E-02
		Stan. Dev.	3.6 E-03	6.0 E-02	2.7 E-03	3.0 E-03	5.4 E-03
A-3	14	Maximum	<2.6 E-02	8.0 E-02	<2.9 E-02	<7.0 E-02	<3.3 E-02
		Minimum	<8.3 E-03	1.7 E-02	<8.5 E-03	<9.3 E-03	<1.2 E-02
		Average	<1.6 E-02	4.6 E-02	<1.5 E-02	<1.8 E-02	<1.9 E-02
		Stan. Dev.	5.3 E-03	2.1 E-02	5.2 E-03	1.5 E-02	6.6 E-03
A-4	14	Maximum	<7.1 E-02	3.7 E-01	<7.0 E-02	<7.8 E-02	<9.2 E-02
		Minimum	<9.1 E-03	1.8 E-02	<9.1 E-03	<8.9 E-03	<1.1 E-02
		Average	<2.4 E-02	9.1 E-02	<2.2 E-02	<2.5 E-02	<2.5 E-02
		Stan. Dev.	1.8 E-02	1.1 E-01	1.7 E-02	2.2 E-02	2.1 E-02
		D.C.G.[b]	2.0 E+03	8.0 E+01	2.0 E+03	4.0 E+02	4.0 E+02

[a]Locations identified in Figure 2-1.
[b]D.C.G. = U.S. Department of Energy (DOE) Derived Concentration Guides.

PST89-3165-C-1

Table C-2. Concentrations of Radionuclides Detected in 100-N Area Air Samples (pCi/m^3).

Sample Location*	Date	^{54}Mn	^{60}Co	^{103}Ru	^{131}I	^{137}Cs
A-1	01/11/88	<1.6 E-02	6.0 E-02	<1.4 E-02	<1.5 E-02	<1.4 E-02
	02/05/88	<7.5 E-02	1.2 E-01	<5.4 E-02	<5.8 E-02	<7.5 E-02
	06/24/88	<1.8 E-02	8.6 E-02	<1.3 E-02	<1.4 E-02	<1.5 E-02
	07/22/88	<1.7 E-02	1.7 E-01	<1.2 E-02	<1.3 E-02	<1.3 E-02
	09/15/88	<5.6 E-03	3.3 E-02	<5.4 E-03	<6.2 E-03	<6.8 E-03
	10/12/88	<1.7 E-02	5.0 E-02	<1.5 E-02	<1.4 E-02	<1.8 E-02
	11/09/88	<1.6 E-02	4.7 E-02	<1.2 E-02	<1.5 E-02	<1.7 E-02
	12/07/88	<1.6 E-02	4.2 E-02	1.3 E-02	<1.6 E-02	<1.8 E-02
	01/06/89	<1.1 E-02	3.0 E-02	<1.1 E-02	<1.1 E-02	<1.4 E-02

*Location identified in Figure 2-1.

PST89-3165-C-2

Table C-3. Concentrations of Radionuclides Detected in 100-N Area Air Samples (pCi/m^3).

Sample Location*	Date	^{54}Mn	^{60}Co	^{103}Ru	^{131}I	^{137}Cs
A-2	01/11/88	<1.3 E-02	2.9 E-02	<1.3 E-02	<1.3 E-02	<1.5 E-02
	02/05/88	<1.2 E-02	1.8 E-02	<1.2 E-02	<1.1 E-02	<1.3 E-02
	03/07/88	<1.1 E-02	2.3 E-02	<1.2 E-02	<1.4 E-02	<6.5 E-03
	04/01/88	<1.3 E-02	3.3 E-02	<1.2 E-02	<1.2 E-02	<1.8 E-02
	04/29/88	<1.3 E-02	7.1 E-02	<1.4 E-02	<1.1 E-02	<1.5 E-02
	05/27/88	<1.8 E-02	1.7 E-01	<1.1 E-02	<1.3 E-02	<1.2 E-02
	06/22/88	<1.5 E-02	5.6 E-02	<1.2 E-02	<1.3 E-02	<1.4 E-02
	07/22/88	<2.0 E-02	<3.9 E-02	<2.1 E-02	<2.1 E-02	<2.9 E-02
	08/19/88	<2.2 E-02	2.2 E-01	<1.3 E-02	<1.3 E-02	<2.2 E-02
	10/17/88	<1.6 E-02	2.9 E-02	<1.2 E-02	<1.3 E-02	<1.2 E-02
	11/11/88	<1.6 E-02	3.8 E-02	<1.7 E-02	<1.7 E-02	<2.1 E-02
	12/07/88	<1.8 E-02	3.2 E-02	<1.5 E-02	<1.8 E-02	<1.7 E-02
	01/06/89	<8.9 E-03	2.0 E-02	<1.1 E-02	<1.0 E-02	<1.5 E-02

*Location identified in Figure 2-1.

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Table C-4. Concentrations of Radionuclides Detected in 100-N Area Air Samples (pCi/m^3).

Sample Location*	Date	^{54}Mn	^{60}Co	^{103}Ru	^{131}I	^{137}Cs
A-3	01/11/88	<1.3 E-02	1.7 E-02	<1.2 E-02	<1.2 E-02	<1.8 E-02
	02/05/88	<1.4 E-02	<2.2 E-02	<1.5 E-02	<1.4 E-02	<1.7 E-02
	03/07/88	<1.0 E-02	2.5 E-02	<8.5 E-03	<1.1 E-02	<1.2 E-02
	04/01/88	<1.4 E-02	4.5 E-02	<1.2 E-02	<1.2 E-02	<1.4 E-02
	04/29/88	<8.3 E-03	<2.1 E-02	<1.1 E-02	<9.3 E-03	<1.3 E-02
	05/27/88	<1.4 E-02	5.2 E-02	<1.2 E-02	<1.3 E-02	<1.2 E-02
	06/10/88	<2.6 E-02	4.3 E-02	<2.9 E-02	<7.0 E-02	<2.8 E-02
	07/20/88	<2.3 E-02	6.0 E-02	<2.2 E-02	<2.2 E-02	<3.1 E-02
	08/17/88	<2.5 E-02	7.5 E-02	<1.9 E-02	<2.1 E-02	<3.3 E-02
	09/15/88	<1.3 E-02	6.3 E-02	<1.0 E-02	<1.1 E-02	<1.7 E-02
	10/12/88	<1.8 E-02	3.5 E-02	<1.5 E-02	<1.7 E-02	<1.8 E-02
	11/09/88	<1.7 E-02	8.0 E-02	<1.6 E-02	<1.5 E-02	<1.8 E-02
	12/07/88	<1.1 E-02	2.9 E-02	<1.3 E-02	<1.0 E-02	<1.6 E-02
	01/04/89	<1.3 E-02	7.6 E-02	<1.3 E-02	<1.4 E-02	<1.8 E-02

*Location identified in Figure 2-1.

.PST89-3165-C-4

Table C-5. Concentrations of Radionuclides Detected in 100-N Area Air Samples (pCi/m^3).

Sample Location*	Date	^{54}Mn	^{60}Co	^{103}Ru	^{131}I	^{137}Cs
A-4	01/11/88	<1.3 E-02	5.8 E-02	<1.0 E-02	<1.2 E-02	<1.3 E-02
	01/25/88	<2.6 E-02	<3.7 E-02	<2.4 E-02	<2.8 E-02	<3.2 E-02
	02/05/88	<6.2 E-02	3.7 E-01	<5.2 E-02	<5.4 E-02	<5.1 E-02
	03/07/88	<9.1 E-03	3.1 E-02	<9.1 E-03	<8.9 E-03	<1.1 E-02
	04/01/88	<1.9 E-02	3.5 E-02	<1.3 E-02	<1.5 E-02	<1.7 E-02
	04/29/88	<1.8 E-02	3.5 E-02	<1.3 E-02	<1.2 E-02	<1.5 E-02
	05/27/88	<1.6 E-02	2.7 E-02	<1.3 E-02	<1.4 E-02	<1.4 E-02
	06/10/88	<3.2 E-02	1.6 E-01	<3.2 E-02	<7.8 E-02	<3.2 E-02
	08/16/88	<7.1 E-02	3.0 E-01	<7.0 E-02	<6.2 E-02	<9.2 E-02
	09/15/88	<1.3 E-02	3.8 E-02	<1.2 E-02	<1.2 E-02	<1.5 E-02
	10/12/88	<1.9 E-02	8.8 E-02	<1.7 E-02	<1.7 E-02	<1.7 E-02
	11/09/88	<1.1 E-02	<1.8 E-02	<1.0 E-02	<1.2 E-02	<1.3 E-02
	12/07/88	<1.3 E-02	2.9 E-02	<1.4 E-02	<1.4 E-02	<1.2 E-02
	01/04/89	<1.7 E-02	5.2 E-02	<1.4 E-02	<1.4 E-02	<1.9 E-02

*Location identified in Figure 2-1.

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APPENDIX D

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Table D-1. Concentrations of ^{3}H Detected in 100-Area Groundwater (pCi/L). (Sheet 1 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	8.8 E+04	8.4 E+04	8.6 E+04	2.0 E+03
N-3	2	4.1 E+04	4.1 E+04	4.1 E+04	0.0 E+00
N-4	2	8.7 E+04	7.7 E+04	8.2 E+04	5.0 E+03
N-5	3	3.3 E+04	2.6 E+04	2.9 E+04	2.9 E+03
N-6	3	1.3 E+05	5.9 E+04	9.1 E+04	2.9 E+04
N-8T	52	1.0 E+05	7.1 E+04	8.3 E+04	9.4 E+03
N-14	4	1.2 E+05	3.7 E+04	9.0 E+04	3.2 E+04
N-15	2	5.5 E+04	4.4 E+04	5.0 E+04	5.5 E+03
N-16	2	<1.9 E+02	<1.6 E+02	<1.8 E+02	1.5 E+01
N-18	4	2.7 E+04	1.3 E+04	2.1 E+04	5.0 E+03
N-19	2	3.7 E+03	1.8 E+03	2.8 E+03	9.5 E+02
N-20	2	1.4 E+03	1.1 E+03	1.3 E+03	1.5 E+02
N-21	4	1.5 E+03	4.9 E+02	1.1 E+03	4.4 E+02
N-22	2	6.6 E+02	1.0 E+01	3.4 E+02	3.2 E+02
N-23	2	2.8 E+03	1.9 E+03	2.4 E+03	4.5 E+02
N-24	1	4.0 E+02	4.0 E+02	4.0 E+02	0.0 E+00
N-25	4	3.7 E+02	<5.7 E+01	2.2 E+02	1.1 E+02
N-27	2	8.9 E+04	4.8 E+04	6.9 E+04	2.1 E+04
N-28	4	1.4 E+05	4.8 E+04	8.1 E+04	3.5 E+04
N-29	3	6.8 E+04	3.9 E+04	5.4 E+04	1.2 E+04
N-30	2	9.2 E+04	9.0 E+04	9.1 E+04	1.0 E+03
N-31	4	4.4 E+05	5.3 E+04	1.5 E+05	1.7 E+05
N-32	2	9.4 E+04	5.8 E+04	7.6 E+04	1.8 E+04
N-33	2	7.7 E+04	5.8 E+04	6.8 E+04	9.5 E+03
N-36	4	1.7 E+05	5.9 E+04	9.5 E+04	4.4 E+04
N-37	2	8.2 E+04	6.6 E+04	7.4 E+04	8.0 E+03
N-39	2	1.1 E+05	5.0 E+04	8.0 E+04	3.0 E+04
N-45	5	4.6 E+05	3.1 E+04	1.9 E+05	1.6 E+05
N-49	2	1.5 E+05	1.3 E+05	1.4 E+05	1.0 E+04
N-50	2	1.3 E+05	1.2 E+05	1.3 E+05	5.0 E+03

PST89-3165-D-1

Table D-1. Concentrations of ^{3}H Detected in 100-Area Groundwater (pCi/L). (Sheet 2 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-51	2	9.7 E+04	9.3 E+04	9.5 E+04	2.0 E+03
N-52	2	9.7 E+04	8.0 E+04	8.9 E+04	8.5 E+03
K-27	2	2.7 E+03	1.8 E+03	2.3 E+03	4.5 E+02
K-28	2	3.3 E+03	3.1 E+03	3.2 E+03	1.0 E+02
K-29	2	1.7 E+04	1.1 E+04	1.4 E+04	3.0 E+03
K-30	2	1.2 E+06	1.2 E+06	1.2 E+06	0.0 E+00

D.C.G.: 2.0 E+06 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

PST89-3165-D-1

Table D-2. Concentrations of ^{60}Co Detected in 100-Area Groundwater (pCi/L). (Sheet 1 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	7.7 E+01	6.8 E+01	7.3 E+01	4.5 E+00
N-3	2	7.5 E+01	4.4 E+01	6.0 E+01	1.6 E+01
N-4	3	1.2 E+02	2.9 E+01	8.6 E+01	4.1 E+01
N-5	3	1.3 E+02	1.1 E+01	5.1 E+01	5.6 E+01
N-6	3	9.0 E+01	5.4 E+01	6.8 E+01	1.6 E+01
N-8T	52	4.8 E+02	4.6 E+01	9.0 E+01	5.8 E+01
N-14	4	1.2 E+02	1.7 E+01	7.2 E+01	4.0 E+01
N-15	2	5.0 E+01	3.1 E+01	4.1 E+01	9.5 E+00
N-16	3	1.2 E+01	5.1 E+00	7.6 E+00	3.1 E+00
N-18	4	9.2 E+01	1.5 E+01	5.3 E+01	2.7 E+01
N-19	3	4.2 E+02	1.3 E+02	2.6 E+02	1.2 E+02
N-20	3	3.1 E+01	1.2 E+01	1.9 E+01	8.5 E+00
N-21	3	8.7 E+00	2.9 E+00	6.7 E+00	2.7 E+00
N-22	1	1.4 E+01	1.4 E+01	1.4 E+01	0.0 E+00
N-23	3	5.4 E+01	2.7 E+01	3.6 E+01	1.3 E+01
N-24	2	1.9 E+01	1.5 E+01	1.7 E+01	2.0 E+00
N-25	5	1.8 E+01	2.0 E+00	8.3 E+00	6.8 E+00
N-27	3	1.8 E+02	1.3 E+02	1.5 E+02	2.4 E+01
N-28	4	1.0 E+02	3.5 E+01	7.3 E+01	2.5 E+01
N-29	3	1.2 E+02	1.6 E+01	7.5 E+01	4.4 E+01
N-30	2	7.3 E+02	6.8 E+02	7.0 E+02	2.5 E+01
N-31	4	8.7 E+01	5.2 E+01	7.5 E+01	1.4 E+01
N-32	3	2.0 E+02	7.1 E+01	1.3 E+02	5.4 E+01
N-33	3	1.3 E+02	7.2 E+01	1.0 E+02	2.4 E+01
N-36	4	1.2 E+02	5.6 E+01	9.2 E+01	2.5 E+01
N-37	2	1.3 E+02	9.9 E+01	1.1 E+02	1.6 E+01
N-39	2	2.0 E+02	6.4 E+01	1.3 E+02	6.8 E+01
N-45	5	1.2 E+02	6.8 E+01	9.0 E+01	1.7 E+01
N-47	12	3.9 E+01	5.9 E+00	2.0 E+01	9.8 E+00

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9 2 1 2 4 9 5 1 9 7 7

Table D-2. Concentrations of ^{60}Co Detected in 100-Area Groundwater (pCi/L). (Sheet 2 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-48	12	3.9 E+01	6.9 E+00	1.8 E+01	8.2 E+00
K-27	3	8.5 E+00	7.7 E+00	8.0 E+00	3.6 E−01
K-28	3	2.0 E+01	7.5 E+00	1.2 E+01	5.7 E+00
K-29	3	9.9 E+00	5.6 E+00	7.1 E+00	2.0 E+00
K-30	3	1.0 E+01	5.7 E+00	7.9 E+00	1.8 E+00

D.C.G.: 5.0 E+03 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-3. Concentrations of ^{90}Sr Detected in 100-Area Groundwater (pCi/L). (Sheet 1 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	2.2 E+03	1.6 E+03	1.9 E+03	3.0 E+02
N-3	2	2.6 E+03	2.3 E+03	2.5 E+03	1.5 E+02
N-4	2	1.2 E+01	1.2 E+01	1.2 E+01	0.0 E+00
N-5	3	5.4 E+03	1.5 E+03	2.9 E+03	1.8 E+03
N-6	3	7.8 E+01	4.2 E+01	5.9 E+01	1.5 E+01
N-8T	52	8.0 E+03	5.1 E+03	6.5 E+03	7.7 E+02
N-14	4	1.4 E+03	1.1 E+03	1.2 E+03	1.2 E+02
N-15	2	1.0 E+00	9.0 E-01	9.5E-01	5.0 E-02
N-16	2	<2.4 E-01	<1.2 E-01	<1.8E-01	6.0 E-02
N-18	4	1.4 E+03	3.9 E+02	7.8 E+02	3.8 E+02
N-19	2	8.6 E+01	7.7 E+01	8.2 E+01	4.5 E+00
N-20	2	1.4 E+01	1.2 E+01	1.3 E+01	1.0 E+00
N-21	4	1.1 E+01	7.5 E+00	9.3 E+00	1.7 E+00
N-22	1	<2.5 E-01	<2.5 E-01	<2.5 E-01	0.0 E+00
N-23	2	1.4 E+00	1.2 E+00	1.3 E+00	1.0 E-01
N-24	1	1.6 E+01	1.6 E+01	1.6 E+01	0.0 E+00
N-25	4	3.1 E+01	5.1 E-02	8.0 E+00	1.3 E+01
N-27	2	2.8 E+02	1.5 E+02	2.2 E+02	6.5 E+01
N-28	4	8.0 E+02	4.9 E+01	2.6 E+02	3.1 E+02
N-29	3	1.1 E+03	6.0 E+02	8.8 E+02	2.1 E+02
N-30	2	4.7 E+00	4.4 E+00	4.6 E+00	1.5 E-01
N-31	4	3.1 E+01	2.0 E+01	2.6 E+01	4.2 E+00
N-32	2	8.1 E+00	6.1 E+00	7.1 E+00	1.0 E+00
N-33	2	4.9 E+02	4.5 E+02	4.7 E+02	2.0 E+01
N-36	4	2.0 E+02	1.6 E+02	1.7 E+02	1.6 E+01
N-37	2	4.7 E+01	3.7 E+01	4.2 E+01	5.0 E+00
N-39	2	9.8 E+02	8.8 E+02	9.3 E+02	5.0 E+01
N-45	5	3.5 E+03	1.2 E+03	2.5 E+03	7.9 E+02
N-49	2	<7.2 E-01	<7.0 E-01	<7.1 E-01	1.0 E-02
N-50	2	<1.1 E-02	<7.7 E-03	<9.4 E-03	1.6 E-03

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Table D-3. Concentrations of ^{90}Sr Detected in 100-Area Groundwater (pCi/L). (Sheet 2 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-51	2	<1.2 E-01	<8.6 E-02	<1.0 E-01	1.7 E-02
N-52	2	<2.8 E-02	<2.7 E-03	<1.5 E-02	1.3 E-02
K-27	2	<1.6 E-01	<7.2 E-02	<1.2 E-01	4.4 E-02
K-28	2	<3.7 E-01	<1.0 E-01	<2.4 E-01	1.3 E-01
K-29	2	<6.1 E-01	<1.0 E-01	<3.5 E-01	2.6 E-01
K-30	2	<2.8 E-01	<2.5 E-01	<2.7 E-01	1.5 E-02

D.C.G.: 1.0 E+03 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-4. Concentrations of ^{103}Ru Detected in 100-Area Groundwater (pCi/L).

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	<4.9 E+00	<4.4 E+00	<4.7 E+00	2.5 E-01
N-3	2	<5.4 E+00	<4.9 E+00	<5.2 E+00	2.5 E-01
N-4	3	<7.0 E+00	<4.8 E+00	<5.7 E+00	9.3 E-01
N-5	1	<4.9 E+00	<4.9 E+00	<4.9 E+00	0.0 E+00
N-8T	52	<6.9 E+00	<4.1 E+00	<4.7 E+00	6.3 E-01
N-14	3	<7.7 E+00	<5.7 E+00	<6.6 E+00	8.4 E-01
N-15	2	<5.2 E+00	<3.9 E+00	<4.5 E+00	6.5 E-01
N-16	3	<5.3 E+00	<4.1 E+00	<4.8 E+00	5.2 E-01
N-18	3	<5.6 E+00	<4.3 E+00	<5.1 E+00	5.6 E-01
N-19	3	<6.6 E+00	<5.2 E+00	<5.8 E+00	5.8 E-01
N-20	3	<6.9 E+00	<4.4 E+00	<5.3 E+00	1.2 E+00
N-21	3	<6.0 E+00	<3.4 E+00	<4.8 E+00	1.1 E+00
N-22	2	<9.5 E+00	<9.2 E+00	<9.3 E+00	1.5 E-01
N-23	3	<6.6 E+00	<4.5 E+00	<5.3 E+00	9.1 E-01
N-24	2	<1.3 E+01	<5.3 E+00	<9.2 E+00	3.8 E+00
N-25	3	<5.8 E+01	<4.8 E+00	<2.3 E+01	2.5 E+01
N-27	3	<7.6 E+00	<5.2 E+00	<6.6 E+00	1.0 E+00
N-28	3	<6.4 E+00	<4.6 E+00	<5.7 E+00	7.7 E-01
N-29	3	<6.7 E+00	<5.1 E+00	<5.9 E+00	6.5 E-01
N-30	2	<7.2 E+00	<6.8 E+00	<7.0 E+00	2.0 E-01
N-31	3	<8.9 E+00	<5.1 E+00	<6.5 E+00	1.7 E+00
N-32	3	<7.6 E+00	<5.1 E+00	<6.5 E+00	1.1 E+00
N-33	3	<7.8 E+00	<6.0 E+00	<7.0 E+00	7.4 E-01
N-47	12	<1.7 E+01	<4.4 E+00	<1.0 E+01	4.1 E+00
N-48	12	<1.8 E+01	<4.5 E+00	<1.1 E+01	4.5 E+00
K-27	3	<8.9 E+00	<5.7 E+00	<7.0 E+00	1.4 E+00
K-28	3	<7.3 E+00	<4.9 E+00	<5.8 E+00	1.1 E+00
K-29	3	<5.6 E+00	<4.6 E+00	<5.0 E+00	4.2 E-01
K-30	3	<6.7 E+00	<4.5 E+00	<5.5 E+00	9.1 E-01

D.C.G.: 5.0 E+04 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-5. Concentrations of ^{106}Ru Detected in 100-Area Groundwater (pCi/L). (Sheet 1 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	4.4 E+01	<4.2 E+01	4.3 E+01	1.0 E+00
N-3	2	<4.3 E+01	<2.3 E+01	<3.3 E+01	1.0 E+01
N-4	3	<5.4 E+01	<4.5 E+01	<5.0 E+01	3.9 E+00
N-5	3	<4.7 E+01	<1.0 E+00	<2.2 E+01	1.9 E+01
N-6	3	7.0 E+01	<4.9 E+00	4.7 E+01	3.0 E+01
N-8T	52	8.4 E+01	2.5 E+01	4.7 E+01	1.1 E+01
N-14	4	<5.9 E+01	<5.6 E+00	<3.4 E+01	1.9 E+01
N-15	2	<4.7 E+01	<2.6 E+01	<3.7 E+01	1.0 E+01
N-16	3	<4.9 E+01	<3.5 E+01	<4.2 E+01	5.7 E+00
N-18	4	<5.1 E+01	<5.6 E+00	<3.6 E+01	1.8 E+01
N-19	3	<6.9 E+01	<4.1 E+01	<5.5 E+01	1.1 E+01
N-20	3	<6.4 E+01	<3.8 E+01	<4.7 E+01	1.2 E+01
N-21	3	<5.9 E+01	<2.6 E+01	<4.0 E+01	1.4 E+01
N-22	2	<8.7 E+01	<4.3 E+01	<6.5 E+01	2.2 E+01
N-23	3	<4.2 E+01	<3.7 E+01	<3.9 E+01	2.2 E+00
N-24	2	<4.6 E+01	<4.4 E+01	<4.5 E+01	1.0 E+00
N-25	5	<5.5 E+01	<5.8 E+00	<3.2 E+01	1.7 E+01
N-27	3	9.6 E+01	6.6 E+01	7.9 E+01	1.3 E+01
N-28	4	<7.1 E+01	<3.1 E+00	<4.2 E+01	2.5 E+01
N-29	3	<5.8 E+01	<4.4 E+01	<5.0 E+01	5.8 E+00
N-30	2	9.8 E+01	5.9 E+01	7.9 E+01	2.0 E+01
N-31	4	8.4 E+01	4.8 E+01	6.8 E+01	1.3 E+01
N-32	3	7.8 E+01	3.3 E+01	6.2 E+01	2.1 E+01
N-33	3	1.2 E+02	2.7 E+01	6.4 E+01	4.0 E+01
N-36	4	1.2 E+02	<3.8 E+01	8.8 E+01	3.5 E+01
N-37	2	<2.8 E+01	<1.8 E+01	<2.3 E+01	5.0 E+00
N-39	2	1.4 E+02	<2.3 E+01	8.2 E+01	5.8 E+01
N-45	5	6.7 E+01	<6.7 E+00	3.1 E+01	2.1 E+01

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Table D-5. Concentrations of ^{106}Ru Detected in 100-Area Groundwater (pCi/L). (Sheet 2 of 2)

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-47	12	<1.9 E+02	<3.9 E+01	<9.9 E+01	4.2 E+01
N-48	12	<1.9 E+02	<3.9 E+01	<1.0 E+02	4.4 E+01
K-27	3	<4.2 E+01	<3.8 E+01	<3.9 E+01	1.9 E+00
K-28	3	<6.7 E+01	<3.6 E+01	<4.7 E+01	1.4 E+01
K-29	3	<5.0 E+01	<3.6 E+01	<4.1 E+01	6.4 E+00
K-30	3	<6.2 E+01	<3.4 E+01	<4.5 E+01	1.2 E+01

D.C.G.: 6.0 E+03 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-6. Concentrations of ^{124}Sb Detected in 100-Area Groundwater (pCi/L).

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	<7.2 E+00	<6.4 E+00	<6.8 E+00	4.0 E-01
N-3	2	<8.2 E+00	<7.2 E+00	<7.7 E+00	5.0 E-01
N-4	3	<1.3 E+01	<7.8 E+00	<9.8 E+00	2.3 E+00
N-5	1	<6.8 E+00	<6.8 E+00	<6.8 E+00	0.0 E+00
N-8T	52	<9.8 E+00	<5.0 E+00	<7.2 E+00	1.0 E+00
N-14	3	<1.0 E+01	<9.4 E+00	<9.8 E+00	2.8 E-01
N-15	2	<8.1 E+00	<4.7 E+00	<6.4 E+00	1.7 E+00
N-16	3	<1.0 E+01	<6.3 E+00	<8.1 E+00	1.5 E+00
N-18	3	<9.5 E+00	<7.6 E+00	<8.7 E+00	8.0 E-01
N-19	3	<1.6 E+01	<8.1 E+00	<1.1 E+01	3.6 E+00
N-20	3	<1.6 E+01	<6.8 E+00	<1.0 E+01	4.2 E+00
N-21	3	<1.4 E+01	<5.7 E+00	<8.6 E+00	3.8 E+00
N-22	2	<2.3 E+01	<1.1 E+01	<1.7 E+01	6.0 E+00
N-23	3	<8.3 E+00	<6.7 E+00	<7.6 E+00	6.7 E-01
N-24	2	<1.4 E+01	<7.3 E+00	<1.1 E+01	3.3 E+00
N-25	3	<3.9 E+01	<5.8 E+00	<1.7 E+01	1.5 E+01
N-27	3	<1.7 E+01	<6.1 E+00	<1.1 E+01	4.6 E+00
N-28	3	<1.7 E+01	<6.6 E+00	<1.1 E+01	4.5 E+00
N-29	3	<1.6 E+01	<7.6 E+00	<1.1 E+01	3.6 E+00
N-30	2	<7.8 E+00	<6.5 E+00	<7.2 E+00	6.5 E-01
N-31	3	<1.1 E+01	<5.9 E+00	<7.9 E+00	2.2 E+00
N-32	3	<1.6 E+01	<6.7 E+00	<1.1 E+01	3.8 E+00
N-33	3	<9.8 E+00	<9.1 E+00	<9.4 E+00	2.9 E-01
N-47	12	<2.9 E+01	<7.0 E+00	<1.7 E+01	7.6 E+00
N-48	12	<3.6 E+01	<7.4 E+00	<2.0 E+01	8.9 E+00
K-27	3	<9.7 E+00	<7.9 E+00	<8.9 E+00	7.5 E-01
K-28	3	<1.7 E+01	<7.1 E+00	<1.0 E+01	4.6 E+00
K-29	3	<9.7 E+00	<7.1 E+00	<8.2 E+00	1.1 E+00
K-30	3	<1.6 E+01	<6.1 E+00	<9.6 E+00	4.5 E+00

D.C.G.: 2.0 E+04 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-7. Concentrations of ^{125}Sb Detected in 100-Area Groundwater (pCi/L).

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	4.2 E+01	3.1 E+01	3.7 E+01	5.5 E+00
N-3	2	2.6 E+01	1.5 E+01	2.1 E+01	5.5 E+00
N-4	3	4.9 E+01	1.5 E+01	3.8 E+01	1.6 E+01
N-5	1	9.9 E+01	9.9 E+01	9.9 E+01	0.0 E+00
N-8T	52	6.0 E+01	4.0 E-01	4.3 E+01	9.3 E+00
N-14	3	6.6 E+01	5.6 E+01	6.1 E+01	4.1 E+00
N-15	2	1.6 E+01	8.3 E+00	1.2 E+01	3.8 E+00
N-16	3	<1.4 E+01	<1.2 E+01	<1.3 E+01	8.2 E-01
N-18	3	3.8 E+01	<1.4 E+01	2.4 E+01	1.0 E+01
N-19	3	1.0 E+02	1.5 E+01	5.4 E+01	3.5 E+01
N-20	3	<1.8 E+01	<1.3 E+01	<1.5 E+01	2.4 E+00
N-21	3	<1.8 E+01	<9.4 E+00	<1.3 E+01	3.6 E+00
N-22	2	<2.1 E+01	<1.3 E+01	<1.7 E+01	4.0 E+00
N-23	3	1.4 E+01	9.5 E+00	1.3 E+01	2.1 E+00
N-24	2	<1.4 E+01	<9.8 E+00	<1.2 E+01	2.1 E+00
N-25	3	<1.4 E+01	<1.2 E+01	<1.3 E+01	8.2 E-01
N-27	3	1.7 E+02	1.1 E+02	1.3 E+02	2.6 E+01
N-28	4	1.5 E+02	1.0 E+02	1.2 E+02	1.9 E+01
N-29	3	1.6 E+02	1.2 E+02	1.5 E+02	1.9 E+01
N-30	2	6.6 E+01	4.8 E+01	5.7 E+01	9.0 E+00
N-31	3	1.6 E+02	1.1 E+02	1.4 E+02	2.1 E+01
N-32	3	1.2 E+02	7.2 E+01	9.0 E+01	2.1 E+01
N-33	3	1.2 E+02	9.4 E+01	1.0 E+02	1.1 E+01
N-36	3	1.4 E+02	9.6 E+01	1.2 E+02	1.8 E+01
N-45	1	1.7 E+02	1.7 E+02	1.7 E+02	0.0 E+00
N-47	12	<5.3 E+01	<1.4 E+01	<3.3 E+01	1.3 E+01
N-48	12	<5.3 E+01	<1.4 E+01	<3.5 E+01	1.4 E+01
K-27	3	2.1 E+02	1.9 E+02	2.0 E+02	8.2 E+00
K-28	3	3.6 E+01	3.1 E+01	3.4 E+01	2.1 E+00
K-29	3	<1.4 E+01	<1.2 E+01	<1.3 E+01	8.2 E-01
K-30	3	<1.7 E+01	<1.2 E+01	<1.4 E+01	2.2 E+00

D.C.G.: 6.0 E+04 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-8. Concentrations of ^{131}I Detected in 100-Area Groundwater (pCi/L).

Well*	Number of Samples	Maximum	Minimum	Average	Std. Dev.
N-2	2	<6.7 E+00	<5.9 E+00	<6.3 E+00	4.0 E-01
N-3	2	<7.2 E+00	<6.1 E+00	<6.7 E+00	5.5 E-01
N-4	3	<3.2 E+01	<6.3 E+00	<1.5 E+01	1.2 E+01
N-5	1	<6.2 E+00	<6.2 E+00	<6.2 E+00	0.0 E+00
N-8T	52	<1.7 E+01	<6.0 E+00	<1.1 E+01	2.9 E+00
N-14	3	<7.5 E+01	<7.1 E+00	<3.9 E+01	2.8 E+01
N-15	2	<1.9 E+01	<6.3 E+00	<1.3 E+01	6.3 E+00
N-16	3	<9.4 E+00	<5.8 E+00	<7.4 E+00	1.5 E+00
N-18	3	<6.8 E+00	<4.8 E+00	<6.0 E+00	8.5 E-01
N-19	3	<8.5 E+00	<6.9 E+00	<7.4 E+00	7.5 E-01
N-20	3	<1.3 E+01	<5.5 E+00	<8.4 E+00	3.3 E+00
N-21	3	<8.2 E+00	<4.7 E+00	<6.6 E+00	1.4 E+00
N-22	2	<2.6 E+02	<1.3 E+01	<1.4 E+02	1.2 E+02
N-23	3	<6.2 E+01	<6.9 E+00	<2.6 E+01	2.6 E+01
N-24	2	<1.1 E+03	<9.7 E+00	<5.5 E+02	5.5 E+02
N-25	2	<7.9 E+00	<7.4 E+00	<7.7 E+00	2.5 E-01
N-27	3	<1.8 E+01	<9.6 E+00	<1.4 E+01	3.5 E+00
N-28	3	<9.6 E+00	<7.3 E+00	<8.2 E+00	1.0 E+00
N-29	3	<1.4 E+01	<8.1 E+00	<1.0 E+01	2.7 E+00
N-30	2	<1.4 E+01	<1.2 E+01	<1.3 E+01	1.0 E+00
N-31	3	<1.9 E+02	<9.0 E+00	<7.2 E+01	8.4 E+01
N-32	3	<2.3 E+01	<1.0 E+01	<1.8 E+01	5.7 E+00
N-33	3	<7.3 E+01	<2.0 E+01	<5.4 E+01	2.4 E+01
N-47	12	<1.9 E+01	<4.1 E+00	<1.2 E+01	4.9 E+00
N-48	12	<1.8 E+01	<4.7 E+00	<1.2 E+01	4.9 E+00
K-27	3	<2.0 E+02	<1.1 E+01	<8.3 E+01	8.3 E+01
K-28	3	<1.3 E+01	<8.8 E+00	<1.0 E+01	1.9 E+00
K-29	3	<1.1 E+01	<9.8 E+00	<1.1 E+01	5.7 E-01
K-30	2	<1.8 E+01	<1.1 E+01	<1.5 E+01	3.5 E+00

D.C.G.: 3.0 E+03 pCi/L.
*Locations identified in Figures 3-1 and 3-2.

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Table D-9. Concentrations of Oil and Grease Detected in 100-Area Groundwater (mg/L). (Sheet 1 of 2)

Date	N-16	N-17	N-18	N-19	N-20	N-21	N-22	N-23	N-24	N-25	N-26
01/05/88						<1.0	<1.0		<1.0		
01/12/88								<1.0		<1.0	<1.0
01/19/88	<1.0							<1.0		<1.0	<1.0
01/26/88		<1.0	<1.0						<1.0		
02/02/88				<1.0	1.4					<1.0	
02/09/88						<1.0	<1.0		<1.0		
02/16/88								<1.0		<1.0	<1.0
02/23/88	<1.0							<1.0		<1.0	<1.0
03/01/88		1.7	4.8						1.2		
03/08/88				<1.0	<1.0					<1.0	
03/15/88						<1.0			<1.0		
03/22/88								<1.0		<1.0	<1.0
03/29/88	<1.0							<1.0		<1.0	<1.0
04/05/88		<1.0	1.4						<1.0		
04/12/88				<1.0	<1.0					<1.0	
04/19/88							<1.0		<1.0		
05/03/88	<1.0							<1.0		<1.0	<1.0
05/10/88		<1.0	6.6						<1.0		
05/17/88				<1.0	<1.0					<1.0	
05/24/88						3.5			<1.0		
05/31/88								<1.0		<1.0	<1.0
06/07/88	1.1							1.0		1.1	1.9
06/09/88		9.8	1.1								
06/13/88		1.1	<1.0								
06/14/88		<1.0	3.4						<1.0		
06/21/88				<1.0	<1.0					<1.0	
06/28/88						<1.0	<1.0		<1.0		
07/05/88								<1.0		<1.0	<1.0
07/12/88	1.1							<1.0		<1.0	<1.0

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Table D-9. Concentrations of Oil and Grease Detected in 100-Area Groundwater (mg/L). (Sheet 2 of 2)

Date	N-16	N-17	N-18	N-19	N-20	N-21	N-22	N-23	N-24	N-25	N-26
07/19/88		<1.0	<1.0						<1.0		
07/26/88				1.0	<1.0					<1.0	
08/02/88						<1.0			<1.0		
08/09/88								1.7		2.4	5.6
08/16/88	<1.0							<1.0		<1.0	<1.0
08/23/88		<1.0	1.4								
09/06/88						<1.0			<1.0		
09/13/88										<1.0	
09/20/88	<1.0							<1.0		2.8	1.9
09/27/88		<1.0	<1.0						<1.0		
10/04/88				<1.0	<1.0					<1.0	
10/11/88						<1.0	<1.0		<1.0		
10/18/88								<1.0		<1.0	<1.0
10/25/88	13.8							<1.0		<1.0	<1.0
11/01/88		<1.0	<1.0						<1.0		
11/08/88				<1.0	<1.0					<1.0	
11/15/88						<1.0			<1.0		
11/22/88								<1.0		<1.0	<1.0
11/29/88	<1.0							<1.0		<1.0	<1.0
12/06/88		<1.0	<1.0						<1.0		
12/13/88				<1.0	<1.0					<1.0	
12/20/88						<1.0			1.1		
12/27/88								<1.0		<1.0	<1.0
Number of samples	10	12	12	9	9	10	5	19	20	29	19
Maximum	13.8	9.8	6.6	1.0	1.4	3.5	<1.0	1.7	1.2	2.8	5.6
Minimum	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Average	2.3	1.8	2.1	1.0	1.0	1.3	<1.0	1.0	1.0	1.1	1.3
Stan. Dev	3.8	2.4	1.8	0.0	0.1	0.8	0.0	0.2	0.0	0.4	1.0

*Locations identified in Figures 3-1.

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0 2 1 2 4 9 5 1 9 8 8

Table D-10. Average Radionuclide Concentrations Detected in Well K-27* from 1982 through 1988 (pCi/L).

Year	^{60}Co	^{103}Ru	^{124}Sb	^{125}Sb
1982	1.4 E+00	NR	1.1 E+02	1.0 E+02
1983	7.3 E+00	NR	NR	6.4 E+02
1984	9.7 E+00	NR	NR	5.2 E+02
1985	1.4 E+01	3.1 E+00	NR	4.0 E+02
1986	6.6 E+00	6.8 E+00	<8.7 E+00	3.3 E+02
1987	5.0 E+00	<8.0 E+00	<8.8 E+00	4.2 E+02
1988	8.0 E+00	<7.0 E+00	<8.9 E+00	2.0 E+02
D.C.G.	5.0 E+03	5.0 E+04	2.0 E+04	6.0 E+04

*Locations identified in Figures 3-4.
NR = Not reported.

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APPENDIX E

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Table E-1. Concentrations of Radionuclides Detected in Surface Soil Samples Near the 1301-N Liquid Waste Disposal Facility (pCi/g, dry weight).

Sample location[a]	Sample type	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}$Pu
N-1	S	<7.8 E-02	1.9 E+00	4.6 E-02	2.0 E-01	5.4 E-04	4.7 E-03
N-2	S	<2.1 E-01	2.5 E-01	7.5 E-01	8.0 E+00	6.3 E-03	3.8 E-02
N-3	S	3.2 E-01	1.1 E+01	7.1 E-01	7.5 E-01	3.7 E-03	3.3 E-02
N-4	S	3.3 E-02	6.2 E-01	1.4 E-01	6.1 E-01	8.1 E-04	9.3 E-03
N-5	S	<6.6 E-02	3.9 E-01	9.2 E-02	4.0 E-01	3.8 E-04	1.7 E-03
Average		1.4 E-01	7.8 E+00	3.5 E-01	2.0 E+00	2.3 E-03	1.7 E-02
Std. Dev		1.1 E-01	9.5 E+00	3.1 E-01	3.0 E+00	2.3 E-03	1.5 E-02
Hanford Site[b]		NR	NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-1.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-1

Table E-2. Concentrations of Radionuclides Detected in 100-N Surface Soil Samples (pCi/g, dry weight).

Sample location[a]	Sample type	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}$Pu
N-6	S	<6.5 E-02	3.4 E-01	2.0 E-01	3.3 E-01	2.7 E-05	6.0 E-03
N-7	S	<6.0 E-02	1.7 E-01	2.5 E-01	7.0 E-01	7.2 E-04	1.8 E-02
N-8	S	<7.6 E-02	3.5 E-01	1.6 E-01	4.0 E-01	2.6 E-04	1.3 E-02
N-9	S	<6.1 E-02	3.0 E-01	1.5 E-01	3.5 E-01	3.1 E-04	8.0 E-03
N-10	S	<6.6 E-02	4.8 E-01	9.1 E-02	2.5 E-01	5.5 E-04	5.8 E-03
N-11	S	<7.4 E-02	5.7 E-01	2.2 E-01	6.0 E-01	1.2 E-03	1.5 E-02
N-12	S	<6.6 E-02	1.5 E-01	2.3 E-02	1.3 E-01	9.5 E-05	5.2 E-04
Average		<6.7 E-02	3.4 E-01	1.6 E-01	3.9 E-01	4.5 E-04	9.5 E-03
Std. Dev		5.6 E-03	1.4 E-01	7.3 E-02	1.8 E-01	3.8 E-04	5.7 E-03
Hanford Site[b]		NR	NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-1.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-2

Table E-3. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-B/C Area Surface Soil Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
B-1	S	3.1 E-01	4.2 E-02	2.0 E-01	<7.2 E-04	1.3 E-03
B-2	S	2.5 E-01	4.0 E-02	1.9 E+00	5.3 E-04	3.3 E-02
C-1	S	3.7 E-01	1.3 E+00	1.2 E+00	2.2 E-03	8.1 E-02
C-2	S	1.5 E-01	1.6 E-01	4.9 E-01	2.3 E-04	3.6 E-03
Average		2.7 E-01	3.9 E-01	9.5 E-01	6.2 E-04	3.0 E-02
Std. Dev		8.1 E-02	5.3 E-01	6.6 E-01	7.6 E-04	3.2 E-02
Hanford Site[b]		NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-2.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-3

Table E-4. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-D/DR Area Surface Soil Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
D-1	S	1.0 E-01	1.2 E-01	2.5 E-01	2.6 E-04	8.6 E-03
D-2	S	3.2 E-01	2.0 E-01	9.4 E-01	1.4 E-04	7.7 E-03
D-3	S	1.9 E-01	8.8 E-02	2.5 E-01	1.4 E-04	6.8 E-03
D-4	S	1.4 E-01	1.8 E-01	2.3 E+00	1.1 E-04	9.8 E-03
Average		1.9 E-01	1.5 E-01	9.3 E-01	6.2 E-04	8.2 E-03
Std. Dev		8.3 E-02	4.5 E-02	8.4 E-01	5.8 E-05	1.1 E-03
Hanford Site[b]		NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-3.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-4

Table E-5. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-F Area Surface Soil Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
F-1	S	2.4 E-01	2.4 E-01	2.9 E-01	7.0 E-04	1.0 E-02
F-2	S	2.2 E-01	8.2 E-02	2.7 E-01	1.5 E-04	5.0 E-03
F-3	S	8.1 E-02	1.8 E-01	1.0 E+00	3.9 E-03	2.1 E-02
F-4	S	1.9 E-01	2.4 E-02	1.2 E-01	3.1 E-04	2.4 E-03
F-5	S	1.3 E-01	2.6 E-01	1.4 E+00	1.4 E-03	3.2 E-02
Average		1.7 E-01	1.6 E-01	6.2 E-01	1.3 E-03	1.4 E-02
Std. Dev		5.9 E-02	9.1 E-02	5.0 E-01	1.4 E-03	1.1 E-02
Hanford Site[b]		NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-4.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-5

Table E-6. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-H Area Surface Soil Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
H-1	S	9.3 E-02	7.4 E-02	2.8 E-01	1.3 E-04	6.2 E-03
H-2	S	2.2 E-01	7.6 E-02	4.3 E-01	1.1 E-03	6.9 E-03
Average		1.6 E-01	7.5 E-02	3.6 E-01	6.1 E-04	6.6 E-03
Std. Dev		6.4 E-02	1.0 E-03	7.5 E-02	4.9 E-04	3.5 E-04
Hanford Site[b]		NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-5.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-6

Table E-7. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-K Area Surface Soil Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
K-1	S	9.7 E-01	3.2 E-01	1.1 E+00	2.0 E-03	5.4 E-02
K-2	S	3.5 E-01	1.8 E-01	1.1 E+00	6.4 E-04	2.0 E-02
K-3	S	1.8 E-01	4.3 E-01	5.5 E-01	2.4 E-04	3.3 E-03
K-4	S	2.2 E-01	1.2 E-01	5.0 E-01	3.4 E-04	1.1 E-02
K-5	S	1.8 E-01	8.5 E-02	3.8 E-01	3.4 E-04	9.2 E-03
Average		3.9 E-01	2.3 E-01	7.3 E-01	7.1 E-04	1.9 E-02
Std. Dev		3.1 E-01	1.3 E-01	3.1 E-01	6.6 E-04	1.8 E-02
Hanford Site[b]		NR	3.1 E-01	2.0 E+00	NR	2.6 E-02
Offsite[b]		NR	1.2 E-01	3.8 E-01	NR	7.0 E-03

[a]Locations identified in Figure 4-6.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-7

Table E-8. Radionuclide Concentrations (pCi/g, dry weight) Detected in Vegetation Samples Near the 1301-N LWDF.

Sample location[a]	Sample type	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
N-1	V	<1.2 E-01	9.1 E-01	2.2 E-02	5.1 E-02	2.5 E-04	1.1 E-03
N-2	V	2.2 E-01	3.2 E+00	3.0 E-01	1.9 E-01	6.2 E-04	4.5 E-03
N-3	V	1.3 E-01	3.1 E+00	4.6 E-02	1.7 E-01	4.1 E-04	2.1 E-03
N-4	V	<6.0 E-02	8.6 E-01	1.8 E-01	1.1 E-01	7.3 E-04	1.1 E-04
N-5	V	<2.4 E-01	1.8 E+00	5.5 E-02	1.2 E-01	1.6 E-04	6.6 E-04
Average		1.5 E-01	2.0 E+00	1.2 E-01	1.3 E-01	4.3 E-04	1.7 E-03
Std. Dev		6.7 E-02	1.0 E+00	1.1 E-01	4.9 E-02	2.2 E-04	1.5 E-03
Hanford Site[b]		NR	NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-7.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-8

Table E-9. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-N Vegetation Samples.

Sample location[a]	Sample type	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
N-6	V	<1.3 E-01	3.2 E-01	2.6 E-01	1.2 E-01	1.7 E-04	3.1 E-04
N-7	V	<1.2 E-01	1.6 E-01	2.7 E-02	4.3 E-01	<1.5 E-04	6.2 E-04
N-8	V	<1.2 E-01	8.0 E-01	5.9 E-01	1.9 E-01	2.2 E-04	1.0 E-03
N-9	V	<1.6 E-01	1.3 E+00	3.3 E-01	1.2 E-01	8.3 E-05	2.8 E-04
N-10	V	<1.6 E-01	2.0 E-01	2.8 E-02	<7.7 E-02	1.4 E-04	6.3 E-04
N-11	V	8.5 E-02	1.9 E+00	1.9 E-02	8.3 E-02	2.4 E-04	1.5 E-03
N-12	V	<1.1 E-01	9.4 E-01	5.2 E-01	8.8 E-02	1.6 E-04	2.9 E-04
Average		<1.3 E-01	8.0 E-01	2.5 E-01	1.6 E-01	1.7 E-04	6.6 E-04
Std. Dev		2.5 E-02	6.0 E-01	2.2 E-01	1.2 E-01	4.8 E-05	4.2 E-04
Hanford Site[b]		NR	NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-7.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-9

Table E-10. Radionuclide Concentrations (pCi/g, dry weight) Detected in N-Springs Vegetation Samples.

Sample location[a]	Sample type	^{54}Mn	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
NS-1	V	<2.5 E-01	2.3 E+00	1.8 E+02	<1.7 E-01	4.9 E-05	2.0 E-05
NS-2	V	<2.5 E-01	2.0 E+00	5.9 E+02	<1.8 E-01	5.2 E-05	2.0 E-04
NS-3	V	<1.5 E-01	1.0 E+00	7.1 E+01	<1.1 E-01	1.8 E-04	6.3 E-05
NS-4	V	<3.0 E-01	1.0 E+00	3.7 E+00	2.4 E-01	2.3 E-04	5.0 E-04
NS-5	V	<2.5 E-01	1.2 E+00	2.3 E+00	2.4 E-01	7.7 E-05	2.6 E-04
NS-6	V	<3.2 E-01	1.2 E+00	3.0 E+01	<2.4 E-01	2.1 E-05	2.9 E-05
NS-7	V	<2.8 E-01	1.0 E+00	4.9 E+01	1.3 E-01	8.5 E-06	2.1 E-05
NS-8	V	<1.4 E-01	1.5 E+00	3.2 E+01	<2.9 E-01	<6.0 E-05	5.3 E-04
Average		<2.4 E-01	1.4 E+00	1.2 E+02	2.0 E-01	8.5 E-05	2.0 E-04
Std. Dev		6.1 E-02	4.7 E-01	1/8 E+02	5.8 E-02	7.3 E-05	2.0 E-04
Hanford Site[b]		NR	NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-7.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-10

Table E-11. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-B/C Area Vegetation Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
B-1	V	6.8 E-01	4.3 E-02	1.8 E-01	8.1 E-05	5.2 E-05
B-2	V	<3.7 E-01	6.0 E-02	3.7 E-01	1.9 E-04	6.1 E-04
C-1	V	2.0 E-01	8.2 E-01	1.2 E-01	5.3 E-05	1.7 E-04
C-2	V	<1.6 E-01	1.1 E-01	1.8 E-01	2.2 E-04	4.0 E-04
Average		3.5 E-01	2.6 E-01	2.1 E-01	1.4 E-04	3.1 E-04
Std. Dev		2.0 E-01	3.3 E-01	9.4 E-02	7.1 E-05	2.1 E-04
Hanford Site[b]		NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-2.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-11

Table E-12. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-D/DR Area Vegetation Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
D-1	V	5.1 E-01	2.0 E-02	1.1 E-01	8.5 E-06	4.8 E-04
D-2	V	1.4 E-01	3.5 E-02	8.6 E-02	9.1 E-05	1.2 E-04
D-3	V	<1.2 E-01	5.6 E-02	<1.0 E-01	<4.5 E-05	<3.4 E-05
D-4	V	3.3 E-01	6.0 E-01	8.7 E-02	8.5 E-06	1.2 E-04
Average		2.8 E-01	1.8 E-01	9.6 E-02	3.8 E-05	1.9 E-04
Std. Dev		1.6 E-01	2.4 E-01	9.9 E-03	3.4 E-05	1.7 E-04
Hanford Site[b]		NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-3.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-12

Table E-13. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-F Area Vegetation Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
F-1	V	1.6 E-01	1.5 E-01	<1.0 E-01	8.5 E-06	2.3 E-04
F-2	V	5.8 E-01	1.8 E-01	6.0 E-02	8.5 E-06	1.5 E-04
F-3	V	1.8 E-01	8.4 E-02	<1.0 E-01	<5.4 E-05	1.0 E-04
F-4	V	3.8 E+00	1.3 E-02	9.0 E-01	7.6 E-05	<2.1 E-06
F-5	V	2.4 E-01	1.7 E-02	4.0 E-01	<1.9 E-05	4.9 E-05
Average		9.9 E-01	8.9 E-02	3.1 E-01	3.3 E-05	1.1 E-04
Std. Dev		1.4 E+00	6.8 E-02	3.2 E-01	2.7 E-05	7.9 E-05
Hanford Site[b]		NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-4.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-13

Table E-14. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-H Area Vegetation Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
H-1	V	1.2 E+00	7.5 E-01	2.1 E-01	4.3 E-05	4.8 E-05
H-2	V	6.0 E-01	3.5 E-02	9.1 E-02	<3.5 E-04	2.5 E-04
Average		9.0 E-01	3.9 E-01	1.5 E-01	2.0 E-04	1.5 E-04
Std. Dev		3.0 E-01	3.6 E-01	5.9 E-02	1.5 E-04	1.0 E-04
Hanford Site[b]		NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-5.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-14

Table E-15. Radionuclide Concentrations (pCi/g, dry weight) Detected in 100-K Area Vegetation Samples.

Sample location[a]	Sample type	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239/240}Pu$
K-1	V	3.1 E-01	6.7 E-01	<1.8 E-01	8.5 E-06	8.5 E-04
K-2	V	3.0 E-01	2.6 E+00	3.6 E-01	<4.7 E-05	2.6 E-05
K-3	V	3.7 E-01	1.9 E+00	<1.1 E-01	8.5 E-06	1.9 E-04
K-4	V	2.6 E-01	8.3 E-01	<6.9 E-02	<1.1 E-04	4.5 E-04
K-5	V	1.2 E+00	4.6 E-02	<1.6 E-01	8.6 E-05	3.7 E-04
Average		4.9 E-01	1.2 E+00	1.8 E-01	5.2 E-05	3.8 E-04
Std. Dev		3.6 E-01	9.2 E-01	1.0 E-01	4.1 E-05	2.8 E-04
Hanford Site[b]		NR	7.5 E-02	1.0 E-01	NR	1.3 E-03
Offsite[b]		NR	3.8 E-02	3.9 E-02	NR	1.5 E-03

[a]Locations identified in Figure 4-6.
[b]Average values obtained from PNL-6464.
NR = Not reported.

PST89-3165-E-15

9 2 1 2 4 9 5 2 0 0 0

APPENDIX F

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Table F-1. The 1988 Thermoluminescent Dosimeter Results from 100-N Area. (Sheet 1 of 2)

Location[a]	Number of samples	Dose Rate			
		mrem/h[b]			mrem/work year[c]
		Maximum	Minimum	Average	
1 RZ	13	0.140	0.084	0.106	221
2 RZ	13	0.138	0.080	0.110	229
3 RZ	13	0.075	0.035	0.055	114
4 RZ	13	0.351	0.165	0.247	515
5 RZ	13	0.125	0.058	0.092	191
6 RZ	13	0.076	0.030	0.050	105
7 RZ	13	0.327	0.132	0.192	400
8	13	0.009	0.005	0.007	16
9	13	0.011	0.004	0.007	14
10	13	0.008	0.005	0.007	14
11	13	0.009	0.005	0.007	15
12	13	0.008	0.004	0.006	12
13	13	0.016	0.010	0.013	26
14	13	0.079	0.046	0.060	126
15 RZ	13	0.126	0.073	0.096	199
16	13	0.068	0.030	0.051	105
17	13	0.007	0.003	0.005	10
18 RZ	13	0.101	0.052	0.077	159
19	13	0.018	0.004	0.006	13
20	13	0.006	0.003	0.005	10
21	13	0.066	0.040	0.054	112
22 RZ	13	0.089	0.055	0.069	144
23	13	0.006	0.003	0.004	9
24	13	0.007	0.004	0.005	10
25	13	0.011	0.004	0.008	16
26	13	0.030	0.015	0.023	48
27	13	0.009	0.006	0.007	15
28 RZ	13	0.163	0.043	0.077	161

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9 2 1 2 4 9 5 2 0 0 3

Table F-1. The 1988 Thermoluminescent Dosimeter Results from 100-N Area. (Sheet 2 of 2)

Location[a]	Number of samples	Dose Rate			
		mrem/h[b]			mrem/work year[c]
		Maximum	Minimum	Average	
29 RZ	13	0.749	0.335	0.541	1,125
30 RZ	13	0.569	0.223	0.381	793
31	13	0.050	0.028	0.037	78
32	13	0.097	0.049	0.066	137
33	13	0.054	0.025	0.035	72
34 RZ	13	1.040	0.482	0.790	1,644
35 RZ	13	0.923	0.352	0.666	1,386
36 RZ	13	0.046	0.028	0.035	73
37	13	0.072	0.037	0.052	108
38	13	0.078	0.040	0.053	110
39	13	0.061	0.032	0.042	88
40	13	0.054	0.032	0.041	86
41	13	0.079	0.044	0.057	119
ALARA guideline for occupational exposure to non-radiation zone workers.					240

[a]Locations identified in Figure 5-1.
[b]Monthly, integrated readings in mrem were converted to hourly dose equivalent rates.
[c]Monthly, integrated readings in mrem were converted to work year dose equivalent rates.
RZ = Area controlled as a radiation zone.

PST89-316S-F-1

Table F-2. The 1988 Monthly Thermoluminescent Dosimeter Results from 100-N Area. (Sheet 1 of 4)

Date	TLD location (mrem/h)*										
	1	2	3	4	5	6	7	8	9	10	11
01/08/88 to 02/05/88	0.104	0.111	0.050	0.233	0.105	0.054	0.222	0.007	0.004	0.005	0.009
02/05/88 to 03/07/88	0.107	0.116	0.061	0.299	0.125	0.076	0.132	0.007	0.007	0.007	0.009
03/07/88 to 04/01/88	0.093	0.099	0.046	0.227	0.074	0.040	0.155	0.006	0.004	0.006	0.006
04/01/88 to 04/29/88	0.110	0.138	0.075	0.351	0.110	0.071	0.153	0.008	0.006	0.007	0.008
04/29/88 to 05/27/88	0.100	0.094	0.044	0.196	0.076	0.049	0.151	0.006	0.005	0.006	0.006
05/27/88 to 06/24/88	0.140	0.136	0.074	0.322	0.110	0.053	0.169	0.007	0.005	0.007	0.007
06/24/88 to -7/22/88	0.103	0.097	0.041	0.193	0.079	0.045	0.148	0.005	0.005	0.005	0.005
07/22/88 to 08/19/88	0.130	0.136	0.067	0.279	0.109	0.067	0.141	0.009	0.009	0.007	0.009
08/19/88 to 09/16/88	0.084	0.090	0.047	0.202	0.068	0.042	0.168	0.009	0.011	0.007	0.008
09/16/88 to 10/17/88	0.110	0.119	0.062	0.258	0.101	0.030	0.218	0.006	0.008	0.007	0.008
10/17/88 to 11/11/88	0.087	0.084	0.042	0.192	0.067	0.030	0.246	0.008	0.007	0.008	0.006
11/11/88 to 12/09/88	0.128	0.130	0.068	0.302	0.110	0.059	0.268	0.009	0.009	0.008	0.009
12/09/88 to 01/06/89	0.087	0.080	0.035	0.165	0.058	0.037	0.327	0.009	0.007	0.006	0.006
Number of samples	13	13	13	13	13	13	13	13	13	13	13
Maximum	0.140	0.138	0.075	0.351	0.125	0.076	0.327	0.009	0.011	0.008	0.009
Minimum	0.084	0.080	0.035	0.165	0.058	0.030	0.132	0.005	0.004	0.005	0.005
Average	0.106	0.110	0.055	0.247	0.092	0.050	0.192	0.007	0.007	0.007	0.007

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Table F-2. The 1988 Monthly Thermoluminescent Dosimeter Results from 100-N Area. (Sheet 2 of 4)

Date	TLD location (mrem/h)*										
	12	13	14	15	16	17	18	19	20	21	22
01/08/88 to02/05/88	0.006	0.011	0.064	0.081	0.054	0.004	0.084	0.005	0.004	0.054	0.058
02/05/88 to 03/07/88	0.005	0.015	0.068	0.113	0.061	0.005	0.091	0.007	0.005	0.065	0.086
03/07/88 to 04/01/88	0.004	0.010	0.053	0.074	0.045	0.004	0.084	0.004	0.004	0.057	0.061
04/01/88 to 04/29/88	0.005	0.015	0.079	0.126	0.060	0.005	0.101	0.005	0.005	0.061	0.089
04/29/88 to 05/27/88	0.005	0.011	0.055	0.087	0.043	0.004	0.069	0.004	0.004	0.048	0.058
05/27/88 to 06/24/88	0.006	0.016	0.071	0.119	0.064	0.005	0.086	0.006	0.005	0.066	0.086
06/24/88 to 07/22/88	0.004	0.011	0.058	0.082	0.043	0.004	0.068	0.004	0.003	0.040	0.060
07/22/88 to 08/19/88	0.006	0.013	0.063	0.105	0.068	0.005	0.080	0.018	0.004	0.055	0.075
08/19/88 to 09/16/88	0.005	0.012	0.057	0.081	0.068	0.006	0.052	0.006	0.006	0.051	0.060
09/16/88 to 10/17/88	0.008	0.012	0.058	0.109	0.046	0.005	0.071	0.005	0.005	0.051	0.075
10/17/88 to 11/11/88	0.008	0.012	0.047	0.074	0.030	0.003	0.060	0.004	0.005	0.047	0.056
11/11/88 to 12/09/88	0.007	0.016	0.066	0.121	0.046	0.007	0.086	0.006	0.005	0.059	0.083
12/09/88 to 01/06/89	0.007	0.010	0.046	0.073	0.031	0.005	0.065	0.005	0.005	0.046	0.055
Number of samples	13	13	13	13	13	13	13	13	13	13	13
Maximum	0.008	0.016	0.079	0.126	0.068	0.007	0.101	0.018	0.006	0.066	0.089
Minimum	0.004	0.010	0.046	0.073	0.030	0.003	0.052	0.004	0.003	0.040	0.055
Average	0.006	0.013	0.060	0.096	0.051	0.005	0.077	0.006	0.005	0.054	0.069

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Table F-2. The 1988 Monthly Thermoluminescent Dosimeter Results from 100-N Area. (Sheet 3 of 4)

Date	TLD location (mrem/h)*										
	23	24	25	26	27	28	29	30	31	32	33
01/08/88 to 02/05/88	0.006	0.004	0.011	0.022	0.007	0.054	0.428	0.283	0.037	0.066	0.028
02/05/88 to 03/07/88	0.005	0.004	0.008	0.024	0.006	0.057	0.335	0.223	0.050	0.097	0.051
03/07/88 to 04/01/88	0.005	0.004	0.008	0.018	0.008	0.045	0.355	0.252	0.042	0.065	0.031
04/01/88 to 04/29/88	0.004	0.005	0.009	0.029	0.008	0.078	0.557	0.407	0.040	0.082	0.040
04/29/88 to 05/27/88	0.004	0.004	0.007	0.020	0.007	0.068	0.749	0.381	0.030	0.056	0.029
05/27/88 to 06/24/88	0.004	0.005	0.009	0.030	0.009	0.070	0.664	0.467	0.042	0.079	0.054
06/24/88 to 07/22/88	0.003	0.004	0.007	0.020	0.007	0.052	0.503	0.408	0.033	0.051	0.029
07/22/88 to 08/19/88	0.004	0.004	0.009	0.024	0.006	0.157	0.436	0.539	0.035	0.067	0.041
08/19/88 to 09/16/88	0.006	0.006	0.009	0.021	0.008	0.163	0.607	0.272	0.037	0.057	0.031
09/16/88 to 10/17/88	0.005	0.005	0.006	0.028	0.007	0.084	0.510	0.434	0.037	0.062	0.030
10/17/88 to 11/11/88	0.004	0.006	0.004	0.016	0.006	0.043	0.625	0.372	0.031	0.050	.0.27
11/11/88 to 12/09/88	0.006	0.007	0.007	0.030	0.008	0.065	0.583	0.269	0.042	0.078	0.036
12/09/88 to 01/06/89	0.003	0.005	0.004	0.015	0.008	0.072	0.677	0.347	0.028	0.049	0.025
Number of samples	13	13	13	13	13	13	13	13	13	13	13
Maximum	0.006	0.007	0.011	0.030	0.009	0.163	0.749	0.569	0.050	0.097	0.054
Minimum	0.003	0.004	0.004	0.015	0.006	0.043	0.335	0.223	0.028	0.049	0.025
Average	0.004	0.005	0.008	0.023	0.007	0.077	0.541	0.381	0.037	0.066	0.035

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Table F-2. The 1988 Monthly Thermoluminescent Dosimeter Results from 100-N Area. (Sheet 4 of 4)

Date	TLD location (mrem/h)*							
	34	35	36	37	38	39	40	41
01/01/88 to 02/05/88	0.749	0.612	0.035	0.049	0.051	0.037	0.032	0.063
02/05/88 to 03/07/88	0.482	0.352	0.046	0.072	0.078	0.061	0.054	0.079
03/07/88 to 04/01/88	0.602	0.486	0.031	0.052	0.053	0.039	0.034	0.050
04/01/88 to 04/29/88	0.877	0.771	0.036	0.064	0.067	0.049	0.049	0.067
04/29/88 to 05/27/88	0.774	0.663	0.029	0.047	0.047	0.037	0.037	0.050
05/27/88 to 06/24/88	0.977	0.782	0.042	0.063	0.058	0.054	0.048	0.070
06/24/88 to 07/22/88	0.860	0.726	0.033	0.043	0.047	0.0399	0.036	0.048
07/22/88 to 08/19/88	1.040	0.923	0.043	0.053	0.057	0.041	0.051	0.059
08/19/88 to 09/16/88	0.615	0.470	0.028	0.043	0.046	0.037	0.038	0.051
09/06/88 to 10/17/88	0.925	0.780	0.036	0.052	0.050	0.043	0.043	0.055
10/17/88 to 11/11/88	0.824	0.612	0.028	0.041	0.040	0.035	0.033	0.045
11/11/88 to 12/09/88	0.850	0.852	0.042	0.058	0.054	0.048	0.050	0.065
12/09/88 to 01/06/89	0.699	0.632	0.028	0.037	0.040	0.032	0.034	0.044
Number of samples	13	13	13	13	13	13	13	13
Maximum	1.040	0.923	0.046	0.072	0.078	0.061	0.054	0.079
Minimum	0.482	0.352	0.028	0.037	0.040	0.032	0.032	0.044
Average	0.790	0.666	0.035	0.052	0.053	0.042	0.041	0.057

*Locations identified in Figure 5-1.

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APPENDIX G

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Table G-1. Concentrations of Radionuclides Detected in 1325-N Liquid Waste Disposal Facility Sediment Samples--1988 (pCi/g) (Dry Weight Concentrations Except Where Noted).

Sample location[a]	^{54}Mn[b]	^{60}Co[b]	^{90}Sr	^{137}Cs[b]	^{144}Ce[b]	^{238}Pu	$^{239/240}Pu$
CS-1	3.8 E+04	4.3 E+05	1.5 E+04	1.6 E+04	1.1 E+04	2.0 E+03	1.3 E+04
CS-2	3.8 E+04	3.8 E+05	3.4 E+03	3.8 E+04	9.1 E+03	6.4 E+02	3.9 E+03
CS-3	3.4 E+04	4.3 E+05	9.3 E+03	3.9 E+04	8.8 E+03	6.6 E+02	4.0 E+03
CS-4	8.2 E+04	1.1 E+06	6.3 E+03	5.9 E+04	<8.8 E+04	1.6 E+03	1.0 E+04
CS-5	1/5 E+05	1.8 E+06	4.9 E+04	5.7 E+04	2.8 E+04	7.6 E+03	4.5 E+04
CS-7	9.5 E+04	1.2 E+06	9.6 E+04	1.2 E+05	1.8 E+04	8.9 E+02	5.4 E+03
CS-8	<2.1 E+04	9.4 E+05	1.0 E+04	1.4 E+04	<8.7 E+04	4.4 E+03	2.8 E+04
CS-9	3.4 E+04	3.2 E+05	6.5 E+03	3.9 E+04	7.3 E+03	2.8 E+02	1.8 E+03
CS-10	5.4 E+04	6.1 E+05	8.4 E+03	4.6 E+04	9.1 E+03	7.9 E+02	4.8 E+03
CS-11	3.7 E+04	3.9 E+05	5.3 E+03	4.3 E+04	7.8 E+03	3.4 E+02	2.3 E+03
CS-12	5.3 E+05	6.6 E+06	4.9 E+04	9.1 E+04	<4.1 E+05	6.3 E+03	4.0 E+04
Maximum	5.3 E+05	6.6 E+06	9.6 E+04	1.2 E+05	2.8 E+04	7.6 E+03	4.5 E+04
Minimum	<2.1 E+04	3.2 E+05	3.4 E+03	1.4 E+04	7.3 E+03	2.8 E+02	1.8 E+03
Average	1.0 E+05	1.3 E+06	2.3 E+04	5.1 E+04	6.2 E+04	2.3 E+03	1.4 E+04
Stan. Dev.	1.4 E+05	1.7 E+06	2.8 E+04	3.0 E+04	1.1 E+05	2.5 E+03	1.5 E+04

[a]Locations identified in Figure 6-1.
[b]Wet weight concentration.

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APPENDIX H

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Table H-1. Environmental Dose Rates (relative μR/h) Measured at the 100-N Area Shoreline.

Location*	Relative dose	Location*	Relative dose	Location*	Relative dose
1	33	33	420	65	180
2	34	34	390	66	180
3	35	35	370	67	170
4	38	36	340	68	150
5	39	37	310	69	140
6	43	38	290	70	120
7	67	39	300	71	100
8	91	40	270	72	100
9	115	41	260	73	80
10	138	42	270	74	80
11	162	43	250	75	80
12	186	44	250	76	70
13	210	45	250	77	60
14	270	46	280	78	60
15	320	47	290	79	50
16	380	48	290	80	50
17	350	49	300	81	45
18	370	50	320	82	35
19	380	51	330	83	35
20	460	52	320	84	33
21	460	53	310	85	32
22	490	54	320	86	29
23	490	55	320	87	27
24	480	56	290	88	22
25	440	57	300	89	22
26	420	58	290	90	22
27	410	59	290	91	20
28	380	60	260	92	19
29	390	61	260	93	15
30	390	62	240	94	15
31	400	63	230		
32	400	64	200		

*Locations identified in Figure 7-1.

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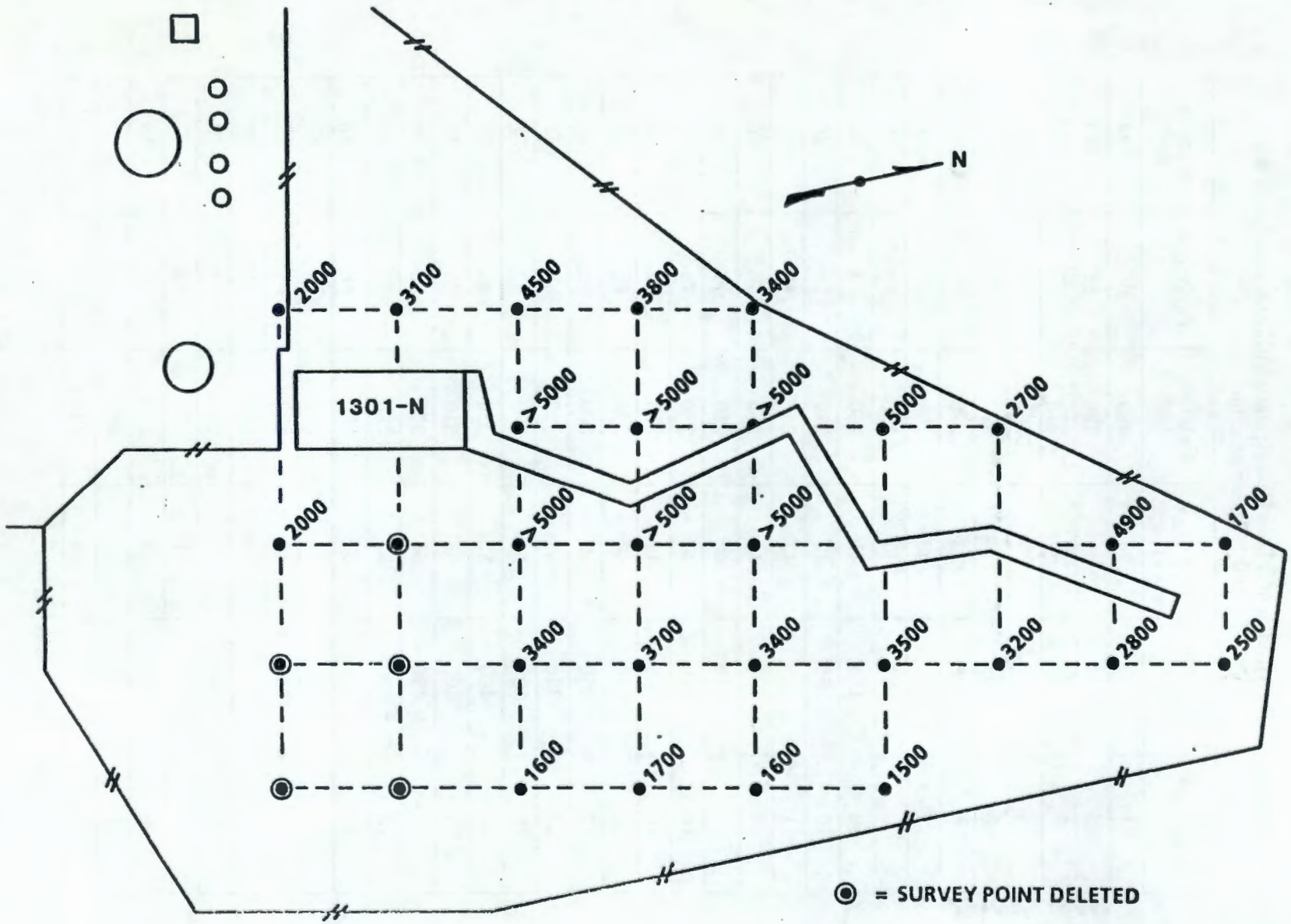

Figure H-1. Environmental Dose Rates (μR/h) Measured at Survey Points around the 1301-N Liquid Waste Disposal Facility in 1987.

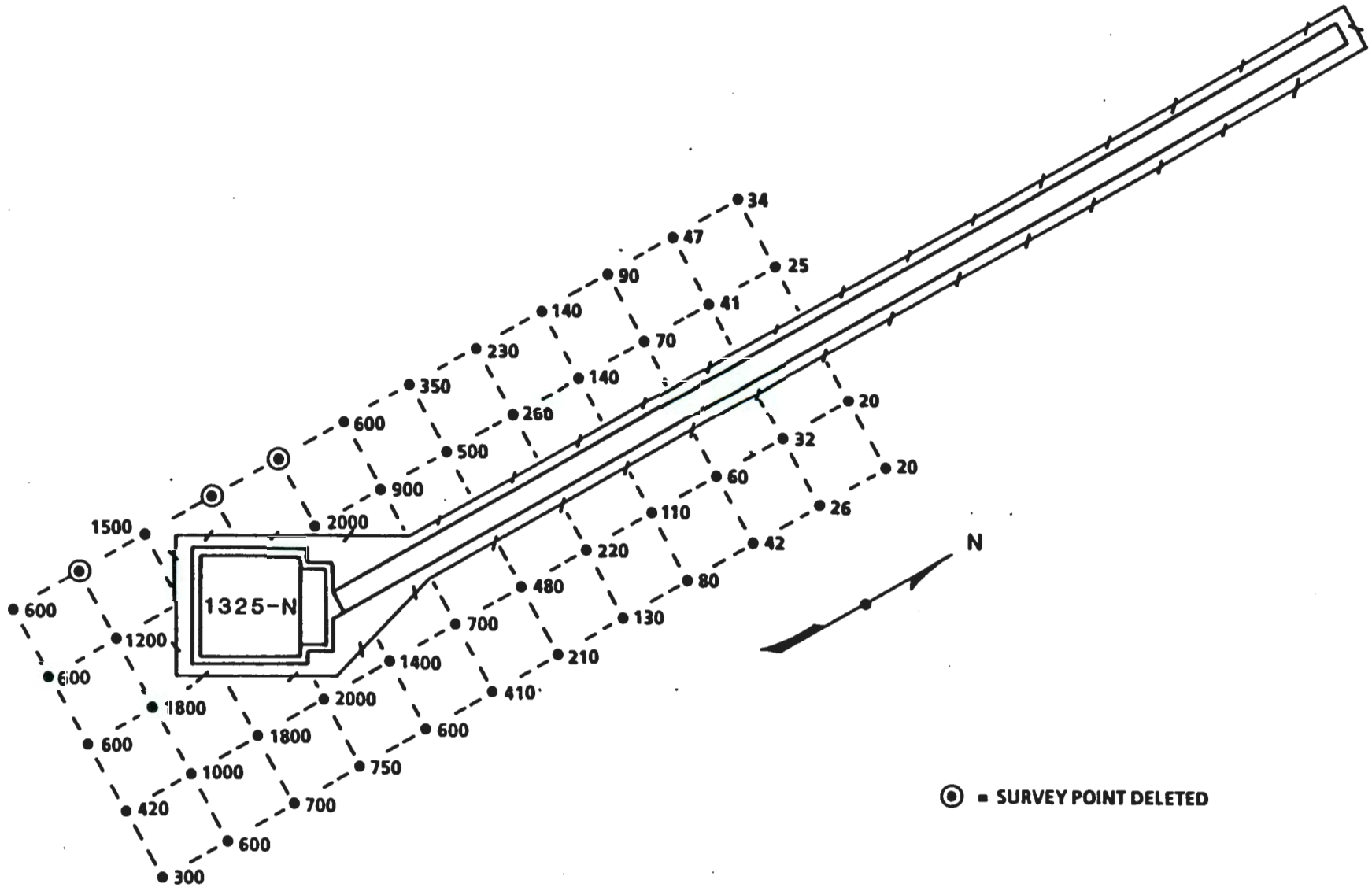

Figure H-2. Environmental Dose Rates (μR/h) Measured at Survey Points around the 1325-N Liquid Waste Disposal Facility in 1987.

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