START

0035889

48

UNCLASSIFIED

UNC NUCLEAR INDUSTRIES

Subsidiary of United Nuclear Corporation
A UNC RESOURCES Company
P O Box 490
Richland Washington 99352

Document No.
UNI-1347

Date
10/01/79

Copy No.
31

PREPARED FOR THE
UNITED STATES DEPARTMENT OF ENERGY
UNDER CONTRACT NUMBER EY-76-C-06-1857

RECORD CENTER FILE

REFERENCE COPY

RECEIVED
OCT 05 1979
UNITED NUCLEAR INDUSTRIES, INC.
DOCUMENT CONTROL CENTER

Title

ONSITE ENVIRONMENTAL SURVEILLANCE PROGRAM
FOR THE 100-N AREA

Author

L. K. Poppe

DISTRIBUTION

NAME	BLDG.	NAME	BLDG.	NAME	BLDG.
BNW		20. LF Munson	1100-N		
		21. LK Poppe	1109-N		
1. PA Eddy	OSB/272	22. LK Poppe	1109-N		
2. JR Houston	OSB/227	23. VR Richards	1109-N		
		24. JW Riches	1101-N		
UNC		25. DR Smith	105-N		
		26. RA Weetman	1105-N		
3. JA Adams	1105-N	27. WG Westover	1105-N		
4. GO Amy	FED	28. RA Winship	1109-N		
5. JJ Bombino	FED	29. MC Williams	1105-N		
6. PA Carlson	1101-N	30. UNC File	FED		
7. WC Catts	FED	31. UNC Record	FED		
8. TE Dabrowski	1105-N	32. Extra			
9. LP Diediker	1109-N	33. Extra			
10. JJ Dorian	1109-N	34. Extra			
11. RE Dunn	1101-N	35. Extra			
12. ML Faught	1101-N	36. Extra			
13. EM Greager	1109-N	37. Extra			
14. GA Hanson	1100-N	38. Extra			
15. DL Hovorka	1100-N	39. Extra			
16. EE Leitz	1100-N	40. Extra			
17. DS Lewis	1101-N				
18. NR Miller	FED				
19. LH Munson	1110-N				

APR 1994
RECEIVED
EDMC

PHOTOCOPY
DO NOT RETURN TO RHA

ROUTE TO	PAYROLL NO.	LOCATION	FILES ROUTE DATE	SIGNATURE AND DATE
UNI RECORD				

BEST AVAILABLE COPY

UNCLASSIFIED

BM-5100-184 (5-79)

GW 3222 1878

GW3222.1879

ONSITE ENVIRONMENTAL SURVEILLANCE PROGRAM FOR THE 100-N AREA

Prepared by: L. K. Poppe, Senior Environmental Engineer Date: 9/27/79

Reviewed by: J. J. Dorian, Manager, Environmental Control Subsection Date: 9/27/79

Approved by: T. E. Dabrowski, Manager, Environmental & Occupational Safety Date: 10/1/79

9111222.1980

LIST OF FIGURES

1.1 Map of Hanford Reservation
1.2 100-N Area Layout
1.3 Primary-Secondary Coolant System Features
1.4 N Reactor Liquid Effluent Flow Schematic
1.5 1301-N Facility and Surrounding Areas
1.6 Calculated Flow Paths Originating from the 1301-N Facility with Travel Time Lines
1.7 Cross Section of the 1301-N Facility
3.1 Major Radiological Release Pathways Between 100-N Facilities and the Environs
3.2 100-N Atmospheric Release Points
3.3 105-N Ventilation and Exhaust Systems
4.1 Riverbank Springs Sample Zones
4.2 N-8 Wells
5.1 Airborne Environmental Release Sampler Locations
5.2 1301-N Facility Groundwater Monitoring Wells
5.3 Sample Transects
5.4 Sediment Sample Locations
5.5 Environmental Dosimeter Locations
5.6 1301-N Facility Direct Radiation Monitoring Grid
5.7 River Shoreline Survey
6.1 Sample Labels
6.2 N Reactor Effluent Liquid Sample Log
6.3 N Reactor Airborne Effluent Sample Log
6.4 Effluent Analysis Log

LIST OF TABLES

1.1 1301-N Facility Decontamination Factors

3.1 Annual Radionuclide Release to Atmosphere From N Reactor Operations

3.2 Exhaust Vents - 109-N Building

3.3 Discharge of Radionuclides to 1301-N Facility and Seepage to River During 1978

3.4 Releases to River Via 102-Inch Discharge Line During CY 1978

4.1 N Reactor Effluent Discharge Monitoring Program

5.1 100-N Area Environmental Surveillance Program

9443222-1881

9117222.1882

1.0 DESCRIPTION OF FACILITIES

The N Reactor is located in an area known as the 100-N Area. This area occupies 90 acres at the north end of the Hanford Reservation on the Columbia River at river mile 380 (shown in Figures 1.1 and 1.2). The N Reactor is dual purpose, graphite-moderated, pressurized light-water reactor, producing special nuclear materials and steam for the production of electricity. From the reactor, primary reactor coolant goes to a number of parallel steam generators in which the process heat is dissipated through the production of steam in a secondary steam system. Figure 1.3 shows the principle features of the primary-secondary coolant system.

The facilities in the 100-N Area which handle radioactive materials and have a potential for release to the environment are:

- 105-N REACTOR BUILDING
- 109-N STEAM GENERATOR BUILDING
- 117-N FILTER BUILDING & 116-N STACK
- 1310-N WASTE TANK & 1314-N FACILITY
- 1301-N CRIB-TRENCH FACILITY

The 105-N Building houses the reactor, its control and cooling systems, and the fuel storage basin. The 109-N heat exchanger building contains the heat exchanger cells, primary coolant recirculation pumps, dump condensers, and, located in a rooftop penthouse, the pressurizer.

The 117-N filter building and 116-N ventilation stack provide filtration and an exhaust system for the 105-N Building ventilation air and confinement zones that can or do contain airborne radioactive material.

The 1310-N tank and 1314-N Facility are used to store and transfer liquid effluents containing radionuclides removed from cooling systems by chemical decontamination.

Figure 1.4 provides a schematic of N Reactor liquid effluent streams, treatment facilities, and discharge points. Radioactive liquid streams are discharged to the 1301-N waste treatment facility during normal reactor operation.

1301-N Facility, which is located northeast of the 105-N Reactor Building, is on a riverbank bluff 60 ft above and 860 ft back from the river (Figure 1.5). The crib is a 125 ft by 280 ft basin with an adjacent 1600 ft by 50 ft crib extension trench. The system is designed such that the maximum crib water level is well below the surface of a three-foot layer of large stones lining the crib bottom. The extension trench has been covered with wire mesh supported on horizontal telephone poles in an effort to preclude access by birds and larger animals. The entire facility is surrounded by an eight-foot security and exclusion fence.

DHW222.1883

The total flow to the 1301-N Facility is approximately 3 million gallons per day. Liquids enter the crib by way of four lines. Normal flow is through a 36-inch low pressure diversion system line and a 12-inch radioactive drain line. These two lines enter a weir box located near the south end of the crib. In addition to these lines, waste can be diverted to the crib from a connection with the six-inch decontamination line from the 109-N Building. There is also a three-inch drain line from the waste disposal valve pit that empties directly into the crib.

Crib and trench liquids percolate through the soil to an unconfined aquifer. This aquifer may carry crib discharge directly to the river or for a considerable distance along the river. Some direct pathways to the river create springs on the shoreline. Figure 1.6 shows the flow path models calculated between the 1301-N Facility and the Columbia River.[1] Figure 1.7 is a cross sectional view of the 1301-N Facility.[2]

During the movement of water in the ground underlying the crib and trench, radioactive materials are retained in the soil through precipitation, filtration, and ion exchange reactions. Additional loss of radioactive material occurs due to the decay of short half-life radionuclides during transit to the river. The total reduction factors for radionuclides discharge to the 1301-N Facility are given in Table 1.1.[3]

2.0 PROGRAM DESCRIPTION

DE84007722 1984

The environmental surveillance program for radionuclide releases is not designed to determine the onsite or offsite population doses resulting from operation of the N Reactor. The program is designed to evaluate trend changes in releases to various pathways to the environs from reactor facilities. The major objectives of this program are as follows:

- Detection and evaluation of changes in the radionuclide concentrations discharged to or existing in the immediate environment. This will serve as a means of detecting system changes or failures, so that appropriate actions may be taken.

- Maintenance of a data base for trend analyses in order to provide the capability for evaluation and response to changes in radioactive material releases from any off-normal or accident condition.

- Provide samples and data to be used for "after the fact" accidental release analyses.

- Demonstrate compliance with applicable regulations.

The evaluation of the population dose resulting from the operation of the N Reactor is the responsibility of Pacific Northwest Laboratory (PNL). United Nuclear Corporation, Nuclear Industries supplies radionuclide discharge data to PNL for use in the preparation of their analyses.[4]

3.0 RELEASE PATHWAYS

In order to establish monitoring requirements, the radiological release pathways from the facilities to the immediate environment were analyzed and a flow diagram produced (see figure 3.1). This pathway diagram has been used as the basis for the monitoring program.

DW 7222. 1985

The major pathways for release from the 100-N Facilities are:

- Airborne release
- Liquid releases
- Direct radiation releases

3.1 AIRBORNE EFFLUENT DISCHARGES

The five pathways for the potential release of airborne material from the 100-N Area to the environment are (1) 105-N reactor building ventilation exhausts, (2) 109-N steam generator building ventilation exhausts, (3) 1310-N liquid waste tank vents, (4) 1314-N liquid waste loadout facility tank vents, and (5) 1301-N crib/trench facility airborne releases from the water surface. The location of these discharge points are shown in Figure 3.2.

Limits on airborne discharges have been established by the Department of Energy, Richland Operations Office, at as low as technically and economically practicable, with the objective of not exceeding DOE Manual Chapter 0524, Appendix A, Table II Concentration Guides at the points of discharge.(5)

3.1.1 105-N REACTOR BUILDING VENTILATION EXHAUSTS

The ventilation systems in 105-N are separated into five zones based on the potential for airborne radioactive material. Zone I is the primary confinement zone servicing the reactor block and reactor coolant system pipe space. Zone II services areas adjacent to Zone I, including the control rod rooms, the fuel

cladding failure monitor rooms, and the ball safety system control room. Zone III serves the fuel transfer area, decontamination facility, fuel storage area, and equipment rooms. Zones IV and V serve offices and administration areas along with the reactor control room.

The 116-N stack is the primary discharge point for airborne radioactive material from N Reactor. Figure 3.3 shows the 105-N Building ventilation exhaust systems that discharge to the atmosphere via the 116-N stack. Immediately preceding the 116-N stack is the 117-N filter and diversion facility through which the exhaust air is routed prior to release to the stack.

DE87007222.1886

There are three relatively minor exhaust systems that also serve the 105-N Building. The 105-N wash pad exhaust, 105-N elevation (+14 ft) decontamination hood exhaust, and the 105-N transfer area exhaust are each provided with a vent located on the roof of the 105-N Building. Discharges through the first two vents are routed through high-efficiency particulate filters. The discharge is intermittent. The 105-N transfer area exhaust is continuous and unfiltered. An example of the normal releases from the 105-N exhausts is given in Table 3.1.[3]

3.1.2 109-N STEAM GENERATOR BUILDING VENTILATION EXHAUSTS

The ventilation system in the 109-N Building is separated into four zones similar to the 105-N ventilation system. Zone I is the primary confinement zone. Two separate and independent Zone I ventilation systems exist in the 109-N Building. The 109-N Zone I cell 6 ventilation system provides ventilation exhaust from steam generator cell 6. The 109-N Zone I Building ventilation system provides ventilation exhaust from steam generator cells 1 through 5, the auxiliary systems, the pipe gallery, the pressurizer penthouse, and the cell access corridor. Both systems use once-through flow that exhaust directly to the atmosphere. Cross vents with 105-N Zone I allow diversion of 109-N Zone I through the 117-N filter system during an emergency.[3]

Zones II and III represent areas of lower airborne radiation potential. Zone IV services offices and other non-radiation areas. Table 3.2 lists the exhaust systems that serve the 109-N Building. An example of the radionuclide releases from the 109-N exhausts is given in Table 3.1.[3]

3.1.3 1310-N AND 1314-N LIQUID WASTE TANK VENTS

Measurable quantities of radionuclides are released to the atmosphere from vents in the 1310-N liquid waste tank. This 900,000 gallon spherical tank is used as a temporary storage facility for approximately 600,000 gallons of liquid waste produced during the reactor coolant piping decontamination.

DOE/RL-87-22, 1987

While the tank is being filled, steam and water vapor are discharged from three vents in the tank top. As the solution in the tank cools, the amount of vapor being discharged decreases.

In the 1314-N facility a 1000-gallon transfer pump tank is used to transfer liquid waste from the 1310-N tank to railroad tankcars.

3.1.4 1301-N CRIB/TRENCH AIRBORNE DISCHARGES

The resuspension of particulates and water vapor, and the release of entrapped gases from the crib and trench water surface can be caused by wind, solar evaporation, pH changes, or temperature changes. Such releases could occur at any point along the crib/trench system and would have an effect on soil and vegetation contamination in 1301-N vicinity.

3.2 LIQUID EFFLUENT DISCHARGE

The two points of discharge of radioactive material to the environment from N Reactor liquid systems are the 1301-N Facility and the 102-inch discharge line. Contributions to these discharges are given in Figure 1.4.

DW8222-1888

3.2.1 1301-N FACILITY

A group of riverbank springs are the result of the discharge of liquid to the soil from the 1301-N Crib/Trench Facility. As previously discussed (Section 1.0), crib and trench liquids percolate through the soil and, after certain fractions of the original radionuclide content are removed, are discharged to the Columbia River at the riverbank springs. Figure 1.6 shows the flow streamlines to the river. Table 3.3 gives the amount of radioactive material discharged in 1978 to the 1301-N Facility and to the Columbia River. The resulting reduction ratio for each radionuclide is also given.(3)

There is also a potential for liquid release from the 1301-N Facility to the environment through minor pathways. These pathways would include:

- Water removal from the crib or trench surface by organisms.
- Root uptake of liquid by plants and the use of these plants in local food chains.

3.2.2 102 INCH LINE

The 102-inch discharge line discharges minor amounts of radioactive material directly to the Columbia River. Figure 1.4 shows the various systems contributing to the 102-inch line discharge and Table 3.4 presents a summary of the quantities of radioactive material released to the Columbia River during 1978.(3)

3.3 DIRECT RADIATION

Direct radiation levels above the normal background in the 100-N Area are related to the operation of three facilities. These are (1) the 1310-N liquid waste tank, (2) the 1314-N liquid waste loadout facility, and (3) the 1301-N crib/trench facility.

GW 9222. 1889

4.0 EFFLUENT DISCHARGE MONITORING AND SAMPLING

Effluent monitoring has been conducted at N Reactor since it first began operation. Effluent streams are sampled on a routine basis and the resulting average and maximum radionuclide concentration along with the total curie quantities released annually are reported to Pacific Northwest Laboratory (PNL). PNL is responsible for evaluating the offiste radiological consequences of operations at the Hanford Area. (As outlined by ERDA-1538, Appendix III-G.)[4]

Approximately 1,900 samples per year are taken of N Reactor effluents. Measurements are made of the radionuclide concentrations in effluent air and water. Analyses of the samples are performed by U.S. Testing Company and UNC. Table 4.1 summarizes the Effluent Monitoring Program.

4.1 GASEOUS EFFLUENT STREAMS

Over 99% of N Reactor's airborne effluent is discharged through the 116-N stack, the 109-N Zone I cell 6 vent and the 109-N Zone I building vent. These discharge points are provided with continuous sampling systems. The sampling systems, located at the effluent discharge points, consist of an insulated, heat-traced, ½-inch stainless steel line that draws an air sample from the center of each stack through a quick disconnect stainless steel sample cartridge containing: (1) membrane particulate filter, (2) 1-inch charcoal bed (GE 602 charcoal) and 2-inch charcoal bed (GE 618 charcoal). The sampling systems also contain a water cooling coil that condenses water vapor for tritium analysis. The sample cartridges and condensate are removed once per week for analysis.

4.2 LIQUID EFFLUENT STREAMS

The following liquid effluent streams are routinely sampled and analyzed.

4.2.1 LIQUID DISCHARGE TO THE 1301-N FACILITY

Liquid discharge to the 1301-N facility is monitored continuously for flow. The flow monitor reading is sent to a flow proportional composite sampler. A small aliquot of the effluent stream is piped into a sample container after a pre-selected quantity of effluent has been discharged to the 1301-N Facility. The composite sample is then collected and analyzed once per week for radionuclide concentrations.

DW-3722-890

4.2.2 RIVERBANK SPRINGS

The radioactive liquid effluent that seeps through the crib soil column to the river appears at distinct riverbank springs. The springs are monitored by means of a series of five wells. These wells are located at the SP-1 spring location (Figures 4.1 and 4.2). This spring is the only one which has an almost continuous surface flow. A composite sampler draws water from the well with the highest activity. This "high" well location is verified by routinely sampling the other wells with two additional composite samplers. The system assures the well with the highest discharge concentrations to the river is being monitored. The composite sample is then collected and analyzed once per week for radionuclide concentrations.

4.2.3 102 INCH DISCHARGE LINE

The 102-inch line is equipped with a sampling pump that normally pumps 100 gal/week of water from the discharge line. The large volumn water sample passes through several particulate filters and resin beds that concentrate the radioactive material present in the sample water. The 102-inch line is continuously sampled with weekly replacement and radioanalysis of ionic resins.

5.0 ENVIRONMENTAL MONITORING AND SAMPLING

Monitoring has been established to assist in evaluating the impact of 100-N Reactor facilities on the immediately surrounding environment. The data obtained from the samples is used to establish trends against which all new data is evaluated. A deviation from normal values will be a signal to look for a change in a facility or to investigate other factors which could cause abnormal sample data. Table 5.1 summarizes the Environmental Surveillance program. The 400 additional samples created by the environmental monitoring program will be analyzed by the UNC counting laboratory and by U.S. Testing Company, Inc. It should also be noted here that UNC does not perform animal sampling as a part of this program. The PNL surveillance program adequately covers this requirement. Special sampling related to the uptake of radionuclides by animals and birds in the 100 N Area will be taken (i.e., bird nest and animal feces).

9113222.1891

5.1 AIR SAMPLING

Environmental air sampling is conducted as a means of evaluating:

- radionuclide discharges which could result in exposures to N Reactor personnel; and

- trend changes which could be an indication of variations in either the input to a facility or in the functioning of some part of the facility.

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

Six air samplers monitor the 100-N Area. They are located as shown in Figure 5.1. Samples are collected monthly and analyzed for gamma emitters. The

particulate filter is also analyzed for gross alpha and beta. At the time of filter removal, a 4.4 litre marinelli beaker, fitted with a cover and an input and output valving arrangement, is used to draw a "sample bomb." The sample is analyzed for radioactive gases. Samples are labeled according to the sampling station designations given in Figure 5.1.

5.2 LIQUID SAMPLING

DWP 222-892

Six ground water monitoring wells in the 1301-N Area are sampled by PNL (Figure 5.1). These wells are sampled every quarter and analyzed for beta emitters and tritium. Semi-annually, the samples are analyzed for strontium and gamma emitters.

Each quarter, a sample of water from each well will be provided to UNC by PNL. These samples will be analyzed for gamma emitters.

Additional water samples will be taken as follows:

- riverbank water samples at locations downstream from the S-1 spring location (see Figure 4.1); and

- runoff water from rains or snowmelts.

5.3 SOIL AND SEDIMENT SAMPLING

Soil sampling provides a means to evaluate the release of radionuclides which settle out of the air or are absorbed from liquid releases to the soil from facilities. The soil samples are taken semi-annually in the vicinity of the transient lines shown in Figure 5.3. Soil samples are collected, where possible, first of the first 2.5 cm of surface soil and then of the next 2.5 cm of underlying soil. The samples will cover a 100 cm^2 area.

The samples help determine whether the radionuclides, if present, originate from airborne fallout, or subsurface liquid. If, due to the soil structure, a sample cannot be taken by this method, a trowel is used to remove approximately a

2.5 cm depth of surface soil covering 100 cm^2. The soil samples are analyzed semi-annually for gamma emitters and one sample per year from each transect location is analyzed for strontium and plutonium.

5.4 VEGETATION SAMPLING

Radionuclides can concentrate in plants by surface deposition, root uptake, and translocation from other parts of the plant. Vegetation samples are collected annually along each transect line shown in Figure 5.3. During sampling, 8 in. (20 cm) by 20 in. (50 cm) plots are analyzed to determine plant species and density information for each transect.

Vegetation samples are also taken annually at the N Springs on the Columbia Riverbank. The samples are taken from new vegetation growth located above known spring locations (see Figure 4.1). The samples will consist of several varieties of riparian plants, collected, combined, and analyzed as described for the other vegetation samples.

5.5 DIRECT RADIATION MEASUREMENT

External radiation dose information is collected at the N Reactor perimeter fence using CaF_2:Mn (TLD-400) thermoluminescent dosimeters. The dosimeters used are delivered and picked up monthly by PNL where they are read, calibrated and annealed. The location of the dosimeters is shown in Figure 5.5.

Direct reading count rate integrating instrumentation is used to perform a survey of the areas adjacent to the 1301-N Crib and Trench. A grid network has been established (see Figure 5.6). The locations will be permanently marked using fence posts driven in to a height of 1 meter and labeled with the location code number. Measurements are made annually at ground level and at the one meter level of these posts and recorded. An annual radiation survey, using the equipment described above, is performed along the Columbia River shoreline in the vicinity of the N Springs. The measurements are made approximately every 50 feet along the shoreline from a point 200 feet up river from spring SP-1 to a point 2500 feet down river (see Figure 5.7).

6.0 SAMPLE LABELING AND DATA RETENTION

The effluent and environmental sampling program consists of approximately 2100 sample analyses per year. Each sample is identified by a printed label which is affixed to the sample container. A log is maintained to verify that samples have been taken and to assure sampling schedules are met. Data from the analyses is filed in the 100-N Area, Building 105, Room 50. Data summaries are generated monthly for about 25% of the samples.(6) The data used to generate the summaries is stored on the computer in the reactor control room. Examples of sample labels and the sampling and analysis logs are shown in Figures 5.1 thru 6.4.

DOE/RL-94-117 Draft A 3222-1894

7.0 EFFLUENT RELEASE AND ENVIRONMENTAL MONITORING REPORTS

Two reports are generated annually to summarize the findings of the monitoring programs. These are formal UNC documents which are sent to DOE-RL as well as other Hanford contractors.

The first report is the "Environmental Release Report." This report covers:

- Atmospheric releases of radionuclides and chemicals to the environs from UNC facilities, including:
  - average and maximum concentrations of radionuclides determined by measurement or calculations; and
  - total curie quantities of radionuclides and total pounds of chemicals determined by calculation.
- Liquid releases of radionuclides and chemicals to the environs from UNC facilities, including:
  - average and maximum concentrations of radionuclides determined by measurement or calculation;

- total curie quantities of radionuclides and total pounds of chemicals determined by calculation; and
- identification of the site of discharge, i.e., to river or ground disposal facility.

- Site of disposal of solid radioactive and nonradioactive waste.

DWA 222.1995

The second report is the "Radiological Surveillance Report for the 100-N Area Environment." This report will cover:

- Data summaries of all environmental measurements made and all analyses performed
- Sampling schedules and sample location
- Environmental surveillance procedures
- Analytical procedures
- Quality assurance procedures
- A summary of the status of the 100-N Area environment based on the results of the surveillance program
- The results of any special samples taken of the 100-N Area environs

Both of the reports will be prepared by the Environmental Control Subsection.

LKP/tlw/WP #2595A

9W3222-1896

REFERENCES

1. Cearlock, D.B. and R.D. Mudd, Analysis of Hydrological Factors Influencing the Operation of the 100-N Emergency Disposal Crib, BNWL-CC-2290, October 24, 1969.

2. Eliason, J.R., Field Evaluation of Ground Disposal of Reactor Effluent - 1301-N Crib, BNWL-CC-1032, February 8, 1967.

3. Operation of N Reactor and Fuels Fabrication Facilities - Environmental Assessment, U.S. Department of Energy, DOE/EA-0030, August 1979.

4. Final Environmental Statement, Waste Management Operations, Hanford Reservation, Richland, Washington, Energy Research and Development Administration, ERDA-1538, December 1975.

5. U.S. Department of Energy, Richland Operations Office, Radioactive Waste Management, Order RL 5820.2, July 26, 1979.

6. L.P. Diediker, Effluent Environmental Program Manual, UNI-M-76, August 1, 1977.

DWA222.897

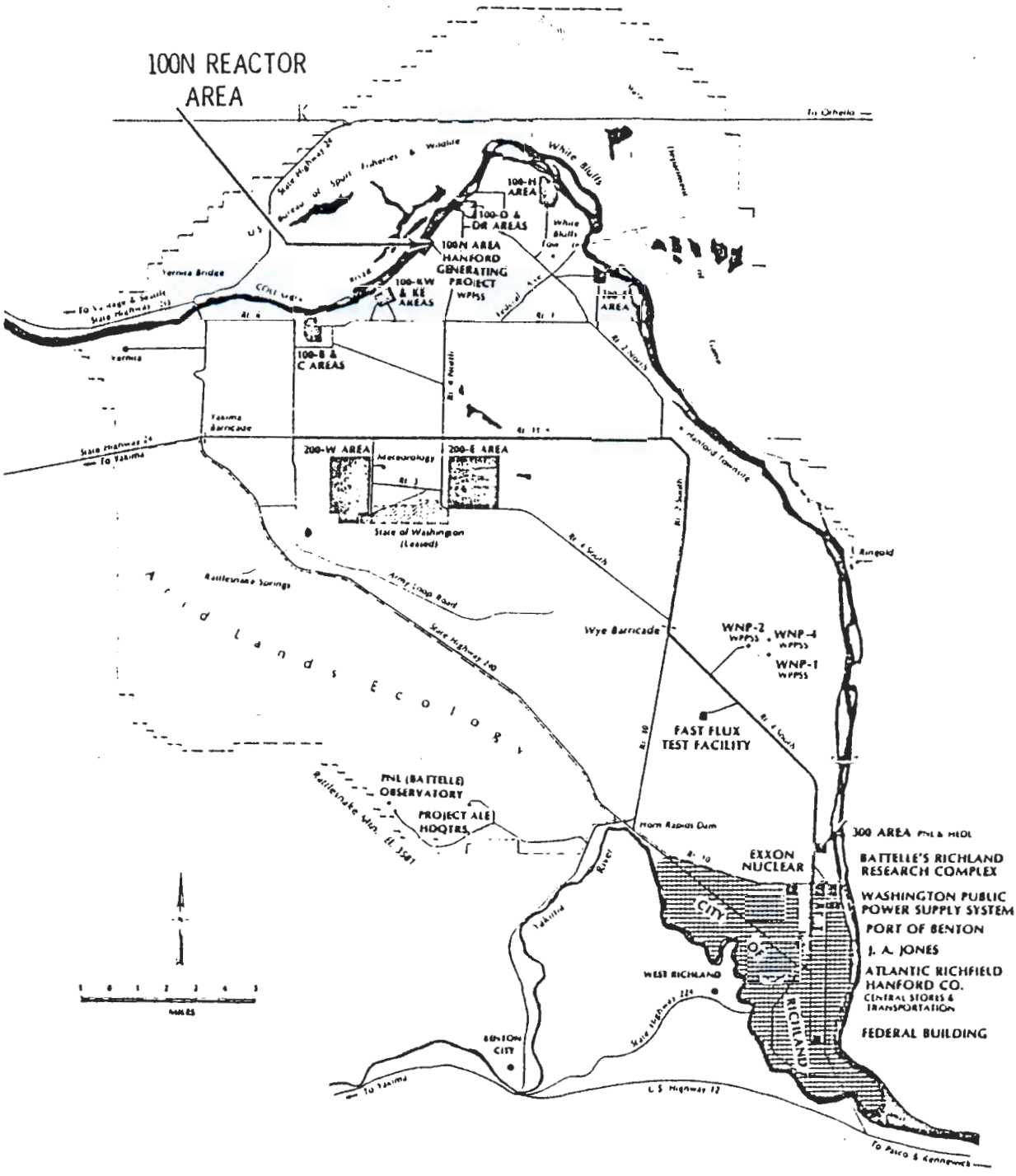


FIGURE 1.1 MAP OF HANFORD RESERVATION

9413222.1898

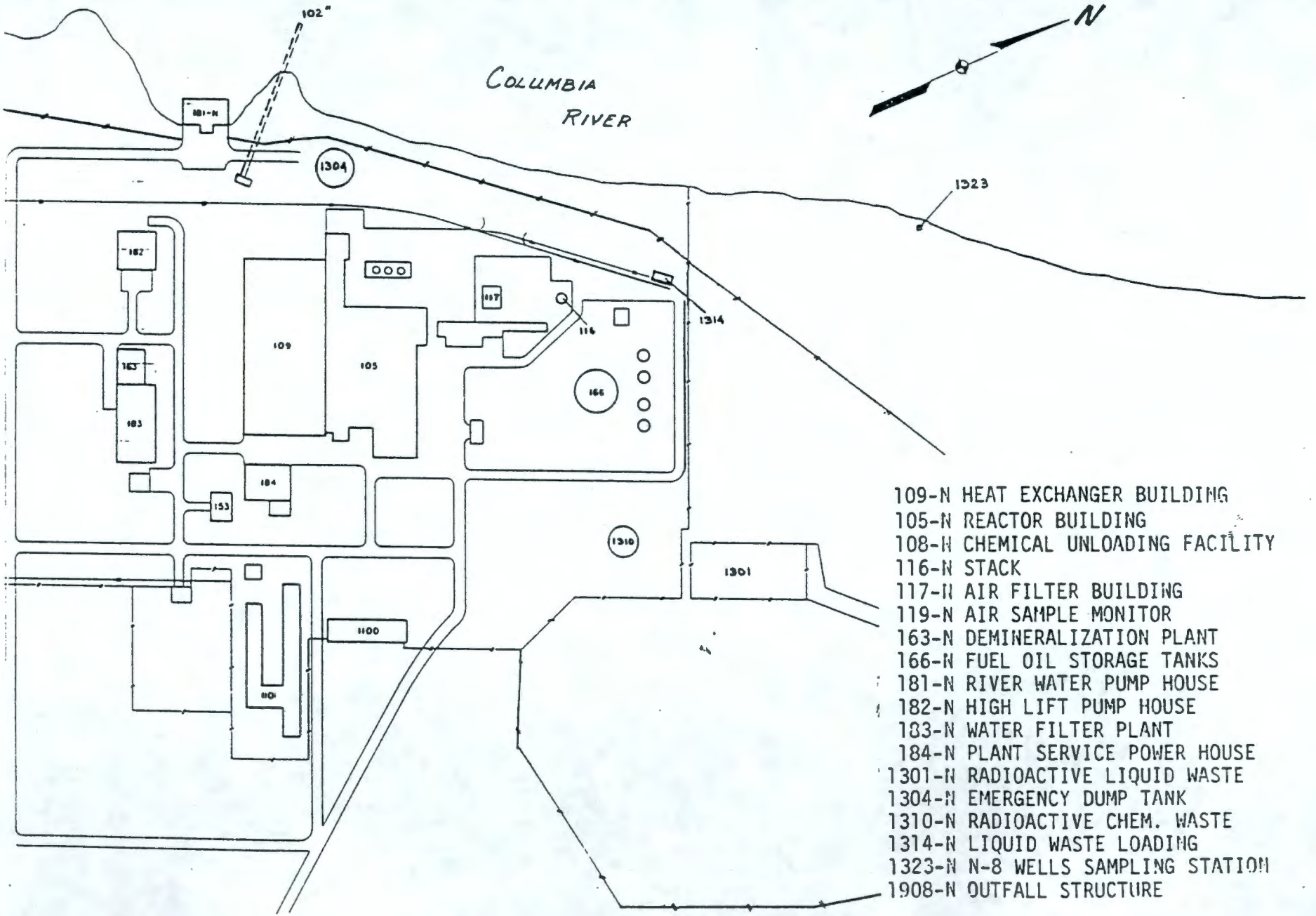


FIGURE 1.2 100-N AREA LAYOUT

9413222.1899

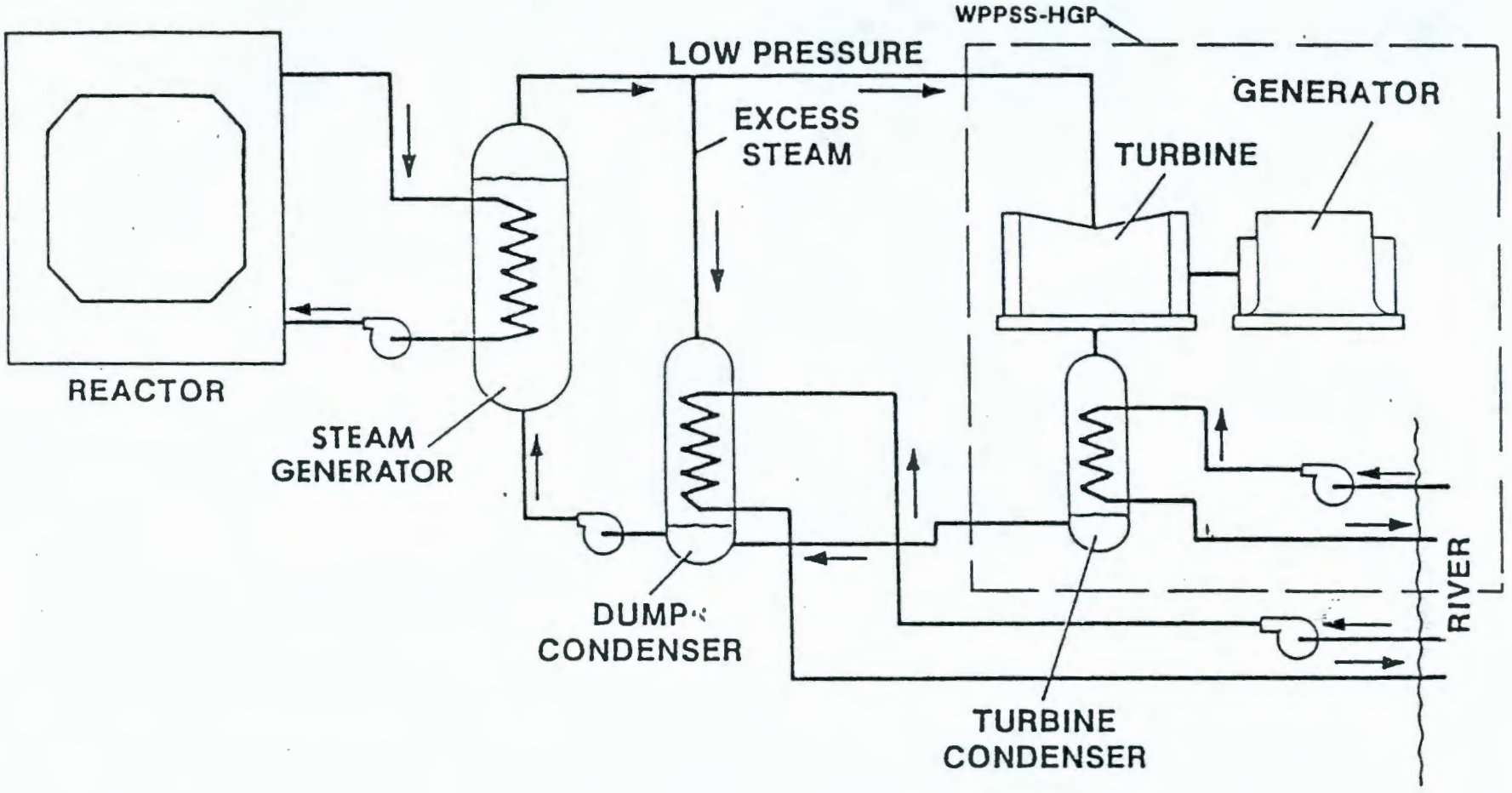


FIGURE 1.3 PRIMARY-SECONDARY COOLANT SYSTEM FEATURES

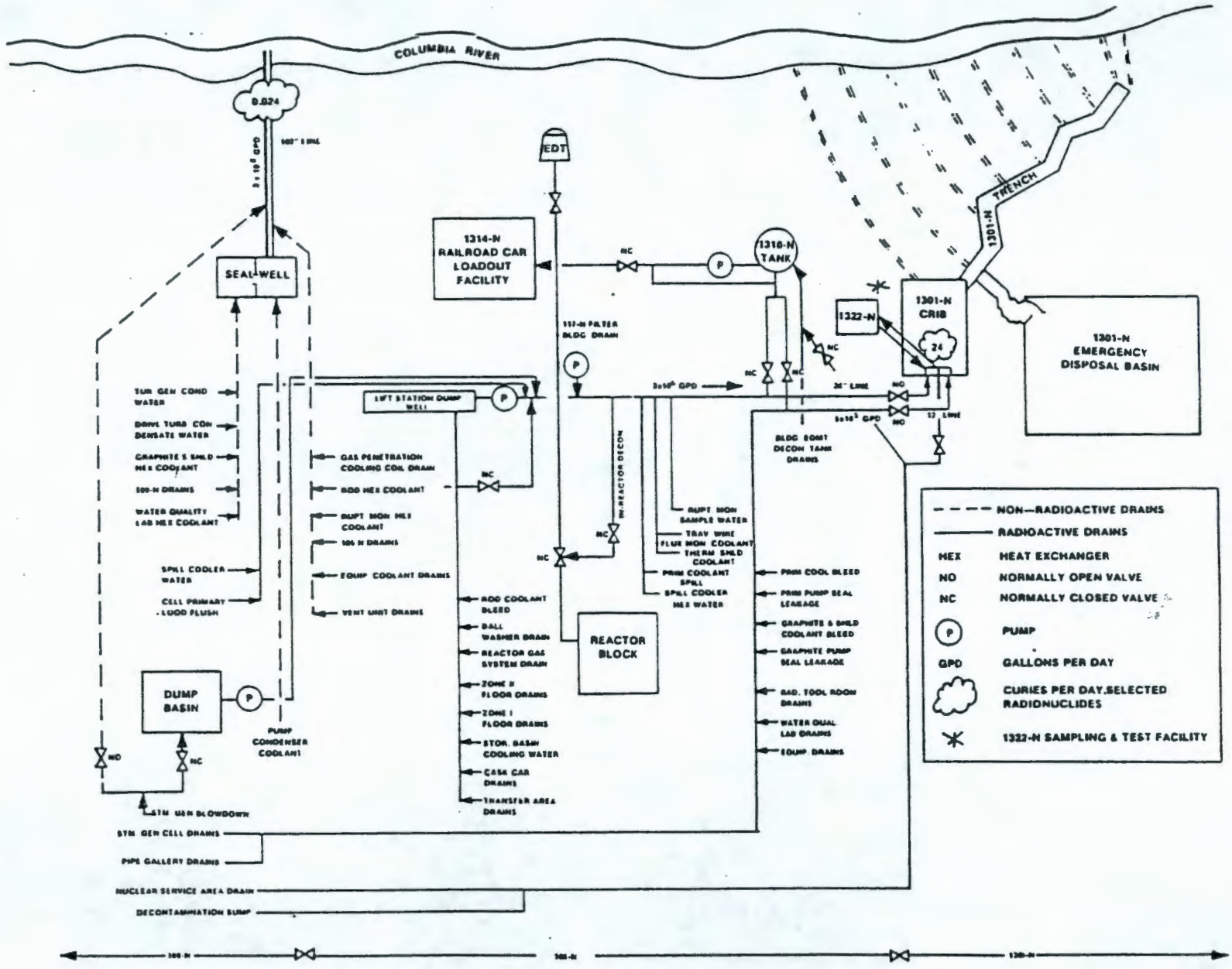


FIGURE 1.4 N Reactor Liquid Effluent Flow Schematic

9117322.1901

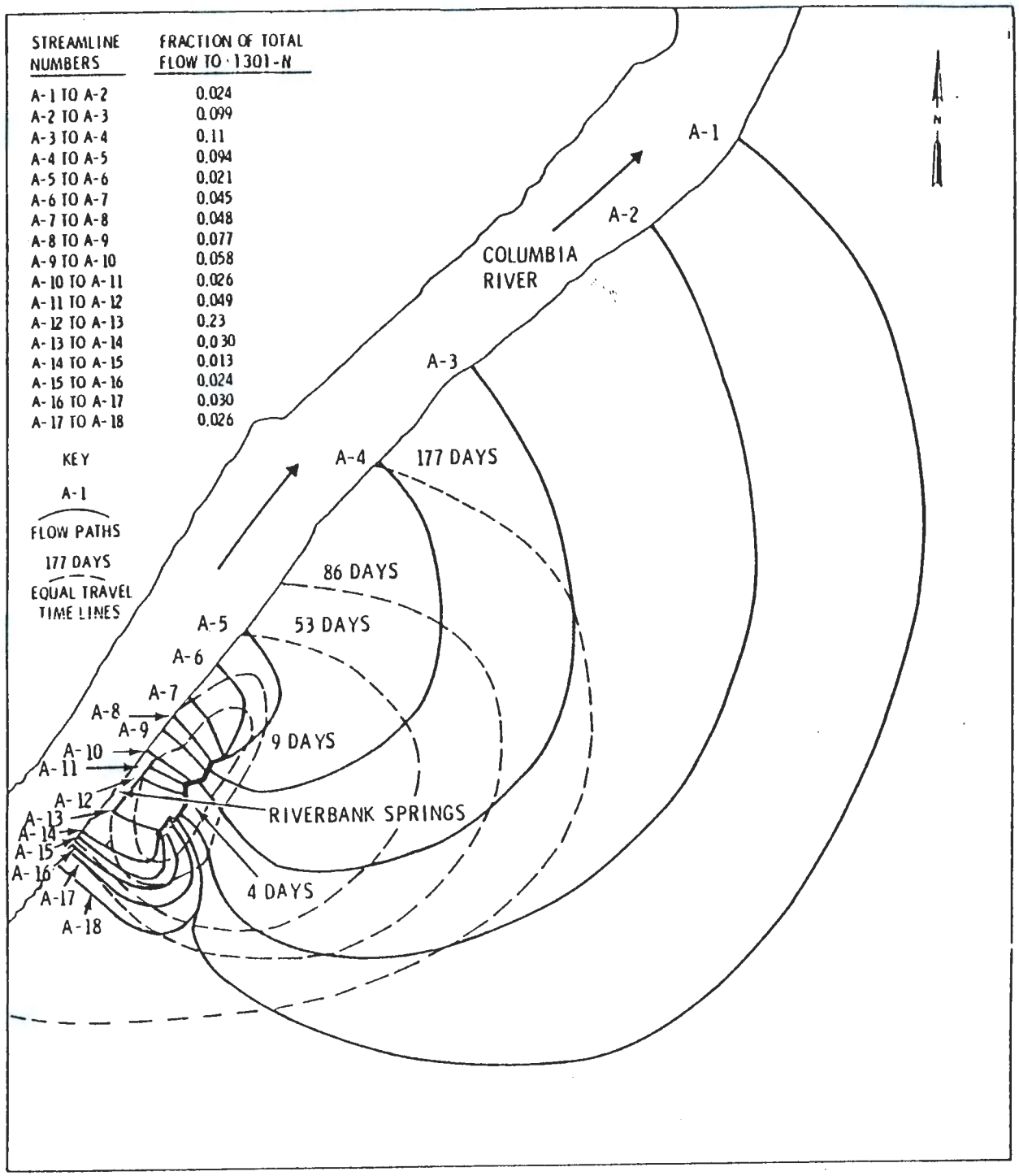


FIGURE 1.6 Calculated Flow Paths Originating from the 1301-N Facility with Travel Time Lines

9413222.1902

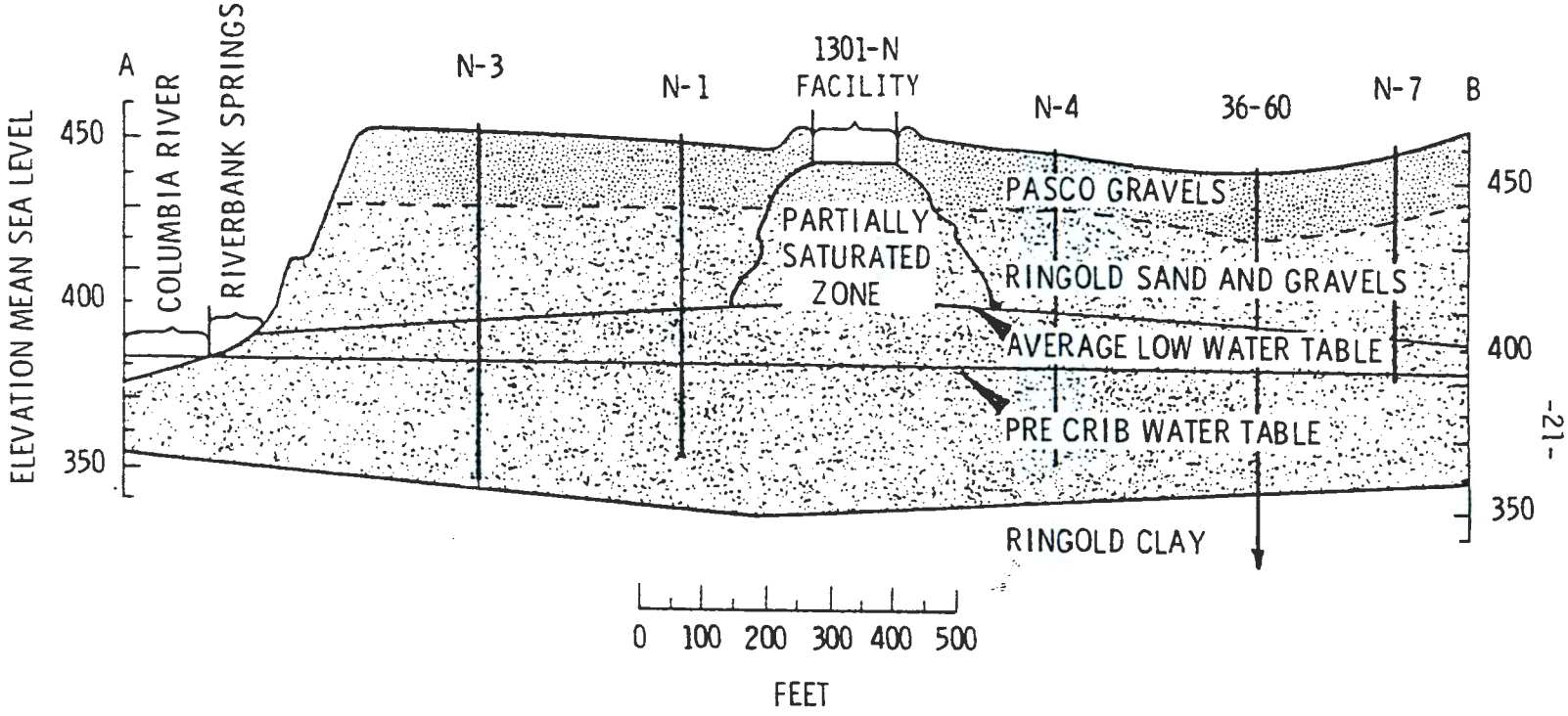
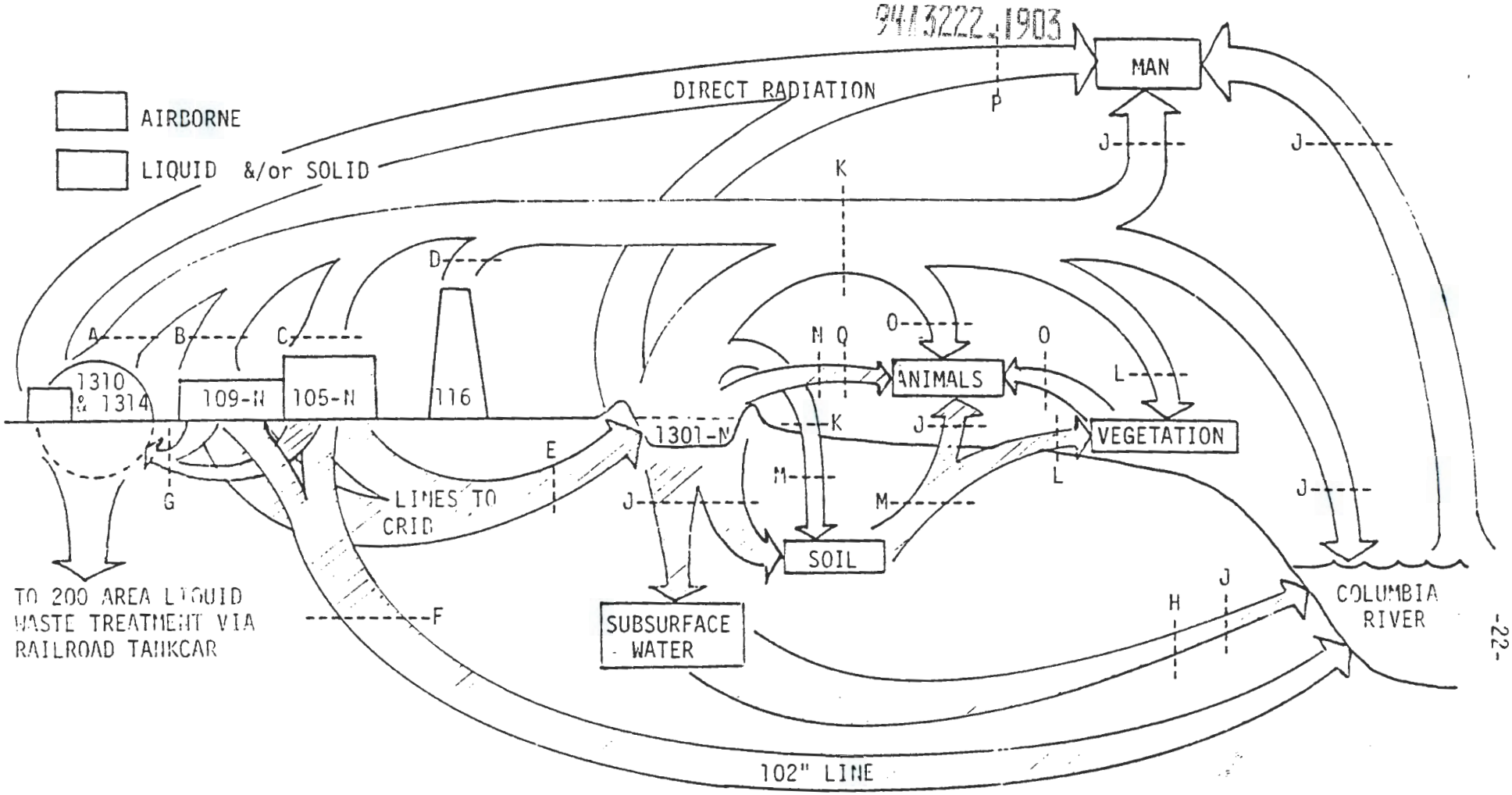


FIGURE 1.7 Cross Section of the 1301-N Facility

9413222.1903



ENVIRONMENTAL BARRIERS OR PATHWAY MONITORS:

EFFLUENT PROGRAM
- A AIRBORNE SAMPLER ON TANK VENTS
- B CONTINUOUS SAMPLING SYSTEM (SEC. 4.1)
- C CONTINUOUS SAMPLING SYSTEM (SEC. 4.1)
- D CONTINUOUS SAMPLING SYSTEM (SEC. 4.1)
- E FLOW PROPORTIONAL COMPOSITE SAMPLER (SEC. 4.2.1)
- F CONTINUOUS LARGE VOLUME SAMPLER (SEC. 4.2.3)
- G SAMPLE ANALYSIS DURING STORAGE & SHIPMENT
- H MULTIPLE CONTINUOUS CONPOSITE SAMPLERS (SEC. 4.2.2)

ENVIRONMENTAL PROGRAM
- J PNL ENVIRONMENTAL PROGRAM (SEC. 2.0 & 5.2)
- K CONTINUOUS AIR SAMPLERS (SEC. 5.1)
- L VEGETATION SAMPLING (SEC. 5.4)
- M SOIL SAMPLING (SEC. 5.3)
- N WIRE MESH TRENCH COVER (SEC. 1.0)
- O 100-N AREA PERIMETER FENCE (SEC. 1.0)
- P TLDs AND DIRECT RADIATION MEASUREMENT(SEC. 5.5)

FIGURE 3.1 MAJOR RADIOLOGICAL RELEASE PATHWAYS BETWEEN 100-N FACILITIES AND THE ENVIRONS

UNI-1347

DOE/RL-91-22, Rev. 1904

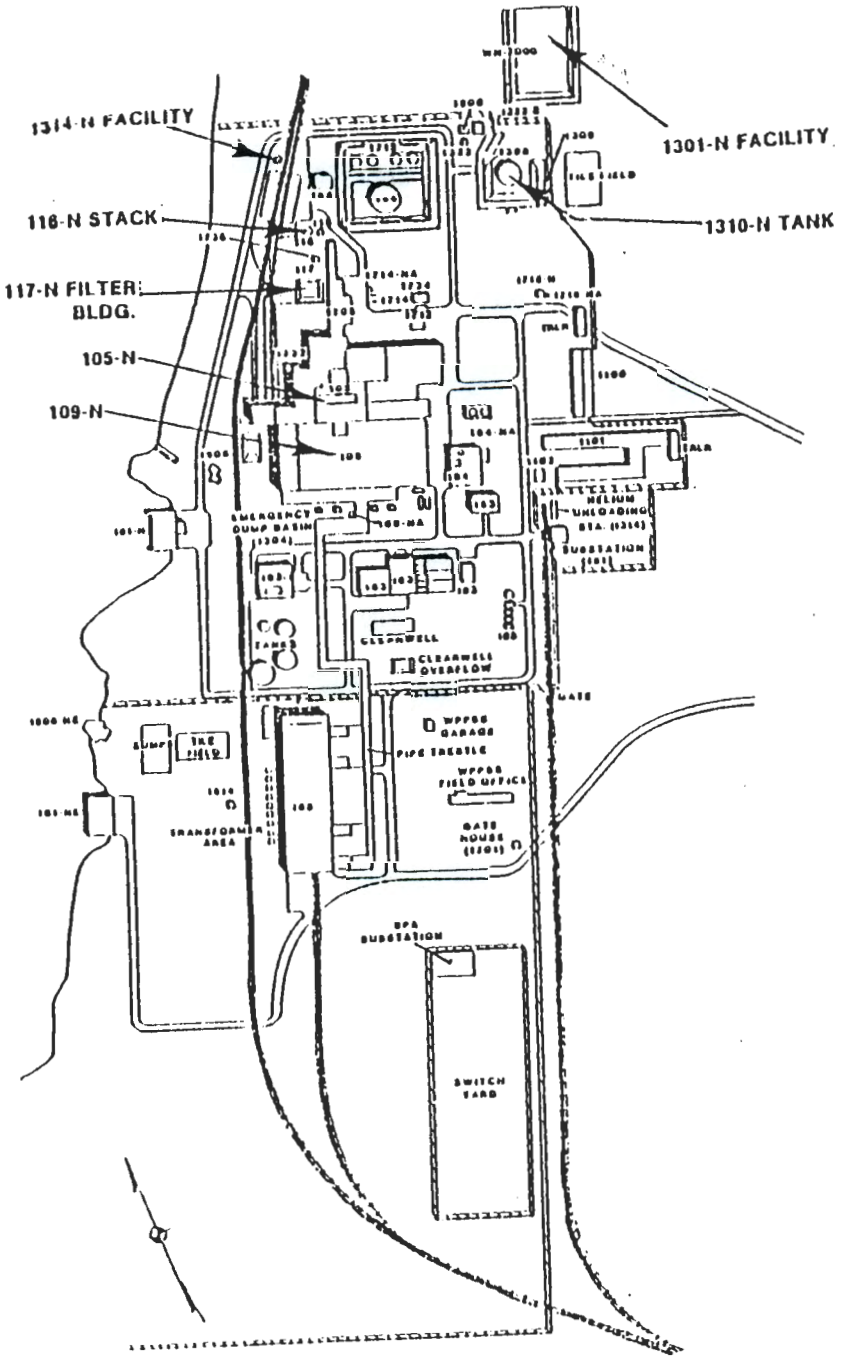


FIGURE 3.2 100-N ATMOSPHERIC RELEASE POINTS

9413222.1905

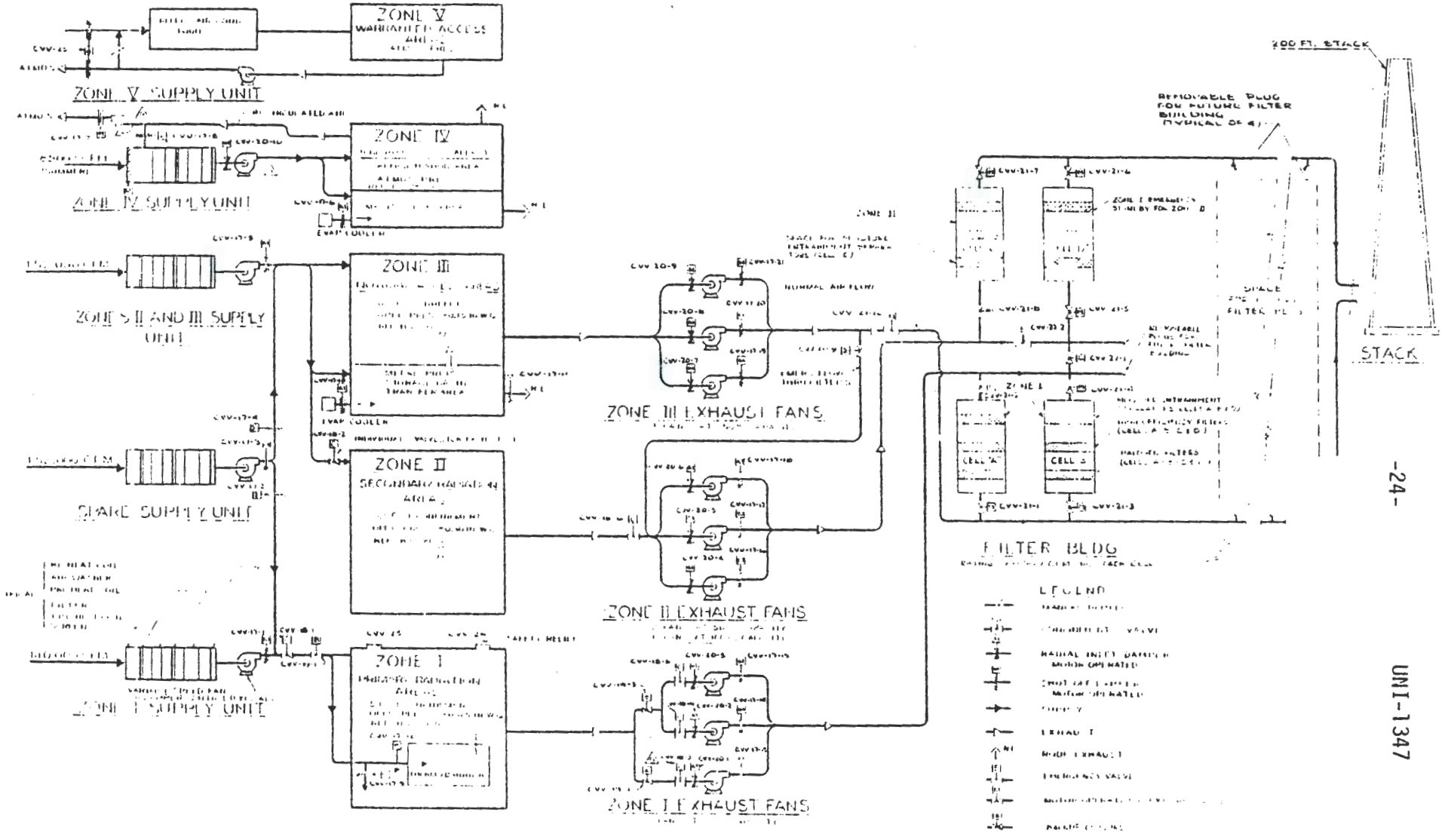


FIGURE 3.3 105-N Ventilation and Exhaust Systems

9473222.1906

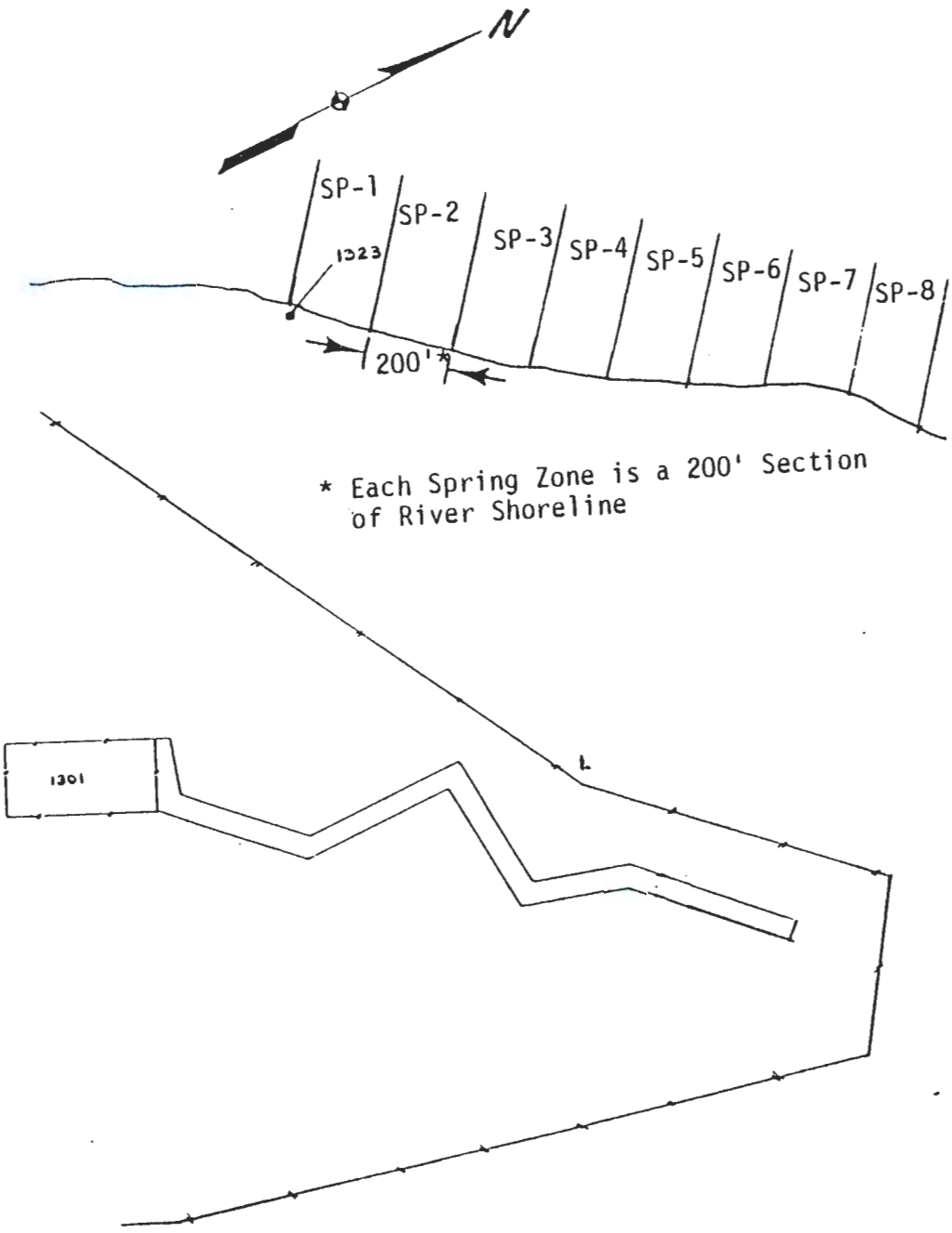


FIGURE 4.1 RIVERBANK SPRINGS SAMPLE ZONES

PHX022.1907

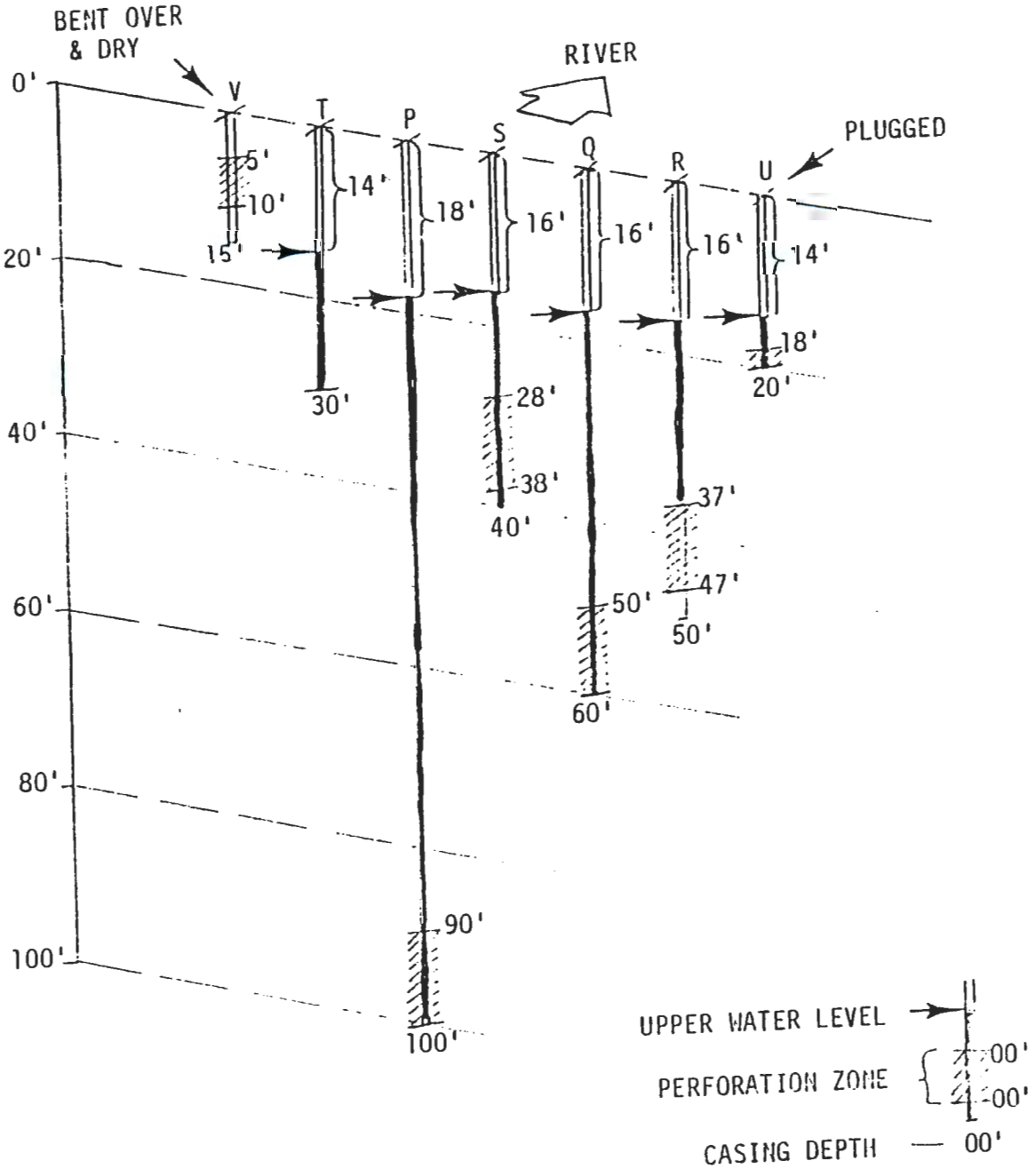


FIGURE 4.2 N-8 WELLS

9413222.1908

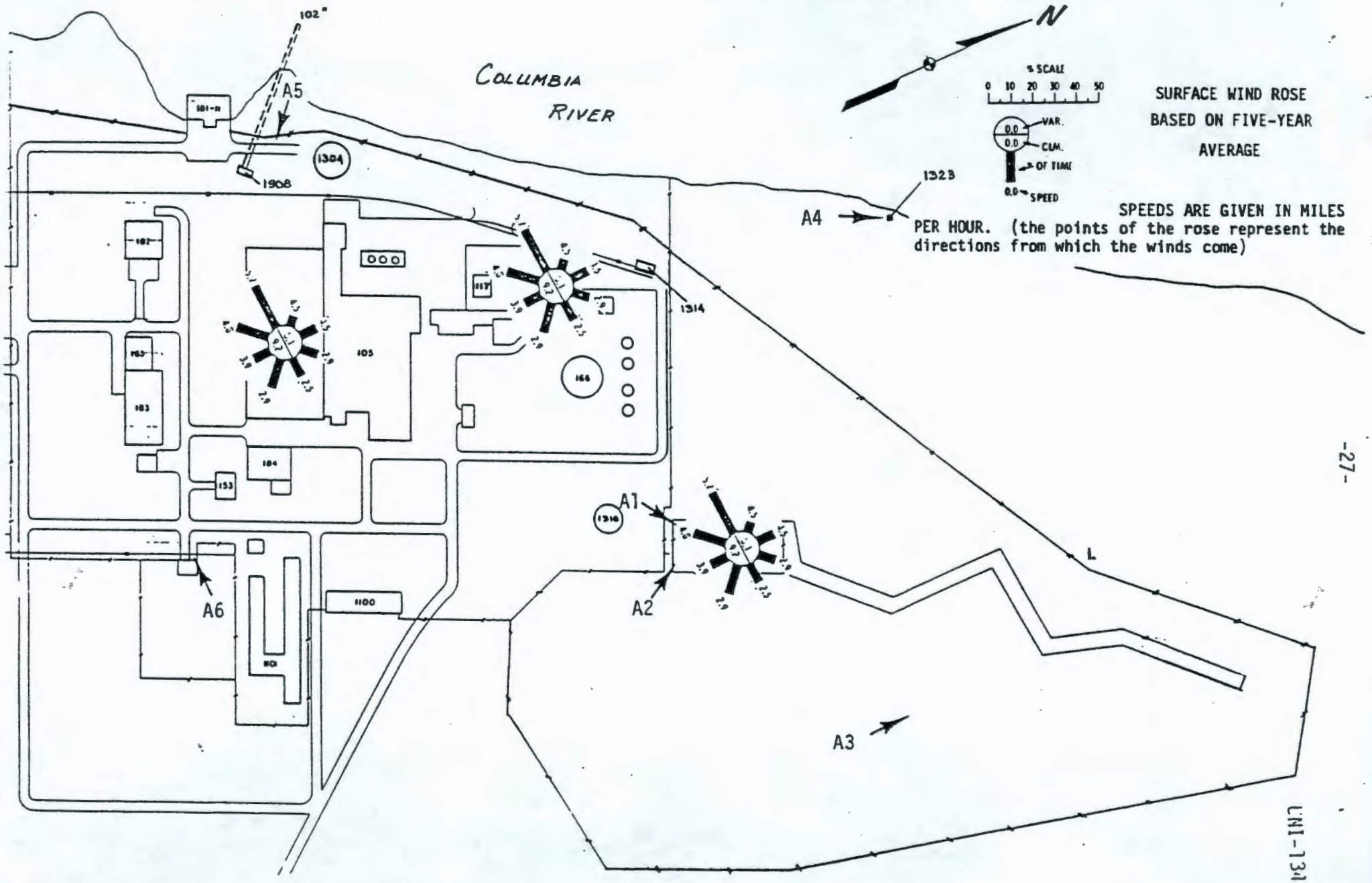


FIGURE 5.1 AIRBORNE ENVIRONMENTAL RELEASE SAMPLER LOCATIONS

9413222.1909

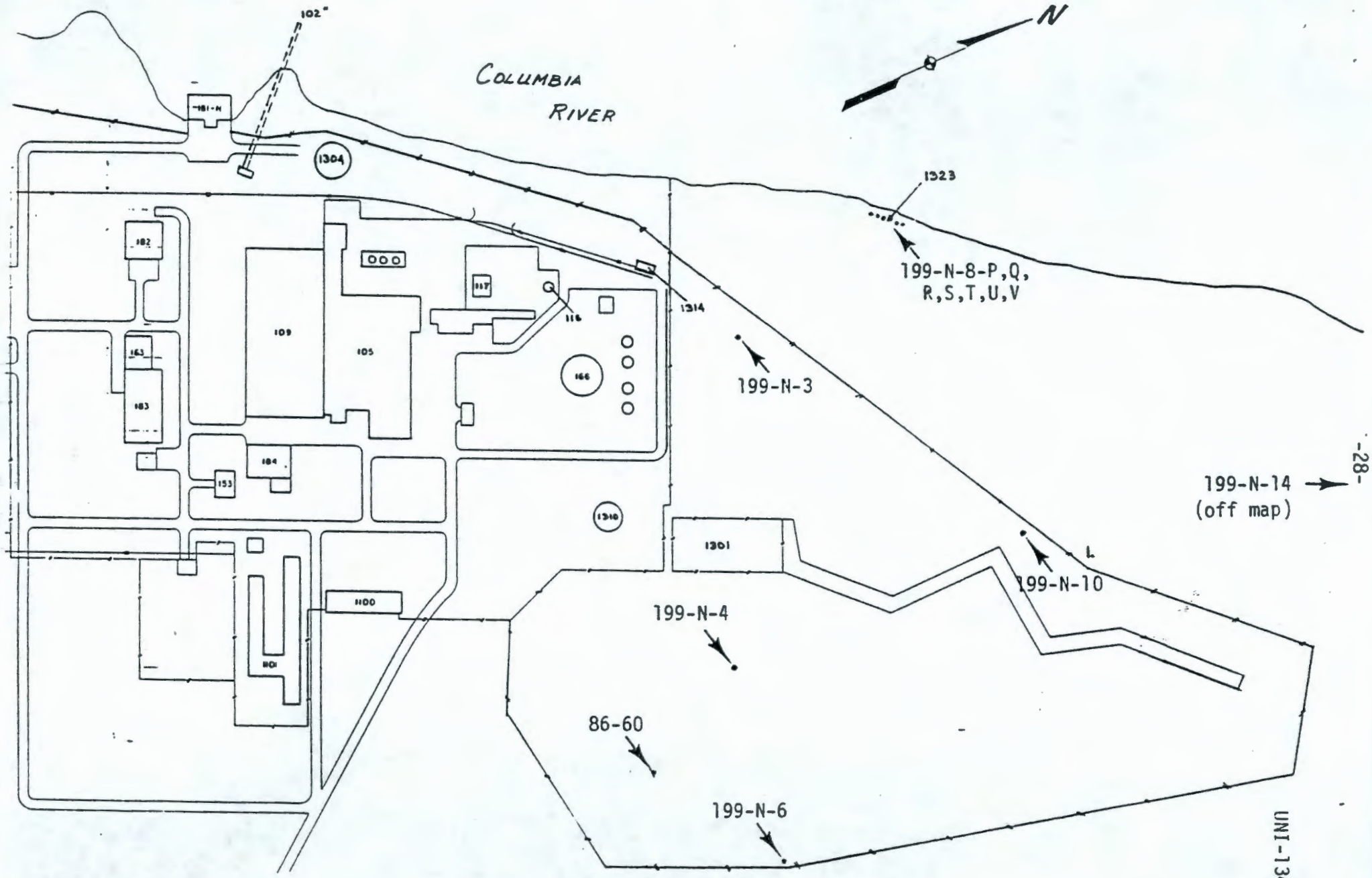


FIGURE 5.2 1301-N FACILITY GROUNDWATER MONITORING WELLS

9413222.1910

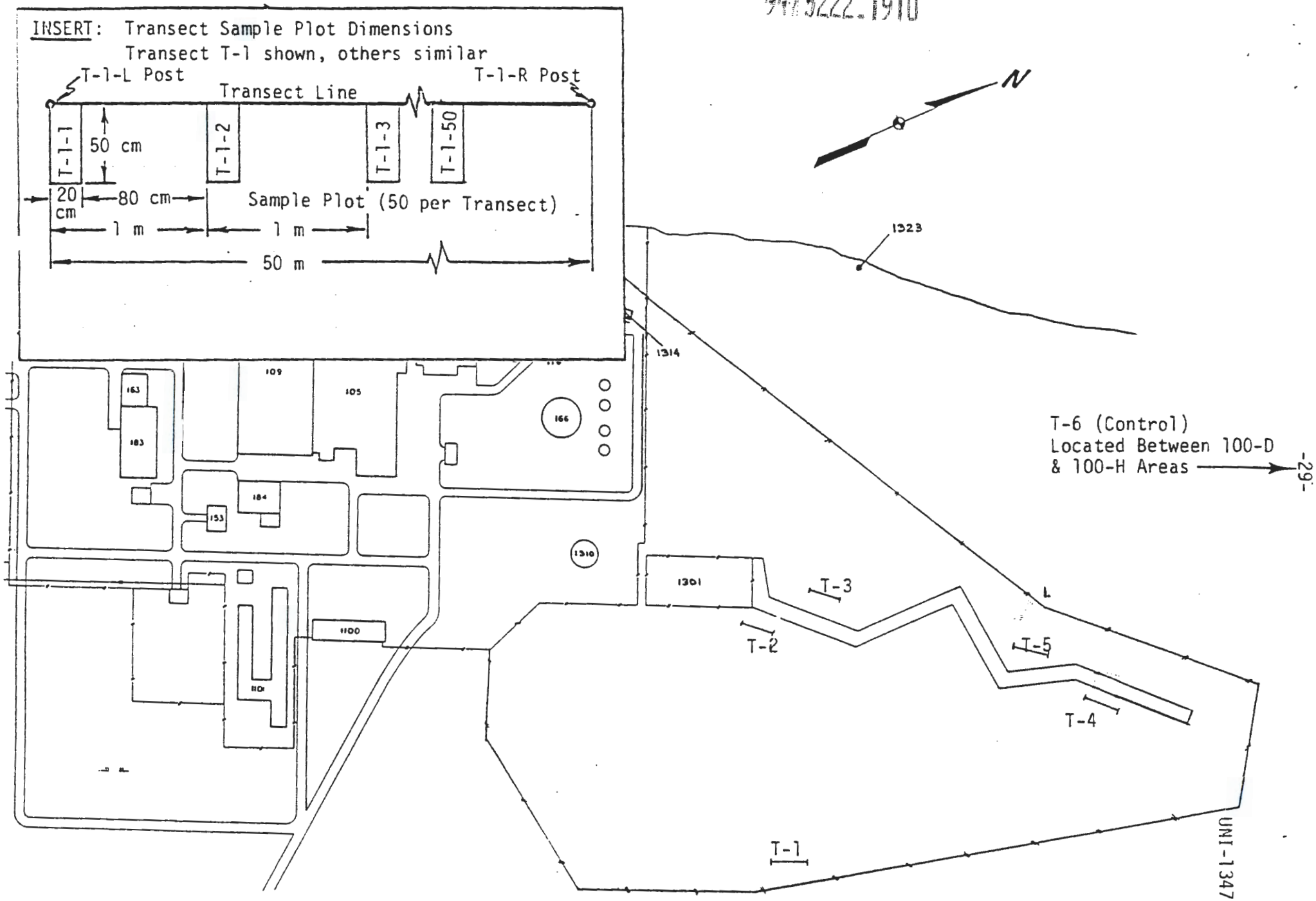


FIGURE 5.3 SAMPLE TRANSECTS

GW3222.911

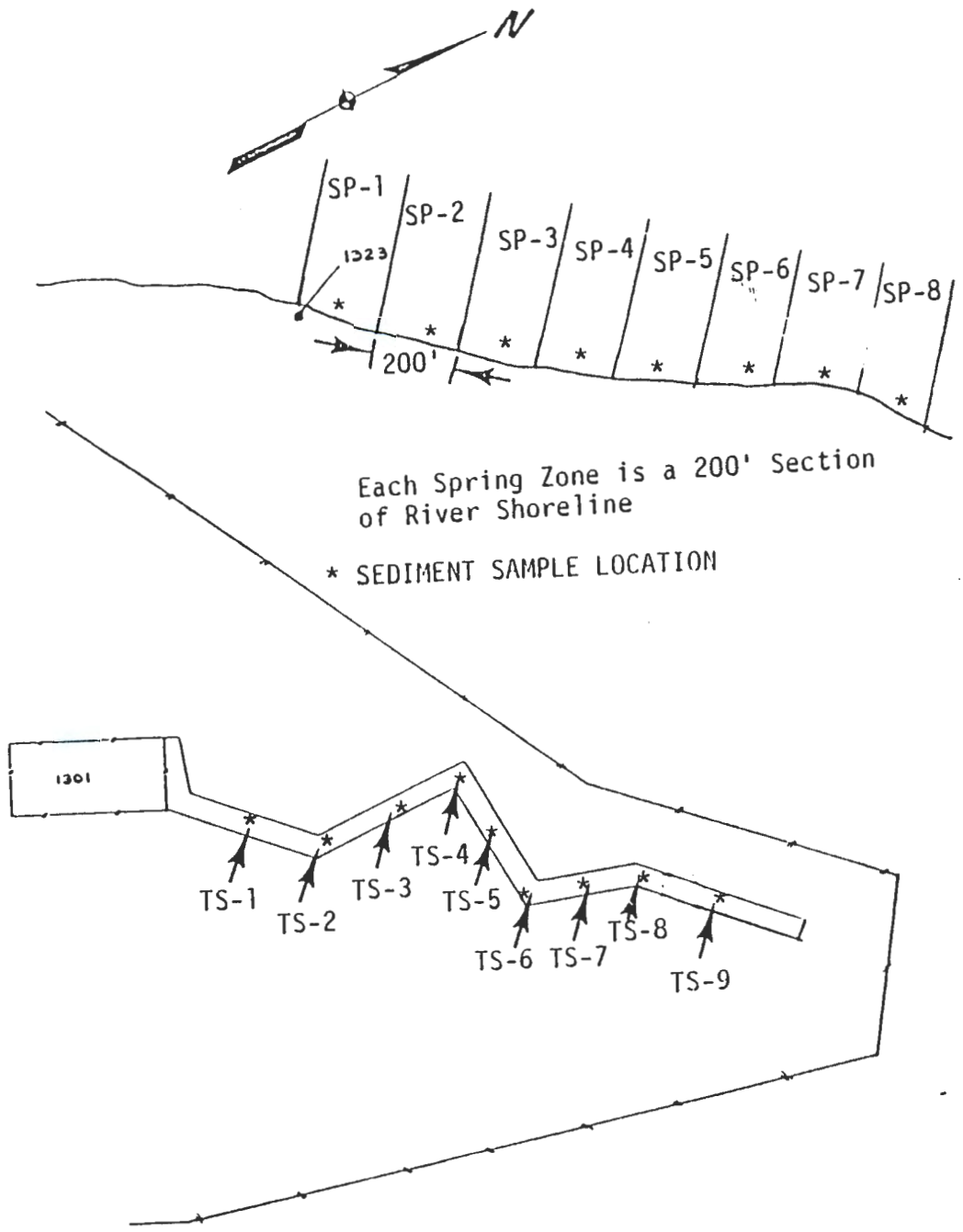


FIGURE 5.4 SEDIMENT SAMPLE LOCATIONS

9413222.1912

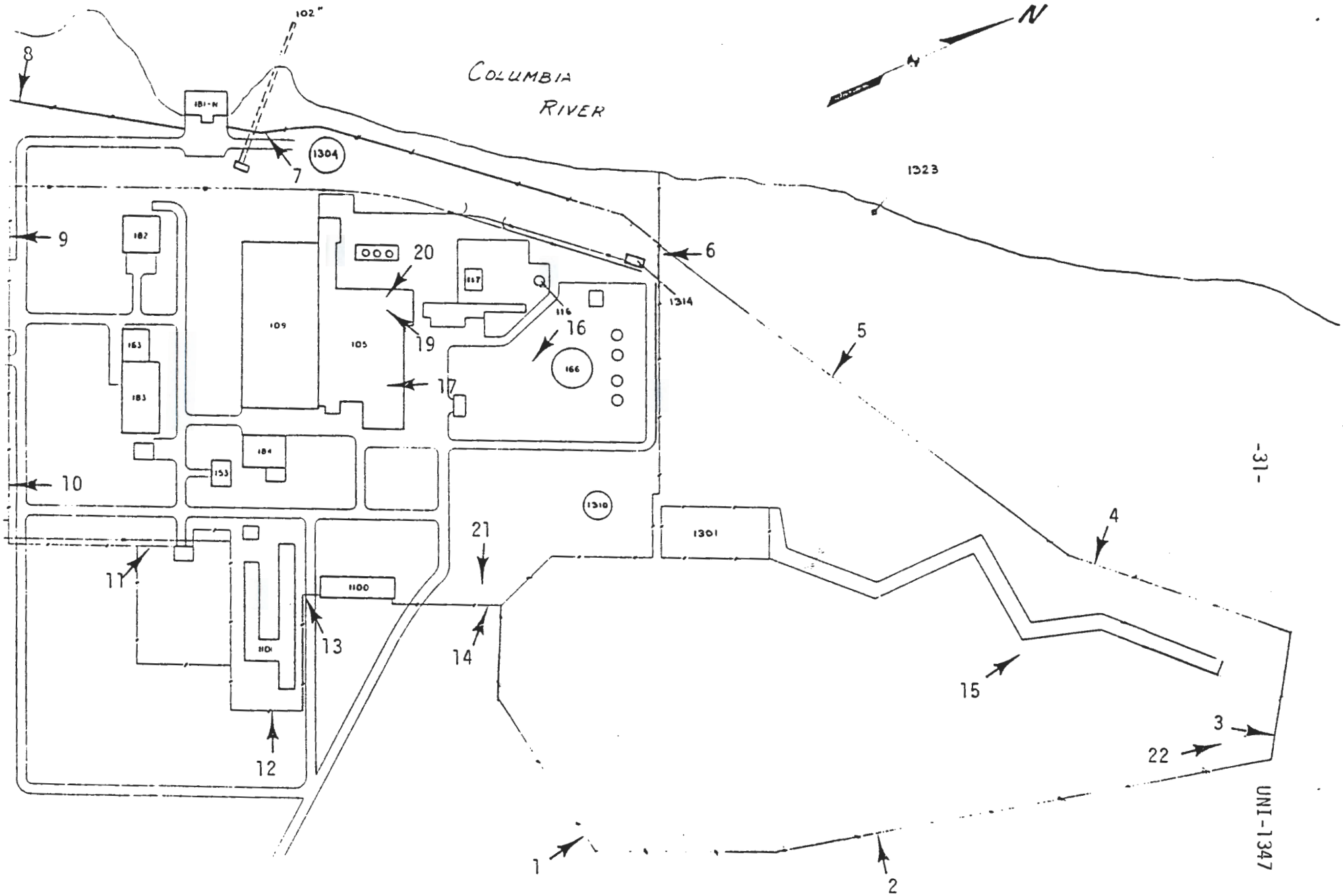


FIGURE 5.5 ENVIRONMENTAL DOSIMETER LOCATIONS

9413222.1913

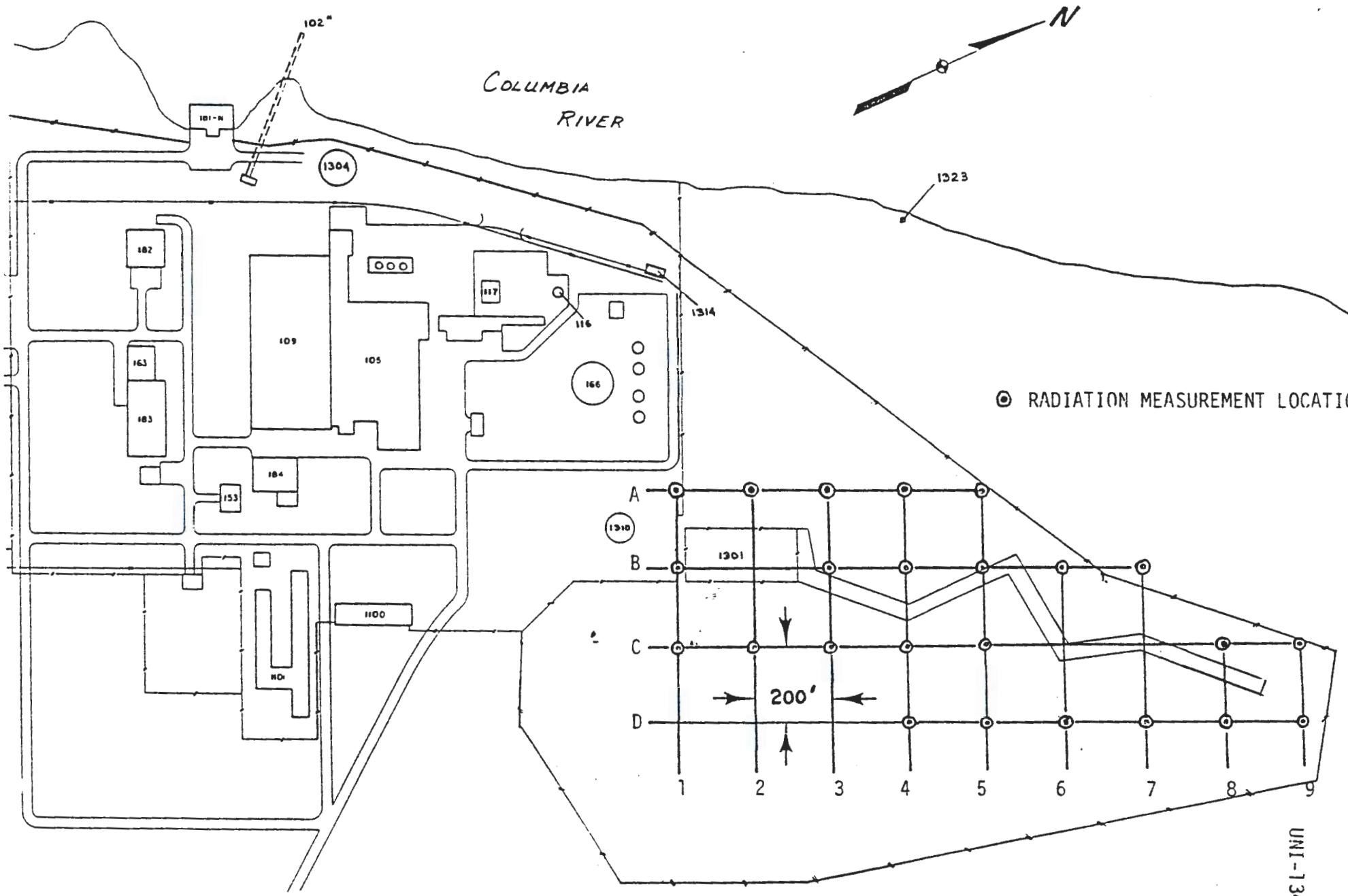


FIGURE 5.6 1301-N FACILITY DIRECT RADIATION MONITORING GRID

GW-3722-91W

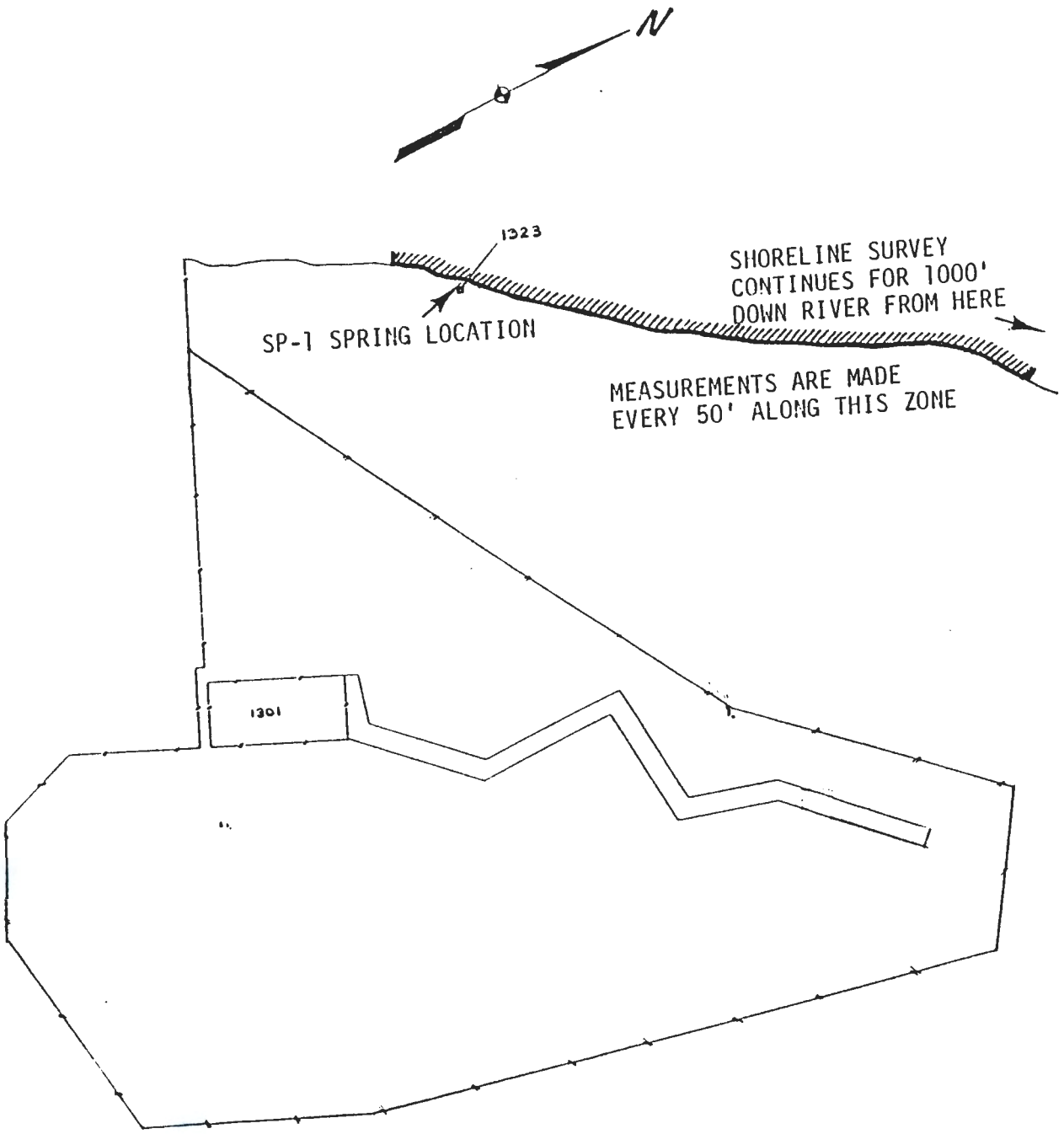


FIGURE 5.7 RIVER SHORELINE SURVEY

N AREA [illegible] SAMPLE _____ TO [illegible]
LOCATION:_____ SAMPLE SIZE _____
DATE ON:_____ TIME _____
DATE OFF:_____ TIME _____
ANALYSES: H-3 , P-32 ,
SR-89/90 ,PU-238,239/240
OTHER:_____

N AREA LIQUID SAMPLE -UST
LOCATION:_____ SAMPLE SIZE _____
DATE ON:_____ TIME _____
DATE OFF:_____ TIME _____
ANALYSES: H-3 , C-14 , P-32 ,
SR-89/90 ,PU-238,239/240
OTHER:_____

N-AREA EFFLUENT SAMPL-
1301-N CRIB COMPOSITE
SAMPLE SIZE : 1 GALLON
DATE ON : _____
DATE OFF : _____
FLOW RATE _____
TAKEN BY _____

N-AREA EFFLUENT SAMPLE
1301-N CRIB GRAB
SAMPLE SIZE : FOR GC
DATE SAMPLED _____

TAKEN BY _____

FIGURE 6.1 SAMPLE LABELS

GW3022.915

9413222.1916

WEEK OF _____

LOCATION	SAMPLED AND DELIVERED TO ROOM 50	COMMENTS	SUPERVISORY VERIFICATION
N-springs			
1301-N Crib Grab			
1301-N Crab Composite			
102" line			
N-Basin			
Rod Coolant Drain			
12" SCD			
Gas Penetration			
Dump Basin			

FIGURE 6.2 N-REACTOR EFFLUENT LIQUID SAMPLE LOG

9413222.1917

WEEK OF _____

REACTOR UP (DAYS)_____

LOCATION	TYPE	SAMPLED AND DELIVERED TO room 50		GM (cpm)	COOLING COIL TEMP.	INITIALS	COMMENTS
116-N stack	200 cc Charcoal						
	43 mm Filter						
	120 cc Condensate						
	Marinelli Gas Sample						
109-N Zone I	200 cc Charcoal						
	43 mm Filter						
	120 cc Condensate						
	Marinelli Gas Sample						
Zone I Cell #6	200 cc Charcoal						
	43 mm Filter						
	120 cc Condensate						
	Marinelli Gas Sample						
EF 7,8	Charcoal and Filter						
EF 10	"						
EF 13	"						
EF 14,15	"						
EF 16	"						
105-N Dummy Spacer Decontamination Exhaust	"						
105-N 14' Decontamination Facility							
105-N Transfer Area	"						

FIGURE 6.3 N-REACTOR AIRBORNE EFFLUENT SAMPLE LOG

UNI-1347

PNL-3222-1918

WEEK OF_____

COMMENTS

(e.g., flow rates, anomalies, etc.)

	REQ'D THIS WEEK	REC'D	PREPARED	Y- ANALYSIS	TO UST	DATA ENTRY	SAMPLE STORED	
CRIB GRAB	X							
CRIB. SOL.	X							
CRIB. SOL. (QC)	X							
CRIB PART.	X							
N-SPRINGS	X							
PRIMARY LOOP	X							
N-BASIN	X							
KE-BASIN	X							
66" GRAB								
102" GRAB								
RAW WATER								
102" LVS								
R.W. LVS								
KE LVS								
GSCS PRIM.								
RCD								
V-19 BYPASS								
SCD								
ROUGHING C.								
GSCS SEC.								
116-N PART.	X							
CAR.	X							
GAS	X							
COND.	X							
109 ZONE I PART.	X							
CHAR	X							
GAS	X							
COND.	X							
CELL #6 PART.	X							
CHAR.	X							
GAS	X							
COND.	X							
EF 7, 8								
EF 10								
EF 13								
EF 14, 15								
TRANSFER AREA								
ACCURACY (QC)								
PRECISION (QC)								
BACKGROUND								
CALIB. STD.								

FIGURE 6.4 EFFLUENT ANALYSIS LOG

Radionuclide	1974	1975	1976	1977	1978
^{3}H	1	1	1	1	1
^{60}Co	1,700	1,200	940	1,400	2,300
^{90}Sr	210	230	310	120	300
$^{95}ZrNb$	10,000	(a)	(a)	(a)	(a)
^{99}Mo	3,300	1,700	5,700	1,800	1,200
^{106}Ru	160	220	300	340	670
^{131}I	210	240	450	130	150
^{137}Cs	3,300	2,500,000	(a)	13,000	21,000
$^{140}BaLa$	2,000	(a)	(a)	(a)	(a)

(a) Radionuclide detected at crib but not at springs.

TABLE 1.1 1301-N FACILITY DECONTAMINATION FACTORS

9113222.1919

Radionuclide Types	116-N Stack	109-N Releases Zone 1 Vent	109-N Releases Cell 6 Exhaust	All Others	Total Released
Noble Gases		(Curies Released)			
Ar-41	120,000	230	410	ND(b)	120,640
Xe-135	1,500	660	88	ND	2,248
H-3	32	0.19	0.037	ND	32.23

Halogens and Particulates	116-N Stack	109-N Releases Zone 1 Vent	109-N Releases Cell 6 Exhaust	All Others	Total Released
		(Curies Released)			
I-131	0.12	0.28	0.073	0.002	0.48
I-132	1.1	3.7	1.4	ND	6.2
I-133	0.46	2.0	0.6	0.0065	3.1
I-135	1.1	3.3	1.7	ND	6.1
Mn-54	0.0025	0.011	0.0068	0.0069	0.027
Mn-56	0.11	2.1	1.5	ND	3.71
Fe-59	0.0058	0.01	0.0069	ND	0.028
Co-60	0.0061	0.02	0.012	0.0085	0.047
As-76	4.0	2.6	0.043	ND	6.64
Sr-89	0.00049	0.016	0.0052	ND	0.022
Sr-90	0.000058	0.0005	0.00016	ND	0.00072
Mo-99	0.0012	0.81	0.17	0.0024	0.98
BaLa-140	0.0036	0.97	0.14	0.00068	1.11

(a) Selected radionuclides based upon Environmental Report for 1978 releases and assumptions including a total of 380,000 CFM exhaust rate from all release points.

(b) ND = Not Detected

TABLE 3.1 Annual Radionuclide Releases to Atmosphere(a) From N Reactor Operations (Measured Activity)

9413222.1920

9413222.1921

ZONE NO.	RATED FLOW (CFM x 10^3)	AREA SERVED	DISCHARGE POINT
I	128	Cells 1-5, auxiliary cell pipe gallery, and pressurizer	109-N roof
IA	14	Cell 6 and Cell 6 pipe gallery	109-N roof
II	23	Hot tool room, hot storage room	109-N roof
III	130	Turbine bay, mechanical & electrical equipment rooms, storage area, offices, lunch rooms, locker rooms	109-N roof
	2.4	Hot water quality labs	109-N roof
	3.1	Rms, 17, 112, 110, locker room, shower, toilet	109-N roof
	0.21	Exhausts hydrogen peroxide room to Zone III	To Zone III Main Exhaust
	0.275	Exhausts crud probe fume hood	To EF-11, 12
	0.25	Exhausting chemical cabinet in Room 207	109-N roof
	21	Cell 6 end of turbine bay	109-N roof
	1.6	Chemical Decontamination Solution Preparation Area	El. 80'0" Decontamination Dry Chemical Storage Area Roof
	1	Same as above	Decontamination Dry Chemical Storage Area Roof

TABLE 3.2 EXHAUST VENTS - 109-N BUILDING

Radionuclide	To the 1301-N Facility			Seepage from Facility to River Via Springs[a]		
	Average Concentration (pCi/ℓ)	Peak Concentration (pCi/ℓ)	Total Released (Ci)	Average Concentration (pCi/ℓ)	Peak Concentration (pCi/ℓ)	Total Released (Ci)
^{3}H	6.9×10^{4}	2.9×10^{5}	3.3×10^{2}	5.8×10^{4}	1.5×10^{5}	3.3×10^{2}
^{32}P	1.2×10^{4}	6.6×10^{4}	5.6×10^{1}	1.3×10^{1}	2.1×10^{2}	2.9×10^{-2}
^{51}Cr	7.9×10^{4}	2.1×10^{5}	3.7×10^{2}	6.4×10^{1}	7.7×10^{1}	1.4×10^{-1}
^{54}Mn	1.7×10^{5}	2.8×10^{5}	8.1×10^{2}	ND	ND	ND
^{59}Fe	1.6×10^{5}	7.4×10^{2}	7.6×10^{2}	ND	ND	ND
^{58}Co	1.4×10^{4}	3.1×10^{4}	6.4×10^{1}	7.8×10^{0}	8.9×10^{0}	1.7×10^{-2}
^{60}Co	2.0×10^{5}	5.6×10^{5}	9.4×10^{2}	1.8×10^{2}	3.9×10^{2}	4.1×10^{-1}
^{65}Zn	8.3×10^{3}	1.3×10^{4}	3.9×10^{1}	ND	ND	ND
^{89}Sr	1.1×10^{5}	1.8×10^{6}	5.2×10^{2}	1.8×10^{2}	4.8×10^{2}	4.0×10^{-1}
^{90}Sr	2.5×10^{4}	9.6×10^{4}	1.2×10^{2}	5.9×10^{2}	1.5×10^{3}	1.3×10^{0}
$^{95}ZrNb$	1.3×10^{5}	1.1×10^{6}	1.2×10^{3}	ND	ND	ND
$^{99m}MoTc$	3.3×10^{5}	5.6×10^{6}	1.6×10^{3}	5.9×10^{2}	1.4×10^{3}	1.3×10^{0}
^{103}Ru	6.3×10^{4}	5.6×10^{5}	3.0×10^{2}	1.4×10^{2}	4.3×10^{2}	3.1×10^{-1}
^{106}Ru	7.0×10^{4}	1.6×10^{5}	3.3×10^{2}	2.2×10^{2}	4.4×10^{2}	4.9×10^{-1}
^{124}Sb	1.3×10^{4}	1.2×10^{4}	6.2×10^{1}	2.8×10^{1}	8.0×10^{1}	6.2×10^{-2}
^{125}Sb	7.6×10^{2}	7.5×10^{2}	4.1×10^{0}	7.7×10^{1}	3.1×10^{2}	1.7×10^{-1}
^{129}I	6.7×10^{-3}	---	1.4×10^{-5}	3.6×10^{-3}	---	8.2×10^{-6}
^{131}I	1.2×10^{5}	1.0×10^{6}	5.6×10^{2}	1.7×10^{3}	2.7×10^{4}	3.8×10^{0}
^{133}Xe	1.1×10^{5}	8.3×10^{5}	5.2×10^{2}	2.6×10^{3}	8.3×10^{3}	5.7×10^{0}
^{134}Cs	1.4×10^{4}	4.6×10^{4}	6.7×10^{1}	ND	ND	ND
^{137}Cs	7.3×10^{4}	2.4×10^{5}	3.4×10^{2}	7.1×10^{0}	1.0×10^{1}	1.6×10^{-2}
$^{140}BaLa$	7.3×10^{5}	1.4×10^{7}	7.1×10^{3}	ND	ND	ND
^{141}Ce	1.0×10^{5}	1.2×10^{6}	4.9×10^{2}	ND	ND	ND
$^{144}CePr$	1.4×10^{5}	5.6×10^{5}	6.6×10^{2}	ND	ND	ND
^{154}Eu	1.2×10^{4}	1.3×10^{4}	5.5×10^{1}	ND	ND	ND
^{155}Eu	7.3×10^{3}	7.3×10^{4}	3.4×10^{1}	NO	ND	ND
^{238}Pu	5.5×10^{1}	1.2×10^{2}	2.6×10^{-1}	5.7×10^{-2}	3.3×10^{-1}	1.3×10^{-4}
$^{239/240}Pu$	2.7×10^{2}	5.6×10^{2}	1.3×10^{0}	1.1×10^{-1}	1.3×10^{0}	3.0×10^{-4}

[a]Estimated Flow = 900 gpm.

ND = Radionuclide not detected in springs but were measured in effluent to the facility.

TABLE 3.3 DISCHARGE OF RADIONUCLIDES TO THE 1301-N FACILITY AND SEEPAGE TO THE RIVER DURING 1978

GH3722.1922

ORNL-922 1923

Radionuclide	Average Concentration (pCi/ℓ)	Total Released (Ci)
^{54}Mn	0.31	0.18
^{56}Mn	2.1	1.2
^{58}Co	0.026	0.015
^{59}Fe	0.19	0.11
^{60}Co	0.96	0.55
$^{95}ZrNb$	0.44	0.26
^{131}I	1.7	0.96
^{133}I	1.7	0.95
^{137}Cs	0.026	0.015
$^{140}BaLa$	7.0	4.1
^{141}Ce	0.06	0.035
^{144}Ce	0.25	0.15
^{147}Nd	0.29	0.17
$^{239/240}Pu$	0.15	0.085

TABLE 3.4 Releases to River Via 102-in. Discharge Line During CY 1978

9003222.924

Released to	Discharge Point	Periodic Sampling Program
Land	1301-N Facility (liquid)	Proportional to Flow Composite Sampler, Analyze Weekly for Radionuclides
River	102-in. Line	Nuclides Large Volume Sampler Used
	N-Springs	Weekly Analysis for Radionuclides
	182-N Raw Water Drain	Annual Analysis of Gamma Emitters
	182-N Tank Farm Flume	Annual Analysis of Gamma Emitters
Air	116-N Stack	Weekly Radionuclide Analysis
	Cell 6 Stack	Weekly Radionuclide Analysis
	109-N Zone I Stack	Weekly Radionuclide Analysis
	109-N Zone II	Quarterly Radionuclide Analysis
	EF-7[(a)], EF-8	
	109-N Zone III	Quarterly Radionuclide Analysis
	EF-10	
	EF-13	
	109-N Zone IV	Quarterly Radionuclide Analysis
	EF-14, EF-15	
	105-N Dummy Spacer Decontamination Facility Exhaust	Quarterly Radionuclide Analysis
	105-N 14 ft Decontamination Facility	Quarterly Radionuclide Analysis
	105-N Transfer Area	Quarterly Radionuclide Analysis

TABLE 4.1 N REACTOR RADIOACTIVE EFFLUENT DISCHARGE MONITORING PROGRAM

Type Sample	Sampling Method	Number of Sample Locations	Sampling Frequency	Type Analysis
Air Samples	Low volume continuous sampler with particulate filtration & charcoal filter. Grab gas sample taken at time of filter change.	6	Monthly	Particulate - Gross alpha & beta & major gamma emitters. Others - major gamma emitters.
Ground Water Samples	Sample provided to UNC by PNL	6	Quarterly	Major gamma emitters
Soil Samples	Surface 2.5 cm deep by 100 cm^2 and subsurface (where possible) sample of second 2.5 cm by 100 cm^2.	18	Semi-Annually	Semi-annual - major gamma emitters. Annual - one composite sample from each transect analyzed for Sr and Pu.
Trench Sediment	Dip samples of ∿50cc of trench bottom sediment.	9	Annually	Major gamma emitters.
Riverbank Springs Sediment	Dip samples of ∿50cc of rivershore sediment	8	Annually	All - major gamma emitters Sp-1 Spring Zone - SR & Pu. Composite of other zones - Sr & Pu
Vegetation Sampling	∿one pound (500 g) sample of vegetation, collected & dried.	6	Annually	Major gamma emitters, Sr & Pu
Riverbank Vegetation Sampling	Same as above	8	Annually	All - major gamma emitters Sp-1 Spring zone - Sr &
Gamma Radiation - 100-N Area	CaF_2:Mn(TLD400) Dosimeters	22	Monthly	------
Gamma Radiation Crib/Trench	Integrated count using hand-held survey instrument	24	Annually	------
Gamma Radiation - Riverbank Springs	Same as above	50	Annually	------

TABLE 5.1 100-N AREA ENVIRONMENTAL SURVEILLANCE PROGRAM