

ADDENDUM D

GROUNDWATER MONITORING PLAN

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1 **D GROUNDWATER MONITORING**

2 **D.1 Aquifer Identification**

3 The unconfined aquifer in the 100-N Area is located primarily in the upper part of the Ringold Formation
4 (sands and gravels) and is approximately 12 to 15 m (40 to 50 ft) thick. The base of the aquifer is
5 believed to be a laterally continuous clay-rich unit containing a series of paleosols. Lithologies in this
6 unit range from clay and silt to sand. Most of the wells in the 100-N Area were completed at the water
7 table; therefore, the thickness of the clay-rich unit is not known at all locations.

8 The water table is approximately 22 m (72 ft) below land surface near the 1324-N and 1324-NA units.
9 Water levels have returned to "pre-Hanford" levels after years of groundwater mounding caused by
10 artificial recharge from the 1324-NA and other effluent disposal in the 100-N Area.

11 A representative range of transmissivity estimates for the unconfined aquifer in the 100-N Area is 93 to
12 560 m²/day (1,000 to 6,030 ft²/day) throughout most of the 100-N Area. Wells in the northwest seem to
13 show a higher transmissivity (up to 1,900 m²/day [20,500 ft²/day]). These values correspond to horizontal
14 hydraulic conductivity of 6 to 37 m/day (20 to 121 ft/day), 120 m/day (394 ft/day) in the northwest.
15 Specific yield is estimated at 0.1 to 0.3. Hartman and Lindsey (1993) describe the hydrogeology of the
16 100-N Area in more detail.

17 **D.2 Interim Status Groundwater Monitoring**

18 The 1324-N and the 1324-NA areas are monitored together because of their proximity to one another and
19 their similar waste histories. Groundwater monitoring began at the 1324-N and 1324-NA units in
20 December 1987. The original monitoring network was modified over the years as water levels declined
21 and new wells were installed to replace dry wells.

22 After the first year of groundwater monitoring at the 1324-N/NA site, statistical evaluations were
23 performed according to 40 *Code of Federal Regulations* (CFR) 265.93. Results indicated that specific
24 conductance in all of the downgradient wells was significantly elevated above background
25 (i.e., upgradient) levels. This was not unexpected, because the effluent discharged to the units had high
26 specific conductance. A groundwater quality assessment program was initiated (Gilmore 1989) in
27 conjunction with the program for the nearby 1301-N Liquid Waste Disposal Facility. The assessment
28 program found no evidence that dangerous waste constituents had entered the groundwater
29 (Hartman 1992). Sulfate and sodium were elevated, but these were not historically defined as dangerous
30 waste constituents under the interim status program defined by 40 CFR 265.

31 The 1324-N and 1324-NA monitoring program did not immediately revert to an indicator evaluation
32 program. Total organic halogen (TOX) had become elevated in two of the downgradient wells. The
33 assessment program was revised to investigate the cause of the elevated TOX (Hartman 1993). The
34 revised program indicated the presence of chloroform, probably from reaction of chlorine with organic
35 material disposed in a French drain near the units (Hartman 1996c). The TOX and chloroform levels
36 decreased, and the units reverted to indicator evaluation monitoring in early 1996 (Hartman 1996c).

37 Groundwater is monitored under several programs in addition to the *Resource Conservation and*
38 *Recovery Act of 1976* (RCRA) in the 100-N Area. The most significant in terms of number of wells and
39 analytes are the RCRA and CERCLA programs, and sitewide surveillance. Sampling and analysis for
40 RCRA, CERCLA, and sitewide surveillance monitoring have been coordinated for several years to avoid
41 duplication. However, this coordination did not include the planning stages of the monitoring programs.

42 In an attempt to reduce redundancy further and make monitoring more efficient, representatives of the
43 various contractors involved in 100-N groundwater monitoring held a series of workshops to consolidate
44 and streamline monitoring. Monitoring networks were redesigned to provide the most information for all
45 programs most efficiently, and constituent lists were trimmed to the constituents of concern. Sampling
46 frequency also decreased in some cases. Sampling trips and analytical costs are divided among data
47 users. Borghese et al. (1996) describe the well and constituent lists for the combined program. That

1 document does not include requirements for sampling and analysis protocols, quality control (QC), or
2 statistical evaluations. Hartman (1996b) presents a revised groundwater-monitoring plan for the RCRA
3 program as summarized in the following section.

4 **D.2.1 Well Location and Design**

5 The monitoring network for the 1324-N/NA site includes one upgradient well and four downgradient
6 wells (Figure 3.1, Table 3.1). Well 199-N-59 was installed when the local water table was higher than it
7 is now. The well is now nearly dry and can only be sampled when the water table is seasonally high as
8 controlled by the Columbia River stage. Well 199-N-165 will replace it. The new well will be located
9 approximately 10 ft from the existing well, and no characterization is planned. The new well will be
10 deeper in order to obtain samples during every sample event, but the well will be screened at the top of
11 the uppermost aquifer, as are all the other wells monitoring this TSD unit. The schedule for construction
12 is in June 2008. All wells monitor the unconfined aquifer, and are constructed to WAC 173-160
13 standards. As-built diagrams are included in Hartman (1996b).

14 **D.2.2 Sampling and Analysis Plan**

15 The *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA, and 1325-N Sites* (Hartman 1996b)
16 describes the interim status sampling and analysis plan for RCRA monitoring. Groundwater is analyzed
17 for the constituents listed in Table B-6. Indicator parameters are analyzed semiannually; additional
18 parameters are analyzed annually.

19 Groundwater sampling procedures, sample collection documentation, and chain-of-custody requirements
20 are described in Environmental Investigation Instructions (EII) (WHC-CM-7-7), The Environmental
21 Activities Procedural Manual (WHC-CM-7-8), and in the Quality Assurance Project Plan for
22 Groundwater Monitoring Activities Managed by Westinghouse Hanford Company (WHC 1995). Work
23 by other contractors is conducted to their equivalent approved standard operating procedures. Procedures
24 for field measurements (pH, conductivity, turbidity) are specified in WHC-CM-7-8 and in the user's
25 manuals for the meters used. Analytical methods are selected from those provided in Test Methods for
26 Evaluating Solid Wastes (EPA 1990) as specified by WHC (1995) or its most recent revision.

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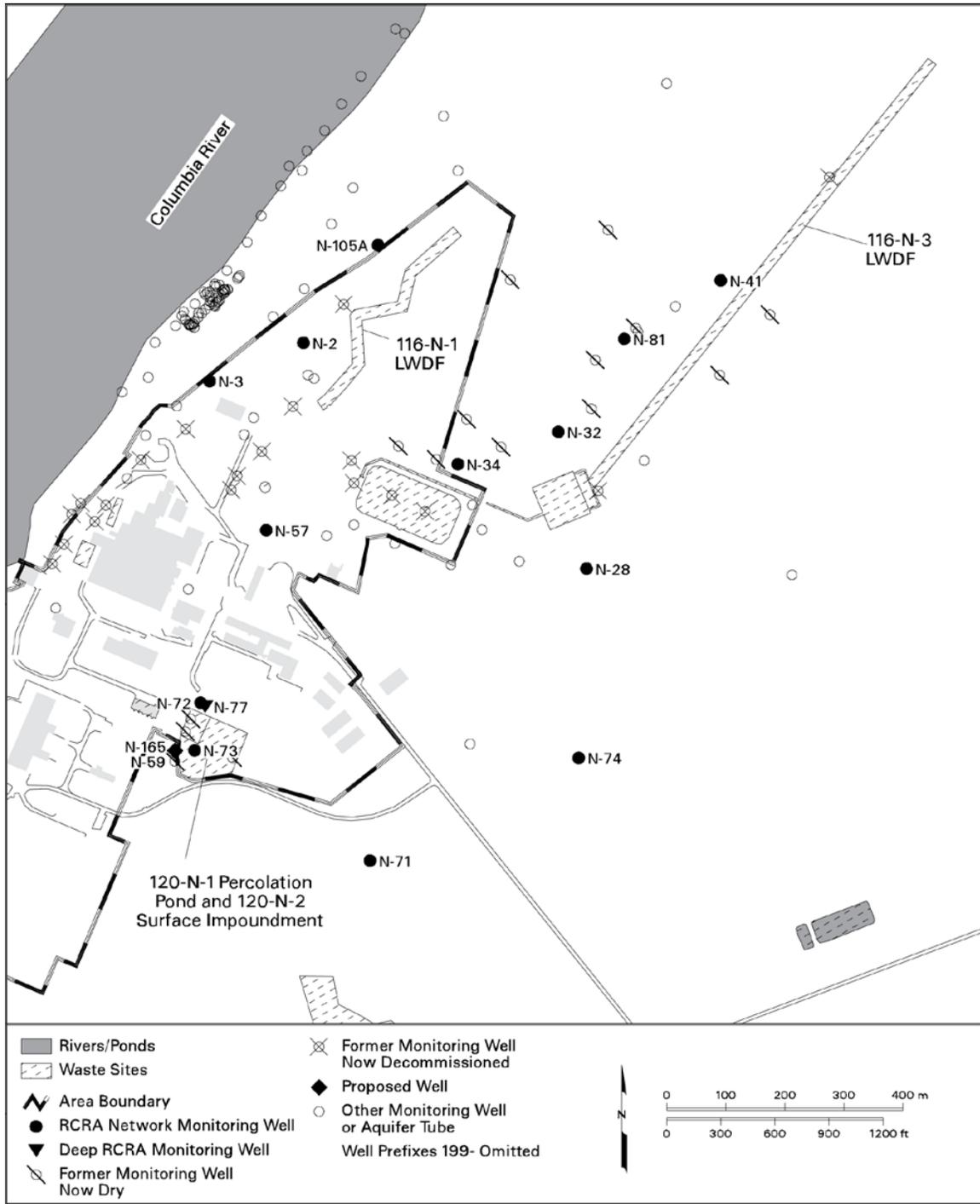


Figure D3.1. Proposed RCRA Groundwater Monitoring Network for 1324-N Surface Impoundment & 1324-NA Percolation Pond

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Table D3.1. Proposed RCRA Groundwater Monitoring Network for 1324-N Surface Impoundment & 1324-NA Percolation Pond

Well number	Drill date	Elev. top of casing ¹ (m)	Casing/screen materials	Screened or perforated depth ² (m)	Depth to water ³ (m)
199-N-165	2008	TBD	Stainless steel/stainless steel	TBD	TBD
199-N-71	1991	141.121	Stainless steel/ stainless steel	19.5 - 25.9	22.314(3/96)
199-N-72	1991	139.889	Stainless steel/ stainless steel	18.6 - 25.0	21.080(3/96)
199-N-73	1991	141.194	Stainless steel/ stainless steel	19.8 - 26.2	22.171(6/96)
199-N-77	1992	141.06	Stainless steel/ stainless steel	25.6 - 29.0	22.231(3/96)

¹ Surveyed to North American Vertical Datum of 1988

² Approximate depth below land surface; converted from feet

³ Depth below top of casing; converted from feet

Table D3.2. Constituent List for 1324-N Surface Impoundment & 1324-NA Percolation Pond

Analyzed Semiannually	Analyzed Annually
Contamination Indicator Parameters (Quadruplicate samples): Specific conductance (field)pH (field)Total Organic Carbon Total Organic Halogen Turbidity (field)	ICP1 Metals (filtered) Anions Alkalinity

¹ ICP = Inductively Coupled Plasma

D.2.3 Quality Assurance and Quality Control

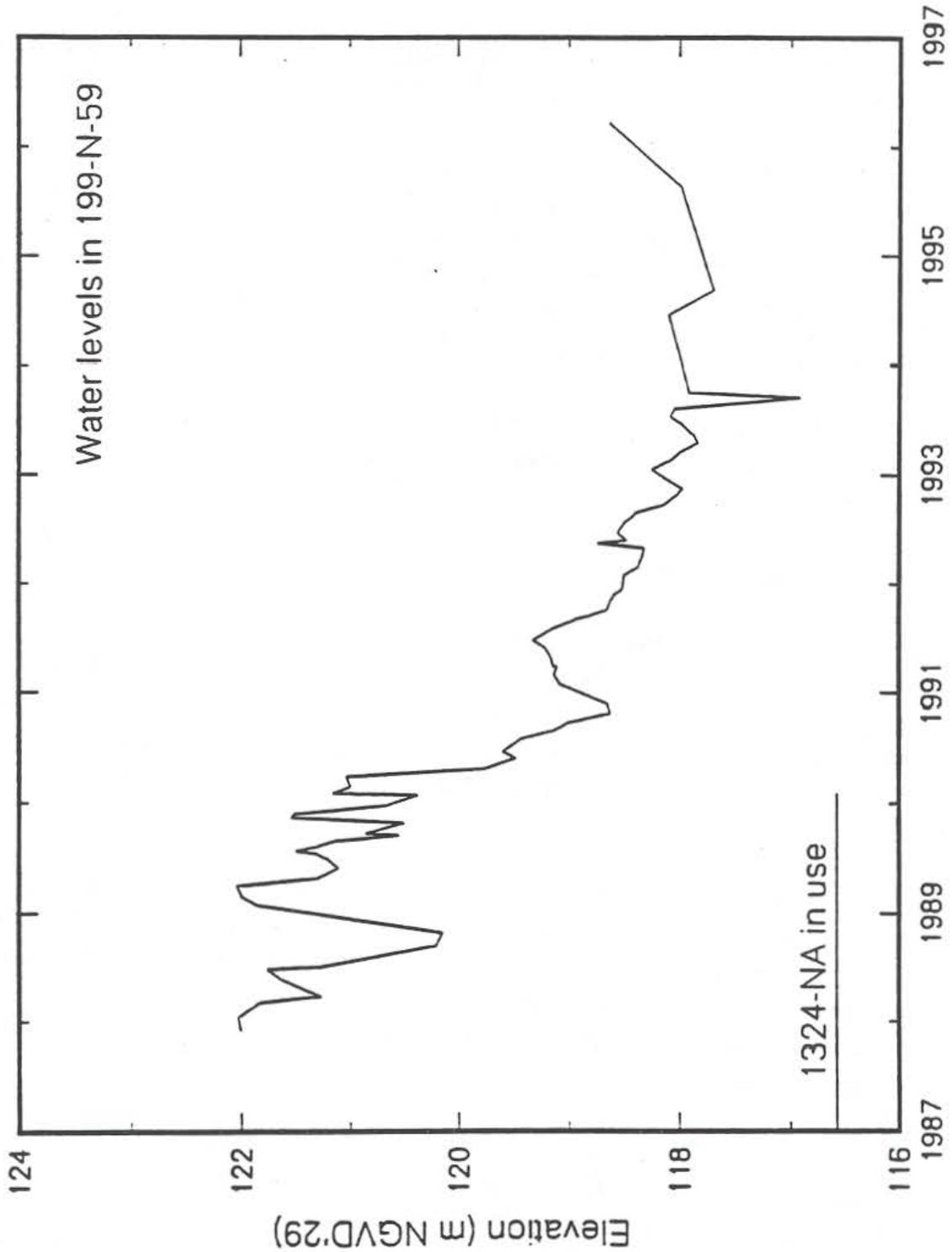
Quality assurance (QA) requirements are defined in the *Westinghouse Hanford Company Quality Assurance Manual* (WHC-CM-4-2) or equivalent procedures, and Article 31 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994). Additional requirements for QA and QC are included in WHC (1995) or its' most recent revision.

D.3 Results of Groundwater Monitoring

D.3.1 Potentiometric Levels

Water levels are measured in all wells before sampling. Many of the wells in the 100-N Area are also measured as part of the sitewide semiannual water level program (Serkowski et al. 1995). About 20 wells are equipped with pressure transducers and data loggers. Any of the data described above can be used to construct water table maps to aid in determining groundwater flow directions.

At various times in the history of waste disposal at the 100-N Area, groundwater mounds formed beneath the 1324-NA Percolation Pond and other effluent disposal sites. Changes in water levels are illustrated in Figure 3.2. Water levels have returned to "pre-Hanford" levels in the 100-N Area but are still affected by changes in river stage. Groundwater flow beneath the 1324-N and 1324-NA units currently is toward the Columbia River.



1 **Figure 3.2. Water Level Changes in Groundwater Below 1324-N and 1324-NA**
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1 Vertical groundwater gradients are not well defined in the 100-N Area. There is no significant difference
2 in head between wells completed at the top and bottom of the unconfined aquifer near the 1324-N and
3 1324-NA units.

4 **D.3.2 Groundwater Quality**

5 The 1301-N Liquid Waste Disposal Facility, 1325-N Liquid Waste Disposal Facility, and
6 1324-NA Percolation Pond have affected groundwater quality in the unconfined aquifer beneath the
7 100-N Area. In addition, various leaks and spills may have affected soil or groundwater chemistry
8 (DOE RL 1991). Data from RCRA sampling and analysis are reported electronically in the Hanford
9 Environmental Information System database. Interpretation of the data has been included in annual
10 reports (Hartman 1996a).

11 Groundwater beneath the 1324-N/NA units is characterized by high specific conductance, primarily
12 because of elevated sulfate and sodium. Specific conductance increased in wells 199-N-72, 199-N-73,
13 and 199-N-77 in 1993 and 1994, but leveled off in 1995. Sulfate and sodium concentrations follow the
14 same pattern as specific conductance. The pH in 1324-N and 1324-NA wells generally is between 8 and
15 8.2, with no significant difference between upgradient and downgradient wells.

16 The TOX was slightly elevated in some of the 1324-N/NA downgradient wells in 1992-93, but
17 subsequently decreased to background levels (usually below detection limits). A revised assessment
18 program investigated the elevated TOX, and results indicated that chloroform was the cause of the TOX.
19 A French drain, used to dispose of nondangerous chlorinated water, is located near the 1324-NA pond and
20 was probably the cause of the chloroform (i.e., chlorine interacting with organic material). Hartman
21 (1996c) presents results of TOX assessment.

22 **D.4 Groundwater Monitoring During Postclosure**

23 **D.4.1 Corrective Action Program**

24 The presence of a sulfate plume attributable to past operations at 1324-N and 1324-NA will require that a
25 corrective action program (WAC 173-303-645[11]) be implemented upon the effective date of the
26 modification to the Permit adding these closure units. Groundwater monitoring will be done in
27 accordance with the existing groundwater-monitoring program (Borghese, et. al., 1996). A corrective
28 action program to remove or treat the sulfate will be determined in a final ROD for the 100-NR-2 OU.

29 **D.4.2 Inspection, Maintenance, and Replacement of Wells**

30 Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the
31 pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to
32 approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year
33 schedule, or as needed to repair problems identified during sampling.

34 If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine
35 if a new or existing well should be substituted.

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