

Appendix C

Supporting Information for Other Regulated Sites

Contents

Supporting Information for Other Regulated Sites	C.1
C.1 KW and KE Basins.....	C.1
C.2 200 Area Treated Effluent Disposal Facility	C.1
C.3 4608 B/C Process Ponds and 400 Area Water Supply Wells	C.1
C.4 Environmental Restoration Disposal Facility	C.2
C.5 Solid Waste Landfill	C.2
C.6 State-Approved Land Disposal Site	C.3
C.7 Performance Assessment at Low-Level Waste Management Areas 1-4	C.3
C.8 References	C.3

Tables

C.1 Wells Not Sampled as Scheduled in Fiscal Year 2003	C.5
C.2 Monitoring Wells and Constituents for the KE and KW Basins	C.5
C.3 Monitoring Wells, Constituents, and Enforcement Limits for the 200 Area Treated Effluent Disposal Facility	C.6
C.4 Monitoring Wells, Constituents, and Enforcement Limits for the 400 Area Process Ponds	C.6
C.5 Monitoring Wells and Constituents for the Environmental Restoration Disposal Facility	C.7
C.6 Monitoring Wells and Constituents for the Solid Waste Landfill	C.7
C.7 Sampling Results for Required Constituents at the Solid Waste Landfill	C.8
C.8 Results of Shapiro and Francia Test for Normality and Background Threshold Values for the Solid Waste Landfill	C.10
C.9 Monitoring Wells, Constituents, and Enforcement Limits for the State-Approved Land Disposal Site	C.11

Figures

C.1 Regulated Units on the Hanford Site Requiring Groundwater Monitoring	C.12
C.2 Groundwater Monitoring Wells at the 100-K Basins	C.13
C.3 Groundwater Monitoring Wells at the 200 Area Treated Effluent Disposal Facility	C.14
C.4 Groundwater Monitoring Wells at the 400 Area Process Ponds	C.15
C.5 Groundwater Monitoring Wells at the Environmental Restoration Disposal Facility	C.16
C.6 Groundwater Monitoring Wells at the Solid Waste Landfill	C.17
C.7 Groundwater Monitoring Wells at the State-Approved Land Disposal Site	C.18

Appendix C

Supporting Information for Other Regulated Sites

The appendix provides constituent lists, well network configurations, and other ancillary information for regulated facilities that fall outside of *Resource Conservation and Recovery Act* (RCRA) and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) programs. Some network wells in the facilities discussed below are shared with RCRA or CERCLA facilities (e.g., the State-Approved Land Disposal Site). Figure C.1 shows the general locations of these facilities. Table C.1 lists the wells not sampled as scheduled during fiscal year 2003.

C.1 KW and KE Basins

The basins associated with the KW and KE Reactors currently store spent nuclear fuel that originated primarily in the N Reactor. The Spent Nuclear Fuels Project is underway to remove the fuel from the basins, improve the integrity of its encapsulation, and transport it to a more secure storage site in the Central Plateau region. The Spent Nuclear Fuels Project also will remove a large amount of highly radioactive sludge and shielding water that has accumulated in the basins. The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1998) Milestone M-34-00 describes the scope and schedule for this major Hanford Site cleanup endeavor. Completion of the basin cleanup project is expected by 2006.

Groundwater monitoring near the basins is conducted under the *Atomic Act of 1954* to (a) describe groundwater movement in the area and (b) characterize the impact of past and potential future loss of shielding water to the ground. The U.S. Department of Energy (DOE) monitors groundwater around these facilities to comply with requirements for nuclear fuel and waste storage facilities (DOE Order 5400.1 [IV]9b). The Hanford Site environmental monitoring plan (DOE/RL-91-50) describes the regulatory basis for monitoring these facilities.

During fiscal year 2003, monitoring revealed no evidence of ongoing loss of water to the ground from either of these basins. Monitoring continues to track groundwater contamination caused by past leakage from the KE Basin. Tritium concentrations increased significantly at two wells near the northwest corner of the KE Reactor, and at one well on the east side of the KW Reactor. No direct cause for these increases has yet been discovered, but they are not believed to be related to shielding water loss from the basins. An off-normal occurrence report has been filed with regard to these increases.

The monitoring network and sampling schedule were last revised during fiscal year 2002 (PNNL-14033; Table C.2 and Figure C.2). Section 2.3 provides discussion of monitoring results.

C.2 200 Area Treated Effluent Disposal Facility

State waste discharge permit (WAC 173-216) governs groundwater sampling and analysis in the three monitoring wells at this facility (Table C.3 and Figure C.3). The constituent list and frequency of sampling are specified in the permit. A groundwater monitoring plan (PNNL-13032) describes details of the monitoring program. Wells were sampled quarterly during fiscal year 2003 as scheduled.

No permit criteria for constituents in groundwater were exceeded in fiscal year 2003. The groundwater monitoring network continues to show that effluent from the facility is not taking a direct route to the uppermost aquifer, but is likely moving southward within the Hanford formation.

C.3 4608 B/C Process Ponds and 400 Area Water Supply Wells

The 4608 B/C ponds (also called the 400 Area process ponds) are regulated under WAC 173-216. The permit, issued on August 1, 1996, and modified on February 10, 1998, defines groundwater enforcement limits applied during

fiscal year 2003 (Table C.4 and Figure C.4). Groundwater quality met permit conditions in fiscal year 2003. A recent modification of the permit (Ecology 2003) indicates that groundwater monitoring activities for this facility will be discontinued effective October 1, 2003.

The water supply in the 400 Area, which comes from wells, is also monitored to maintain compliance with drinking water standards. In the past, tritium concentrations have exceeded the drinking water standard (20,000 pCi/L) in the backup water supply wells, but levels remained below the standard in fiscal year 2003 (see Section 2.11.4.2). Water supply sampling indicates that tritium in the drinking water is maintained at a level below the 4-millirem-per-year dose equivalent standard. Groundwater quality for the 400 Area is discussed in Section 2.11. Sampling frequency was reduced from monthly to quarterly beginning in fiscal year 2002. The wells were sampled three times in fiscal year 2003. They could not be sampled one quarter because the flush line was plugged.

C.4 Environmental Restoration Disposal Facility

This facility is a landfill authorized by CERCLA that is designed to meet RCRA requirements of Subpart N, 40 CFR 264. The groundwater monitoring network consists of one upgradient and three downgradient wells that are sampled semiannually (Table C.5 and Figure C.5). In addition, the facility has a system to collect and remove leachate that helps evaluate whether the liner system is performing within design standards. BHI-00873 describes the sampling plan for groundwater monitoring. In fiscal year 2003, leachate monitoring detected low levels of common metals, anions, and mobile radionuclides (see Section 3.2). Groundwater monitoring results showed that concentrations of some constituents of concern remained elevated. Possible upward trends were noted for gross beta in two downgradient wells and total chromium in one downgradient well. This contamination most likely is a result of migration of groundwater plumes from the 200 West Area. High zinc concentrations continued in one downgradient monitoring well and may indicate continued galvanic corrosion of well components. Another downgradient well previously had high zinc concentrations as well. This well was repaired in 2000 and initial results following the repair showed much lower zinc values, but recent analyses have shown erratic results for this cation.

C.5 Solid Waste Landfill

State dangerous waste regulations (WAC 173-304) govern groundwater monitoring at this landfill. The final closure plan for the site has been implemented. Wells are sampled quarterly for constituents specified in WAC 173-304 plus the site-specific constituents including various chlorinated hydrocarbons, filtered arsenic, and 1,4-dioxane (Table C.6 and Figure C.6).

Statistical evaluations of the constituents specified in WAC 173-304 for landfills (Table C.7 and Table C.8) revealed that eight exceeded their background threshold levels (or range for pH) during fiscal year 2003:

- Specific conductance exceeded its threshold level (583 $\mu\text{S}/\text{cm}$) in all eight of the downgradient wells in the monitoring network.
- Sulfate exceeded its threshold level (47.2 mg/L) in five of the eight downgradient wells.
- Reported results for pH were lower than the background threshold range (6.68 to 7.84) in four downgradient wells.
- Chloride exceeded its background threshold level (7,820 $\mu\text{g}/\text{L}$) in one downgradient well during fiscal year 2003.
- Various results for ammonia, chemical oxygen demand, coliform bacteria, and temperature were anomalies in several Solid Waste Landfill network wells, but these results may have been caused by errors in sampling or analysis.

Tritium exceeded its drinking water standard at many of the monitoring wells on the east side of the landfill, but the source is upgradient. Two chlorinated hydrocarbons equaled or exceeded WAC 173-200 groundwater quality criteria in at least one well of the Solid Waste Landfill network during fiscal year 2003. Eleven wells exceeded groundwater quality criteria for 1,1-dichloroethane and tetrachloroethene. Section 2.8 discusses monitoring results for the Solid Waste Landfill.

The monitoring network for the Solid Waste Landfill has two upgradient wells and eight downgradient wells. During fiscal year 2003, one downgradient well (699-25-34C) along the southeast side of the landfill had a water-level decline that was significant enough to prevent further sampling. During fiscal year 2004, discussion with the Washington

State Department of Ecology will determine whether the well should be replaced or deepened or whether the well network can function adequately with the dry well.

C.6 State-Approved Land Disposal Site

A state waste discharge permit (WAC 173-216) requires groundwater monitoring at this site. The permit was granted in June 1995, and the site began to operate in December 1995 (see PNNL-13121). Groundwater monitoring for tritium only is conducted in 19 wells near the facility (Table C.9 and Figure C.7). The permit stipulates requirements for groundwater monitoring and establishes enforcement limits for concentrations of 15 constituents in 3 additional wells immediately surrounding the facility (Table C.9).

During fiscal year 2003, tritium concentrations in proximal wells 699-48-77A and 699-48-77D generally decreased. Tritium concentrations remained highest in well 699-48-77C. This reflects the result of the delayed penetration of effluent deeper into the aquifer from historical tritium discharges. Tritium-tracking wells along the north boundary of the 200 West Area continue to go dry. Wells 299-W6-8 and 299-W7-8 became unserviceable during late fiscal year 2002, and hence, was not sampled during fiscal year 2003. Also, well 299-W7-6 went dry after the January 2003 sample. However, because of the original high density of wells located in this area, the wells that became dry have not as yet significantly affected the network coverage.

No permit enforcement limits were exceeded during fiscal year 2003. Evaluation of the well network indicates that well coverage is currently adequate to satisfy groundwater monitoring requirements. Monitoring results are discussed in Section 2.8.

C.7 Performance Assessment at Low-Level Waste Management Areas 1-4

Groundwater performance assessment continued at the four low-level waste management areas during fiscal year 2003 (see Sections B.13 through B.16). The well networks for these facilities were sampled twice for performance assessment parameters iodine-129, technetium-99, and uranium in Low-Level Waste Management Areas 2, 3, and 4. Only technetium-99 is sampled as a performance assessment parameter in Low-Level Waste Management Area 1 (see Tables B.21, B.23, B.25, and B.27).

C.8 References

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WAC 173-160-400. *What are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?* Washington Administrative Code, Olympia, Washington.

WAC 173-200. *Water Quality Standards for Ground Waters of the State of Washington*. Washington Administrative Code, Olympia, Washington.

WAC 173-216. *State Waste Discharge Program*. Washington Administrative Code, Olympia, Washington.

WAC 173-304. *Minimum Functional Standards for Solid Waste Handling*. Washington Administrative Code, Olympia, Washington.

WAC 173-304-490. *Ground Water Monitoring Requirements*. Washington Administrative Code, Olympia, Washington.

Table C.1. Wells Not Sampled as Scheduled in Fiscal Year 2003

Well	Schedule	Site	Comments
299-E34-3	10/01/02	LLBG (2) PA	Dry
299-E34-3	04/01/03	LLBG (2) PA	Dry
299-W10-13	03/01/03	LLBG (3) PA	Dry
299-W10-13	09/01/03	LLBG (3) PA	Dry
299-W18-24	07/01/03	LLBG (4) PA	Dry; one semiannual sample missed
299-W6-8	01/01/03	SALDS	Dry
299-W7-6	01/01/03	SALDS	Dry
299-W7-6	07/01/03	SALDS	Dry
299-W7-8	03/01/03	LLBG (3) PA/ SALDS	Dry
299-W7-8	09/01/03	LLBG (3) PA	Dry
499-S0-7	10/01/02	400 DW	Maintenance problems; one quarter missed
499-S0-8	10/01/02	400 DW	Maintenance problems; one quarter missed
499-S1-8J	10/01/02	400 DW	Maintenance problems; one quarter missed
699-25-34C	08/01/03	SWL	Dry; one quarter missed

400 DW = 400 Area drinking water supply wells.
 LLBG = Low-level burial ground.
 PA = Performance assessment.
 SALDS = State-Approved Land Disposal Site.
 SWL = Solid Waste Landfill.

Table C.2. Monitoring Wells and Constituents for the KE and KW Basins (adapted from PNNL-14033)

Well ^(a)	Hydrogeologic Unit Monitored	Field Parameters	
199-K-27 (P)	Top of unconfined	pH	Temperature
199-K-29 (P)	Top of unconfined	Specific conductance	Turbidity
199-K-30 (P)	Top of unconfined	Site-Specific Parameters ^(b)	
199-K-32A	Top of unconfined	Anions	ICP metals (filtered)
199-K-33 (S)	Top of unconfined	Carbon-14	Trichloroethene
199-K-34	Top of unconfined	AEA Parameters	
199-K-106A	Top of unconfined	Gross alpha	Technetium-99
199-K-107A	Top of unconfined	Gross beta	Tritium
199-K-108A (S)	Top of unconfined	Strontium-90	
199-K-109A	Top of unconfined		
199-K-110A (S)	Top of unconfined		
199-K-111A	Top of unconfined		

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells sampled quarterly unless noted (S), semiannually. Note: Well 199-K-33 was decommissioned in June 2003.

(b) Sampling frequency varies by constituent.

AEA = Atomic Energy Act of 1954.

ICP = Inductively coupled plasma emission spectroscopy.

RCRA = Resource Conservation and Recovery Act.

Table C.3. Monitoring Wells, Constituents, and Enforcement Limits for the 200 Area Treated Effluent Disposal Facility (adapted from PNNL-13032)

Well ^(a)	Hydrogeologic Unit	Constituent ^(b) and Enforcement Limit (µg/L)	
699-40-36	Ringold confined	Cadmium = 5	Lead = 10
699-41-35	Ringold confined	pH = 6.5 to 8.5 pH units	
699-42-37	Ringold confined		

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA.

(b) All wells sampled quarterly. All wells also monitored for ICP metals, anions, trace metals, alkalinity, specific conductance, total dissolved solids, turbidity, gross alpha, gross beta, and low-level tritium (annually). No enforcement limits for those constituents.

Bold italic = Upgradient well.

ICP = Inductively coupled plasma emission spectroscopy.

RCRA = *Resource Conservation and Recovery Act*.

Table C.4. Monitoring Wells, Constituents, and Enforcement Limits for the 400 Area Process Ponds (specified in state waste discharge permit)

Well ^(a)	Hydrogeologic Unit Monitored	Constituent and Enforcement Limit (µg/L) ^(b,c)	
699-2-6A	Unconfined aquifer	Cadmium (unfiltered) = 10	Mercury (unfiltered) = 2
699-2-7 (P)	Unconfined aquifer	Chromium (unfiltered) = 50	pH = Monitor only
699-8-17 (P)	Unconfined aquifer	Lead (unfiltered) = 50	Sulfate = Monitor only
		Manganese (unfiltered) = 50	Total organic carbon = Monitor only

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA.

(b) Defined as the average of four quarterly measurements from a well. Average to be calculated using the four most recent quarterly measurements from a well.

(c) Enforcement limit in groundwater shall be met in point-of-compliance well 699-2-7.

Bold italic = Upgradient well.

RCRA = *Resource Conservation and Recovery Act*.

Table C.5. Monitoring Wells and Constituents for the Environmental Restoration Disposal Facility (adapted from BHI-00873)

Well ^(a)	Field Parameters	
699-35-66A	pH (field)	Turbidity
699-36-67	Specific conductance (field)	
699-36-70A (P)		
699-37-68		
	Site-Specific Parameters	
	Alkalinity	Carbon tetrachloride
	Anions	ICP metals (filtered)
	Arsenic (filtered)	Total dissolved solids
	Carbon-14	Total organic halides
	AEA Parameters ^(b)	
	Gross alpha	Radium
	Gross beta	Technetium-99
	Iodine-129	Uranium

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells sampled semiannually. All wells completed at the top of the unconfined aquifer.

(b) Sampled for AEA monitoring.

AEA = Atomic Energy Act of 1954.

Bold italic = Upgradient well.

ICP = Inductively coupled plasma emission spectroscopy.

RCRA = Resource Conservation and Recovery Act.

Table C.6. Monitoring Wells and Constituents for the Solid Waste Landfill (adapted from PNNL-13014)

Well ^(a)	Parameters/Constituents Required by WAC 173-304-490	
699-22-35	Ammonia as nitrogen	Nitrite
699-23-34A	Chemical oxygen demand	pH (field)
699-23-34B	Chloride	Specific conductance (field)
699-24-33 ^(b) (P)	Dissolved iron	Sulfate
699-24-34A	Dissolved zinc	Temperature (field)
699-24-34B	Manganese	Total coliform
699-24-34C	Nitrate	Total organic carbon
699-24-35		
699-25-34C ^(c)		
699-26-35A		
	Site-Specific Parameters	
	Anions	Volatile organic compounds
	ICP metals (filtered)	

(a) All wells are constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells sampled quarterly. All wells completed at the top of the unconfined aquifer.

(b) Used for supplemental information; no statistical evaluations.

(c) Well went dry following May 2003 sampling event.

Bold italic = Upgradient wells.

ICP = Inductively coupled plasma emission spectroscopy.

RCRA = Resource Conservation and Recovery Act.

Table C.7. (contd)

Constituent, unit	Value ^(b)	Date	Well 699-22-35	Well 699-23-34A	Well 699-23-34B	Well 699-24-33	Well 699-24-34A	Well 699-24-34B	Well 699-24-34C	Well 699-24-35	Well 699-25-34C	Well 699-26-35A
Field pH	6.68 - 7.84	November 2002	7.07	6.58	6.71	6.82	6.66	6.68	7.5	6.9	6.92	7.19
		February 2003	6.91	6.61	6.7	6.78	6.63	6.63	6.97	6.94	7.33	7.2225
		May 2003	7	6.59	6.81	6.86	6.78	6.79	6.89	6.89	8.28	7.25
		August 2003	6.96	6.59	6.67	6.85	6.68	6.72	6.91	6.9	^(c)	7.185
Specific conductance, µS/cm	583	November 2002	843	765	815	776	708	722	770	597	694	553
		February 2003	834	743	800	776	694	721	752	578	679	545
		May 2003	843	741	797	780	693	706	743	605	839	544
		August 2003	822	753	795	752	653	722	703	592	^(c)	548
Sulfate, µg/L	47,200	November 2002	48,600	49,200	48,200	43,100	46,700	47,800	41,100	45,200	42,600	38,880
		February 2003	46,500	48,200	48,800	42,800	45,100	44,800	41,000	44,600	41,600	38,300
		May 2003	48,500	47,550	47,000	42,200	42,800	44,800	41,600	46,300	88,900	39,400
		August 2003	49,500	48,800	50,700	41,300	46,400	46,900	41,100	47,800	^(c)	40,200
Temperature, °C	20.7	November 2002	18.4	18.4	18.4	19.8	18.8	18.6	18.5	17.8	19.1	19.4
		February 2003	17.7	17.5	17.5	19.3	17.8	18.2	17.9	17.2	18	18.95
		May 2003	19	18.3	18.2	19.7	18.7	18.8	18.5	19.2	17.6	20.6
		August 2003	18.9	24.2	18.7	19.4	18.5	20	18.9	18.3	^(c)	19.6
Total organic carbon, µg/L	1,360	November 2002	1,800	1,100	2,800	1,900	1,700	2,800	1,700	1,900	980	1,400
		February 2003	2,200	1,800	2,200	1,800	1,500	1,600	140	1,400	660	1,575
		May 2003	6,600	7,100	4,900	5,600	6,200	7,100	6,200	5,000	3,300	4,000
		August 2003	8,700	<390	<390	<390	<390	<390	<390	5,100	^(c)	3,625
Zinc, filtered, µg/L	42.3	November 2002	<2.2	<2.2	3.8	15.6	4	<2.2	7.4	3.4	4.9	8.8
		February 2003	3.2	<1.8	3.2	11.7	<1.8	2.2	7.9	2.9	6.3	8.6
		May 2003	<3.5	<3.5	4.9	11.4	<3.5	<3.5	8	5.7	6.6	7.6
		August 2003	<3.5	<3.5	<3.5	4.6	<3.5	4.4	7.8	<3.5	^(c)	6.7

(a) WAC 173-304.

(b) Number obtained from Table C.8, background threshold value.

(c) Sample not collected. Well dry.

Results in **bold** type exceed background threshold value.

Table C.8. Results of Shapiro and Francia Test for Normality and Background Threshold Values for the Solid Waste Landfill

Constituent, ^(a) unit	Test Statistic, W' Log Value	Test Statistic, W' Raw Data	Critical Value, ^(b) W'α	Upper Tolerance Limit	Background Threshold Value
Temperature, °C	0.953 s	0.961 s	0.963	20.7 ^(c)	20.7
Specific conductance, μS/cm	0.978 ns	NA	0.960	583 ^(d)	583
Field pH	0.988 ns	NA	0.963	[6.68, 7.84] ^(d)	[6.68, 7.84]
Total organic carbon, μg/L	NC	NC	NC	842 ^(c) 1,360 ^(e)	1,360
Chloride, μg/L	0.954 s	0.962 s	0.963	7,820 ^(c)	7,820
Nitrate (as NO ₃), μg/L	0.833 s	0.844 s	0.963	29,000 ^(c)	29,000
Nitrite (as NO ₂), μg/L	NC	NC	NC	66 ^(f)	66
Ammonium (as NH ₃), μg/L	NC	NC	NC	90 ^(c) 118 ^(e)	118
Sulfate, μg/L	0.983 ns	NA	0.963	47,200 ^(d)	47,200
Iron, dissolved, μg/L	0.960 s	0.802 s	0.962	160 ^(c) 65.3 ^(e)	160
Zinc, dissolved, μg/L	NC	NC	NC	42.3 ^(c) 5.9 ^(e)	42.3
Manganese, dissolved, μg/L	NC	NC	NC	10 ^(c) 3.6 ^(e)	10
Coliform bacteria, colonies/100 ml	NC	NC	NC	3.7 ^(f)	3.7
Chemical oxygen demand, μg/L	NC	NC	NC	10,000 ^(f)	10,000

(a) Constituents are specified in WAC 173-304-490(2)(d). Data collected from March 1993 to May 2000 from upgradient well 699-24-35 and 699-26-35A.

(b) Obtained from Table A-9 (Shapiro 1980) for α = 5%.

(c) Maximum value reported.

(d) Based on log-normal distribution.

(e) Based on limit of quantitation using method detection limit (see Tables D.23 and D.24).

(f) Based on laboratory practical quantitation limit.

NA = Not applicable.

NC = Not calculated; insufficient measured values.

ns = Not significant at 0.05 level of significance.

s = Significant at 0.05 level of significance.

Table C.9. Monitoring Wells, Constituents, and Enforcement Limits for the State-Approved Land Disposal Site (adapted from PNNL-13121)

Well ^(a)	Hydrogeologic Unit Monitored	Constituent	Enforcement Limit (µg/L)
299-W6-6 (A)	Bottom of unconfined	Acetone	160
299-W6-7 (A)	Top of unconfined	Benzene	5
299-W6-11 (A)	Top of unconfined	Cadmium, total	10
299-W6-12 (A)	Top of unconfined	Chloroform	6.2
299-W7-1 (A)	Top of unconfined	Copper, total	70
299-W7-3 (S)	Bottom of unconfined	Lead, total	50
299-W7-5 (S)	Top of unconfined	Mercury, total	2
299-W7-6 (S)	Top of unconfined	pH	6.5 - 8.5 pH units
299-W7-7 (S)	Top of unconfined	Sulfate	250,000
299-W7-9 (A)	Top of unconfined	Tetrahydrofuran	100
299-W7-12 (A)	Top of unconfined	Total dissolved solids	500,000
299-W8-1 (A)	Top of unconfined		
699-48-71 (A,P)	Unconfined	AEA Parameters	
699-48-77A (Q)	Ringold unit E; upper	Gross alpha	Strontium-90
699-48-77C (Q)	Ringold unit E; mid to lower	Gross beta	Tritium
699-48-77D (Q)	Ringold unit E; upper		
699-49-79 (A,P)	Top of unconfined		
699-51-75 (S,P)	Top of unconfined		
699-51-75P (A,P)	Lower unconfined		

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. Wells noted (A) sampled annually, (Q), quarterly, and (S), semiannually.

AEA = Atomic Energy Act of 1954.

RCRA = Resource Conservation and Recovery Act.

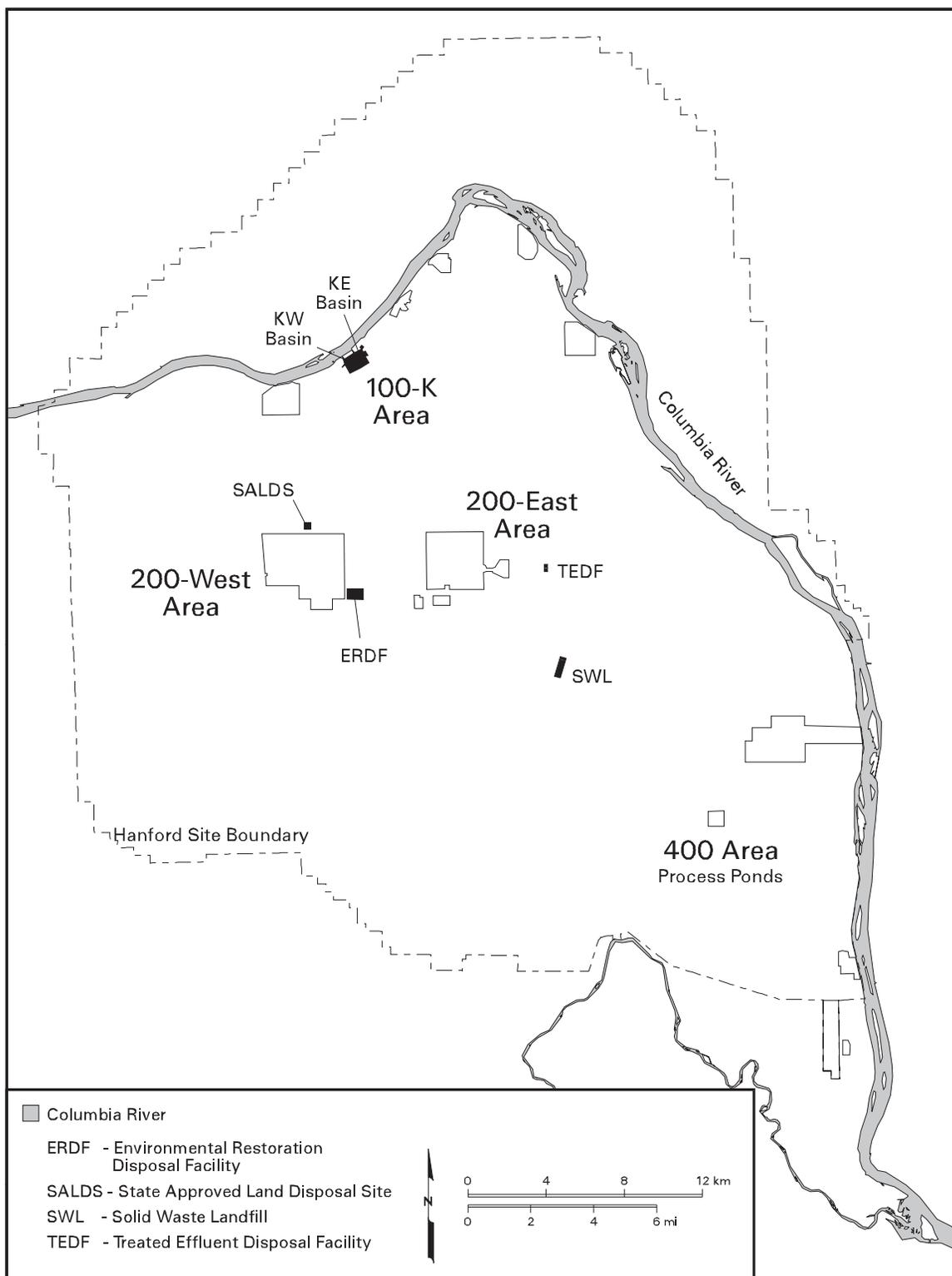
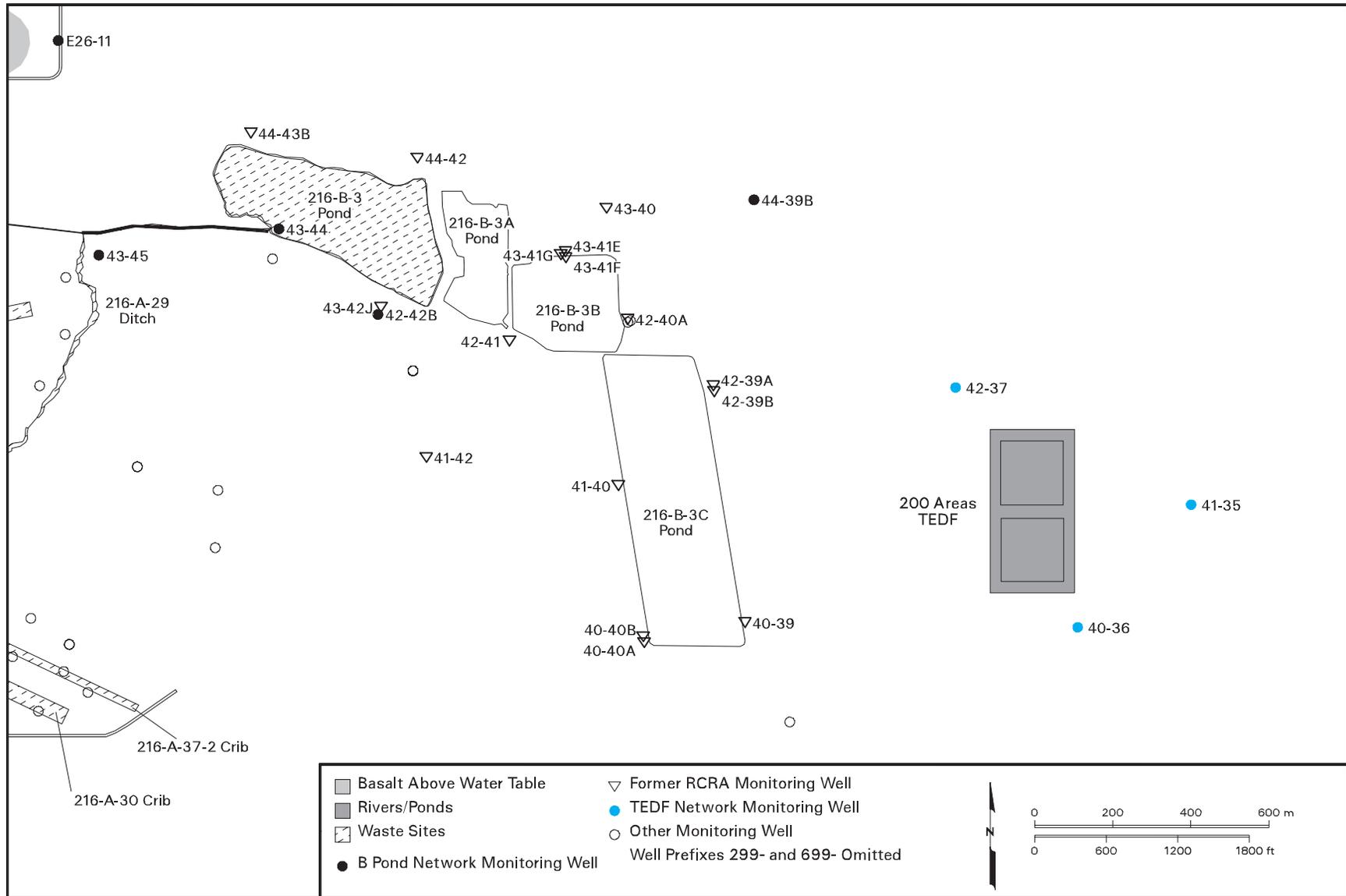
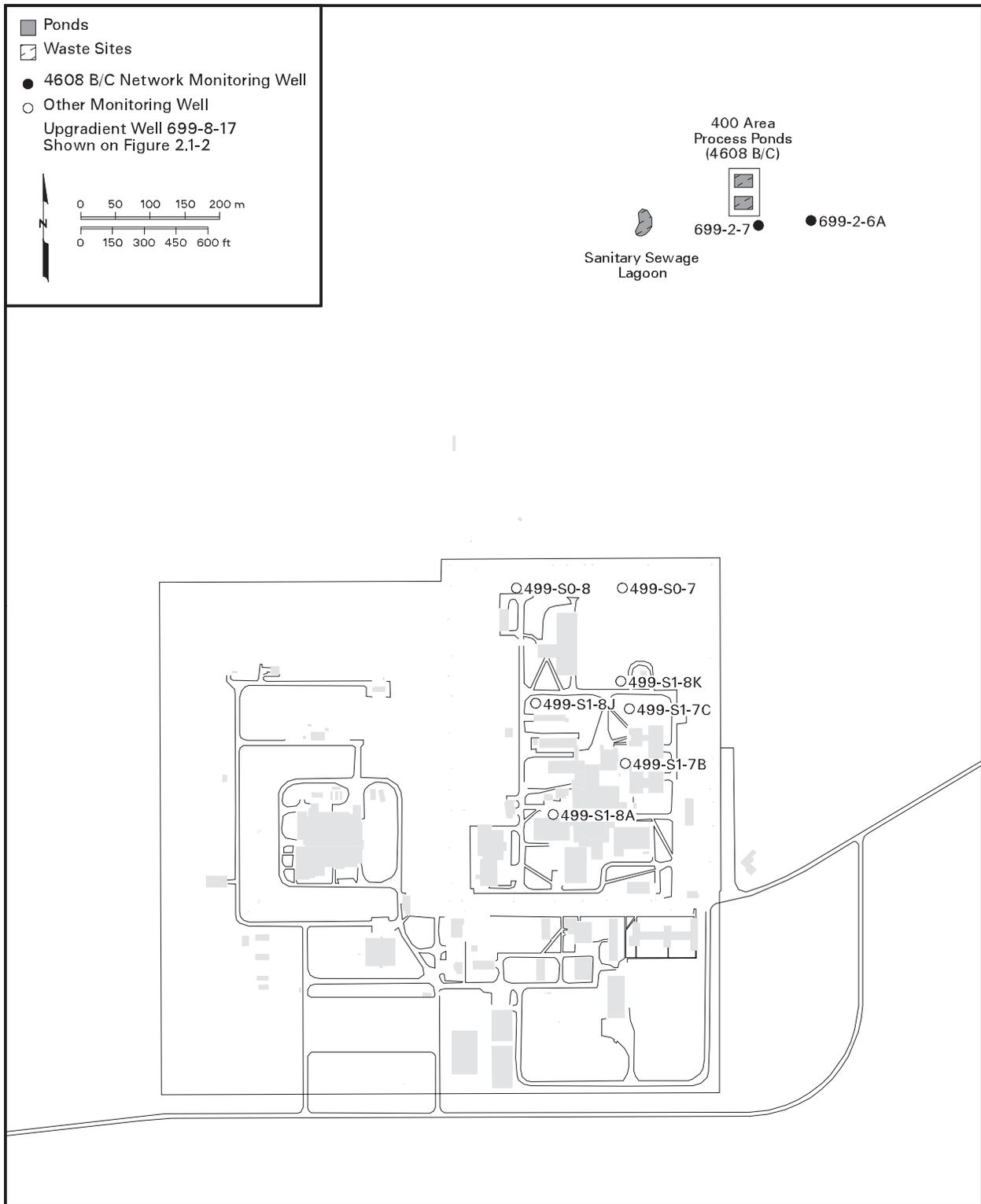


Figure C.1. Regulated Units (other than RCRA and CERCLA units) on the Hanford Site Requiring Groundwater Monitoring



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Figure C.3. Groundwater Monitoring Wells at the 200 Area Treated Effluent Disposal Facility



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Figure C.4. Groundwater Monitoring Wells at the 400 Area Process Ponds

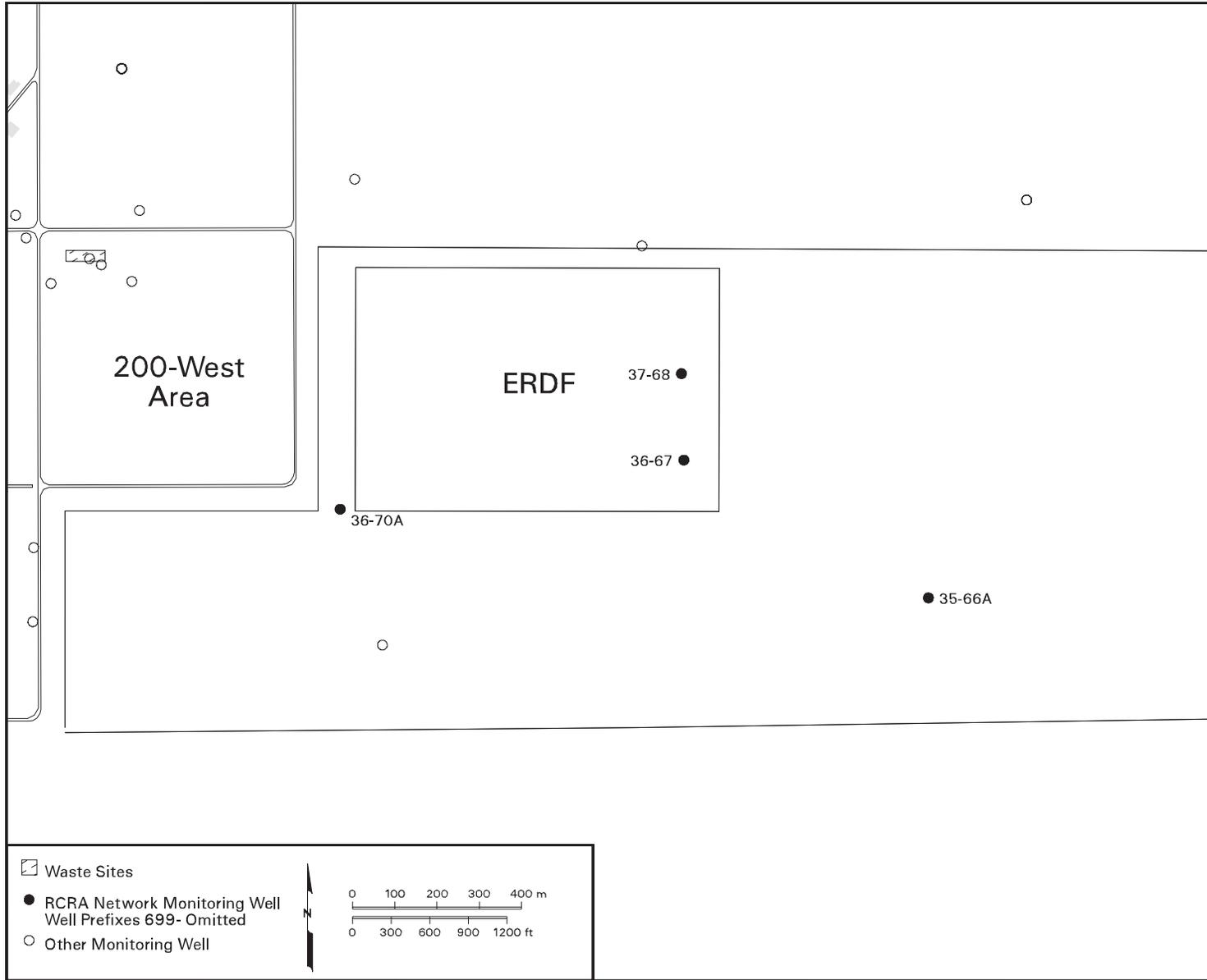
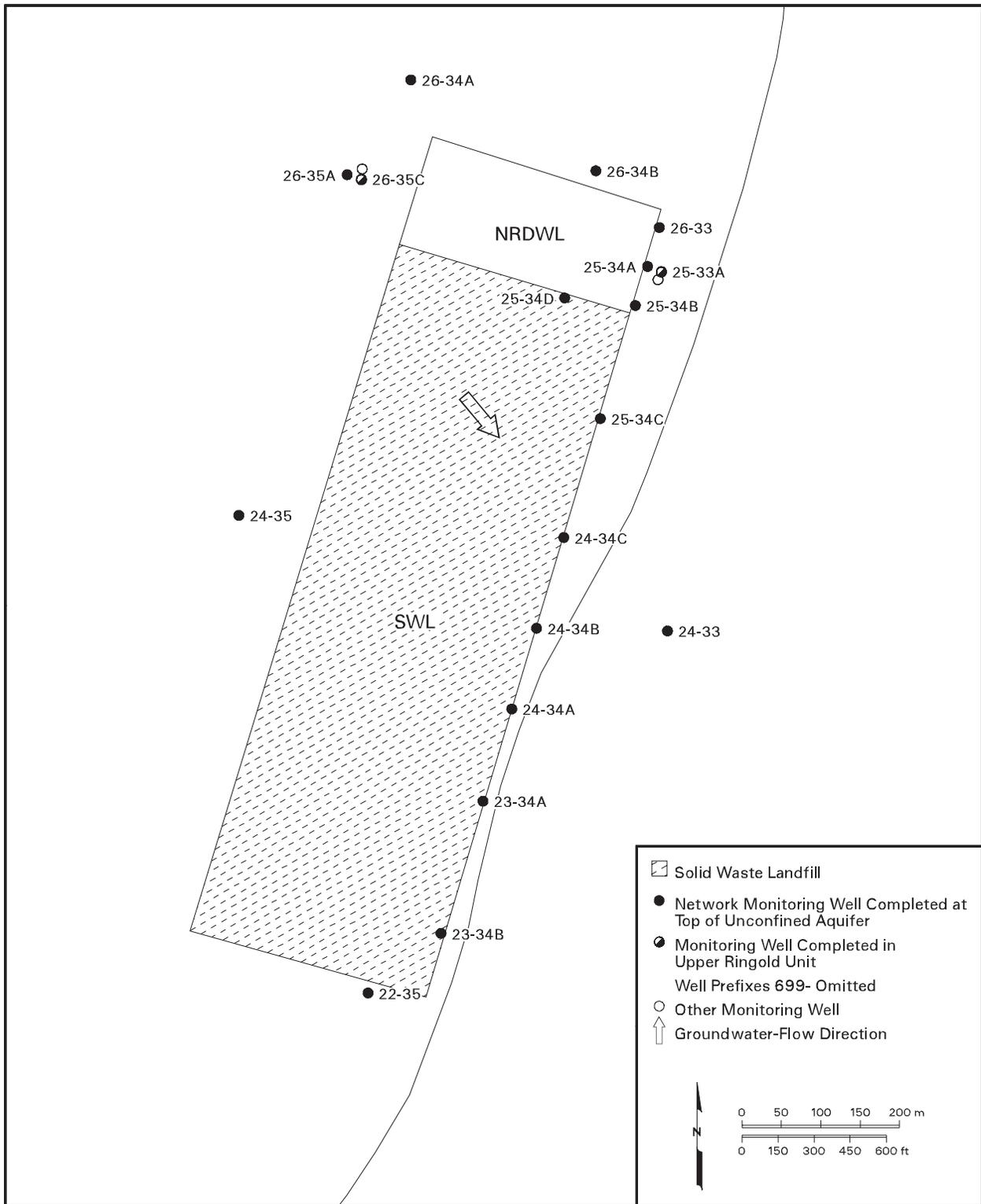
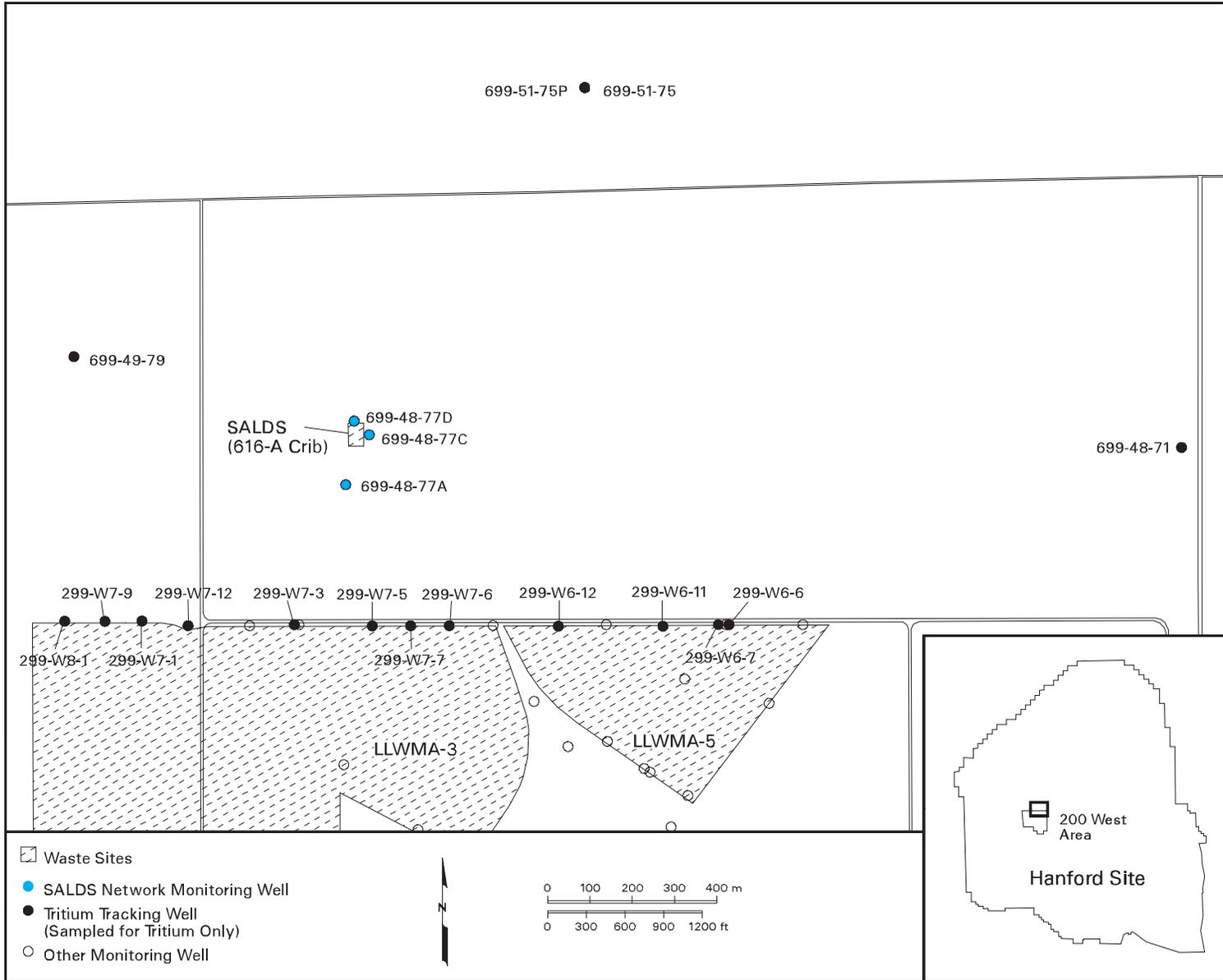


Figure C.5. Groundwater Monitoring Wells at the Environmental Restoration Disposal Facility



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Figure C.6. Groundwater Monitoring Wells at the Solid Waste Landfill



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Figure C.7. Groundwater Monitoring Wells at the State-Approved Land Disposal Site