Appendix B

Supporting Information for Monitored Facilities

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Appendix B

Supporting Information for Monitored Facilities

This appendix provides supplemental information for *Resource Conservation and Recovery Act* (RCRA) and other regulated units on the Hanford Site that require groundwater monitoring excluding *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) units (discussed in Appendix A). Site-specific discussions for each facility in Appendix B are found in the body of the document under the respective operable unit in which the facility lies (see Figure A.1 in Appendix A for operable units).

RCRA groundwater monitoring continued during fiscal year (FY) 2004 at 24 waste management areas (Figure B.1). Estimates of groundwater velocity, hydrologic properties, and associated references are shown in Table B.1 for all RCRA sites and two other regulated facilities. Tables B.2 through B.41 provide supporting information for these sites. Figures B.2 through B.20 show locations of monitoring wells.

This appendix also provides constituent lists, well network configurations, and other ancillary information for regulated facilities that fall outside of RCRA programs except CERCLA units. Some network wells in these facilities are shared with RCRA facilities (e.g., the State-Approved Land Disposal Site). Figure B.21 shows the general locations of these facilities. Locations of monitoring wells are shown in Figures B.22 through B.27. Tables B.38 through B.44 list the constituents list and/or results summaries for the facilities.

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Table B.1. Estimates of Groundwater Flow Rates at Hanford Site Facilities

Site	Flow Direction	Flow Rate (m/d)	Method	Hydraulic Conductivity (m/d) (source)	Effective Porosity[a]	Gradient[b]	Comments
116-N-1 LWDF	NW	0.07 to 1.2	Darcy	6.1 to 37 (PNL-8335)		0.0033	Gradient calculated between wells 199-N-66 and 199-N-2.
120-N-1 and 120-N-2	NW	0.07 to 1.4	Darcy	6.1 to 37 (PNL-8335)		0.0037	Gradient calculated between wells 199-N-72 and 199-N-26.
116-N-3 LWDF	N	0.04 to 0.77	Darcy	6.1 to 37 (PNL-8335)		0.0021	Gradient calculated between wells 199-N-28 and 199-N-81.
116-H-6 evaporation basins	E	0.17 to 4.8	Darcy	15 to 140 (PNL-6728)		0.0034	Gradient calculated between wells 199-H4-14 and 199-H4-3.
200 Area TEDF	SW	0.004	Darcy	1.1 (WHC-SD-EN-ES-004)	0.25[c]	0.0009	Gradient calculated between wells 699-41-35 and 699-40-36.
216-A-29 ditch	WSW	~0.01 to ~0.04	Darcy	18 (WHC-SD-EN-DP-047)		~0.0002	
216-B-3 pond	SW	0.016	Darcy	1.0 (WHC-SD-EN-EV-002; PNL-10195)	0.25	0.004	Gradient calculated between wells 699-44-39B and 699-43-44.
216-B-63 trench	SW	0.03 to 0.4	Darcy	52 to 200 (WHC-SD-EN-EV-002)		~0.0002	
216-S-10 pond	ESE	0.007 to 0.30	Darcy	10 (WHC-SD-EN-DP-052) 12 to 150 (BNWL-1709)		0.0002	Wells are dry. Gradient calculated using regional water-table maps.
216-U-12 crib	ESE	0.008 to 0.01	Darcy	4.2 to 5.4 (PNNL-13378)		0.0002	Wells are dry. Gradient calculated using regional water-table maps.
316-5 process trenches	SE	10.7 (PNL-5408)	Movement of PCE spill				
	SE	0.15 to 45	Darcy	150 to 15,000 (PNL-6716)		0.0003	
IDF	SE	0.002 to 0.0075	Darcy	68 to 75 (PNNL-13652; PNNL-11957)		0.00001	Uncertainty in gradient and rate of flow. Flow direction inferred from plume maps.
LERF	W	0.04 to 2.4	Darcy	6.1 to 120 (PNNL-11620)		0.002	

Table B.1. (contd)

Site	Flow Direction	Flow Rate (m/d)	Method	Hydraulic Conductivity (m/d) (source)	Effective Porosity[a]	Gradient[b]	Comments
LLWMA 1	NW	~0.01 to ~1.6	Darcy	73 to 760 (PNL-6820)		0.00006	Uncertainty with flow direction, rate, and gradient.
LLWMA 2	W to SW	~0.04 to ~0.6	Darcy	430 to 2,000 (PNL-6820)		~0.00003	Gradient calculated between wells 299-E34-10 and 299-E27-9. Uncertainty with flow direction, rate, and gradient.
LLWMA 3	70° E of N	0.0001 to 0.14	Darcy	0.02 to 9.8 (PNL-6820)		0.0014	Flow direction from trend-surface analysis.
LLWMA 4	E to ENE	0.2 to 0.7	Darcy	24 (PNL-6820)		0.003	Flow direction is variable due to effects of pump-and-treat system.
NRDWL	125° E of N (based on plume maps)	0.015 to 0.02	Darcy	518 to 1,524 (WHC-EP-0021)		0.00001	Uncertainty with gradient and rate of flow. Flow direction inferred from plume maps.
PUREX cribs	SE	0.0006 to 0.3	Darcy	18 to 3,000 (PNNL-11523; PNNL-11523-ICN-1)		0.00001	Uncertainty with gradient and rate of flow. Flow direction inferred from plume maps.
SALDS	ENE	0.07 to 0.7	Darcy	3.5 to 36.3 (WHC-SD-C018H-RPT-003)	0.25	0.005	Gradient is calculated from maximum head difference observed between wells 699-48-77A and 699-48-77D during FY 2004 (02/24/04).
SWL	125° E of N (based on plume maps)	0.013 to 0.02	Darcy	640 to 1,280 (PNL-6820)		0.00001	Uncertainty with gradient and rate of flow. Flow direction inferred from plume maps.
WMA A-AX	SE	1.2 to 2.2	Darcy	1,981 to 2,519	0.2 to 0.3	0.000174	Gradient and flow rate calculated between wells 299-E24-20 and 299-E25-93.
WMA B-BX-BY	WSW (north half) SSE to SE (south half)	0.6 to 1.2	Darcy	1,270 to 2,520	0.3	0.00014	Flow rate uncertain. Hydraulic conductivity based on aquifer test data.[d]
WMA C	SW	1.4 to 4.8	Darcy	1,890 to 6,888 (PNNL-14656)	0.3	0.00033	Gradient and flow rate calculated between wells 299-E27-7 and 299-E27-13. Hydraulic conductivity based on a multi-stress slug test performed on well 299-E27-22 and reported in PNNL-14656.
WMA S-SX	E to ESE	0.07 to 0.14	Contaminant travel time (PNNL-13441)	NA	NA	NA	Based on inferred contaminant travel time between 216-S-25 crib and downgradient wells 299-W23-15 and 299-W22-46, and between wells 299-W22-46 and 299-W22-83.
		0.009 to 0.36	Darcy	0.58 to 17.2 (aquifer test data)	0.09 to 0.12	0.0018 to 0.0019	Based on aquifer tests (PNNL-13514 and PNNL-14113).

Table B.1. (contd)

Site	Flow Direction	Flow Rate (m/d)	Method	Hydraulic Conductivity (m/d) (source)	Effective Porosity[a]	Gradient[b]	Comments
WMA T	5°N of E to 8°E of S	0.003 to 0.024 0.022 to 0.029	Darcy Tracer tests	1 to 28 (PNNL-13378; PNNL-14113; PNNL-14186)	0.04 to 1.1	0.001	Flow direction based on trend surface analysis: PNNL-14113, PNNL-13378.
WMA TX-TY (north part)	18° E of S to 43° E of S	0.0007 to 2.46 0.122 to 1.1	Darcy Tracer test	0.05 to 4.9 (PNNL-13378; PNNL-14113; PNNL-14186)	0.002 to 1	0.009	Flow direction based on trend surface analysis: PNNL-14113, PNNL-13378, and PNNL-14186.
WMA TX-TY (south part)	South to southwest	0.29 0.374	Darcy Tracer test	14.2 to 19.9 (PNNL-13378; PNNL-14113; PNNL-14186)	0.068	0.001	Flow direction based on water-table evaluations; Flow rate and direction affected by 200-ZP-1 pump-and treat in south part of WMA. PNNL-13514.
WMA U	E	0.008 to 0.20	Darcy	1.2 to 9.5 (PNNL-13378)		0.0021	

(a) Effective porosity assumed to be between 0.1 and 0.3, a representative range for the unconfined aquifer system, unless otherwise noted.
(b) March 2004 unless noted otherwise.
(c) PNNL-11801.
(d) Letter report from FA Spane and DR Newcomer, Pacific Northwest National Laboratory, to JV Borghese, Fluor Hanford, Inc., *Slug Test Characterization Results for Multi-Test/Depth Intervals Conducted During the Drilling of WMA B-BX-BY Well 299-E33-49 (C4261)*, dated October 8, 2004.

FY = Fiscal year.
IDF = Integrated Disposal Facility.
LERF = Liquid effluent retention facility.
LLWMA = Low-level waste management area.
LWDF = Liquid waste disposal facility.
NA = Not applicable.
NRDWL = Nonradioactive Dangerous Waste Landfill.
PCE = Tetrachloroethene.
PUREX = Plutonium-Uranium Extraction (Plant).
SALDS = State-Approved Land Disposal Site.
SWL = Solid Waste Landfill.
TEDF = Treated Effluent Disposal Facility.
WMA = Waste management area.

Table B.2. Monitoring Wells and Constituents for 100-N Area Units (adapted from PNNL-13914)

Well[a]	Hydrogeologic Unit Monitored
116-N-1 (1301-N) Liquid Waste Disposal Facility	
199-N-2 (P)	Top of unconfined
199-N-3 (P)	Top of unconfined
199-N-34 (P)	Top of unconfined
199-N-57	Top of unconfined
199-N-105A[e]	Unconfined
120-N-1 and 120-N-2 (1324-N/NA) Liquid Waste Disposal Facilities	
199-N-59[d]	Top of unconfined
199-N-71	Top of unconfined
199-N-72	Top of unconfined
199-N-73	Top of unconfined
199-N-77[g]	Bottom of unconfined
116-N-3 (1325-N) Liquid Waste Disposal Facility	
199-N-28[g] (P)	Top of unconfined
199-N-32 (P)	Top of unconfined
199-N-41 (P)	Top of unconfined
199-N-74	Top of unconfined
199-N-81	Top of unconfined

Contamination Indicator Parameters[b]	
pH (field)	Total organic carbon
Specific conductance (field)	Total organic halides

Site-Specific Parameters	
Alkalinity[c]	ICP metals (filtered)[c]
Anions[c]	Turbidity[b]

AEA Parameters
Gross alpha[b,f]

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA.
(b) Sampled semiannually.
(c) Sampled annually.
(d) Can be sampled only when water table is high. Not sampled in FY 2004.
(e) Extraction well; screened over entire thickness of aquifer.
(f) Gross alpha analyzed for wells 199-N-59 and 199-N-77 only.
(g) Used for supplemental information; no statistical evaluations.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
FY = Fiscal year.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.3. Critical Means for 116-N-1 (1301-N) Liquid Waste Disposal Facility for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	8	7	5.4079	522.2	103.8	1,118	1,118
Field pH	8	7	6.0818	7.751	0.171	[6.65, 8.85]	[6.65, 8.85]
Total organic carbon,[b] µg/L	8	7	5.4079	296.35	240.487	1,676	1,680[c]
Total organic halides,[b] µg/L	8	7	5.4079	5.062	2.228	17.8	17.8

(a) Based on semiannual sampling events from March 2003 to September 2004 for upgradient well 199-N-57 and from September 2002 to March 2003 for upgradient well 199-N-34.
(b) Critical means calculated from values reported below vendor's specified method detection limit.
(c) Rounded to the nearest 10 µg/L.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 20 comparisons.

Table B.4. Critical Means for 120-N-1 and 120-N-2 (1324-N/NA) Liquid Waste Disposal Facilities for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	7.5288	371.5	10.0	454	454
Field pH	5	4	9.0294	8.112	0.041	[7.70, 8.52]	[7.70, 8.52]
Total organic carbon,[b] µg/L	5	4	7.5288	239.5	163.883	1,591	1,590[c]
Total organic halides,[b] µg/L	5	4	7.5288	6.61	1.846	21.8	21.8

(a) Based on semiannual sampling events from September 2002 to September 2004 for upgradient well 199-N-71.
(b) Critical means calculated from values reported below vendor's specified method detection limit.
(c) Rounded to the nearest 10 µg/L.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 12 comparisons.

Table B.5. Critical Means for 116-N-3 (1325-N) Liquid Waste Disposal Facility for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	8.1216	366.7	4.5	407	407
Field pH	5	4	9.7291	8.10	0.049	[7.58, 8.61]	[7.58, 8.61]
Total organic carbon,[b,c] µg/L	5	4	8.1216	NC	NC	NC	1,510
Total organic halides, µg/L	5	4	8.1216	7.27	2.056	25.6	25.6

(a) Based on semiannual sampling events from September 2002 to September 2004 for upgradient well 199-N-74.
(b) Critical means cannot be calculated because essentially all measurements are below vendor specified method detection limit.
(c) Upgradient/downgradient comparison value is the most recently determined limit of quantitation.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
NC = Not calculated.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

Table B.6. Monitoring Wells and Constituents for the 116-H-6 (183-H) Evaporation Basins (adapted from PNNL-11573)

Well[a]	Hydrogeologic Unit Monitored	Dangerous Waste Constituents	
199-H4-3 (P)	Top of unconfined	Chromium (filtered)	Nitrate
199-H4-7[b]	Top of unconfined	Fluoride	
199-H4-12A[b]	Top of unconfined	**Site-Specific Parameters**	
199-H4-12C	Mid-depth unconfined	Alkalinity	pH
		Anions	Specific conductance
		ICP metals (filtered)	Turbidity
		Other Parameters[c]	
		Technetium-99	Uranium

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells are sampled annually.
(b) Also a CERCLA extraction well.
(c) Radionuclides not typically subject to RCRA monitoring, but included in the current Hanford Facility RCRA Permit (Ecology 1994) for this facility.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act*.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.7. Monitoring Wells and Constituents for the 216-A-29 Ditch (adapted from PNNL-13047)

Well[a]	Hydrogeologic Unit Monitored
299-E25-26	Upper unconfined
299-E25-28[b]	Deep unconfined
299-E25-32P	Top of unconfined
299-E25-34	Top of unconfined
299-E25-35	Top of unconfined
299-E25-48	Top of unconfined
299-E26-12	Top of unconfined
299-E26-13	Top of unconfined
699-43-45	Top of unconfined

Contamination Indicator Parameters	
pH (field)	Total organic carbon
Specific conductance (field)	Total organic halides

Site-Specific Parameters	
Alkalinity	Phenols
Anions	Turbidity
ICP metals (filtered)[c]	

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled quarterly.
(b) Used for supplemental information; no statistical evaluations.
(c) Analyzed annually.
Bold italic = Upgradient wells.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.8. Critical Means for the 216-A-29 Ditch for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	9.729	238.4	6.9	312	312
Field pH	5	4	11.629	8.39	0.099	[7.14, 9.65]	[7.14, 9.65]
Total organic carbon, µg/L	4[b]	3	15.145	316.88	157.366	2,982	2,980[c]
Total organic halides, µg/L	5	4	9.729	2.94	1.330	17.1	17.1

(a) Based on quarterly sampling events from November 2003 to October 2004 for upgradient well 699-43-45.
(b) Excluded suspected total organic carbon values collected in April 2004.
(c) Rounded to the nearest 10 µg/L.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 32 comparisons.

Table B.9. Monitoring Wells and Constituents for the 216-B-3 Pond (adapted from PNNL-13367-ICN-1)

Well[a]	Hydrogeologic Unit Monitored	Site-Specific Indicator Parameters	
699-42-42B	Top of uppermost	Specific conductance (field)	Total organic halides, pH
699-43-44	Bottom of uppermost	Total organic carbon	
699-43-45	Top of uppermost	**Site-Specific Parameters**	
699-44-39B	Top of uppermost	Anions[b]	Nitrate[c]
		Arsenic[c]	Phenols[b]
		Metals (filtered, unfiltered)[b,d]	Turbidity
		AEA Parameters	
		Gross alpha	Iodine-129[c]
		Gross beta	Tritium[c]

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually.
(b) Analyzed annually.
(c) Constituents of site-wide concern; selected wells analyzed under AEA monitoring.
(d) ICP plus cadmium, lead, mercury, and silver.
Bold italic = Upgradient well.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.10. Critical Means for the 216-B-3 Pond for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	8.1216	254.8	7.2	318	318
Field pH	5	4	9.7291	8.16	0.030	[7.83, 8.48]	[7.83, 8.48]
Total organic carbon, µg/L	5	4	8.1216	414.25	228.356	2,446	2,450[c]
Total organic halides,[b] µg/L	5	4	8.1216	NC	NC	NC	12.7

(a) Based on semiannual sampling events from June 2002 to July 2004 for specific conductance and field pH and from June 2000 to July 2004 for total organic carbon and total organic halides from upgradient well 699-44-39B. Background levels will be revised when data are available in 2005.
(b) Critical mean cannot be calculated because essentially all measurements are below vendor's specified method detection limit. Upgradient/downgradient comparison value is the most recently determined limit of quantitation.
(c) Rounded to the nearest 10 µg/L.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
NC = Not calculated.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

Table B.11. Monitoring Wells and Constituents for the 216-B-63 Trench (adapted from PNNL-14112)

Well[a]	Contamination Indicator Parameters	
299-E27-8	pH (field)	Total organic carbon
299-E27-9	Specific conductance (field)	Total organic halides
299-E27-11		
299-E27-16	**Site-Specific Parameters**	
299-E27-17	Alkalinity[b]	Phenols[b]
299-E27-18	Anions[b]	Turbidity
299-E27-19	ICP metals (filtered)[b]	
299-E33-33		
299-E33-36	**AEA Parameters[c]**	
299-E33-37	Gross alpha	Gross beta
299-E34-8		
299-E34-10		

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually. All wells completed at the top of the unconfined aquifer.
(b) Analyzed annually.
(c) Analyzed to support AEA monitoring.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.12. Critical Means for the 216-B-63 Trench for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	20	19	4.267	423.9	38.7	593	593
Field pH	20	19	4.572	8.076	0.069	[7.75, 8.40]	[7.75, 8.40]
Total organic carbon,[b] µg/L	20	19	4.267	330.5	230.068	1,336	1,510[c]
Total organic halides,[d] µg/L	20	19	4.267	NC	NC	NC	12.7[c]

(a) Based on semiannual sampling events from October 2002 to April 2004 for upgradient wells 299-E27-8, 299-E27-9, 299-E27-11, 299-E27-17, and 299-E34-10.
(b) Critical mean calculated from values reported below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the most recently determined limit of quantitation.
(d) Critical mean cannot be calculated because essentially all measurements are below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
NC = Not calculated.
t_c = Bonferroni critical t-value for appropriate df and 48 comparisons.

Table B.13. Monitoring Wells and Constituents for the 216-S-10 Pond and Ditch (adapted from PNNL-14070 and PNNL-14070-ICN-1)

Well[a]	Hydrogeologic Unit Monitored	Contamination Indicator Parameters	
299-W26-13	Top of unconfined	pH (field)	Specific conductance (field)
299-W26-14	Top of unconfined	Total organic carbon[b]	Total organic halides[b]
299-W27-2[c]	Base of unconfined		
		Site-Specific Parameters	
		Alkalinity[d]	ICP metals (filtered)[d]
		Anions[d]	Phenols[b,d]
		Hexavalent chromium (filtered)[e]	Turbidity[e]
			Volatile organic compounds[e]

(a) All wells constructed to WAC 173-160-400 standards and sampled semiannually.
(b) Not analyzed in well 299-W27-2.
(c) Used for supplemental information; no statistical evaluation.
(d) Analyzed annually only.
(e) Analyzed semiannually.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.14. Critical Means for the 216-S-10 Pond and Ditch for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	4	3	10.8689	269.8	2.2	296	296
Field pH	4	3	13.745	8.109	0.041	[7.49, 8.73]	[7.49, 8.73]
Total organic carbon,[b] µg/L	4	3	10.8689	195.625	90.884	1,300	1,510[c]
Total organic halides,[d] µg/L	4	3	10.8689	NC	NC	NC	12.7[c]

(a) Based on semiannual sampling events from December 2001 to June 2003 for upgradient well 299-W26-7, which went dry in 2003. Background levels will be revised when data from a new upgradient well are available.
(b) Critical mean calculated from values reported below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the most recently determined limit of quantitation.
(d) Critical mean cannot be calculated because essentially all measurements are below vendor specified detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
NC = Not calculated.
t_c = Bonferroni critical t-value for appropriate df and 12 comparisons.

Table B.15. Monitoring Wells and Constituents for the 216-U-12 Crib (adapted from WHC-SD-EN-AP-108, PNNL-14301, and PNNL-14301-ICN-1)

Well[a]	Contamination Indicator Parameters	
299-W22-79	pH (field)	Specific conductance (field)
699-36-70A		
	Site-Specific Parameters	
	Alkalinity[b,c]	ICP metals (filtered)[b]
	Anions	Total dissolved solids[b,d]
	Arsenic[b]	Turbidity
	CERCLA Parameters[c]	
	Iodine-129	Tritium
	Technetium-99	

(a) Both wells constructed to WAC 173-160-400 standards and sampled quarterly. Both wells completed at the top of the unconfined aquifer.
(b) Analyzed annually.
(c) Analyzed to support CERCLA monitoring (frequency varies).
(d) Well 699-36-70A only.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act*.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.16. Monitoring Wells and Constituents for the 316-5 Process Trenches (adapted from WHC-SD-EN-AP-185)

Well[a]	Hydrogeologic Unit Monitored	Field-Measured Parameters	
399-1-10A	Top of unconfined	pH	Turbidity
399-1-10B	Bottom of unconfined	Specific conductance	
399-1-16A	Top of unconfined		
399-1-16B	Bottom of unconfined	**Site-Specific Parameters**	
399-1-17A	Top of unconfined	cis-1,2-dichloroethene	Trichloroethene
399-1-17B	Bottom of unconfined	Tetrachloroethene	
399-1-18A	Top of unconfined		
399-1-18B	Bottom of unconfined	**AEA Parameters**	
		Uranium	

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled for four consecutive months, twice per year (semiannually).
AEA = *Atomic Energy Act of 1954*.
WAC = Washington Administrative Code.

Table B.17. Monitoring Wells and Constituents for the Integrated Disposal Facility (adapted from DOE/RL-2003-12)

Well[a]	Contaminants of Concern[b]	
299-E17-22	40 CFR 264, Appendix IX	
299-E17-23		
299-E17-25	**Indicator Parameters[c]**	
299-E18-1	Chromium (filtered)	Total organic carbon
299-E24-21	pH	Total organic halides
Proposed downgradient well 1	Specific conductance (field)	
Proposed downgradient well 2		
Proposed upgradient well 3	**Supplemental Parameters[d]**	
	Alkalinity	ICP metals
	Anions	Turbidity (field)

(a) All wells constructed to WAC 173-160-400 standards. All wells completed at the top of the unconfined aquifer. One upgradient well and one downgradient well scheduled for installation in late FY 2005. The second downgradient well is proposed for an unspecified time in the future.
(b) Sampled one time per well.
(c) Sampled two times per quarter for 1 year to establish background, then four times semiannually (total of eight samples per well per year) thereafter.
(d) Sampled semiannually.
Bold italic = Upgradient well.
FY = Fiscal year.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.18. Monitoring Wells and Constituents for the Liquid Effluent Retention Facility (adapted from WHC-SD-EN-AP-024)

Well[a]	Hydrogeologic Unit Monitored	Contamination Indicator Parameters[b]	
299-E26-10 (S)	Top of unconfined	pH (field)	Total organic carbon
299-E26-11 (Q)	Top of unconfined	Specific conductance (field)	Total organic halides
		Site-Specific Parameters	
		Alkalinity[c]	Phenols[c]
		Ammonium[c]	Temperature
		Anions[c]	Turbidity
		ICP metals (filtered)[c]	Volatile organic compounds
		AEA Parameters[d]	
		Gross alpha[c]	Gross beta[c]

(a) Both wells constructed to WAC 172-160-400 standards. Both wells sampled quarterly.
(b) Statistical evaluations suspended in January 2001 because only one downgradient well is not dry.
(c) Analyzed annually.
(d) Analyzed to support AEA monitoring.
Bold italic = Upgradient well.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
(Q) = Sampled quarterly.
(S) = Sampled semiannually.
WAC = Washington Administrative Code.

Table B.19. Monitoring Wells and Constituents for Low-Level Waste Management Area 1 (adapted from WHC-SD-EN-AP-015)

Well[a]
299-E28-26
299-E28-27
299-E28-28
299-E32-2
299-E32-3
299-E32-4
299-E32-5
299-E32-6
299-E32-7
299-E32-8
299-E32-9
299-E32-10
299-E33-28
299-E33-29
299-E33-30
299-E33-34
299-E33-35

RCRA Contamination Indicator Parameters	
pH (field)	Total organic carbon
Specific conductance (field)	Total organic halides

RCRA Site-Specific Parameters	
Alkalinity	Mercury (filtered)
Anions	Phenols[b]
ICP metals (filtered)	Turbidity
Lead (filtered)	

AEA Parameters[c]	
Gross alpha	Tritium
Gross beta	Uranium
Technetium-99[d]	

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually. All wells completed at the top of the unconfined aquifer.
(b) Analyzed annually.
(c) Analyzed to support AEA monitoring.
(d) Performance assessment parameter.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.20. Critical Means for Low-Level Waste Management Area 1 for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	28	27	4.1542	490.5	52.1	711	711
Field pH	28	27	4.4138	8.026	0.133	[7.43, 8.62]	[7.43, 8.62]
Total organic carbon, µg/L	25[b]	24	4.2304	437.4	190.957	1,261	1,510[c]
Total organic halides,[d] µg/L	28	27	4.1542	NC	NC	NC	12.7[c]

(a) Based on semiannual sampling events from December 2002 to June 2004 for upgradient wells 299-E28-26, 299-E28-27, 299-E28-28, 299-E32-4, 299-E33-28, 299-E33-29, and 299-E33-35.
(b) Excluded suspected total organic carbon values collected in June 2003 from wells 299-E28-27, 299-E32-4, and 299-E33-28.
(c) Upgradient/downgradient comparison value is the most recently determined limit of quantitation.
(d) Critical mean cannot be calculated because essentially all of the measurements are below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
NC = Not calculated.
t_c = Bonferroni critical t-value for appropriate df and 68 comparisons.

Table B.21. Monitoring Wells and Constituents for Low-Level Waste Management Area 2 (adapted from WHC-SD-EN-AP-015)

Well[a]	RCRA Contamination Indicator Parameters	
299-E27-8	pH (field)	Total organic carbon
299-E27-9	Specific conductance (field)	Total organic halides
299-E27-10		
299-E27-11	**RCRA Site-Specific Parameters**	
299-E27-17	Alkalinity	Mercury (filtered)
299-E34-2[b]	Anions	Phenols[c]
299-E34-5[d]	ICP metals (filtered)	Polychlorinated biphenyls
299-E34-7	Lead (filtered)	Turbidity
299-E34-9		
299-E34-10	**AEA Parameters[e]**	
299-E34-12	Gross alpha	Technetium-99[f]
	Gross beta	Tritium
	Iodine-129[f]	Uranium[f]

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually. All wells completed at the top of the unconfined aquifer.
(b) This well went dry during FY 2003 after sampling was completed.
(c) Analyzed annually.
(d) Used for supplemental information; no statistical evaluation.
(e) Analyzed to support AEA monitoring.
(f) Performance assessment parameters.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
FY = Fiscal year.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.22. Critical Means for Low-Level Waste Management Area 2 for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	6	5	7.9757	827.8	59.1	1,337	1,337
Field pH	6	5	9.2355	7.878	0.085	[7.03, 8.72]	[7.03, 8.72]
Total organic carbon, µg/L	6	5	7.9757	631.88	388.086	3,975	3,980[b]
Total organic halides,[c] µg/L	6	5	7.9757	3.988	1.363	15.7	15.7

(a) Based on semiannual sampling events from May 2002 to April 2004 for upgradient well 299-E27-10. Data from well 299-E34-7 are excluded due to elevated levels of all indicator parameters.
(b) Rounded to the nearest 10 µg/L.
(c) Critical mean calculated from values below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 40 comparisons.

Table B.23. Monitoring Wells and Constituents for Low-Level Waste Management Area 3 (adapted from WHC-SD-EN-AP-015)

Well[a]	Hydrogeologic Unit Monitored
299-W7-1[b]	Top of unconfined
299-W7-3[c]	Deep unconfined
299-W7-4	Top of unconfined
299-W7-5	Top of unconfined
299-W7-7[b]	Top of unconfined
299-W7-12	Top of unconfined
299-W8-1	Top of unconfined
299-W10-14[c]	Deep unconfined
299-W10-19[b]	Top of unconfined
299-W10-20	Top of unconfined
299-W10-21	Top of unconfined

RCRA Contamination Indicator Parameters	
pH (field)	Total organic carbon
Specific conductance (field)	Total organic halides

RCRA Site-Specific Parameters	
Alkalinity	Mercury (filtered)
Anions	Phenols
ICP metals (filtered)	Volatile organic compounds
Lead (filtered)	

AEA Parameters[d]	
Gross alpha	Tritium
Gross beta	Turbidity
Iodine-129[e]	Uranium[e]
Technetium-99[e]	

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually.
(b) Well went dry in FY 2004.
(c) Used for supplemental information; no statistical evaluations.
(d) Analyzed to support AEA monitoring.
(e) Performance assessment parameters.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
FY = Fiscal year.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.24. Monitoring Wells and Constituents for Low-Level Waste Management Area 4 (adapted from WHC-SD-EN-AP-015)

Well[a]	Hydrogeologic Unit Monitored
299-W15-15	Top of unconfined
299-W15-16[b]	Top of unconfined
299-W15-17[c]	Deep unconfined
299-W18-21[b]	Top of unconfined
299-W18-22[c]	Deep unconfined
299-W18-23	Top of unconfined

RCRA Contamination Indicator Parameters	
pH (field)	Total organic carbon
Specific conductance (field)	Total organic halides

RCRA Site-Specific Parameters	
Alkalinity	Mercury (filtered)
Anions	Phenols
ICP metals (filtered)	Turbidity
Lead (filtered)	Volatile organic compounds

AEA Parameters[d]	
Gross alpha	Technetium-99
Gross beta	Tritium
Iodine-129	Uranium[e]

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually.
(b) Well went dry in FY 2004.
(c) Used for supplemental information; no statistical evaluations.
(d) Analyzed to support AEA monitoring.
(e) Performance assessment parameter.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
FY = Fiscal year.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.25. Critical Means for Low-Level Waste Management Area 4 for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	12	11	4.3034	472.3	90.0	875	875
Field pH	12	11	4.7248	7.944	0.129	[7.31, 8.58]	[7.31, 8.58]
Total organic carbon, µg/L	10[b]	9	4.6231	434.625	190.407	1,358	1,510[c]
Total organic halides, µg/L	12	11	4.3034	19.054	17.841	99.0	99.0

(a) Based on semiannual sampling events from January 2003 to July 2004 for upgradient wells 299-W15-15, 299-W18-21, and 299-W18-23.
(b) Excluded suspected total organic carbon values collected in July 2003 from wells 299-W15-15 and 299-W18-21.
(c) Upgradient/downgradient comparison value is the most recently determined limit of quantification.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

Table B.26. Monitoring Wells and Constituents for the Nonradioactive Dangerous Waste Landfill (adapted from PNNL-12227 and PNNL-12227-ICN-1)

Well[a]	Hydrogeologic Unit Monitored
699-25-33A[b]	Top of LPU[c]
699-25-34A	Top of unconfined
699-25-34B	Top of unconfined
699-25-34D	Top of unconfined
699-26-33	Top of unconfined
699-26-34A	Top of unconfined
699-26-34B	Top of unconfined
699-26-35A	Top of unconfined
699-26-35C[b]	Top of LPU[c]

Contamination Indicator Parameters	
pH (field)	Total organic carbon
Specific conductance (field)	Total organic halides

Site-Specific Parameters	
Anions	Turbidity
ICP metals (filtered)	Volatile chlorinated hydrocarbons
Phenols[d]	

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually.
(b) Used for supplemental information; no statistical evaluation.
(c) Low-permeability unit (LPU) in upper Ringold Formation.
(d) Analyzed annually.
Bold italic = Upgradient wells.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.27. Critical Means for Nonradioactive Dangerous Waste Landfill for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	8	7	5.7282	545.3	4.7	574	574
Field pH	8	7	6.4295	7.219	0.058	[6.83, 7.61]	[6.83, 7.61]
Total organic carbon,[b] µg/L	6[c]	5	7.3884	NC	NC	NC	1,510[d]
Total organic halides,[b] µg/L	8	7	5.7282	NC	NC	NC	12.7[d]

(a) Based on most recent sampling events from February 2003 to August 2004 for upgradient wells 699-26-34A and 699-26-35A.
(b) Critical mean cannot be calculated because essentially all the measurements are below vendor's specified method detection limit.
(c) Excluded suspected total organic carbon values collected in February and August 2003 from well 699-26-35A.
(d) Upgradient/downgradient comparison value is the most recently determined limit of quantitation.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
NC = Not calculated.
t_c = Bonferroni critical t-value for appropriate df and 28 comparisons.

Table B.28. Monitoring Wells and Constituents for PUREX Cribs 216-A-10, 216-A-36B, and 216-A-37-1 (adapted from PNNL-11523 and PNNL-11523-ICN-1)

Well[a]	Hydrogeologic Unit Monitored
Upgradient Wells	
299-E24-18	Top of unconfined
299-E25-31	Top of unconfined
Near-Field Wells – 216-A-10 Crib	
299-E17-1 (P)	Top of unconfined
299-E17-19	Top of unconfined
299-E24-16 (Q)	Top of unconfined
Near-Field Wells – 216-A-36B Crib	
299-E17-14 (Q)	Top of unconfined
299-E17-16	Top of unconfined
299-E17-18	Top of unconfined
Near-Field Wells – 216-A-37-1 Crib	
299-E25-17 (P)	Top of unconfined
299-E25-19 (P,Q)	Top of unconfined
699-37-47A	Top of unconfined
Far-Field Wells[d]	
57 wells	Unconfined

Contamination Indicator Parameters	
pH (field)[b]	Specific conductance (field)[b]

Site-Specific Parameters	
Alkalinity	ICP metals (filtered)
Ammonium ion	Phenols
Anions[b]	Turbidity[b]
Arsenic (filtered)	

AEA Parameters[c]		
Gross alpha	Iodine-129[b]	Tritium[b]
Gross beta	Strontium-90	

(a) Wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. Wells sampled semiannually unless noted (Q), quarterly.
(b) Far-field wells analyzed for these constituents only.
(c) Analyzed to support AEA monitoring.
(d) Far-field wells sampled annually to triennially.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
PUREX = Plutonium-Uranium Extraction (Plant).
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.29. Monitoring Wells and Constituents for Waste Management Area A-AX (adapted from PNNL-13023-ICN-1)

Well[a]	Contamination Indicator Parameters	
299-E24-19[b]	pH (field)	Total organic carbon
299-E24-20	Specific conductance (field)	Total organic halides
299-E24-22		
299-E24-33[c]	**Site-Specific Parameters**	
299-E25-40	Alkalinity	ICP metals (filtered)
299-E25-41	Anions	Phenols[d]
299-E25-46[b]		
299-E25-93	**AEA Parameters[e]**	
299-E25-94[c]	Gross beta	Technetium-99
	Gross gamma[d]	Tritium[d]
	Iodine-129[d]	Uranium[d]
	Strontium-90[d]	

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled semiannually. All wells completed at the top of the unconfined aquifer.
(b) Decommissioned in 2003 due to corroded casing. Not sampled in FY 2004. Well 299-E25-94 drilled to replace wells 299-E24-19 and 299-E25-46.
(c) New well constructed in FY 2004. First samples scheduled for December 2004.
(d) Annually.
(e) Analyzed to support AEA monitoring.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
FY = Fiscal year.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.30. Critical Means for Waste Management Area A-AX for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	8	7	5.7282	378.6	23.6	522	522
Field pH	8	7	6.4295	8.078	0.070	[7.60, 8.55]	[7.60, 8.55]
Total organic carbon, µg/L	6[b]	5	7.3884	401.875	146.210	1,568	1,570[c]
Total organic halides,[d] µg/L	8	7	5.7282	4.15	3.115	23.1	23.1

(a) Based on semiannual sampling events from December 2002 to June 2004 for upgradient well 299-E24-20 and from quarterly sampling events from January 2004 to September 2004 for upgradient well 299-E24-22.
(b) Excluded suspected total organic carbon values collected in June 2003 from well 299-E24-20 and in September 2004 from well 299-E24-22.
(c) Rounded to the nearest 10 µg/L.
(d) Critical mean calculated from values reported below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 28 comparisons.

Table B.31. Monitoring Wells and Constituents for Waste Management Area B-BX-BY (adapted from PNNL-13022, PNNL-13022-ICN-1, and PNNL-13022-ICN-2)

Well[a]
Near-Field Wells
299-E33-7 (P)
299-E33-9 (P)
299-E33-10 (P)
299-E33-15 (P)
299-E33-16 (P)
299-E33-17 (P)
299-E33-18 (P)
299-E33-20 (P)
299-E33-21 (P)
299-E33-31
299-E33-32
299-E33-38
299-E33-39
299-E33-41
299-E33-42
299-E33-43
299-E33-44
299-E33-47[c]
299-E33-48[c]
299-E33-49[c]
299-E33-334
299-E33-335
299-E33-337
299-E33-338
299-E33-339
Far-Field Wells
299-E28-8 (P)
299-E33-26
299-E33-28

Contamination Indicator Parameters	
pH	Total organic carbon
Specific conductance	

Site-Specific Parameters	
Alkalinity	ICP metals (filtered)
Anions	Turbidity
Cyanide	

AEA Parameters[b]	
Gross alpha	Technetium-99
Gross beta	Tritium
Low-level gamma (cobalt-60, cesium-137)	Uranium

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA, and are completed in the unconfined aquifer. Wells sampled quarterly to support RCRA assessment.
(b) Analyzed to support AEA monitoring.
(c) New well constructed in FY 2004. First samples scheduled for December 2004.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.32. Monitoring Wells and Constituents for Waste Management Area C (adapted from PNNL-13024-ICN-1, PNNL-13024-ICN-2, and PNNL-13024-ICN-3)

Well[a]	Contamination Indicator Parameters	
299-E27-4	pH (field)	Total organic carbon
299-E27-7 (P)	Specific conductance (field)	Total organic halides
299-E27-12		
299-E27-13	**Site-Specific Parameters**	
299-E27-14	Alkalinity	ICP metals (filtered)
299-E27-15	Anions	Phenols
299-E27-21	Cyanide	Turbidity
299-E27-22		
299-E27-23[b]	**AEA Parameters[c]**	
	Gamma scan	Technetium-99
	Gross beta	Total uranium

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells completed at the top of the unconfined aquifer. All wells sampled semiannually.
(b) Used for supplemental information; no statistical evaluation.
(c) Analyzed to support AEA monitoring.
Bold italic = Upgradient well.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.33. Critical Means for Waste Management Area C for FY 2005 Comparisons[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	8	7	5.7282	567.2	49.4	867	867
Field pH	8	7	6.4295	8.133	0.188	[6.85, 9.41]	[6.85, 9.41]
Total organic carbon,[b] µg/L	6	5	7.3884	535.21	303.472	2,957	2,960[c]
Total organic halides, µg/L	6	5	7.3884	6.362	2.836	29.0	29.0

(a) Based on quarterly sampling events from January 2004 to September 2004 for upgradient well 299-E27-22 and from December 2003 to September 2004 for upgradient well 299-E27-7.
(b) Critical mean calculated from values reported below vendor's specified method detection limit.
(c) Rounded to the nearest 10 µg/L.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 28 comparisons.

Table B.34. Monitoring Wells and Constituents for Waste Management Area S-SX (adapted from PNNL-12114-ICN-1 and PNNL-12114-ICN-2)

Well[a]	Contamination Indicator Parameters	
299-W22-44	pH (field)	Specific conductance (field)
299-W22-45		
299-W22-46	**Site-Specific Parameters**	
299-W22-48	Alkalinity	ICP metals (filtered)
299-W22-49	Anions	Turbidity
299-W22-50		
299-W22-80	**AEA Parameters[b]**	
299-W22-81	Gamma scan	Technetium-99
299-W22-82	(cesium-137)[c]	Tritium
299-W22-83	Gross beta[d]	Uranium
299-W22-84		
299-W22-85		
299-W23-15		
299-W23-19		
299-W23-20		
299-W23-21		

(a) All wells constructed to WAC 173-160-400 standards. All wells sampled quarterly, except for certain constituents as noted. All wells completed at the top of the unconfined aquifer.
(b) Analyzed to support AEA monitoring.
(c) Analysis done only on well 299-W23-19 annually.
(d) Analysis done only on well 299-W23-19 quarterly.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.35. Monitoring Wells and Constituents for Waste Management Area T (adapted from PNNL-12057-ICN-1)

Well[a]	Contamination Indicator Parameters	
299-W10-1 (P)	pH (field)	Specific conductance (field)
299-W10-4 (P)		
299-W10-8 (P)	**Site-Specific Parameters**	
299-W10-22 (S)	Alkalinity	Oxidation-reduction potential (field)
299-W10-23	Anions	
299-W10-24	Dissolved oxygen (field)	Turbidity (field)
299-W10-28	ICP metals (filtered)	
299-W11-7 (S,P)		
299-W11-12 (P)	**AEA Parameters[b,c]**	
299-W11-39	Gamma scan (cesium-137, cobalt-60)	Iodine-129
299-W11-40		Strontium-90
299-W11-41	Gross alpha	Technetium-99
299-W11-42	Gross beta	Tritium

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells sampled quarterly unless noted (S), semiannually. All wells completed at the top of the unconfined aquifer.
(b) Constituent list varies by well; applies only to AEA constituents.
(c) Analyzed to support AEA monitoring. AEA parameters vary in frequency of sampling and not all wells are analyzed for each constituent shown.

Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.36. Monitoring Wells and Constituents for Waste Management Area TX-TY (adapted from PNNL-12072-ICN-1)

Well[a]	Contamination Indicator Parameters	
299-W10-26	pH (field)	Specific conductance (field)
299-W10-27		
299-W14-6 (P)	**Site-Specific Parameters**	
299-W14-13	Alkalinity	Oxidation-reduction potential (field)
299-W14-14	Anions	
299-W14-15	Dissolved oxygen (field)	Turbidity (field)
299-W14-16	ICP metals (filtered)	
299-W14-17		
299-W14-18	**AEA Parameters[b,c]**	
299-W14-19	Gamma scan (cesium-137, cobalt-60)	Iodine-129
299-W15-40		Strontium-90
299-W15-41	Gross alpha	Technetium-99
299-W15-44	Gross beta	Tritium
299-W15-763		
299-W15-765		

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells sampled quarterly, but not all constituents are sought quarterly. All wells completed at the top of the unconfined aquifer.
(b) Constituent list varies by well; applies only to AEA constituents.
(c) Analyzed to support AEA monitoring. AEA parameters vary in frequency of sampling and not all wells are analyzed for each constituent shown.

Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.37. Monitoring Wells and Constituents for Waste Management Area U (adapted from PNNL-13612 and PNNL-13612-ICN-1)

Well[a]	Contamination Indicator Parameters	
299-W18-30	pH (field)	Specific conductance (field)
299-W18-31		
299-W18-40	**Site-Specific Parameters**	
299-W19-12	Alkalinity	ICP metals (filtered)
299-W19-41	Anions	Volatile organic compounds[b]
299-W19-42		
299-W19-44	**AEA Parameters[c]**	
299-W19-45	Gamma scan[b]	Technetium-99
	Gross alpha[b]	Tritium[b]
	Iodine-129[b]	

(a) All wells constructed to WAC-173-160-400 standards. All wells sampled quarterly. All wells completed at the top of the unconfined aquifer.
(b) Annually.
(c) Analyzed to support AEA monitoring.
Bold italic = Upgradient wells.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
WAC = Washington Administrative Code.

Table B.38. Monitoring Wells and Constituents for the KE and KW Basins (adapted from PNNL-14033)

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

(a) All wells constructed to WAC 173-160-400 standards unless noted (P), pre-RCRA. All wells sampled quarterly unless noted (S), semiannually. All wells completed at the top of the unconfined aquifer.
(b) Sampling frequency varies by constituent.
AEA = *Atomic Energy Act of 1954*.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.39. Monitoring Wells, Constituents, and Enforcement Limits for the 200 Area Treated Effluent Disposal Facility (adapted from PNNL-13032)

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

(a) All wells constructed to WAC 173-160-400 standards. All wells completed at the top of the Ringold confined aquifer.
(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.
WAC = Washington Administrative Code.

Table B.40. 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	ICP metals (dissolved and unfiltered)
	Anions	
	Carbon-14	Total dissolved solids
	Carbon tetrachloride	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*.
WAC = Washington Administrative Code.

Table B.41. 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	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	Dissolved manganese	Total coliform
699-24-34C	Nitrate	Total organic carbon
699-24-35		
699-26-35A	Site-Specific Parameters	
	Anions (nitrate)	Volatile organic compounds
	ICP metals (filtered)	Arsenic (dissolved)

(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.
Bold italic = Upgradient wells.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = *Resource Conservation and Recovery Act*.
WAC = Washington Administrative Code.

Table B.42. Analytical Results for Required Constituents[a] at the Solid Waste Landfill

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 699-26-35A
Ammonium, µg/L	118	November 2003	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6
		February 2004	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6
		May 2004	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6	<21.6
		August 2004	<21.6	<21.6	<21.6	<21.6	[c]	<21.6	<21.6	<21.6	<21.6
Chemical oxygen demand, mg/L	10	November 2003	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	5	<3.6	<3.6
		February 2004	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6
		May 2004	<9	<9	**10**	9	<9	**16**	**10**	9	<9
		August 2004	**10**	**17**	**15**	<7.1	[c]	**17**	**13**	**17**	9
Chloride, mg/L	7.82	November 2003	6.4	6.6	6.3	6.9	6.4	6.5	6.7	6.2	7
		February 2004	5.9	6.4	6.3	6.6	6.4	5.6	6.9	6.5	6.3
		May 2004	6.8	6.3	6.7	7.2	6.9	6.8	7	6.3	7.1
		August 2004	**8.4**	6.6	6.5	6.8	[c]	6.4	6.7	6.1	6.9
Coliform bacteria, Col/100 ml	1	November 2003	0	**18.3**	0	0	0	0	0	**120**	0
		February 2004	0	**4.1**	0	0	0	0	0	**129**	0
		May 2004	0	0	0	0	0	0	0	0	0
		August 2004	0	0	0	**5.2**	[c]	0	0	0	0
Iron, filtered, µg/L	160	November 2003	70.7	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5
		February 2004	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5
		May 2004	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5	<54.5
		August 2004	30.3	30.6	28.2	31.8	[c]	39	29.1	22	10.3
Manganese, filtered, µg/L	10	November 2003	5.1	2.4	2.7	1.9	3.1	2.6	3	2.5	1.7
		February 2004	<1.2	1.4	1.2	1.3	2.8	<1.2	2.8	4	<1.2
		May 2004	1.8	2.8	1.6	<1.2	2.2	1.3	1.8	1.6	1.6
		August 2004	1.4	1	<0.99	1.5	[c]	<0.99	1.3	<0.99	<0.99
Nitrate, mg/L	29	November 2003	3.7	3.3	3.5	3.2	2.7	2.9	3.5	2.6	3.9
		February 2004	3.6	3.3	3.4	3.1	2.7	2.9	3	2.6	3.9
		May 2004	3.7	3.5	3.7	3.3	3	3.3	3.2	2.5	4
		August 2004	3.5	3.3	3.3	2.8	[c]	2.8	2.9	2.7	3.6
Nitrite, mg/L	0.059	November 2003	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074
		February 2004	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074
		May 2004	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074	<0.0074
		August 2004	<0.0074	<0.0074	<0.0074	<0.0074	[c]	<0.0074	<0.0074	<0.0074	<0.0074

Table B.42. (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 699-26-35A
Field pH	6.68 - 7.84	November 2003	6.96	**6.59**	6.7	6.88	6.81	6.75	[c]	7.06	7.36
		February 2004	7.01	**6.65**	6.72	6.97	6.73	6.73	6.95	6.77	7.26
		May 2004	7.02	**6.59**	6.96	6.87	6.69	6.74	6.95	6.89	7.12
		August 2004	7.01	**6.62**	**6.68**	6.84	6.69	**6.65**	6.94	6.88	7.14
Specific conductance, µS/cm	583	November 2003	**827**	**754**	**796**	**772**	**687**	**704**	[c]	**601**	545
		February 2004	**829**	**755**	**795**	**745**	**695**	**676**	**738**	**611**	540
		May 2004	**849**	**766**	**801**	**773**	**662**	**707**	**742**	**601**	550
		August 2004	**834**	**761**	**801**	**771**	**675**	**703**	**705**	**604**	548
Sulfate, mg/L	47.2	November 2003	**47.4**	**48.8**	**48.1**	41.8	45.7	44.2	44.3	45.8	38.9
		February 2004	**47.4**	**49.2**	**47.4**	42.2	45.6	45.8	40	44.9	38.2
		May 2004	**48.4**	**50.3**	**49.1**	44	**48.7**	**48.8**	42.1	**47.6**	39.2
		August 2004	45.3	46.5	43.8	39.7	[c]	44	38.7	43.4	36.4
Temperature, °C	20.7	November 2003	16.9	18	18.7	20	18.7	19.2	[c]	18.5	19.8
		February 2004	18	18.1	17.9	18.9	17.8	18	18.1	17.9	18.8
		May 2004	18	18.6	18.2	21.8	18.8	19	19.2	17.9	18.9
		August 2004	18.7	19	18.2	19.5	19	20.1	18.5	18.7	19.5
Total organic carbon, mg/L	1.51	November 2003	0.43	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
		February 2004	<0.39	<0.39	<0.39	0.4	0.48	<0.39	0.49	1	0.46
		May 2004	<0.39	0.41	<0.39	<0.39	0.5	0.45	0.54	0.56	0.43
		August 2004	**1.6**	0.44	0.54	<0.39	[c]	<0.39	0.46	<0.39	<0.39
Zinc, filtered, µg/L	42.3	November 2003	5.6	6.1	<2.7	9.6	<2.7	<2.7	10.3	5.7	10.7
		February 2004	<2.7	<2.7	<2.7	8.3	<2.7	<2.7	13.6	7.4	9.9
		May 2004	<2.7	<2.7	<2.7	21.1	<2.7	<2.7	11.3	6.5	6.5
		August 2004	<1.5	2.2	<1.5	15.1	[c]	<1.5	14.2	<1.5	6.4

(a) WAC 173-304.
(b) Number obtained from Table B.43, background threshold value.
(c) Sample not collected or constituent not analyzed.
Results in **bold** type exceed background threshold value.

Table B.43. Results of Shapiro and Francia Test for Normality and Background Threshold Values for the Solid Waste Landfill

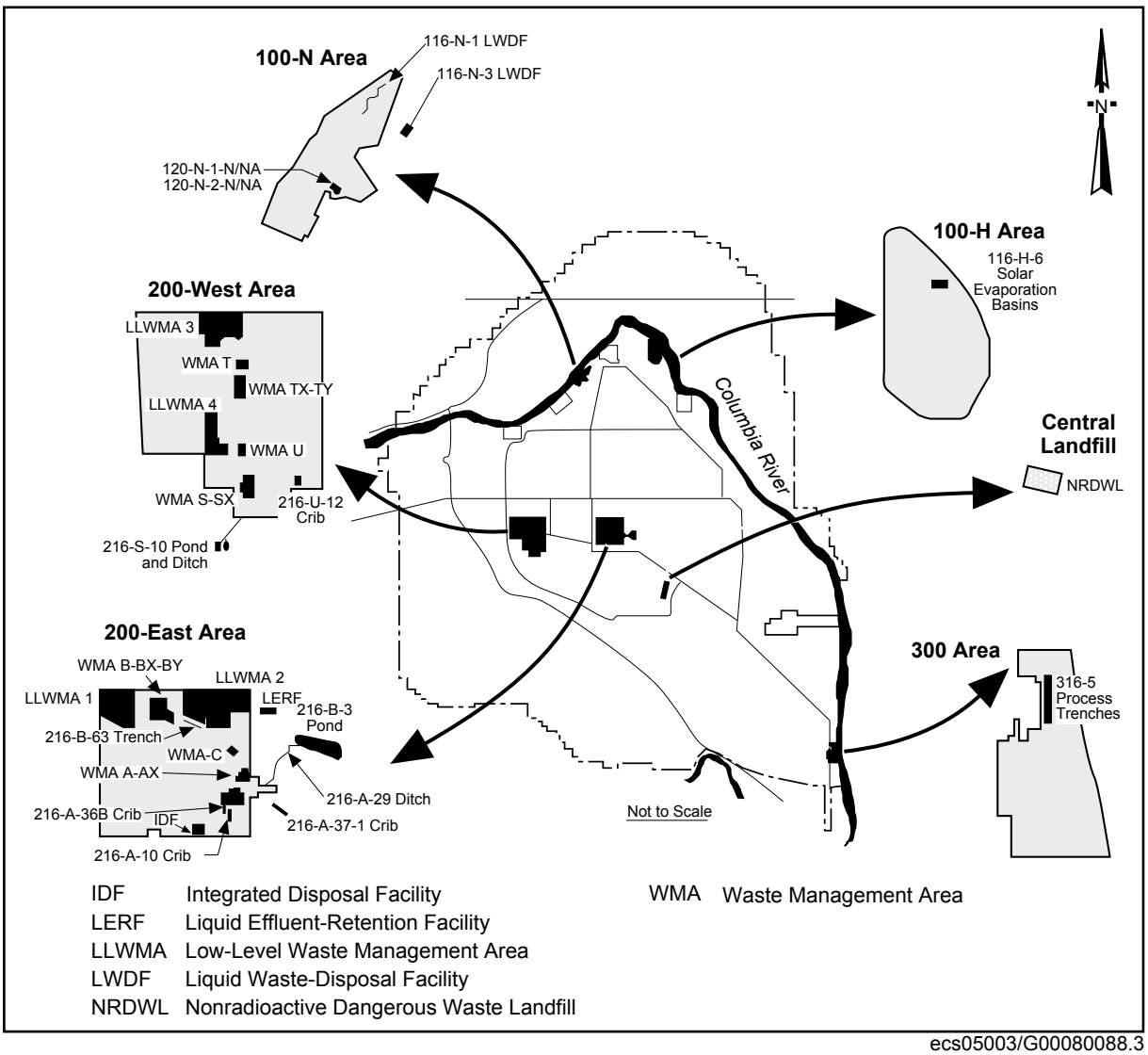
Constituent,[a] unit	W-test Statistic,[b] (log value)	W-test Statistic,[b] (raw data)	W-test[b] Critical Value, Wα[c]	Upper Tolerance Limit	Background Threshold Value
Temperature, °C	0.953 s	0.961 s	0.963	20.7[d]	20.7
Specific conductance, µS/cm	0.978 ns	NA	0.960	583[e]	583
Field pH	0.988 ns	NA	0.963	[6.68, 7.84][e]	[6.68, 7.84]
Total organic carbon, µg/L	NC	NC	NC	842[d] 1,510[f]	1,510
Chloride, µg/L	0.954 s	0.962 s	0.963	7,820[d]	7,820
Nitrate (as NO_3^-), µg/L	0.833 s	0.844 s	0.963	29,000[d]	29,000
Nitrite (as NO_2^-), µg/L	NC	NC	NC	59[f]	59
Ammonium (as NH_3^-), µg/L	NC	NC	NC	90[d] 118[f]	118
Sulfate, µg/L	0.983 ns	NA	0.963	47,200[e]	47,200
Iron, dissolved, µg/L	0.960 s	0.802 s	0.962	160[d] 54.0[f]	160
Zinc, dissolved, µg/L	NC	NC	NC	42.3[d] 10.31[f]	42.3
Manganese, dissolved, µg/L	NC	NC	NC	10[d] 9[f]	10
Coliform bacteria, colonies/100 ml	NC	NC	NC	1[g]	1
Chemical oxygen demand, µg/L	NC	NC	NC	10,000[g]	10,000

(a) Constituents are specified in WAC 173-304-490(2)(d). Data collected from March 1993 to May 2000 from upgradient wells 699-24-35 and 699-26-35A.
(b) Shapiro and Francia (1972).
(c) Obtained from Table A-9 (Shapiro 1980) for α = 5%.
(d) Maximum value reported.
(e) Based on log-normal distribution.
(f) Based on limit of quantitation using method detection limit.
(g) Based on laboratory lowest detected result.
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 B.44. 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-W6-11 (A)	Top of unconfined	Benzene	5
299-W6-12 (A)	Top of unconfined	Cadmium, total	10
299-W7-3 (S)	Bottom of unconfined	Chloroform	6.2
299-W7-5 (S)	Top of unconfined	Copper, total	70
299-W7-12 (A)	Top of unconfined	Lead, total	50
299-W8-1 (A)	Top of unconfined	Mercury, total	2
699-48-71 (A,P)	Unconfined	pH	6.5 - 8.5 pH units
699-48-77A (Q)	Ringold unit E; upper	Sulfate	250,000
699-48-77C (Q)	Ringold unit E; mid to lower	Tetrahydrofuran	100
		Total dissolved solids	500,000
699-48-77D (Q)	Ringold unit E; upper		
699-49-79 (A,P)	Top of unconfined	AEA Parameters	
699-51-75 (S,P)	Top of unconfined	Gross alpha	Strontium-90
699-51-75P (A,P)	Lower unconfined	Gross beta	Tritium

(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*.
WAC = Washington Administrative Code.



ecs05003/G00080088.3

Figure B.1. RCRA Units on the Hanford Site Requiring Groundwater Monitoring. (The 216-A-10, 216-A-36B, and 216-A-37-1 cribs are monitored as a single waste management unit, PUREX Cribs.)

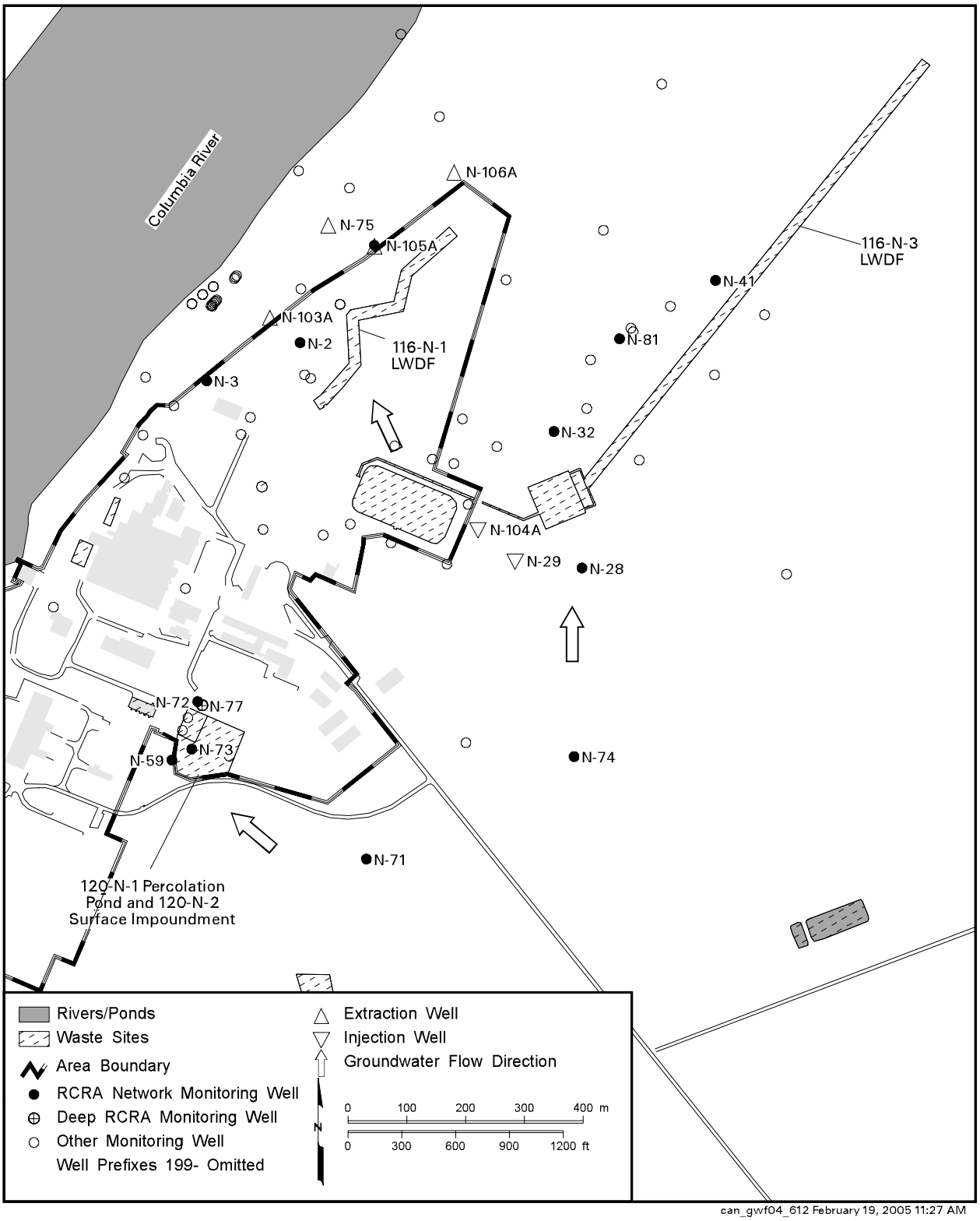


Figure B.2. Groundwater Monitoring Wells for 100-N Area RCRA Sites

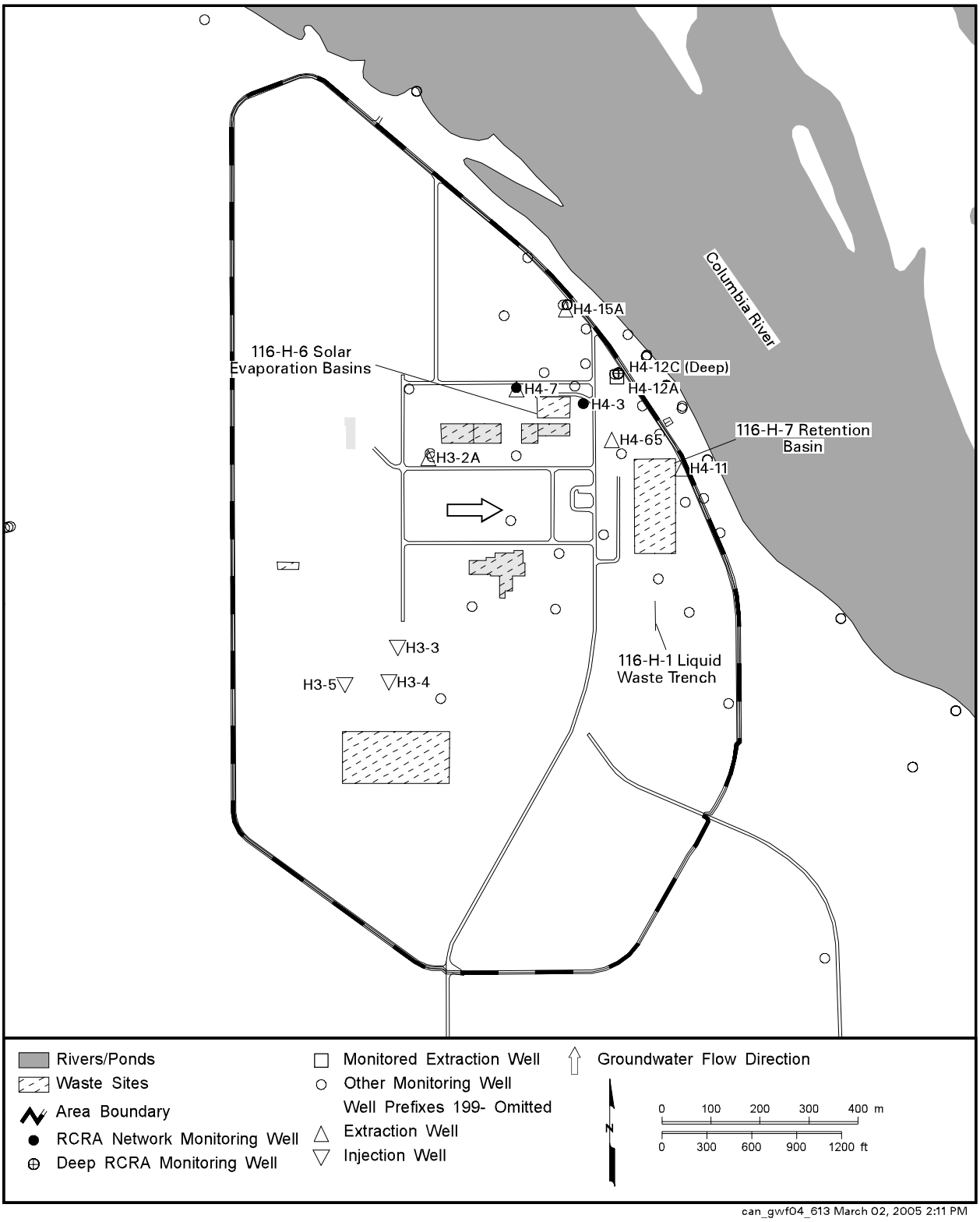


Figure B.3. Groundwater Monitoring Wells at the 116-H-6 (183-H) Evaporation Basins

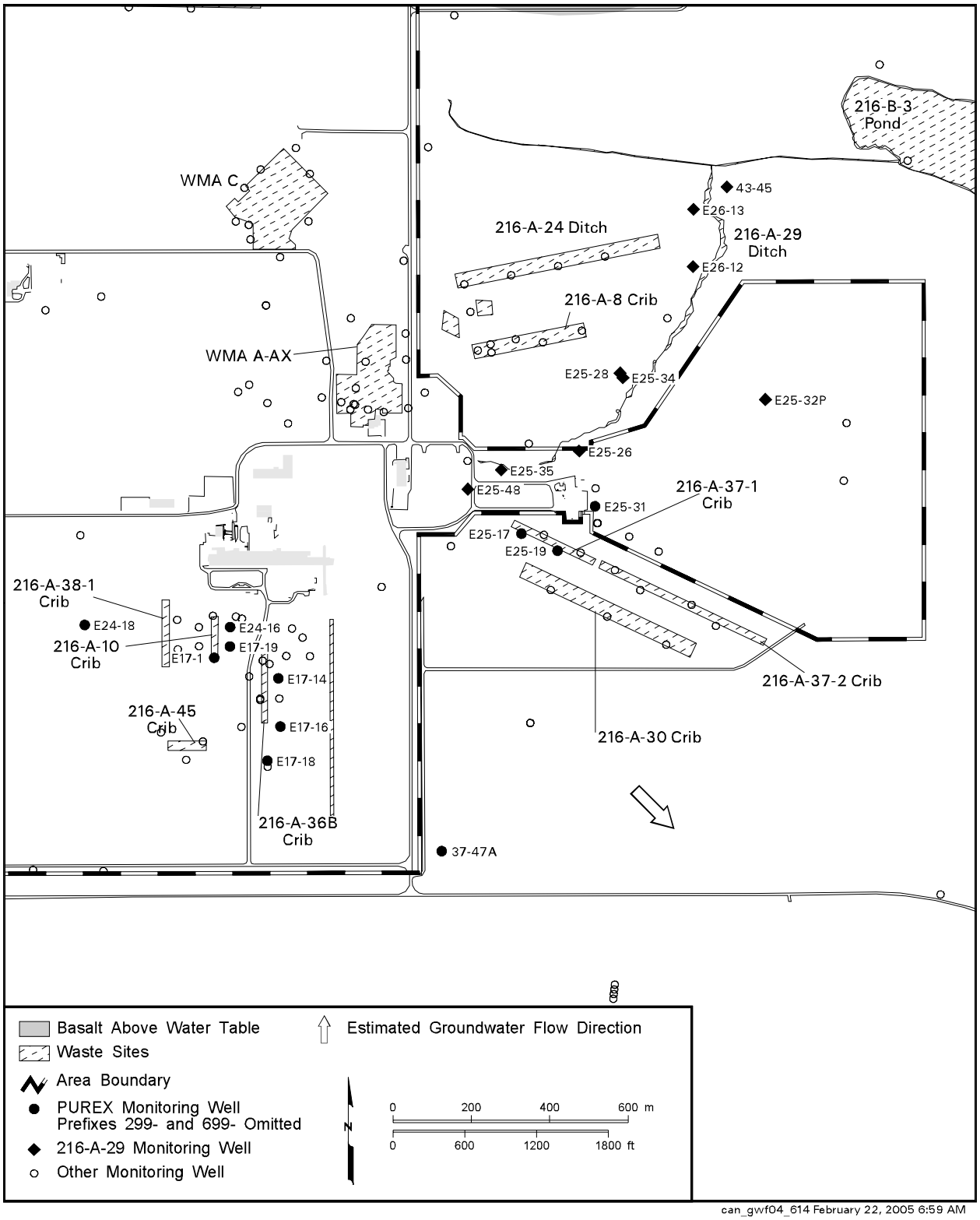


Figure B.4. Groundwater Monitoring Wells at the 216-A-29 Ditch and PUREX Cribs

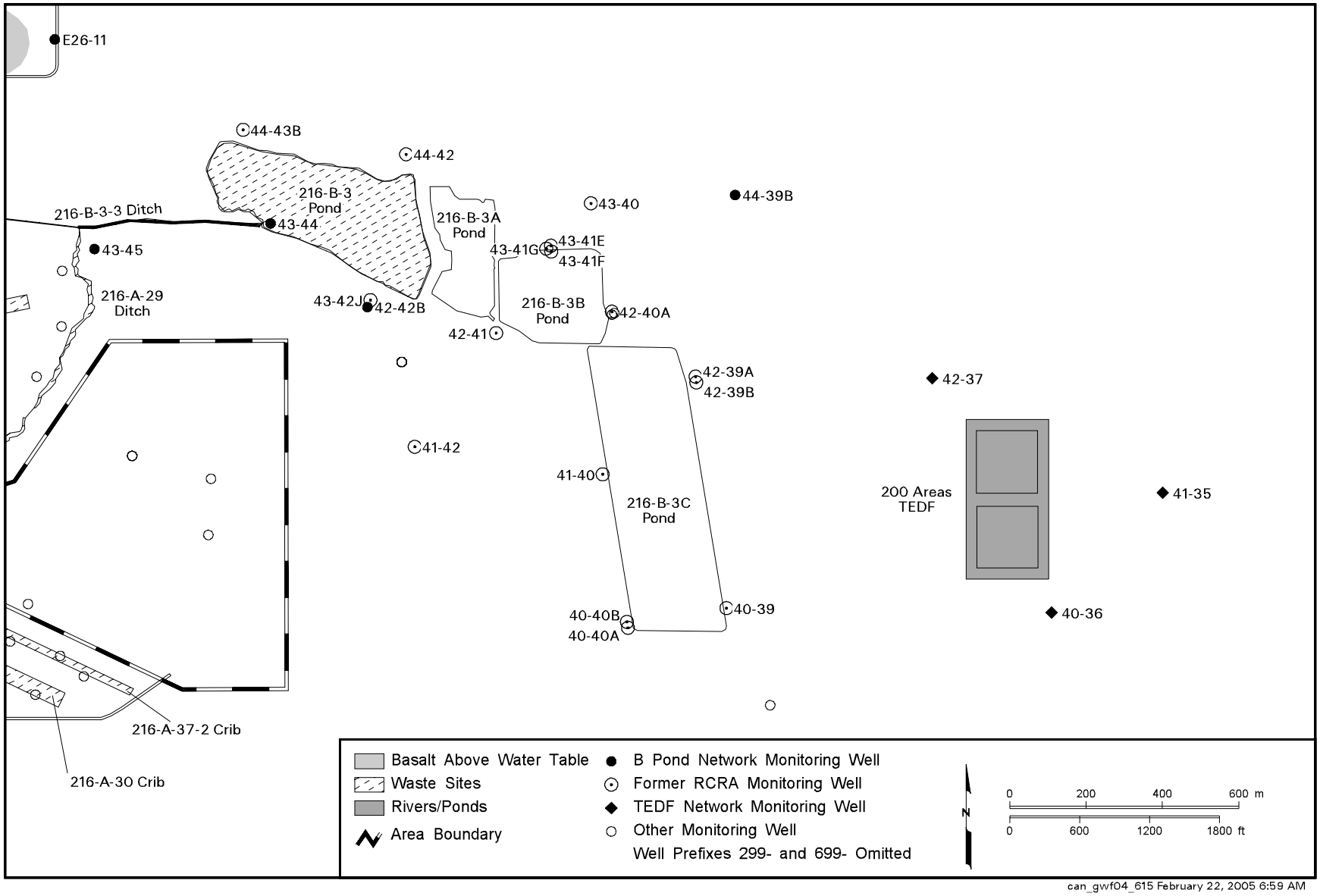


Figure B.5. Groundwater Monitoring Wells at the 216-B-3 Pond and 200 Area Treated Effluent Disposal Facility

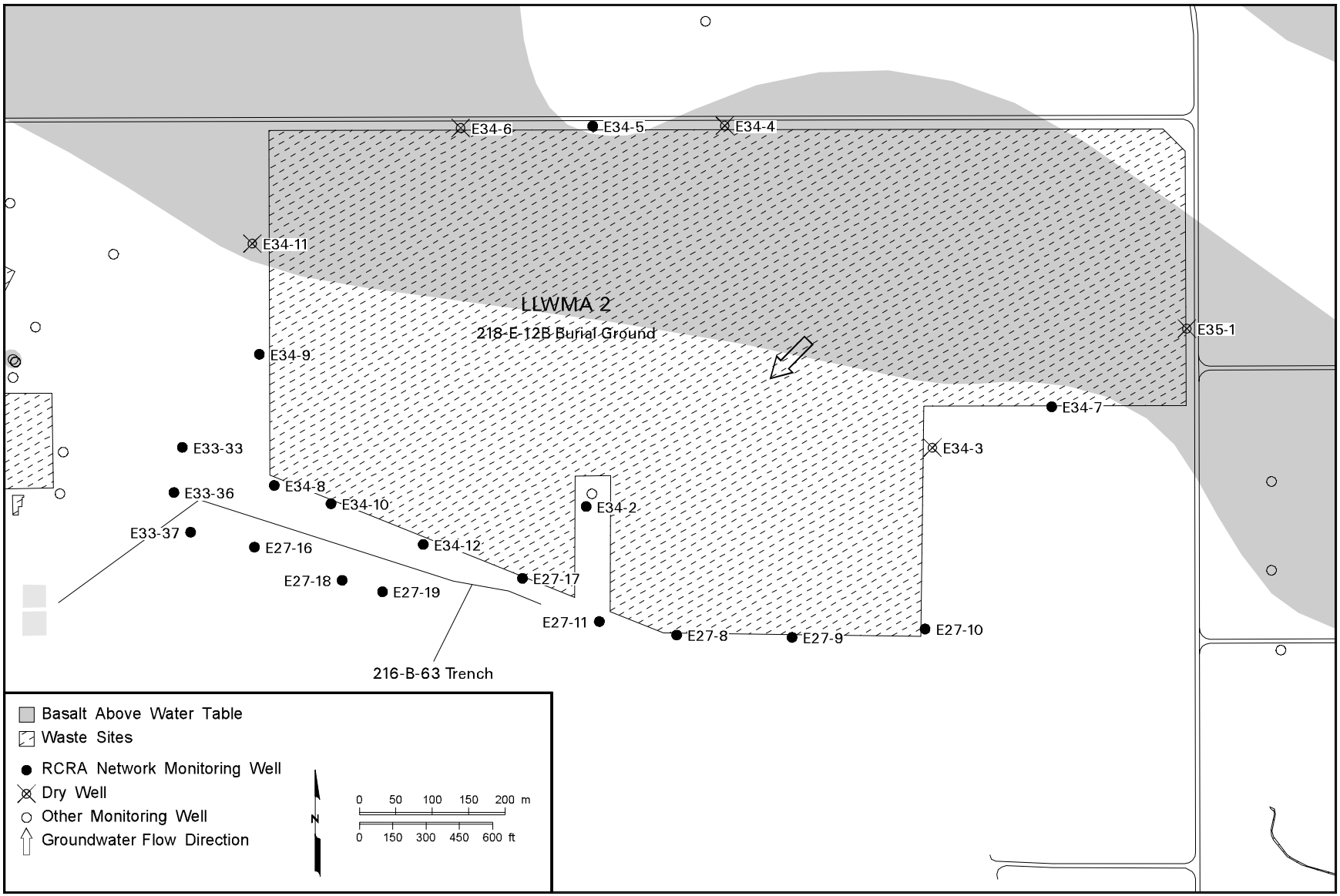


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Figure B.6. Groundwater Monitoring Wells at the 216-B-63 Trench and Low-Level Waste Management Area 2

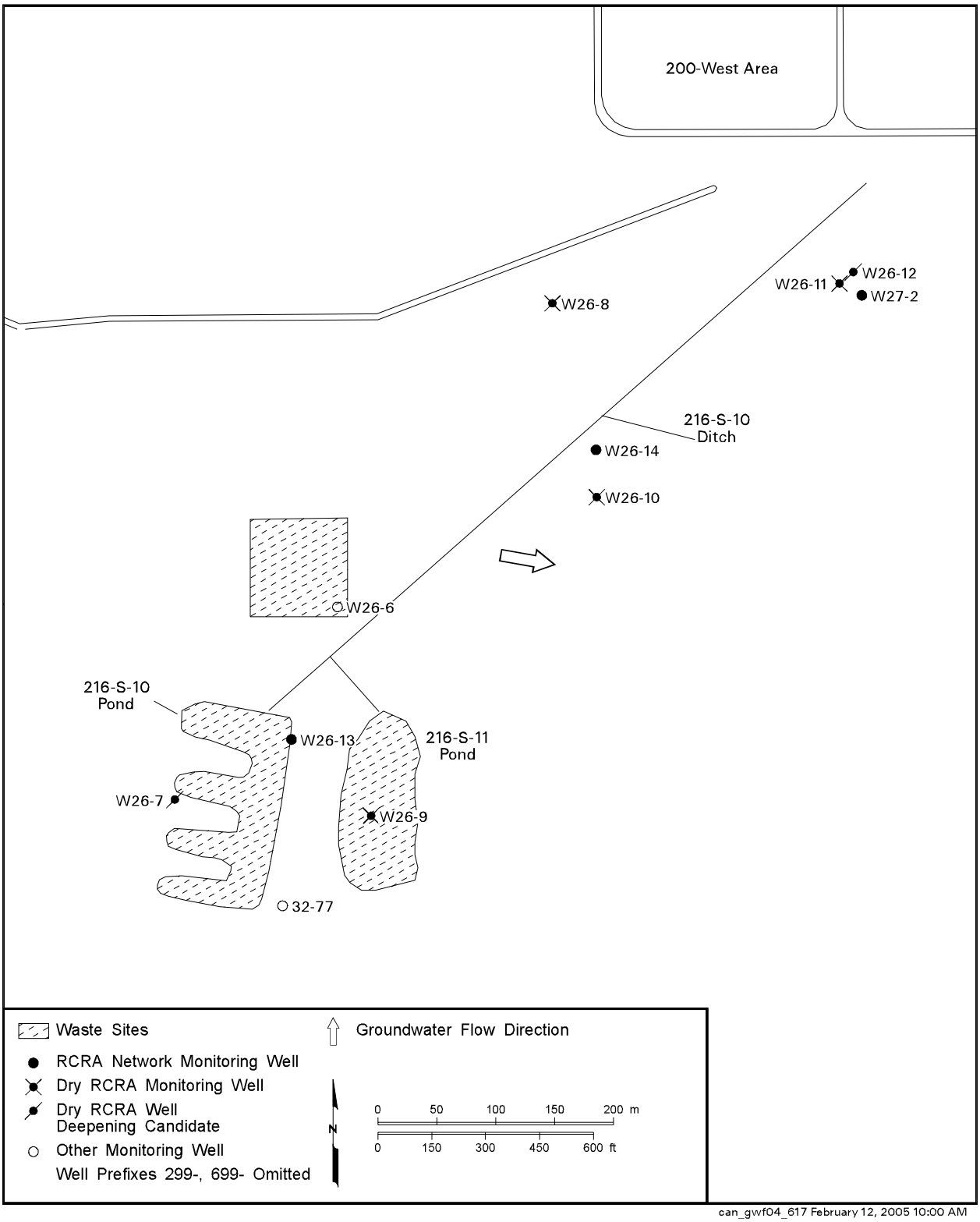

Figure B.7. Groundwater Monitoring Wells at the 216-S-10 Pond and Ditch

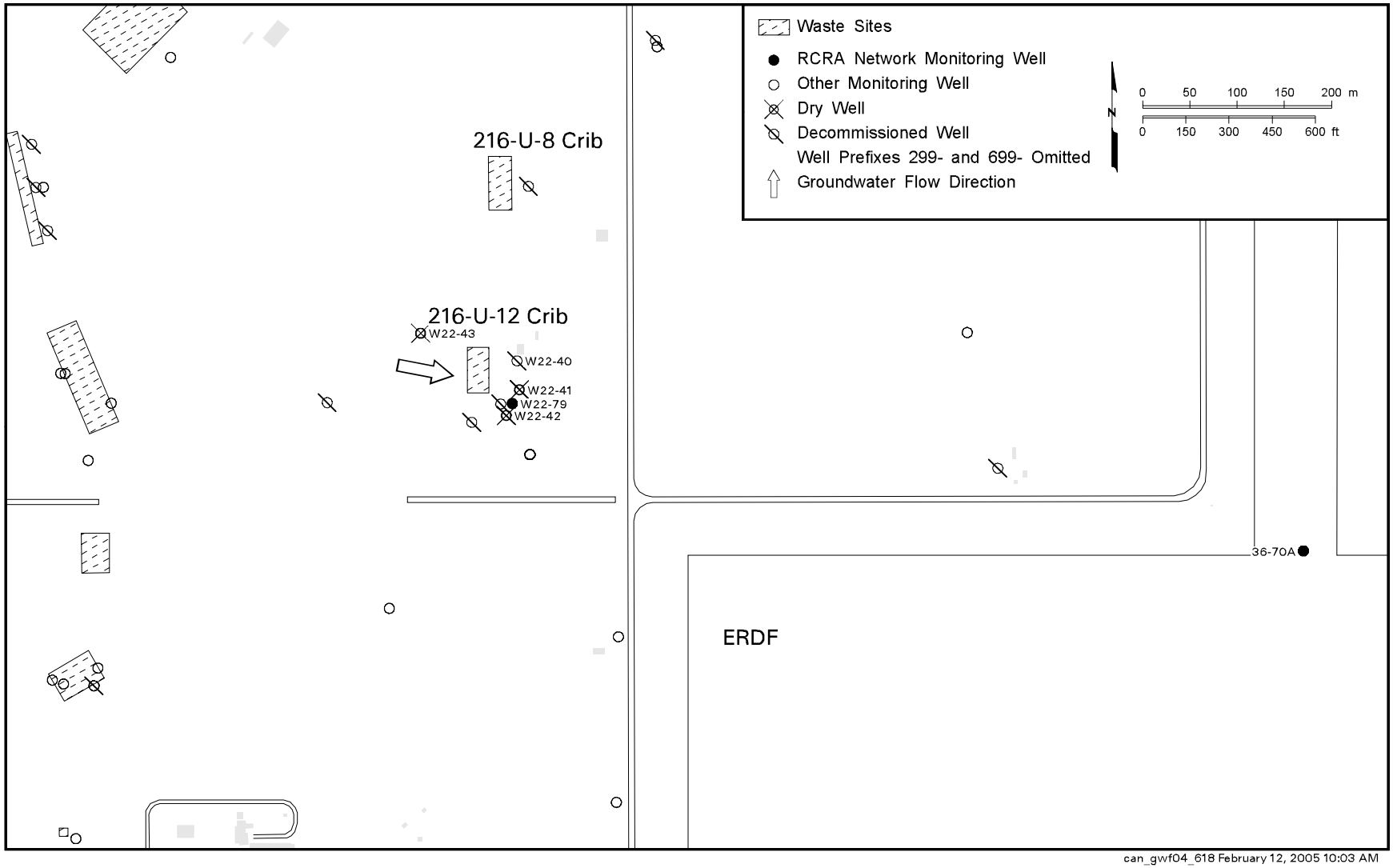

Figure B.8. Groundwater Monitoring Wells at the 216-U-12 Crib

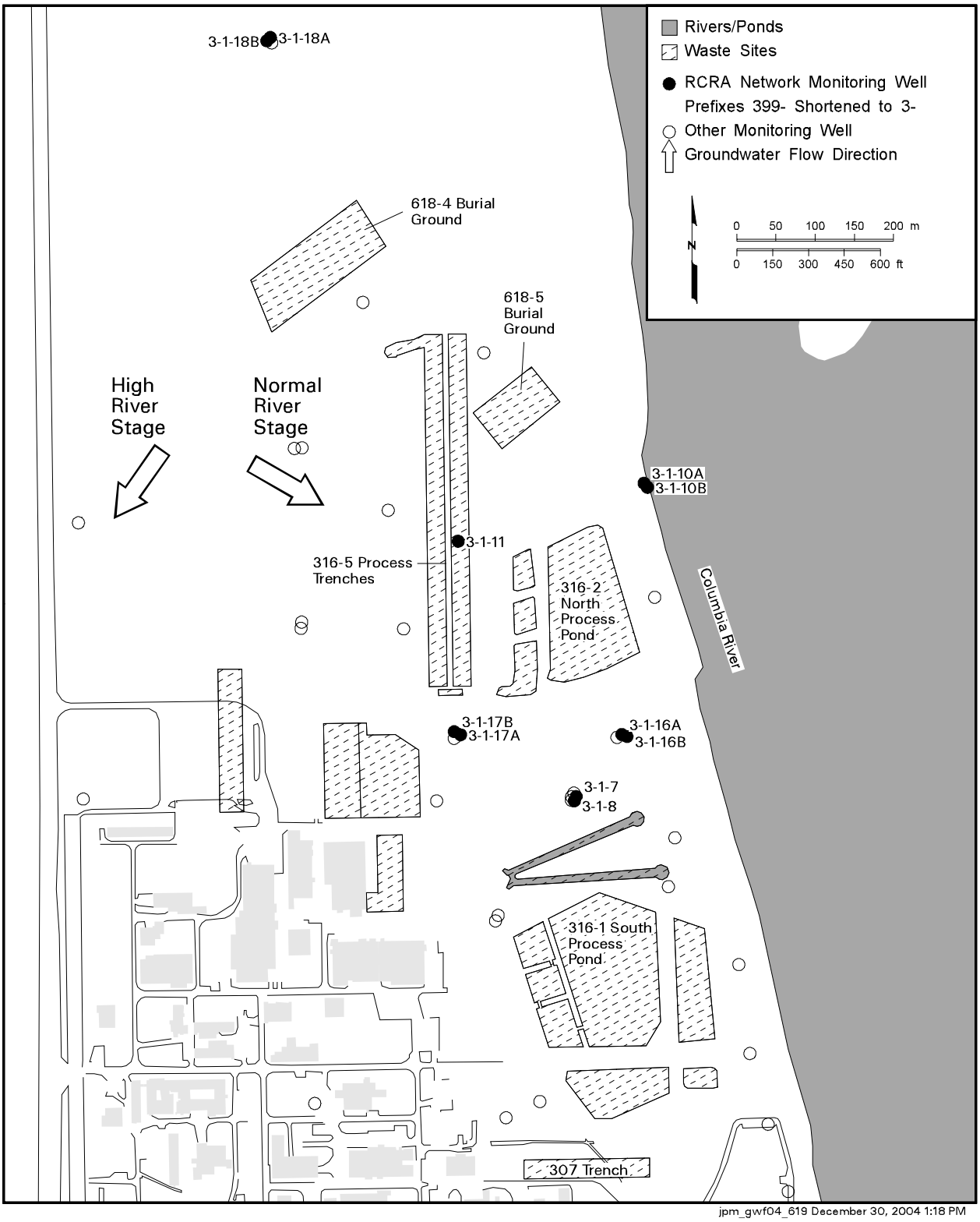

Figure B.9. Groundwater Monitoring Wells at the 316-5 Process Trenches

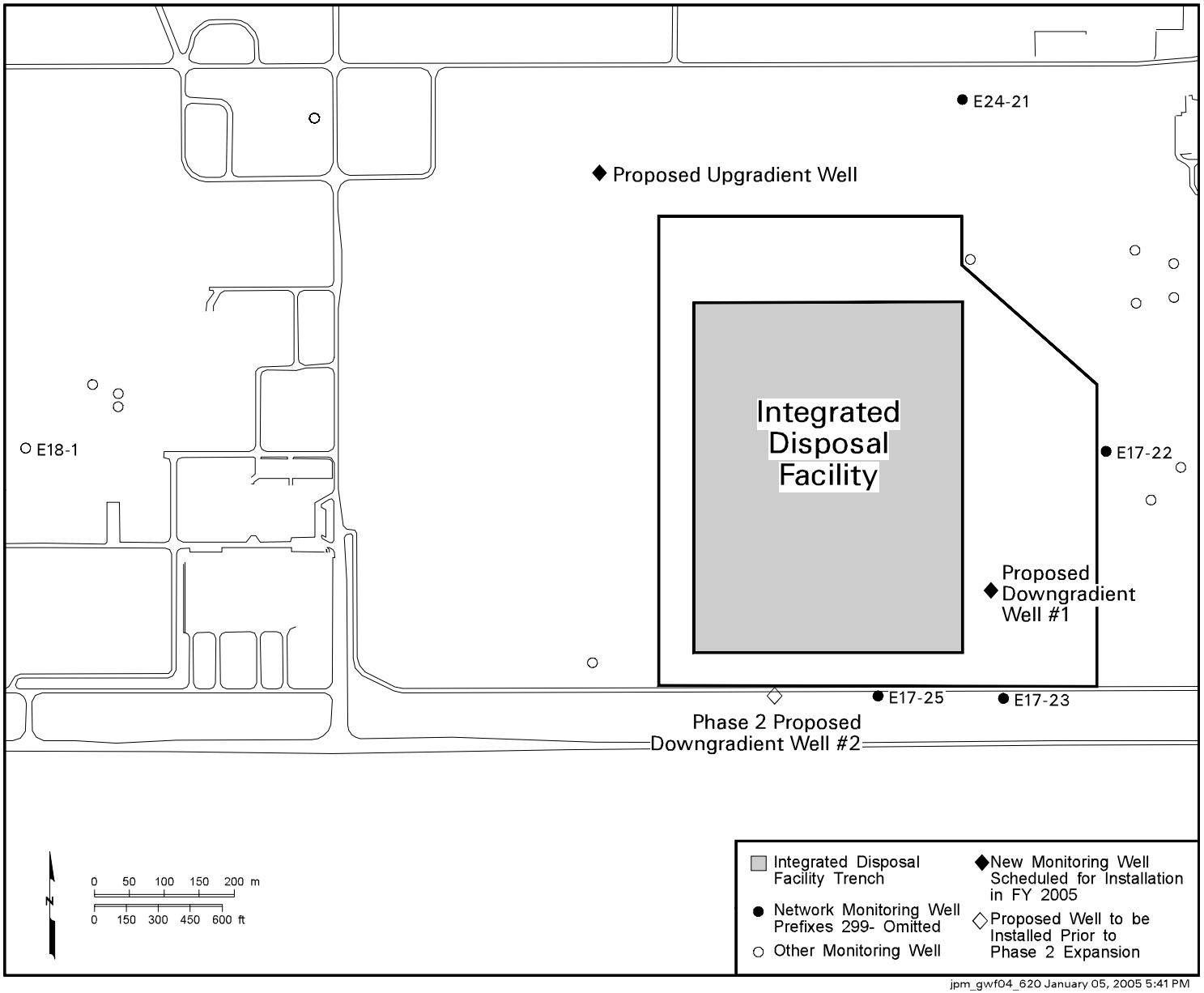

Figure B.10. Groundwater Monitoring Wells at the Integrated Disposal Facility

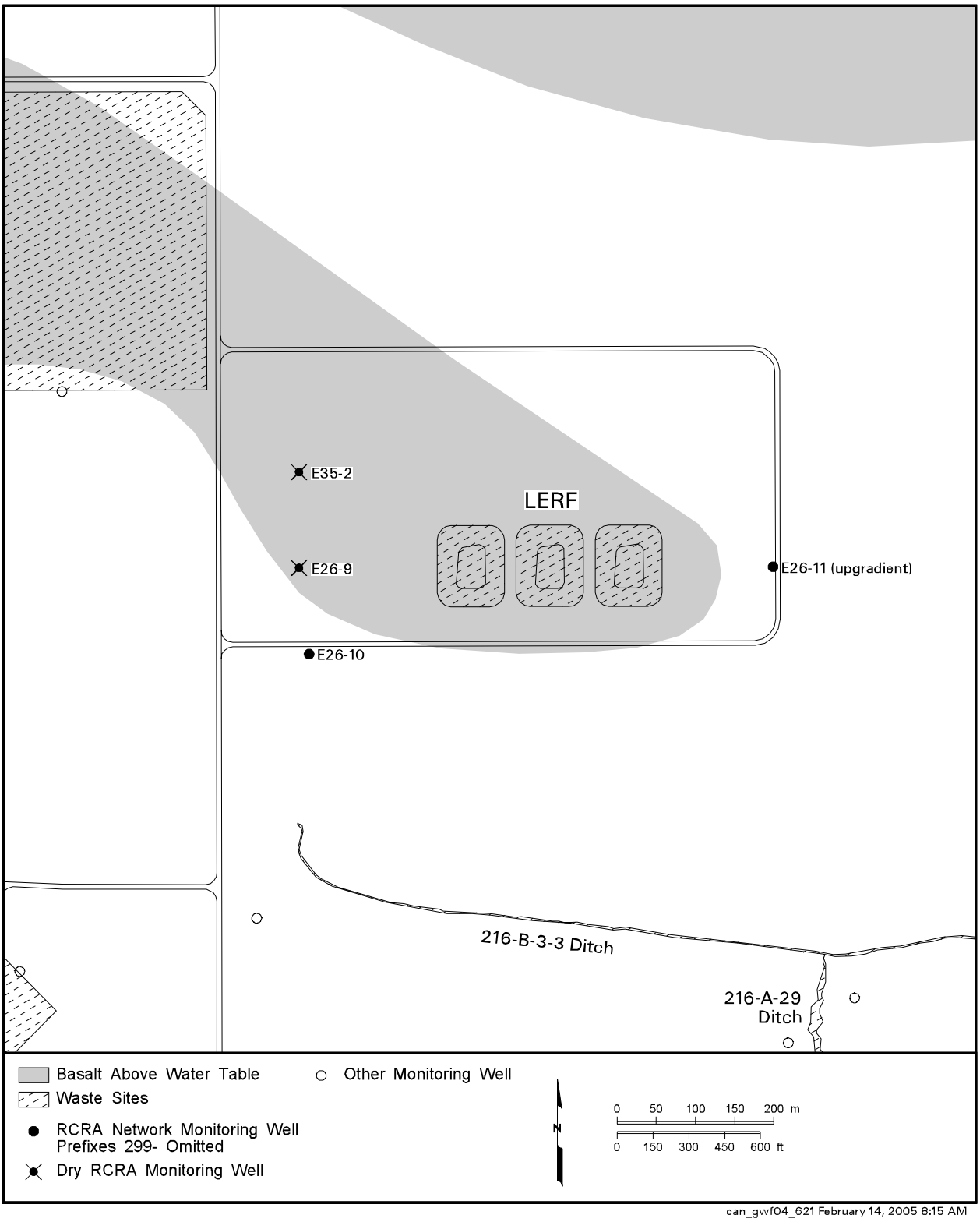

Figure B.11. Groundwater Monitoring Wells at the Liquid Effluent Retention Facility

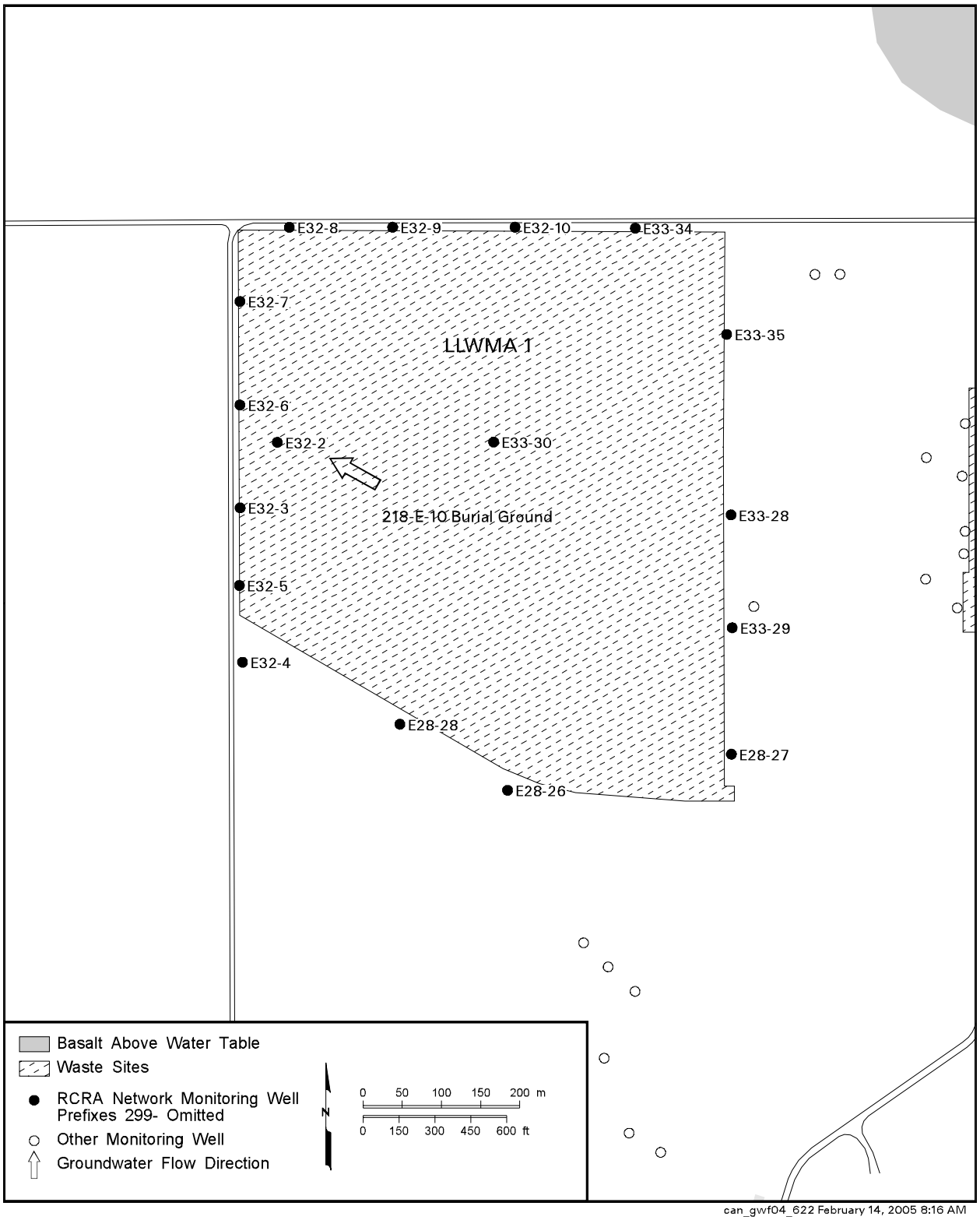

Figure B.12. Groundwater Monitoring Wells at Low-Level Waste Management Area 1

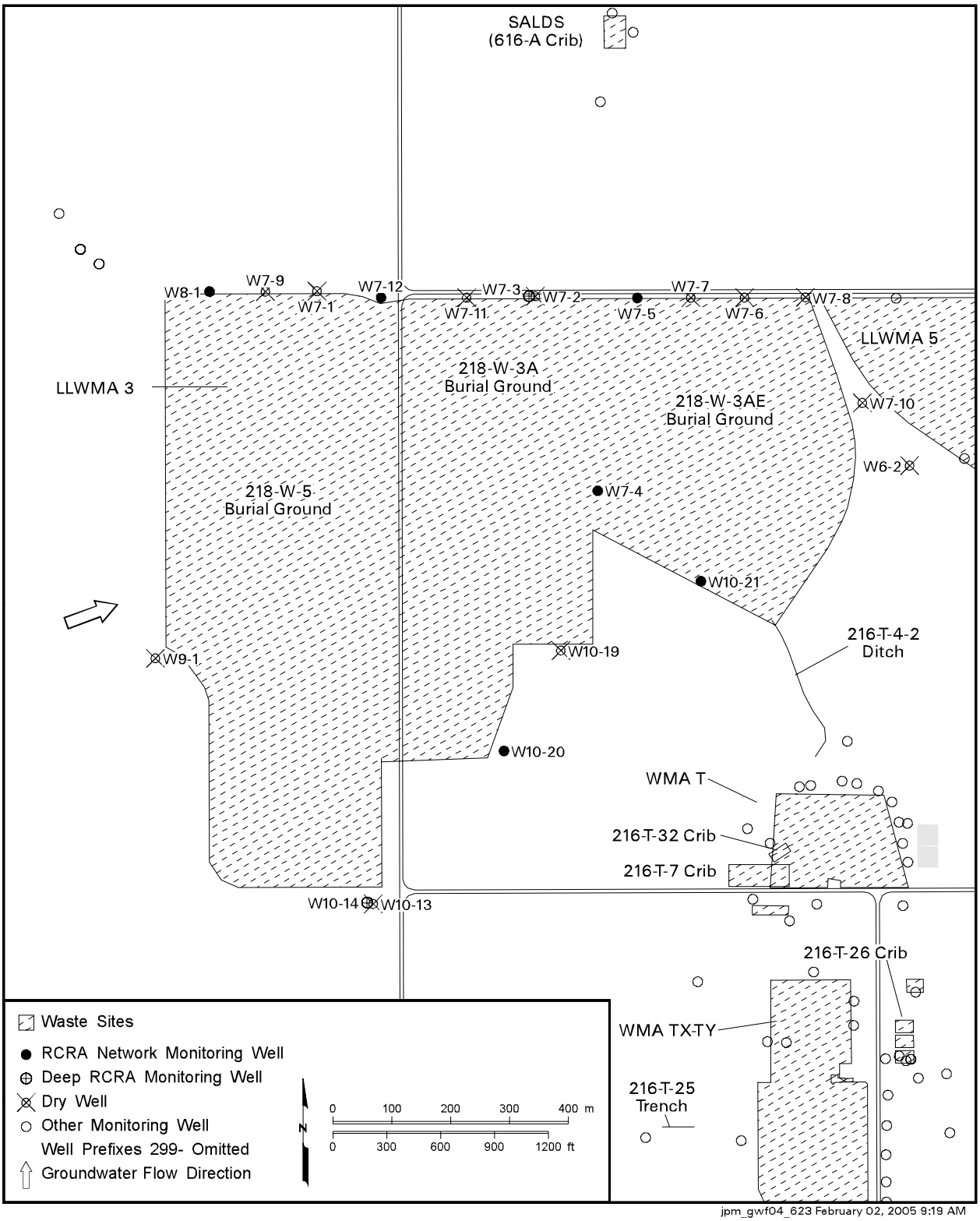

Figure B.13. Groundwater Monitoring Wells at Low-Level Waste Management Area 3

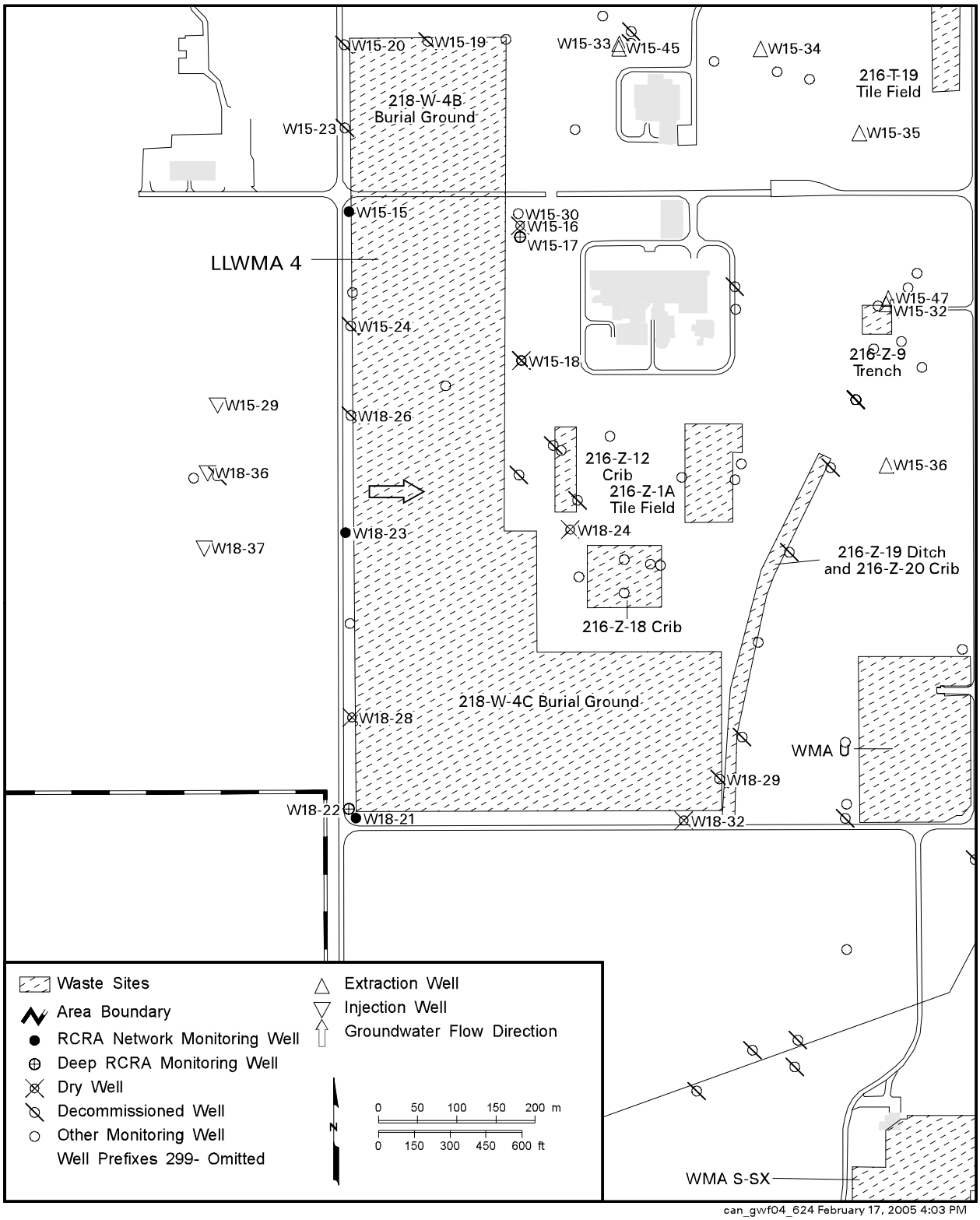

Figure B.14. Groundwater Monitoring Wells at Low-Level Waste Management Area 4

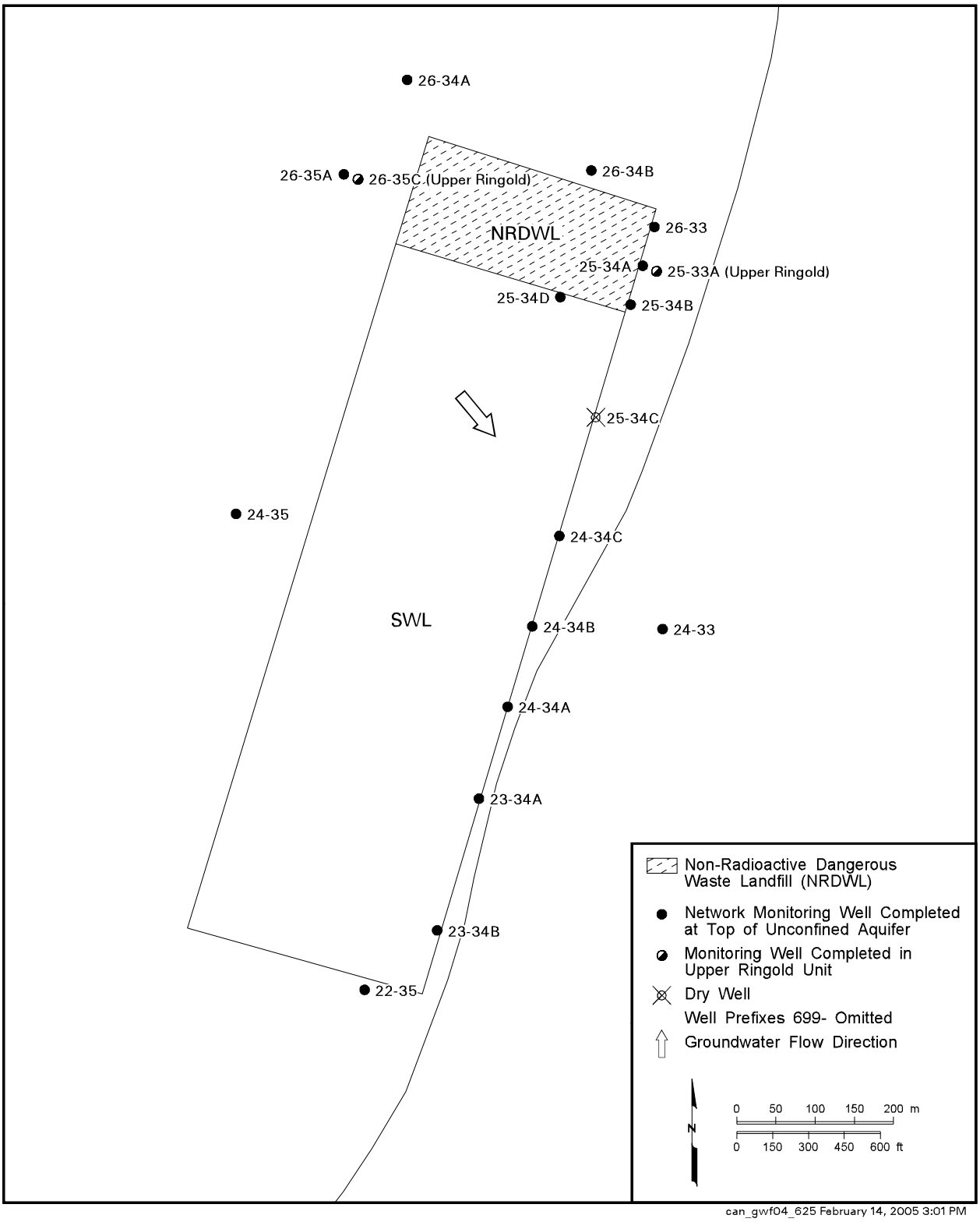

Figure B.15. Groundwater Monitoring Wells at the Nonradioactive Dangerous Waste Landfill

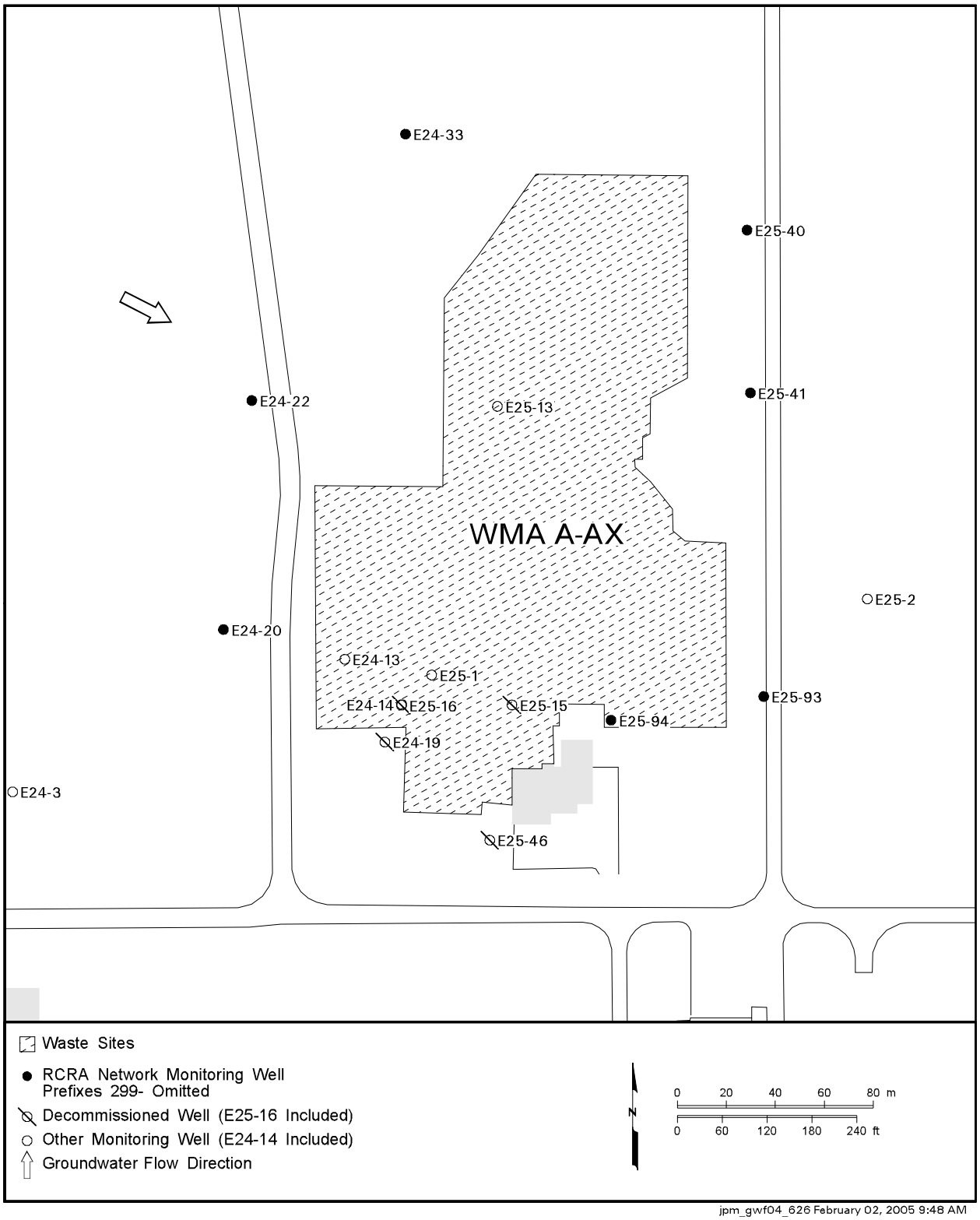

Figure B.16. Groundwater Monitoring Wells at Waste Management Area A-AX

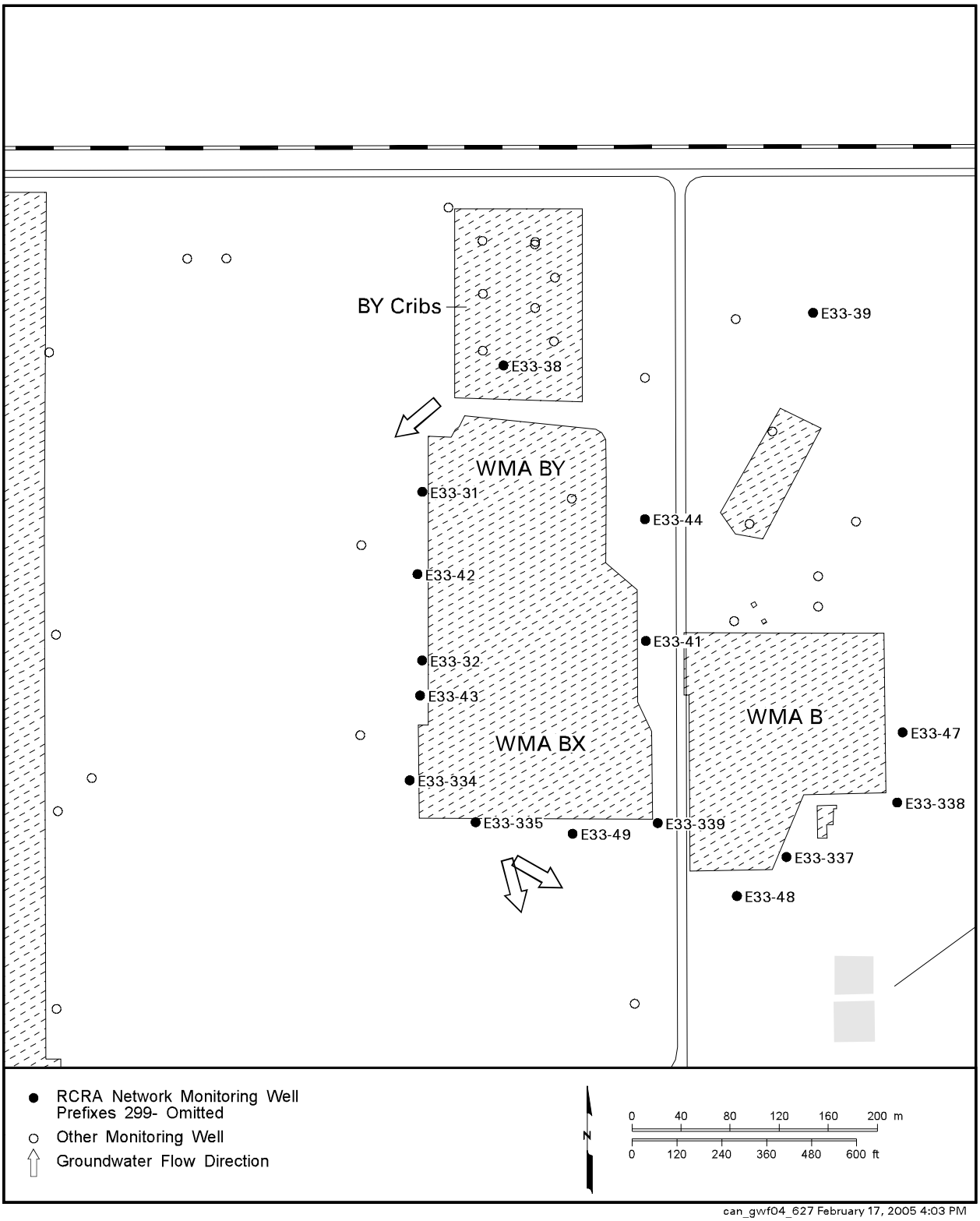

Figure B.17. Groundwater Monitoring Wells at Waste Management Area B-BX-BY

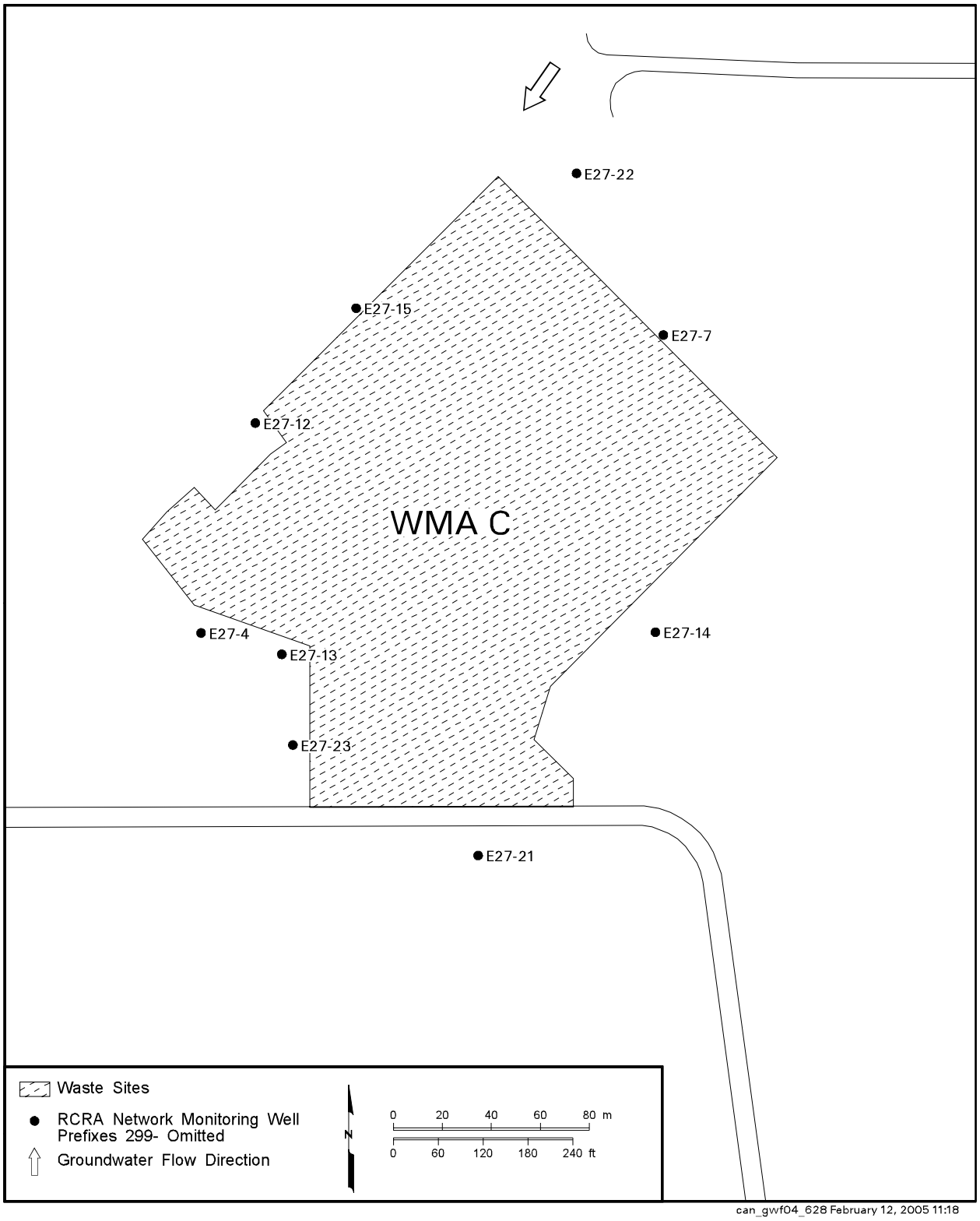

Figure B.18. Groundwater Monitoring Wells at Waste Management Area C

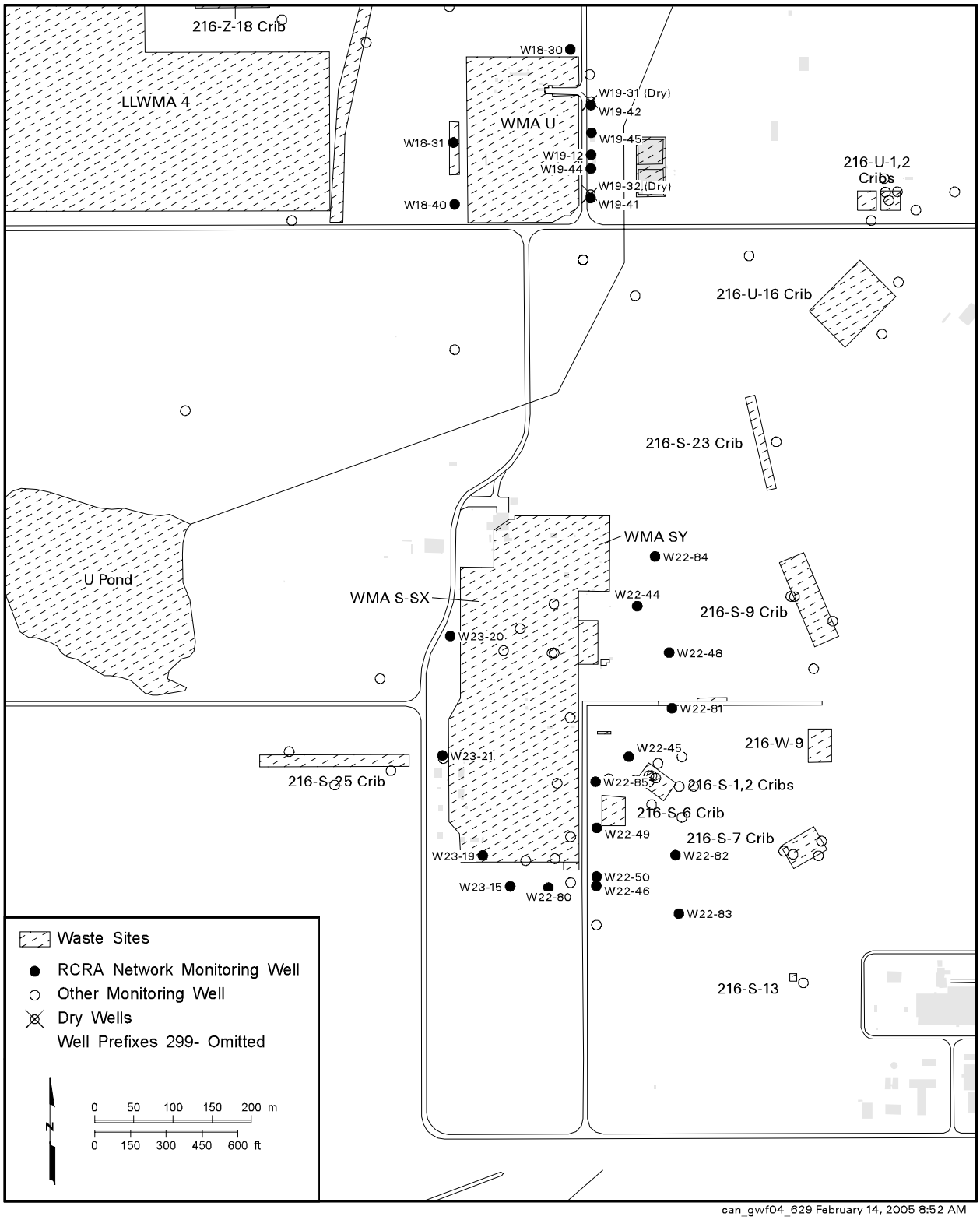

Figure B.19. Groundwater Monitoring Wells at Waste Management Areas S-SX and U

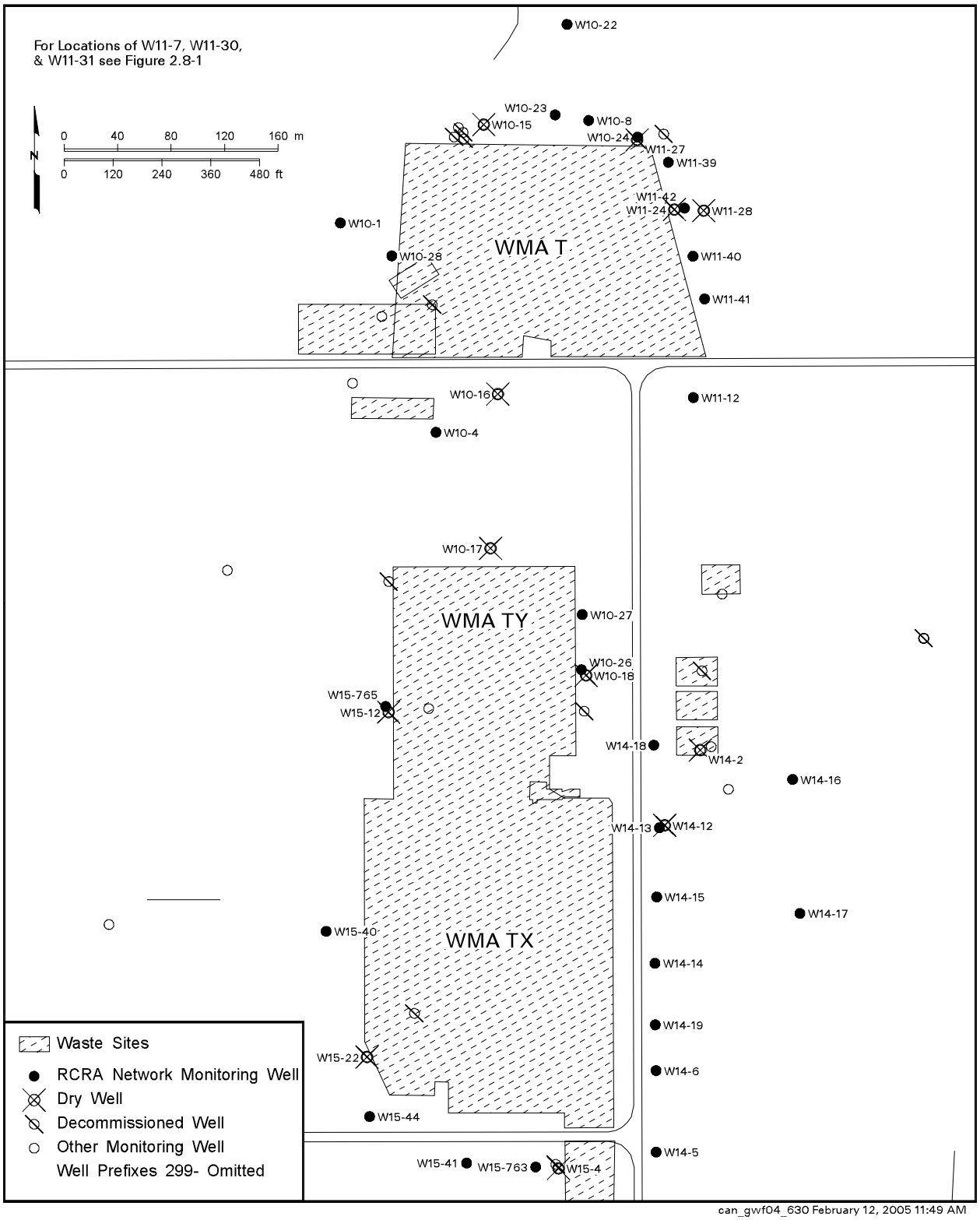

Figure B.20. Groundwater Monitoring Wells at Waste Management Areas T and TX-TY

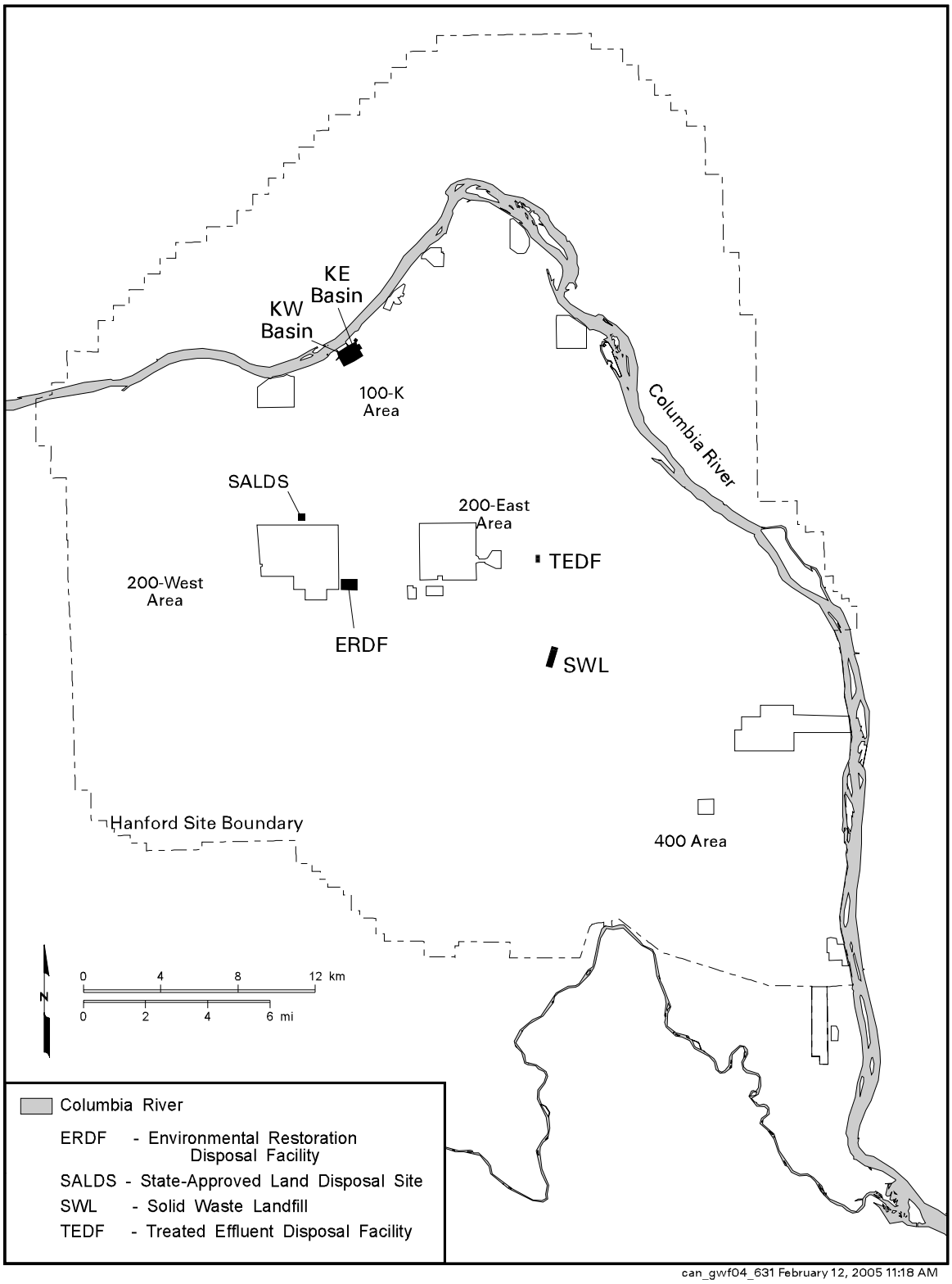

Figure B.21. Regulated Units (other than RCRA units) on the Hanford Site Requiring Groundwater Monitoring

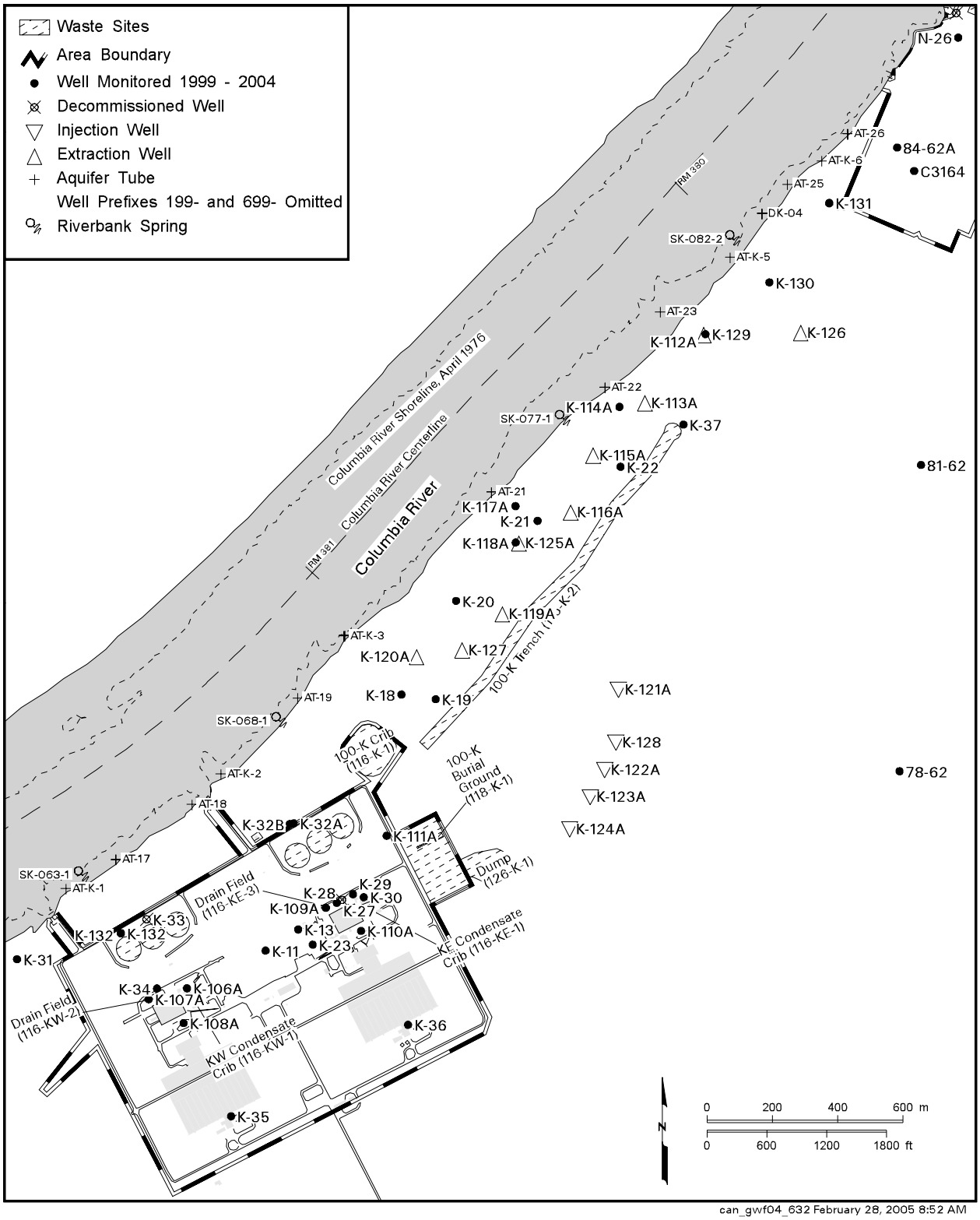

Figure B.22. Groundwater Monitoring Wells at 100-K Basins

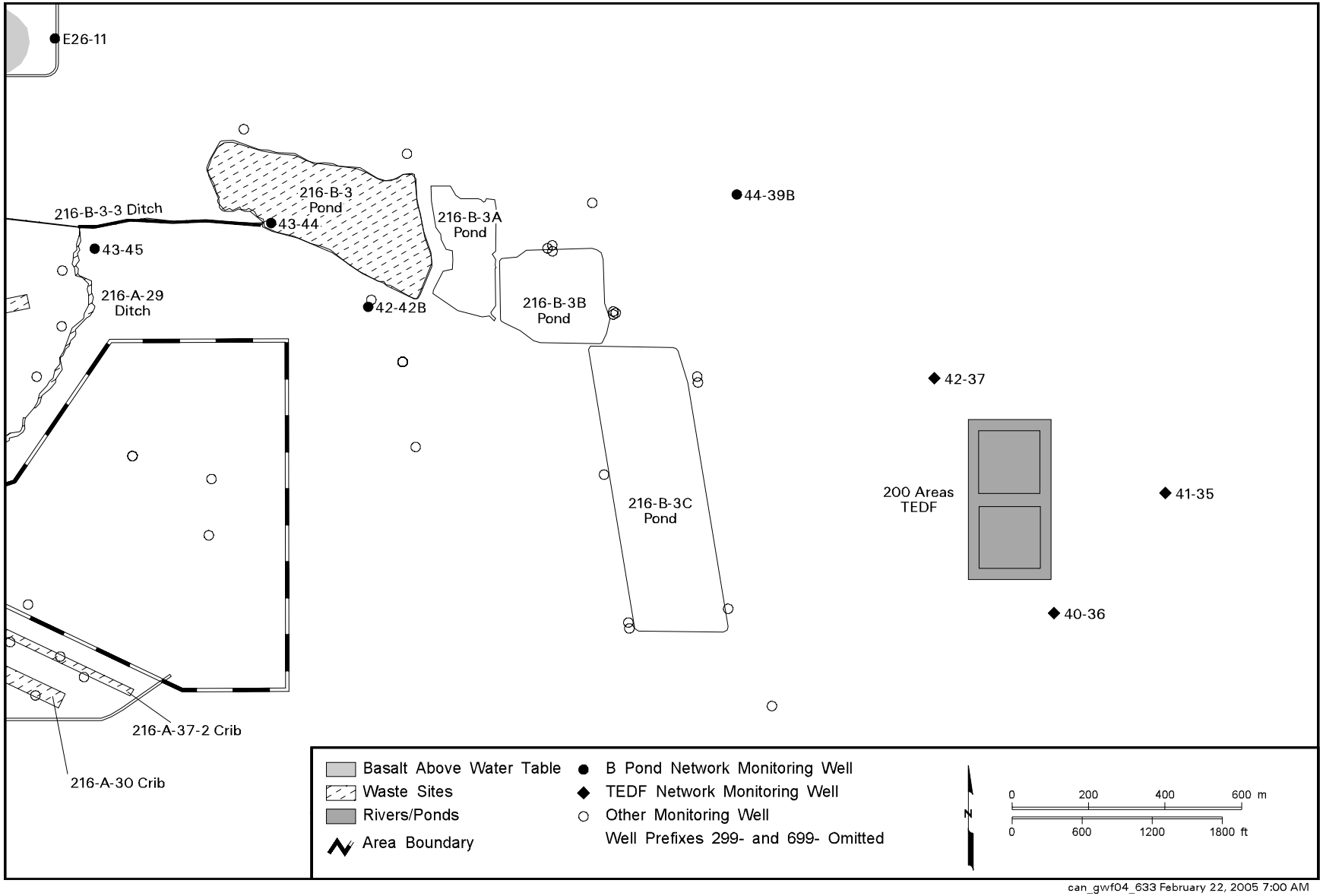

Figure B.23. Groundwater Monitoring Wells at the 200 Area Treated Effluent Disposal Facility

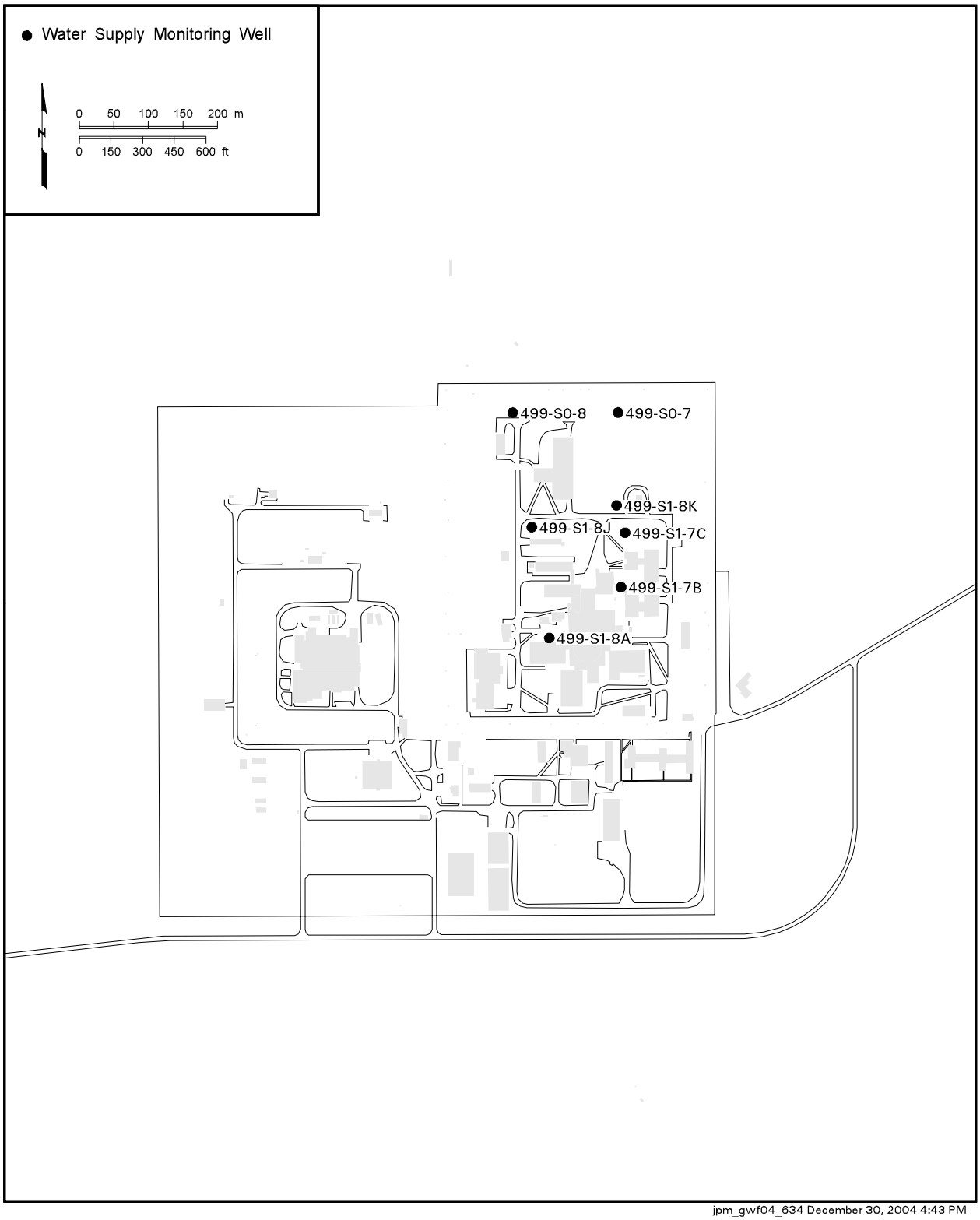

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Figure B.24. Water-Supply Monitoring Wells in the 400 Area

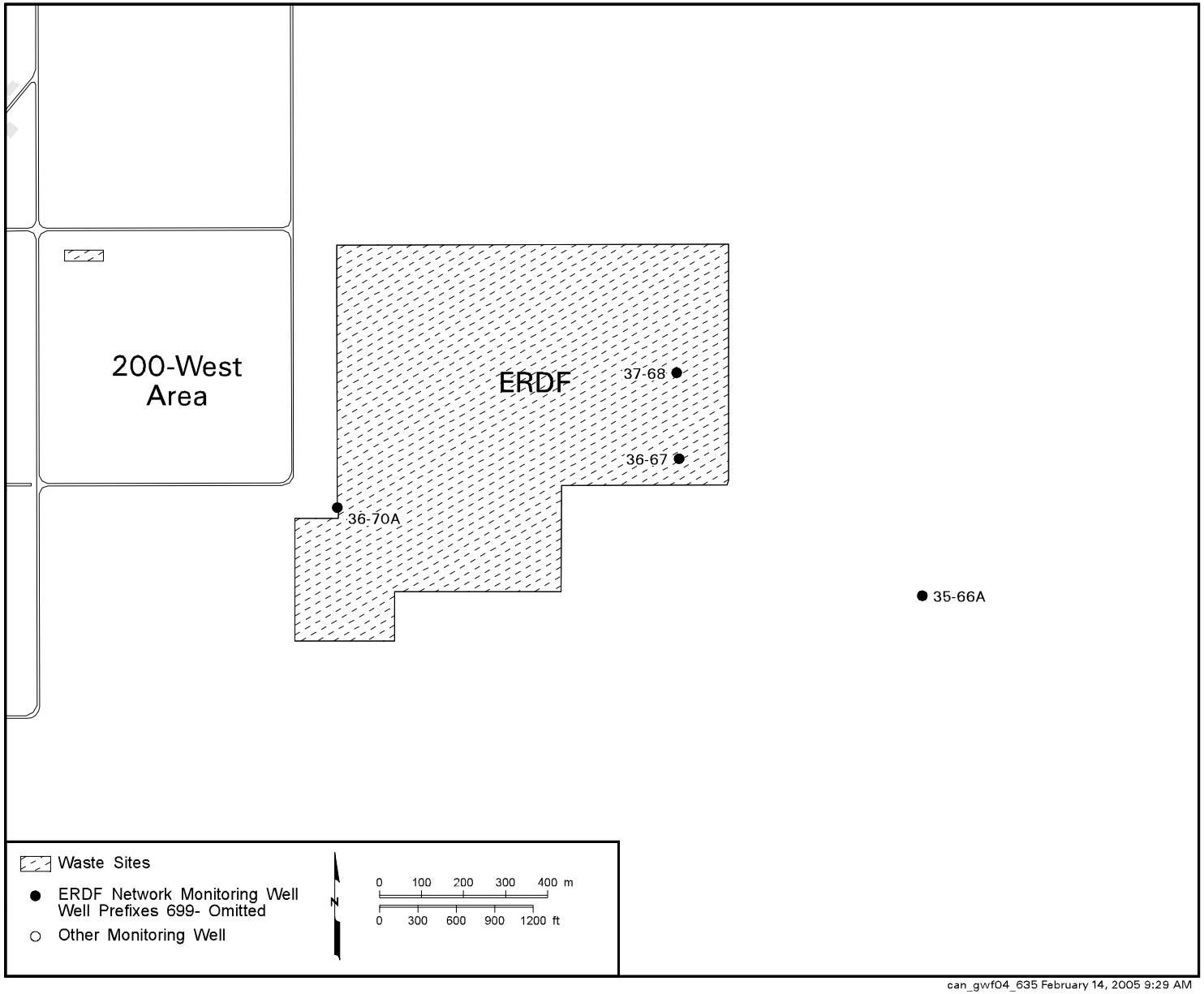

Figure B.25. Groundwater Monitoring Wells at the Environmental Restoration Disposal Facility

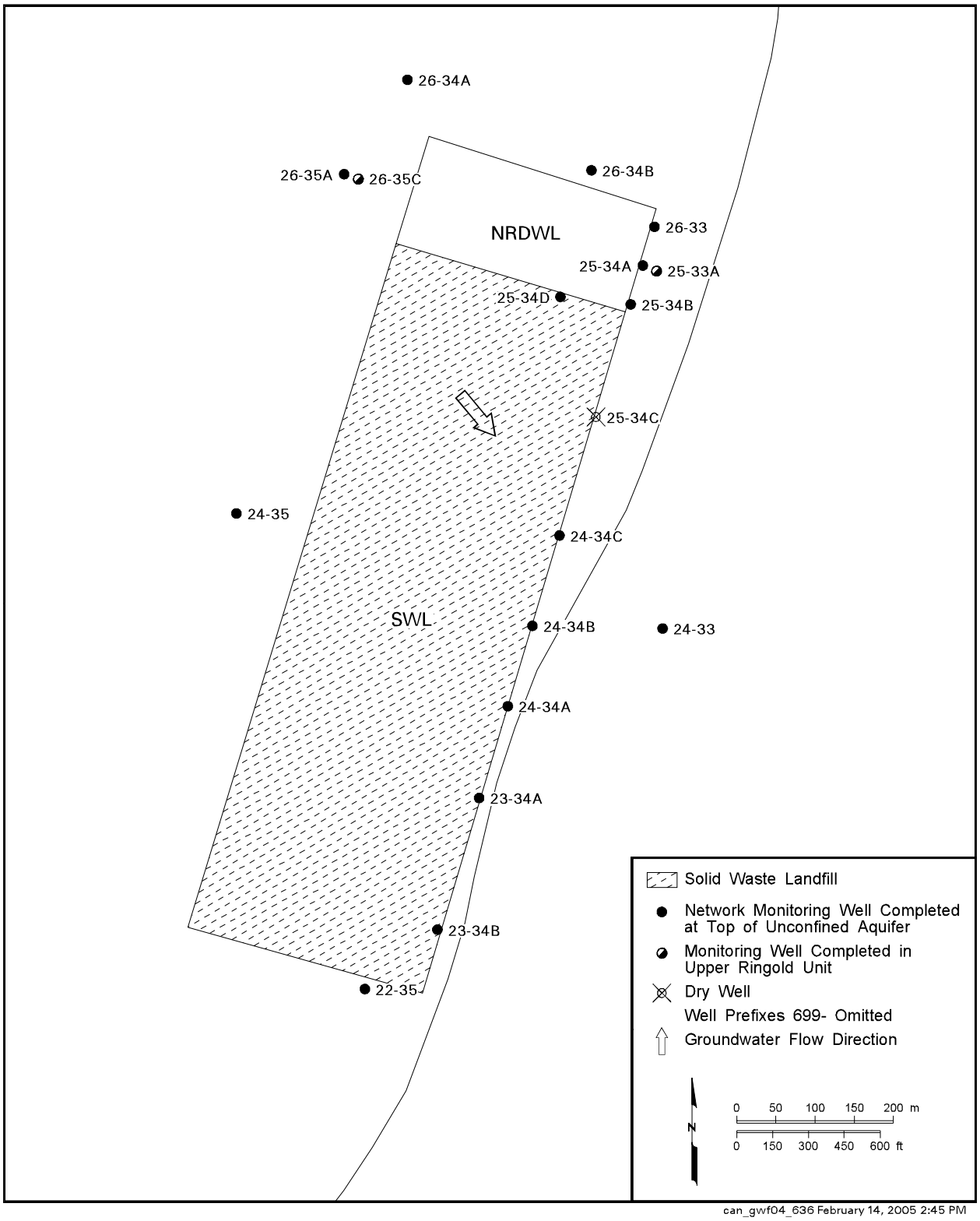

Figure B.26. Groundwater Monitoring Wells at the Solid Waste Landfill

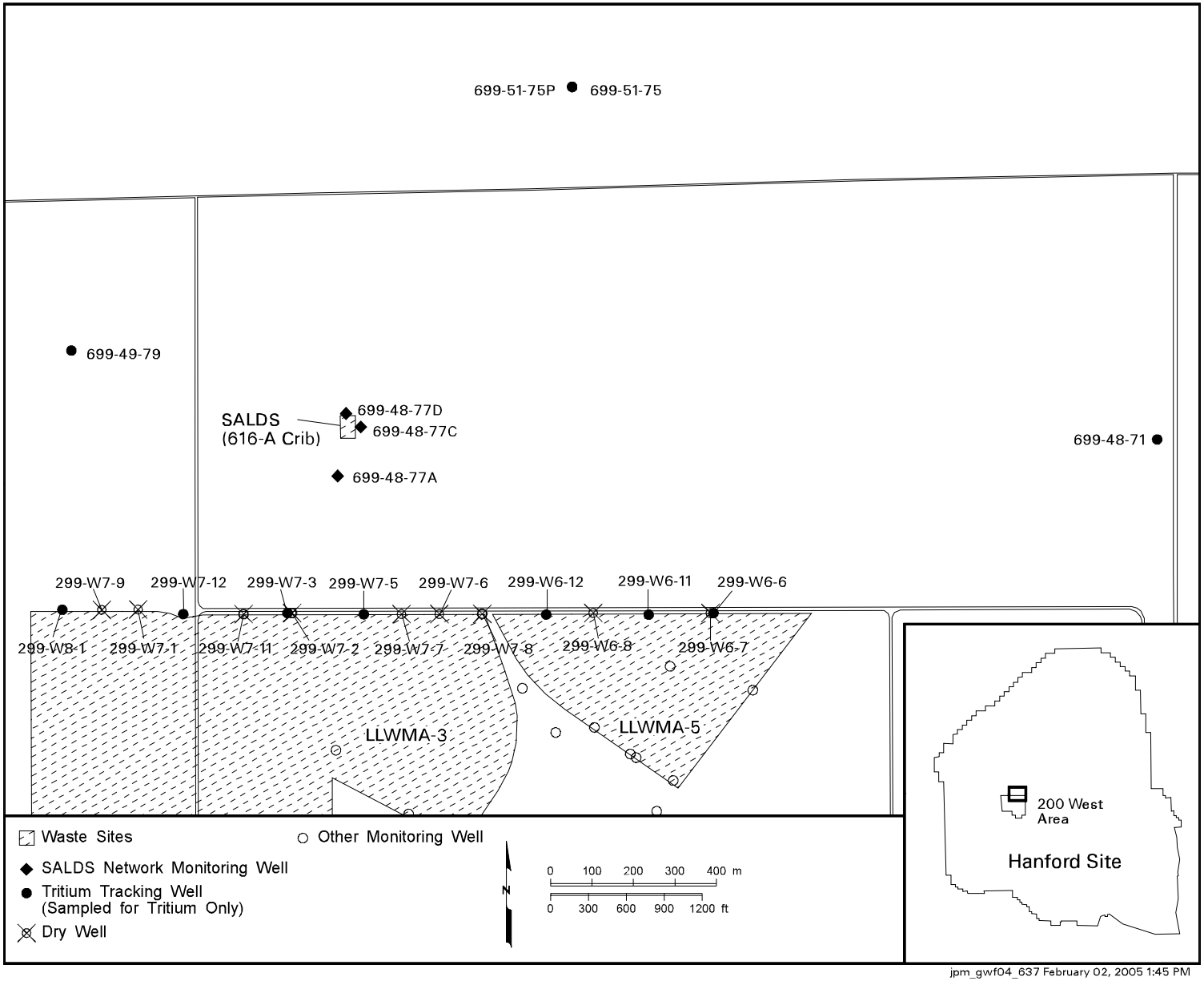

Figure B.27. Groundwater Monitoring Wells at the State-Approved Land Disposal Site