TABLE 9-20

Summary of Groundwater Quality: Well Concentration Ranges for the H-Area Seepage Basins Water-Table Wells (7/84-12/86)

Constituent	SC and Federal DWS	HSB 65	HSB 65C	HSB 66	HSB 67
pH (pH)	6.5-8.5	4.0-5.5	4.7-6.2	4.3-5.5	3.1-4.3
Conductivity (µmhos/cm)	NA	32-59	46-72	18-46	120-215
Silver (mg/L)	0.05	<0.0020-0.0050	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.002	<0.001	<0.001
Barium (mg/L)	1.0	0.013-0.017	0.007-0.008	<0.004-0.005	0.038-0.044
Beryllium (mg/L)	NA	---	---	---	<0.005
Carbon tetrachloride (mg/L)	0.005	---	---	---	<0.005
Cadmium (mg/L)	0.010	<0.001-0.002	<0.002-0.006	<0.001-0.002	<0.001-0.003
Chloroform (mg/L)	0.100*	---	---	---	<0.005
Chloride (mg/L)	250	2.6-3.5	4.5-4.6	2.9-5.8	2.3-2.7
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	---	---	---	<0.025
Cyanide (mg/L)	0.2	---	---	<0.005	---
DOC (mg/L)	NA	<5.0	---	<5.0-6.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10	<0.10-0.22	<0.10-0.24
Iron (mg/L)	0.3	0.010-0.115	0.010-0.014	0.011-0.077	0.010-0.051
Mercury (mg/L)	0.002	<0.0002-0.0002	<0.0002	<0.0002-0.0002	0.0016-0.0051
Manganese (mg/L)	0.05	<0.002-0.008	0.022-0.027	0.004-0.011	0.101-0.214
Sodium (mg/L)	NA	2.19-4.03	5.72-7.74	2.04-2.50	11.90-30.90
Nickel (mg/L)	NA	---	---	---	<0.040
Nitrate (as N) (mg/L)	10	2.17-3.75	2.75-3.20	0.68-1.93	12.00-23.00
Lead (mg/L)	0.05	0.018-0.067	<0.005-0.026	<0.004-0.008	0.012-0.100
Phenols (mg/L)	NA	<0.002	<0.002-0.002	<0.002-0.003	<0.002
Selenium (mg/L)	0.01	<0.001	<0.002	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<3.0	<5.0	<5.0
Tetrachloroethylene (mg/L)	NA	---	---	---	<0.005
TDS (mg/L)	500	<5	---	22-30	130-132
TOC (mg/L)	NA	0.225-3.53	0.390-0.680	0.230-10.96	0.260-11.7
TOH (mg/L)	NA	<0.005-0.037	<0.005-0.018	<0.005-0.032	0.010-0.030
Trichloroethylene (mg/L)	0.005	---	---	---	<0.005
1,1,1-TCE (mg/L)	0.200	---	---	---	<0.005
Zinc (mg/L)	5	0.013-0.828	0.046-0.049	0.051-1.050	0.012-0.818
Gross alpha (pCi/L)	15	1.4	<2.0-3.0	1.1-3.0	13.3-106.0
Nonvol. beta (pCi/L)	NA	<2.0-4.0	<2.0-14.0	<2.0-12.1	745.6-956.0
Tritium (pCi/mL)	20	60-70	32-35	11-61	3,753-6,700
Total radium (pCi/L)	5	<1.0-4.0	<1.0	<1.0-1.8	11.6-17.0

TABLE 9-20 (cont.)

Constituent	SC and Federal DWS	HSB 68	HSB 69	HSB 70	HSB 71
pH (pH)	6.5-8.5	2.9-4.6	3.3-4.8	4.3-5.7	4.0-5.6
Conductivity (µmhos/cm)	NA	395-665	361-770	40-240	94-460
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.140	0.093-0.165	0.048-0.067	0.019-0.031
Beryllium (mg/L)	---	---	---	---	---
Carbon tetrachloride (mg/L)	0.005	<0.005	<0.005	---	<0.005
Cadmium (mg/L)	0.010	0.004-0.013	<0.002-0.004	<0.001	<0.001-0.002
Chloroform (mg/L)	0.100*	<0.005	<0.005	---	<0.005
Chloride (mg/L)	250	1.6-3.2	1.4-3.2	2.6-4.0	2.7-6.4
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	---	---	---	---
Cyanide (mg/L)	0.2	---	<0.005	---	---
DOC (mg/L)	NA	<5.0	2.5	<5.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.13-0.21	0.25-0.29	<0.10	<0.10
Iron (mg/L)	0.3	0.012-0.055	0.014-0.084	0.022-0.269	0.013-0.116
Mercury (mg/L)	0.002	0.0003-0.0019	<0.0002-0.0020	<0.0002-0.0004	<0.0002-0.0002
Manganese (mg/L)	0.05	1.600-3.580	0.950-1.480	0.014-0.024	0.022-0.050
Sodium (mg/L)	NA	20.21-74.60	18.54-72.90	1.10-28.00	1.57-57.00
Nickel (mg/L)	NA	---	---	---	---
Nitrate (as N) (mg/L)	10	38.70-69.00	41.40-62.00	<0.50-22.00	1.65-58.00
Lead (mg/L)	0.05	<0.005-0.118	<0.005-0.079	0.012-0.046	<0.005-0.051
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0-5.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.005	<0.005	---	<0.005
TDS (mg/L)	500	448-450	466-526	20	210
TOC (mg/L)	NA	0.300-15.0	0.720-7.00	0.350-32.7	0.247-8.40
TOH (mg/L)	NA	<0.005-0.034	<0.005-0.434	<0.005-0.041	<0.005-0.067
Trichloroethylene (mg/L)	0.005	<0.005	<0.005	---	<0.005
1,1,1-TCE (mg/L)	0.200	<0.005	<0.005	---	<0.005
Zinc (mg/L)	5	0.175-0.851	0.084-0.765	0.071-0.611	0.213-2.830
Gross alpha (pCi/L)	15	24.3-297.0	<2.0-483.0	1.6-8.9	1.3-55.1
Nonvol. beta (pCi/L)	NA	4,000-9,640	<3.0-9,206	17.0-39.7	8.0-117.0
Tritium (pCi/mL)	20	19,200-31,512	19,738-55,557	458-11,000	8,569-11,000
Total radium (pCi/L)	5	30.8-62.6	<1.0-35.8	<1.0	<1.0-8.0

TABLE 9-20 (cont.)

Constituent	SC and Federal DWS	HSB 83D	HSB 84D	HSB 85C	HSB 86C
pH (pH)	6.5-8.5	4.3-4.8	3.8-4.2	4.7-6.5	4.1-4.8
Conductivity (µmhos/cm)	NA	431-870	86-205	20-40	440-600
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.059-0.061	0.022-0.034	<0.004-0.004	0.016-0.023
Beryllium (mg/L)	NA	---	---	---	---
Carbon tetrachloride (mg/L)	0.005	---	---	---	---
Cadmium (mg/L)	0.010	<0.001-0.001	<0.001-0.002	<0.001	<0.002-0.005
Chloroform (mg/L)	0.100*	---	---	---	---
Chloride (mg/L)	250	4.6-5.1	2.9-4.5	2.3-2.9	1.7-3.2
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	---	---	---	---
Cyanide (mg/L)	0.2	---	---	---	---
DOC (mg/L)	NA	---	---	---	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.12	0.14-0.30	<0.10	0.15-0.33
Iron (mg/L)	0.3	0.010-0.011	0.004-0.008	0.008-0.030	0.012-0.026
Mercury (mg/L)	0.002	<0.0002-0.0020	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.133-0.599	0.082-0.251	0.005-0.006	0.616-1.130
Sodium (mg/L)	NA	83.30-137.79	5.78-23.00	1.90-2.96	23.34-106.46
Nickel (mg/L)	NA	---	---	---	---
Nitrate (as N) (mg/L)	10	49.40-97.20	11.80-19.00	<0.50-1.21	44.80-71.20
Lead (mg/L)	0.05	0.006-0.048	<0.005-0.030	<0.005-0.023	<0.005-0.030
Phenols (mg/L)	NA	<0.002	<0.002	<0.002-0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<3.0	<3.0	<5.0-5.0	<5.0-9.0
Tetrachloroethylene (mg/L)	NA	---	---	---	---
TDS (mg/L)	500	---	---	---	---
TOC (mg/L)	NA	0.870-14.600	0.230-5.000	0.340-2.270	0.300-6.000
TOH (mg/L)	NA	<0.005-0.014	<0.005-0.006	<0.005-0.008	<0.005-0.009
Trichloroethylene (mg/L)	0.005	---	---	---	---
1,1,1-TCE (mg/L)	0.200	---	---	---	---
Zinc (mg/L)	5	0.028-0.067	0.039-0.047	0.002-0.021	0.024-0.036
Gross alpha (pCi/L)	15	1.0-33.4	8.5-136.0	1.1-2.7	0.8-31.1
Nonvol. beta (pCi/L)	NA	35.1-117.0	518-2,100.5	<2.0-12.6	60.7-88.3
Tritium (pCi/mL)	20	7,690-15,131	6,410-76,400	1-3	30,614-39,002
Total radium (pCi/L)	5	7.1-12.9	10.7-16.0	<1.0-3.0	3.3-3.9

TABLE 9-20 (cont.)

Constituent	SC and Federal DWS	HSB 86D
pH (pH)	6.5-8.5	3.0-4.0
Conductivity (µmhos/cm)	NA	335-450
Silver (mg/L)	0.05	<0.0020
Arsenic (mg/L)	0.05	<0.002
Barium (mg/L)	1.0	0.047-0.067
Beryllium (mg/L)	NA	---
Carbon tetrachloride (mg/L)	0.005	---
Cadmium (mg/L)	0.010	<0.001-0.004
Chloroform (mg/L)	0.100*	---
Chloride (mg/L)	250	2.9-3.4
Chromium (mg/L)	0.05	<0.004
Copper (mg/L)	1	---
Cyanide (mg/L)	0.2	---
DOC (mg/L)	NA	---
Endrin (mg/L)	0.0002	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.17
Iron (mg/L)	0.3	0.020-0.036
Mercury (mg/L)	0.002	<0.0002
Manganese (mg/L)	0.05	0.262-1.230
Sodium (mg/L)	NA	16.43-110.00
Nickel (mg/L)	NA	---
Nitrate (as N) (mg/L)	10	36.00-82.40
Lead (mg/L)	0.05	<0.005-0.059
Phenols (mg/L)	NA	<0.002
Selenium (mg/L)	0.01	<0.002
Sulfate (mg/L)	250	3.0
Tetrachloroethylene (mg/L)	NA	---
TDS (mg/L)	500	---
TOC (mg/L)	NA	0.350-5.400
TOH (mg/L)	NA	<0.005-0.016
Trichloroethylene (mg/L)	0.005	---
1,1,1-TCE (mg/L)	0.200	---
Zinc (mg/L)	5	0.063-0.068
Gross alpha (pCi/L)	15	17.3-775.0
Nonvol. beta (pCi/L)	NA	1,670.2-5,820.6
Tritium (pCi/mL)	20	19,100-31,201
Total radium (pCi/L)	5	31.4-41.4

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes

TABLE 9-21

Summary of Groundwater Quality: Well Concentration Ranges for the H-Area Seepage Basins Lower Water-Table Wells (7/84-12/86)

Constituent	SC and Federal DWS	HSB 68C	HSB 83C	HSB 84C
pH (pH)	6.5-8.5	4.6-5.8	4.2-5.6	9.3-10.4
Conductivity (µmhos/cm)	NA	110-160	23-32	113-180
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.021-0.028	<0.002	0.015-0.026
Carbon tetrachloride (mg/L)	0.005	---	---	<0.005
Cadmium (mg/L)	0.010	0.003-0.008	<0.001	<0.001
Chloroform (mg/L)	0.100*	---	---	<0.005
Chloride (mg/L)	250	4.9-6.9	3.4-4.0	4.2-4.6
Chromium (mg/L)	0.05	<0.004	<0.004-0.004	<0.004
Copper (mg/L)	1	---	---	---
Cyanide (mg/L)	0.2	---	---	---
DOC (mg/L)	NA	---	---	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.11	<0.10	<0.10
Iron (mg/L)	0.3	0.051-0.067	0.015-0.025	0.008-0.009
Mercury (mg/L)	0.002	<0.0002	<0.0002-0.002	<0.0002
Manganese (mg/L)	0.05	0.055-0.071	0.008-0.014	<0.002
Sodium (mg/L)	NA	12.66-17.00	1.44-2.62	6.71-12.00
Nitrate (as N) (mg/L)	10	9.75-12.99	0.11	0.65-1.02
Lead (mg/L)	0.05	<0.005-0.018	<0.005-0.008	<0.005
Phenols (mg/L)	NA	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<5.0-8.0	<3.0	<3.0
Tetrachloroethylene (mg/L)	NA	---	---	<0.005
TOC (mg/L)	NA	0.580-10.600	0.620-3.300	0.530-1.680
TOH (mg/L)	NA	<0.005-0.011	<0.005-0.009	<0.005-0.174
Trichloroethylene (mg/L)	0.005	---	---	<0.005
1,1,1-TCE (mg/L)	0.200	---	---	<0.005
Zinc (mg/L)	5	0.197-0.371	0.014-0.050	<0.002-0.024
Gross alpha (pCi/L)	15	1.0-6.6	1.8	0.1-1.8
Nonvol. beta (pCi/L)	NA	13.0-21.0	<2.0-13.0	7.0-13.0
Tritium (pCi/mL)	20	1,516-2,620	2-3	285-298
Total radium (pCi/L)	5	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 9-22

Summary of Groundwater Quality: Well Concentration Ranges for the H-Area Seepage Basins McBean Wells (7/84-12/86)

Constituent	SC and Federal DWS	HSB 65B	HSB 68B	HSB 83B	HSB 84B
pH (pH)	6.5-8.5	6.2-8.7	6.8-9.4	6.1-6.7	9.0-10.7
Conductivity (µmhos/cm)	NA	150-220	120-220	110-150	150-690
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.014-0.016	0.036	0.047-0.048	0.042-0.051
Cadmium (mg/L)	0.010	<0.001	<0.001	0.001	<0.001
Chloride (mg/L)	250	2.8-4.0	3.4-5.5	3.4	3.4
Chromium (mg/L)	0.05	<0.004-0.004	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10	0.14-0.16	0.10-0.20
Iron (mg/L)	0.3	0.011-0.021	<0.004-0.014	0.014-0.027	<0.004-0.006
Mercury (mg/L)	0.002	<0.0002-0.0003	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002	<0.002-0.004	0.011-0.042	<0.002
Sodium (mg/L)	NA	1.47-6.14	2.72-13.00	3.09-6.35	9.47-18.80
Nitrate (as N) (mg/L)	10	<0.05	0.25	0.12	0.95-2.60
Lead (mg/L)	0.05	<0.005	<0.005	<0.005-0.026	<0.005
Phenols (mg/L)	NA	<0.002-0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<3.0	5.0-8.0	6.0-8.0	<3.0
TOC (mg/L)	NA	0.380-5.700	0.560-1.300	0.700-1.600	0.640-0.960
TOH (mg/L)	NA	<0.005-0.030	<0.005-0.007	<0.005-0.008	<0.005
Zinc (mg/L)	5	<0.002-0.008	<0.002-0.005	0.002-0.010	<0.002-0.008
Gross alpha (pCi/L)	15	1.6	0.3-9.4	0.8	0.7-3.6
Nonvol. beta (pCi/L)	NA	<2.0-3.3	12.8-29.0	1.4-5.4	11.8-15.0
Tritium (pCi/mL)	20	0.4-1	41-78	30-51	664-1,033
Total radium (pCi/L)	5	<1.0	<1.0-4.0	<1.0-2.0	<1.0

TABLE 9-22 (cont.)

Constituent	SC and Federal DWS	HSB 85B	HSB 86B
pH (pH)	6.5-8.5	7.3-10.2	6.5-7.3
Conductivity (µmhos/cm)	NA	163-248	175-240
Silver (mg/L)	0.05	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002
Barium (mg/L)	1.0	0.036-0.065	0.033-0.036
Cadmium (mg/L)	0.010	<0.001	<0.001
Chloride (mg/L)	250	2.9-3.4	4.0
Chromium (mg/L)	0.05	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.12-0.22	<0.10-0.16
Iron (mg/L)	0.3	<0.004-0.005	0.010-0.467
Mercury (mg/L)	0.002	<0.0002-0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002	0.004-0.010
Sodium (mg/L)	NA	3.70-14.48	1.99-6.21
Nitrate (as N) (mg/L)	10	0.06	<0.05
Lead (mg/L)	0.05	<0.005	≤0.005-0.016
Phenols (mg/L)	NA	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002
Sulfate (mg/L)	250	11.0-14.0	6.0-10.0
TOC (mg/L)	NA	0.500-2.700	0.570-2.400
TOH (mg/L)	NA	<0.005-0.007	<0.005-0.007
Zinc (mg/L)	5	<0.002-0.009	0.003-0.010
Gross alpha (pCi/L)	15	0.7	0.1-4.1
Nonvol. beta (pCi/L)	NA	2.6-6.2	1.5-11.7
Tritium (pCi/mL)	20	0.3-27	5-42
Total radium (pCi/L)	5	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 9-23

Summary of Groundwater Quality: Well Concentration Ranges for the H-Area Seepage Basins Congaree Wells (7/84-12/86)

Constituent	SC and Federal DWS	HSB 65A	HSB 68A	HSB 83A	HSB 84A
pH (pH)	6.5-8.5	6.7-7.6	7.2-9.5	6.0-6.7	4.2-5.5
Conductivity (µmhos/cm)	NA	160-225	138-205	60-225	320-460
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.038-0.041	0.034-0.036	0.028-0.031	0.058-0.077
Beryllium (mg/L)	NA	---	---	---	<0.005
Carbon tetrachloride (mg/L)	0.005	---	---	---	<0.005
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001	<0.001
Chloroform (mg/L)	0.100*	---	---	---	<0.005
Chloride (mg/L)	250	2.3-4.0	3.4-6.6	3.4-4.0	2.9-2.9
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	---	---	---	<0.025
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10-0.11	<0.10	<0.10-0.22
Iron (mg/L)	0.3	<0.004-0.012	<0.004-0.008	0.006-0.018	0.016-0.031
Mercury (mg/L)	0.002	<0.0002-0.0003	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002-0.002	<0.002-0.019	<0.002	0.273-0.561
Sodium (mg/L)	NA	2.10-2.96	2.69-8.10	1.72-2.17	22.63-68.90
Nickel (mg/L)	NA	---	---	---	<0.040
Nitrate (as N) (mg/L)	10	<0.05	0.15-0.65	<0.05	37.20-54.00
Lead (mg/L)	0.05	<0.005	<0.005	<0.005	<0.005-0.019
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	8.0	5.0	7.0-9.0	3.0
Tetrachloroethylene (mg/L)	NA	---	---	---	<0.005
TOC (mg/L)	NA	0.340-2.010	0.390-0.660	0.510-0.520	0.270-9.100
TOH (mg/L)	NA	<0.005-0.006	<0.005	<0.005	<0.005
Trichloroethylene (mg/L)	0.005	---	---	---	<0.005
1,1,1-TCE (mg/L)	0.200	---	---	---	<0.005
Zinc (mg/L)	5	0.003-0.005	<0.002-0.021	<0.002-0.006	0.029-0.038
Gross alpha (pCi/L)	15	<2.0-3.9	0.5-4.7	0.8	4.5-576.0
Nonvol. beta (pCi/L)	NA	2.3-10.8	16.0-32.0	1.2-4.3	1,927.4-6,474.9
Tritium (pCi/mL)	20	0.2-1	96-130	0.2-1	16,500-46,545
Total radium (pCi/L)	5	<1.0-1.4	<1.0-2.0	<1.0	30.3-45.6

TABLE 9-23 (cont.)

Constituent	SC and Federal DWS	HSB 85A	HSB 86A
pH (pH)	6.5-8.5	6.0-6.9	5.8-6.5
Conductivity (μmhos/cm)	NA	150-280	110-130
Silver (mg/L)	0.05	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002
Barium (mg/L)	1.0	0.036-0.037	0.020-0.023
Beryllium (mg/L)	NA	---	---
Carbon tetrachloride (mg/L)	0.005	---	---
Cadmium (mg/L)	0.010	<0.001	<0.001
Chloroform (mg/L)	0.100*	---	---
Chloride (mg/L)	250	3.4	2.9-3.5
Chromium (mg/L)	0.05	<0.004	<0.004
Copper (mg/L)	1	---	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.10	0.11-0.24
Iron (mg/L)	0.3	<0.004-0.019	0.009
Mercury (mg/L)	0.002	<0.0002-0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002-0.004	<0.002-0.003
Sodium (mg/L)	NA	1.92-19.90	1.64-2.21
Nickel (mg/L)	NA	---	---
Nitrate (as N) (mg/L)	10	<0.05	<0.05
Lead (mg/L)	0.05	<0.005	<0.005
Phenols (mg/L)	NA	<0.002	<0.002-0.008
Selenium (mg/L)	0.01	<0.002	<0.002
Sulfate (mg/L)	250	8.0-13.0	10.0-18.0
Tetrachloroethylene (mg/L)	NA	---	---
TOC (mg/L)	NA	0.370-4.100	0.420-0.920
TOH (mg/L)	NA	<0.005	<0.005-0.006
Trichloroethylene (mg/L)	0.005	---	---
1,1,1-TCE (mg/L)	0.200	---	---
Zinc (mg/L)	5	<0.002-0.006	0.004-0.009
Gross alpha (pCi/L)	15	1.0	0.5-3.0
Nonvol. beta (pCi/L)	NA	2.1-7.2	2.3-6.2
Tritium (pCi/mL)	20	0.3-1	1-9
Total radium (pCi/L)	5	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

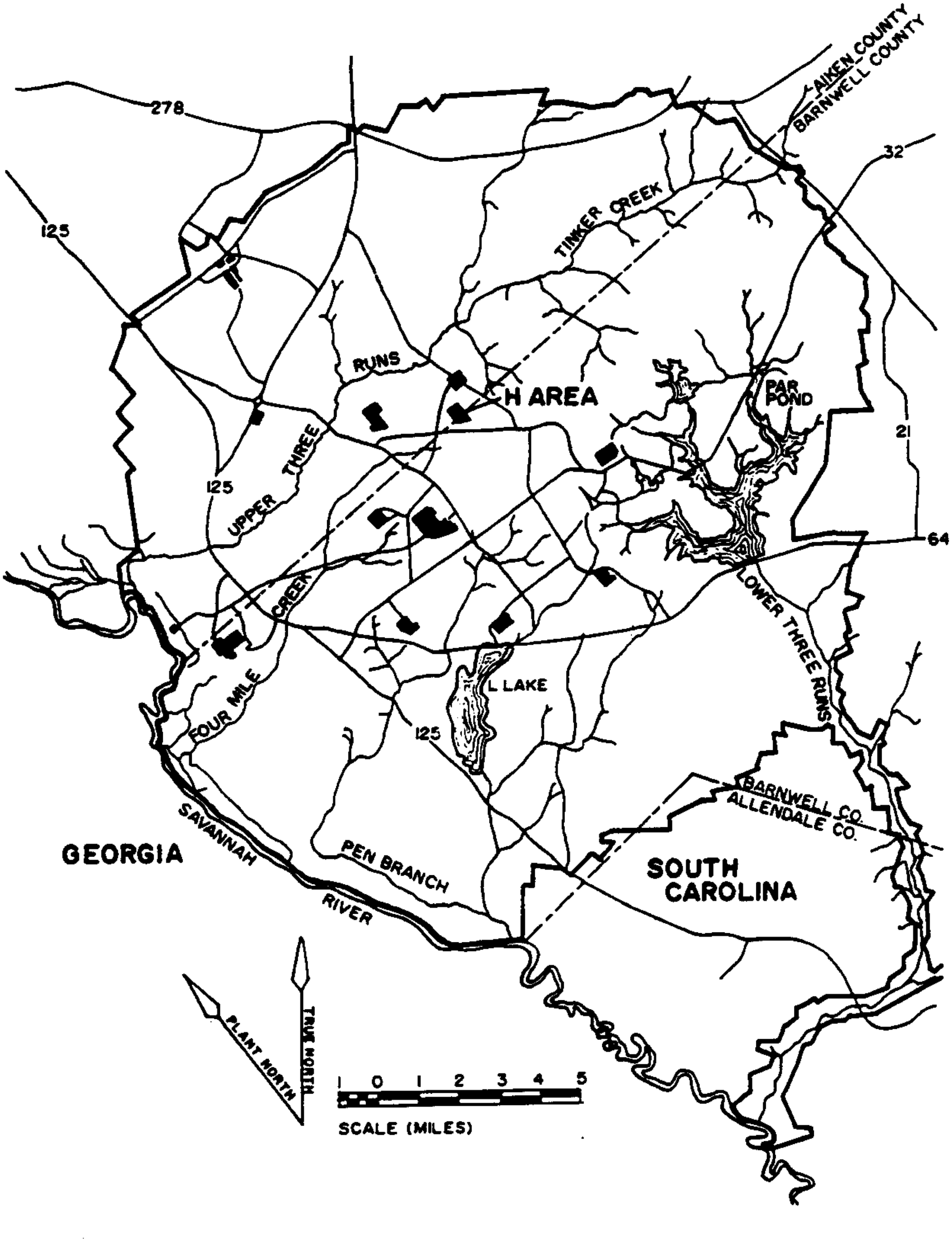
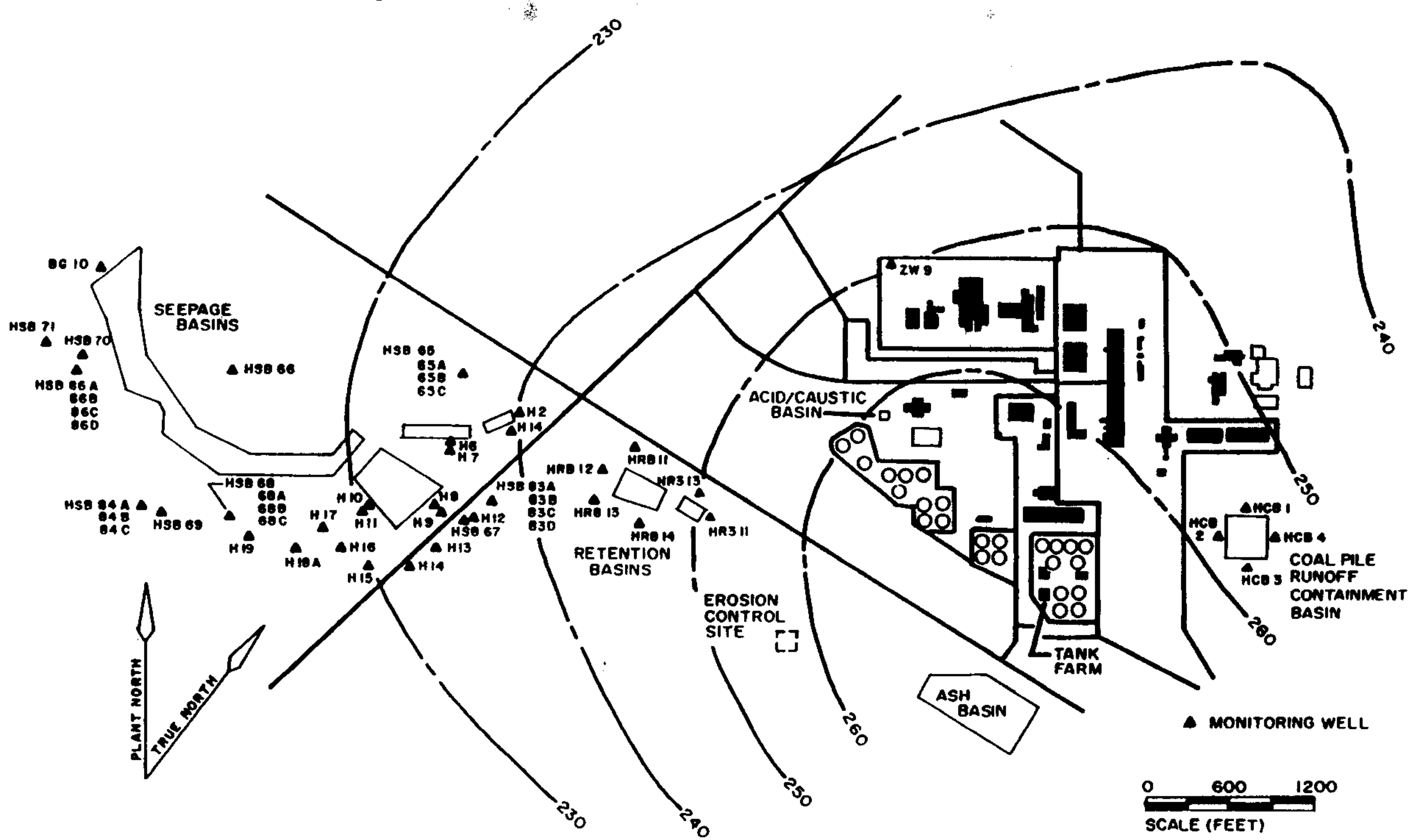


FIGURE 9-1. Location of H Area at SRS



NOTE: WATER ELEVATIONS ARE IN FEET MSL AND ARE AVERAGED VALUES FOR EACH WASTE SITE. DATA ARE FROM 5/86.

FIGURE 9-2. H-Area Water-Table Elevation Map

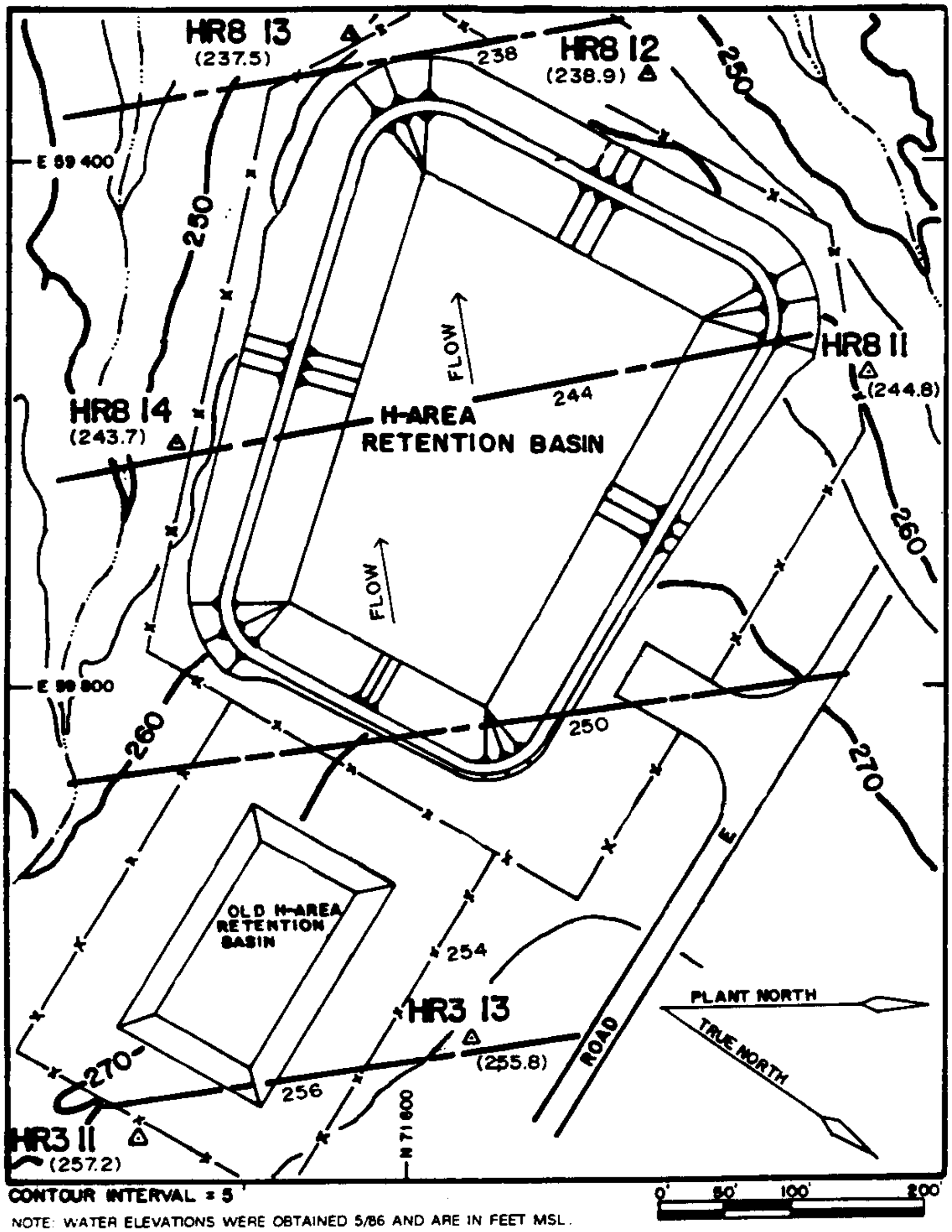


FIGURE 9-3. H-Area Retention Basins Water-Table Elevation Map

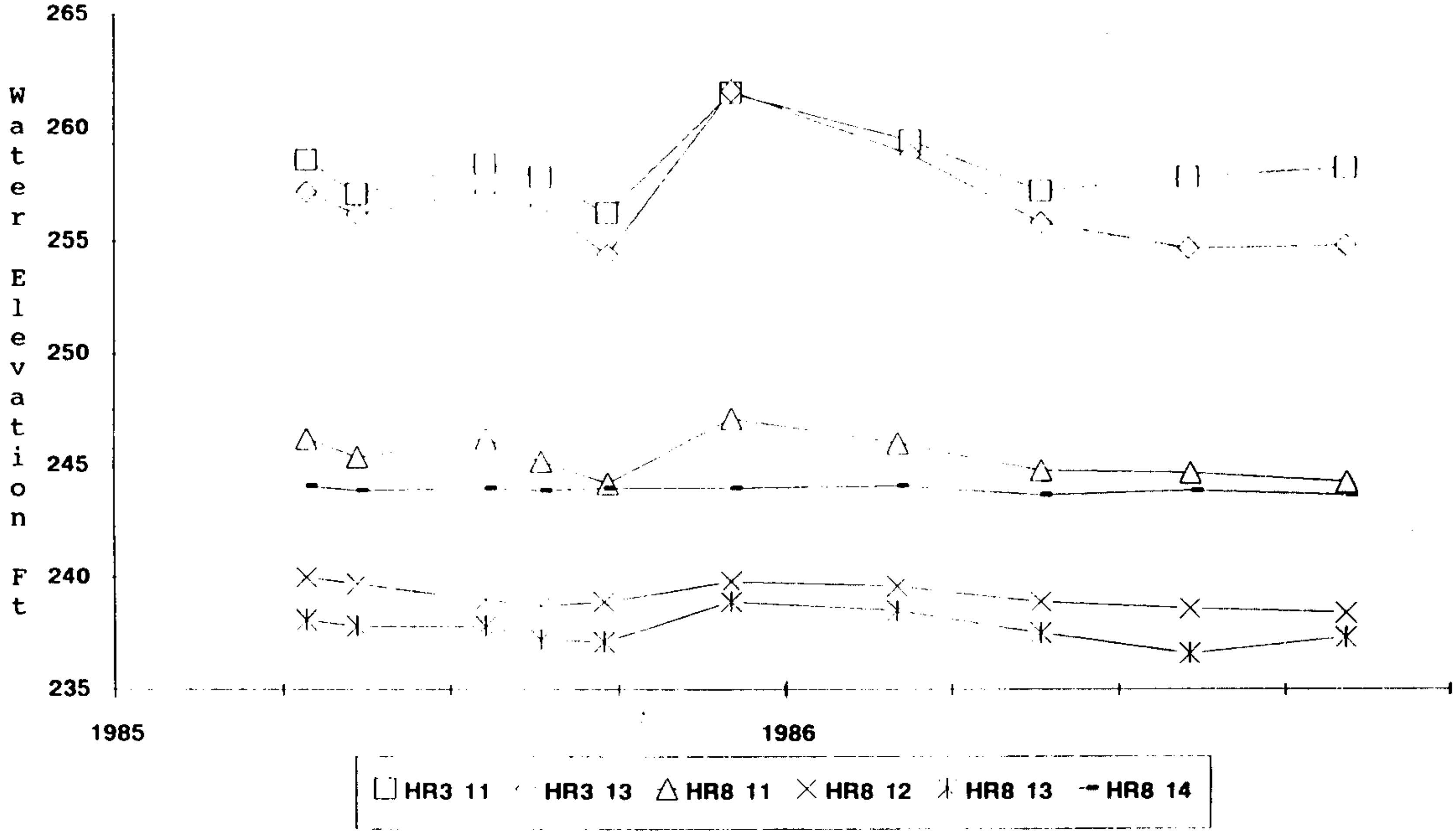
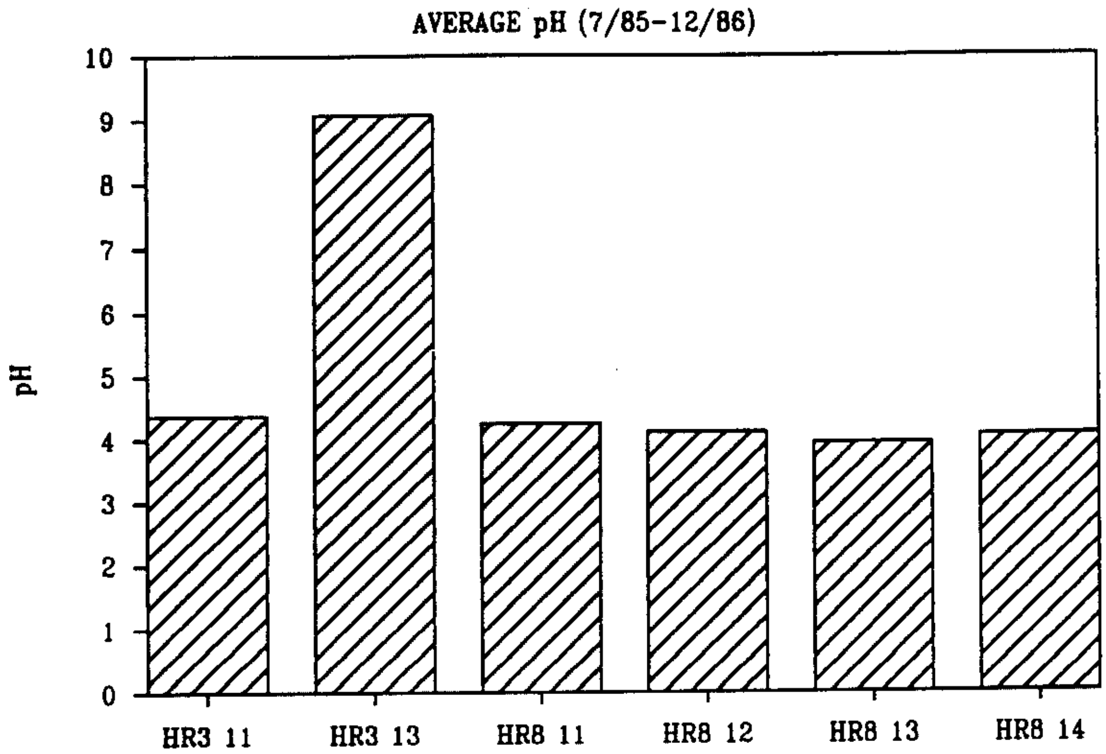


FIGURE 9-4. Hydrograph of the H-Area Retention Basins Wells



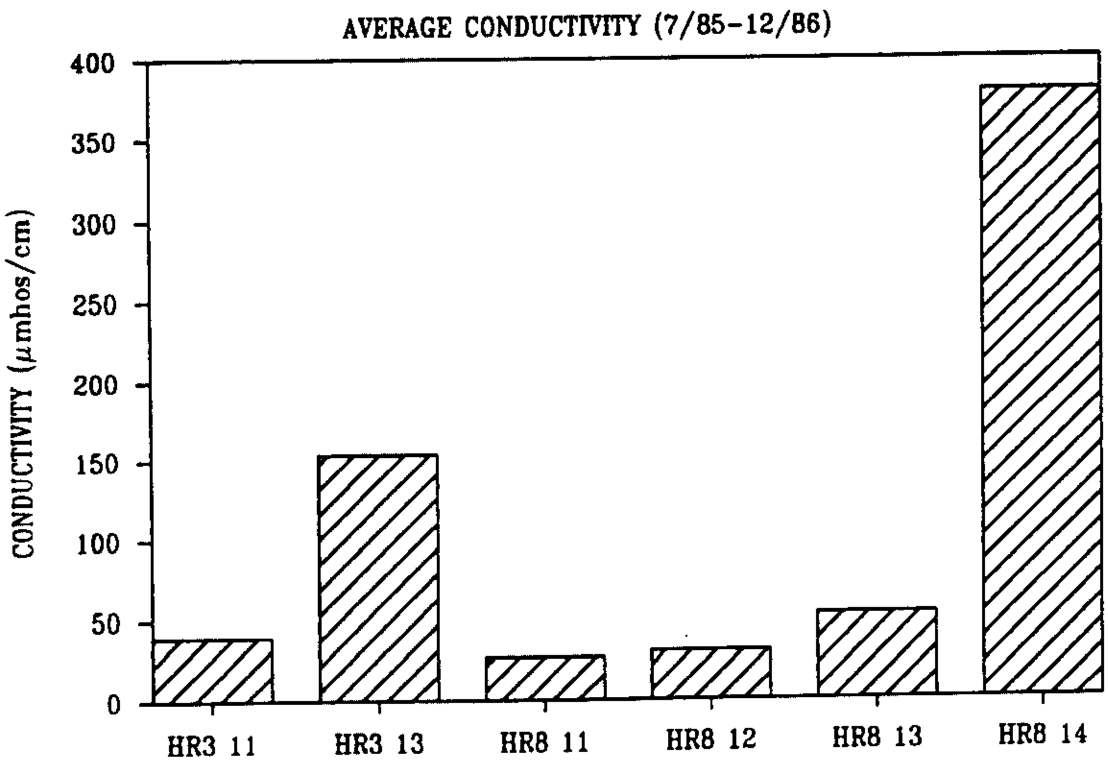
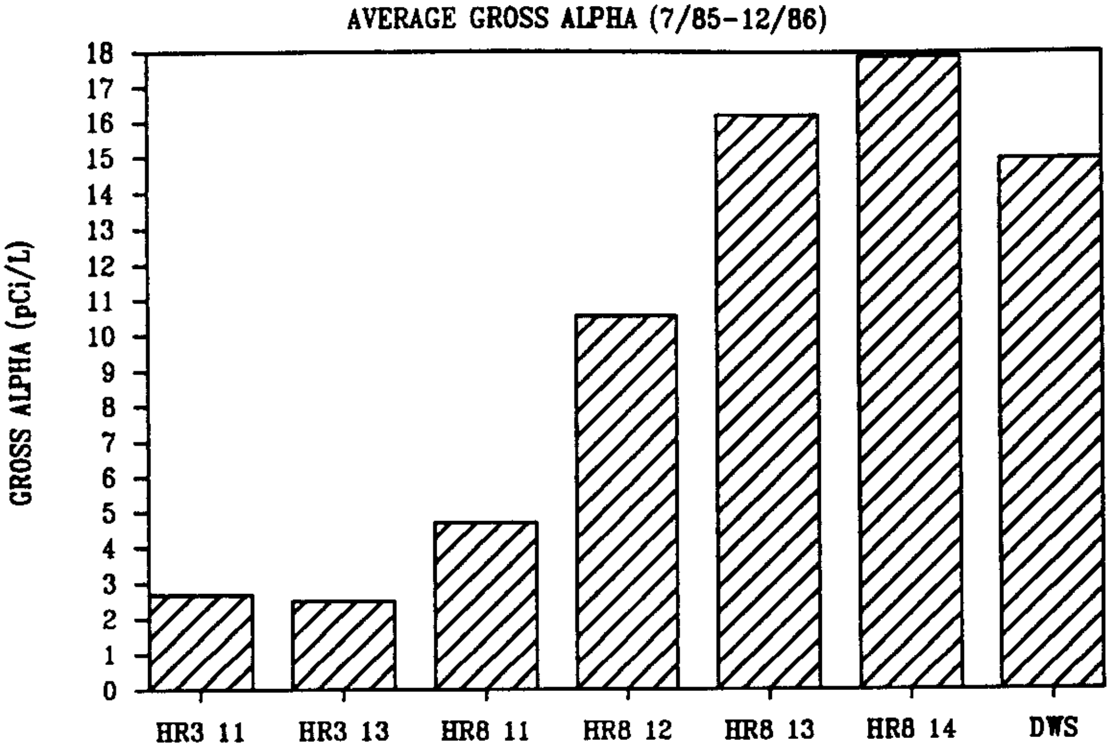


FIGURE 9-5. Average pH and Conductivity in the H-Area Retention Basins Wells



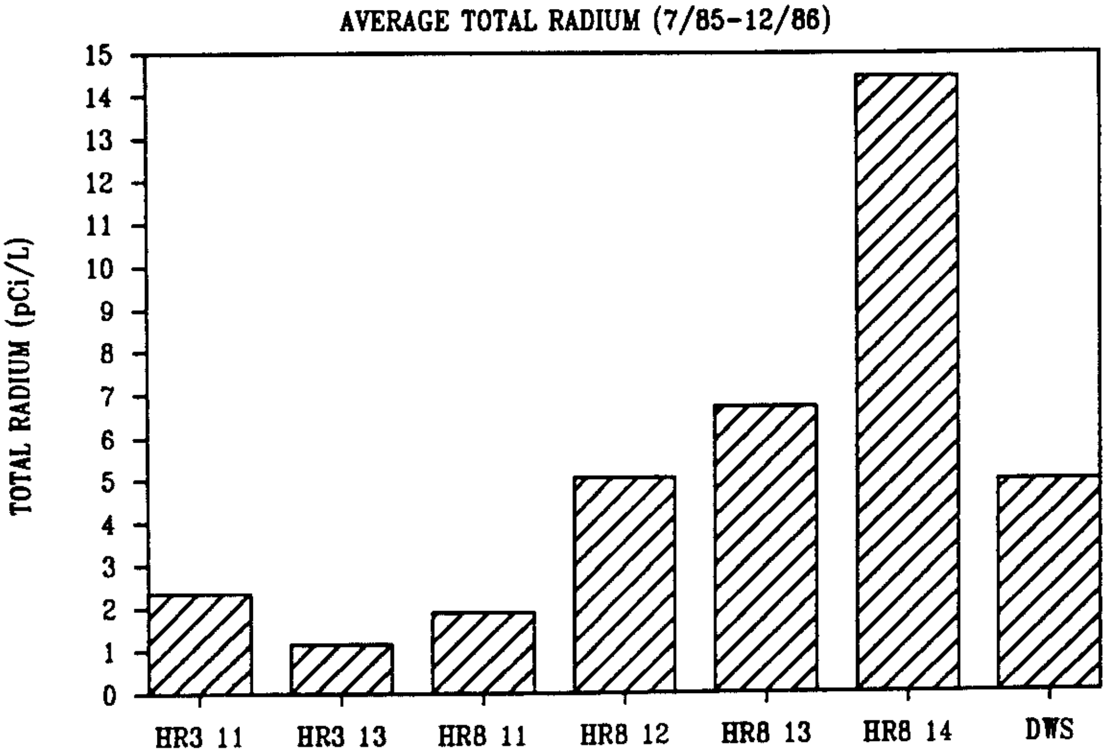


FIGURE 9-6. Average Gross Alpha and Total Radium Activities in the H-Area Retention Basins Wells

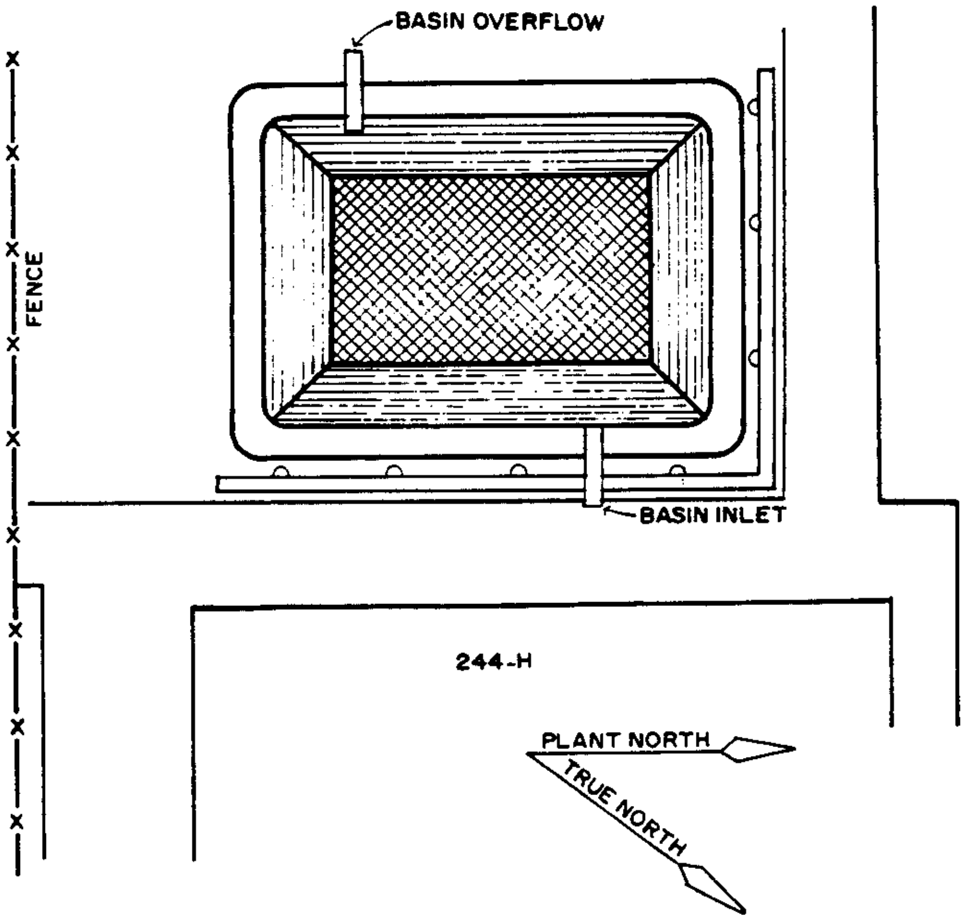
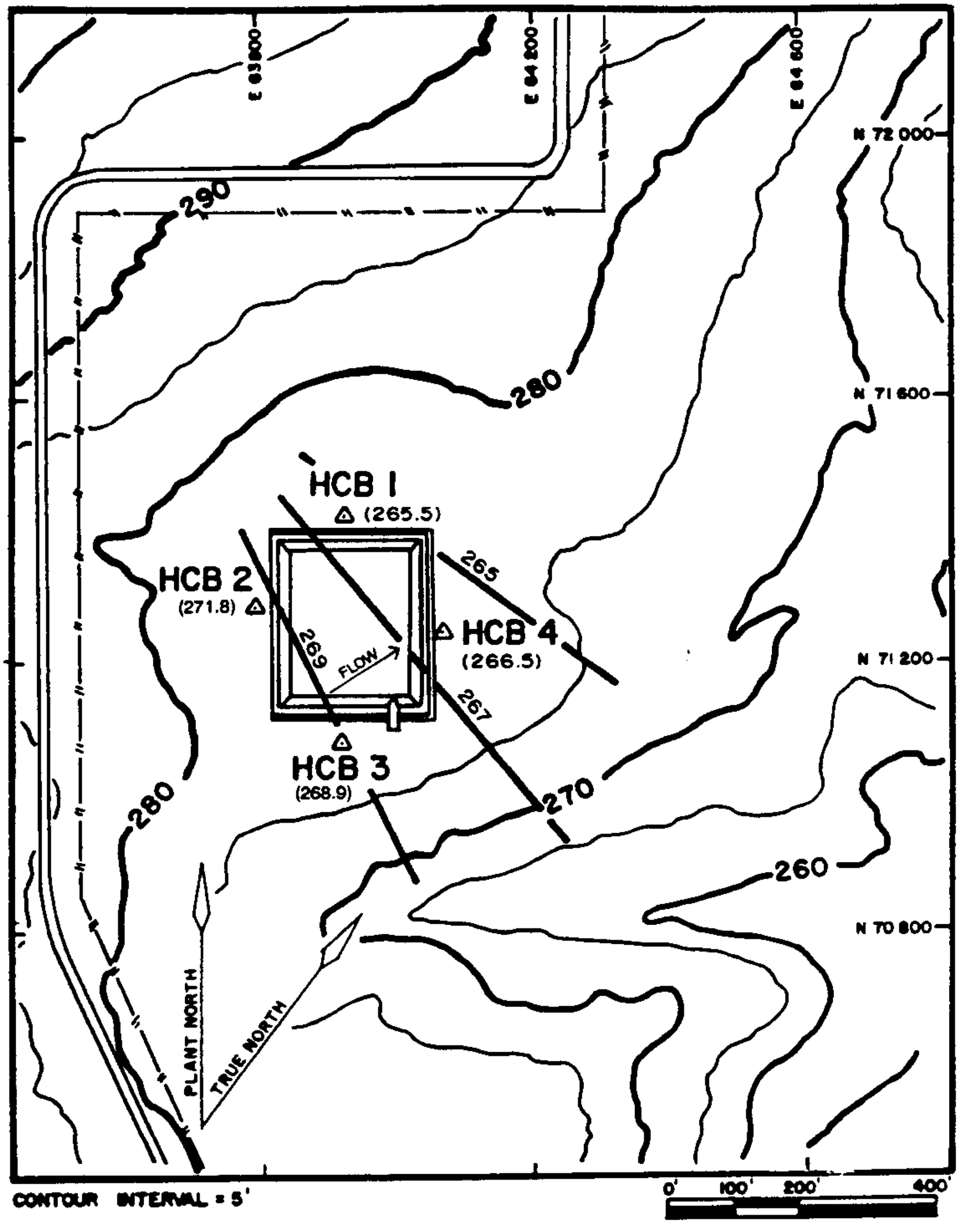
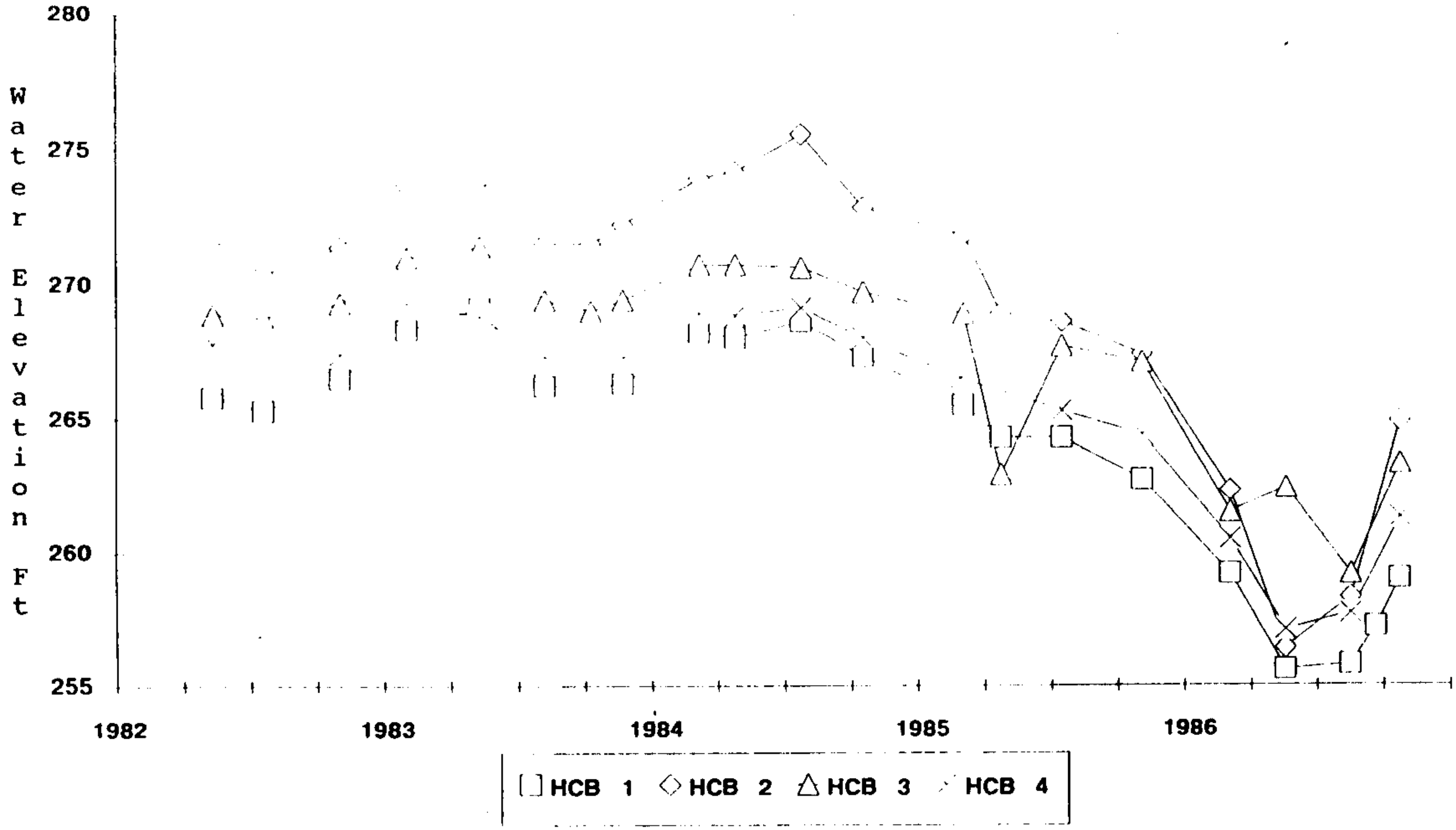


FIGURE 9-7. The H-Area Acid/Caustic Basin



NOTE: WATER ELEVATIONS WERE OBTAINED 2/85 AND 3/85 AND ARE IN FEET MSL.

FIGURE 9-8. H-Area Coal Pile Runoff Containment Basin (CPRB) Water-Table Elevation Map



NOTE: A WATER LEVEL OF 202 FT OBTAINED FOR WELL HCB 4 ON 4/24/85 IS NOT PLOTTED.

FIGURE 9-9. Hydrograph of the H-Area Coal Pile Runoff Containment Basin (CPRB) Wells

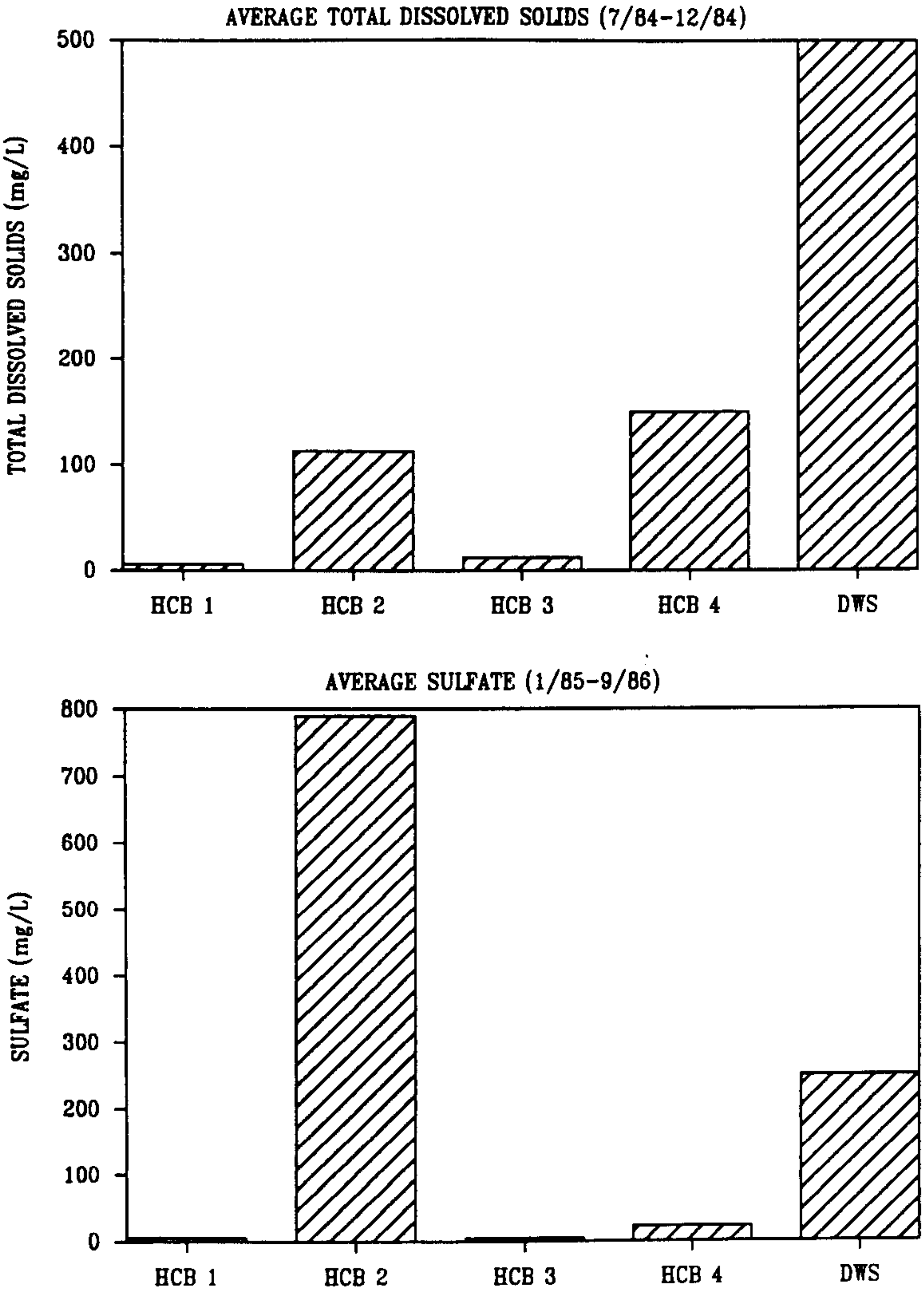


FIGURE 9-10. Average Total Dissolved Solids (TDS) and Sulfate Concentrations in the H-Area Coal Pile Runoff Containment Basin (CPRB) Wells

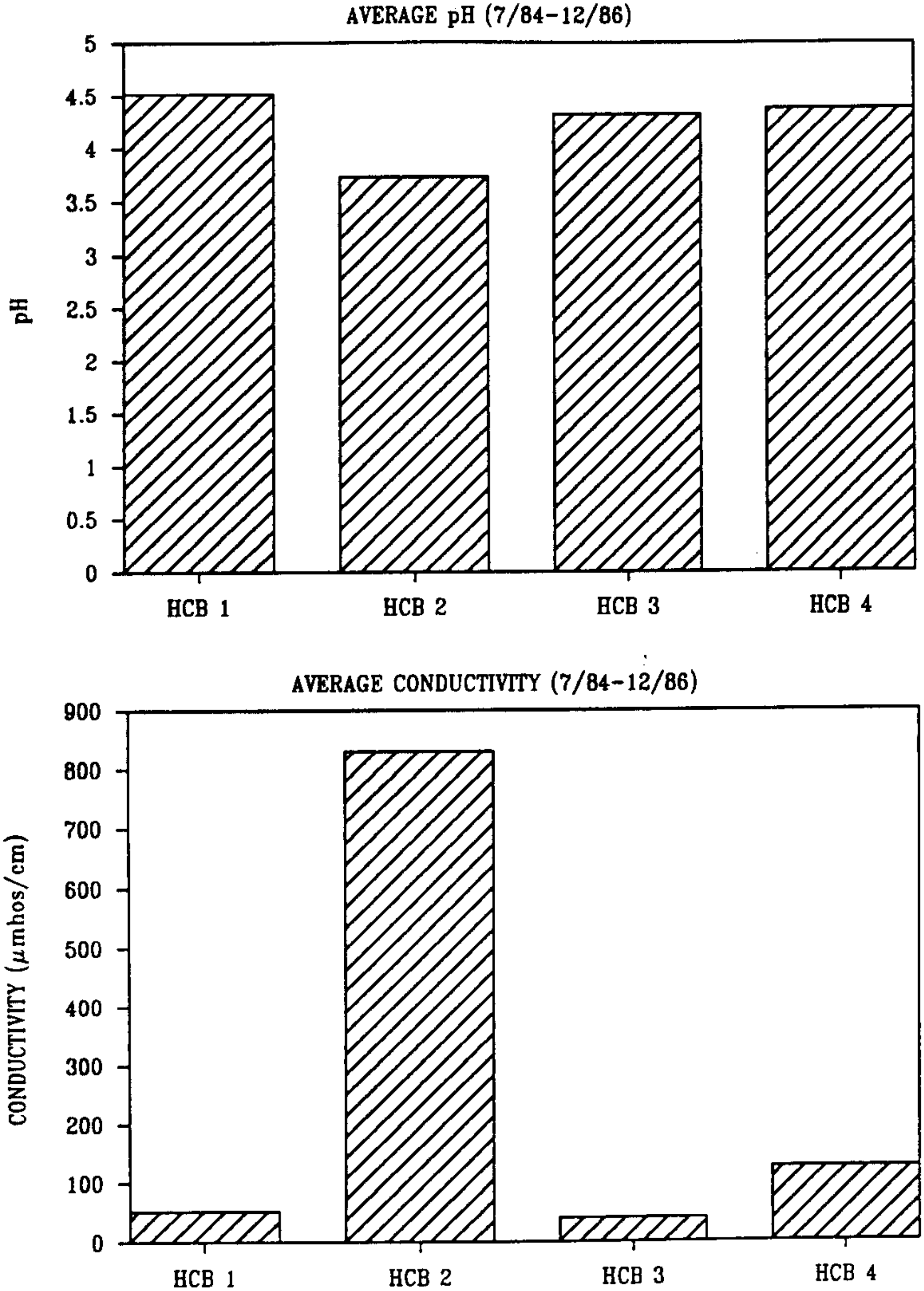


FIGURE 9-11. Average pH and Conductivity in the H-Area Coal Pile Runoff Containment Basin (CPRB) Wells

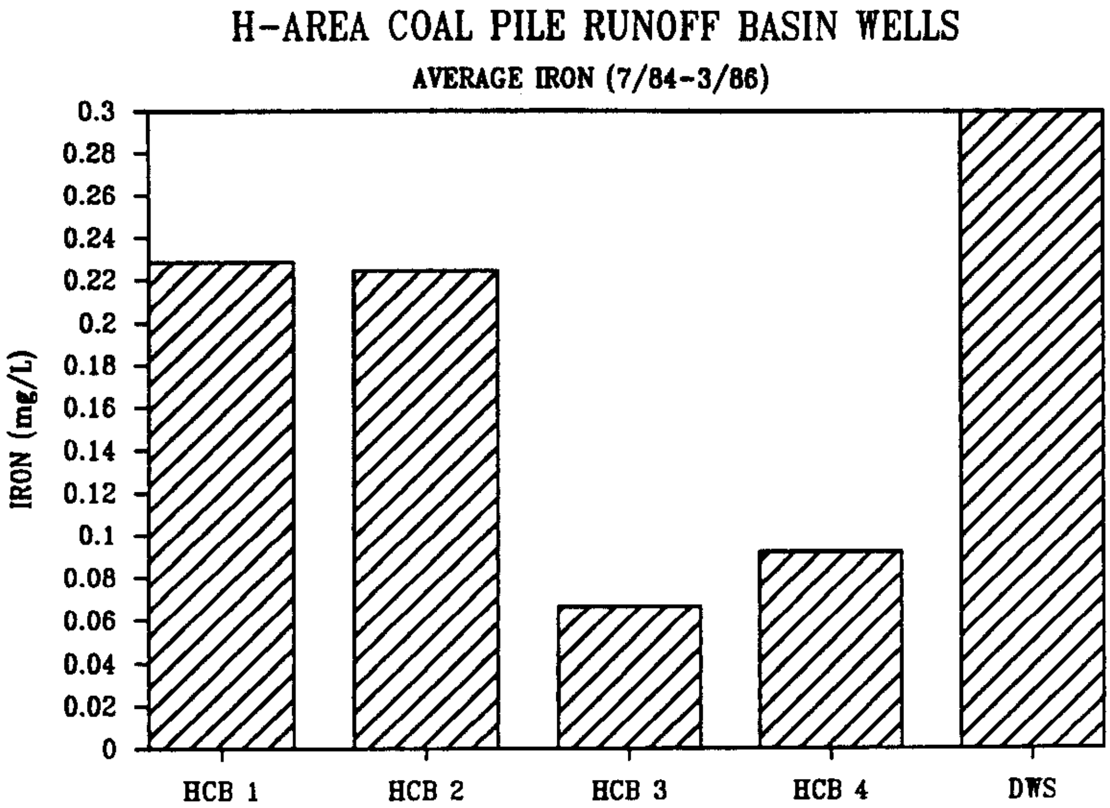


FIGURE 9-12. Average Iron Concentrations in the H-Area Coal Pile Runoff Containment Basin (CPRB) Wells

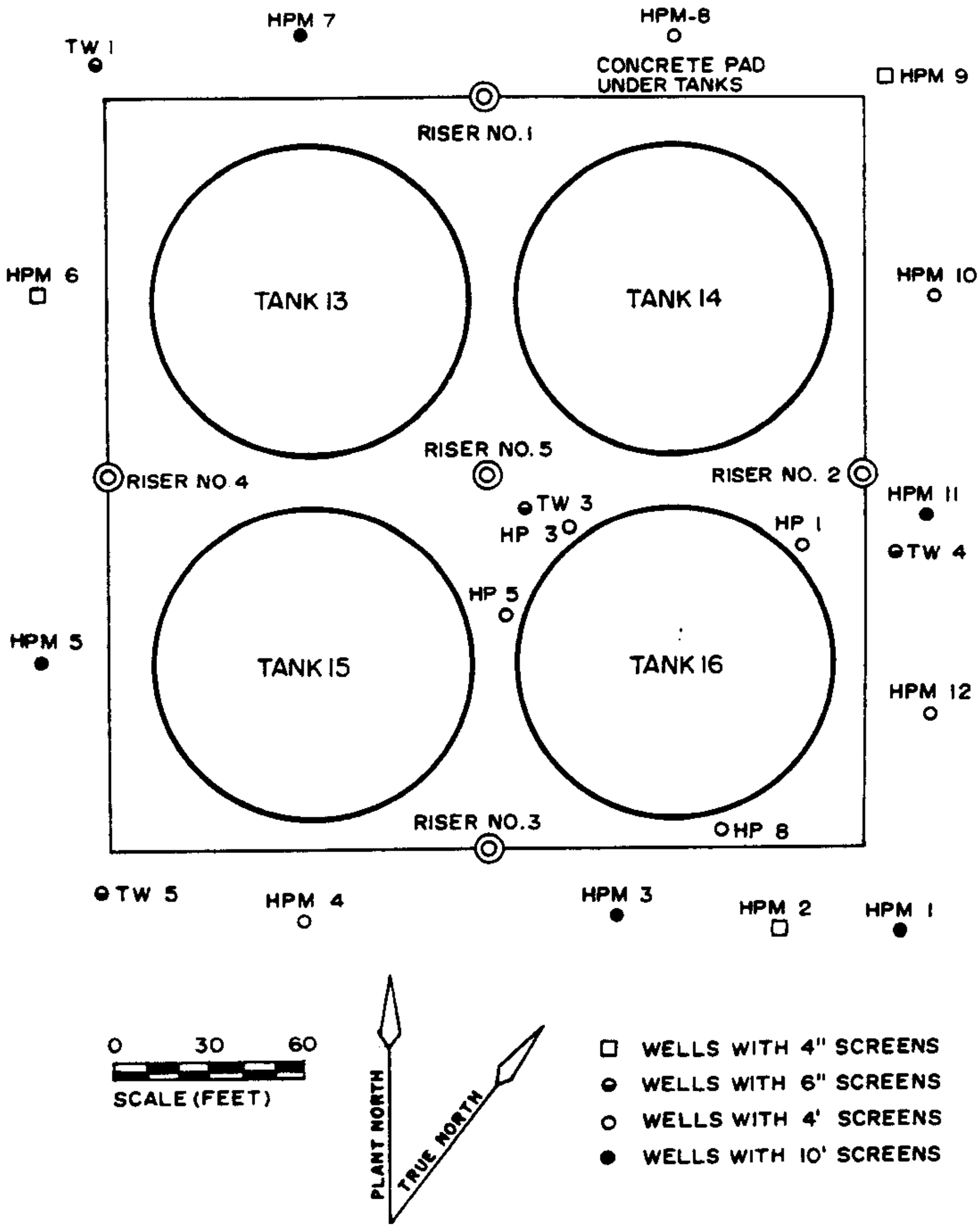


FIGURE 9-13. Location of the TW, HP, and HPM Series Wells at the H-Area Tank Farm

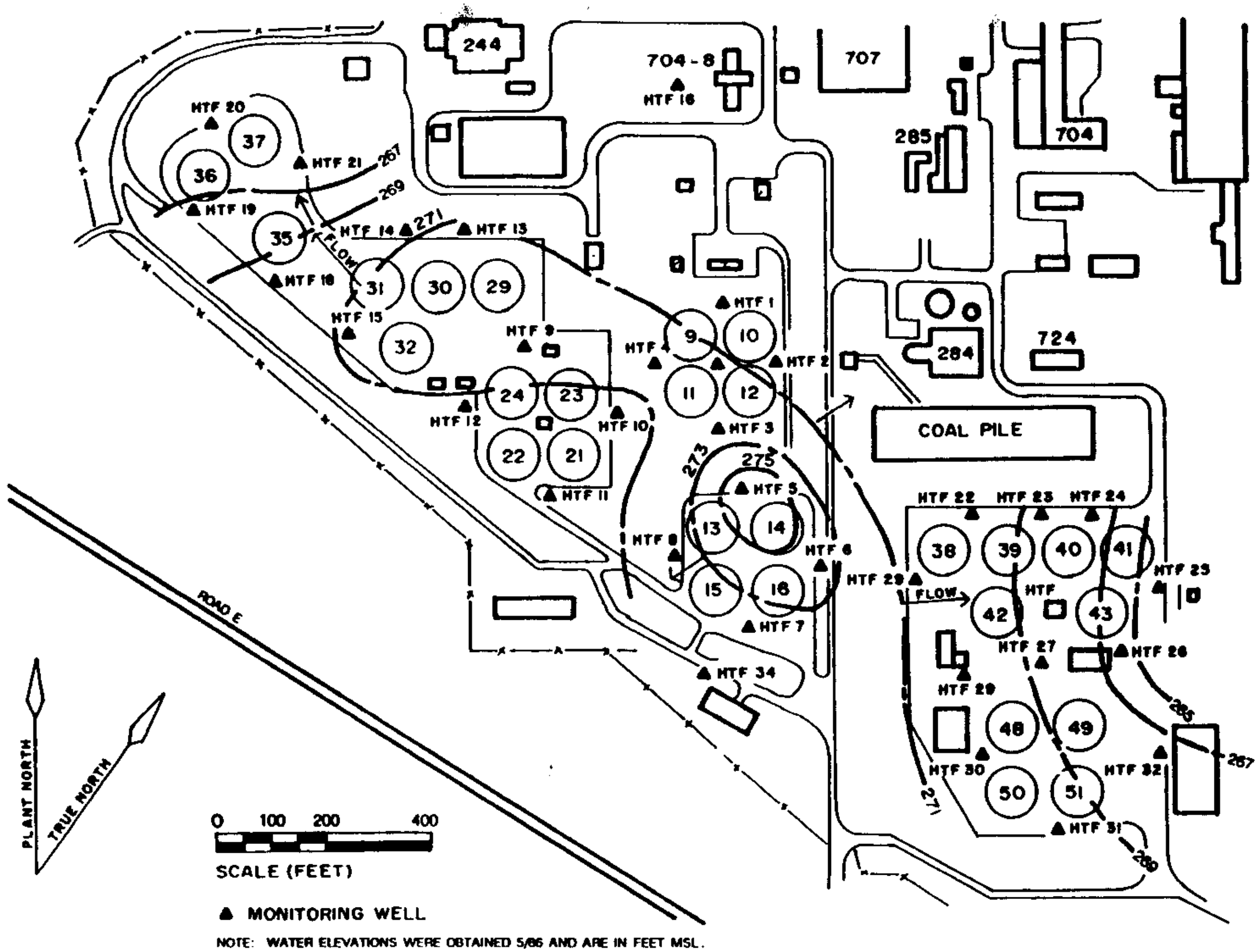


FIGURE 9-14. H-Area Tank Farm Water-Table Elevation Map

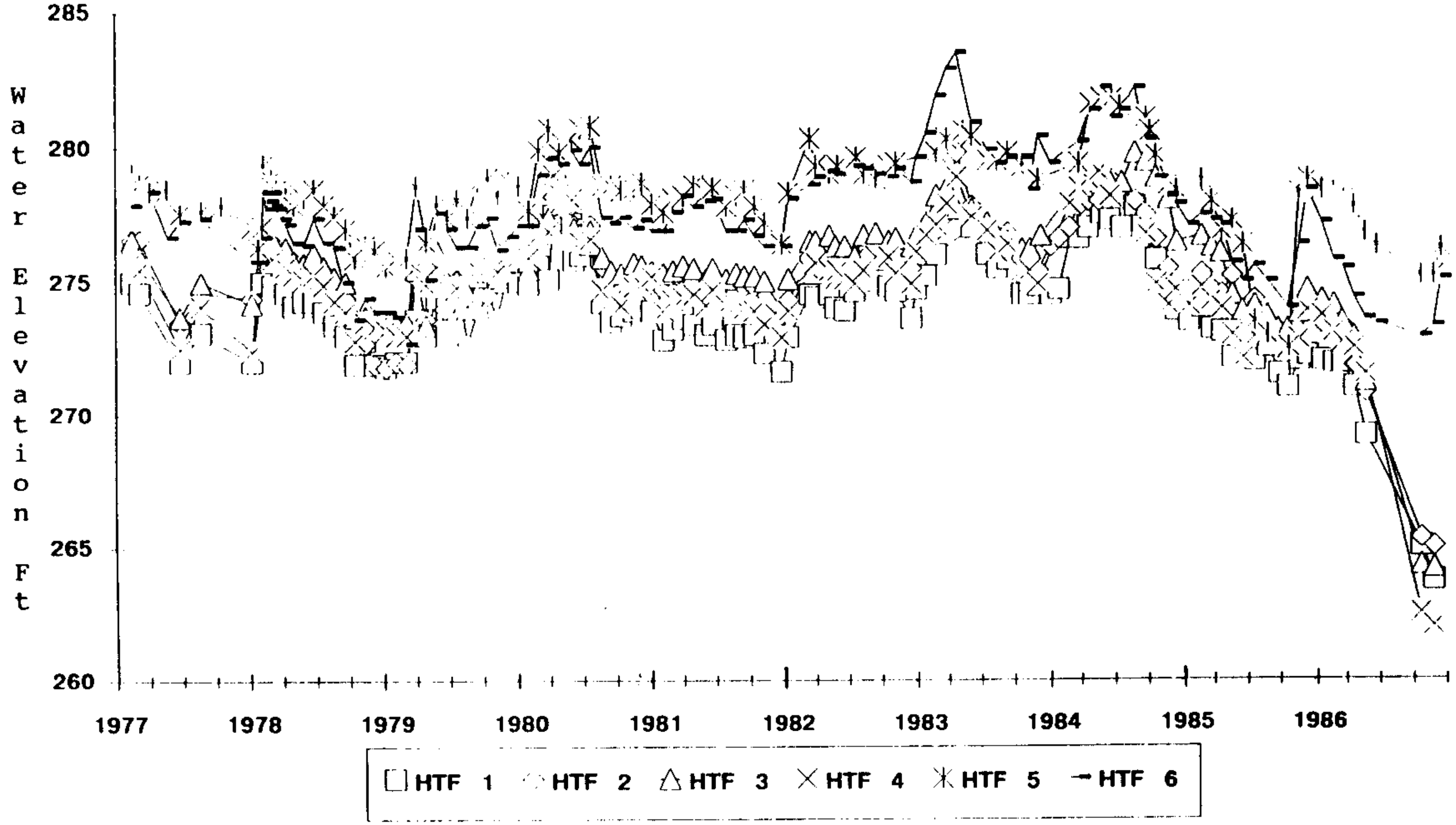


FIGURE 9-15. Hydrograph of H-Area Tank Farm Wells HTF 1 Through HTF 6

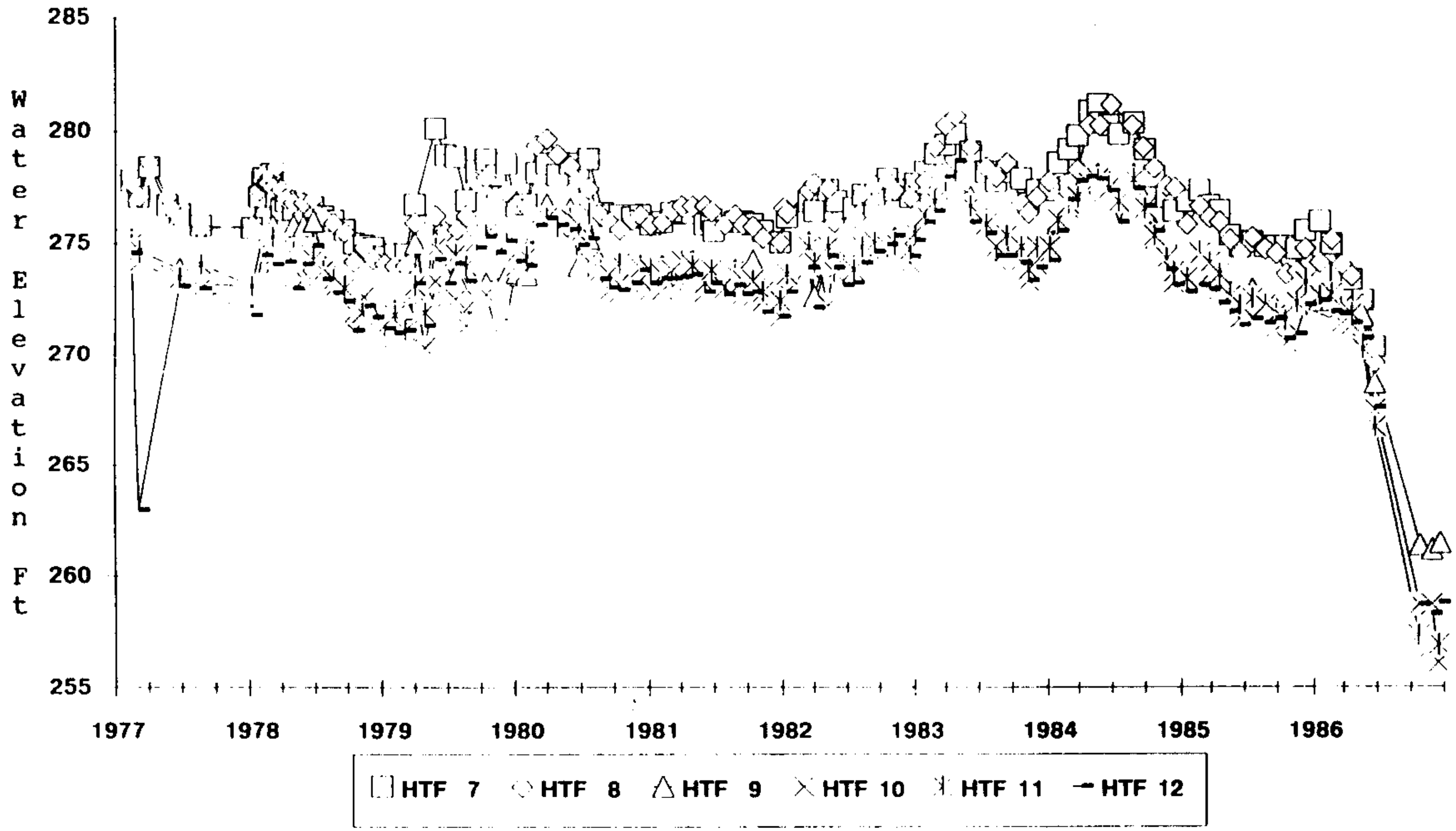


FIGURE 9-16. Hydrograph of H-Area Tank Farm Wells HTF 7 Through HTF 12

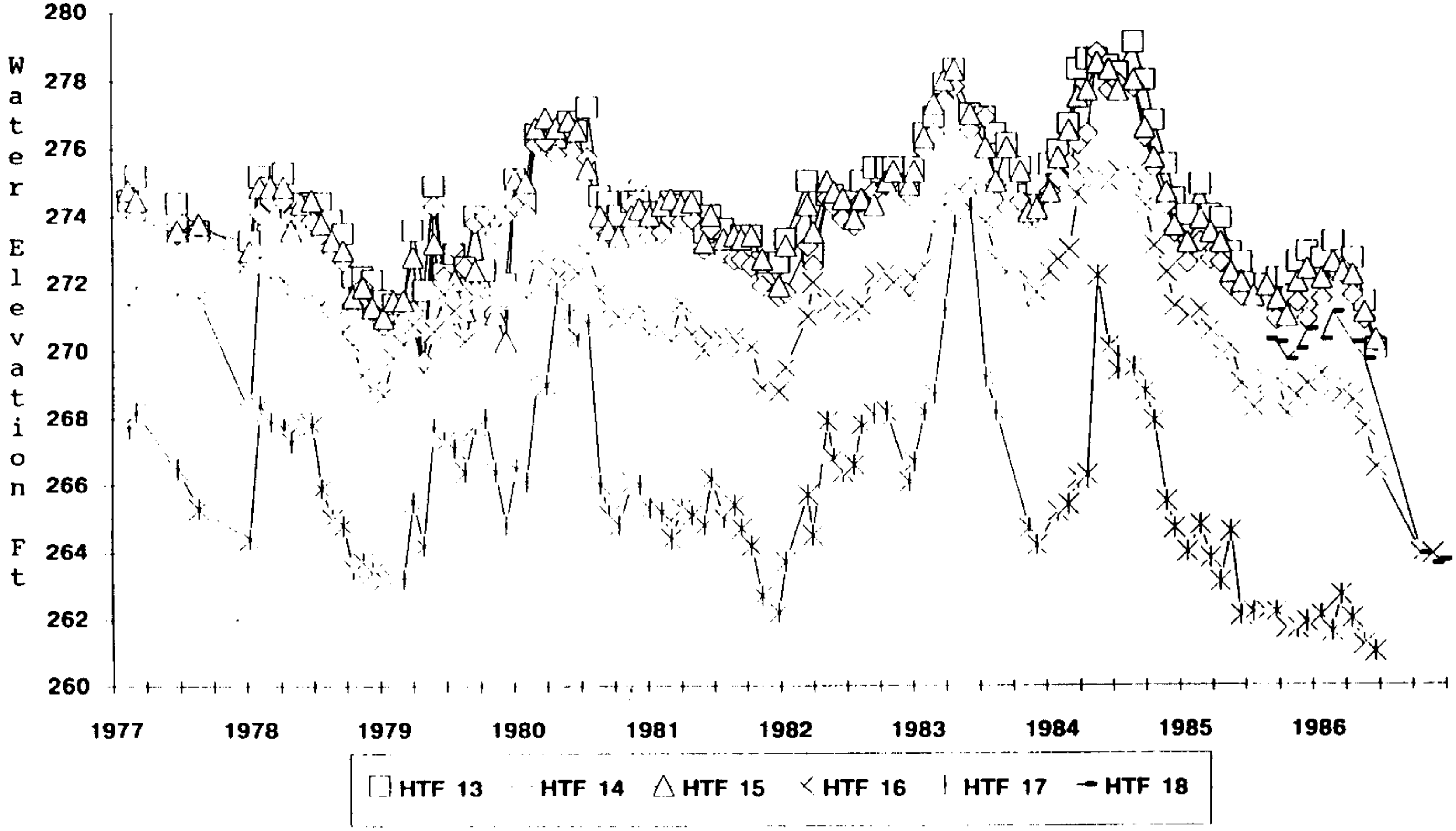


FIGURE 9-17. Hydrograph of H-Area Tank Farm Wells HTF 13 Through HTF 18

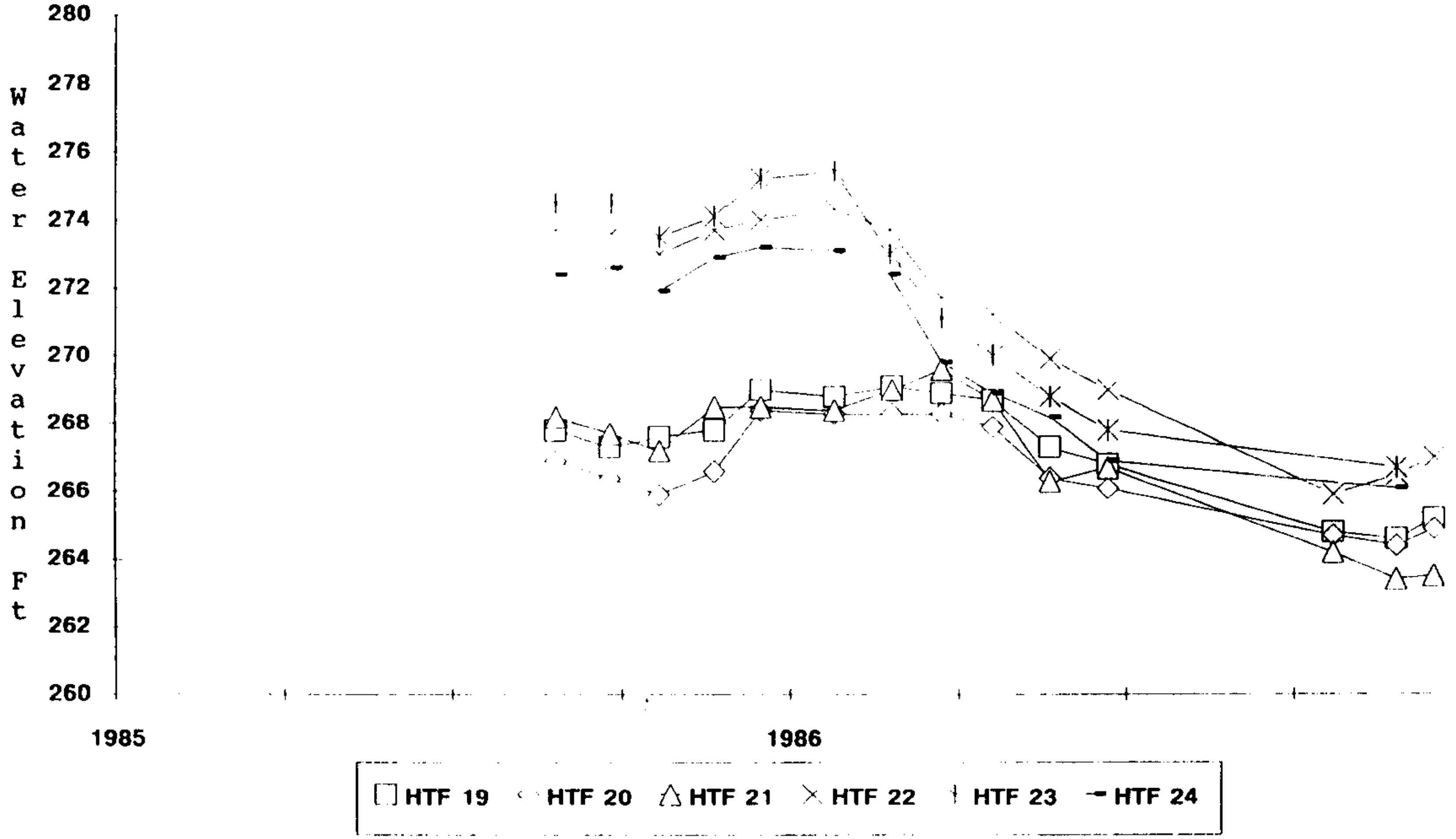


FIGURE 9-18. Hydrograph of H-Area Tank Farm Wells HTF 19 Through HTF 24

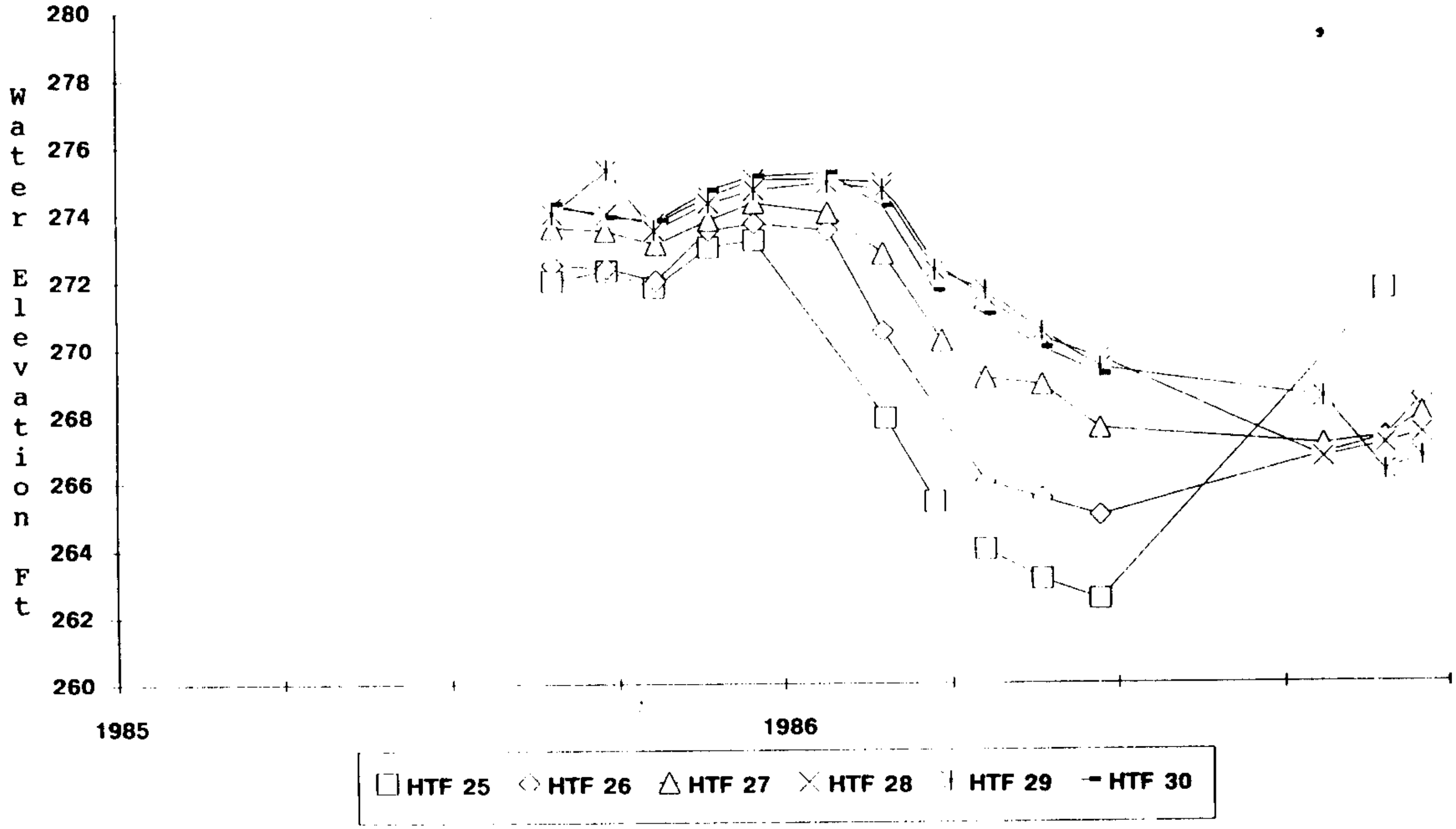


FIGURE 9-19. Hydrograph of H-Area Tank Farm Wells HTF 25 Through HTF 30

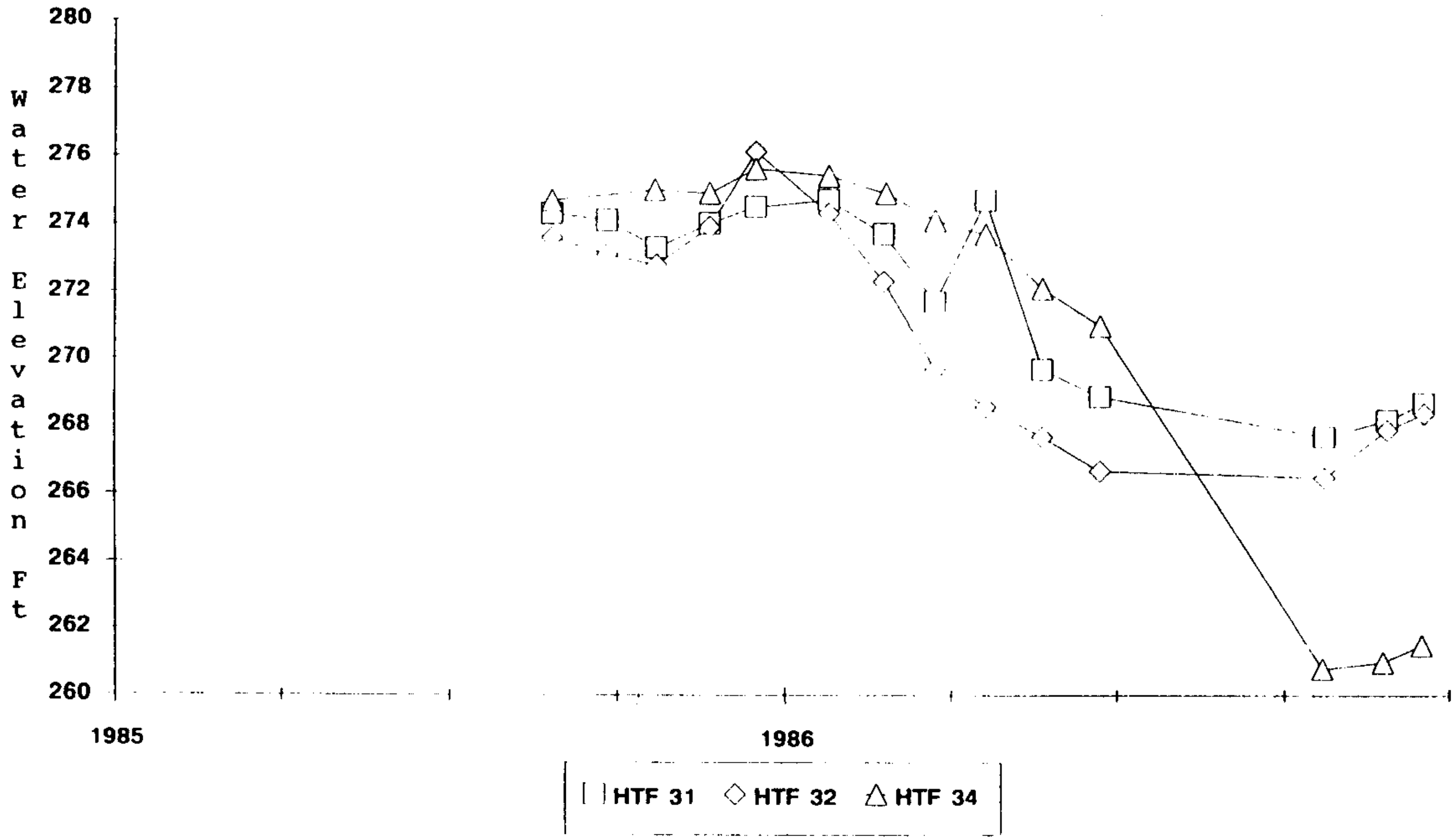


FIGURE 9-20. Hydrograph of H-Area Tank Farm Wells HTF 31 Through HTF 34

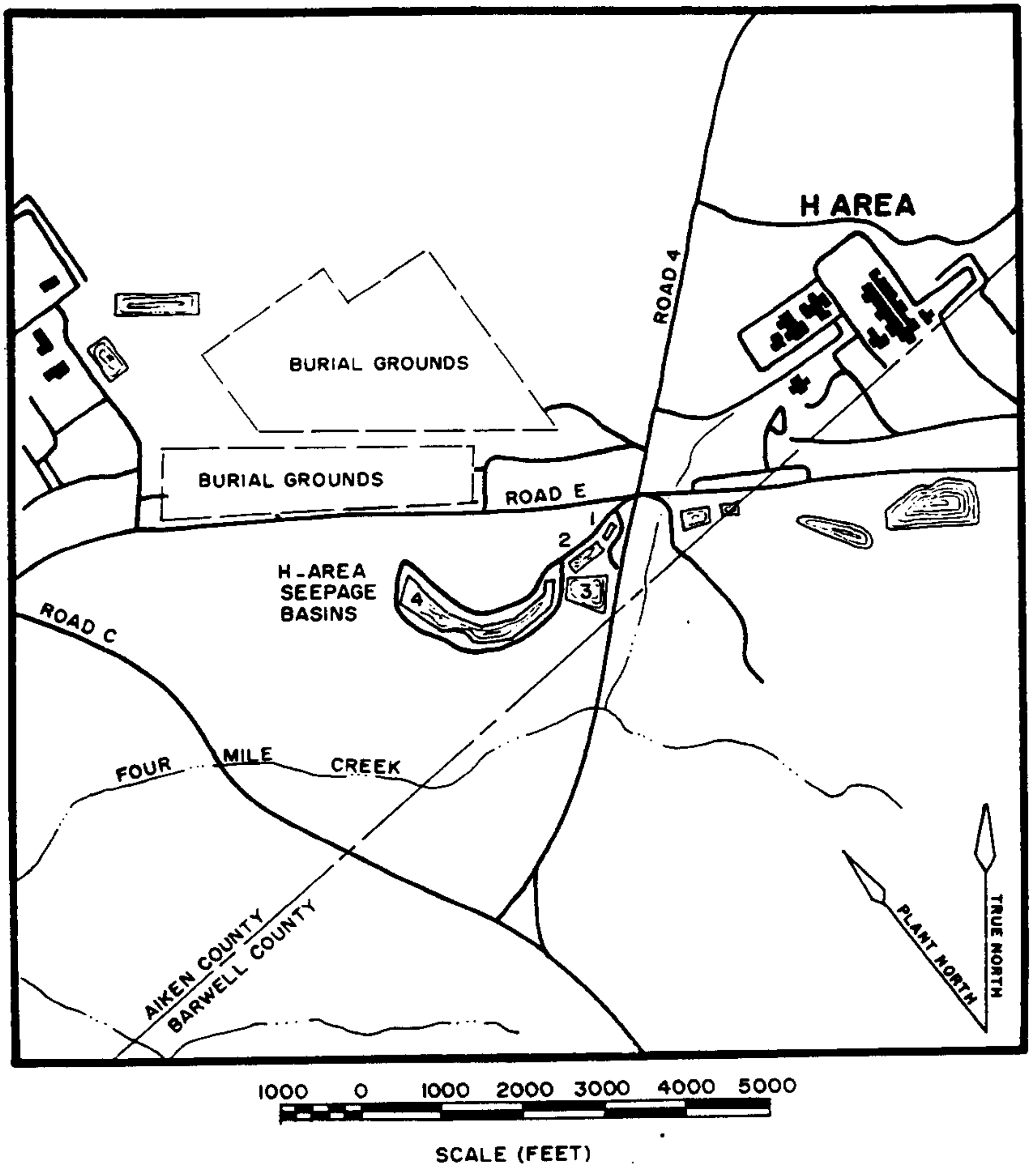


FIGURE 9-21. The H-Area Seepage Basins

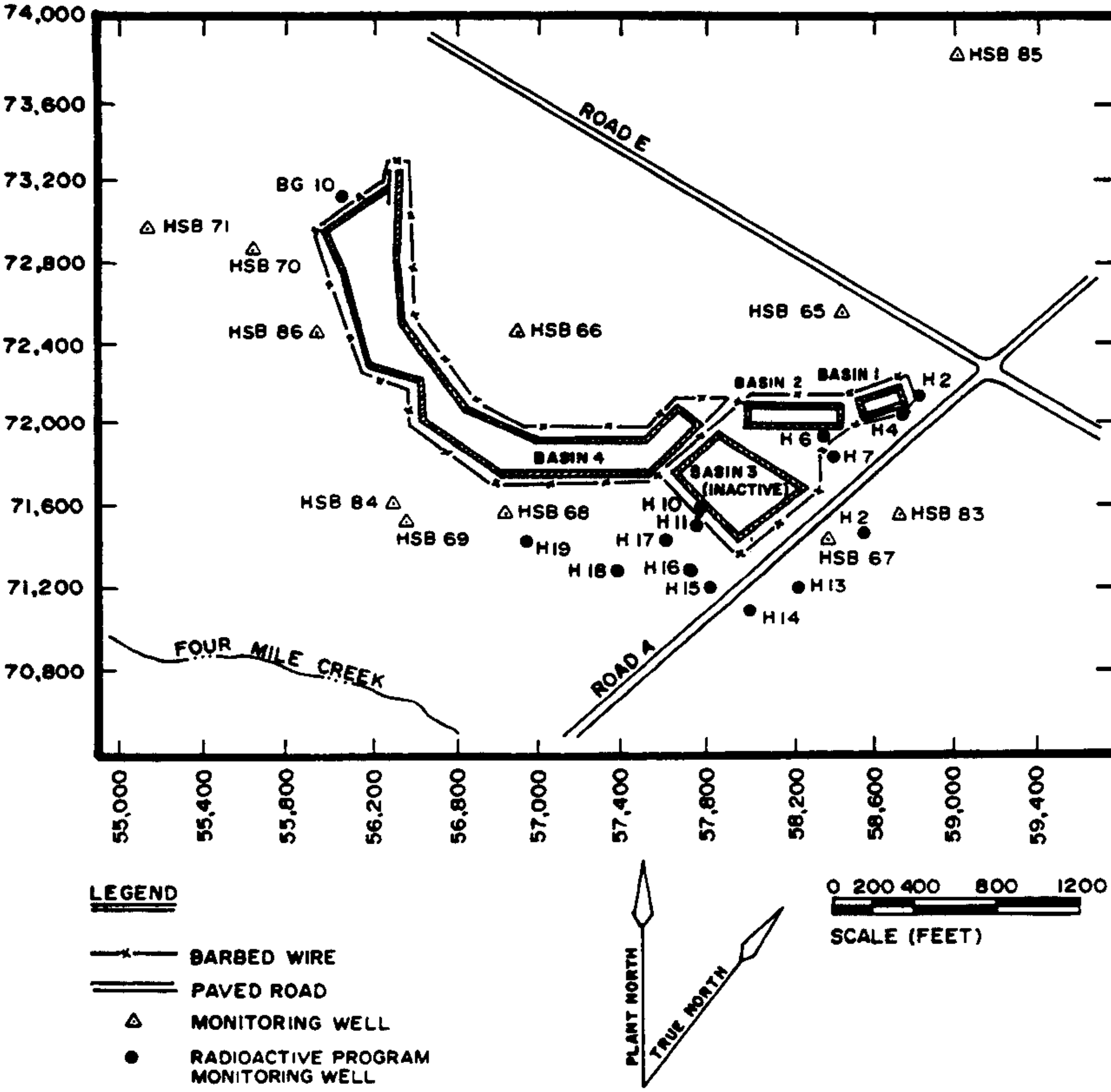


FIGURE 9-22. H-Area Seepage Basins Monitoring Well Locations

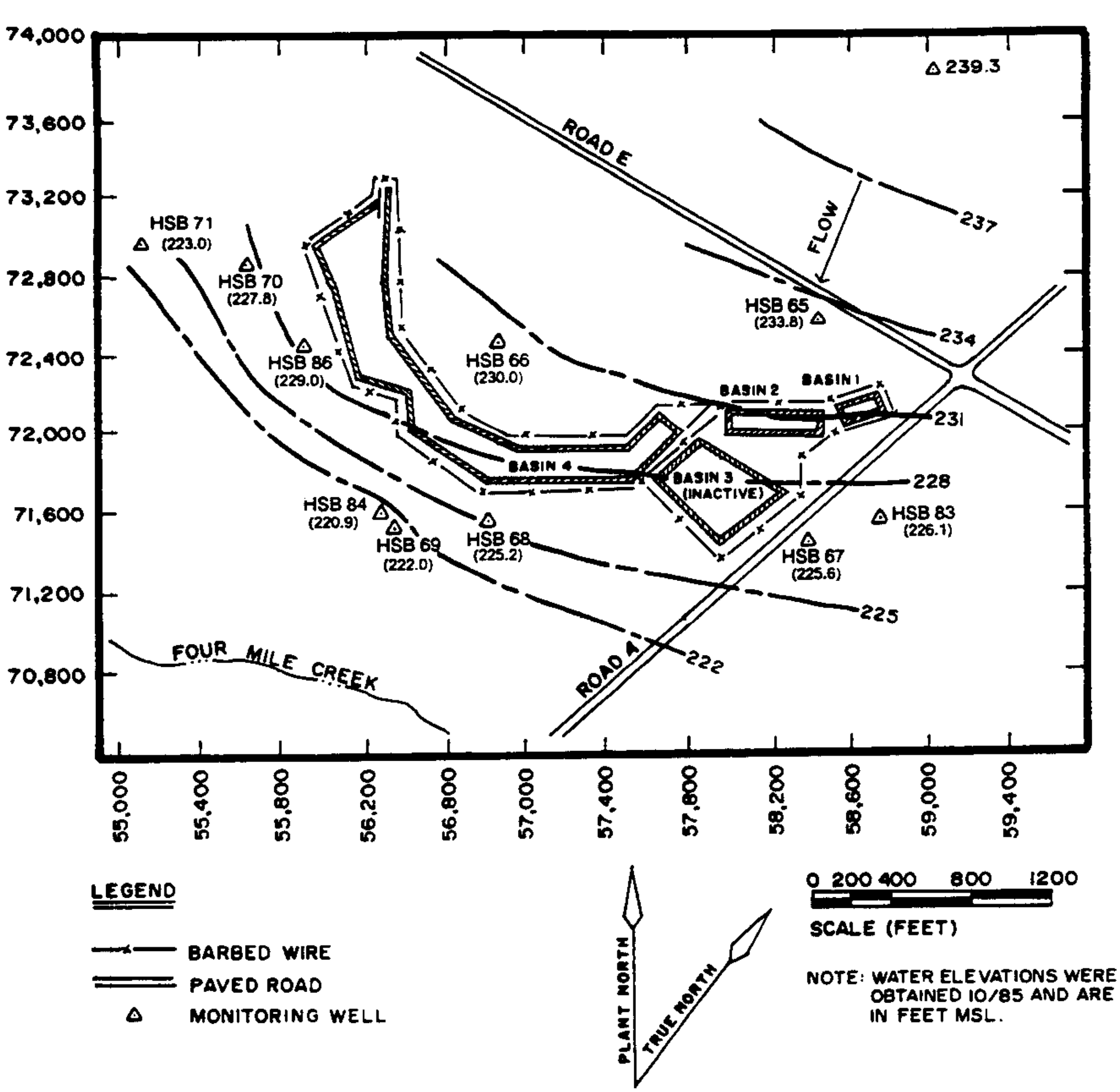


FIGURE 9-23. H-Area Seepage Basins Water-Table Elevation Map

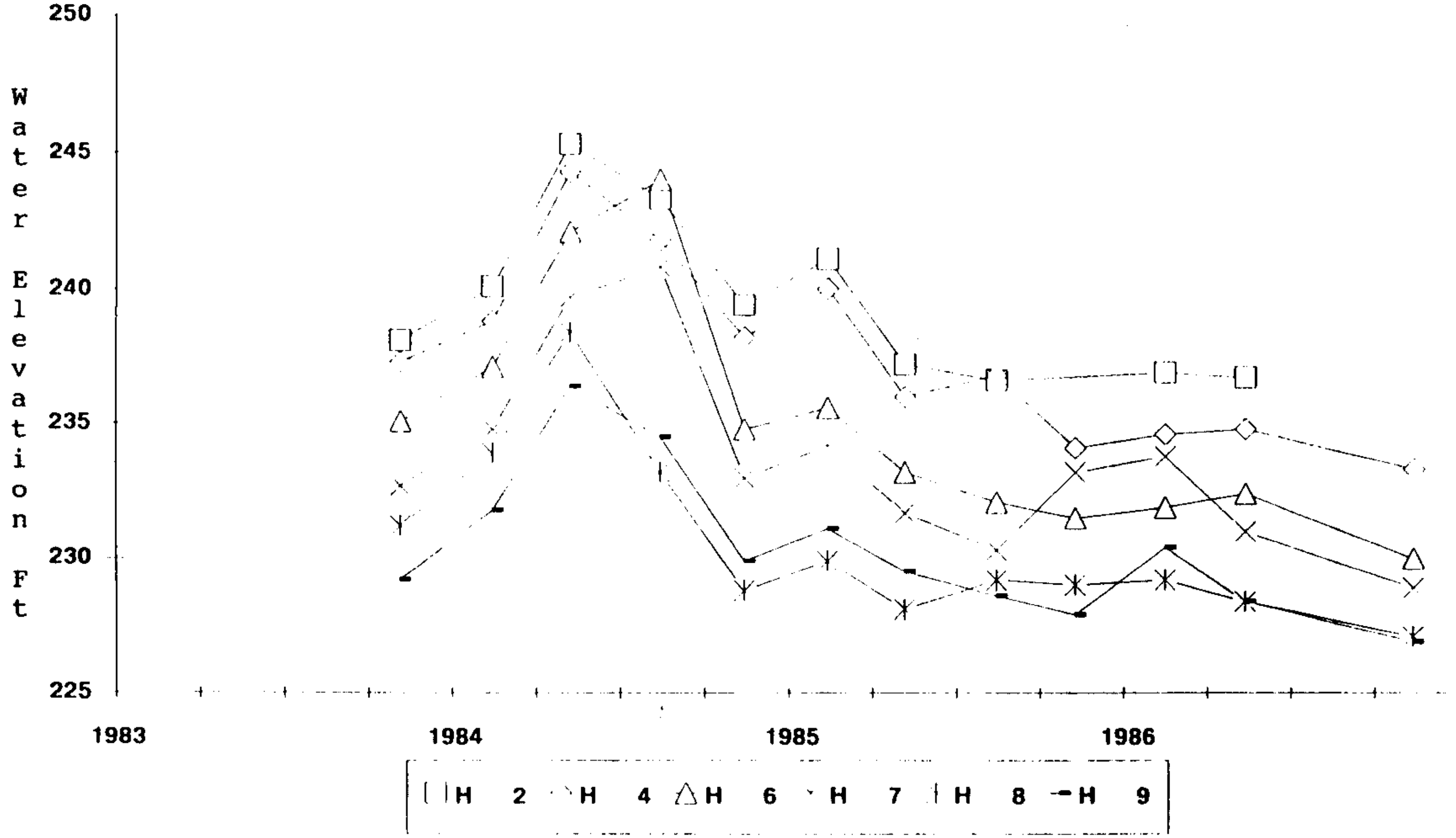


FIGURE 9-24. Hydrograph of H-Area Seepage Basins Water-Table Monitoring Wells H 2 Through H 9

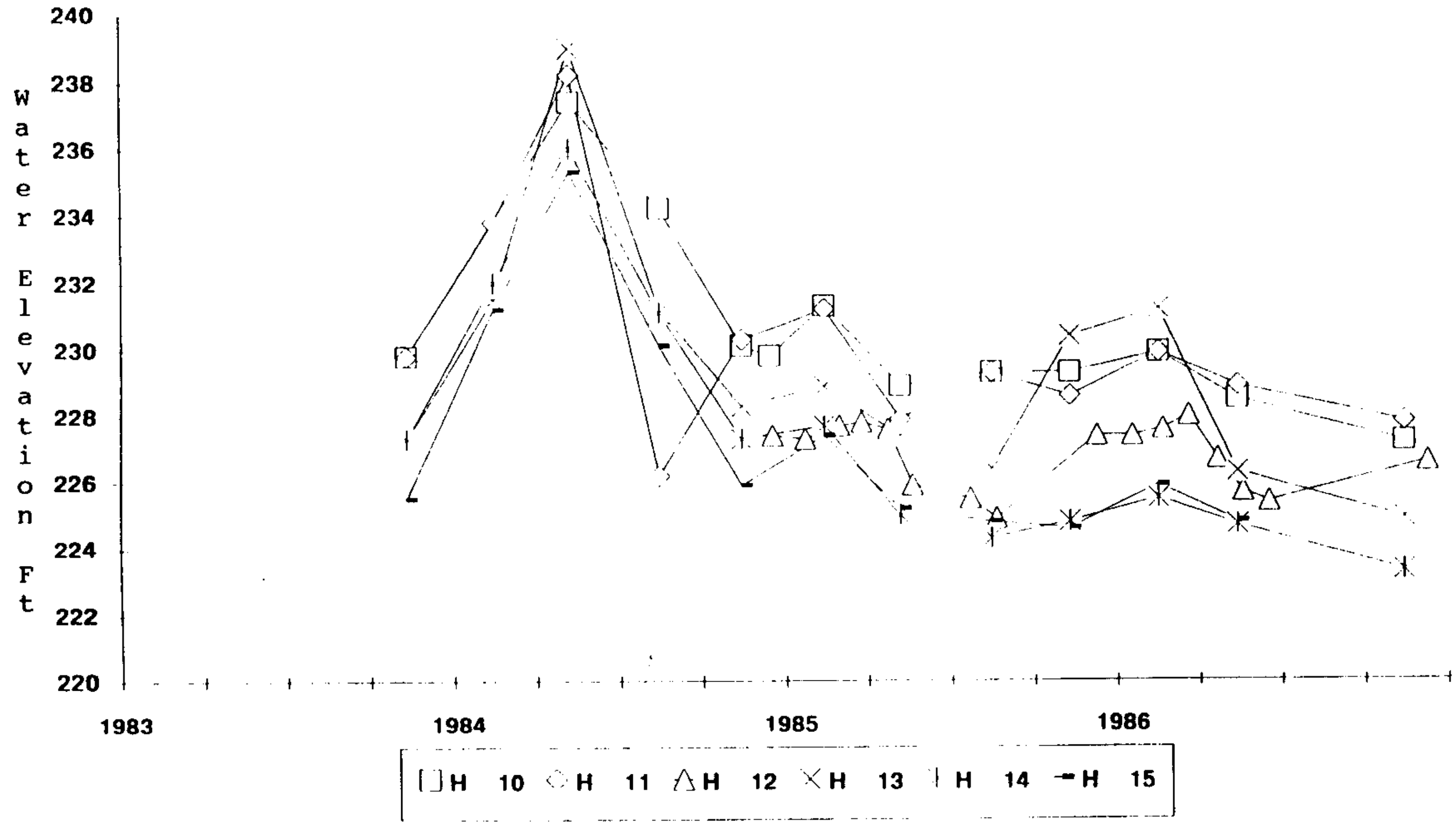


FIGURE 9-25. Hydrograph of H-Area Seepage Basins Water-Table Monitoring Wells H 10 Through H 15

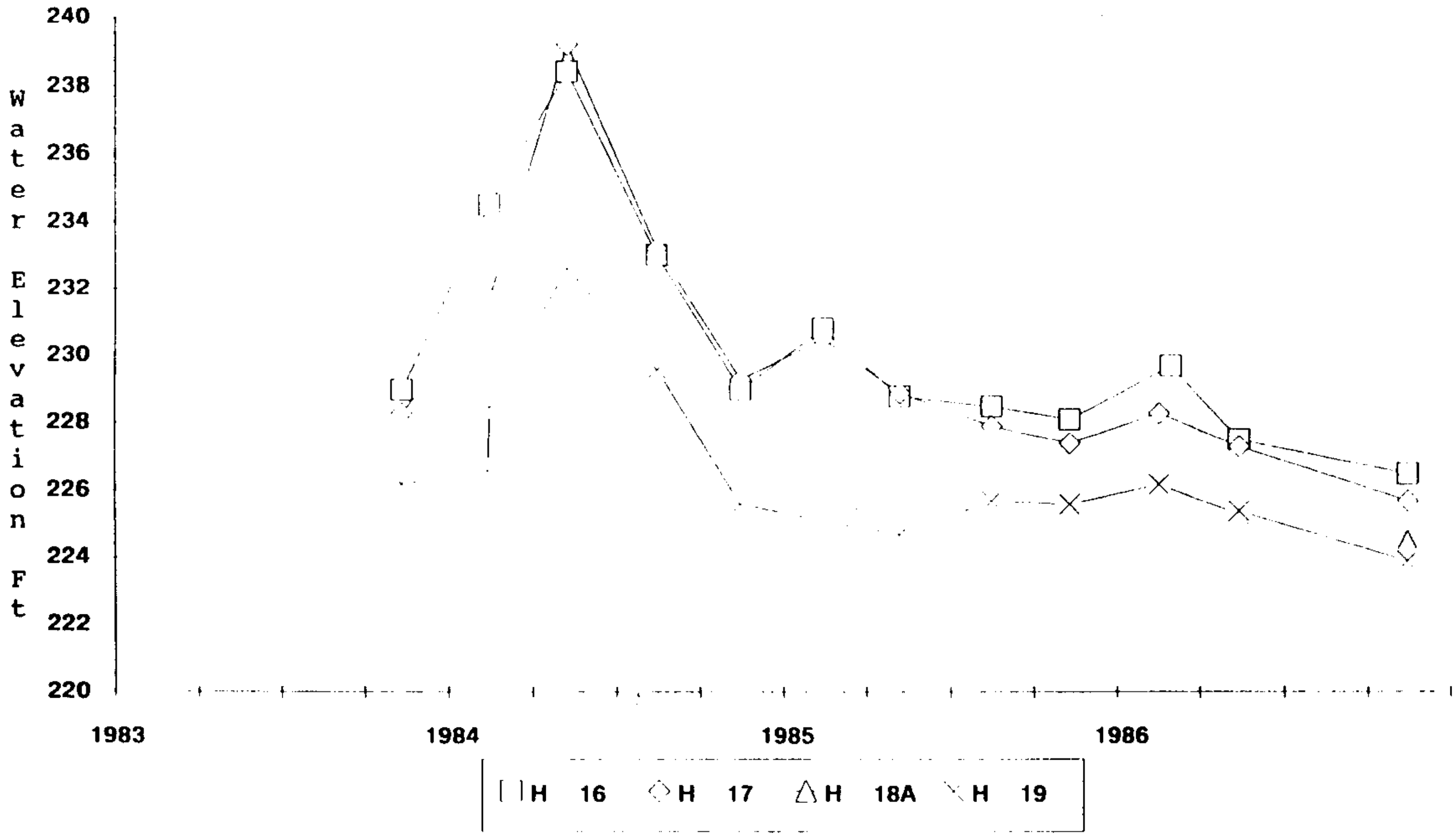


FIGURE 9-26. Hydrograph of H-Area Seepage Basins Water-Table Monitoring Wells H 16 Through H 19

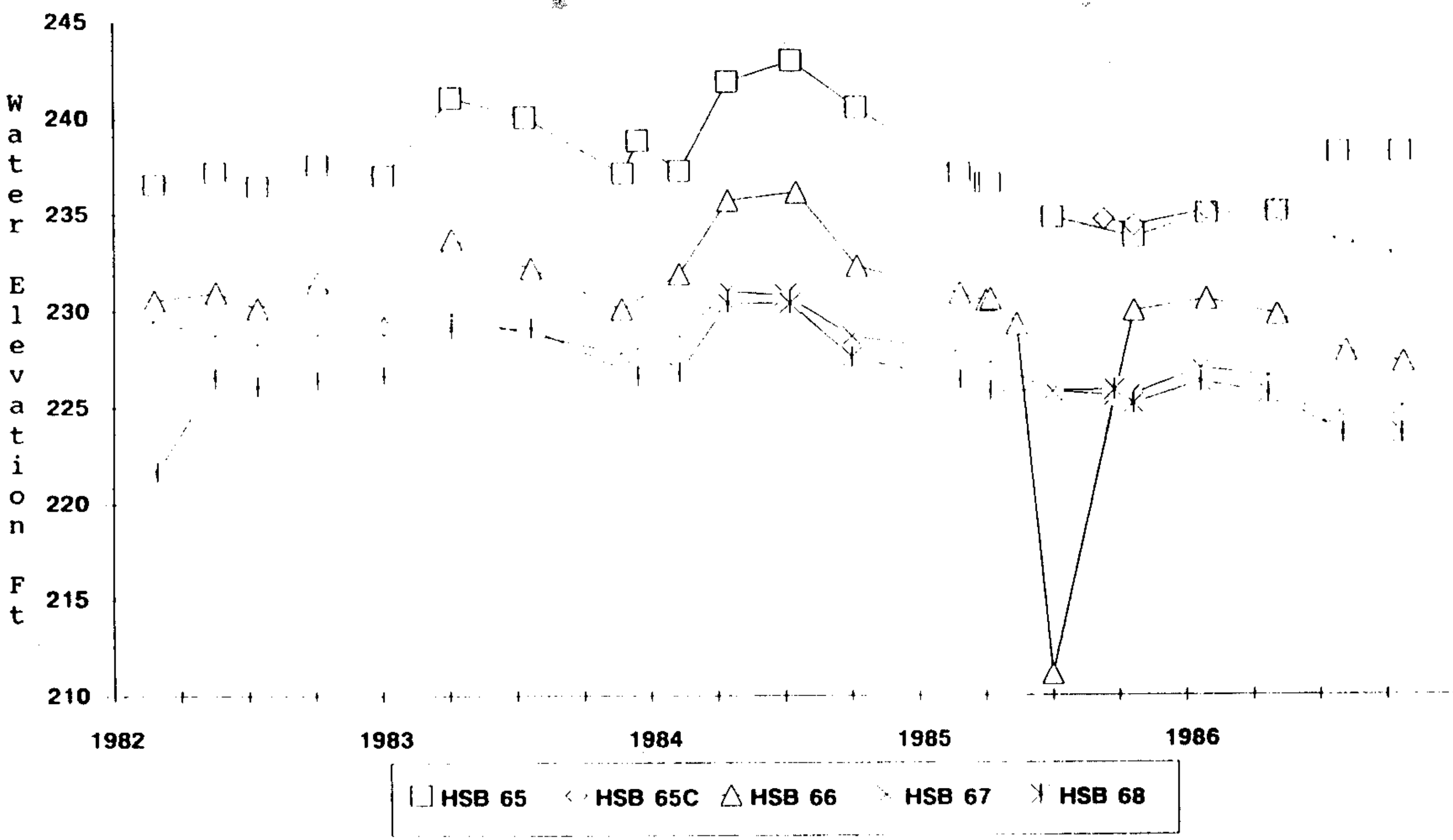


FIGURE 9-27. Hydrograph of H-Area Seepage Basins Water-Table Monitoring Wells HSB 65 Through HSB 68

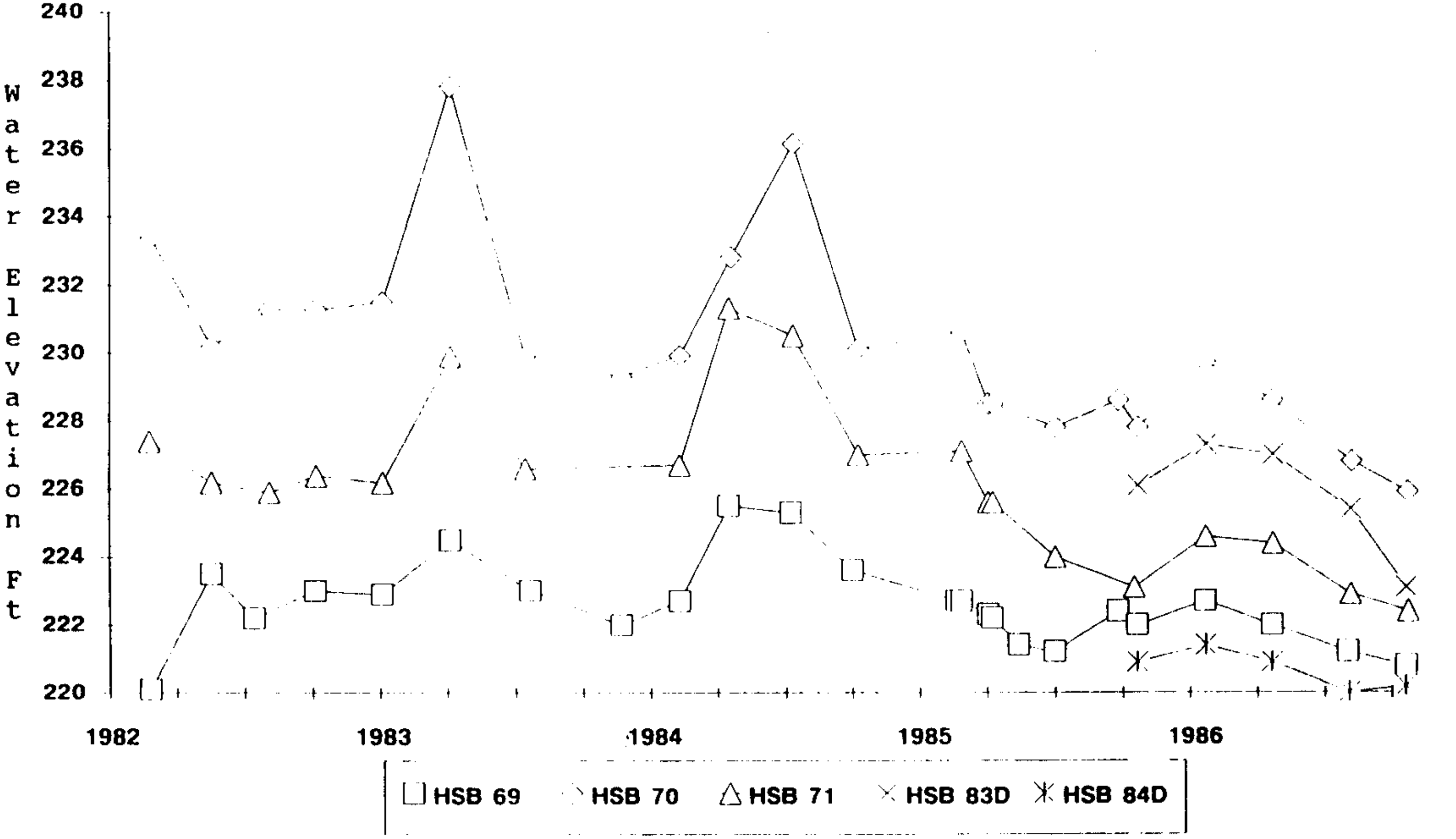


FIGURE 9-28. Hydrograph of H-Area Seepage Basins Water-Table Monitoring Wells HSB 69 Through HSB 84D

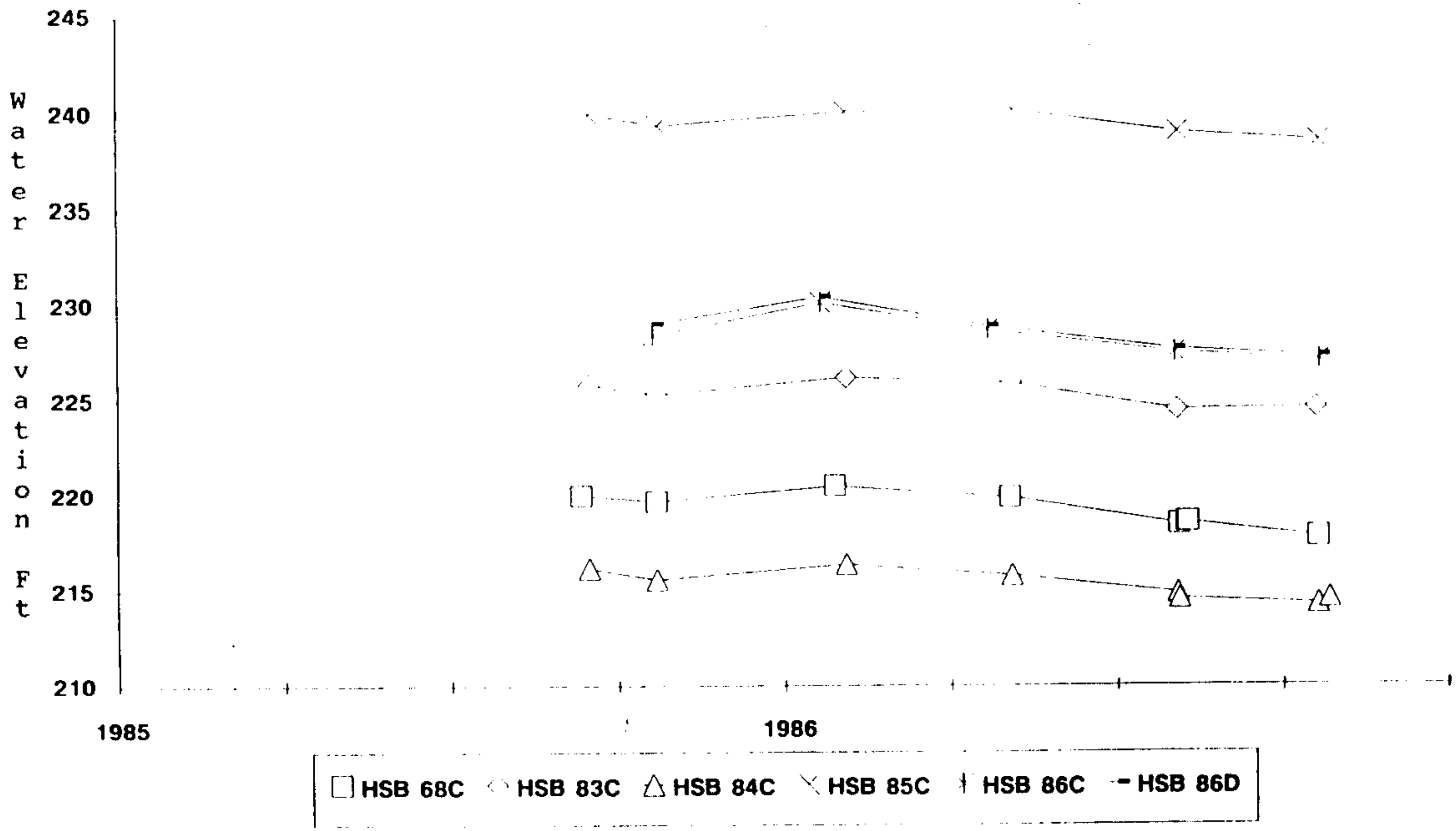


FIGURE 9-29. Hydrograph of H-Area Seepage Basins Water-Table Monitoring Wells HSB 68C Through HSB 86D

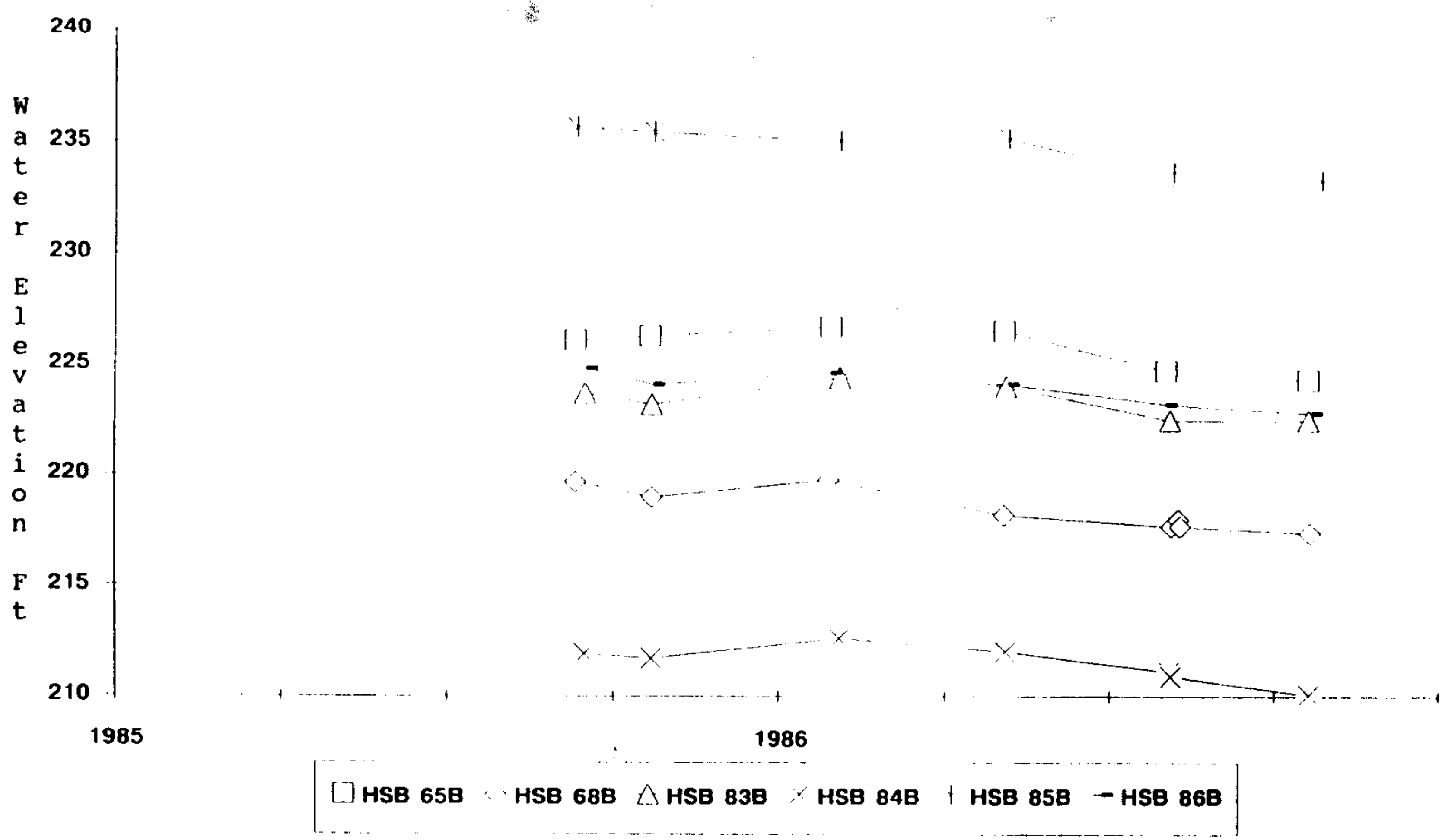


FIGURE 9-30. Hydrograph of the H-Area Seepage Basins McBean Formation Monitoring Wells

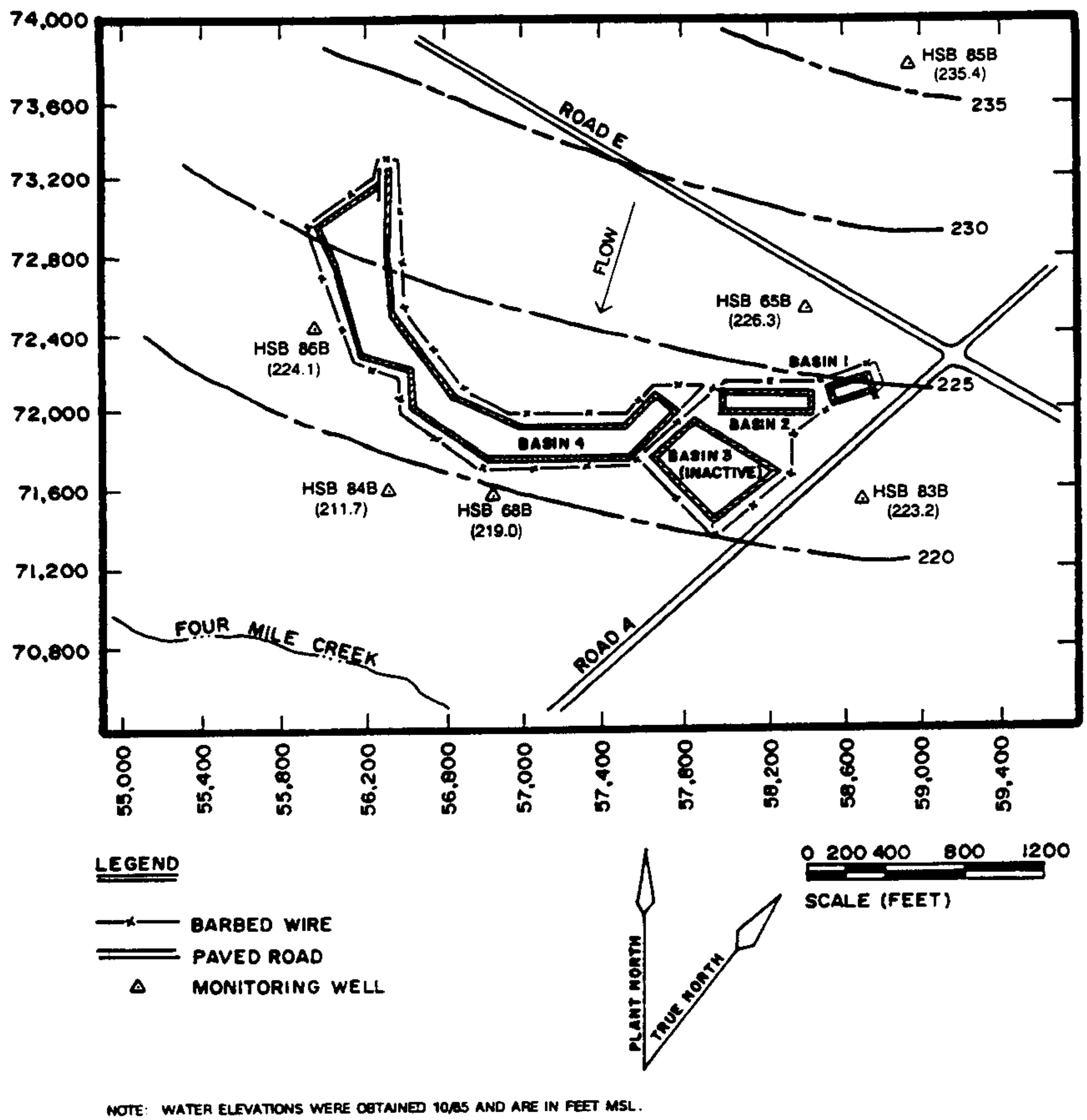


FIGURE 9-31. McBean Formation Piezometric Contour Map at the H-Area Seepage Basins

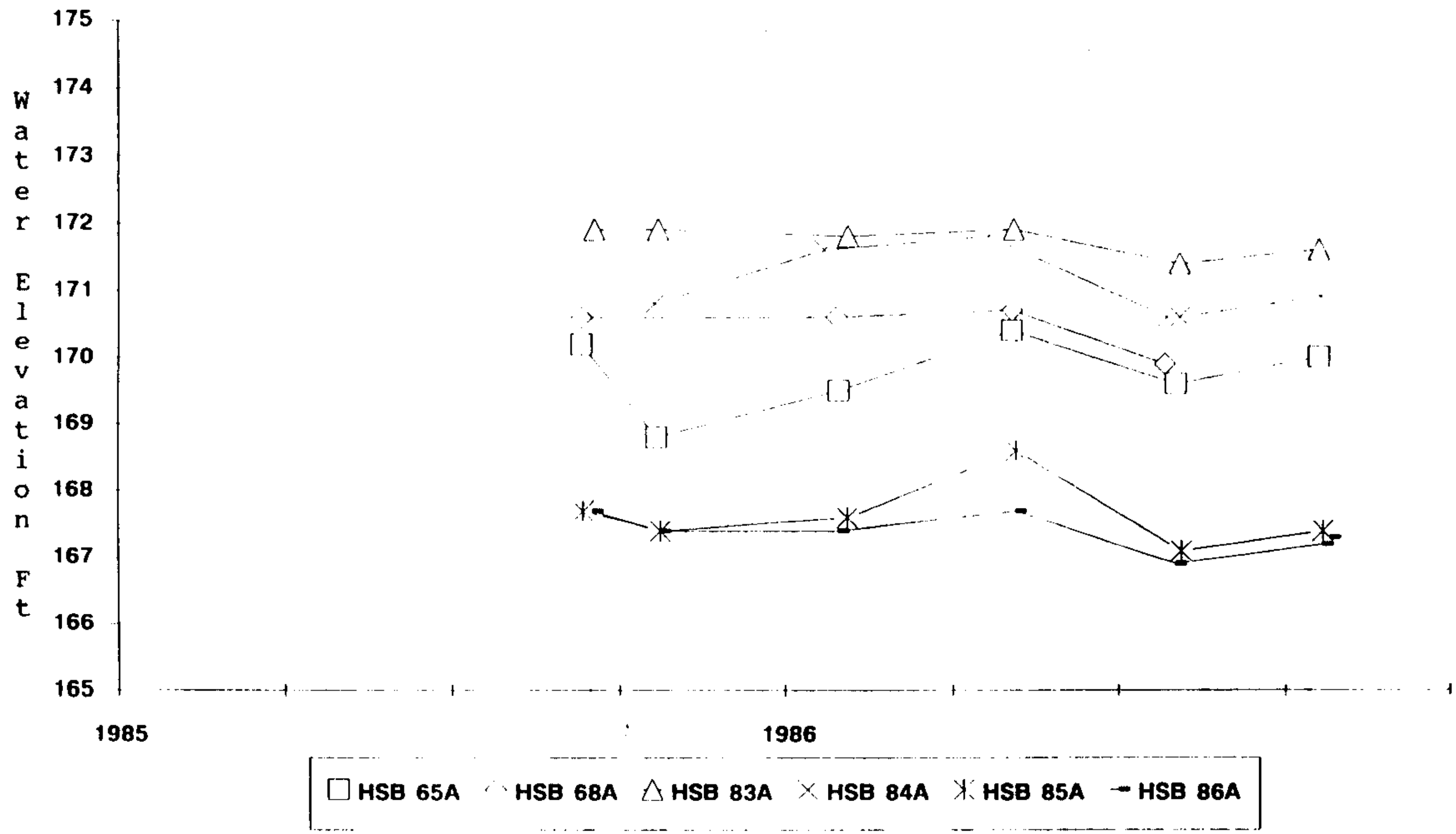


FIGURE 9-32. Hydrograph of the H-Area Seepage Basins Congaree Formation Monitoring Wells

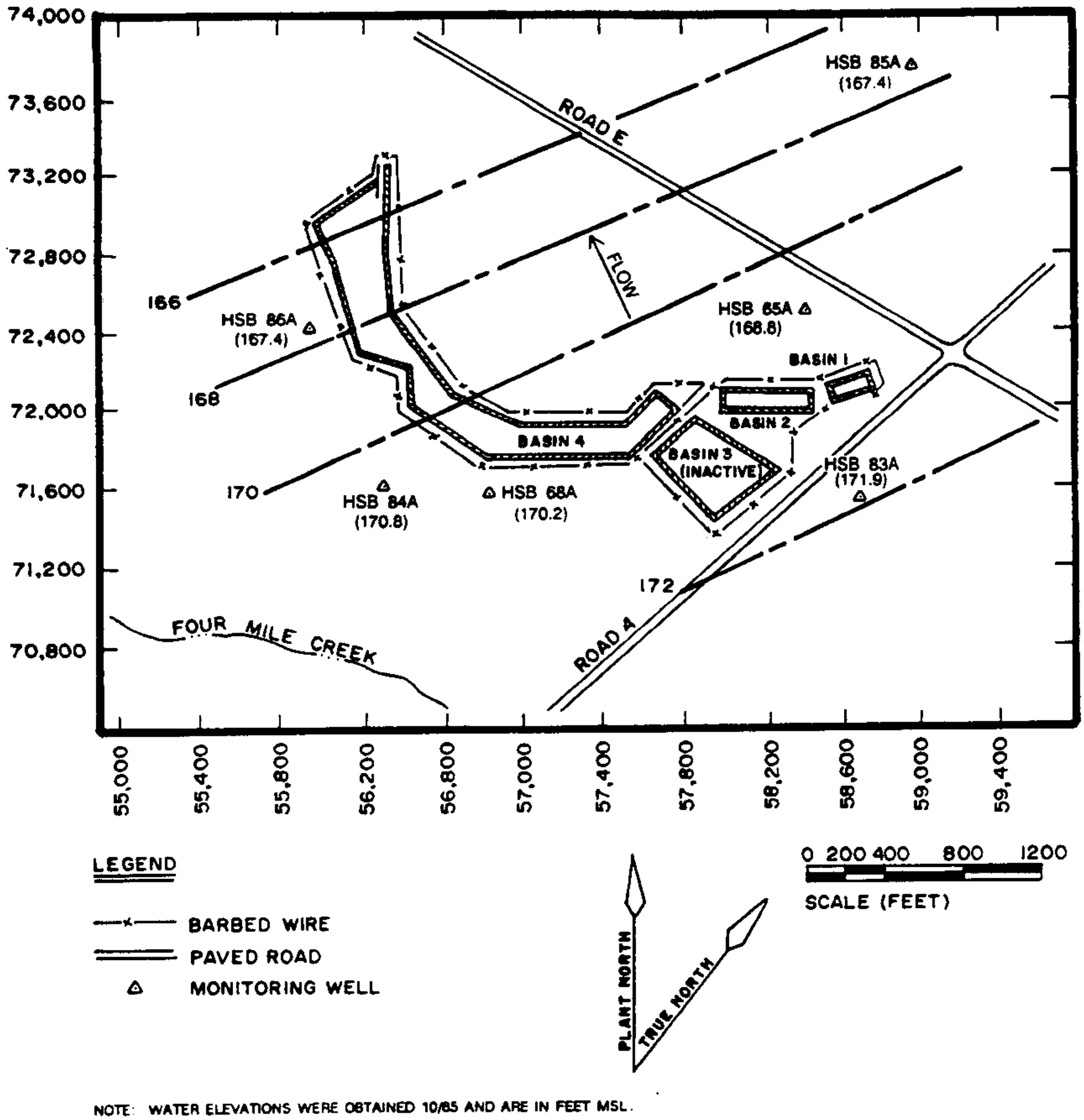


FIGURE 9-33. Congaree Formation Piezometric Contour Map at the H-Area Seepage Basins

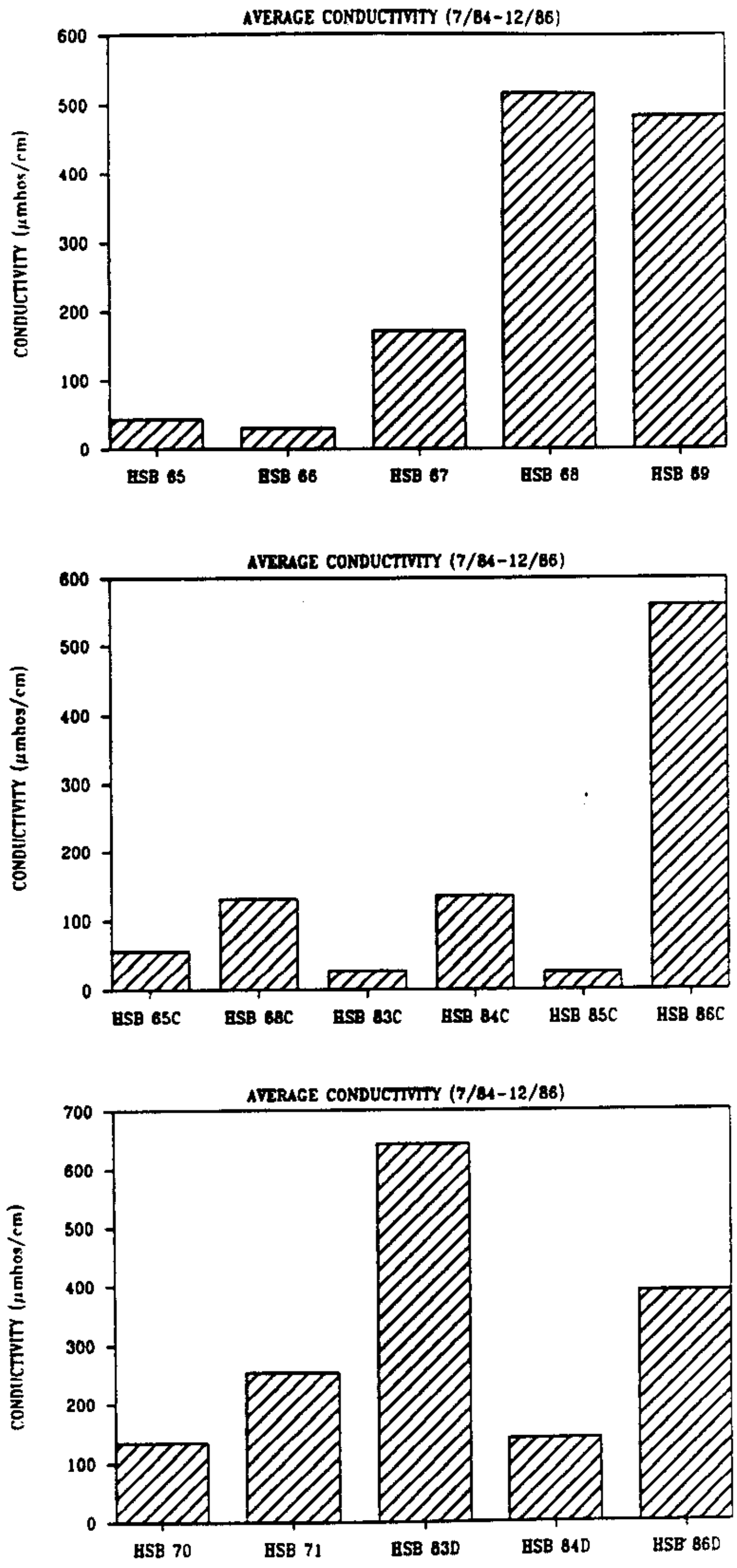


FIGURE 9-34. Average Conductivity in the H-Area Seepage Basins Water-Table Monitoring Wells

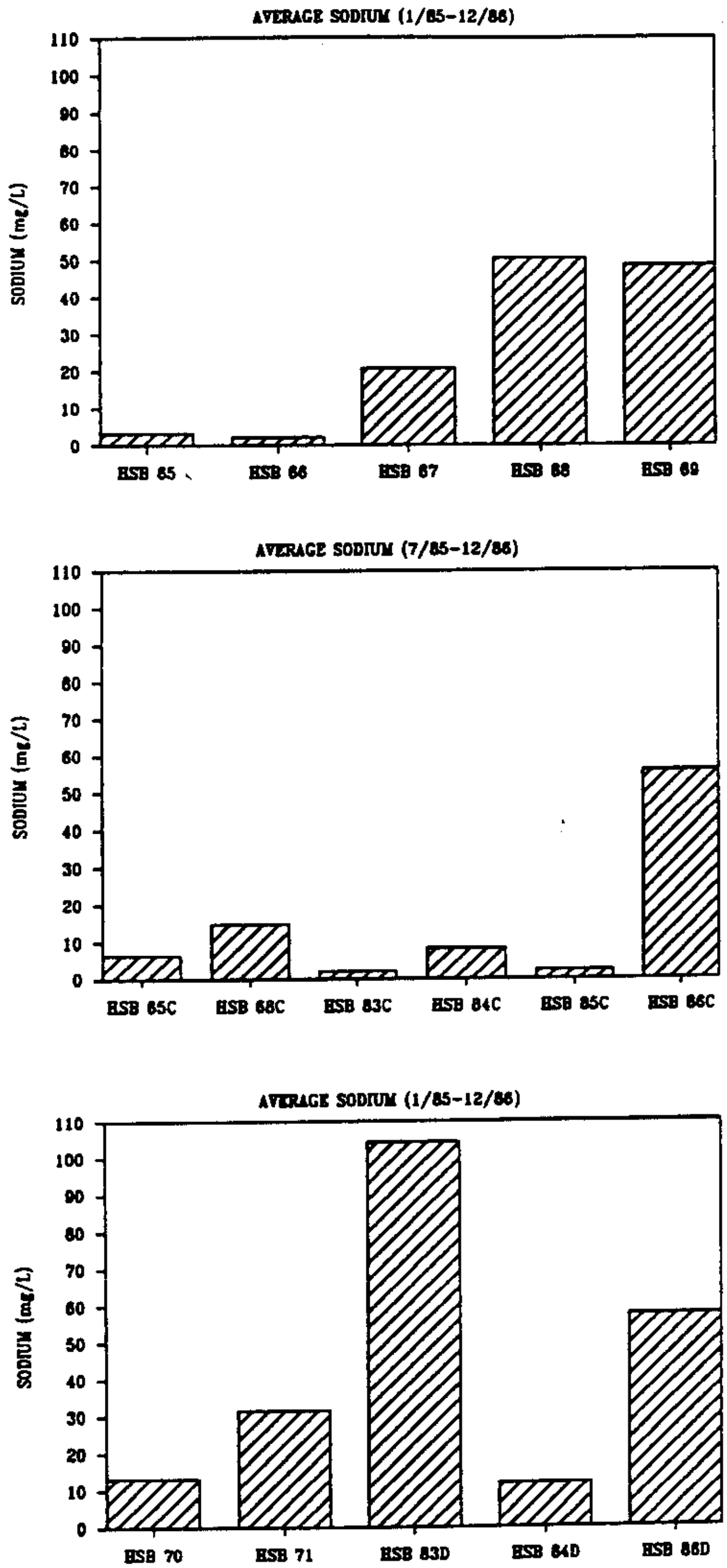


FIGURE 9-35. Average Sodium Concentrations in the H-Area Seepage Basins Water-Table Monitoring Wells

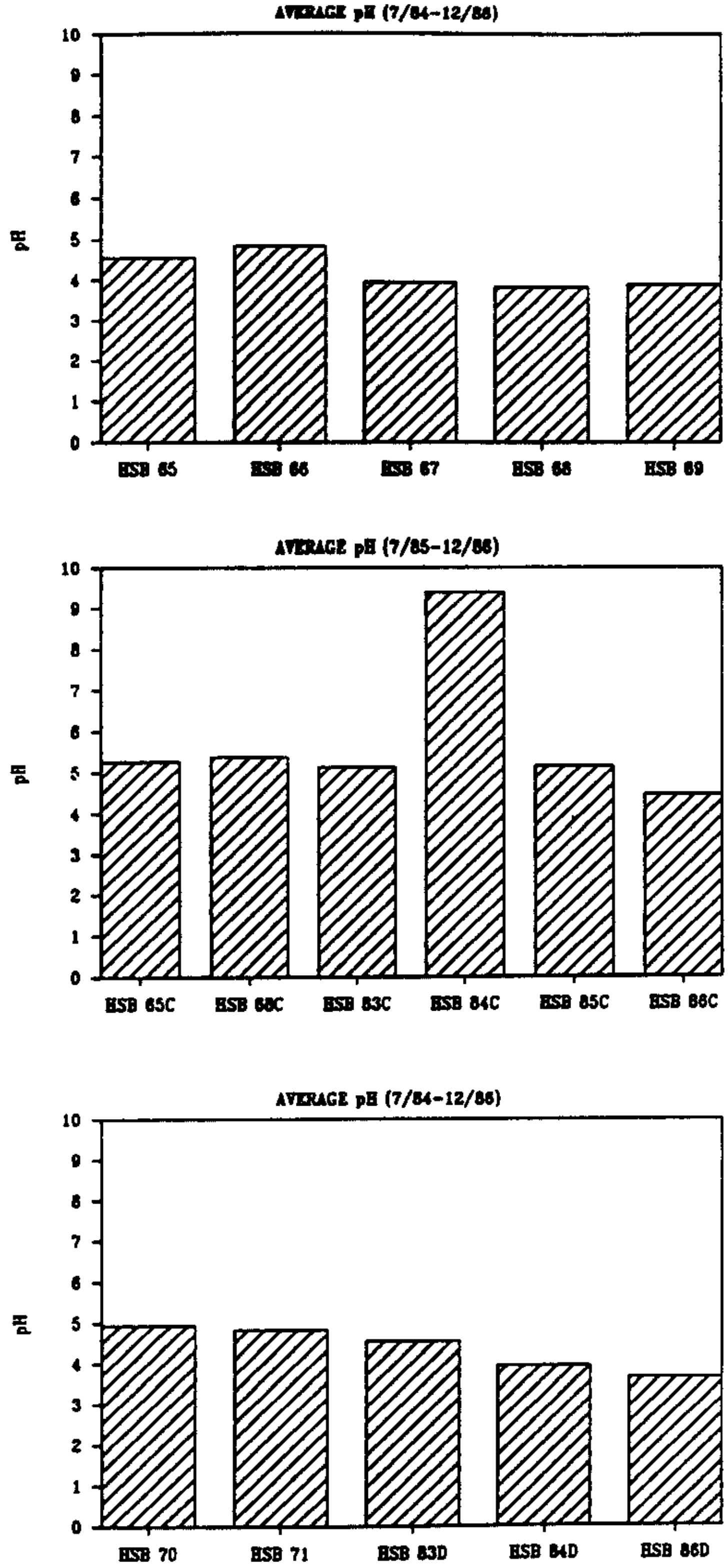


FIGURE 9-36. Average pH in the H-Area Seepage Basins Water-Table Monitoring Wells

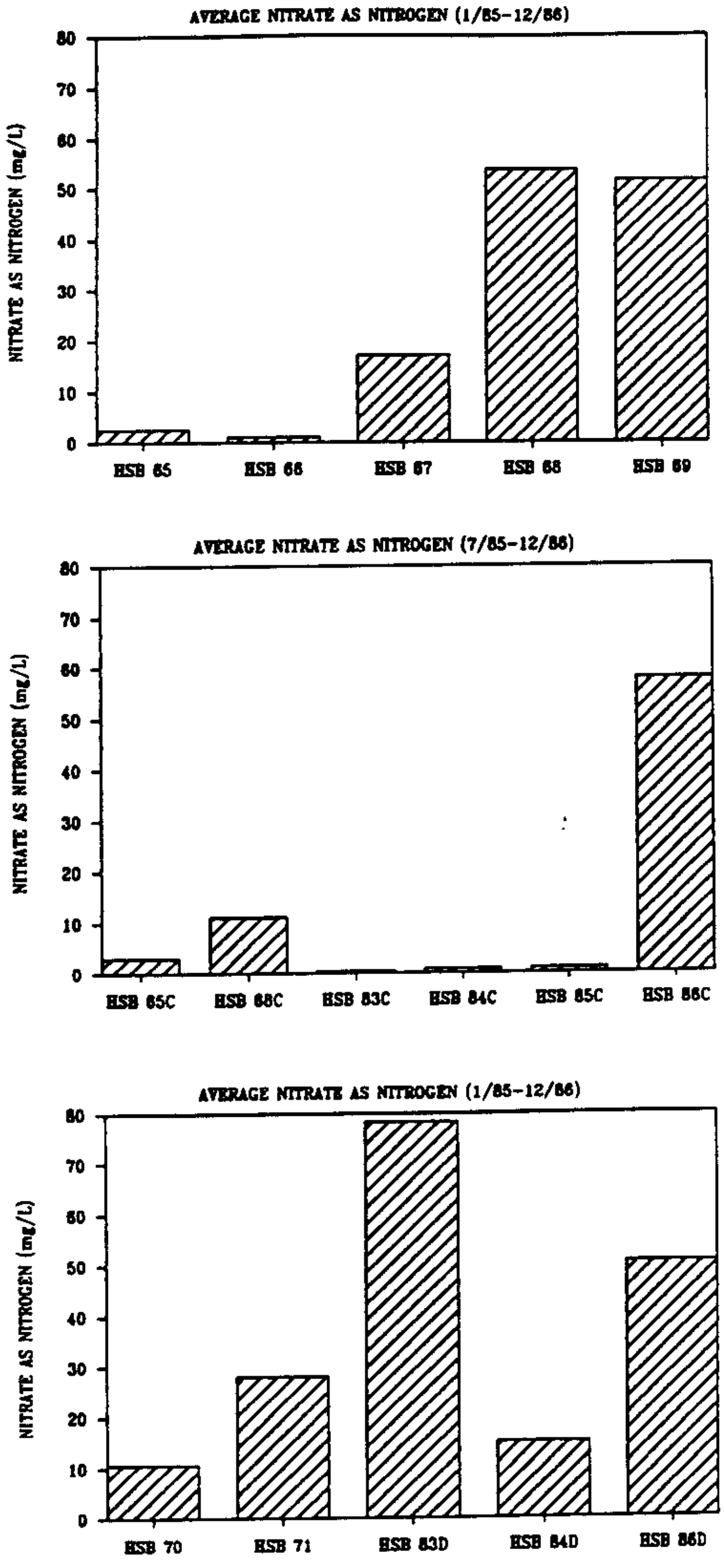


FIGURE 9-37. Average Nitrate (as N) Concentrations in the H-Area Seepage Basins Water-Table Monitoring Wells

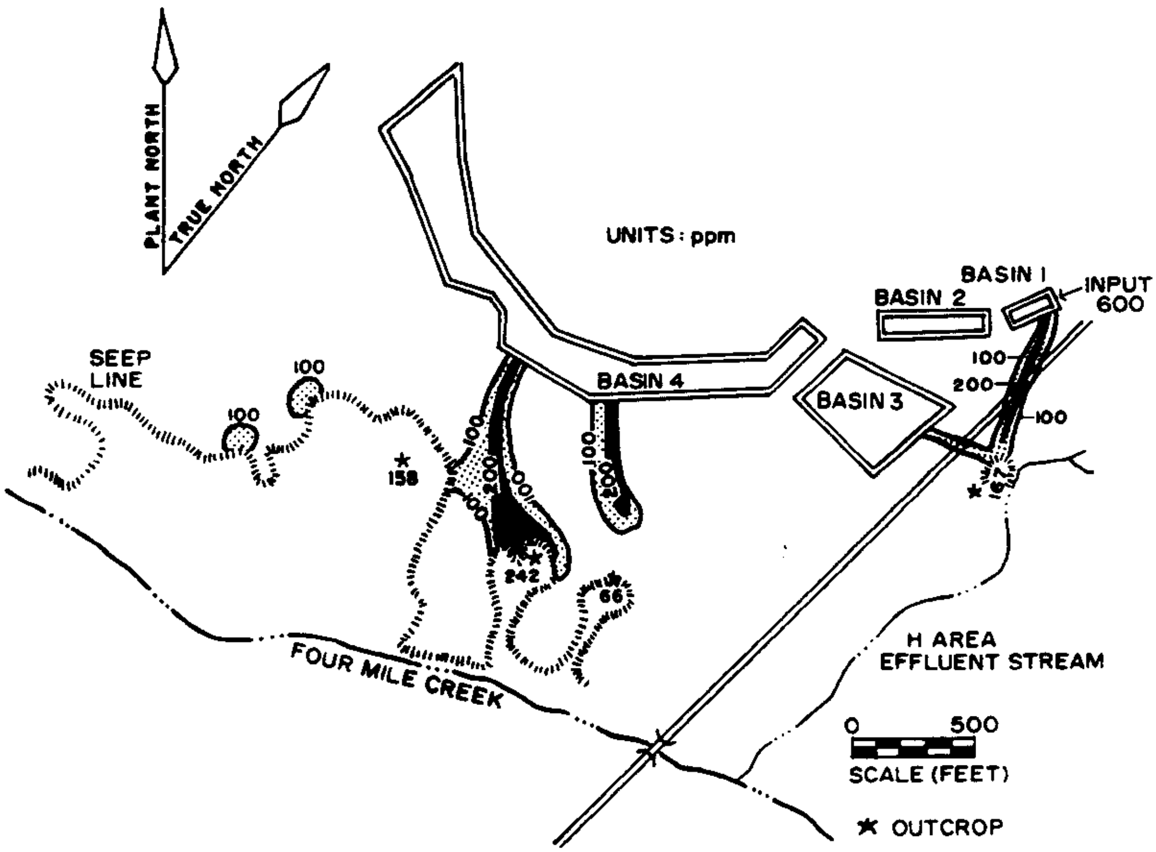


FIGURE 9-38. Isoconcentration Contours of Nitrate in Groundwater at the H-Area Seepage Basins

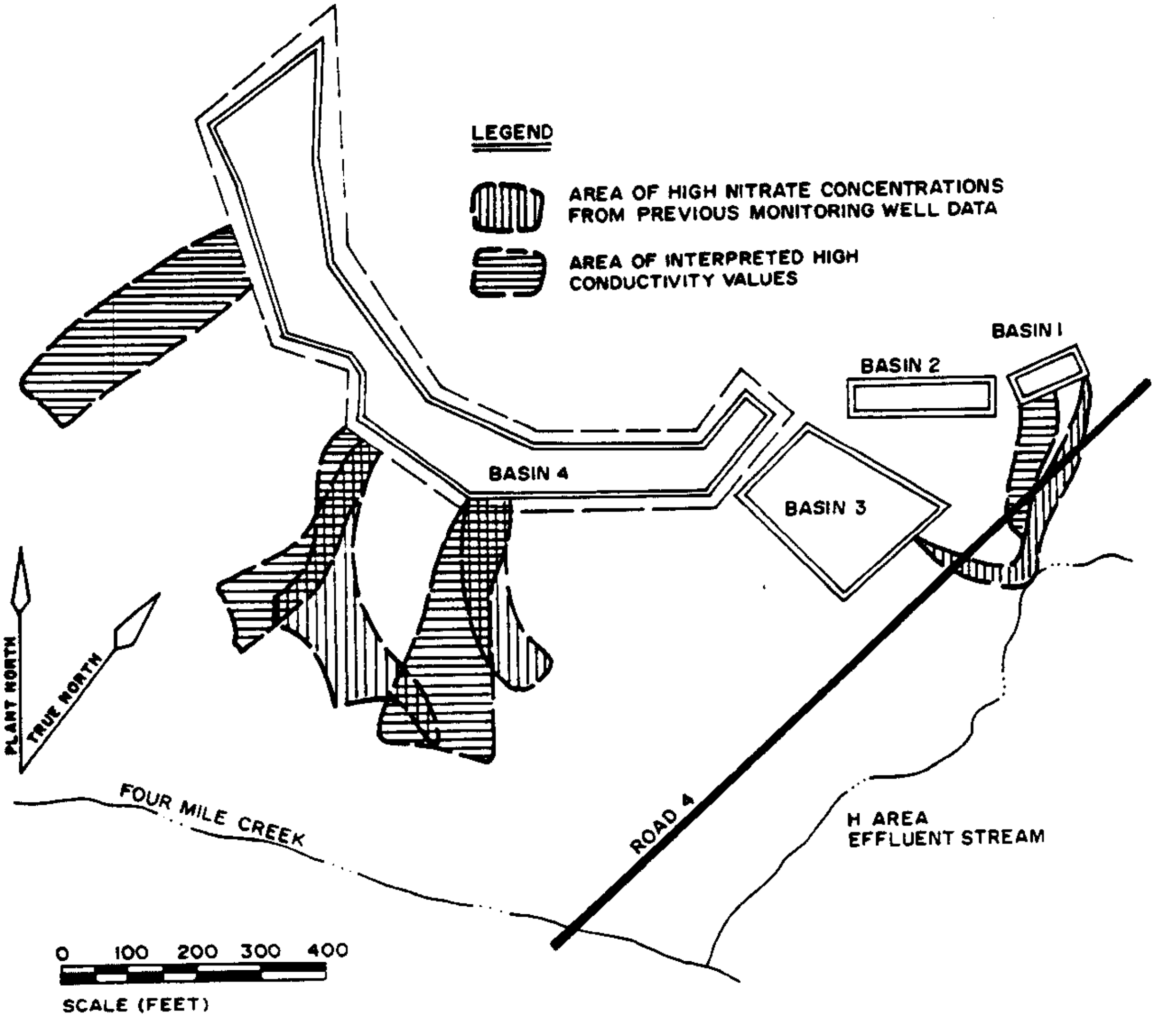


FIGURE 9-39. Comparison of Groundwater Nitrate Plumes with Areas of High Terrain Conductivity Values

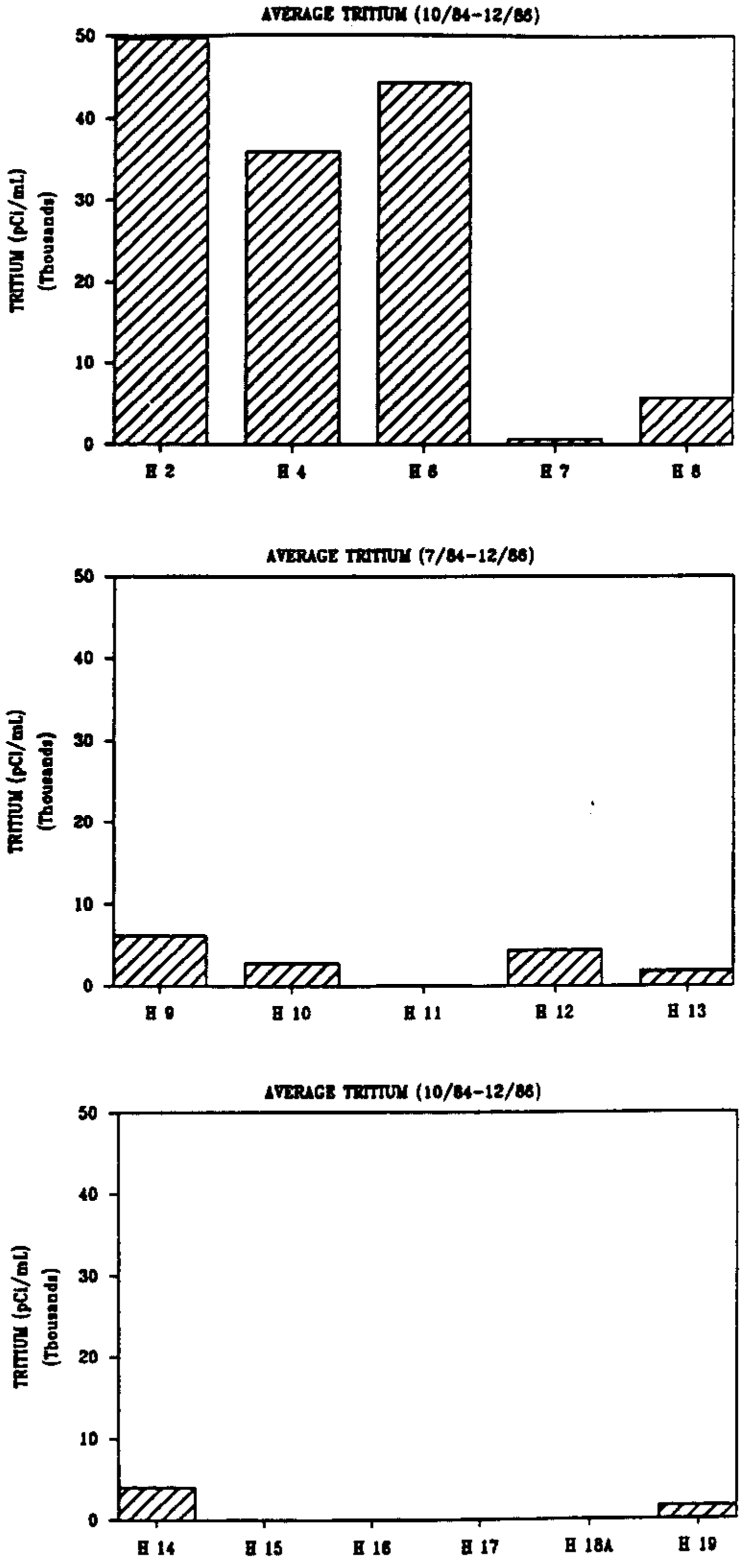


FIGURE 9-40. Average Tritium Activity in the H-Area Seepage Basins H Series Water-Table Monitoring Wells

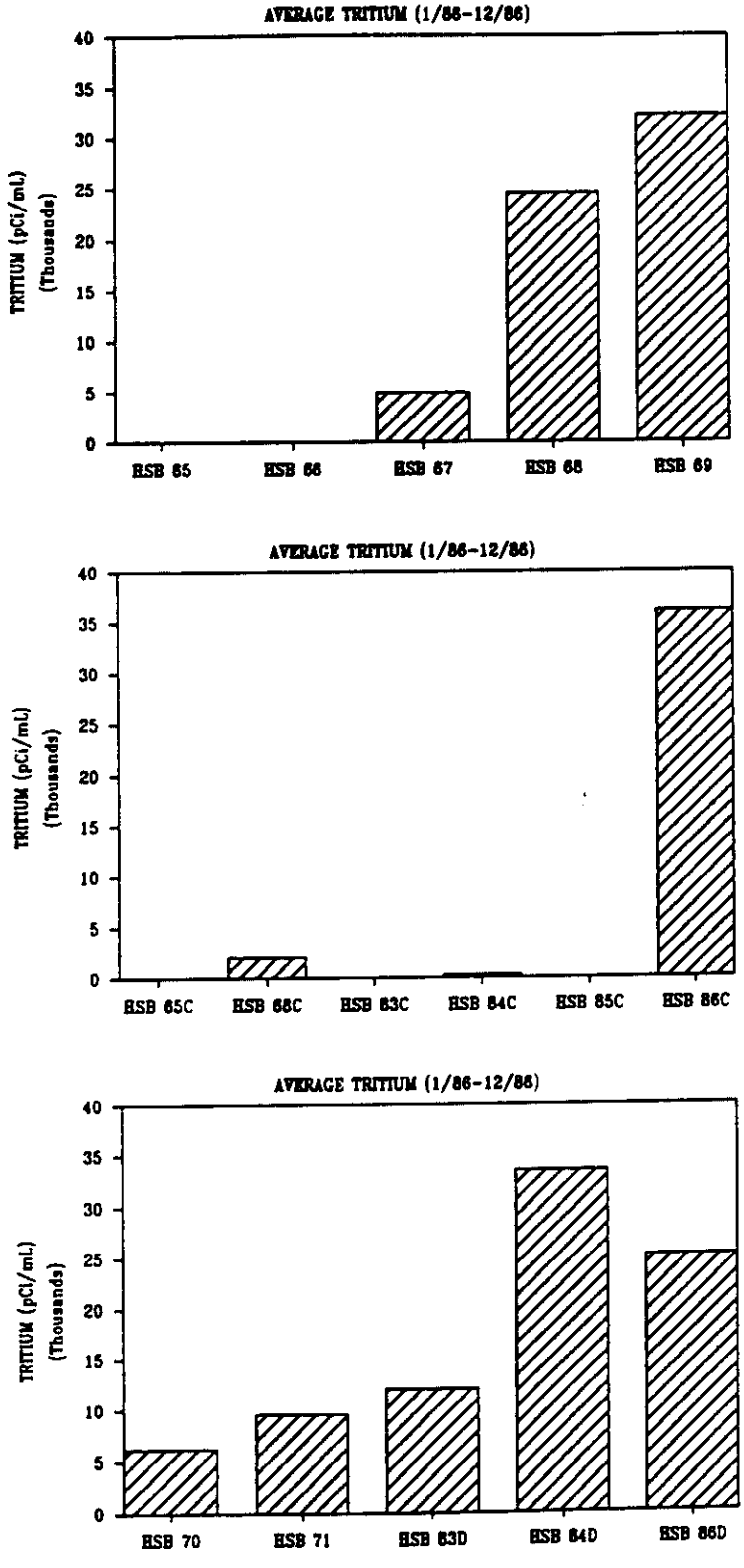


FIGURE 9-41. Average Tritium Activity in the H-Area Seepage Basins HSB Series Water-Table Monitoring Wells

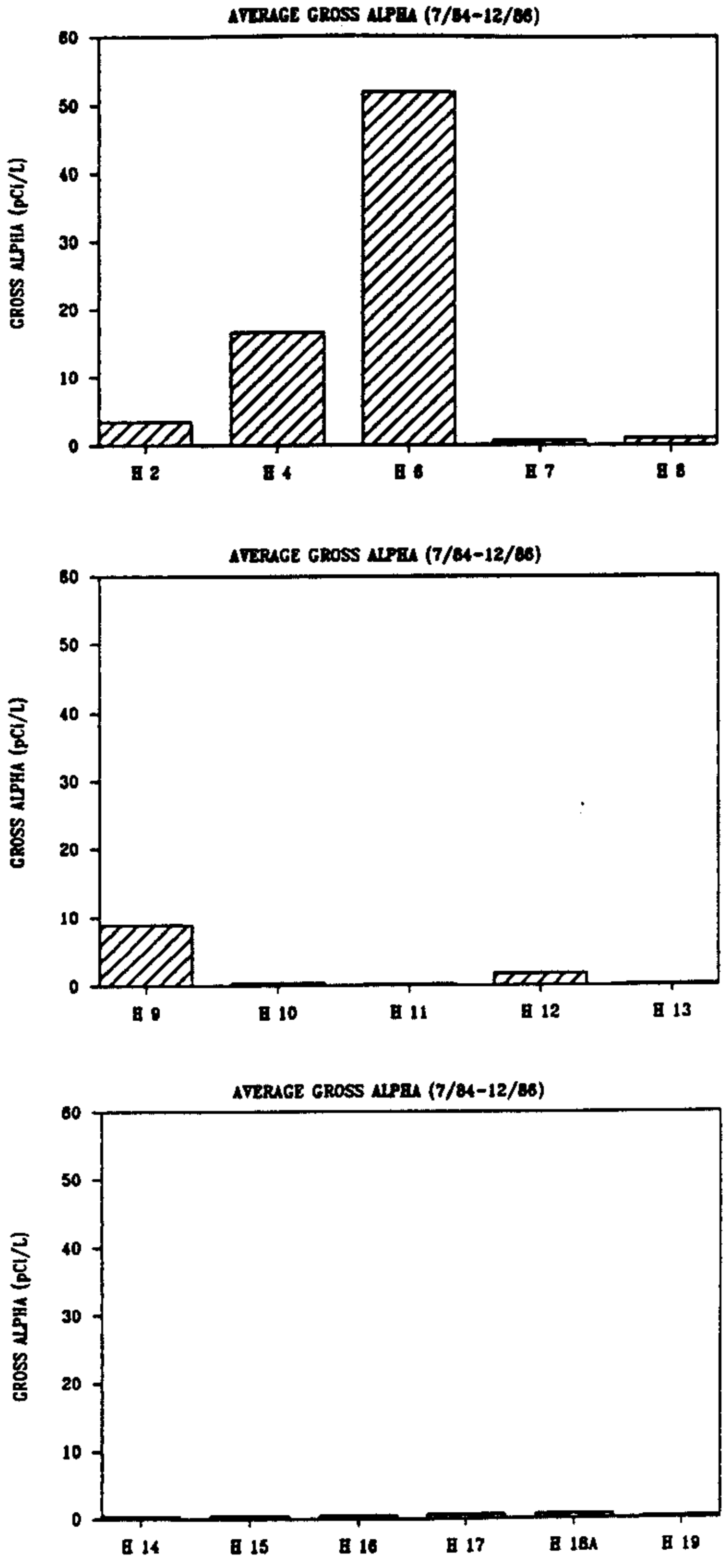


FIGURE 9-42. Average Gross Alpha Activity in the H-Area Seepage Basins H Series Water-Table Monitoring Wells

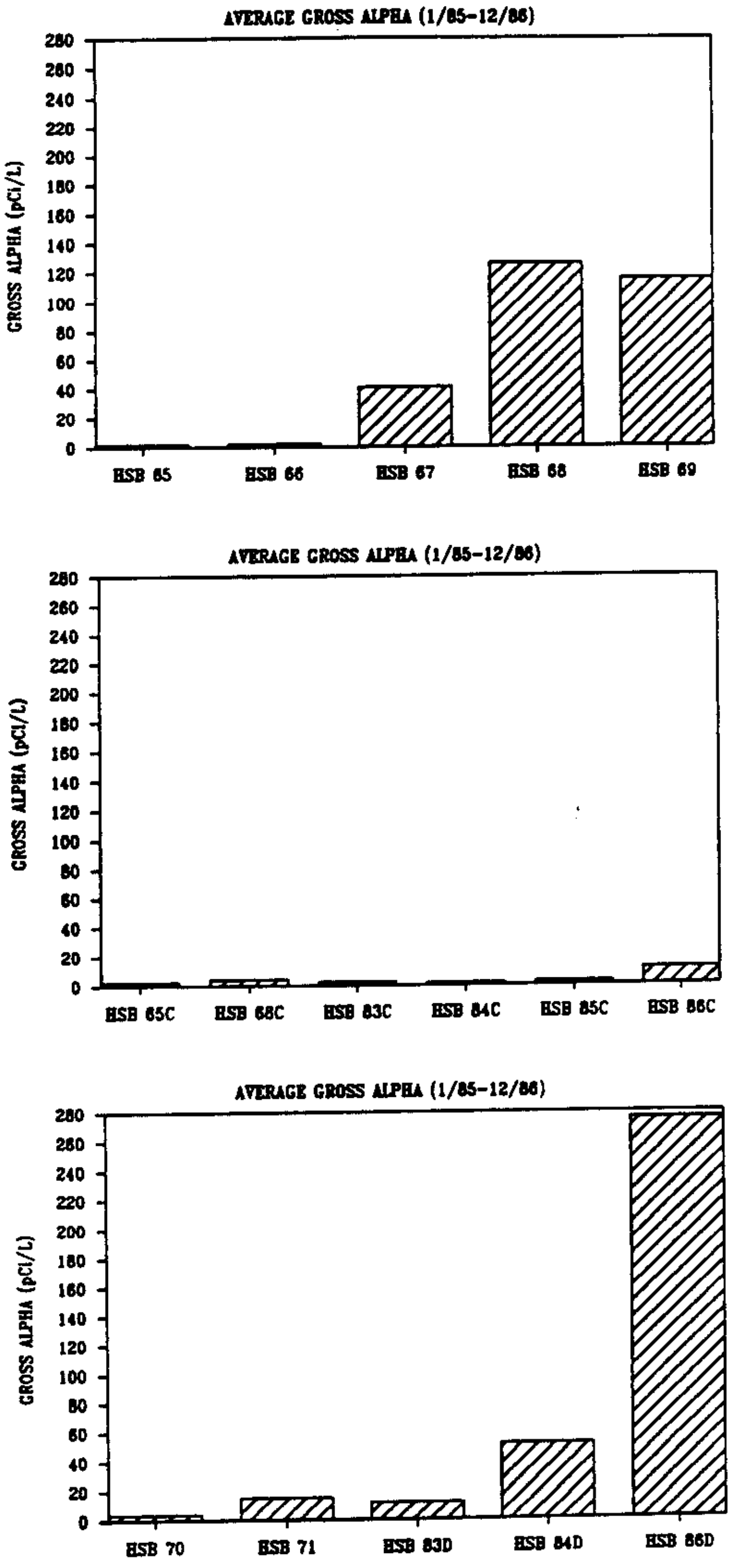


FIGURE 9-43. Average Gross Alpha Activity in the H-Area Seepage Basins HSB Series Water-Table Monitoring Wells

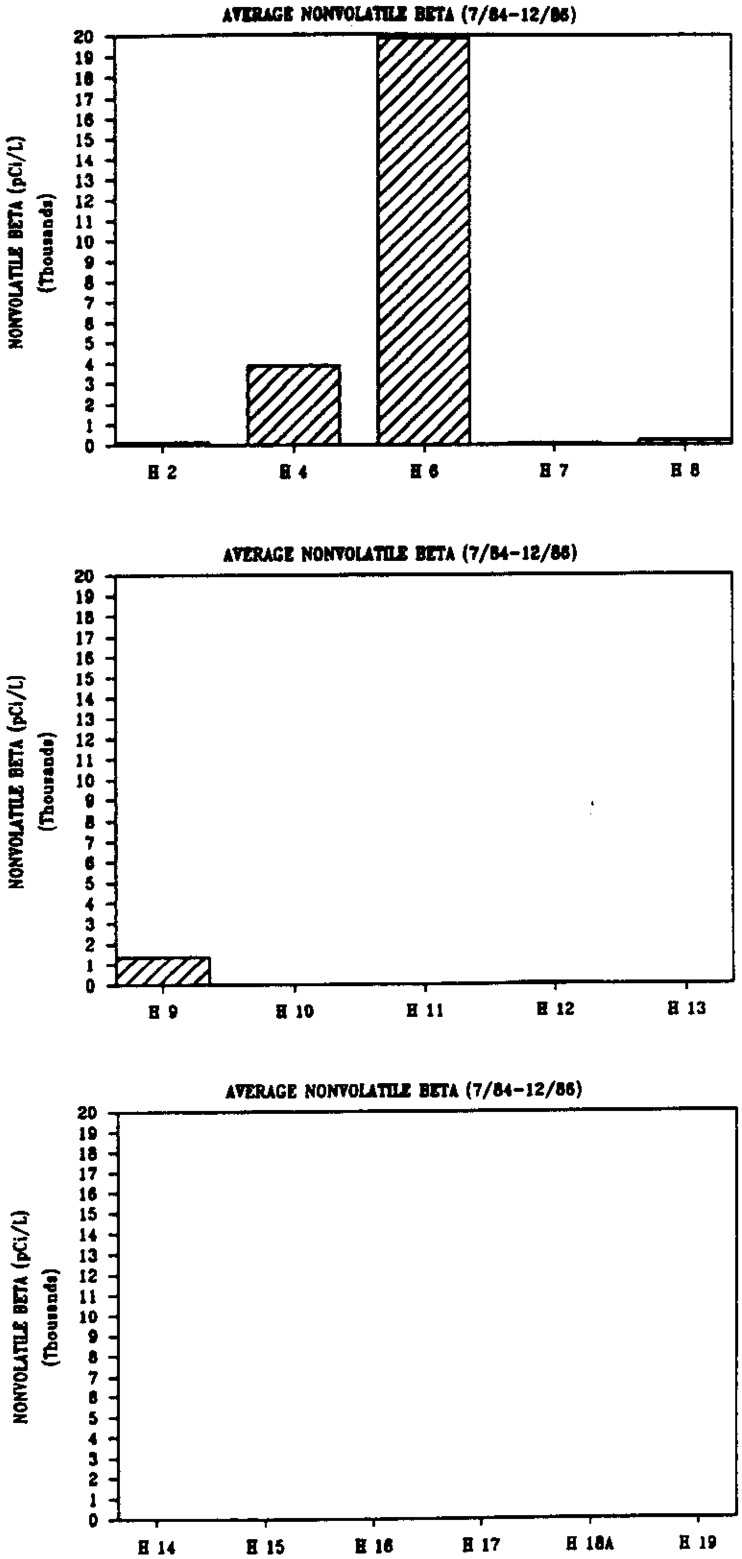


FIGURE 9-44. Average Nonvolatile Beta Activity in the H-Area Seepage Basins H Series Water-Table Monitoring Wells

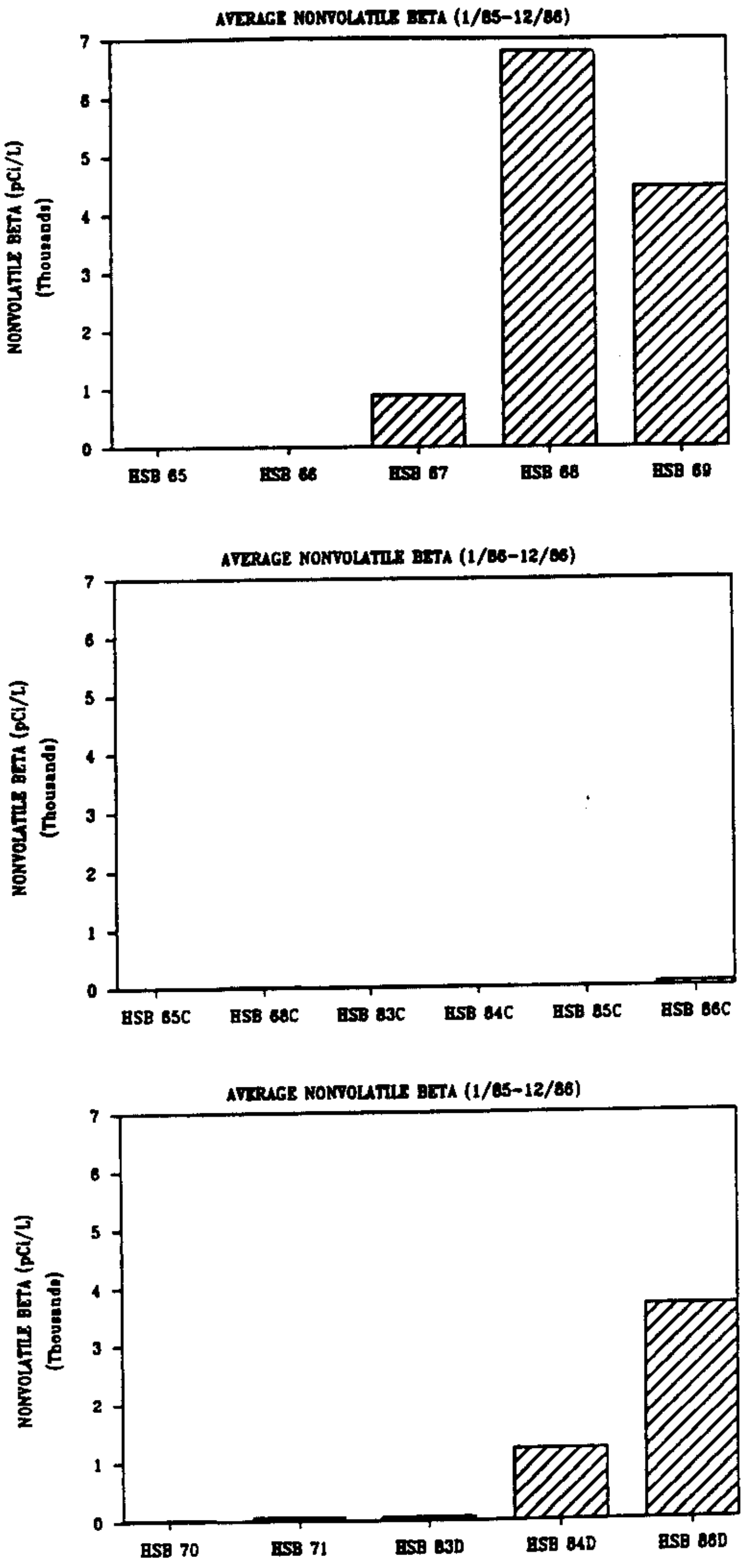


FIGURE 9-45. Average Nonvolatile Beta Activity in the H-Area Seepage Basins HSB Series Water-Table Monitoring Wells

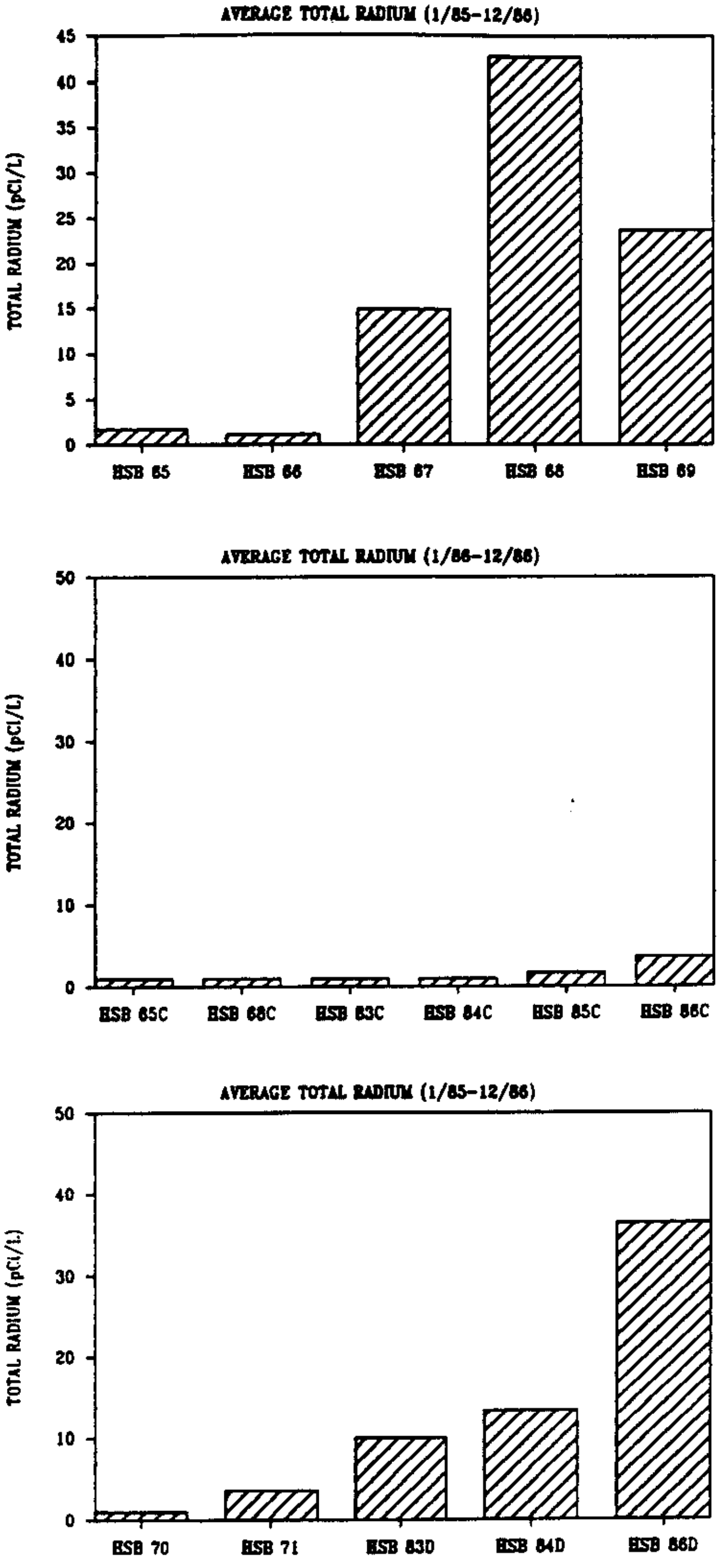


FIGURE 9-46. Average Total Radium Activity in the H-Area Seepage Basins HSB Series Water-Table Monitoring Wells

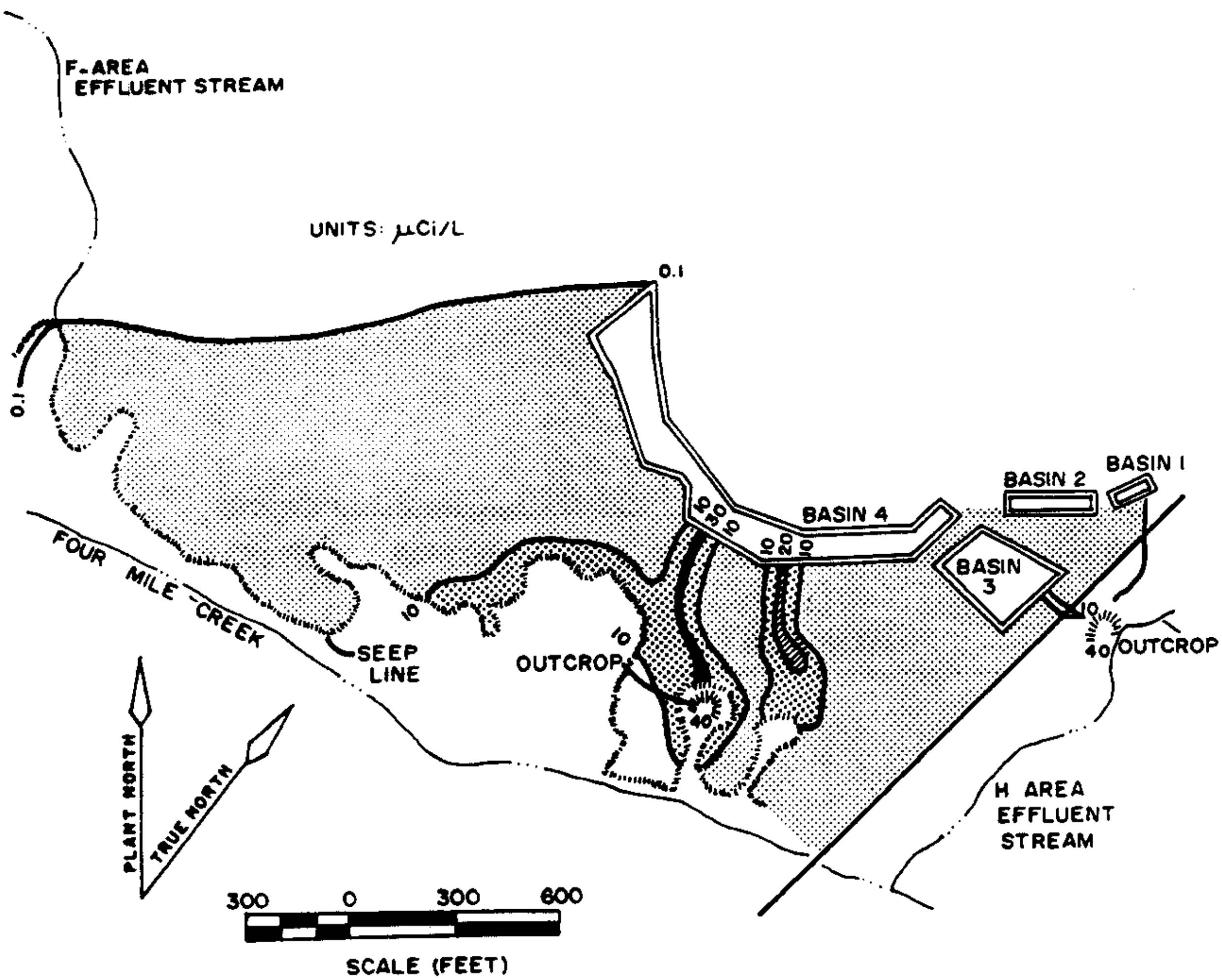


FIGURE 9-47. Isoconcentration Contours of Tritium in Groundwater at the H-Area Seepage Basins

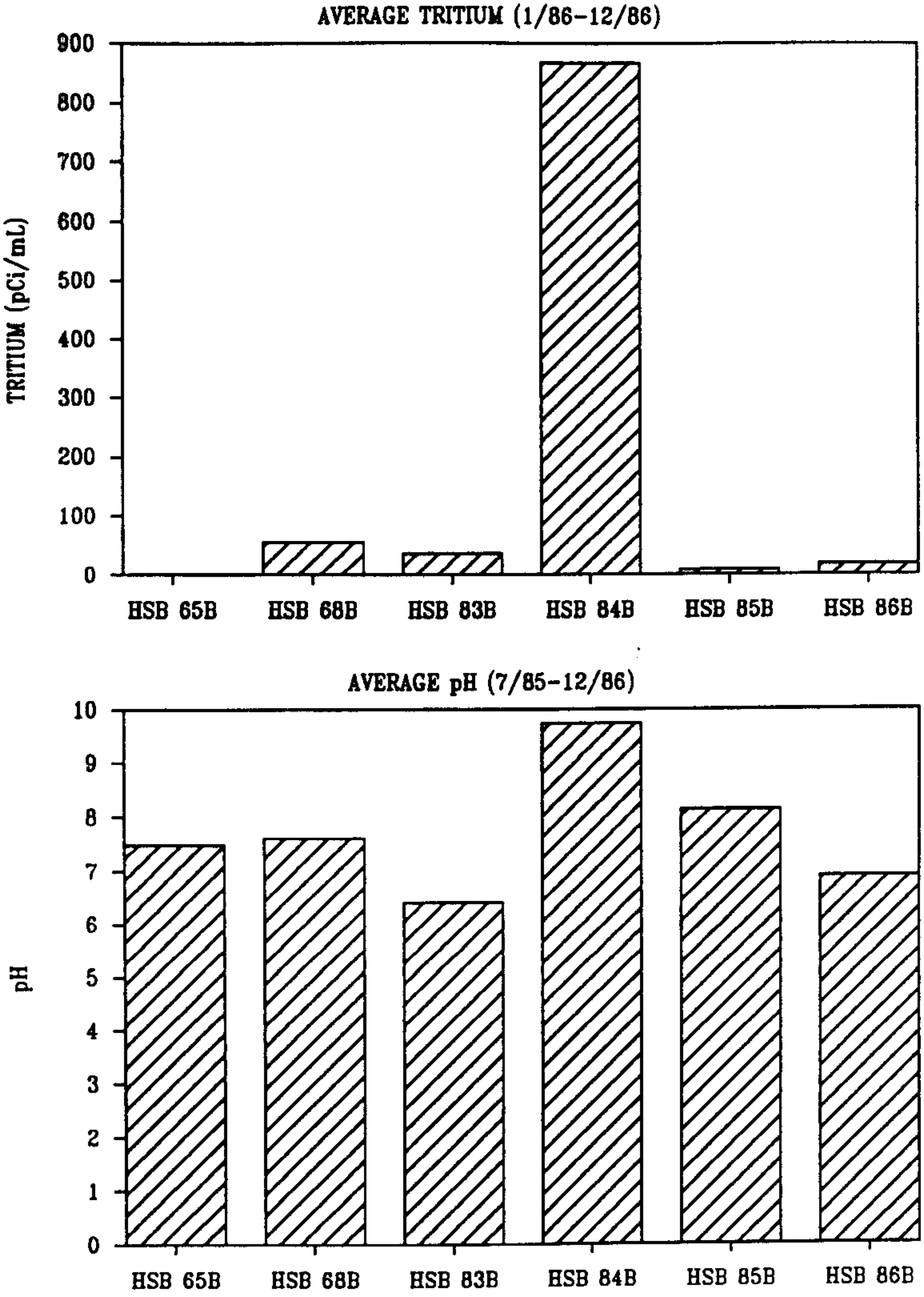


FIGURE 9-48. Average Tritium Activity and pH in the H-Area Seepage Basins McBean Formation Monitoring Wells

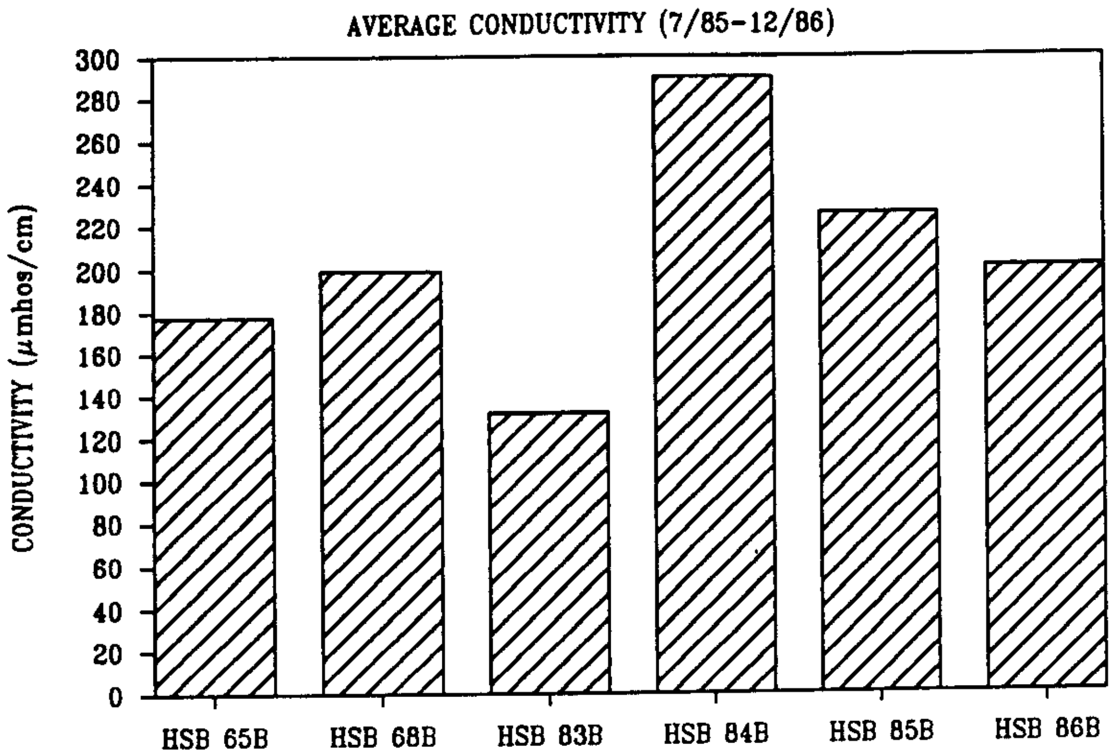


FIGURE 9-49. Average Conductivity in the H-Area Seepage Basins McBean Formation Monitoring Wells

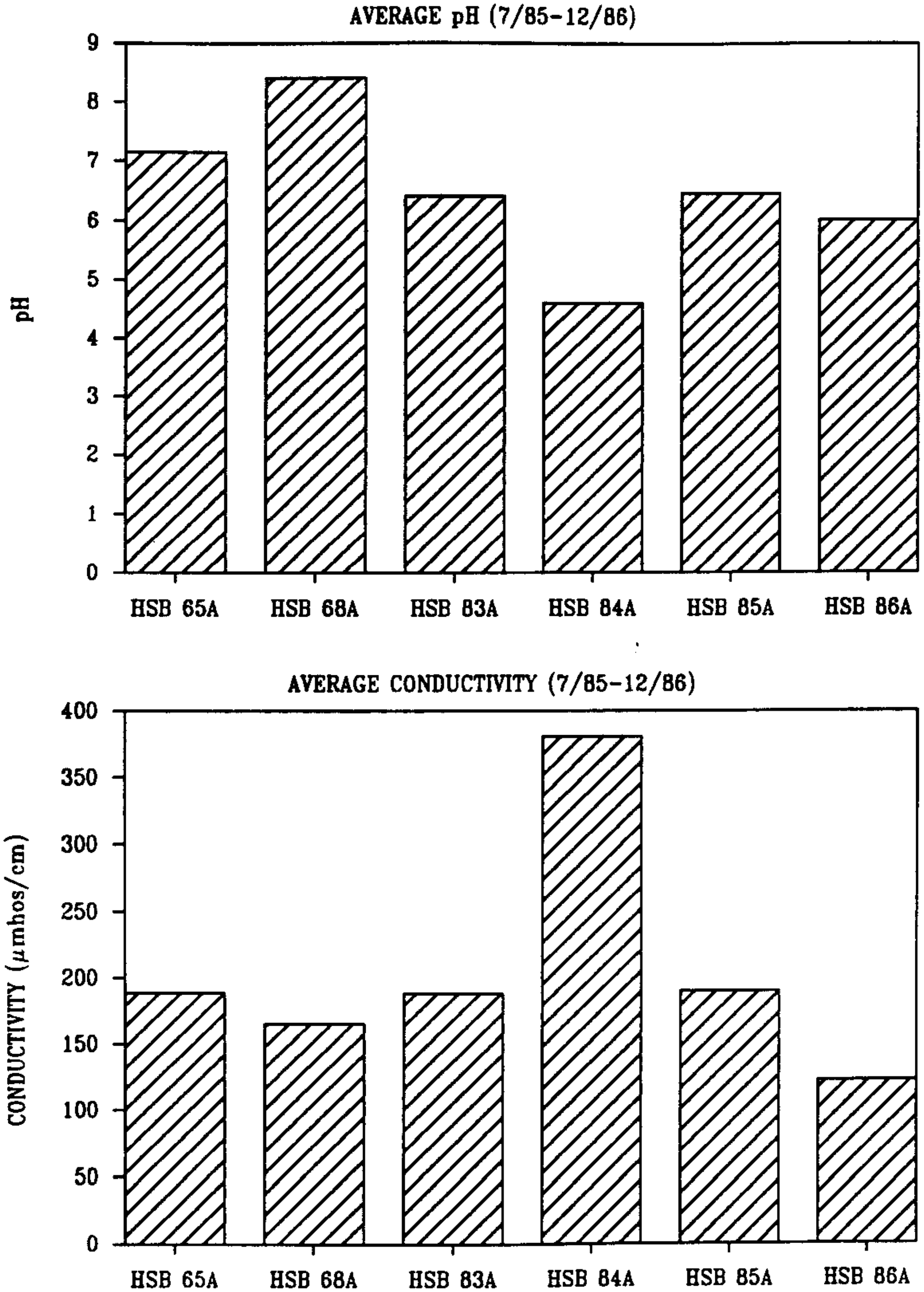
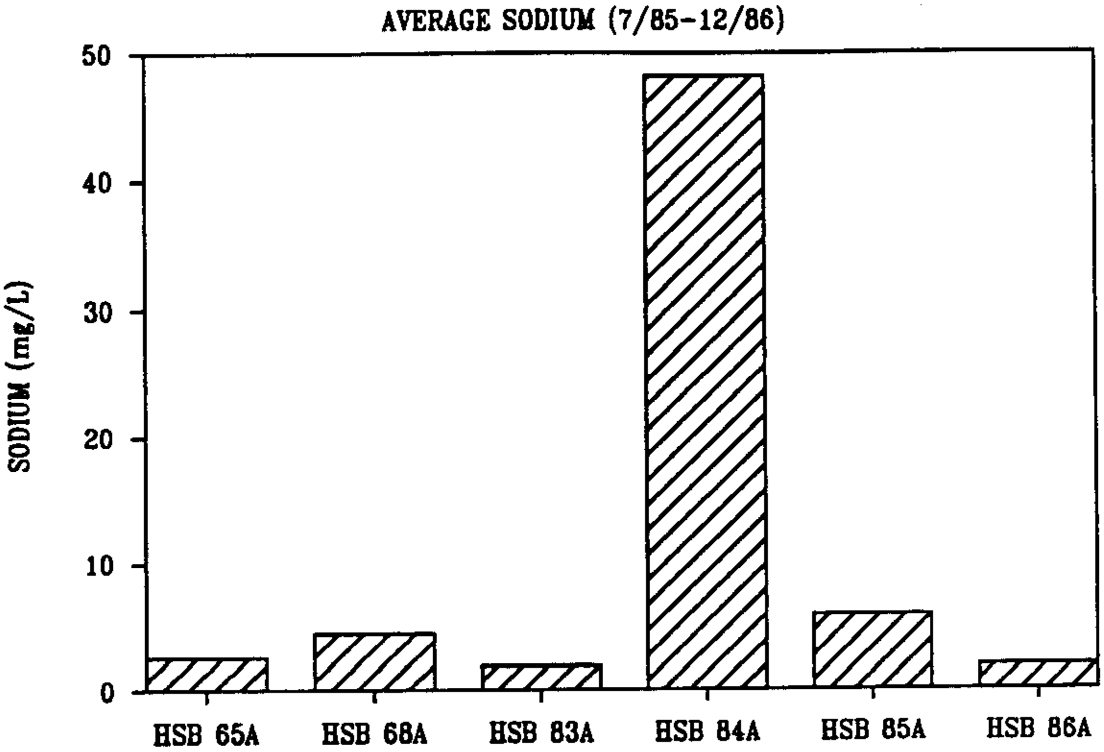


FIGURE 9-50. Average pH and Conductivity in the H-Area Seepage Basins Congaree Formation Monitoring Wells



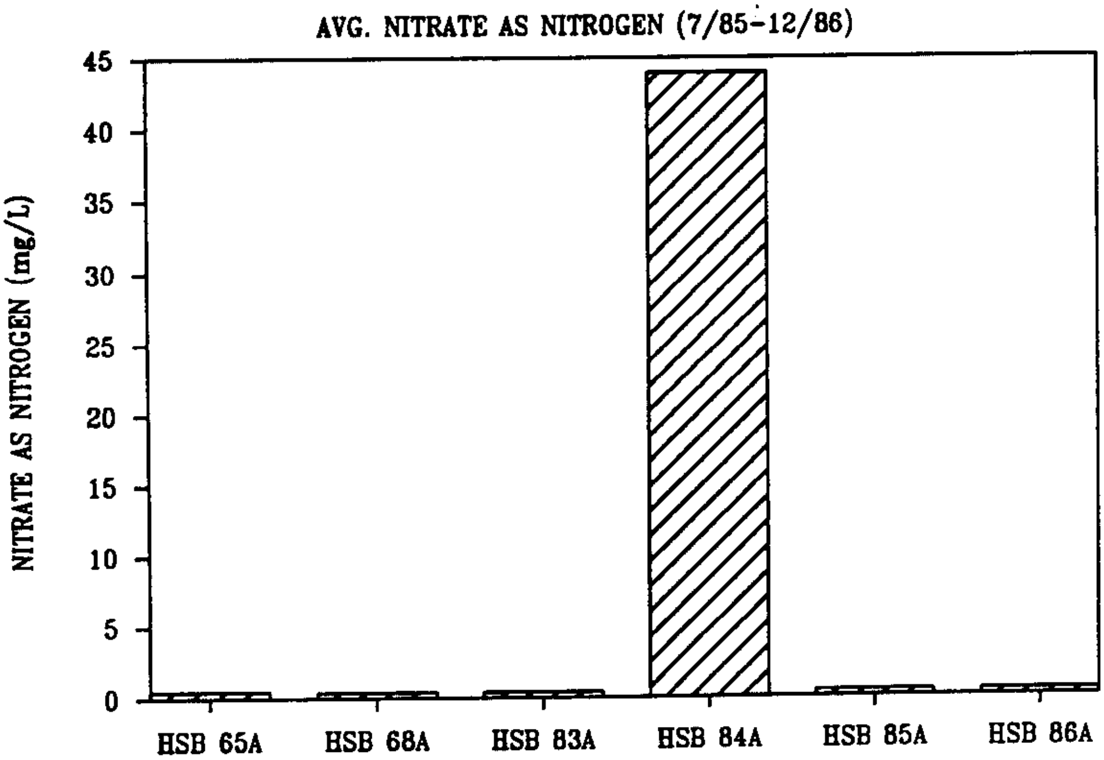
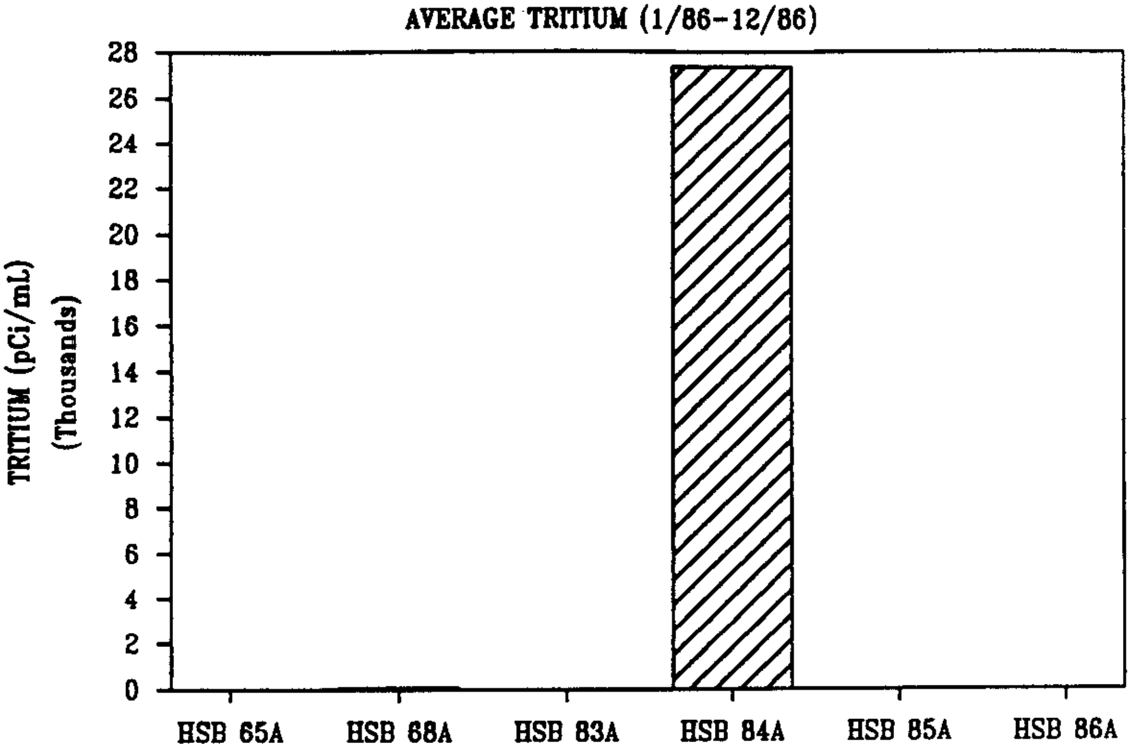


FIGURE 9-51. Average Sodium and Nitrate (as N) Concentrations in the H-Area Seepage Basins Congaree Formation Monitoring Wells



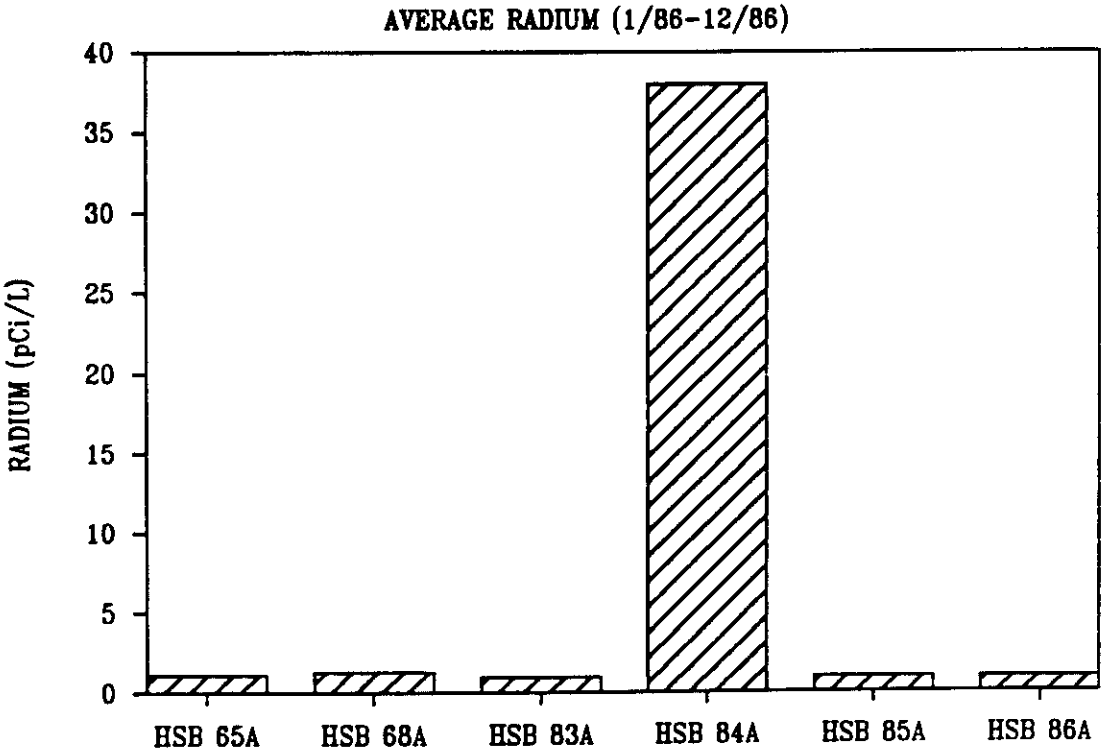


FIGURE 9-52. Average Tritium and Total Radium Activities in the H-Area Seepage Basins Congaree Formation Monitoring Wells

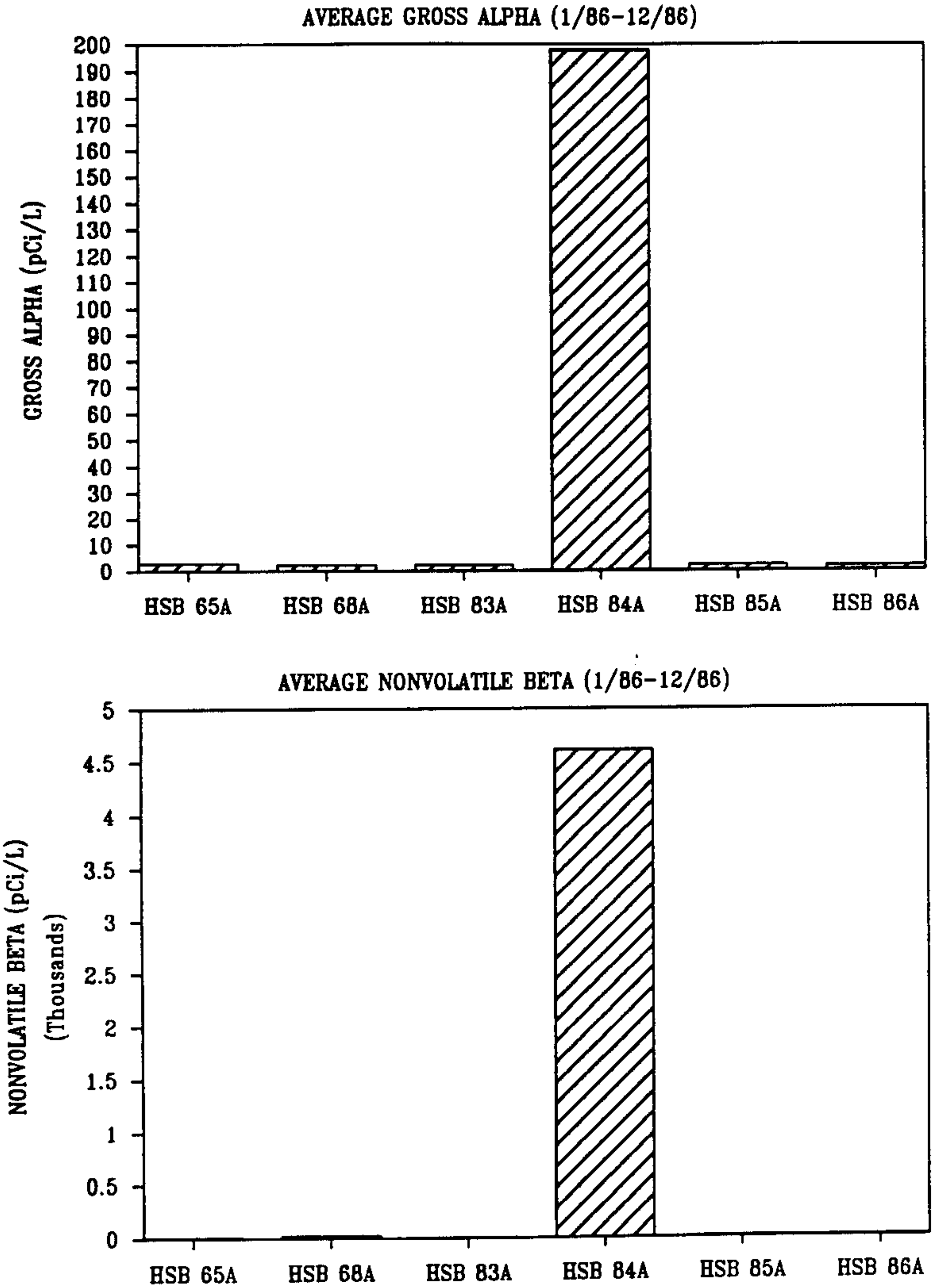


FIGURE 9-53. Average Gross Alpha and Nonvolatile Beta Activities in the H-Area Seepage Basins Congaree Formation Monitoring Wells

SECTION 10 K AREA

10.01 GENERAL INFORMATION

10.01.01 General Area Description

K Area is located in the south-central part of SRS as shown in Figure 10-1. The ground surface elevation near the central part of K Area is approximately 260 ft msl, and the slope gently decreases to the west toward Indian Grave Branch and to the east toward Pen Branch.

There are eight K-Area waste sites as indicated in Figure 10-2:

L The K-Area Reactor Seepage Basin

L The K-Area Retention Basin

L The K-Area Acid/Caustic Basin

L The K-Area Coal Pile Runoff Containment Basin

L The K-Area Ash Basin

L The K-Area Burning/Rubble Pit

L The K-Area Bingham Pump Outage Pit

L The K-Area Earthen Basin (see Section 15)

10.01.02 General Hydrologic Conditions

By the end of 1986, 26 monitoring wells had been installed around the K-Area waste sites to delineate subsurface conditions and to monitor the water-table elevation and groundwater quality. Twenty-five wells are currently being monitored; the remaining well has been abandoned. Based on the surface geologic map presented by Siple (1967), the monitoring wells in K Area were installed in the Barnwell Formation. Section 3 contains a detailed discussion of the hydrostratigraphy beneath SRS.

The water table in K Area has ranged approximately from 220 to 205 ft msl, and the vadose zone has been approximately 40 to 55 ft thick. As shown in Figure 10-2, K Area is near a groundwater divide. Horizontal groundwater flow generally has been to the northwest toward Indian Grave Branch and to the southwest toward an unnamed tributary of Pen Branch. Groundwater beneath K Area naturally discharges to these tributaries and streams.

Mathematical modeling of the Barnwell Formation near the center of the plant in the Separations Areas indicates that the horizontal groundwater flow velocity ranges approximately from 15 to 60 ft/yr per percent gradient (Duffield et al., 1986; Parizek and Root, 1986). As shown in Figure 10-2, the hydraulic gradient of the water table is variable across K Area. Therefore, the near-surface groundwater flow velocity across K Area will vary. The horizontal flow direction and estimated flow velocity for the water table at each K-Area waste site are discussed in the following specific waste-site sections.

10.01.03 Migration Potential of Dissolved Chemical Constituents from K Area

The potential for any dissolved constituents to be naturally discharged from a waste site to nearby surface water depends on the location of the waste site, the hydraulic gradient, and the flow path between the waste site and the discharge point. Horizontal and vertical groundwater flow velocities also depend upon the medium through which the groundwater travels (i.e., sand, silt, or clay). Similarly, interactions with the soil/sediment medium (retardation) will affect the horizontal and vertical movements of dissolved chemical constituents.

The nearest plant boundary to K Area is approximately 5 mi to the west. Pen Branch and Indian Grave Branch dissect the Barnwell and McBean formations, creating a groundwater island in these formations. Therefore, migration of dissolved waste constituents through the near-surface groundwater system to the plant boundary is not likely.

10.02 K-AREA REACTOR SEEPAGE BASIN

10.02.01 Summary

The K-Area Reactor Seepage Basin (Building 904-65G) was built in 1957 to receive low-level radioactive purge water from the K-Area Disassembly Basin. Available records indicate that the seepage basin did not receive any purge water until 1959. A review of the radioactive releases to the K-Area Reactor Seepage Basin shows that, although many radionuclides were discharged to the basin, almost all of the radioactivity is due to ^{3}H, ^{90}Sr, and ^{137}Cs. Trace quantities of aluminum, iron, sodium, chloride, carbonate, nitrate, phosphate, sulfite, sulfate, oil, and grease also were discharged to the basin (Stone and Christensen, 1983). Purge water from the K-Area Disassembly Basin is now discharged to the 50-million gal K-Area Retention Basin. The K-Area Reactor Seepage Basin is currently open but has been inactive since 1960 (Pekkala et al., 1987b).

Soil/sediment data show that the highest radionuclide concentrations in the basin soil/sediments are from ^{137}Cs, ^{90}Sr, and ^{60}Co, with the maximum levels of these radionuclides occurring from 0.0 to 1.0 ft below ground surface. Radionuclide activities from 1.0 to 20.0 ft below ground surface were substantially lower.

The monitoring data for the K-Area Reactor Seepage Basin indicate that groundwater at the basin has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Gross alpha and total radium activities remained below their respective drinking water standards of 15 and 5 pCi/L. Nonvolatile beta levels in the basin wells remained below 7 pCi/L. Tritium levels ranged from 463 to 1,770 pCi/mL in the upgradient well and from 53 to 281 pCi/mL in the downgradient and sidegradient wells. The drinking water standard for tritium is 20 pCi/mL.

10.02.02 Waste-Site Description and Nature of Disposal

The K-Area Reactor Seepage Basin (Building 904-65G) is outside the K-Area perimeter fence on a gently west-trending slope leading to Indian Grave Branch. As shown in Figure 10-3, ground surface elevations at the K-Area Reactor Seepage Basin range approximately from 258 to 262 ft msl. The nearest flowing stream, Indian Grave Branch, is about 2,330 ft west of the basin. The nearest plant boundary is approximately 5 mi to the west. The basin was constructed by excavating below grade and building diked walls around the sides at grade level. The basin is rectangular, with approximate dimensions of 135 ft long by 69 ft wide by 7 ft deep. The estimated volume of the K-Area Reactor Seepage Basin is approximately 65,200 ft^3 (0.50 million gal).

Until 1960, SRS used the K-Area Reactor Seepage Basin for the disposal of low-level radioactive purge water from the K-Area Disassembly Basin. This water purge is necessary to keep the tritium activity in the disassembly basin water within a safe working range. Purge water from the K-Area Disassembly Basin is currently discharged to the K-Area Retention Basin (Building 904-88G).

Although many radionuclides were discharged to the K-Area Reactor Seepage Basin, almost all of the radioactivity is due to ^{3}H, ^{90}Sr, and ^{137}Cs. The radionuclides enter the disassembly basin water as a film of liquid on the irradiated components as they are discharged from the reactor tank to the disassembly basin, in the oxide corrosion film on the irradiated components, and, infrequently, from leaks in porous components. The inventory of radionuclides discharged to the K-Area Reactor Seepage Basin (corrected for radioactive decay through 1985) is shown in Table 10-1. Approximately 200,000 gal of purge water were discharged to the basin in both 1959 and 1960, for a total known discharge volume of 400,000 gal (Pekkala et al., 1987b).

In addition to radionuclides, trace quantities of aluminum, iron, sodium, chloride, carbonate, nitrate, phosphate, sulfite, sulfate, oil, and grease were discharged to the basin (Stone and Christensen, 1983). These chemicals enter the disassembly basin water in small amounts through additions for pH control, filter promotion, and algae treatment and through minimal additions of wastewater to the settler tank from other sources in the reactor buildings.

The K-Area Reactor Seepage Basin has been open, but inactive, since 1960. Vegetation near the basin has been checked for radioactivity and removed to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G) if found to be contaminated.

10.02.03 Groundwater Monitoring Program

Five wells (KSB Series) have been installed to monitor the water-table elevation and groundwater quality at the K-Area Reactor Seepage Basin (Figure 10-3). Wells KSB 1, KSB 2, KSB 3, and KSB 4A were installed in the last two quarters of 1984 using PVC casings and 30-ft screens. Well KSB 4 was installed in the third quarter of 1984 but was abandoned in the fourth quarter of that year because of a grouted screen.

In the first quarter of 1986, the K-Area Reactor Seepage Basin wells were included in the SRS quarterly groundwater monitoring program. The groundwater samples acquired in 1986 were filtered prior to analysis.

In 1985, wells KSB 1 through KSB 4A were added to the radioactive groundwater monitoring program at SRS, which monitors for gross alpha, nonvolatile beta, and tritium. Wells KSB 1 through KSB 4 remain under this program.

10.02.04 Site-Specific Hydrology

Measurements obtained from the K-Area Reactor Seepage Basin monitoring wells since April 1985 indicate that the water-table elevation has been declining since that date, rebounding slightly in the last half of 1986. A hydrograph for the K-Area Reactor Seepage Basin wells is presented in Figure 10-4. Water-table measurements indicate an apparent 25-ft decline in water levels for May, June, August, and September of 1985. These measurements (not plotted in Figure 10-4) are suspect because the apparent rapid declines and rebounds occurred during one-month periods, and the water levels reported for each well are identical for each respective date. The water-table elevation for the fourth quarter of 1986 was approximately 207 ft msl, and the vadose zone was approximately 54 ft thick.

A water-table elevation contour map for the first quarter of 1986 (Figure 10-3) indicates that the horizontal groundwater flow direction was to the northwest, consistent with local topography. Excluding the four suspect measurement dates discussed above, the hydrograph (Figure 10-4) indicates that this has been the consistent groundwater flow direction, although water-level fluctuations indicate that minor shifts in flow direction and gradient have occurred. Relative to the basin, well KSB 1 has been upgradient, well KSB 3 has remained downgradient, and wells KSB 2 and KSB 4A have been sidegradient. The hydraulic gradient beneath the K-Area Reactor Seepage Basin has been about 0.008 ft/ft. Using an estimated horizontal groundwater flow velocity range for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the basin has ranged approximately from 12 to 48 ft/yr.

10.02.05 Waste-Site Content Characterization Data

The contents of the K-Area Reactor Seepage Basin have not been sampled.

10.02.06 Soil/Sediment Characterization Data

A soil/sediment core sample obtained from the center of the K-Area Reactor Seepage Basin in 1978 was analyzed for radioactive constituents (Ashley and Zeigler, 1981), and the results are presented in Table 10-2. Maximum radioactivity found in the basin soil core was 510 pCi/g for ^{137}Cs and 30 pCi/g for ^{60}Co (0.0 to 0.5 ft below ground surface) and 140 pCi/g for ^{90}Sr (0.5 to 1.0 ft below ground surface). Radioactivity in the K-Area Reactor Seepage Basin soil/sediment core sample was substantially lower in the 1.0 to 20.0 ft depth intervals.

10.02.07 Groundwater Monitoring Results

The 1986 groundwater monitoring data for the K-Area Reactor Seepage Basin are included in Appendix H. Groundwater characterization data, summarized in Table 10-3, reflect four or fewer quarterly analyses. Because the K-Area Reactor Seepage Basin monitoring data base is limited, consistent trends in the data cannot be accurately identified. Comparisons in water quality between the upgradient and downgradient wells were not made because of the limited data base. Instead, the monitoring results were compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess general groundwater quality at the basin.

Monitoring well locations relative to the K-Area Reactor Seepage Basin are presented in Figure 10-3 along with the predominant horizontal groundwater flow direction. As shown in Figure 10-3 and discussed in

Section 10.02.04, well KSB 1 has been upgradient, well KSB 3 downgradient, and wells KSB 2 and KSB 4A sidegradient relative to the basin.

Data from the quarterly groundwater monitoring program (Table 10-3) show that, except for tritium and pH, all nonradioactive and radioactive parameters were below drinking water standards. The pH values in the KSB wells did not meet the drinking water standard and were below the naturally occurring groundwater pH range at SRS (Appendix B). The conductivity levels in these wells were low (below 40 μmhos/cm). These conductivity levels reflect the low dissolved chemical constituent levels reported compared to the drinking water standards. Nonvolatile beta activity, as measured in the nonradioactive program, remained below 7 pCi/L in all of the site wells. Tritium levels in upgradient well KSB 1 (463 to 1,770 pCi/mL), downgradient well KSB 3 (69 to 72 pCi/mL), and sidegradient wells KSB 2 (53 pCi/mL) and KSB 4A (169 to 281 pCi/mL), as measured by the nonradioactive program, remained above the drinking water standard of 20 pCi/mL. Tritium levels were highest in the upgradient well.

Annual maximum and average gross alpha, nonvolatile beta, and tritium activities, as measured in the radioactive monitoring program for the K-Area Reactor Seepage Basin wells in 1985 and 1986, are shown in Table 10-4. These data indicate that the average gross alpha levels in these wells remained well below the drinking water standard of 15 pCi/L. The annual tritium activity averages reported in this program are consistent with the values reported in the quarterly groundwater monitoring program for 1985 and 1986 and are above the drinking water standard of 20 pCi/mL. As discussed in Section 10.02.02, radioactivity is known to be related to past site activities.

10.02.08 Planned Action

The K-Area Reactor Seepage Basin is currently inactive. Groundwater monitoring will continue at this site. A site assessment is planned for 1988 as discussed in Section 16.

10.03 K-AREA RETENTION BASIN

10.03.01 Summary

The K-Area Retention Basin (Building 904-88G) has received low-level radioactive purge water from the K-Area Disassembly Basin since 1966. A review of the radioactive releases to the K-Area Retention Basin shows that, although many radionuclides have been discharged to the basin, almost all of the radioactivity is due to ^{3}H, ^{90}Sr, and ^{137}Cs. In addition to radionuclides, trace quantities of aluminum, iron, sodium, chloride, carbonate, nitrate, phosphate, sulfite, sulfate, oil, and grease have been discharged to the basin (Stone and Christensen, 1983). The 50-million gal K-Area Retention Basin is currently active and receiving purge water.

The K-Area Retention Basin monitoring data show that groundwater at the basin has met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for tritium and pH and a few excursions of radium, cadmium, iron, manganese, and lead. The low levels of cadmium, lead, and manganese in the basin influent compared to drinking water standards indicate that the basin may not be the cause of elevated levels of these constituents in the groundwater. Iron levels slightly above drinking water standards are consistent with levels reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Manganese and lead concentrations were above drinking water standards in the upgradient wells and in some of the downgradient wells.

The monitoring data for the K-Area Retention Basin show that tritium levels were above drinking water standards in all of the basin wells. Tritium concentrations were highest in upgradient well KRB 8, indicating a background source. Gross alpha and total radium levels in the K-Area Retention Basin wells remained below drinking water standards except for radium in downgradient well KRB 15.

10.03.02 Waste-Site Description and Nature of Disposal

K Area has used earthen seepage basins to contain low-level radioactive water from the K-Area Disassembly Basin. In K Area, the K-Area Seepage Basin (see Section 10.02) and the K-Area Retention Basin received purge water from the K-Area Disassembly Basin. The K-Area Seepage Basin was in service until 1960 and is no longer active. The K-Area Retention Basin, built in 1963, has been used for the containment of disassembly basin purge water since 1965.

The K-Area Retention Basin currently receives purge water from the K-Area Disassembly Basin. Since 1970, water from the disassembly basin has been passed through two mixed-bed deionizers in series during purging operations to remove radionuclides (except tritium) before release to the retention basin. Effluents from the deionizers are monitored during the purge. Should activity in the effluent from the second bed in the series begin to rise, the first bed is replaced with regenerated resin, and the fresh deionizer is placed second in the series. Spent deionizer resin is regenerated in the Separations Areas, and the activity is concentrated and stored in high-level radioactive waste tanks. A summary of the radioactive releases to the K-Area Retention Basin cumulative through 1985 is given in Table 10-5.

Although many radionuclides have been discharged to the K-Area Retention Basin, almost all of the radioactivity is due to ^{3}H, ^{90}Sr, and ^{137}Cs. In addition to radionuclides, trace quantities of aluminum, iron, sodium, chloride, carbonate, nitrate, phosphate, sulfite, sulfate, oil, and grease have been discharged to the K-Area Retention Basin. Concentrations of nonradioactive constituents in disassembly basin purge water are given in Table 10-6.

The K-Area Retention Basin was constructed in 1963 on a north-trending, gently sloping region in the north part of K Area. The ground surface elevation near the basin is about 260 ft msl and decreases toward Indian Grave Branch, approximately 1,100 ft from the site. The basin is semi-circular and approximately 425 ft across (Figure 10-5). The containment volume of the K-Area Retention Basin is about 50 million gal.

10.03.03 Groundwater Monitoring Program

Five wells (KRB Series) have been installed to monitor the water-table elevation and groundwater quality at the K-Area Retention Basin (Figure 10-5). Monitoring wells KRB 1 and KRB 8 were installed when the basin was constructed in 1963, and three additional wells (KRB 13, KRB 14, and KRB 15) were installed in 1966. Many of the construction details are unavailable for these wells; however, they were constructed using 4-in. diameter galvanized steel casings.

In the mid-1970s, the K-Area Retention Basin wells were added to the radioactive groundwater monitoring program at SRS, which monitors for gross alpha, nonvolatile beta, and tritium. The wells remain under this program.

In the first quarter of 1986, the K-Area Retention Basin wells were included in the SRS quarterly groundwater monitoring program. The groundwater samples acquired in 1986 were filtered prior to analysis.

10.03.04 Site-Specific Hydrology

Measurements obtained from the K-Area Retention Basin wells since January 1984 indicate that the water-table elevation has been approximately 216 to 204 ft msl and that the vadose zone has been approximately 55 ft thick. A hydrograph for the K-Area Retention Basin wells is presented in Figure 10-6. Dramatic changes in water-level elevations in wells KRB 1 (June 1986), KRB 8 (May 1986), KRB 14 (May 1986), and KRB 15 (August 1985) are suspect and, therefore, are not reported in Figure 10-6. Excluding these suspect data, the hydrograph indicates an overall declining trend in the water-table elevation beneath the basin.

A water-table elevation contour map for the first quarter of 1986 (Figure 10-5) indicates that the horizontal groundwater flow direction was generally to the northwest, consistent with local topography. As the hydrograph (Figure 10-6) indicates, this has been the predominant flow direction (excluding the suspect readings discussed above). Fluctuations in water levels indicate that minor shifts in flow direction and gradient have occurred. The hydraulic gradient beneath the basin has been approximately 0.01 ft/ft. Using a groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the basin has ranged approximately from 15 to 60 ft/yr.

The water-level data indicate that wells KRB 14 and KRB 15 have been downgradient of the basin, and well KRB 13 has been sidegradient. Wells KRB 1 and KRB 8 have been upgradient of the basin, with well KRB 8 being the most directly upgradient well.

10.03.05 Waste-Site Content Characterization Data

The contents of the K-Area Retention Basin have not been sampled. Section 10.03.02 contains information on the materials discharged to the basin.

10.03.06 Soil/Sediment Characterization Data

Soil/sediment samples from the K-Area Retention Basin were analyzed for radioactive constituents in 1976 (Ashley and Zeigler, 1978). In the six 3-ft-deep cores taken at the basin, the most abundant radionuclide was ^{137}Co (115,000 pCi/g). Strontium-89,90 (2,600 pCi/g) and small amounts of ^{60}Co, ^{125}Sb, and ^{134}Cs were also detected. Greater than 90% of the ^{137}Cs was confined to the top 3-in. interval. Strontium-89,90 was more evenly distributed throughout the predominantly sandy soil.

10.03.07 Groundwater Monitoring Results

The 1986 groundwater quality data for the K-Area Retention Basin are included in Appendix H. Groundwater characterization data are summarized in Table 10-7 and reflect four or fewer quarterly analyses. Because the K-Area Retention Basin monitoring data base is limited and consistent trends in the data cannot be accurately identified, comparisons between the upgradient and downgradient monitoring well data were not used to assess the basin's effect on groundwater. Instead, the monitoring data were compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess groundwater quality.

The monitoring data from the quarterly groundwater monitoring program (Table 10-7) show that groundwater in the site wells has met drinking water standards except for cadmium in well KRB 14; manganese in wells KRB 8 and KRB 14; lead in wells KRB 1, KRB 8, and KRB 13; and iron in well KRB 13. These wells have had higher concentrations of these metals than the levels contained in the basin influent. Cadmium concentrations in downgradient well KRB 14 (<0.002 to 0.012 mg/L) slightly exceeded the drinking water standard of 0.010 mg/L on one occasion. Manganese levels in upgradient well KRB 8 (0.035 to 0.051 mg/L) and downgradient well KRB 14 (0.024 to 0.434 mg/L) exceeded the drinking water standard of 0.05 mg/L on a few occasions. Lead levels in upgradient wells KRB 1 (<0.004 to 0.274 mg/L) and KRB 8 (<0.005 to 0.161 mg/L) and in sidegradient well KRB 13 (<0.005 to 0.740 mg/L) exceeded the drinking water standard of 0.05 mg/L on a few occasions. The iron concentrations in sidegradient well KRB 13 (0.007 to 0.464 mg/L) exceeded the standard of 0.3 mg/L on one occasion. However, an iron concentration of 0.464 mg/L is consistent with levels as high as 0.52 mg/L reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

The radioactive monitoring data from the quarterly groundwater monitoring program (Table 10-7) show that tritium levels were above the drinking water standard of 20 pCi/mL in all of the K-Area Retention Basin wells. Tritium levels in the vicinity of the K-Area Retention Basin were highest in upgradient well KRB 8 (275,000 to 339,640 pCi/mL), indicating a background source. Similarly, tritium levels in upgradient well KRB 1 (109 to 182 pCi/mL), sidegradient well KRB 13 (9,201 to 23,546 pCi/mL), and downgradient wells KRB 14 (17,400 to 32,800 pCi/mL) and KRB 15 (98,934 to 123,259 pCi/mL) were above the drinking water standard of 20 pCi/mL. Reported total radium levels were consistently below the drinking water standard of 5 pCi/L, except for an isolated excursion in well KRB 15 (5.2 pCi/L). Reported nonvolatile beta and gross alpha levels remained below 13 pCi/L (except for well KRB 15) and below 6 pCi/L, respectively. Nonvolatile beta activity in well KRB 15 ranged from 32.7 to 89.1 pCi/L.

Annual maximum and average gross alpha, nonvolatile beta, and tritium activity levels as measured in the radioactive monitoring program for the K-Area Retention Basin wells from 1974 through 1986 are presented in Table 10-8. The data indicate that the average gross alpha levels in the K-Area Retention Basin wells remained well below the drinking water standard of 15 pCi/L. The annual tritium activity averages reported in this program are consistent with the values reported in the quarterly monitoring program for 1986 and are above the drinking water standard of 20 pCi/mL.

10.03.08 Planned Action

The K-Area Retention Basin is currently active. The basin will continue to be used, and groundwater monitoring will continue. No other action is planned for this waste site.

10.04 K-AREA ACID/CAUSTIC BASIN

10.04.01 Summary

The K-Area Acid/Caustic Basin (Building 904-80G) received dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion-exchange units in the water purification process areas. This basin allowed for the mixing and neutralization of the dilute solutions before their discharge to an unnamed tributary of Pen Branch. Constructed between 1952 and 1954, the K-Area Acid/Caustic Basin remained in service until new neutralization facilities became operational in 1982. The basin is currently inactive and contains rainwater (Ward et al., 1987).

Basin surface water and soil/sediments were sampled in August 1985. Basin surface water data indicate that all tested parameters were low except for iron at 1.55 mg/L. Concentrations of tested parameters for the K-Area Acid/Caustic Basin soil/sediments, including sulfate and sodium, were generally consistent with background levels. Extraction Procedure (EP) toxicity test results for metals and pesticides indicate that concentrations in the basin soil/sediments are less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

Chemical inventory records indicate that sodium and sulfate were discharged to the K-Area Acid/Caustic Basin. These ions serve as indicator parameters because they are soluble and migrate readily in soil or groundwater. Monitoring data indicate that groundwater quality in wells KAC 1 and KAC 3 (the wells closest to the basin) has been affected by seepage from the K-Area Acid/Caustic Basin as demonstrated by the elevated indicator parameter levels in samples acquired from these wells. Groundwater quality in wells KAC 2 and KAC 4 (the wells farthest from the basin) has been less influenced by the basin. Water quality from these two wells has been characterized by low levels of dissolved chemical constituents compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards.

10.04.02 Waste-Site Description and Nature of Disposal

The K-Area Acid/Caustic Basin (Building 904-80G) was constructed between 1952 and 1954 (Ward et al., 1987) in an area of relatively low topographic relief. Surface elevations around the basin range approximately from 255 to 264 ft msl (Figure 10-7).

The K-Area Acid/Caustic Basin is an unlined earthen depression with approximate dimensions of 50 ft long by 50 ft wide by 7 ft deep, resulting in a maximum storage capacity of about 17,500 ft^3 (0.13 million gal). The basin was formed by removing existing soils below grade and building sloped side walls. The soils in the area are predominantly composed of yellowish-red-to-brown, well-graded, dense sandy clays, with clay content ranging from 60 to 70%.

Dilute sulfuric acid and sodium hydroxide solutions were used to regenerate ion exchange units in the K-Area water purification process area. The K-Area Acid/Caustic Basin provided containment for the mixing and neutralization of the spent solutions. Effluent resulting from discharges and rainwater intermittently flowed from the basin to an unnamed tributary of Pen Branch through an overflow weir set to maintain a maximum working water depth of 3 ft in the basin. Effluent records for the K-Area Acid/Caustic Basin were not maintained.

Calculated annual acid and caustic discharge rates to the basin are summarized in Table 10-9. Discharges to the basin were terminated in 1982 when the influent process piping was deactivated and a new neutralization facility was installed in K Area.

The basin is currently inactive and contains water from direct rainfall and local runoff. Above the water line, vegetation grows on the side slopes and floor of the basin.

10.04.03 Groundwater Monitoring Program

Four wells (KAC 1 through KAC 4) were installed to monitor the water-table elevation and groundwater quality at the K-Area Acid/Caustic Basin (Figure 10-7). Wells KAC 1 through KAC 3 were installed in the fourth quarter of 1983, and well KAC 4 was installed in the third quarter of 1984. All of the wells were constructed using PVC casings and 30-ft screens.

The K-Area Acid/Caustic Basin wells are included in the SRS quarterly groundwater monitoring program. Monitoring began in the second quarter of 1984 for wells KAC 1 through KAC 3 and in the first quarter of 1985 for well KAC 4. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

10.04.04 Site-Specific Hydrology

Measurements obtained from the K-Area Acid/Caustic Basin wells since June 1984 indicate that the water-table elevation has been steadily declining. This decrease in water-table elevation is similar to that observed at the other K-Area sites during this time. In the fourth quarter of 1985 the water-table elevation was approximately 220 ft msl, and the vadose zone was approximately 40 ft thick. A hydrograph for the K-Area Acid/Caustic Basin wells is presented in Figure 10-8.

A water-table elevation contour map for the second quarter of 1985 (Figure 10-7) shows the horizontal groundwater flow direction to the west. Water-level information from well KAC 4 was not used to construct this contour map because the screen zone in this well is significantly lower than that of the other wells at the site, which could result in an artificially low water elevation in this well. Relative to the basin, wells KAC 1 and KAC 2 are downgradient, and well KAC 3 is upgradient. The groundwater flow gradient beneath the basin has been approximately 0.01 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the basin has ranged approximately from 15 to 60 ft/yr.

10.04.05 Waste-Site Content Characterization Data

Analytical data from K-Area Acid/Caustic Basin water samples collected in the third quarter of 1985 are listed in Table 10-10. The data indicate that surface water chemical constituent concentrations of all tested parameters were low except for iron at 1.55 mg/L. The pH of the basin water was 6.2. Concentrations of indicator parameters such as calcium (20.8 mg/L), sulfate (7.0 mg/L), sodium (59.5 mg/L), and magnesium (19.4 mg/L), were low relative to surrounding groundwater concentrations (see Section 10.04.07).

10.04.06 Soil/Sediment Characterization Data

K-Area Acid/Caustic Basin soil/sediments were sampled in August 1985 as part of a basin characterization program. Three 5-ft continuous borings were obtained near the basin inlet and outlet structures and along one side wall. Soil boring samples were separated into 0.5-ft intervals for analysis. Soil/sediment analytical results, including Extraction Procedure (EP) toxicity test results for metals, are summarized in Table 10-11. EP toxicity test results for metals and pesticides indicate concentrations less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24). Aluminum (4,040 to 34,100 μg/g) and iron (8,120 to 37,200 μg/g) levels were relatively high, which is characteristic of SRS area soils. Iron concentrations were generally uniform throughout the basin soil/sediments. Aluminum concentrations were highest in the top layer, and progressively decreased with depth. The concentrations of the other soil/sediment parameters were generally low, including magnesium (20.8 to 1,060 μg/g), sulfate (53.6 to 134.3 μg/g), and sodium (946 to 4,540 μg/g).

10.04.07 Groundwater Monitoring Results

Groundwater monitoring data from 1984 through 1986 are presented in Appendix H. Groundwater chemical characterization data since July 1984 are summarized in Table 10-12.

The monitoring data indicate that groundwater in wells KAC 1 and KAC 3 (the wells closest to the basin) apparently has been affected by seepage from the K-Area Acid/Caustic Basin as demonstrated by the elevated indicator parameter levels in these wells. Groundwater in wells KAC 2 and KAC 4 (the wells farther from the basin) also has been influenced by the basin, although water quality from these two wells has been characterized by low levels of dissolved chemical constituents compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards.

The data in Table 10-12 show that groundwater in wells KAC 1 and KAC 3 has been characterized by elevated levels of sulfate, conductivity, and sodium, which are indicator parameters for the site (Section 10.04.02). Sulfate levels in well KAC 1 ranged from 166 to 1,180 mg/L, with an average concentration of 492.9 mg/L. In well KAC 3, sulfate levels ranged from 116 to 765 mg/L, with an average concentration of 434.3 mg/L. The average sulfate concentrations in wells KAC 1 and KAC 3 were high relative to the secondary drinking water standard of 250 mg/L. Conductivity levels in well KAC 1 (415 to 2,300 μmhos/cm) and well KAC 3 (510 to 1,750 μmhos/cm) were consistently high. Likewise, sodium concentrations in well KAC 1 (21.6 to 399 mg/L) and well KAC 3 (11.1 to 411.0 mg/L) were well above background levels. Sulfate, conductivity, and sodium levels have shown a generally increasing trend in these two wells since July 1984. The pH levels ranged from 5.6 to 6.2 in well KAC 1 and from 6.2 to 9.7 in well KAC 3.

As shown in Table 10-12, the remaining tested parameter levels in well KAC 1 were less than drinking water standards except for isolated excursions of iron (0.593 mg/L), manganese (0.091 mg/L), gross alpha (34.9 pCi/L), and selenium (0.018 mg/L). For well KAC 3, the remaining tested parameter levels were below drinking water standards except for an isolated excursion of selenium (0.054 mg/L), which has a drinking water standard of 0.01 mg/L, and an excursion of iron (0.035 mg/L), which has a drinking water standard of 0.3 mg/L. Iron concentrations as high as 0.52 mg/L have been reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Because the radioactivity, manganese, and selenium levels in the basin water were less than drinking water standards, the isolated excursions of these constituents in the groundwater are indicative of a source other than the basin.

The summary of groundwater quality data for wells KAC 2 and KAC 4 (Table 10-12) indicates that these wells may have been influenced by the K-Area Acid/Caustic Basin, although water quality from these wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards. Sulfate, conductivity, and sodium levels in wells KAC 2 and KAC 4 have been elevated and may be attributable to past site activities. Sulfate levels in well KAC 2 ranged from 44.0 to 500 mg/L, with an average concentration of 147.8 mg/L. In well KAC 4, sulfate levels ranged from 57.0 to 165 mg/L, with an average level of 104.3 mg/L. As illustrated in Figure 10-9, these average sulfate concentrations were below the secondary drinking water standard of 250 mg/L. Conductivity levels in wells KAC 2 (94 to

960 µmhos/cm) and KAC 4 (103 to 342 µmhos/cm) were consistently high. Similarly, sodium concentrations in well KAC 2 (7.09 to 188 mg/L) and well KAC 4 (18.2 to 69.0 mg/L) also were elevated compared to background levels.

Although sulfate, conductivity, and sodium levels were elevated in wells KAC 2 and KAC 4, they were low compared to the levels reported for wells KAC 1 and KAC 3. Figures 10-9 and 10-10 are graphic comparisons of the average indicator parameter concentrations among the K-Area Acid/Caustic Basin wells and illustrate more clearly the relationship of water quality among these wells. Sulfate, conductivity, and sodium concentrations have not shown any consistent increasing or decreasing trends in wells KAC 2 or KAC 4 since July 1984. The pH levels ranged from 5.9 to 7.1 in well KAC 2 and from 4.3 to 5.1 in well KAC 4. As shown in Table 10-12, the remaining tested parameters for wells KAC 2 and KAC 4 met the drinking water standards except for isolated excursions of iron (1.37 mg/L) and manganese (0.526 mg/L) in well KAC 2 and gross alpha (28 pCi/L) in well KAC 4.

10.04.08 Planned Action

The K-Area Acid/Caustic Basin is inactive. Groundwater monitoring will continue at this site. A closure plan is scheduled to be completed in 1987 as discussed in Section 16.

10.05 K-AREA COAL PILE RUNOFF CONTAINMENT BASIN

10.05.01 Summary

The K-Area Coal Pile Runoff Containment Basin (Building 189-K) receives runoff from the K-Area coal pile (Christensen and Gordon, 1983). The groundwater monitoring data indicate that there has been no apparent effect on local groundwater quality from the K-Area Coal Pile Runoff Containment Basin (CPRB). The dissolved chemical constituent levels in these wells have remained below South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards since filtering was included in the sampling program in the third quarter of 1984. The water-quality data from wells KCB 1, KCB 3, and KCB 4 suggest, however, that local groundwater quality may have been influenced by the K-Area coal pile. Groundwater quality in well KCB 2 apparently has not been influenced by the coal pile.

10.05.02 Waste-Site Description and Nature of Disposal

Electricity and steam at SRS are generated by burning coal in the powerhouses. The K-Area coal supply is stored in an open pile. The coal is generally moderate-to-low sulfur coal (1-2%) received by rail from Kentucky, Pennsylvania, and Virginia. Coal is placed on a hopper, sprayed with water to control coal dust, and loaded onto a pile at the K-Area facility (Christensen and Gordon, 1983).

The facility generally contains a 90-day reserve of coal. The coal pile is not rotated, resulting in long-term exposure of the unused coal to the environment. Weathering results in the formation of sulfuric acid caused by the oxidation of sulfur in the coal. Rainfall washes the acid from the coal pile into the coal pile runoff containment basin via gravity flow ditches and sewers.

Prior to the construction of the coal pile runoff containment basins, rainfall runoff from the coal storage piles flowed to onsite streams. The National Pollutant Discharge Elimination System (NPDES) permit issued in 1977 specifies limits on pH and suspended solids for coal pile runoff from rainfall up to the maximum 24-hr, 10-yr recurrence event (5.9 in. for SRS). Suspended solids are limited to 50 mg/L, and pH is limited to between 6 and 9. To achieve compliance, the K-Area CPRB was constructed in 1981 to contain coal pile runoff and prevent direct discharge to an unnamed tributary of Indian Grave Branch. This containment basin allows for the passive equalization of runoff prior to its seepage into the subsurface, where it can undergo natural renovation. There has been minimal discharge from the K-Area CPRB to the tributary.

The K-Area CPRB is on a southwest-trending slope where surface elevations range approximately from 240 to 250 ft msl across the basin (Figure 10-11). Surface drainage is to the southwest toward an unnamed tributary of Indian Grave Branch, approximately 1,000 ft from the site.

The basin is approximately 230 ft west of the K-Area coal pile and about 5.6 mi east of the nearest plant boundary. The basin covers about 2 acres and has a maximum capacity of about 365,600 ft^3 (2.7 million gal). The coal pile that drains to this basin occupies approximately 2 acres and typically contains about 16,000 tons of low sulfur (1-2%) coal.

Coal pile runoff samples were collected on October 2, 1985, to characterize the K-Area CPRB influent and to establish indicator parameters for identifying the effect of the basin on local groundwater quality. The first individual grab sample was collected 15 to 30 min after the beginning of a storm and the second several hours after the end of the storm. In addition, a composite sample was taken during the entire period between the two individual sampling times.

The K-Area CPRB influent characterization data are presented in Table 10-13. Elevated levels of conductivity, total dissolved solids (TDS), iron, sulfate, and low pH are typical of coal pile runoff and are the indicator parameters used to assess the effect of the basin on groundwater quality. Basin influent samples were not filtered prior to analysis and may have contained insoluble, particulate matter.

10.05.03 Groundwater Monitoring Program

Four wells (KCB 1 through KCB 4) were installed in the third quarter of 1981 to monitor the water-table elevation and groundwater quality at the K-Area CPRB (Figure 10-11). Wells KCB 1 through KCB 4 were constructed using PVC casings and 30-ft screens.

In 1982, a quarterly groundwater monitoring program was initiated at SRS. Sampling of wells KCB 1 through KCB 4 began in the second quarter of 1982. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

10.05.04 Site-Specific Hydrology

Measurements obtained from the KCB wells since April 1982 indicate that the water-table elevation has been approximately 217 to 203 ft msl and that the vadose zone has been approximately 35 to 50 ft thick. A hydrograph for the K-Area CPRB wells is presented in Figure 10-12. A water-table elevation contour map for the fourth quarter of 1986 (Figure 10-11) shows that horizontal groundwater flow was to the west, consistent with local topography. Fluctuations in water-level elevations indicate that minor shifts in the flow direction and gradient have occurred. Figures 10-11 and 10-12 indicate that, relative to the basin, well KCB 1 has been upgradient, well KCB 3 has been downgradient, and wells KCB 2 and KCB 4 have been sidegradient. The hydraulic gradient across the basin has been approximately 0.01 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the K-Area CPRB has ranged approximately from 15 to 60 ft/yr.

10.05.05 Waste-Site Content Characterization Data

The K-Area CPRB contents have not been sampled. Section 10.05.02 contains information on the basin influent characterization data.

10.05.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the K-Area CPRB.

10.05.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix H. Groundwater chemical characterization data since July 1984 are summarized in Table 10-14.

Comparisons of the monitoring results between upgradient well KCB 1 and the other site wells were used to evaluate the effect of the K-Area CPRB on groundwater. Indicator parameters are pH, sulfate, iron, conductivity, and total dissolved solids (TDS).

The groundwater characterization data summarized in Table 10-14 indicate that the K-Area CPRB has had no apparent influence on groundwater quality. The analytical data indicate that groundwater in wells KCB 1, KCB 3, and KCB 4 may have been influenced by the K-Area coal pile. However, the dissolved chemical constituent levels in these wells have consistently remained below South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Groundwater quality in well KCB 2 apparently has not been influenced and has been characterized by low dissolved chemical constituent levels compared to drinking water standards.

Generally, indicator parameter concentrations in downgradient well KCB 3 have been similar to those measured in upgradient well KCB 1 and sidegradient well KCB 4. The TDS concentration in downgradient well KCB 3 (218 mg/L) was similar to the level measured in upgradient well KCB 1 (104 mg/L) and was substantially below the drinking water standard of 500 mg/L. Likewise, conductivity, sulfate, iron, and pH levels were similar between the downgradient and upgradient wells. Conductivity levels ranged from 90 to 370 μmhos/cm in downgradient well KCB 3 compared to a similar range of 80 to 212 μmhos/cm in upgradient well KCB 1. Sulfate levels in all of the wells were below the drinking water standard of 250 mg/L, with concentrations ranging from 30.0 to 172.0 mg/L in well KCB 3 and from 26.0 to 77.0 mg/L in well KCB 1. Iron concentrations in the downgradient well (0.08 to 0.20 mg/L) and the upgradient well (0.039 to 0.110 mg/L) met the drinking water standard of 0.3 mg/L. The pH values ranged from 3.4 to 4.2 in the downgradient well and from 3.8 to 5.2 in the upgradient and sidegradient wells; pH values as low as 4.0 are consistent with pH values naturally occurring in Barnwell Formation groundwater (Appendix B). Figures 10-13 and 10-14, which are graphic comparisons of the average indicator parameter concentrations among the KCB wells, indicate the similarity in indicator parameter levels between the downgradient and upgradient wells.

Although the existing characterization data indicate no apparent effect on groundwater quality from the K-Area CPRB, a review of the groundwater quality data from wells KCB 1, KCB 3, and KCB 4 suggests that local groundwater quality may have been influenced by the K-Area coal pile. Well KCB 2 is sidegradient-to-downgradient relative to the K-Area CPRB. Groundwater quality in well KCB 2 is characterized by low dissolved chemical constituent levels, as reflected by the TDS (34 mg/L) and conductivity (39 to 66 μmhos/cm) levels. Notably, sulfate levels (<5.0 to 15.0 mg/L) in well KCB 2 have been low compared to the secondary drinking water standard of 250 mg/L. Iron concentrations also have been low, ranging from 0.034 to 0.266 mg/L. These concentration ranges for TDS, conductivity, sulfate, and iron were relatively lower in well

KCB 2 than in upgradient well KCB 1 and wells KCB 3 and KCB 4, as illustrated in Figures 10-13 and 10-14.

The upgradient location of well KCB 1 relative to the K-Area CPRB, the downgradient location of wells KCB 1, KCB 3, and KCB 4 relative to the coal pile, and the similarity in the water-quality data among wells KCB 1, KCB 3, and KCB 4 indicate that these wells may have been influenced by the coal pile and not by the K-Area CPRB. Well KCB 1 is closest to the coal pile, approximately 180 ft west (downgradient). Well KCB 4 is furthest from the coal pile at approximately 250 ft in the same general direction. Although the data indicate that wells KCB 1, KCB 3, and KCB 4 may have been influenced by the K-Area coal pile, the water-quality data from these wells are characterized by consistently low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards.

The concentrations of organics in the K-Area CPRB wells are relatively low, as indicated by the low levels of dissolved organic carbon (DOC; <5.0 mg/L), total organic carbon (TOC; below 7 mg/L), total organic halogens (TOH; <0.005 to 0.064 mg/L), phenols (<0.002 mg/L), and extractable pesticides (all reported levels are less than detection limits). The indicator parameter concentrations (TDS, conductivity, sulfate, and pH) have not shown any increasing or decreasing trends over the monitoring period in wells KCB 1, KCB 2, and KCB 4. However, the concentrations of these parameters in well KCB 3 apparently peaked in the third quarter of 1984 and have steadily decreased since.

10.05.08 Planned Action

The K-Area CPRB is currently active and in use. Groundwater monitoring will continue. A soil/sediment sampling and analysis program is planned for 1988.

10.06 K-AREA ASH BASIN

10.06.01 Summary

The K-Area Ash Basin (Building 188-K) has received ash sluice water from the K-Area powerhouse since plant startup in 1951. The annual ash disposal rate into the K-Area Ash Basin has been about 18,000 yd^3/yr (Christensen and Gordon, 1983). The K-Area Ash Basin is currently active and receiving sluice water.

The groundwater monitoring data indicate that the K-Area Ash Basin has had no apparent effect on local groundwater quality. Dissolved chemical constituent levels in downgradient well KAB 4 have remained low compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for iron, manganese, total dissolved solids

(TDS), and radioactivity. Water quality in sidegradient well KAB 3 has been characterized by low dissolved chemical constituent levels compared to both the drinking water standards and the other K-Area Ash Basin wells. Water quality in upgradient well KAB 2, sidegradient well KAB 1, and downgradient well KAB 4 has apparently been influenced by the K-Area coal pile as indicated by the elevated levels of both sulfate and conductivity in these three wells and the downgradient position of these wells relative to the K-Area coal pile.

10.06.02 Waste-Site Description and Nature of Disposal

Electricity and steam at SRS are generated by burning coal in the powerhouses, which produces dry ash. Ash sluice water from the K-Area powerhouse has been discharged to the K-Area Ash Basin since plant startup in 1951. Overflow from this basin would be directed through NPDES (National Pollutant Discharge Elimination System) Outfall 10-6; however, no overflow has occurred. The annual ash disposal rate into the K-Area Ash Basin has been approximately 18,000 yd^3/yr (Christensen and Gordon, 1983).

The K-Area Ash Basin (Building 188-K) is outside the K-Area perimeter fence (Figure 10-15) on a west-trending slope leading to an unnamed tributary of Indian Grave Branch, approximately 600 ft away. Surface elevations across the basin range approximately from 235 to 260 ft msl. The nearest plant boundary from the K-Area Ash Basin is approximately 5.3 mi to the west. The basin covers approximately 11.7 acres and is currently active and receiving ash sluice water.

Ash sluice water contains fly and bottom ash. Horton, Dorsett, and Cooper conducted a study in 1977 to identify trace metals present in the fly and bottom ash disposed to the SRS ash basins and piles. Table 10-15 lists typical trace metal concentrations obtained for fly and bottom ash. These results indicate significant levels of barium, strontium, manganese, zinc, vanadium, cerium, and chromium (Horton et al., 1977).

10.06.03 Groundwater Monitoring Program

Four wells (KAB 1 through KAB 4) were installed in the third quarter of 1983 to monitor the water-table elevation and groundwater quality at the K-Area Ash Basin (Figure 10-15). These wells were constructed using PVC casings and 30-ft screens.

In the fourth quarter of 1983, the K-Area Ash Basin wells were included in the SRS quarterly groundwater monitoring program. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

10.06.04 Site-Specific Hydrology

Measurements obtained from the K-Area Ash Basin wells since December 1983 indicate that the water-table elevation has been approximately 206 ft msl and that the vadose zone has been approximately 45 ft thick. A hydrograph for the K-Area Ash Disposal Basin wells is presented in Figure 10-16.

Figure 10-15 shows that the horizontal water-table flow direction for the second quarter of 1986 was to the southwest, consistent with the general K-Area groundwater flow direction and local topography. Excluding the 1985 fourth quarter water-table elevation (254.4 ft) reported for well KAB 4, the hydrograph indicates that the groundwater flow direction has remained consistently to the southwest. Relative to the basin, well KAB 2 has been upgradient, well KAB 4 downgradient, and wells KAB 3 and KAB 1 sidegradient. The approximate hydraulic gradient has been 0.006 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the ash basin has ranged approximately from 9 to 36 ft/yr.

10.06.05 Waste-Site Content Characterization Data

Sampling and analysis of the K-Area Ash Basin contents have not been conducted. Section 10.06.02 contains a discussion of the nature of the materials disposed at the site. However, in conjunction with 1980 monitoring for NPDES permit renewal, analyses were performed on discharges from the K-Area Ash Basin. Analytical results (Table 10-16) show that all tested parameters were low except for iron at 0.68 mg/L and mercury at 0.003 mg/L. All tested organic parameters were close to or below detection limits.

10.06.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the K-Area Ash Basin. The materials and nature of disposal into the K-Area Ash Basin are similar to those of the D-Area Ash Basin (488-D); therefore, Extraction Procedure (EP) toxicity test results from analyses performed on the 488-D Ash Basin sludge are presented in Table 10-17, which shows that extractable metal concentrations in the D-Area Ash Basin sludge were less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

10.06.07 Groundwater Monitoring Results

The groundwater monitoring data from 1983 through 1986 are included in Appendix H. Groundwater chemical characterization data since July 1984 are summarized in Table 10-18.

Comparisons of monitoring results among upgradient well KAB 2, sidegradient wells KAB 3 and KAB 1, and downgradient well KAB 4 were used to evaluate the effect of the K-Area Ash Basin on groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Indicator parameters are barium, strontium, manganese, zinc, vanadium, cerium, chromium, and conductivity. Except for conductivity, these materials are potential indicator parameters because the concentrations of these trace metals in the fly and bottom ash disposed to the basin were elevated (see Section 10.06.02).

The groundwater monitoring data summarized in Table 10-18 indicate that the K-Area Ash Basin has had no apparent influence on groundwater quality near the basin. The dissolved chemical constituent levels in the site wells have remained below South Carolina and federal drinking water standards except for iron, manganese, TDS, and radioactivity. A comparison in conductivity levels between downgradient well KAB 4 (305 to 550 μmhos/cm) and upgradient well KAB 2 (70 to 590 μmhos/cm) indicates that conductivity levels between these two wells were consistent. The levels of the remaining indicator parameters in the downgradient well were generally consistent with levels reported in the upgradient well.

Sulfate concentrations have been elevated in wells KAB 1 (48.0 to 80.0 mg/L), KAB 2 (5.0 to 215.0 mg/L), and KAB 4 (57.0 to 107.0 mg/L) compared to sidegradient well KAB 3 (18.0 to 25.0 mg/L), although levels remained below the drinking water standard of 250 mg/L (Figure 10-17). The positioning of wells KAB 2 (approximately 200 ft upgradient of the basin) and KAB 1 (approximately 100 ft sidegradient of the basin), and the fact that sulfate is not an indicator parameter for the K-Area Ash Basin (the sulfate level in the basin discharge stream was only 15 mg/L as shown in Table 10-16), indicates that the K-Area Ash Basin has not caused elevated conductivity or sulfate levels in the K-Area Ash Basin wells.

The K-Area coal pile is approximately 200 ft upgradient of the K-Area Ash Basin. As illustrated in Figure 10-2, wells KAB 1, KAB 2, and KAB 4 are directly downgradient of the K-Area coal pile, while well KAB 3 is apparently sidegradient to the coal storage pile. The downgradient location of wells KAB 1, KAB 2, and KAB 4 relative to the K-Area coal pile, in addition to the fact that elevated conductivity and sulfate levels are indicative of coal pile runoff effect (see Section 10.04.02), indicates that the K-Area coal pile has influenced groundwater quality in the vicinity of wells KAB 1, KAB 2, and KAB 4. This conclusion is consistent with the monitoring data results for the K-Area Coal Pile Runoff Containment Basin, which show that wells KCB 1, KCB 3, and KCB 4 (located downgradient of the K-Area coal pile and sidegradient of the K-Area Ash Basin) have also been influenced by the K-Area coal pile (see Section 10.04.07). The K-Area Coal Pile Runoff Containment Basin is approximately 800 ft downgradient of the coal storage pile and 250 ft sidegradient of the K-Area Ash Basin.

Iron levels in sidegradient wells KAB 1 (0.013 to 0.562 mg/L) and KAB 3 (0.012 to 0.535 mg/L) and downgradient well KAB 4 (0.349 to 1.25 mg/L) occasionally exceeded the drinking water standard of 0.3 mg/L. Iron concentrations as high as 0.52 mg/L are generally consistent with iron concentrations naturally occurring in Barnwell Formation groundwater (Appendix B). Manganese levels ranged above drinking water standards in wells KAB 1, KAB 2, and KAB 4. Manganese levels were higher in upgradient well KAB 2 (0.008 to 0.411 mg/L) and sidegradient well KAB 1 (0.005 to 0.797 mg/L) than in downgradient well KAB 4 (0.017 to 0.054 mg/L), but levels in all three wells ranged above the drinking water standard of 0.05 mg/L. TDS levels (46 to 762 mg/L) ranged above the drinking water standard of 500 mg/L in well KAB 3. Gross alpha levels in downgradient well KAB 4 (12.0 to 41.6 pCi/L) exceeded the drinking water standard of 15 pCi/L. Total radium levels in sidegradient well KAB 3 (4.0 to 9.0 pCi/L) and downgradient well KAB 4 (7.2 to 16.0 mg/L) were above the drinking water standard of 5 pCi/L.

The groundwater pH in the site wells ranged from 4.0 to 6.7. This pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

10.06.08 Planned Action

The K-Area Ash Basin is active, and continued use is planned. Groundwater monitoring will continue. No other action is scheduled for this site.

10.07 K-AREA BURNING/RUBBLE PIT

10.07.01 Summary

Burnable wastes such as paper, plastics, rubber, oil, degreasers, and drummed solvents were received and incinerated in the K-Area Burning/Rubble Pit (Building 131-K) from 1951 to 1973, at which time the pit was covered with a layer of soil. Rubble wastes (including paper, wood, cans, empty galvanized steel drums, and scrap metal) were then disposed in the pit until the site reached capacity in 1978 and was covered with soil. The site is currently inactive (Huber et al., 1987c).

The groundwater monitoring data indicate that the K-Area Burning/Rubble Pit has had no apparent effect on groundwater quality except for influence from halogenated organics on downgradient well KRP 4. Water quality in upgradient well KRP 2 and sidegradient wells KRP 1 and KRP 3 has been characterized by low dissolved chemical constituent and organic levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for isolated excursions of iron, manganese, and gross alpha in well KRP 2 and of lead in well KRP 1.

10.07.02 Waste-Site Description and Nature of Disposal

The K-Area Burning/Rubble Pit was constructed in 1951 to collect burnable waste from K Area including paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents. The wastes were incinerated monthly. Disposal of chemically contaminated oils was not allowed at the K-Area Burning/Rubble Pit (Huber et al., 1987c).

In 1973, the plantwide procedure of burning waste ceased, and the K-Area Burning/Rubble Pit was converted to receive only rubble by placing a layer of soil over the incinerated waste. Rubble waste disposed in the pit included paper, wood, scrap metal, cans, and empty galvanized steel drums. Rubble disposal continued until 1978, when the pit reached capacity and was backfilled.

The K-Area Burning/Rubble Pit (Building 131-K) is north-northeast of K Area (Figure 10-2). Ground surface elevations range approximately from 255 to 260 ft msl at the K-Area Burning/Rubble Pit (Figure 10-18) and slope to the north and south toward Indian Grave Branch and an unnamed tributary to Pen Branch, respectively. The pit had approximate dimensions of 230 ft long by 30 ft wide by 10 ft deep at the time of construction. The original capacity of the pit was 69,000 ft^3. The nearest plant boundary is approximately 5.2 mi to the west.

10.07.03 Groundwater Monitoring Program

Four wells (KRP Series) have been installed to monitor the water-table elevation and groundwater quality at the K-Area Burning/Rubble Pit (Figure 10-18). Wells KRP 1 through KRP 3 were installed in the last quarter of 1983, and well KRP 4 was installed during the third quarter of 1984. All four wells were constructed using PVC casings and 30-ft screens.

K-Area Burning/Rubble Pit wells KRP 1 through KRP 3 were included in the quarterly groundwater monitoring program in the first quarter of 1984, and well KRP 4 was added in the first quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

10.07.04 Site-Specific Hydrology

Measurements obtained from the K-Area Burning/Rubble Pit wells indicate that the water-table elevation has been approximately 220 ft msl and that the vadose zone has been approximately 40 ft thick. A hydrograph for the K-Area Burning/Rubble Pit monitoring wells is presented in Figure 10-19. The 20-ft drop in water elevation in well KRP 2 during the third quarter of 1984 is suspect in view of the observation that wells KRP 1 and KRP 3 indicate a concurrent slight increase in the water-table elevation. Excluding the elevations observed in well KRP 2 for the third and fourth quarter of 1984, the water table has been consistently declining beneath the K-Area Burning/Rubble Pit. This decline also was observed in the nearby K-Area Acid/Caustic Basin monitoring wells (see Section 10.04.04).

A water-table elevation contour map for the second quarter of 1986 indicates that the groundwater flow direction was to the south (Figure 10-18). This flow direction is not consistent with the flow direction at the nearby K-Area Acid/Caustic Basin nor with local topography and probably reflects a groundwater divide near the pit (Figure 10-2). The hydrograph indicates that there has been little change in the hydraulic gradient. Well KRP 4 has remained downgradient of the pit, with well KRP 2 upgradient and wells KRP 3 and KRP 1 sidegradient. The approximate hydraulic gradient beneath the pit has been 0.006 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 and 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the pit has ranged approximately from 9 to 36 ft/yr.

10.07.05 Waste-Site Content Characterization Data

The contents of the K-Area Burning/Rubble Pit have not been sampled. Section 10.07.02 contains a discussion on the materials incinerated or disposed at the waste site.

10.07.06 Soil/Sediment Characterization Data

In late 1985 and early 1986, soils were collected and analyzed for volatile organic constituents from seventeen 18 to 24 in. deep auger holes at the K-Area Burning/Rubble Pit (Figure 10-20). In addition, one 30-ft deep auger hole was drilled, and a sample from each 1-ft interval was analyzed for volatile organics. The maximum concentration found in the samples was 107.35 μg/kg tetrachloroethylene (Price et al., 1987).

10.07.07 Groundwater Monitoring Results

The monitoring data from 1984 through 1986 are included in Appendix H. Groundwater chemical characterization data since July 1984 are summarized in Table 10-19.

Comparisons of monitoring data between downgradient well KRP 4 and the other K-Area Burning/Rubble Pit wells were used to evaluate the effect of the pit on groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. The indicator parameters most likely to show the effects of the pit are total organic carbon (TOC), total organic halogens (TOH), chloroform, trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane (1,1,1-TCE) because organic solvents are known to be related to past site activities (see Section 10.07.02).

The monitoring data summarized in Table 10-19 indicate that there has been no apparent effect on groundwater quality at the K-Area Burning/Rubble Pit except for influence from halogenated organics on water quality near downgradient well KRP 4. Groundwater in upgradient well KRP 2 and sidegradient wells KRP 1 and KRP 3 apparently has not been influenced by the pit and has met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for an isolated excursion each of iron, manganese, and gross alpha in well KRP 2 and of lead in well KRP 1.

The monitoring data summarized in Table 10-19 show that groundwater quality in well KRP 2, which is directly upgradient of the K-Area Burning/Rubble Pit, has been characterized by low organic constituent levels compared to drinking water standards for all tested parameters. Trichloroethylene levels in upgradient well KRP 2 (<0.001 to 0.001 mg/L) met the drinking water standard of 0.005 mg/L. Chloroform levels in well KRP 2 (<0.001 mg/L) were well below the trihalomethane drinking water standard of 0.100 mg/L. Tetrachloroethylene concentrations in upgradient well KRP 2 remained below the detection limit (0.001 mg/L), while TOH levels in upgradient well KRP 2 have remained below 0.020 mg/L for the monitoring period. Also for the period of monitoring, TOC levels in upgradient well KRP 2 have remained below 4.0 mg/L. Inorganic chemical constituent and radioactivity levels were also well below drinking water standards except for an excursion of gross alpha (20 pCi/L), which was over the drinking water standard of 15 pCi/L. Radioactivity is not known to be related to past K-Area Burning/Rubble Pit site activities. The consistently low conductivity in upgradient well KRP 2 (22 to 39 μmhos/cm) provides further indication that groundwater in upgradient well KRP 2 is characterized by low dissolved chemical constituent concentrations.

Water quality in downgradient well KRP 4 has been characterized by low dissolved chemical constituent and radioactivity levels compared to drinking water standards for all tested parameters except halogenated organics and manganese. The TOH levels in downgradient well KRP 4 (0.094 to 0.199 mg/L) have consistently been above the TOH levels reported for the other K-Area Burning/Rubble Pit wells except for a probably erroneous result of 35.95 mg/L for well KRP 1. The monitoring data for the specific halogenated organic parameters indicate that chloroform (<0.005 to 0.012 mg/L), trichloroethylene (0.025 to 0.045 mg/L), and tetrachloroethylene (0.069 to 0.140 mg/L) levels in downgradient well KRP 4 also have remained above levels reported for the other K-Area Burning/Rubble Pit wells. Trichloroethylene levels in well KRP 4 were above the drinking water standard of 0.005 mg/L, while chloroform levels remained below the trihalomethane drinking water standard of 0.100 mg/L.

The slightly elevated conductivity in well KRP 4 (83 to 205 μmhos/cm) relative to the other K-Area Burning/Rubble Pit wells may be attributable to the influence of the pit on groundwater quality in the vicinity of this well. Figure 10-21 illustrates the relative differences in average TOH and conductivity levels between downgradient well KRP 4 and the other K-Area Burning/Rubble Pit wells. The 1,1,1-trichloroethane (1,1,1-TCE) levels in downgradient well KRP 4 have remained below detection limits over the period of monitoring. In addition, TOC levels in downgradient well KRP 4 have remained below 10 mg/L. Manganese levels in well KRP 4 (0.128 to 0.167 mg/L) were consistently above the drinking water standard of 0.05 mg/L.

The monitoring data summarized in Table 10-19 show that groundwater quality in the vicinity of sidegradient wells KRP 1 and KRP 3 has been characterized by low dissolved chemical constituent and organic levels. All tested parameters for sidegradient well KRP 1 consistently met drinking water standards except for an isolated excursion in October 1985 when lead at 0.06 mg/L was over the drinking water standard (0.05 mg/L). Except for an inconsistent case in March 1986 (35.95 mg/L), TOH levels in sidegradient well KRP 1 have remained below 0.020 mg/L for the period of monitoring. Similarly, TOC levels in well KRP 1 have remained below 7.0 mg/L. All tested parameters for sidegradient well KRP 3 consistently met drinking water standards except iron (0.025 to 0.719 mg/L), which ranged above the drinking water standard of 0.30 mg/L. Iron contrations as high as 0.52 mg/L are generally consistent with naturally occurring levels of iron in Barnwell Formation groundwater (Appendix B). TOH and TOC levels in well KRP 3 remained below 0.065 mg/L and 5 mg/L, respectively, for the period of monitoring. The low dissolved chemical constituent concentrations in sidegradient wells KRP 1 and KRP 3 are reflected in the low conductivity levels reported for these wells (23 to 48 μmhos/cm and 16 to 33 μmhos/cm, respectively).

10.07.08 Planned Action

The K-Area Burning/Rubble Pit is currently inactive. Groundwater monitoring will continue. A site assessment is scheduled for 1988 as discussed in Section 16.

10.08 K-AREA BINGHAM PUMP OUTAGE PIT

10.08.01 Summary

The K-Area Bingham Pump Outage Pit (Building 643-1G) received solid low-level radioactive waste during 1957. The estimated amount of activity originally buried in this pit was approximately 1 Ci (Pekkala et al., 1987a). The K-Area Bingham Pump Outage Pit was deactivated and backfilled with clean soil in 1958, and the site has remained inactive since. Most of the radioactivity at the pit has been eliminated by radioactive decay. Groundwater monitoring and soil sampling have not been performed at the K-Area Bingham Pump Outage Pit.

10.08.02 Waste-Site Description and Nature of Disposal

Normally, all radioactive solid waste generated in the reactor areas is sent to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G). An exception to this practice was made during 1957 and 1958 when major modifications were made to the primary and secondary cooling water systems in the reactor areas (Pekkala et al., 1987a). The K-Area pit was used from May through September 1957 and was backfilled in 1958.

In K Area, the radioactive waste generated during the modification was surveyed, and solid waste with low levels of surface contamination was buried in the K-Area Bingham Pump Outage Pit. This waste pit was subsequently backfilled with clean soil. No pumps are buried in the pit. The radiation level of the buried waste was less than 25 mRad/hr, and no alpha activity was noted. Waste with higher levels of contamination was sent to the Radioactive Waste Burial Ground (Building 643-G). A conservative estimate of the activity buried in the K-Area Bingham Pump Outage Pit is 0.3 Ci (decay corrected through 1985) (Pekkala et al., 1987a).

The K-Area Bingham Pump Outage Pit (Building 643-1G) is outside the K-Area perimeter fence on a gentle southwest-trending slope leading to a tributary of Indian Grave Branch, about 950 ft from the pit. The nearest plant boundary is approximately 5.6 mi to the west. The elevation of the waste site is approximately 260 ft msl. The pit covered approximately 0.54 acres and had nominal dimensions of 400 ft long by 59 ft wide by 13 ft deep at the time of construction (Figure 10-22). Vegetation has been allowed to grow over the K-Area Bingham Pump Outage Pit since it was backfilled in 1958.

10.08.03 Groundwater Monitoring System

Groundwater monitoring has not been conducted at the K-Area Bingham Pump Outage Pit.

10.08.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the K-Area Bingham Pump Outage Pit; therefore, groundwater conditions at the waste site are undefined.

10.08.05 Waste-Site Content Characterization Data

The contents of the K-Area Bingham Pump Outage Pit have not been sampled. Section 10.08.02 contains information on the materials disposed in the pit. The estimated radionuclide inventory in the K-Area Bingham Pump Outage Pit at the time of burial (1957) and in December 1985 is listed in Table 10-20, which indicates that most of the radioactivity at the K-Area Bingham Pump Outage Pit has been eliminated by radioactive decay.

A comparison between radioactivity levels in vegetation samples from the surface of the K-Area Bingham Pump Outage Pit in 1970 and vegetation samples from the SRS perimeter in that same year is presented in Table 10-21. The vegetation growing above the outage pit exhibited little or no increase in activity compared to background levels, as shown in Table 10-21 (Fenimore and Horton, 1974).

10.08.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the K-Area Bingham Pump Outage Pit.

10.08.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the K-Area Bingham Pump Outage Pit.

10.08.08 Planned Action

The K-Area Bingham Pump Outage Pit is inactive. A site assessment is scheduled for 1988 as discussed in Section 16.

TABLE 10-1

Summary of Radioactive Releases to the K-Area Reactor Seepage Basin

Radionuclide	Radioactivity (Ci)
^{3}H*	1.2E+02
^{60}Co	2.6E-03
^{90}Sr	1.4E-02
^{137}Cs	7.8E-02
^{147}Pm	5.45-05

Note: Release values are cumulative through 1985. All values are decay corrected through December 31, 1985. Data are from Pekkala et al. (1987b).

* Most of the tritium is believed to have left the basin via the atmosphere or groundwater.

TABLE 10-2

Radioactivity in K-Area Reactor Seepage Basin Soil

Core Depth (ft)	Concentration (pCi/g--dry) ^{60}Co	^{137}Cs	^{90}Sr
0.0-0.5	30	510	130
0.5-1.0	<1	70	140
1.0-1.5	<1	20	50
1.5-2.0	<1	8	<1
9.5-10.0	<1	2	2
19.5-20.0	<1	1	<1

Note: Data are for 1978 (Ashley and Zeigler, 1981). Core depths were taken in 15-cm intervals; therefore, depths in feet are approximate.

TABLE 10-3

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Reactor Seepage Basin (1/86-12/86)

Constituent	SC and Federal DWS	KSB 1	KSB 2	KSB 3	KSB 4A
pH (pH)	6.5-8.5	4.0-4.7	3.6-4.6	4.2-4.6	4.3-4.9
Conductivity (µmhos/cm)	NA	23-36	20-34	28-38	22-34
Silver (mg/L)	0.05	<0.0020	<0.0020-0.0050	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004-0.006	0.004-0.006	0.006-0.007	<0.004-0.004
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.9-4.0	2.3-4.0	2.9-4.0	2.3-4.0
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.42	0.06-0.18	0.06-0.17	0.08-0.22
Iron (mg/L)	0.3	<0.004-0.038	0.008-0.015	0.007-0.015	0.017-0.022
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.007-0.016	<0.002	0.003-0.005	0.006-0.018
Sodium (mg/L)	NA	2.56-3.98	2.29-3.07	2.34-3.31	2.30-3.14
Nitrate (as N) (mg/L)	10	0.74-1.10	0.84-0.95	1.12-1.38	0.85-0.98
Lead (mg/L)	0.05	<0.005-0.020	<0.005-0.023	<0.005-0.025	<0.006-0.013
Phenols (mg/L)	NA	<0.002	<0.002-0.003	<0.002-0.003	<0.002-0.003
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<3.0-5.0	<3.0	<3.0	<3.0-5.0
TOC (mg/L)	NA	0.320	0.400	0.330	0.410
TOH (mg/L)	NA	<0.005-0.011	<0.005-0.005	<0.005-0.006	<0.005-0.013
Gross alpha (pCi/L)	15	0.4-4.1	0.1	0	0.3-1.4
Nonvol. beta (pCi/L)	NA	1.7-3.1	1.7-2.8	1.3-2.8	1.5-6.8
Total radium (pCi/L)	5	0.5	0.5	<1.0-1.0	<1.0-1.6
Tritium (pCi/mL)	20	463-1,770	53	69-72	169-281

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

TABLE 10-4

Radioactivity in the K-Area Reactor Seepage Basin Wells (Annual Averages)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
KSB 1						
1985	0.13	0.19	1.40	2.60	160	170
1986	0.10	0.19	0.88	1.70	280	420
KSB 2						
1985	0.13	0.21	0.04	0.84	56	60
1986	0.00	0.00	0.49	1.30	55	56
KSB 3						
1985	0.10	0.21	2.90	7.60	110	150
1986	0.19	0.49	0.35	0.69	66	68
KSB 4A						
1985	0.23	0.48	0.64	0.91	150	160
1986	0.31	0.43	1.10	1.70	180	180

Note: These results are from SRS annual and semiannual reports. Omitted wells and years indicate the absence of data in these reports.

TABLE 10-5

Summary of Radioactive Releases to the K-Area Retention Basin

Radionuclide	Radioactivity (Ci)
^{3}H*	1.7E+05
^{35}S	3.1E-03
^{51}Cr	2.6E-04
^{54}Mn	6.5E-07
^{60}Co	3.2E-02
^{65}Zn	1.5E-05
^{89}Sr	1.2E-05
^{90}Sr	4.6E+00
^{91}Y	9.4E-07
^{95}Zr,^{95}Nb	4.2E-03
$^{103,106}Ru$	9.2E-04
^{125}Sb	5.4E-01
$^{124,125}Sb$	8.3E-02
^{134}Cs	1.1E-02
^{137}Cs	9.1E+00
$^{141,144}Ce$	1.7E-02
^{147}Pm	2.5E-02
Alpha emitters (unidentified)	2.1E-02
Beta-gamma emitters (unidentified)	1.6E+02

Note: Release values are cumulative through 1985. All values are decay corrected through December 31, 1985, except for unidentified alpha and beta-gamma emitters. Data are from Zeigler and Lawrimore (1987).

* Most of the tritium is believed to have left the basin via the atmosphere or groundwater.

TABLE 10-6

Typical Analyses of Disassembly Basin Purge Water

Parameter	Concentrations (mg/L)
Cyanide	<0.005
Chloride	17.0
Nitrite	<0.5
Nitrate	6.0
Surfactants	---
Turbidity	0
Sulfate	8.9
Sulfide	<1
Dissolved organic carbon	4
Total organic carbon	---
Fluoride	---
Phenol	<0.002
Odor	0
Color	---
Total organic halogens	---
Corrosivity	No
Total dissolved solids	---
Phosphate	<0.02
pH (pH units)	6.5
Grease and oil	<5
Aluminum	0.3
Calcium	7.5
Magnesium	0.14
Potassium	<0.05
Silver	<0.01
Arsenic	<0.03
Barium	<0.001
Beryllium	<0.001
Cadmium	<0.006
Copper	<0.004
Iron	0.03
Mercury	<0.002
Manganese	<0.03
Sodium	15.8
Lead	<0.07
Selenium	<0.002
Zinc	0.01
Chromium	<0.005
Nickel	0.1
Silicon	2.5

TABLE 10-7

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Retention Basin (1/86-12/86)

Constituent	SC and Federal DWS	KRB 1	KRB 8	KRB 13	KRB 14
pH (pH)	6.5-8.5	4.1-4.7	4.4-5.2	4.0-5.4	4.9-6.3
Conductivity (µmhos/cm)	NA	25-34	34-44	38-64	69-83
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.012-0.018	0.013-0.016	<0.004-0.006	0.018-0.050
Carbon tetrachloride (mg/L)	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium (mg/L)	0.010	<0.001	<0.001	0.001	<0.002-0.012
Chloroform (mg/L)	0.100*	<0.005	<0.005	<0.005	<0.005
Chloride (mg/L)	250	3.5-5.1	4.7-6.8	6.8-8.6	10.2-22.1
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.31	<0.10-0.27	<0.10-0.21	<0.10-0.18
Iron (mg/L)	0.3	0.006-0.109	0.012-0.073	0.007-0.464	0.010-0.020
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.008-0.014	0.035-0.051	0.007-0.045	0.024-0.434
Sodium (mg/L)	NA	2.25-2.54	3.89-4.20	5.36-7.38	7.34-9.77
Nitrate (as N) (mg/L)	10	0.33-0.65	1.37-2.22	1.16-1.50	0.78-0.90
Lead (mg/L)	0.05	<0.004-0.274	<0.005-0.161	<0.005-0.740	<0.005
Phenols (mg/L)	NA	<0.002-0.002	<0.002	<0.002-0.004	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<3.0	<3.0	<3.0	<5.0-5.0
Tetrachloroethylene (mg/L)	NA	<0.005	<0.005	<0.005	<0.005
TOC (mg/L)	NA	<1.000-15.000	<1.000-3.000	<1.000-11.500	4.000-15.700
TOH (mg/L)	NA	0.005-0.021	<0.005-0.178	0.012-0.121	<0.005-0.109
Trichloroethylene (mg/L)	0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-TCE (mg/L)	0.200	<0.005	<0.005	<0.005	<0.005
Gross alpha (pCi/L)	15	0.9-1.2	0.8-2.0	0.4-1.9	0.8-5.2
Nonvol. beta (pCi/L)	NA	1.2-9.8	2.9-5.0	1.6-1.7	3.0-12.2
Total radium (pCi/L)	5	<1.0-2.6	1.0	<1.0	1.4-4.3
Tritium (pCi/mL)	20	109-182	275,000-339,640	9,201-23,546	17,400-32,800

TABLE 10-7 (cont.)

Constituent	SC and Federal DWS	KRB 15
pH (pH)	6.5-8.5	5.5-6.8
Conductivity (µmhos/cm)	NA	40-72
Silver (mg/L)	0.05	<0.0020
Arsenic (mg/L)	0.05	<0.001
Barium (mg/L)	1.0	0.005-0.010
Carbon tetrachloride (mg/L)	0.005	<0.005
Cadmium (mg/L)	0.010	0.001-0.003
Chloroform (mg/L)	0.100*	<0.005
Chloride (mg/L)	250	4.1-5.2
Chromium (mg/L)	0.05	<0.004
Endrin (mg/L)	0.0002	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.27
Iron (mg/L)	0.3	0.005-0.071
Mercury (mg/L)	0.002	<0.0002
Manganese (mg/L)	0.05	0.005-0.021
Sodium (mg/L)	NA	3.07-5.10
Nitrate (as N) (mg/L)	10	0.37-0.88
Lead (mg/L)	0.05	<0.005-0.034
Phenols (mg/L)	NA	<0.002-0.002
Selenium (mg/L)	0.01	<0.002
Sulfate (mg/L)	250	<3.0-12.0
Tetrachloroethylene (mg/L)	NA	<0.005
TOC (mg/L)	NA	4.000-7.000
TOH (mg/L)	NA	0.011-0.045
Trichloroethylene (mg/L)	0.005	<0.005
1,1,1-TCE (mg/L)	0.200	<0.005
Gross alpha (pCi/L)	15	1.3-5.6
Nonvol. beta (pCi/L)	NA	32.7-89.1
Total radium (pCi/L)	5	1.3-5.2
Tritium (pCi/mL)	20	98,934-123,259

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 10-8

Radioactivity in the K-Area Retention Basin Wells (Annual Averages)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
KRB 1						
1976	1.10	2.50	3.79	10.97	3	17
1977	1.10	1.90	3.50	10.00	1	3
1978	0.79	1.40	2.10	10.00	0	2
1979	0.79	1.50	3.00	16.00	310	650
1980	0.59	1.50	1.70	7.40	200	450
1981	0.74	1.30	2.30	20.00	670	1,400
1982	0.45	0.74	4.90	6.90	930	2,200
1983	0.34	0.82	1.80	4.10	180	290
1984	0.44	0.97	0.35	0.82	81	100
1985	0.69	1.30	0.32	0.88	64	66
1986	0.83	1.20	1.80	2.90	160	220
KRB 8						
1976	0.81	1.81	5.59	14.45	24	74
1977	0.83	1.20	5.10	11.00	13	22
1978	1.10	2.30	4.40	11.00	25	47
1979	1.20	4.50	6.80	20.00	66,000	170,000
1980	0.51	0.89	0.98	7.40	54,000	86,000
1981	0.75	1.10	5.70	13.00	49,000	57,000
1982	0.41	0.58	2.20	9.60	31,000	47,000
1983	0.32	0.67	1.90	5.70	25,000	33,000
1984	0.36	0.68	1.80	2.30	330,000	840,000
1985	0.41	0.48	0.85	1.70	73,000	110,000
1986	0.76	1.10	2.90	5.00	230,000	290,000
KRB 13						
1976	0.91	1.65	5.66	14.94	237	291
1977	1.00	2.90	12.00	31.00	180	290
1978	0.93	1.80	3.60	6.70	110	140
1979	1.10	2.20	22.00	230.00	130,000	460,000
1980	0.91	1.60	5.70	12.00	93,000	170,000
1981	0.99	2.10	16.00	36.00	72,000	120,000
1982	0.81	1.10	3.00	6.60	70,000	100,000
1983	1.80	3.20	3.50	7.10	49,000	54,000
1984	0.97	1.40	1.60	1.80	69,000	81,000
1985	0.51	0.63	0.74	1.50	25,000	33,000
1986	0.44	0.54	1.20	1.70	31,000	38,000

TABLE 10-8 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
KRB 14						
1974	1.07	2.65	5.83	22.49	110	355
1975	0.92	4.12	77.66	947.75	84	399
1976	0.79	1.34	9.91	46.58	25	71
1977	0.84	1.50	9.80	23.00	100	720
1978	1.00	1.80	5.30	9.00	72	150
1979	0.90	1.50	12.00	120.00	110,000	300,000
1980	1.20	2.00	5.30	26.00	37,000	82,000
1981	0.85	1.60	11.00	30.00	61,000	110,000
1982	0.83	1.50	5.50	11.00	68,000	110,000
1983	1.40	1.90	2.00	2.50	25.000	41,000
1984	0.93	0.97	1.80	1.90	29,000	43,000
1985	0.28	0.38	0.58	1.00	14,000	16,000
1986	1.20	3.30	3.00	9.00	19,000	20,000
KRB 15						
1977	1.90	2.80	62.00	110.00	33	126
1978	1.60	2.60	41.00	89.00	14	22
1979	1.70	3.30	33.00	42.00	160,000	280,000
1980	1.30	2.50	37.00	97.00	49,000	150,000
1981	1.60	3.40	40.00	50.00	120,000	150,000
1982	0.93	1.60	37.00	50.00	63,000	85,000
1983	1.10	1.70	31.00	34.00	27,000	36,000
1984	2.00	3.60	65.00	100.00	32,000	130,000
1985	0.88	1.20	42.00	48.00	86,000	120,000
1986	1.20	1.80	43.00	70.00	110,000	130,000

Note: These results are from SRS annual and semiannual reports. Omitted wells and years indicate the absence of data in these reports.

TABLE 10-9

Calculated Annual Quantities for Cation and Anion Exchange Units for the K-Area Acid/Caustic Basin

Calculated Annual Quantities from the Cation Exchange Unit

Acid Wastewater Volume (L/yr)	Conc. Wt. % H_2SO_4	Total Excess H_2SO_4 (kg)	Total Cations (kg)
2.7E+03	0.13	4,100	2,500

Calculated Annual Discharges from the Anion Exchange Unit

Basic Wastewater Volume (L/yr)	Conc. Wt. % NaOH	Total Excess NaOH (kg)	Total Anions (kg)
3.1E+03	0.30	10,100	3,100

Note: Data are for 1974, and are representative of the total period (Ward et al., 1987). Values were calculated using assumed resin performance.

TABLE 10-10

Selected Surface Water Chemical Analyses for the K-Area Acid/Caustic Basin

Parameter	Units	Results
pH	SU	6.2
Calcium	mg/L	20.8
Chloride	mg/L	4.86
Dissolved organic carbon	mg/L	16.2
Fluoride	mg/L	0.13
Iron	mg/L	1.55
Mercury	mg/L	<0.0002
Potassium	mg/L	4.00
Magnesium	mg/L	19.4
Sodium	mg/L	59.5
Nitrate	mg/L	<0.5
Sulfate	mg/L	7.0
Odor	TON	0
Total organic carbon	mg/L	1.59
Turbidity	NTU	0.08
Conductivity	µmhos/cm	429.6
Surfactants	mg/L	10.0

Note: Samples were collected in August 1985.

TABLE 10-11

Summary of Sediment and Soil Chemical Analyses for the K-Area Acid/Caustic Basin

Metals	Concentration Range (μg/g)*	EP Toxicity Results (mg/L)	EP Toxicity Standards (mg/L)**
Aluminum	4,040-34,100	---	---
Arsenic	0.59-2.78	0.002	5.0
Barium	14.0-129.0	0.43	100.0
Cadmium	2.0	0.04	1.0
Chromium	15.0-37.6	0.08	5.0
Copper	4.0-18.7	---	---
Iron	8,120-37,200	---	---
Lead	5.0-15.9	0.1	5.0
Magnesium	20.8-1,060.0	---	---
Manganese	2.0-60.8	---	---
Mercury	0.20-0.25	0.0002	0.2
Nickel	4.0-20.9	---	---
Selenium	0.25	0.002	1.0
Silver	2.0	0.289	5.0
Sodium	946-4,540	---	---
Tin	15.0-31.0	---	---
Zinc	38.4-476.0	---	---
Inorganics			
Boron	6.89-40.91		
Sulfate	53.6-134.3		
Sulfide	25.0		
Nitrate	1.80-4.95		
Nitrite	0.5-2.5		
Ammonium	2.8-19.6		
Fluoride	0.45-5.50		
Chloride	22.4-2.30		
Phosphate	24.0-138.0		
Radioactivity			
Gross alpha	0-44.16 pCi/g		
Nonvolatile beta	Background levels		
Gross gamma	Background levels		

* Concentration range for samples taken at 0-0.5 ft, 0.5-1.0 ft, 1.5-2.0 ft, and 4.5-5.0 ft depth intervals.

** Federal Regulation 40 CFR 261.

TABLE 10-12

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Acid/Caustic Basin (7/84-12/86)

Constituent	SC and Federal DWS	KAC 1	KAC 2	KAC 3	KAC 4
pH (pH)	6.5-8.5	5.6-6.2	5.9-7.1	6.2-9.7	4.3-5.1
Conductivity (µmhos/cm)	NA	415-2,300	94-960	510-1750	103-342
Silver (mg/L)	0.05	<0.0020-0.0020	0.0006	<0.0020-0.0039	<0.0005-0.0017
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001-0.001	<0.001
Barium (mg/L)	1.0	0.004-0.007	<0.002-0.004	0.005-0.021	0.009-0.011
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Carbon tetrachloride (mg/L)	0.005	<0.005	---	<0.005	<0.005
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	0.009	---	<0.005	0.011
Chloride (mg/L)	250	15.3-30.0	4.6-7.1	8.1-16.2	13.3-17.5
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	<0.004-0.006	<0.004-0.020	<0.004-0.004	0.004
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0-7.0	13.0	<5.0-20.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.35	0.20-0.65	0.25-0.68	0.10-0.38
Iron (mg/L)	0.3	0.043-0.593	0.009-1.370	0.006-0.035	0.006-0.231
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.005-0.091	0.002-0.526	<0.002-0.004	0.004-0.016
Sodium (mg/L)	NA	21.60-399.00	7.09-188.00	11.10-411.00	18.20-69.00
Nickel (mg/L)	NA	<0.004	<0.004	<0.004	---
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	0.90-1.42	0.47-0.60	0.60-1.60	1.00-1.17
Lead (mg/L)	0.05	<0.004-0.006	<0.004	<0.004	<0.004-0.010
Phenols (mg/L)	NA	<0.002	<0.002-0.003	<0.002	<0.002-0.003
Selenium (mg/L)	0.01	<0.002-0.018	0.001-0.003	<0.001-0.054	<0.002-0.006
Sulfate (mg/L)	250	166.0-1,180.0	44.0-500.0	116.0-765.0	57.0-165.0
Tetrachloroethylene (mg/L)	NA	<0.005	---	<0.005	<0.005
TDS (mg/L)	500	464-490	132	246-410	---
TOC (mg/L)	NA	0.880-43.500	0.470-1.000	<1.000-11.000	0.490-2.680
TOH (mg/L)	NA	0.008-0.025	0.006-0.019	0.007-0.041	0.010-0.020
Trichloroethylene (mg/L)	0.005	<0.005	---	<0.005	<0.005
1,1,1-TCE (mg/L)	0.200	<0.005	---	<0.005	<0.005
Zinc (mg/L)	5	0.016-0.026	0.010	0.006-0.007	---
Gross alpha (pCi/L)	15	<2.0-34.9	<2.0-10.0	<2.0-8.7	<2.0-28.0
Nonvol. beta (pCi/L)	NA	<3.0-460.0	1.5-14.0	<2.0	2.5-59.0
Total radium (pCi/L)	5	<1.0-2.0	<1.0-3.0	<1.0	<1.0-5.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 10-13

K-Area Coal Pile Runoff Containment Basin Influent Characterization Data

Parameter	Units	Initial	Final	Composite
Time	NA	1222	1654	NA
Temperature	°C	23.8	25.1	NA
Flow	gal/min	5-10	<1	NA
pH	SU	2.74	2.60	2.71
Conductivity	μmhos/cm	1,300	2,500	1,760
Sulfate (as SO_4)	mg/L	541	1,390	891
Total suspended solids	mg/L	640	40	1,172
Total dissolved solids	mg/L	753	1,917	1,186
Phenols	mg/L	0.001	0.001	0.004
Acidity (as $CaCO_3$)	mg/L	235	405	280
Beryllium	mg/L	0.0097	0.0167	0.0139
Cadmium	mg/L	<0.006	0.030	0.018
Copper	mg/L	0.314	0.732	0.487
Chromium	mg/L	0.073	0.158	0.099
Iron	mg/L	108	204	145
Lead	mg/L	0.0021	<0.001	0.0030
Mercury	mg/L	0.00026	0.00010	0.00036
Nickel	mg/L	0.216	0.592	0.687
Selenium	mg/L	0.0076	0.0093	0.0071
Zinc	mg/L	0.083	0.174	0.183
Aluminum	mg/L	30.8	63.4	48.7
Manganese	mg/L	1.48	3.60	2.28
Magnesium	mg/L	11.9	25.8	11.6
Arsenic	mg/L	0.0567	0.0333	0.0311
Silver	mg/L	<0.001	<0.001	<0.001
Barium	mg/L	<0.03	<0.03	<0.03

Note: Samples were collected in October 1985. NA = not applicable.

TABLE 10-14

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Coal Pile Runoff Containment Basin (7/84-12/86)

Constituent	SC and Federal DWS	KCB 1	KCB 2	KCB 3	KCB 4
pH (pH)	6.5-8.5	4.6-5.2	3.8-4.8	3.4-4.2	4.1-5.0
Conductivity (µmhos/cm)	NA	80-212	39-66	90-370	223-320
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.010-0.032	<0.010-0.010	0.040-0.062	<0.004
Carbon tetrachloride (mg/L)	0.005	---	<0.005	<0.005	<0.005
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	---	<0.005	<0.005	<0.005
Chloride (mg/L)	250	2.9-9.3	1.7-4.0	6.7-7.5	11.7-17.6
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	<0.004	<0.004-0.010	<0.004-0.024	<0.004
DOC (mg/L)	NA	<5.0	<5.0	<5.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.18	0.14	0.82	0.25
Iron (mg/L)	0.3	0.039-0.110	0.034-0.266	0.080-0.200	0.031-0.074
Mercury (mg/L)	0.002	<0.0002	0.0002	0.0003	0.0002
Manganese (mg/L)	0.05	0.008-0.022	0.005-0.007	0.272-0.855	0.008-0.010
Sodium (mg/L)	NA	5.92-6.78	2.90-6.48	5.00-6.37	11.80-14.50
Nitrate (as N) (mg/L)	10	0.78	1.37	2.15	0.23
Lead (mg/L)	0.05	0.007	0.013	0.012	0.006
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	0.001	<0.001	<0.002-0.004	<0.001
Sulfate (mg/L)	250	26.0-77.0	<5.0-15.0	30.0-172.0	95.0-130.0
Tetrachloroethylene (mg/L)	NA	---	<0.005	<0.005	<0.005
TDS (mg/L)	500	104	34	218	160
TOC (mg/L)	NA	0.600-1.600	0.820-2.000	0.940-6.864	0.360-3.000
TOH (mg/L)	NA	<0.005-0.050	<0.005-0.054	<0.005-0.064	<0.005-0.019
Trichloroethylene (mg/L)	0.005	---	<0.005	<0.005	<0.005
1,1,1-TCE (mg/L)	0.200	---	<0.005	<0.005	<0.005
Zinc (mg/L)	5	0.041	0.060	0.113	0.007
Gross alpha (pCi/L)	15	<3.0-26.0	1.9-9.0	11.0-21.1	<2.0-3.3
Nonvol. beta (pCi/L)	NA	8.0-20.0	6.0-11.0	9.0-13.0	8.0-9.0
Total radium (pCi/L)	5	<1.0-9.0	<1.0-5.0	5.8-11.0	<1.0-4.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 10-15

Trace Elements in Different Types of Ash

Element	Ash Type (mg/L) Fly Ash (Electrostatic Precipitator)	Fly Ash (Mechanical Collector)	Bottom Ash
Barium	889	792	808
Strontium	579	589	333
Manganese	352	275	811
Zinc	280	116	95
Vanadium	218	166	140
Cerium	189	251	150
Chromium	171	140	160
Arsenic	164	55	4
Copper	130	93	67
Nickel	89	87	77
Gallium	72	32	20
Lanthanum	69	61	61
Cobalt	67	47	40
Lead	60	28	5
Bromine	47	12	3
Scandium	32	28	20
Thorium	23	24	25
Antimony	19	6	3
Molybdenum	18	11	7
Beryllium	16	12	9
Samarium	15	13	12
Selenium	15	6	3
Cesium	14	13	10
Uranium	13	8	8
Europium	11	12	8
Ytterbium	12	8	10
Terbium	2.5	2.1	2
Mercury	0.84	0.33	0.08
Cadmium	0.71	0.39	0.5

Note: Data, from Christensen and Gordon (1983), were collected in 1977.

TABLE 10-16

NPDES Monitoring of K-Area Ash Basin Discharges (Outfall K-6) in 1980

Parameter	Unit	Discharge
Biochemical oxygen demand	mg/L	<2
Chemical oxygen demand	mg/L	9
Total organic carbon	mg/L	6
Total suspended solids	mg/L	8
Ammonia (as N)	mg/L	<1.0
Flow	L/min	380
pH	Std. Units	6.3-6.7
Bromide	mg/L	<2.0
Total residual chlorine	mg/L	ND
Color	Pt-Co Units	32
Fecal coliform	No/100 mL	0
Fluoride	mg/L	<1.0
Nitrate/Nitrite (as N)	mg/L	0.44
Total organic nitrogen (as N)	mg/L	<1.0
Oil and grease	mg/L	<10
Phosphorus (as P)	mg/L	1.12
Radioactivity		
Alpha	pCi/L	1.4 ±0.9
Beta	pCi/L	2.7 ±1.0
Radium	pCi/L	<0.38
Radium 226	pCi/L	<0.24
Sulfate (as SO_4)	mg/L	15
Sulfide (as S)	mg/L	<1
Sulfite (as SO_3)	mg/L	<2
Surfactants	mg/L	0.027
Aluminum	mg/L	0.9
Barium	mg/L	<0.3
Boron	mg/L	0.13
Cobalt	mg/L	<0.001
Iron	mg/L	0.68
Magnesium	mg/L	1.2
Molybdenum	mg/L	<0.001
Manganese	mg/L	0.026
Tin	mg/L	0.022
Titanium	mg/L	<0.02
Antimony	mg/L	<0.003
Arsenic	mg/L	<0.001
Beryllium	mg/L	<0.001
Cadmium	mg/L	0.005
Chromium	mg/L	0.039
Copper	mg/L	0.003
Lead	mg/L	<0.0002
Mercury	mg/L	0.003
Nickel	mg/L	<0.002
Selenium	mg/L	<0.001

TABLE 10-16 (cont.)

Parameter	Unit	Discharge
Silver	mg/L	<0.001
Thallium	mg/L	<0.003
Zinc	mg/L	0.034
Cyanide	mg/L	<0.02
Phenols	mg/L	<0.002
Dioxin		ND
Acrolein	µg/L	ND
Acrylonitrile	µg/L	ND
Benzene	µg/L	<1*
Bis(chloromethyl)ether	µg/L	ND
Bromoform	µg/L	ND
Carbon tetrachloride	µg/L	ND
Chlorobenzene	µg/L	ND
Chlorodibromomethane	µg/L	ND
Chloromethane	µg/L	ND
2-Chloroethylvinyl ether	µg/L	ND
Chloroform	µg/L	4
Dichlorobromomethane	µg/L	ND
Dichlorodifluoromethane	µg/L	ND
1,1-Dichloroethane	µg/L	ND
1,2-Dichloroethane	µg/L	ND
1,1-Dichloroethylene	µg/L	ND
1,2-Dichloropropane	µg/L	ND
1,2-Dichloropropylene	µg/L	ND
Ethylbenzene	µg/L	ND
Methylbromide	µg/L	ND
Methylchloride	µg/L	ND
Methylene chloride	µg/L	11*
1,1,2,2-Tetrachloroethane	µg/L	ND
Tetrachloroethylene	µg/L	1*
Toluene	µg/L	1*
1,2-trans-Dichloroethylene	µg/L	ND
1,1,1-Trichloroethane	µg/L	<1*
1,1,2-Trichloroethane	µg/L	ND
Trichloroethylene	µg/L	1
Trichlorofluoromethane	µg/L	ND
Vinyl chloride	µg/L	ND
2-Chlorophenol	µg/L	ND
2,4-Dichlorophenol	µg/L	ND
2,4-Dimethylphenol	µg/L	ND
4,6-Dinitro-o-cresol	µg/L	ND
2,4-Dinitrophenol	µg/L	ND
2-Nitrophenol	µg/L	ND
4-Nitrophenol	µg/L	ND
p-Chloro-m-cresol	µg/L	ND
Pentachlorophenol	µg/L	ND
Phenol	µg/L	ND
2,4,6-Trichlorophenol	µg/L	ND
Acenaphthene	µg/L	ND

TABLE 10-16 (cont.)

Parameter	Unit	Discharge
Acenaphtylene	μg/L	ND
Anthracene	μg/L	<1
Benzidine	μg/L	ND
Benzo(a)anthracene	μg/L	ND
Benzo(a)pyrene	μg/L	ND
3,4-Benzofluoranthene	μg/L	ND
Benzo(ght)perylene	μg/L	ND
Benzo(k)fluoranthene	μg/L	ND
Bis(2-chloroethoxy)methane	μg/L	ND
Bis(2-chloroethyl)ether	μg/L	ND
Bis(2-chloroisopropyl)ether	μg/L	ND
Bis(2-ethylhexyl)phthalate	μg/L	4*
4-Bromophenyl phenyl ether	μg/L	ND
Butyl benzyl phthalate	μg/L	ND
2-Chloronapthalene	μg/L	ND
4-Chlorophenyl phenyl ether	μg/L	ND
Chrysene	μg/L	ND
Dibenzo(a,h)anthracone	μg/L	ND
1,2-Dichlorobenzene	μg/L	ND
1,3-Dichlorobenzene	μg/L	ND
1,4-Dichlorobenzene	μg/L	ND
3,3-Dichlorobenzidine	μg/L	ND
Diethylphthalate	μg/L	8*
Dimethylphthalate	μg/L	ND
Di-n-butyl phthalate	μg/L	<1*
2,4-Dinitrotoluene	μg/L	ND
2,6-Dinitrotoluene	μg/L	ND
Di-n-octylphthalate	μg/L	ND
1,2-Diphenylhydrazine	μg/L	ND
Fluoranthene	μg/L	ND
Fluorene	μg/L	ND
Hexachlorobenzene	μg/L	ND
Hexachlorobutadiene	μg/L	ND
Hexachlorocyclopentadiene	μg/L	ND
Hexachloroethane	μg/L	ND
Indeno-(1,2,3-cd)pyrene	μg/L	ND
Isophorone	μg/L	ND
Naphthalene	μg/L	ND
Nitrobenzene	μg/L	ND
n-Nitrosodimethylamine	μg/L	ND
n-Nitrosodi-n-propylamine	μg/L	ND
n-Nitro-sodiphenylamine	μg/L	ND
Phenanthrene	μg/L	ND
Pyrene	μg/L	ND
1,2,4-Trichlorobenzene	μg/L	ND
Aldrin	μg/L	ND
Alpha BHC	μg/L	ND
Beta BHC	μg/L	ND
Gamma BHC	μg/L	ND

TABLE 10-16 (cont.)

Parameter	Unit	Discharge
Delta BHC	μg/L	ND
Chlordane	μg/L	ND
4,4' DDT	μg/L	ND
4,4' DDE	μg/L	ND
4,4' DDD	μg/L	ND
Dieldrin	μg/L	ND
alpha-Endosulfan	μg/L	ND
beta-Endosulfan	μg/L	ND
Endosulfansulfate	μg/L	ND
Endrin	μg/L	ND
Endrinaldehyde	μg/L	ND
Heptachlor	μg/L	ND

Note: ND = not detected.

* Present in Laboratory Blank.

TABLE 10-17

Trace Metal Analysis of 488-D Ash Basin Sludge Sample Extracts

Metal	Ash Basin Sludge (mg/L)	EPA Extract Level Limit (mg/L)
Chromium	<0.002	5.0
Cadmium	<0.001	1.0
Barium	1	100.0
Silver	<0.001	5.0
Mercury	<0.01	0.2
Lead	<0.002	5.0
Arsenic	<0.01	5.0
Selenium	<0.01	1.0

Note: Data, from Christensen and Gordon (1983), were collected in January 1980.

TABLE 10-18

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Ash Basin (7/84-12/86)

Constituent	SC and Federal DWS	KAB 1	KAB 2	KAB 3	KAB 4
pH (pH)	6.5-8.5	4.8-6.7	5.1-6.5	4.0-5.4	5.9-6.4
Conductivity (µmhos/cm)	NA	163-265	70-590	64-1,200	305-550
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.010-0.031	0.039-0.042	0.018-0.039	0.063-0.092
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride (mg/L)	0.005	<0.005	---	---	<0.005
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.005	---	---	<0.005
Chloride (mg/L)	250	9.4-11.0	5.2-8.1	2.7-7.5	2.9-18.8
Chromium (mg/L)	0.05	<0.004-0.005	<0.004-0.025	<0.004	<0.004
Copper (mg/L)	1	<0.004	<0.004	<0.004	<0.004
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	<0.005
DOC (mg/L)	NA	<5.0	<5.0	<5.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.37	<0.10-0.30	<0.10-0.22	<0.10-0.24
Iron (mg/L)	0.3	0.013-0.562	0.037-0.148	0.012-0.535	0.349-1.250
Mercury (mg/L)	0.002	<0.0002-0.0003	<0.0002	<0.0002-0.0003	0.0003
Manganese (mg/L)	0.05	0.005-0.797	0.008-0.411	0.007-0.015	0.017-0.054
Sodium (mg/L)	NA	8.92-14.50	4.99-9.67	1.63-4.70	9.55-14.40
Nickel (mg/L)	NA	<0.004	0.014	<0.004	<0.004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	0.45	1.05	0.95-0.96	<0.50
Lead (mg/L)	0.05	<0.004	<0.004	0.005-0.007	<0.004
Phenols (mg/L)	NA	<0.002-0.006	<0.002-0.014	<0.002-0.003	<0.002
Selenium (mg/L)	0.01	<0.001-0.002	<0.001-0.002	<0.001	<0.001
Sulfate (mg/L)	250	48.0-80.0	5.0-215.0	18.0-25.0	57.0-107.0
Tetrachloroethylene (mg/L)	NA	<0.005	---	---	<0.005
TDS (mg/L)	500	184-194	228-348	46-762	280-302
TOC (mg/L)	NA	0.740-2.000	0.780-2.000	0.572-0.950	0.860-3.968
TOH (mg/L)	NA	<0.005-0.018	<0.005-0.051	<0.005-0.011	<0.005-0.035
Trichloroethylene (mg/L)	0.005	<0.005	---	---	<0.005
1,1,1-TCE (mg/L)	0.200	<0.005	---	---	<0.005
Zinc (mg/L)	5	0.251	0.088	0.056	0.173
Gross alpha (pCi/L)	15	<2.0-6.2	<2.0-4.0	5.0-14.0	12.0-41.6
Nonvol. beta (pCi/L)	NA	<3.0-17.0	6.0-11.0	6.0-17.0	14.0-26.0
Total radium (pCi/L)	5	<1.0-2.0	1.0-4.0	4.0-9.0	7.2-16.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 10-19

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Burning/Rubble Pit (7/84-12/86)

Constituent	SC and Federal DWS	KRP 1	KRP 2	KRP 3	KRP 4
pH (pH)	6.5-8.5	3.7-5.1	4.1-5.0	4.0-5.1	4.2-5.0
Conductivity (µmhos/cm)	NA	23-48	22-39	16-33	83-205
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.014-0.022	0.014-0.022	0.022-0.030	0.057-0.066
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.005
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	<0.001	<0.001	<0.005-0.012
Chloride (mg/L)	250	1.7-3.2	0.8-3.2	2.9-3.8	8.8-12.0
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	0.016-0.043	0.014-0.083	<0.004-0.063	0.006
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0-5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.19	<0.10-0.20	<0.10-0.13	<0.10-0.31
Iron (mg/L)	0.3	0.024-0.247	0.018-0.125	0.025-0.719	<0.004-0.029
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.022-0.032	0.006-0.025	0.025-0.052	0.128-0.167
Sodium (mg/L)	NA	2.25-3.18	2.39-2.68	1.29-1.85	9.23-13.00
Nickel (mg/L)	NA	0.007-0.008	<0.004-0.004	0.005-0.006	---
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	1.30-1.40	1.10-1.22	<0.50	0.55-1.66
Lead (mg/L)	0.05	0.013-0.060	0.012-0.040	<0.010-0.025	<0.004-0.025
Phenols (mg/L)	NA	<0.002	<0.002	<0.002-0.009	<0.002-0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0	25.0-29.0
Tetrachloroethylene (mg/L)	NA	0.002-0.004	<0.001	<0.001	0.069-0.140
TDS (mg/L)	500	24-32	36-40	20-38	---
TOC (mg/L)	NA	0.300-6.00	0.300-3.76	0.350-4.17	0.747-9.97
TOH (mg/L)	NA	<0.005-35.950	<0.005-0.018	<0.005-0.063	0.094-0.199
Trichloroethylene (mg/L)	0.005	0.002	<0.001-0.001	<0.001	0.025-0.045
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001	<0.005
Zinc (mg/L)	5	0.025-0.029	0.019-0.023	0.032-0.064	---
Gross alpha (pCi/L)	15	<2.0	<2.0-20.0	<2.0	<2.0-4.0
Nonvol. beta (pCi/L)	N	<3.0	<3.0-22.0	<3.0-4.0	<3.0-8.0
Total radium (pCi/L)	5	<1.0	<1.0-2.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 10-20

Estimated Radionuclide Inventory in the K-Area Bingham Pump Outage Pit

Radionuclide	At Burial (Ci)	Decay Corrected through 12/31/85 (mCi)
^{60}Co	0.172	5
^{90}Sr	0.112	60
$^{103,106}Ru$	0.130	1.0E-06
^{137}Cs	0.414	220
^{147}Pm	0.172	0.1

Note: Data are from Pekkala et al. (1987a).

TABLE 10-21

Radioactivity in Vegetation at the K-Area Bingham Pump Outage Pit Versus Radioactivity in Vegetation at Plant Boundary

Alpha (pCi/g)				Nonvolatile Beta (pCi/g)			
Pit		Plant Boundary		Pit		Plant Boundary	
Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
0.2	0.3	0.2	0.6	28	34	21	31

Note: Data are from Pekkala et al. (1987a).

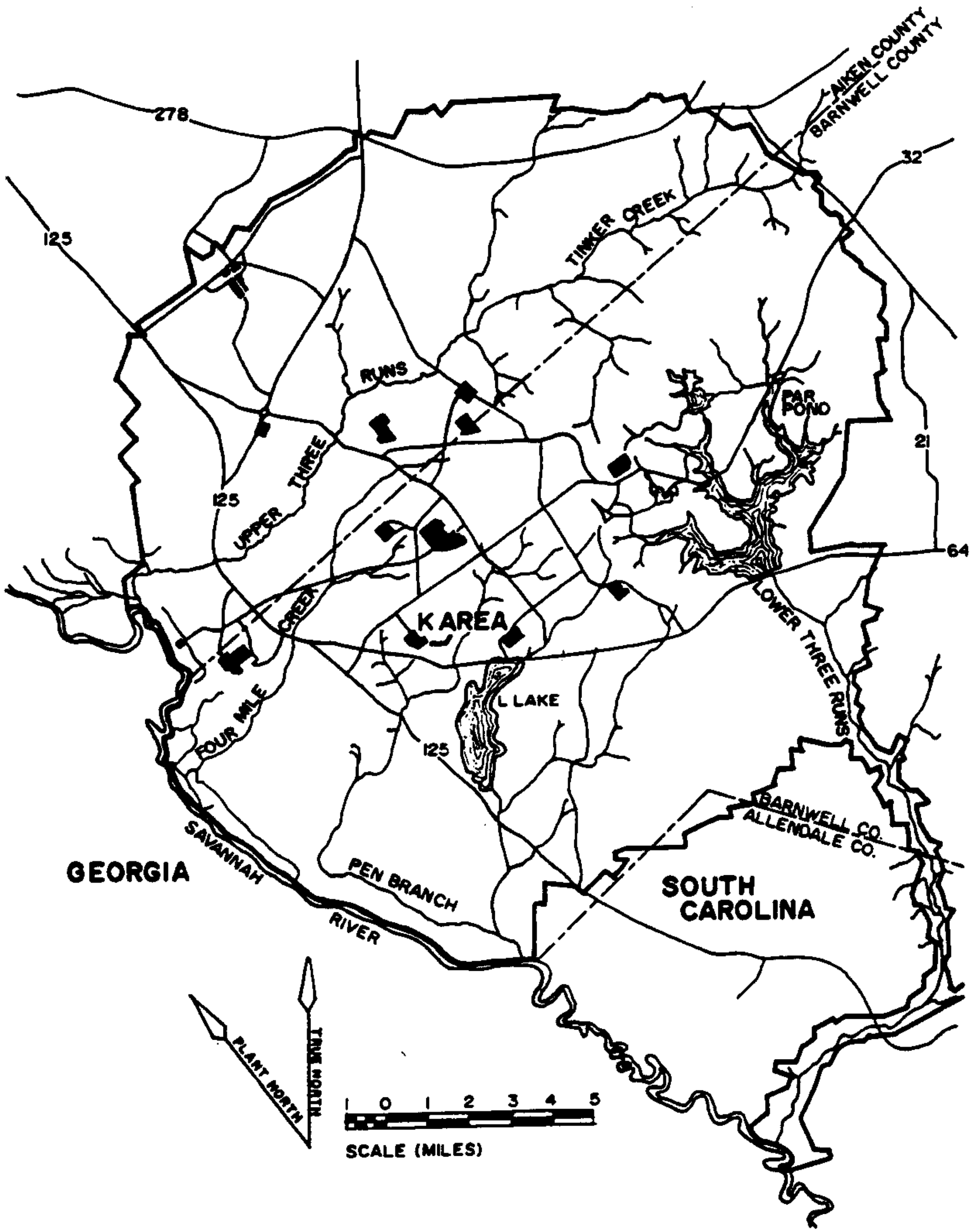


FIGURE 10-1. Location of K Area at SRS

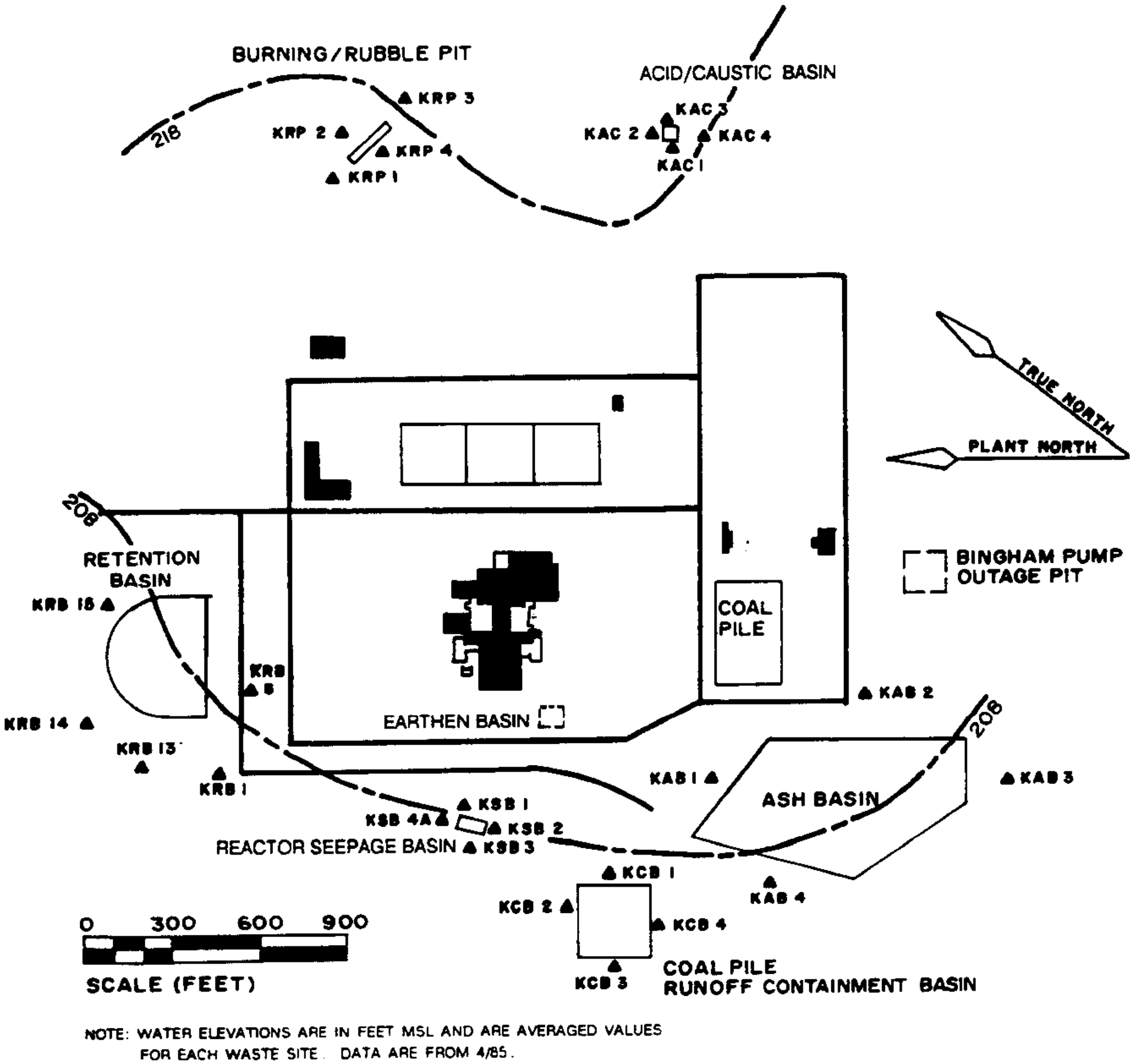
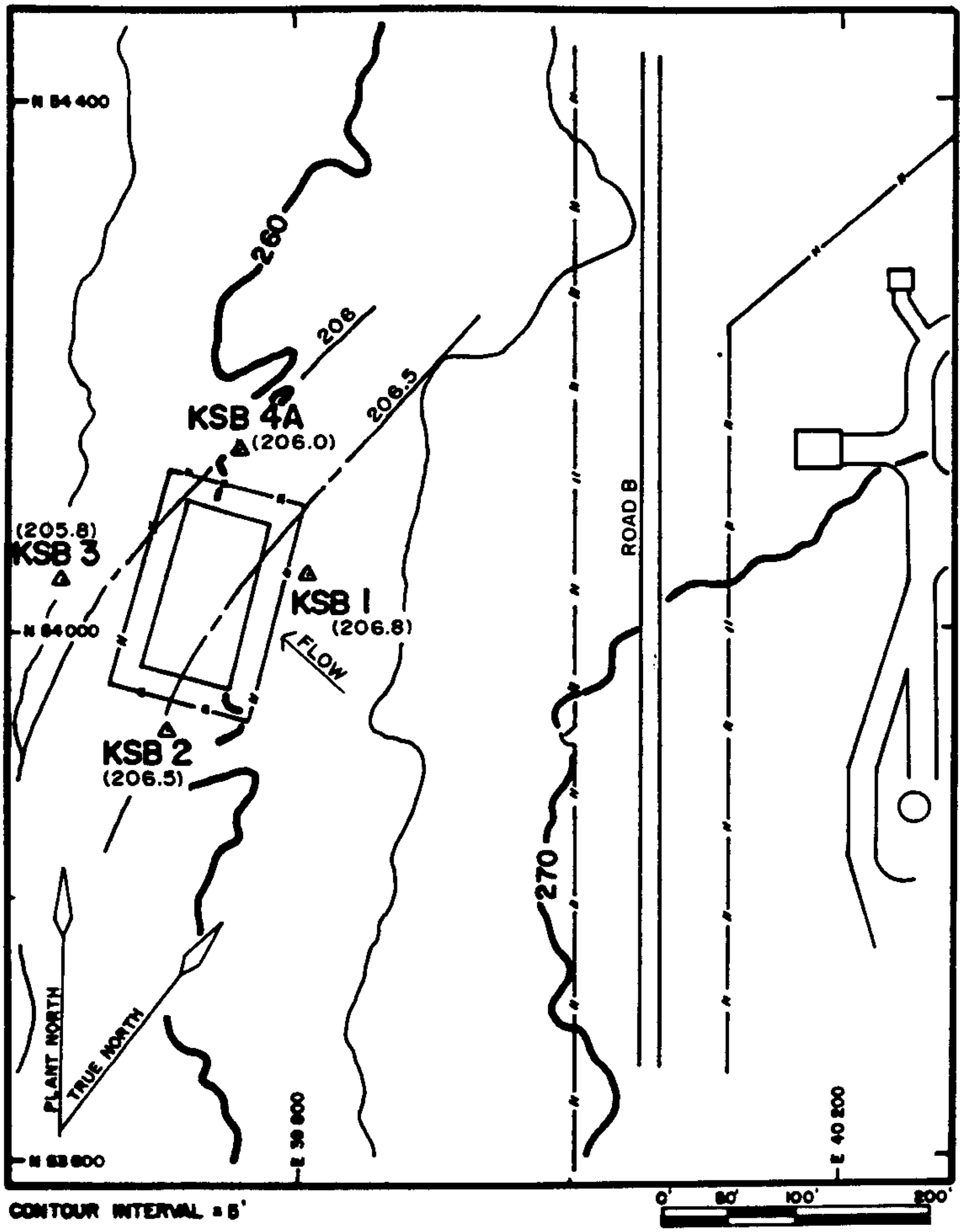


FIGURE 10-2. K-Area Water-Table Elevation Map



NOTE: WATER ELEVATIONS WERE OBTAINED 2/86 AND ARE IN FEET MSL.

FIGURE 10-3. K-Area Reactor Seepage Basin Water-Table Elevation Map

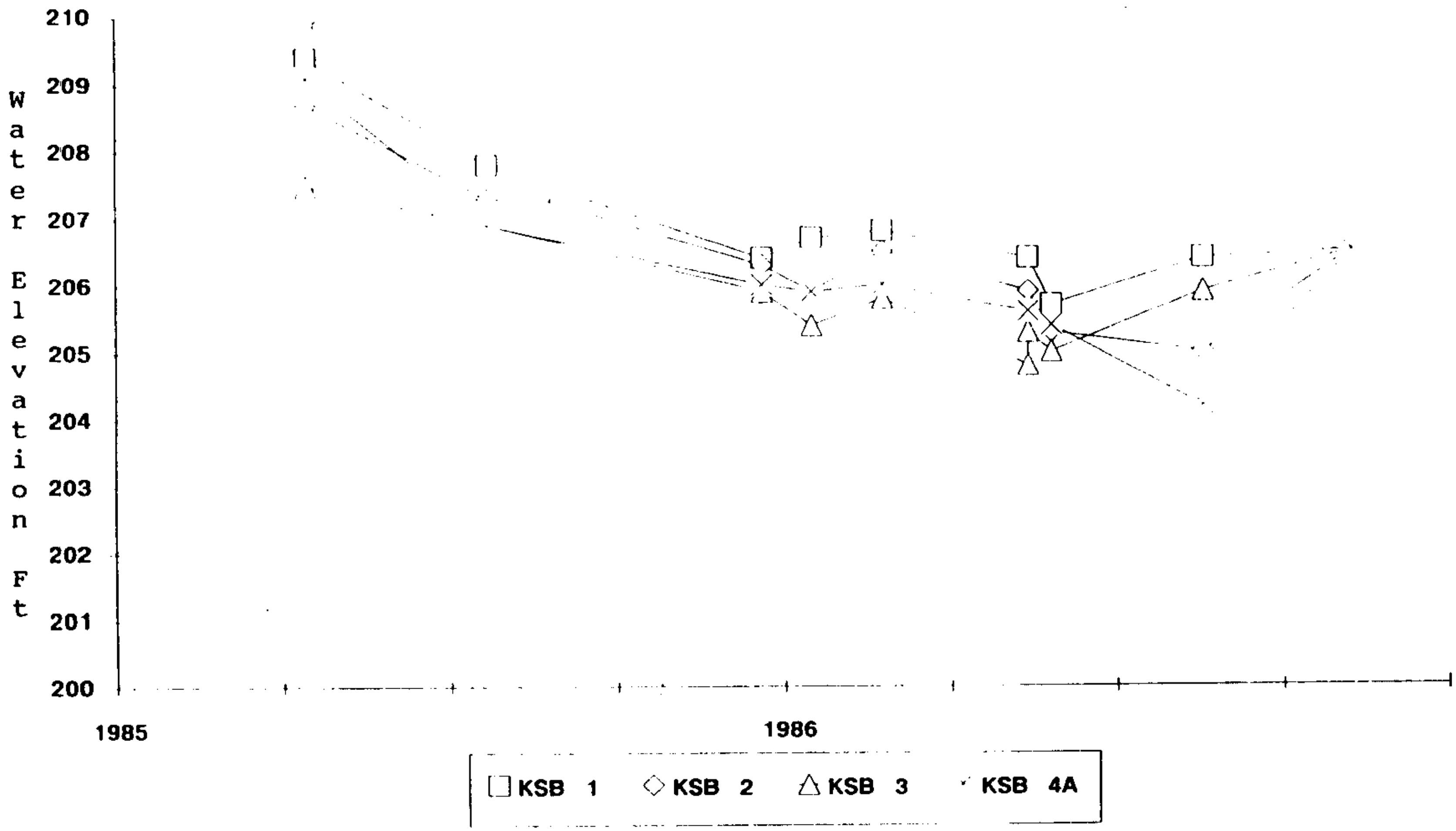


FIGURE 10-4. Hydrograph of the K-Area Reactor Seepage Basin Wells

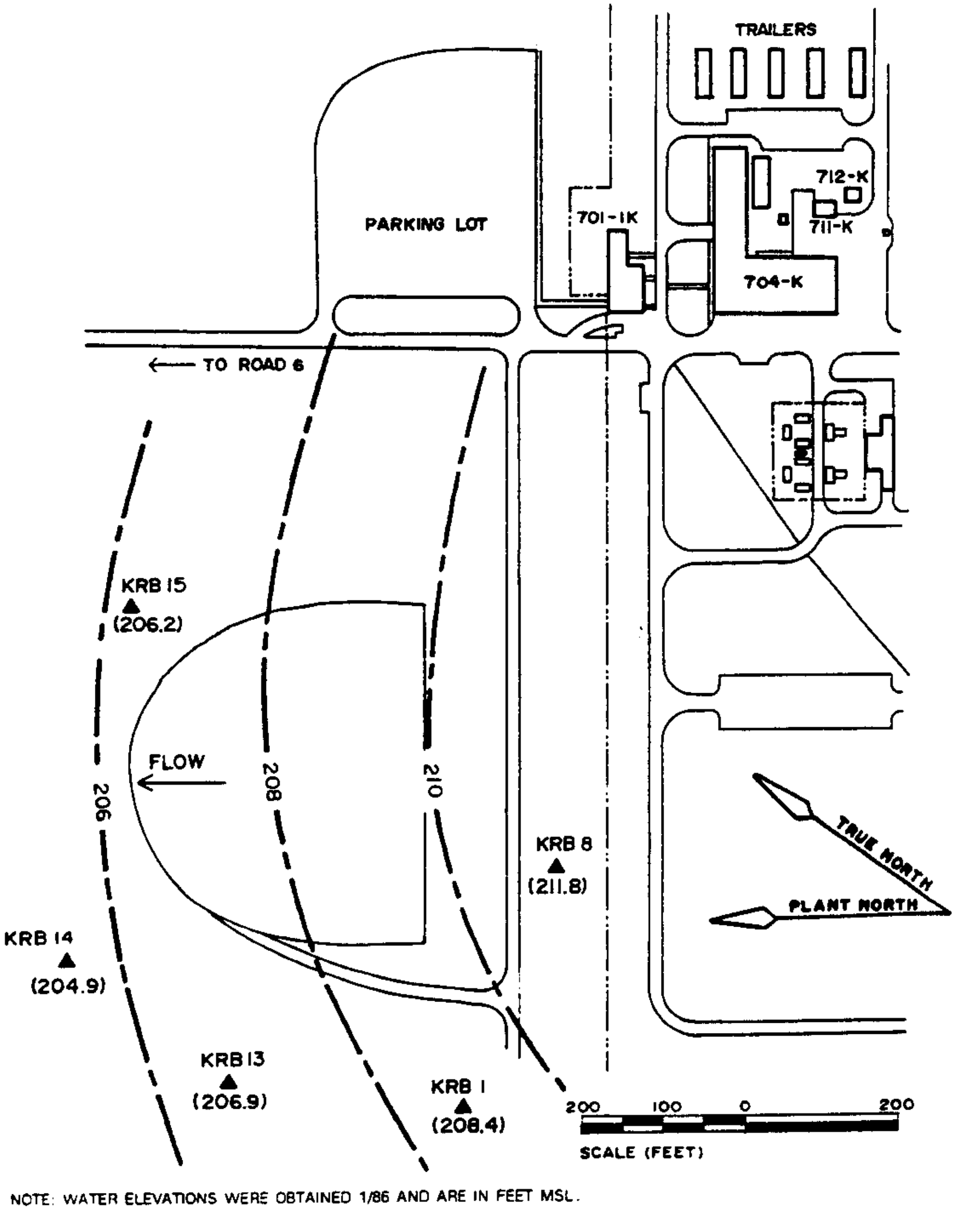
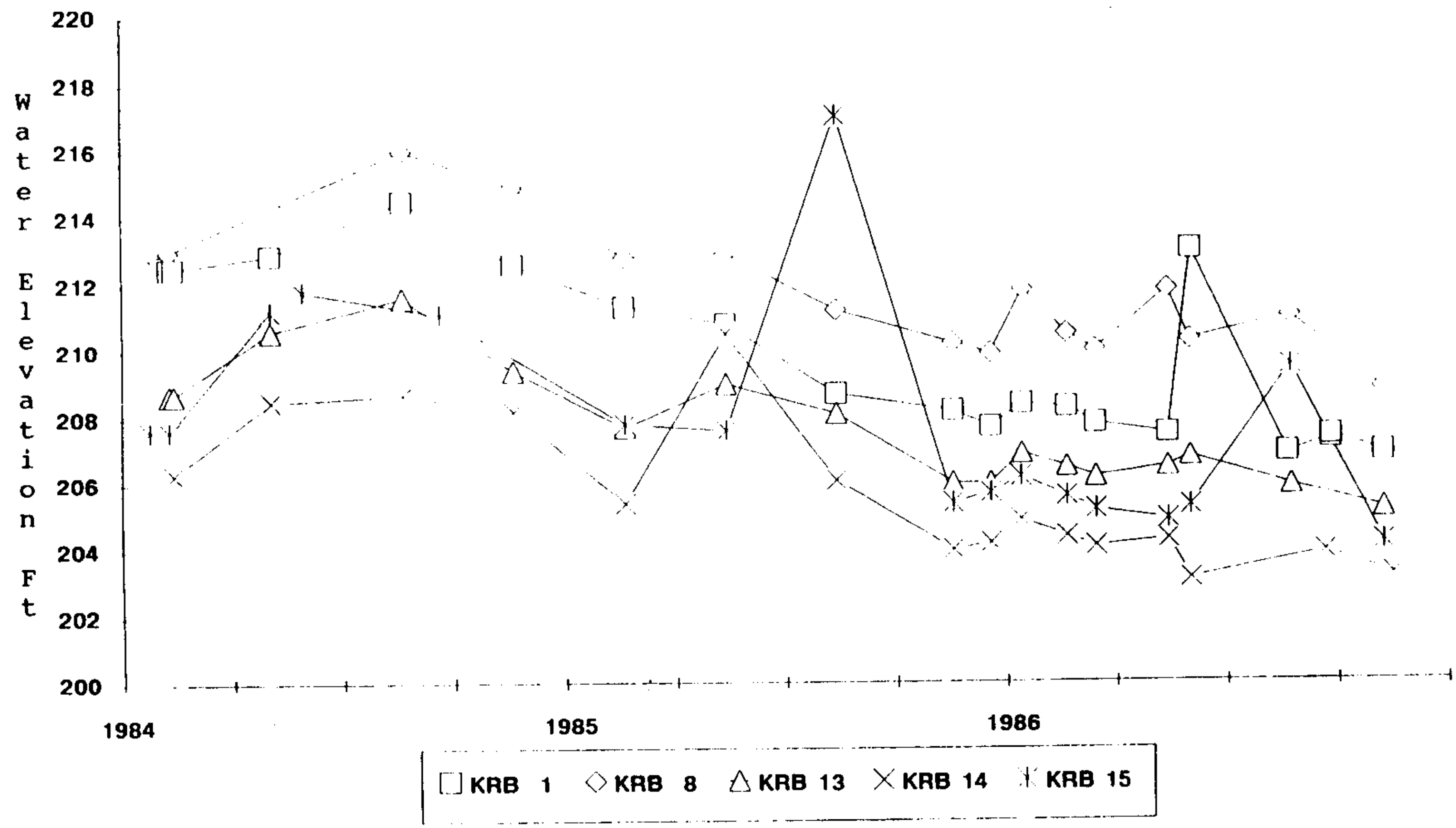
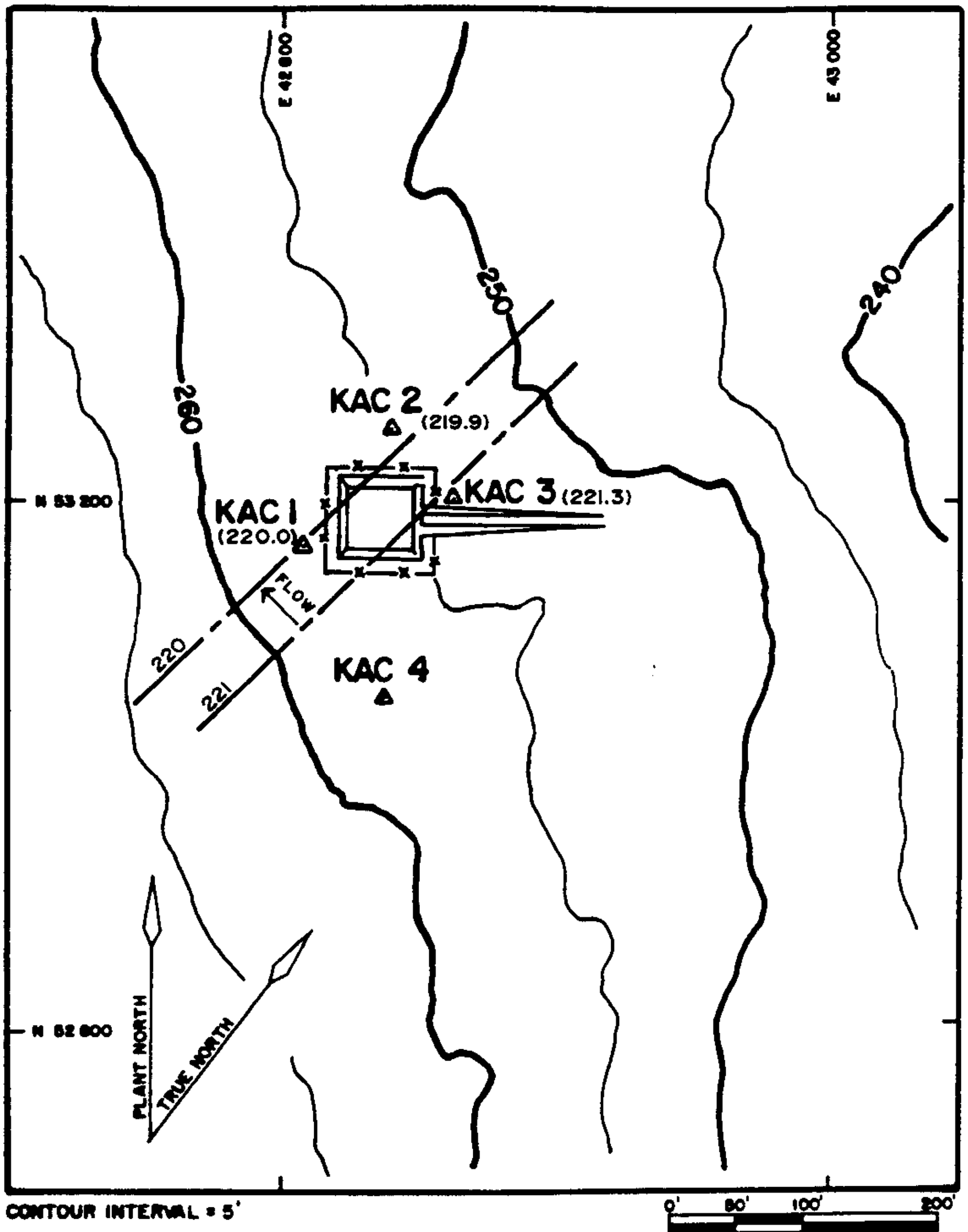


FIGURE 10-5. K-Area Retention Basin Water-Table Elevation Map



NOTE: ANOMALOUS DATA POINTS FROM 8/85, 5/86, AND 6/86 ARE NOT PLOTTED.

FIGURE 10-6. Hydrograph of the K-Area Retention Basin Wells



CONTOUR INTERVAL = 5'

NOTE: WATER ELEVATIONS WERE OBTAINED 5/85 AND ARE IN FEET MSL. THE WATER ELEVATION IN WELL KAC 4 WAS NOT USED TO CONSTRUCT THIS MAP BECAUSE THE SCREEN ZONE IN THIS WELL IS SIGNIFICANTLY LOWER THAN THOSE IN THE OTHER KAC WELLS.

FIGURE 10-7. K-Area Acid/Caustic Basin Water-Table Elevation Map

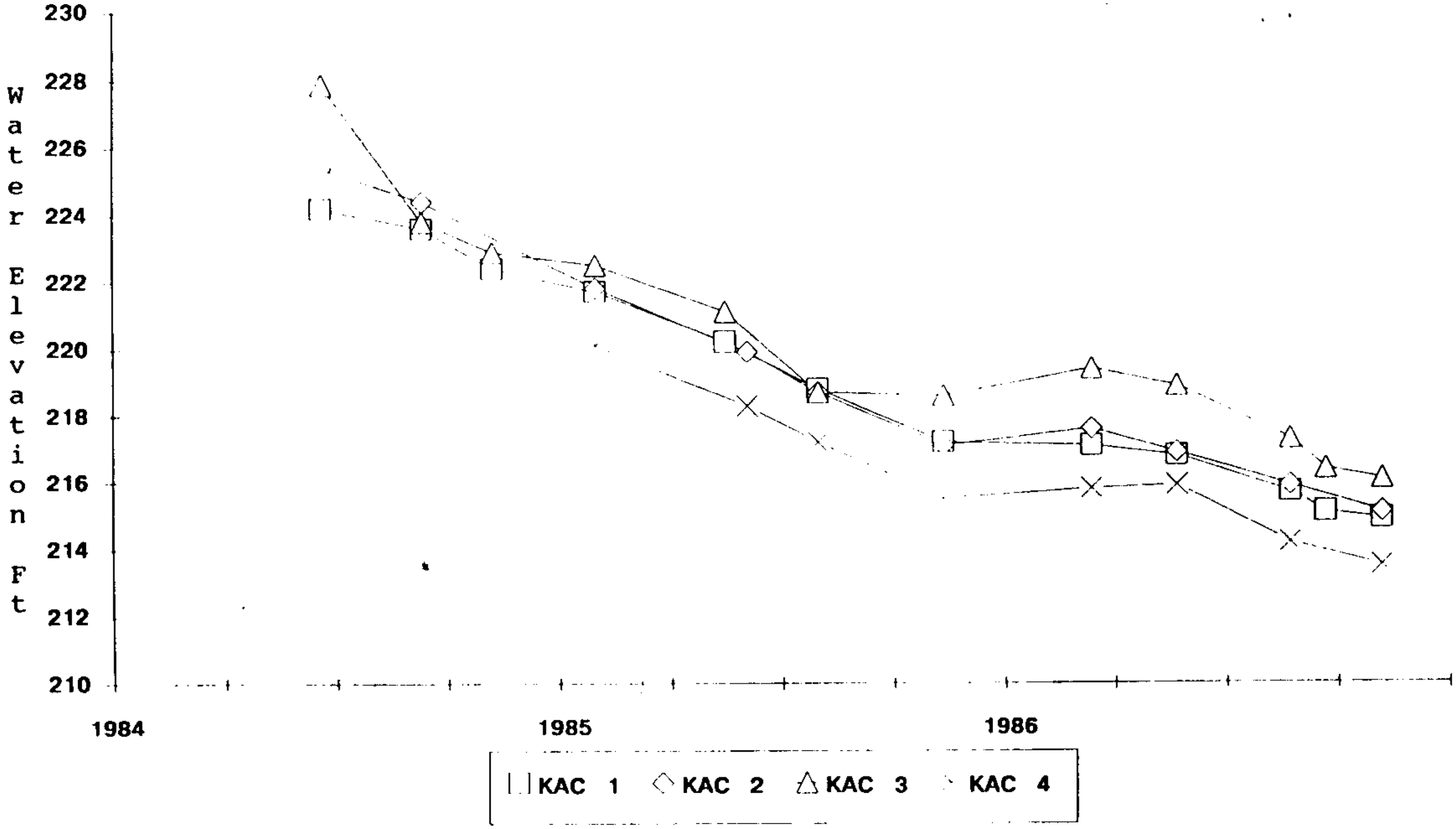
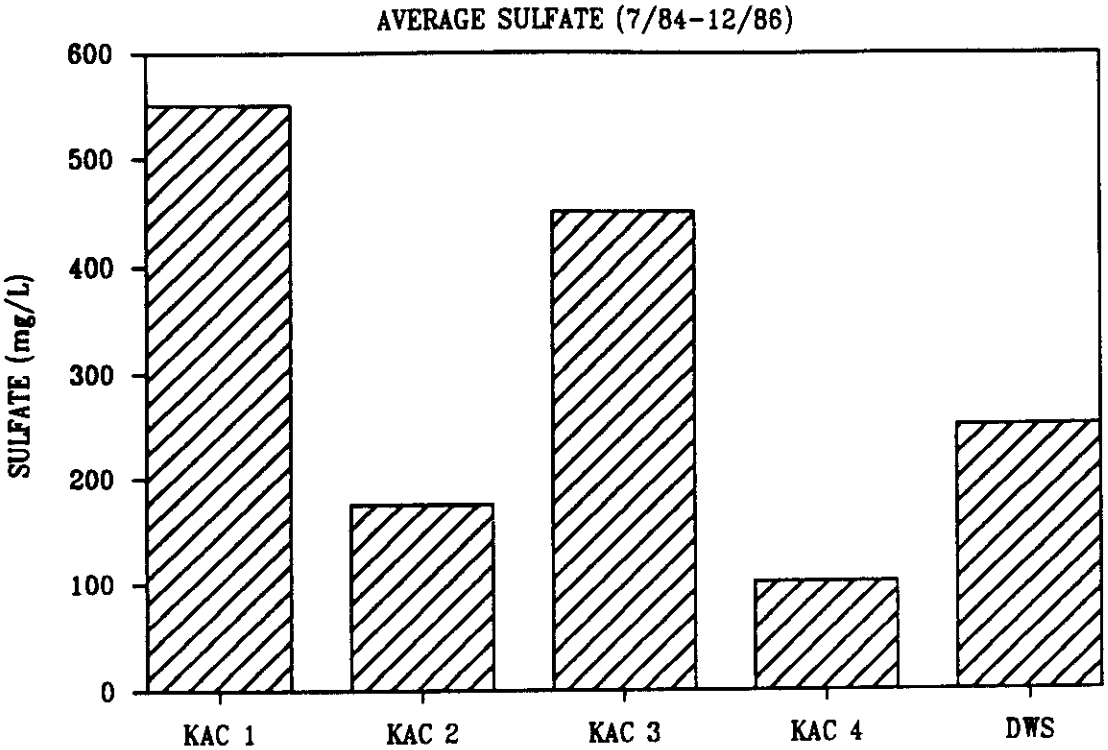


FIGURE 10-8. Hydrograph of the K-Area Acid/Caustic Basin Wells



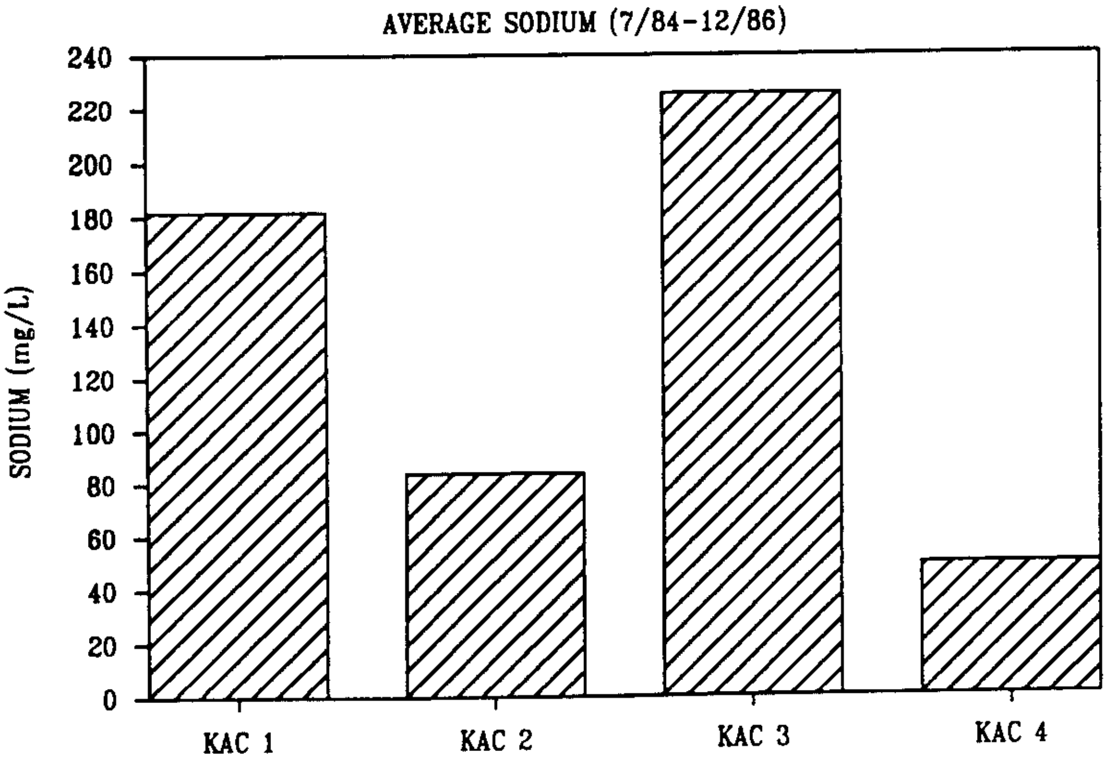


FIGURE 10-9. Average Sulfate and Sodium Concentrations in the K-Area Acid/Caustic Basin Wells

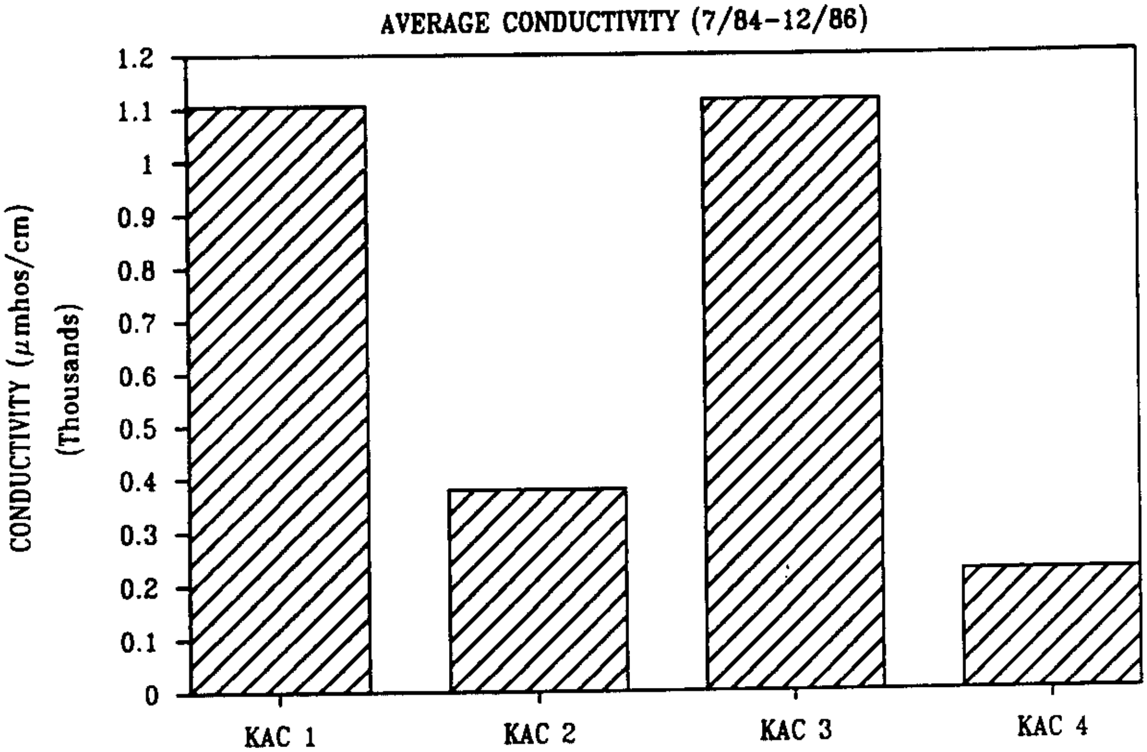


FIGURE 10-10. Average Conductivity in the K-Area Acid/Caustic Basin Wells

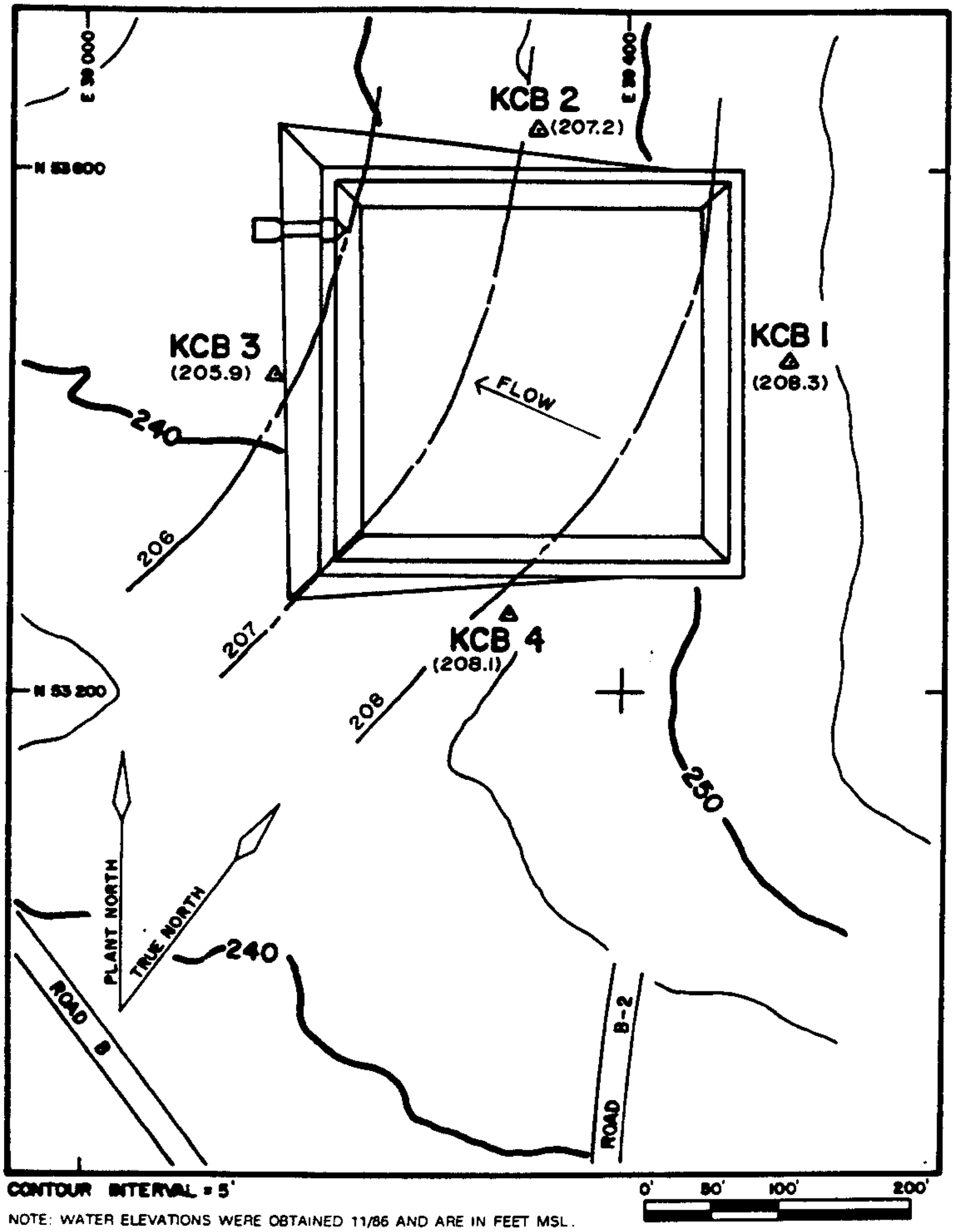


FIGURE 10-11. K-Area Coal Pile Runoff Containment Basin (CPRB) Water-Table Elevation Map

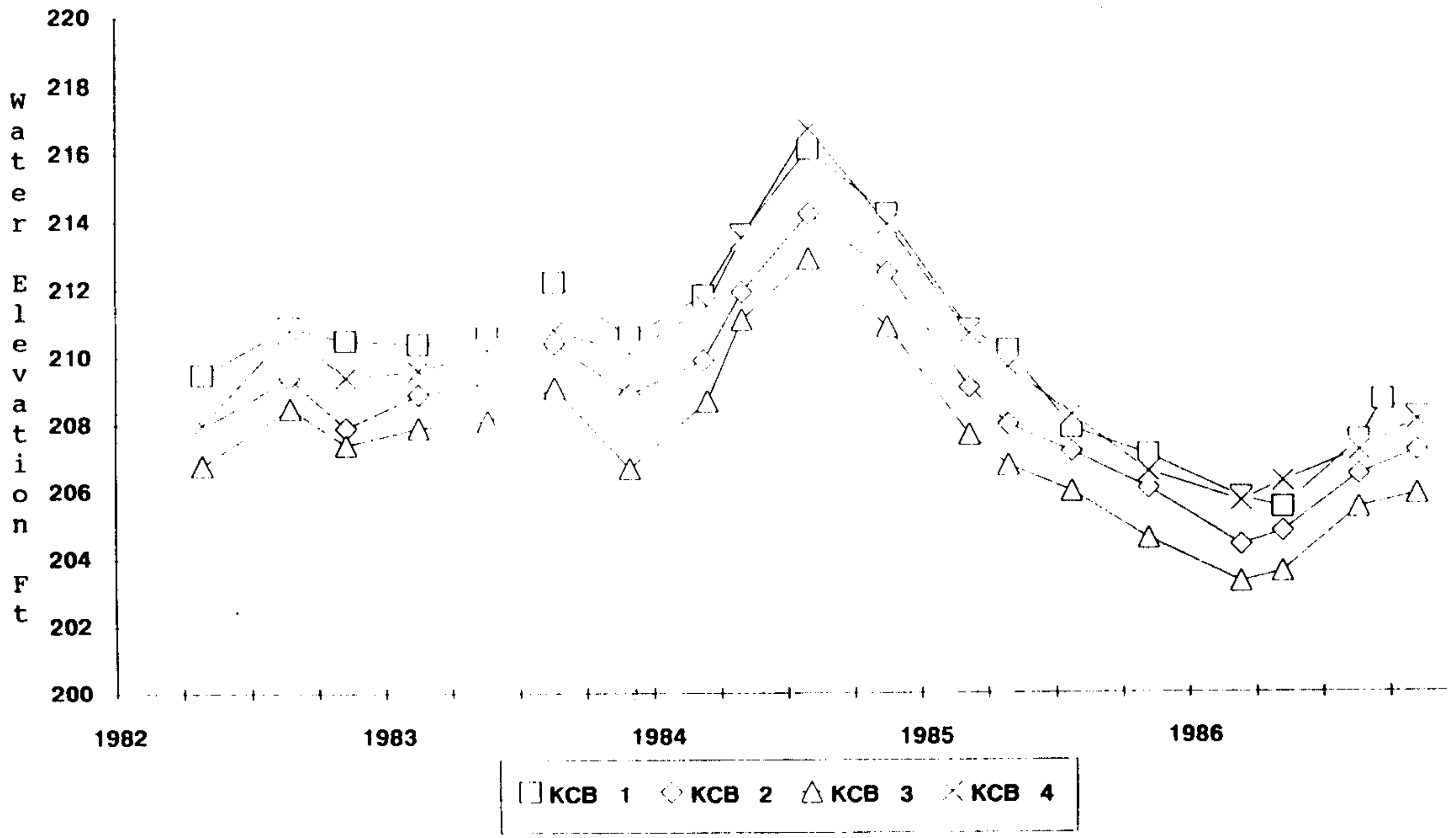


FIGURE 10-12. Hydrograph of the K-Area Coal Pile Runoff Containment Basin (CPRB) Wells

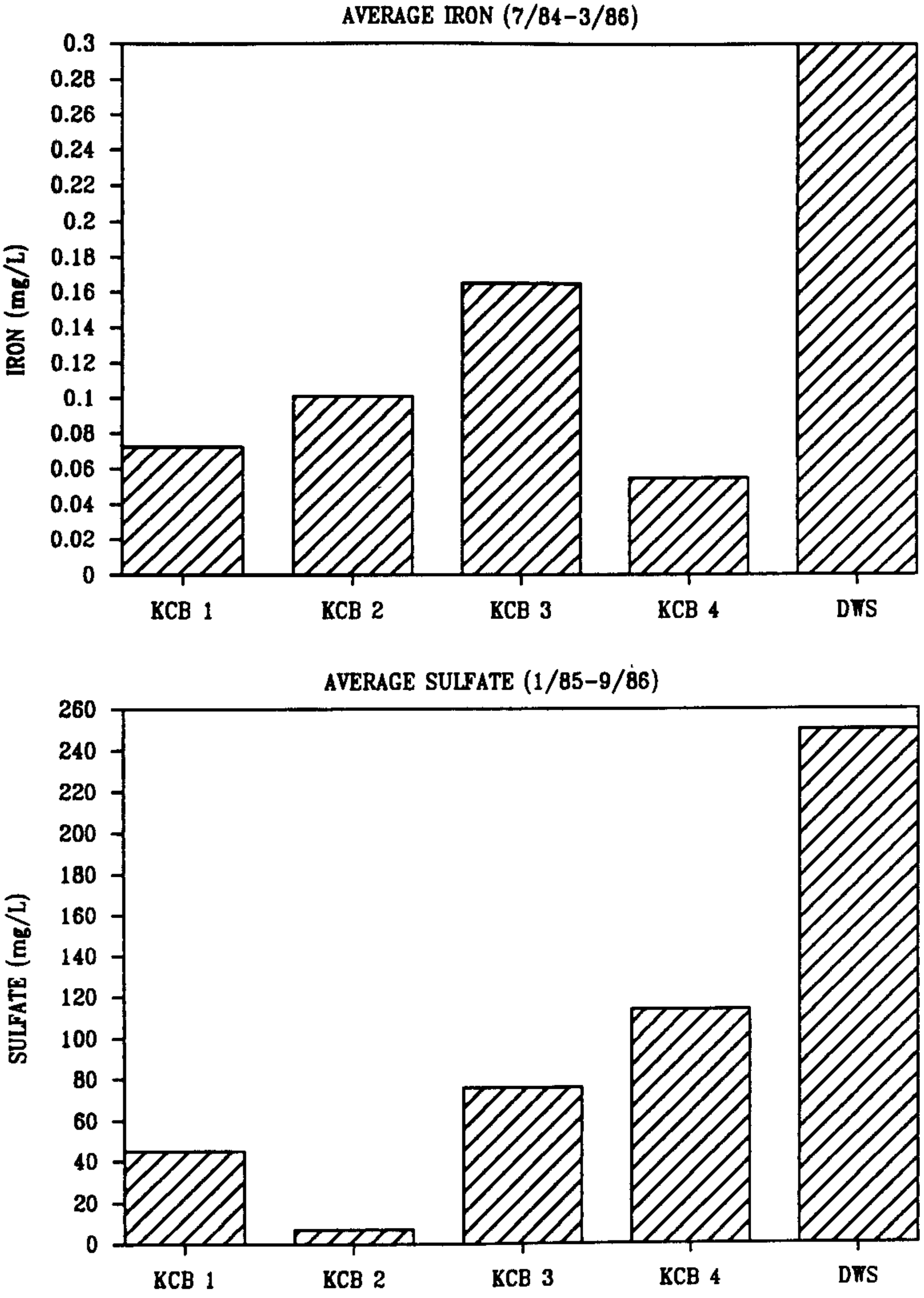


FIGURE 10-13. Average Iron and Sulfate Concentrations in the K-Area Coal Pile Runoff Containment Basin (CPRB) Wells

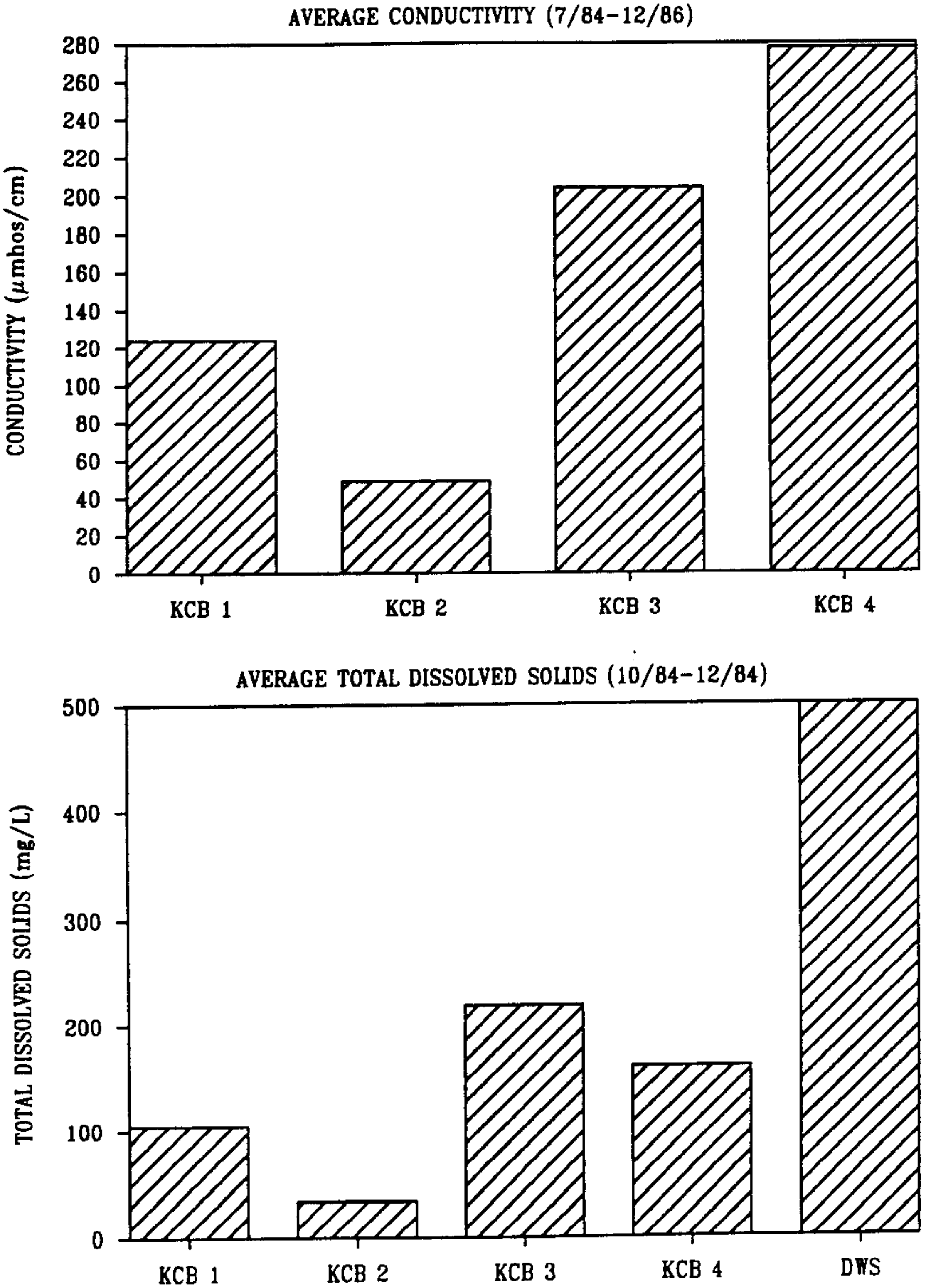
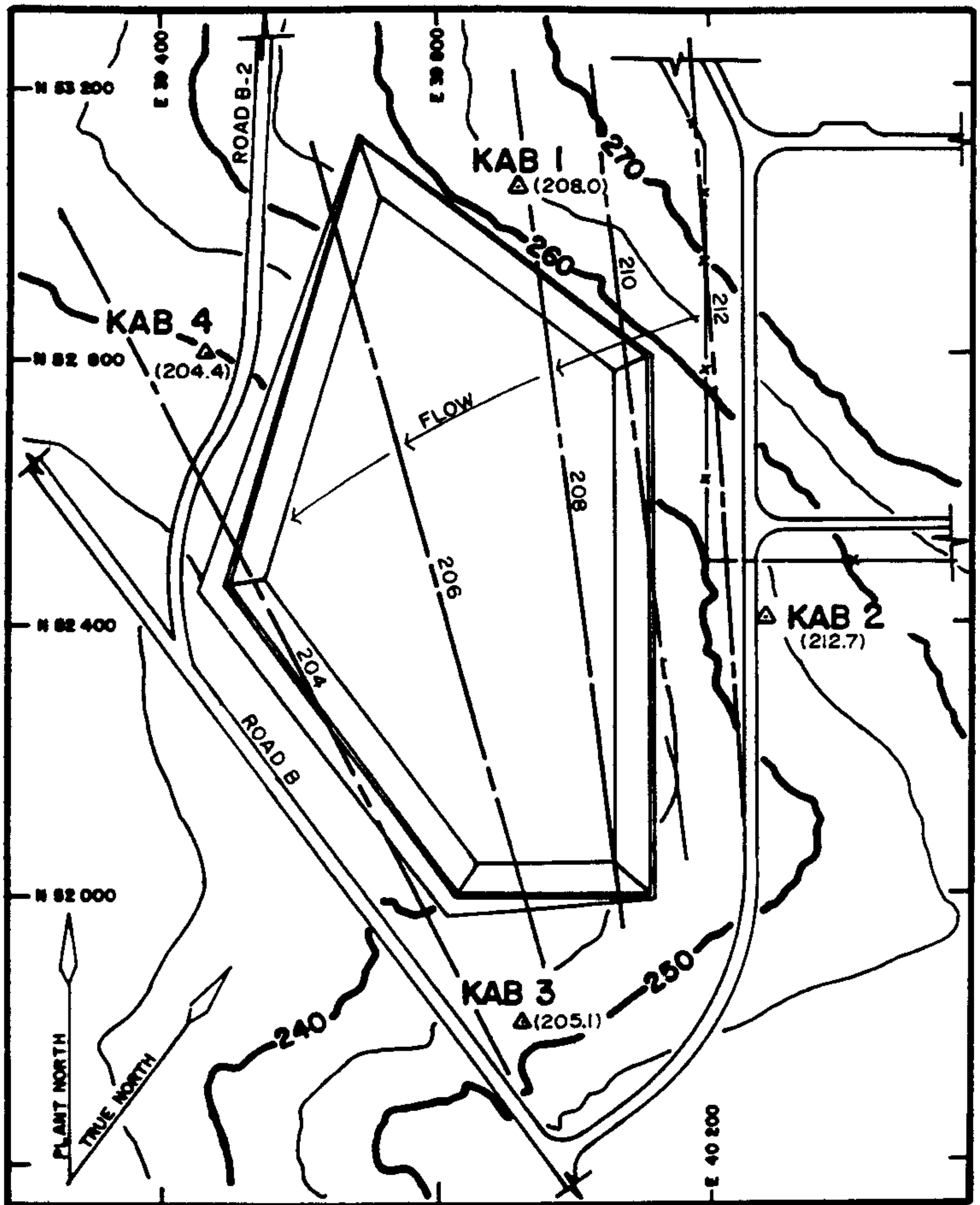


FIGURE 10-14. **Average Conductivity and Total Dissolved Solids (TDS) Concentrations in K-Area Coal Pile Runoff Containment Basin (CPRB) Wells**



CONTOUR INTERVAL = 5'

NOTE: WATER ELEVATIONS WERE OBTAINED 5/86 AND ARE IN FEET MSL.

FIGURE 10-15. K-Area Ash Basin Water-Table Elevation Map

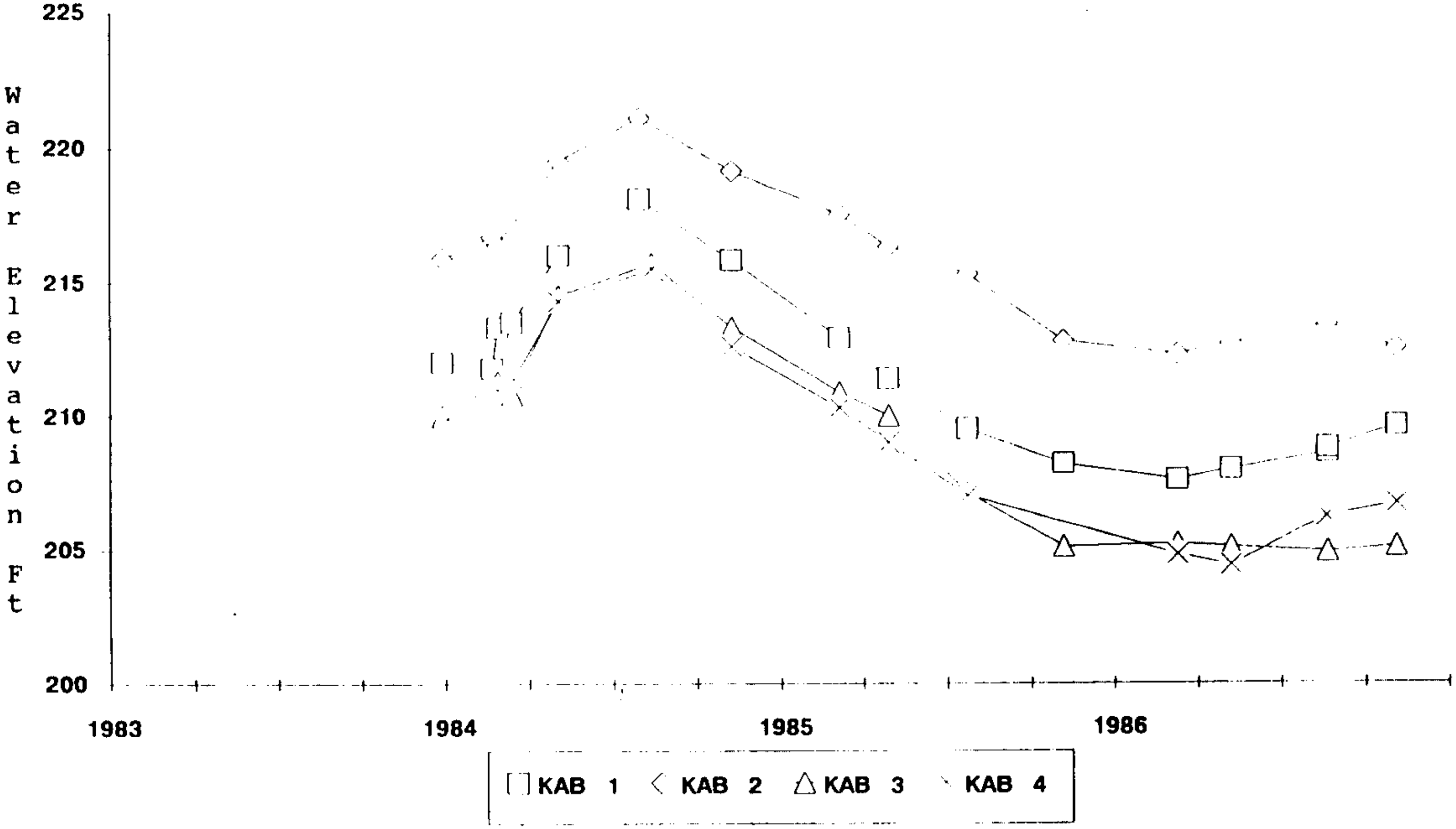


FIGURE 10-16. Hydrograph of the K-Area Ash Basin Wells

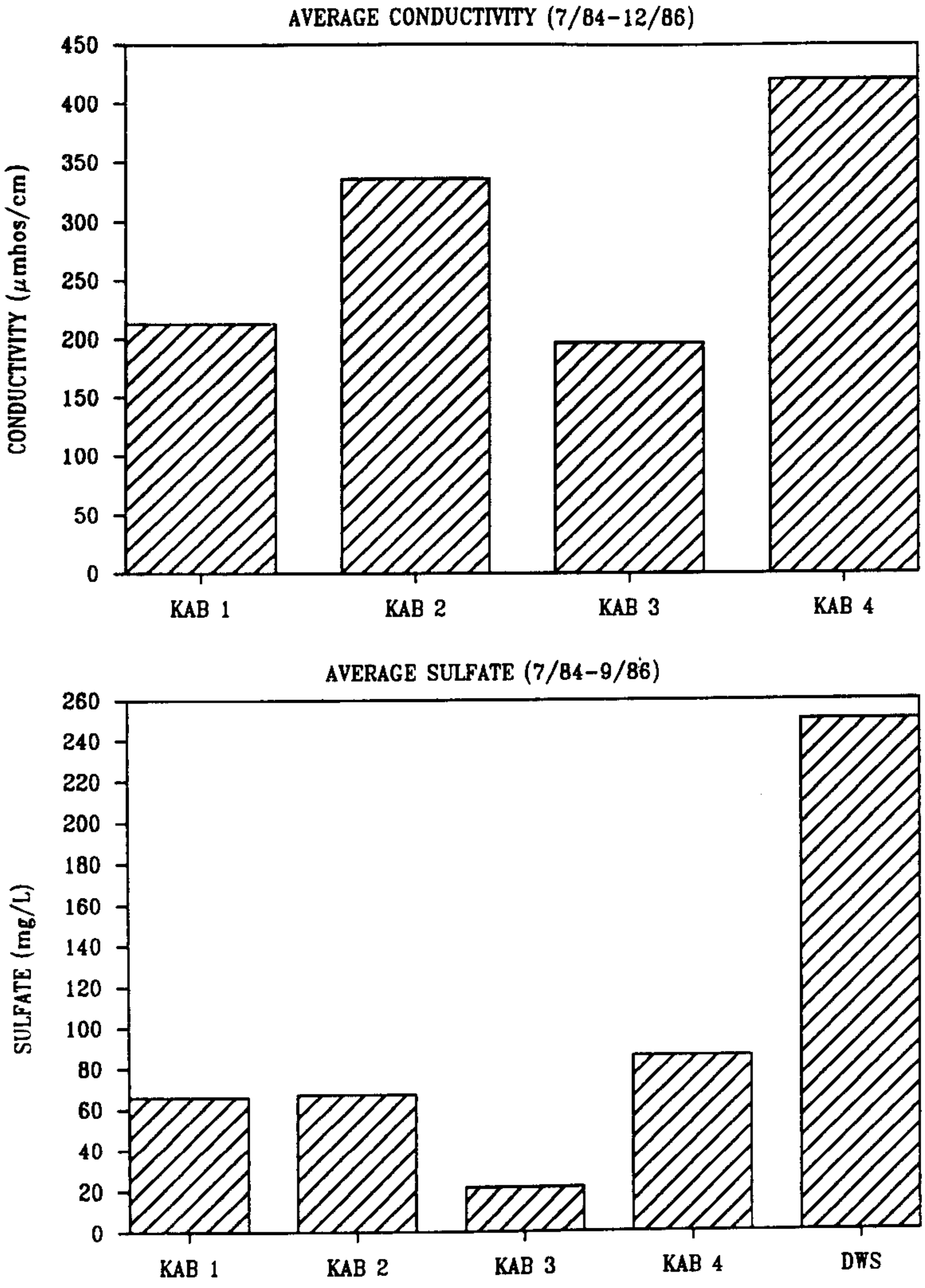


FIGURE 10-17. Average Conductivity and Sulfate Concentrations in the K-Area Ash Basin Wells

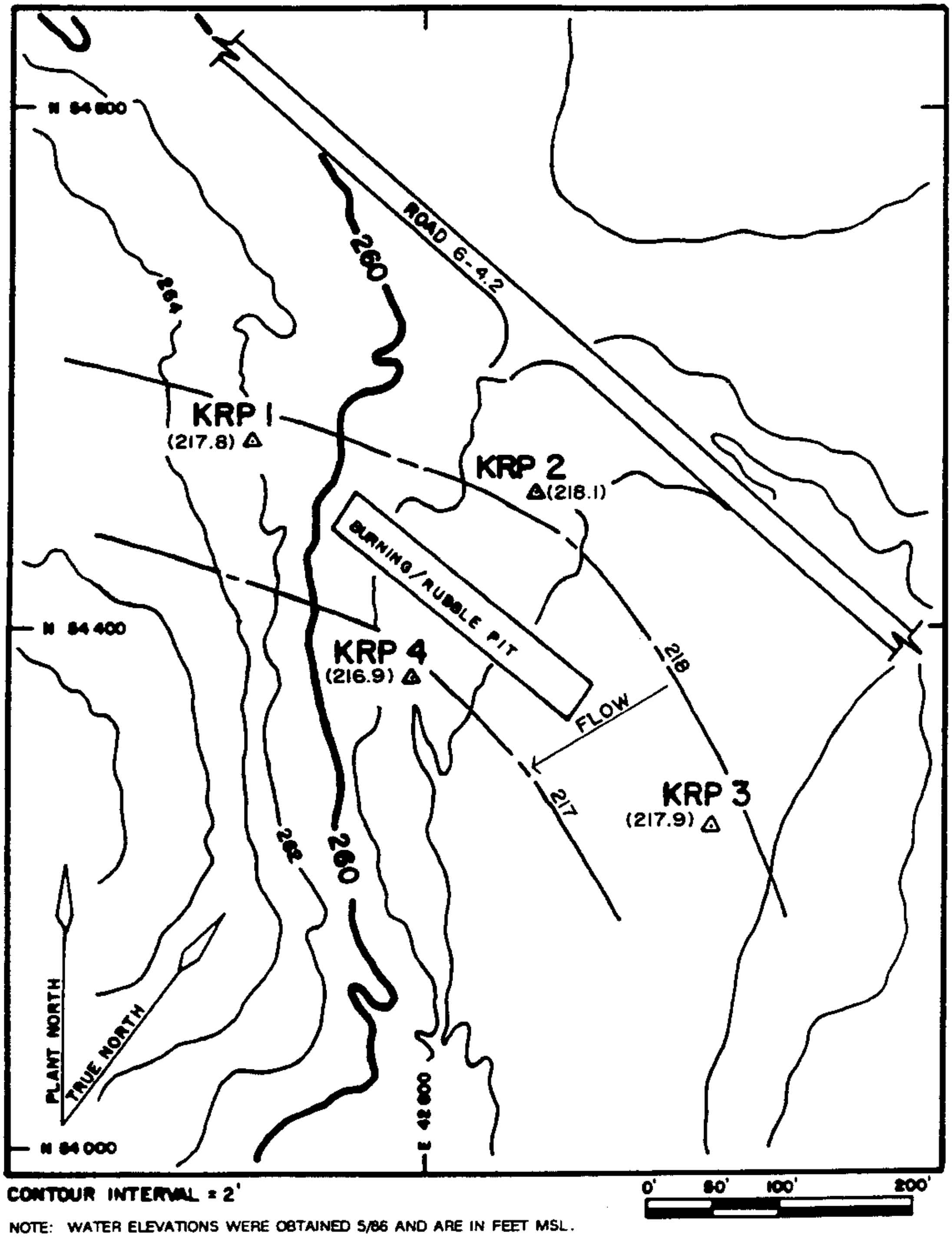


FIGURE 10-18. K-Area Burning/Rubble Pit Water-Table Elevation Map

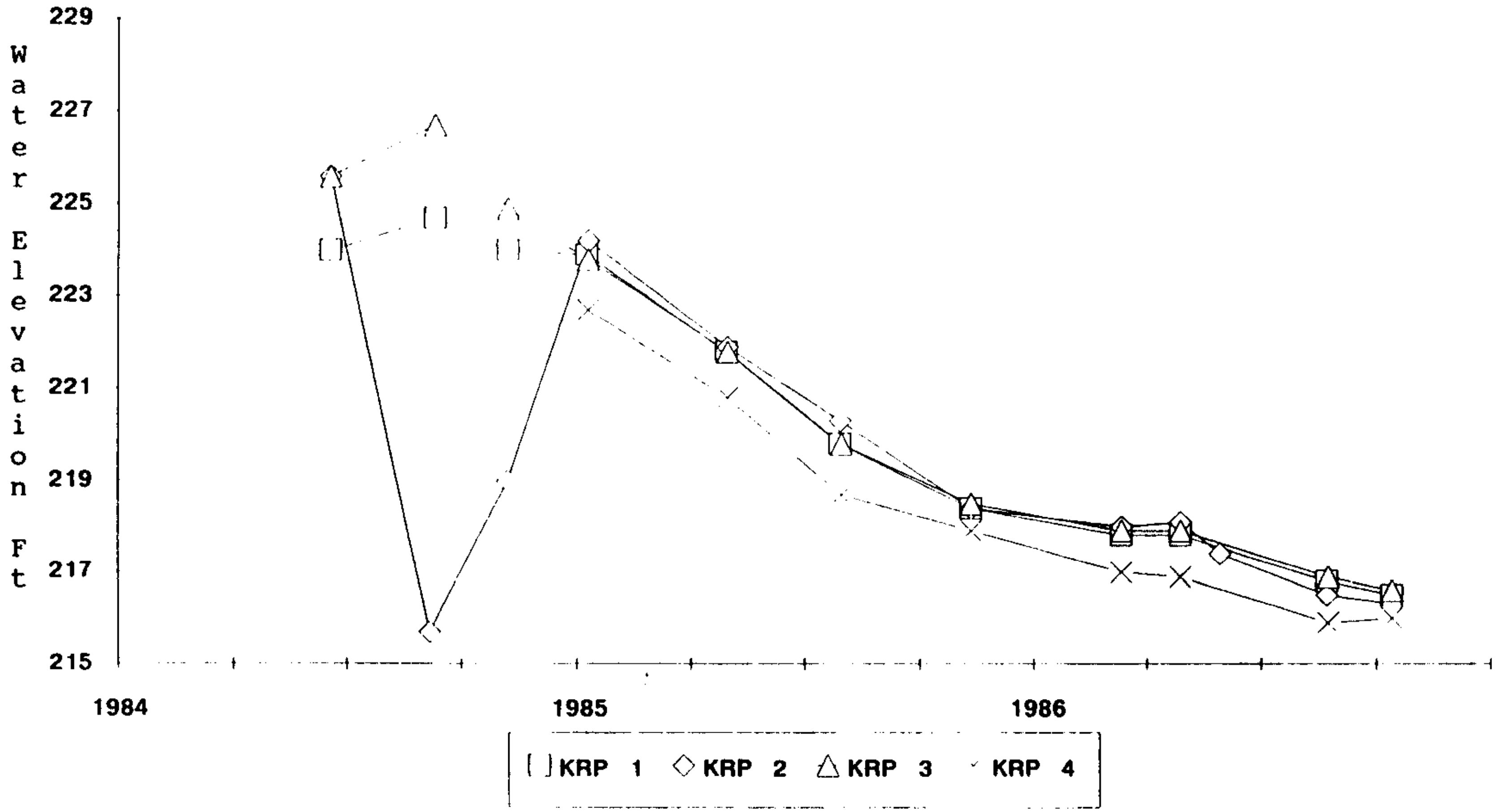


FIGURE 10-19. Hydrograph of the K-Area Burning/Rubble Pit Wells

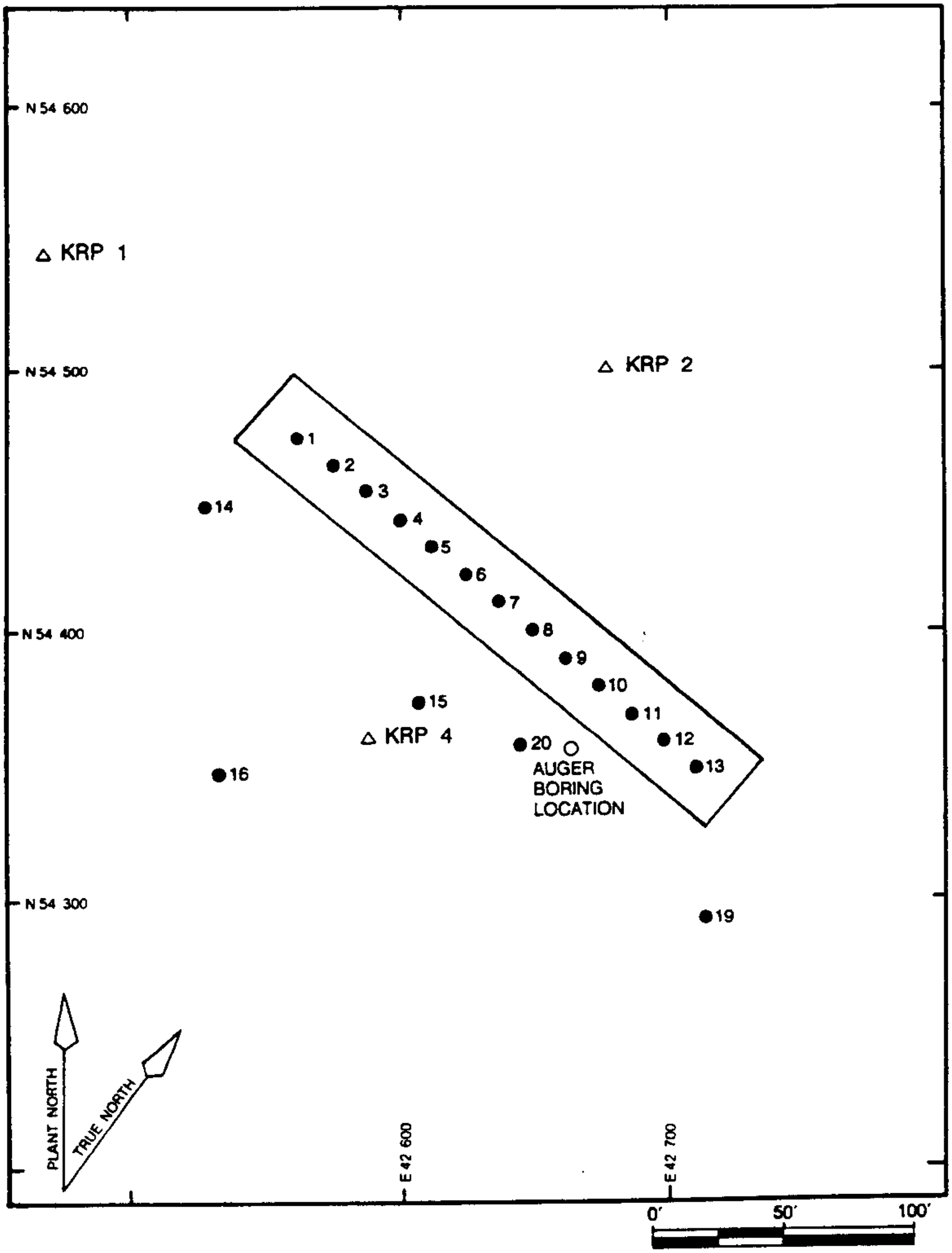
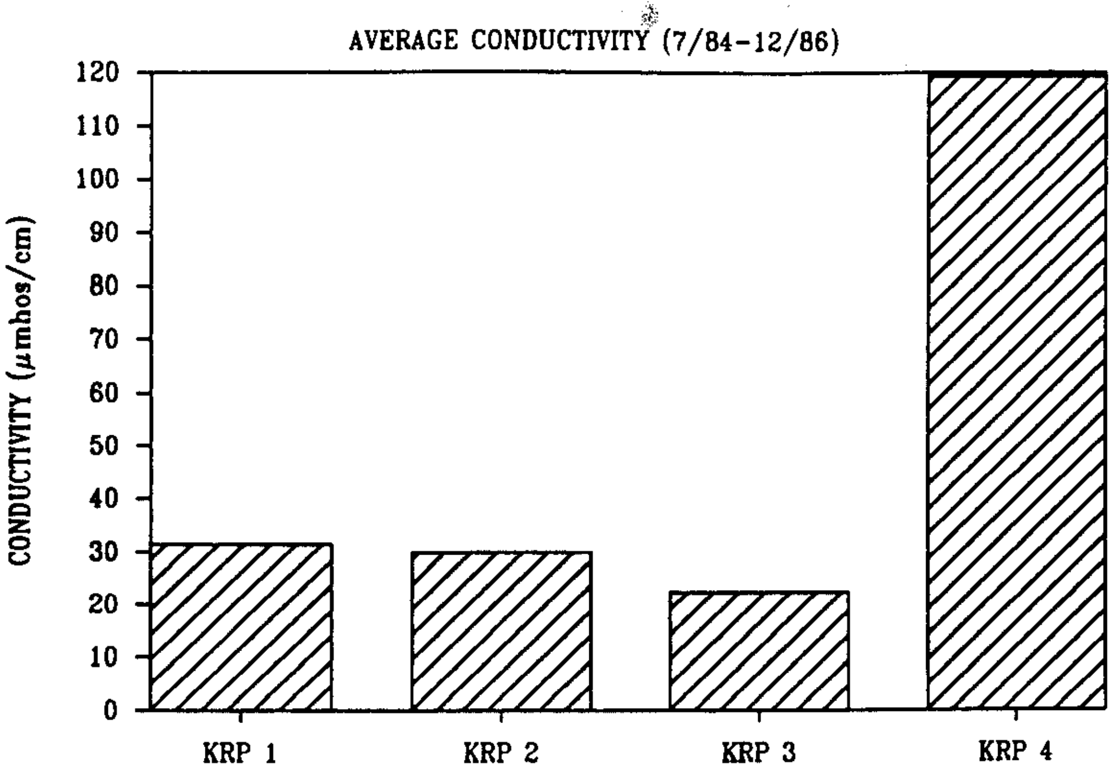
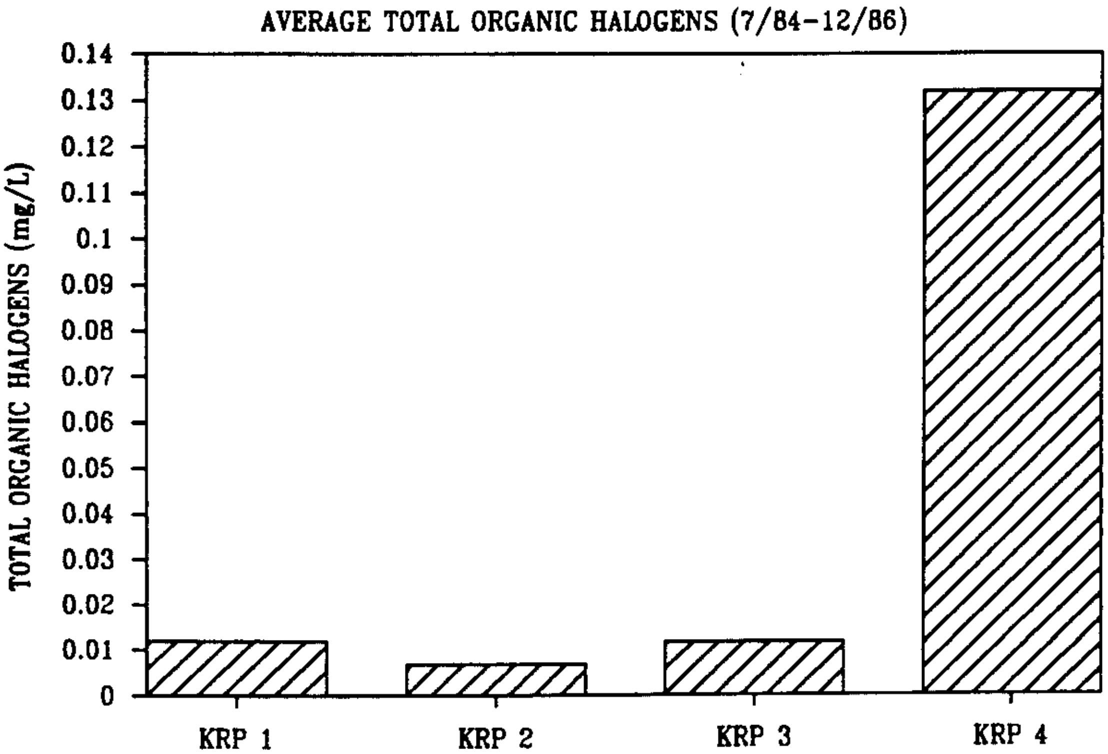


FIGURE 10-20. Soil Sampling Locations at the K-Area Burning/Rubble Pit





NOTE: A SUSPECT TOTAL ORGANIC HALOGENS DATA POINT OF 35.95 MG/L FOR WELL KRP 1 WAS OMITTED FROM THE GRAPH.

FIGURE 10-21. Average Conductivity and Total Organic Halogens (TOH) Concentrations in the K-Area Burning/Rubble Pit Wells

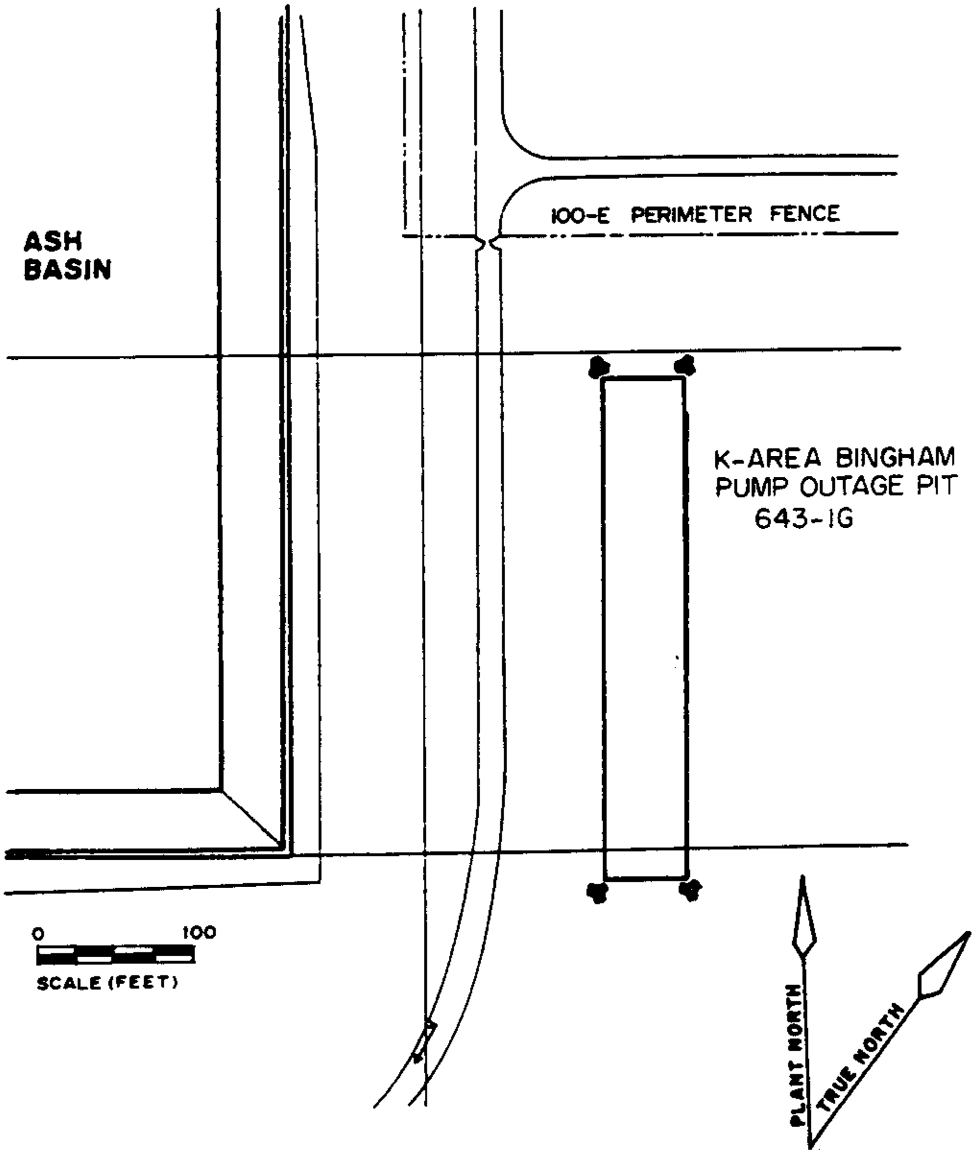


FIGURE 10-22. The K-Area Bingham Pump Outage Pit

SECTION 11 L AREA

11.01 GENERAL INFORMATION

11.01.01 General Area Description

L Area is located in the south-central part of SRS as shown in Figure 11-1. Surface elevations across L Area range approximately from 230 to 260 ft msl and decrease toward Steel Creek, approximately 2,500 ft to the southeast. A number of small tributaries of Steel Creek receive surface drainage from L Area.

There are 14 L-Area waste sites as indicated in Figure 11-2:

L The L-Area Reactor Seepage Basin

L The L-Area Acid/Caustic Basin

L The L-Area Ash Basin

L The L-Area Burning/Rubble Pit

L The L-Area Oil and Chemical Basin

L The L-Area Bingham Pump Outage Pits (2 pits)

L The L-Area Rubble Pits (3 pits) (see Section 15)

L The Gas Cylinder Disposal Facility (see Section 15)

L The L-Area Rubble Pile (see Section 15)

L The L-Area Erosion Control Site (see Section 15)

L The L-Area Earthen Basin (see Section 15)

11.01.02 General Hydrologic Conditions

By the end of 1986, 16 monitoring wells had been installed around the L-Area waste sites to delineate subsurface conditions and to monitor the water-table elevation and quality. All 16 wells are currently being monitored. According to the surface geologic map presented by Siple (1967), the monitoring wells in L Area were installed in the Barnwell Formation. Section 3 contains detailed information concerning the hydrostratigraphy beneath SRS.

The water-table elevation in L Area has ranged approximately from 240 to 210 ft msl, and the vadose zone has been approximately 20 to 40 ft thick. As shown in Figure 11-2, the general horizontal groundwater flow direction is to the southeast toward Steel Creek, approximately 2,500 ft away. The hydraulic gradient increases in the general direction of Steel Creek and its tributaries. The near-surface groundwater beneath L Area naturally discharges to these streams.

Mathematical modeling of the Barnwell Formation near the center of the plant in the Separations Areas indicates that the horizontal groundwater flow velocity ranges approximately from 15 to 60 ft/yr per percent gradient (Duffield et al., 1986; Parizek and Root, 1986). As shown in Figure 11-2, the hydraulic gradient of the water table is variable across L Area; therefore, horizontal groundwater flow velocity across L Area will vary. The horizontal flow direction and estimated flow velocity for the water table at each L-Area waste site are discussed in the following specific waste-site sections.

11.01.03 Migration Potential of Dissolved Chemical Constituents from L Area

The potential for any dissolved constituents to be naturally discharged from a waste site to nearby surface water from the groundwater system depends on the location of the waste site, the hydraulic gradient, and the flow path between the waste site and the discharge point. Horizontal and vertical groundwater flow velocities also depend upon the medium through which the groundwater travels (i.e., sand, silt, or clay). Similarly, interactions with the soil/sediment medium (retardation) will affect the horizontal and vertical movements of dissolved chemical constituents.

The nearest plant boundary to L Area is approximately 5.5 mi to the southeast. Steel Creek represents a sink into which groundwater from the Barnwell and McBean formations discharges. The incision of the Aiken Plateau by Pen Branch to the northwest and Steel Creek to the southeast creates a groundwater island in the Barnwell Formation; thus, contamination from L Area is not likely to reach the plant boundary through the near-surface groundwater system.

11.02 L-AREA REACTOR SEEPAGE BASIN

11.02.01 Summary

The L-Area Reactor Seepage Basin (Building 904-64G) received low-level radioactive purge water from the L-Area Disassembly Basin from 1958 until 1969 and from 1985 until the present. Although many radionuclides have been discharged to the basin, almost all of the radioactivity is due to ^{3}H, ^{90}Sr, ^{137}Cs, and ^{60}Co. In addition to radionuclides, trace quantities of aluminum, iron, sodium, chloride, carbonate, nitrate, phosphate, sulfite, sulfate, oil, and grease have also been discharged to the basin (Stone and Christensen, 1983). The L-Area Reactor Seepage Basin is currently active and receiving purge water.

Four soil cores were augered in the L-Area Reactor Seepage Basin in 1978 and analyzed for ^{90}Sr and gamma emitters. The major radionuclide in the soil was ^{60}Co, and the majority of the radioactivity was contained in the top foot of soil.

The groundwater monitoring data indicate that there has been no apparent effect on groundwater quality from the L-Area Reactor Seepage Basin except for elevated levels of tritium in upgradient well LSB 4 and downgradient well LSB 1. Groundwater quality in sidegradient well LSB 2 and upgradient well LSB 3 has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for two excursions of lead in sidegradient well LSB 2. Groundwater in upgradient well LSB 4 and downgradient well LSB 1 has met South Carolina and federal drinking water standards except for tritium in both of these wells and lead in upgradient well LSB 4. Lead is not known to be related to past site activities.

11.02.02 Waste-Site Description and Nature of Disposal

The L-Area Reactor Seepage Basin (Building 904-64G) is south of the L-Area perimeter fence. As shown in Figure 11-3, the basin is on a southwest-trending slope where surface elevations range approximately from 227 to 232 ft msl. The nearest plant boundary is approximately 5.6 mi south of the seepage basin. The L-shaped basin was constructed by excavating below grade and forming earthen dike walls at grade level.

In 1958, SRS began using the L-Area Reactor Seepage Basin for the disposal of low-level radioactive purge water from the L-Area Disassembly Basin. This water purge is necessary to keep the tritium activity in the disassembly basin water within a safe working range. Although many radionuclides have been discharged to the L-Area Reactor Seepage Basin, nearly all the radioactivity is due to ^{3}H, ^{90}Sr, ^{137}Cs, and ^{60}Co. The radionuclides enter the disassembly basin water as a film of liquid on the irradiated components as they are discharged from the reactor tank to the disassembly basin, in the oxide corrosion film on the irradiated components, and, infrequently, from leaks in porous components. The inventory of radionuclides discharged to the L-Area Reactor Seepage Basin (corrected for radioactive decay through 1982) is presented in Table 11-1 (Stone and Christensen, 1983).

In the late 1950s and early 1960s, purge water from the disassembly basins in the L-Area reactor building was pumped directly from the disassembly basins to the seepage basin. In the 1960s, mixed-bed deionizers were placed in service to reduce the ionic constituents in the water purged from the disassembly basins. The L-Area Reactor Seepage Basin was in operation until 1969. The basin was reopened in 1985 and remains active.

In normal practice, disassembly basin water is recirculated through sand filters to remove particulates. Particulates removed from the disassembly basin water are backwashed from the sand filter to a settler tank. Periodically, the particulate accumulation in the settler tank is transferred to a tank trailer and sent to the Separations Areas for concentration and storage.

After particulates in the recirculating disassembly basin water have been reduced by filtration, the basin water is pumped through mixed-bed deionizers and sand filters to reduce ionic concentrations to meet procedural limits. After the ionic concentrations have been reduced, the purge water is pumped to the reactor seepage basin. During the purging operation, the deionizer effluents are monitored. Should radioactivity in the deionizer effluents approach the control limit, the deionizers are taken offline and regenerated.

In addition to purge water from the disassembly basin, the seepage basin receives low-level radioactive wastewater from other sources in the reactor area. This discharged water must meet the same contamination control limits as disassembly basin purge water before it is released to the seepage basin.

Trace quantities of aluminum, iron, sodium, chloride, carbonate, nitrate, phosphate, sulfite, sulfate, oil, and grease have been discharged to the basin. These chemicals enter the disassembly basin water in small amounts through additives for pH control, filter promotion, and algae treatment and through minimal additions of wastewater to the settler tank from other sources in the reactor buildings.

The L-Area Reactor Seepage Basin will continue in service until no longer needed for discharge of disassembly basin purge water. Vegetation at the site is checked periodically for radioactivity and removed to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G) if elevated activity is found. Vegetation at the site is controlled with herbicides.

11.02.03 Groundwater Monitoring Program

Four wells (LSB 1 through LSB 4) have been installed to monitor the water-table elevation and groundwater quality at the L-Area Reactor Seepage Basin (Figure 11-3). Wells LSB 1 through LSB 4 were constructed in the second quarter of 1983 using PVC casings and 30-ft screens.

The L-Area Reactor Seepage Basin wells were included in the SRS quarterly groundwater monitoring program in the fourth quarter of 1983. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

11.02.04 Site-Specific Hydrology

Measurements obtained from the L-Area Reactor Seepage Basin wells since the fourth quarter of 1983 indicate that the water-table elevation has been approximately 210 ft msl and that the vadose zone has been approximately 24 ft thick. A hydrograph for the L-Area Reactor Seepage Basin wells is presented in Figure 11-4. The water-table elevation for the fourth quarter of 1986 ranged approximately from 212 ft to 206 ft msl, or about 22 ft to 26 ft below ground surface.

The water-table elevation contour map for the second quarter of 1985 (Figure 11-3) indicates that the horizontal groundwater flow direction was to the southeast. As the hydrograph for the L-Area Reactor Seepage Basin wells (Figure 11-4) indicates, this horizontal flow direction has remained relatively consistent over the period of monitoring, although minor fluctuations in flow direction and gradient have occurred. Relative to the basin, wells LSB 3 and LSB 4 have been upgradient, well LSB 1 downgradient, and well LSB 2 sidegradient.

The hydraulic gradient of the water table beneath the seepage basin has been approximately 0.022 ft/ft. Using an estimated horizontal groundwater flow velocity range for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, horizontal groundwater flow beneath the L-Area Reactor Seepage Basin has ranged approximately from 33 to 132 ft/yr.

11.02.05 Waste-Site Content Characterization Data

The L-Area Reactor Seepage Basin surface water was analyzed for radioactive parameters only. Gross alpha, nonvolatile beta, and specific radionuclide activities in the L-Area Reactor Seepage Basin water from 1982 through 1986 are listed in Table 11-2, which shows that the highest activity is from tritium. The tritium levels in the basin water were elevated in 1982, 1984, and 1986.

11.02.06 Soil/Sediment Characterization Data

In 1978, four soil cores were taken from the L-Area Reactor Seepage Basin: two cores were augered in each arm of the L-shaped basin. Two samples were cored to 10-ft depths; the other two samples were cored to 20-ft depths. The cores were analyzed for gamma emitters at 0.5-ft intervals to a depth of 2 ft and at the 9.5 to 10 ft depth interval. The two deeper cores were also analyzed for ^{90}Sr and were sampled at an additional depth interval (19.5 to 20 ft). Results of the sampling are presented in Table 11-3 and show that the predominant radionuclide in the soil was ^{60}Co. The majority of the radioactivity was contained in the top foot of soil, with maximum activities of 12,800 pCi/g for ^{60}Co, 400 pCi/g for ^{137}Cs, and 112 pCi/g for ^{90}Sr (Ashley and Zeigler, 1981).

11.02.07 Groundwater Monitoring Results

The groundwater monitoring data from 1983 through 1986 for the L-Area Reactor Seepage Basin are included in Appendix I. Groundwater characterization data since July 1984 are summarized in Table 11-4.

Comparisons of the monitoring data between downgradient well LSB 1 and the other L-Area Reactor Seepage Basin wells were used to evaluate the effect of the basin on the groundwater. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. Based on the discharges to the seepage basin (Section 11.02.02), radioactivity was chosen as the indicator parameter to assess the effect of the basin on the groundwater.

The groundwater monitoring data summarized in Table 11-4 indicate that the L-Area Reactor Seepage Basin has had no apparent influence on local groundwater quality except for elevated tritium activity in upgradient well LSB 4 and downgradient well LSB 1 and lead in upgradient well LSB 4 and sidegradient well LSB 2. Low conductivity values were reported for wells LSB 1 (19 to 36 μmhos/cm), LSB 2 (25 to 43 μmhos/cm), LSB 3 (17 to 29 μmhos/cm), and LSB 4 (30 to 60 μmhos/cm).

Tritium activities in well LSB 4 (116 to 207 pCi/mL) and well LSB 1 (105 to 118 pCi/mL) were above the drinking water standard of 20 pCi/mL. Figure 11-5 is a graphic comparison of average tritium activity among the influenced site wells and the drinking water standard. As indicated in Figure 11-5, tritium activities in sidegradient well LSB 2 and upgradient well LSB 3 remained below the drinking water standard of 20 pCi/mL. Although LSB 4 generally has been upgradient of the basin, the well's close proximity to the basin (less than 50 ft) and observed fluctuations in the site groundwater flow direction indicate that tritium from the basin may have influenced groundwater quality near this well. Gross alpha (0.720 to 5.00 pCi/L) and total radium (<1.0 pCi/L) activities remained below their respective drinking water standards of 15 pCi/L and 5 pCi/L in the site wells. Nonvolatile beta activity in the site wells remained below 22 pCi/L.

Lead levels in sidegradient well LSB 2 (0.042 to 0.192 mg/L) and upgradient well LSB 4 (0.042 to 0.202 mg/L) exceeded the drinking water standard of 0.05 mg/L in two excursions for each well. Lead levels in downgradient well LSB 1 (0.012 to 0.050 mg/L) and upgradient well LSB 3 (0.023 to 0.048 mg/L) met the drinking water standard of 0.05 mg/L. Lead is not known to be related to past site activities.

Groundwater pH in the L-Area Reactor Seepage Basin wells ranged between 3.4 and 5.5; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

11.02.08 Planned Action

The L-Area Reactor Seepage Basin is active, and continued use is planned. Groundwater monitoring will continue at the site. No other action is planned.

11.03 L-AREA ACID/CAUSTIC BASIN

11.03.01 Summary

The L-Area Acid/Caustic Basin (Building 904-79G) received dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion-exchange units in the water purification process areas. This basin allowed for the mixing and neutralization of the dilute solutions before their discharge to Steel Creek. Constructed between 1952 and 1954, the basin remained in service until 1968. The L-Area Acid/Caustic Basin is currently open and inactive (Ward et al., 1987).

Basin soil/sediments were sampled in August 1985. Concentrations of tested soil/sediment parameters, including sulfate and sodium, were generally consistent with background levels. Extraction Procedure (EP) toxicity test results for metals and pesticides indicate that concentrations in the basin soil/sediments are below Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

Groundwater samples from downgradient well LAC 1 and upgradient well LAC 2 have been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for trichloroethylene (0.048 to 0.083 mg/L) in well LAC 2 and an excursion of iron (1.39 mg/L) in well LAC 1. Iron levels as high as 0.52 mg/L are consistent with levels reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Trichloroethylene is not known to be related to past site activities.

Groundwater samples from downgradient well LAC 4 have also consistently met South Carolina and federal drinking water standards except for trichloroethylene at 0.007 mg/L. However, a comparison of indicator parameter levels between downgradient wells LAC 4 and LAC 1 and upgradient well LAC 2 indicates that the L-Area Acid/Caustic Basin has had a slight influence on groundwater quality in downgradient well LAC 4. Indicator parameter levels in well LAC 4 have shown a generally increasing trend since March 1986.

The groundwater data for downgradient well LAC 3 suggest that this well may have been affected by leaching of the well's cement grout. Groundwater quality data for well LCO 4 (L-Area Oil and Chemical Basin), approximately 250 ft downgradient of the L-Area Acid/Caustic Basin, indicate influence from the Acid/Caustic Basin on water quality in this well (see Section 11.06.07).

11.03.02 Waste-Site Description and Nature of Disposal

The L-Area Acid/Caustic Basin (Building 904-79G) is in an area of low relief where surface elevations range approximately from 235 to 239 ft msl (Figure 11-3). The L-Area Acid/Caustic Basin is an unlined earthen depression with nominal dimensions of 50 ft long by 50 ft wide by 7 ft deep. The basin was formed by removing existing soils below grade and building sloped side walls. The soils in the area are predominantly composed of brownish-yellow to red sandy clay, with clay content ranging from 5 to 40%.

Dilute sulfuric acid and sodium hydroxide solutions were used to regenerate ion exchange units in the L-Area water purification process area. The L-Area Acid/Caustic Basin provided containment for the mixing and neutralization of the spent solutions before their discharge to Steel Creek (Ward et al., 1987). Calculated annual historic acid and caustic discharge rates to the basin are summarized in Table 11-5.

The L-Area Acid/Caustic Basin was constructed between 1952 and 1954 and remained in service until 1968. During basin operation, effluent resulting from discharges and rainwater runoff intermittently flowed out of the basin to Steel Creek through an overflow weir, which was set to maintain a maximum working water depth of 3 ft in the basin. Detailed effluent records for the L-Area Acid/Caustic Basin were not maintained (Ward et al., 1987).

The basin is currently open, inactive, and contains no wastewater. The side slopes and basin floor are vegetated.

11.03.03 Groundwater Monitoring Program

Four wells (LAC 1 through LAC 4) were installed to monitor the water-table elevation and groundwater quality near the L-Area Acid/Caustic Basin. Wells LAC 1 through LAC 3 were installed in the last half of 1983, and well LAC 4 was installed in the third quarter of 1984. All four wells were constructed using PVC casings and 30-ft screens.

The L-Area Acid/Caustic Basin wells are sampled as part of the SRS quarterly groundwater monitoring program. Monitoring was initiated in the second quarter of 1984 for wells LAC 1 through LAC 3 and in the first quarter of 1985 for well LAC 4. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

11.03.04 Site-Specific Hydrology

Measurements obtained from the L-Area Acid/Caustic Basin wells indicate that the water-table elevation has been steadily declining since the second quarter of 1984. A hydrograph for the L-Area Acid/Caustic Basin wells is presented in Figure 11-6. The water-table elevation for the fourth quarter of 1986 was approximately 212 ft msl, and the vadose zone was approximately 25 ft thick.

A water-table elevation map for the second quarter of 1985 (Figure 11-3) shows that the horizontal near-surface groundwater flow direction was to the southeast, consistent with local topography. The hydrograph (Figure 11-6) indicates that this has been the predominant groundwater flow direction, although fluctuations in the water-level data suggest that some flow direction and gradient changes have occurred. Relative to the basin, well LAC 2 has been upgradient, and wells LAC 1, LAC 3, and LAC 4 have been downgradient. The hydraulic gradient across the basin has been approximately 0.01 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the near-surface groundwater flow velocity beneath the L-Area Acid/Caustic Basin has ranged approximately from 15 to 60 ft/yr.

11.03.05 Waste-Site Content Characterization Data

The L-Area Acid/Caustic Basin contents have not been sampled.

11.03.06 Soil/Sediment Characterization Data

The L-Area Acid/Caustic Basin soil/sediments were sampled in August 1985 as part of a basin characterization program. Three 5-ft continuous borings were obtained near the basin inlet and outlet structures and along one side wall. Soil boring samples were separated into 0.5-ft intervals for analysis. Soil/sediment analytical results, including Extraction Procedure (EP) toxicity test results for metals, are summarized in Table 11-6. EP toxicity test results for metals and pesticides indicate concentrations less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24). Concentrations of other soil/sediment parameters tested were generally consistent with background soil levels, including sulfate (39.5 to 411.5 $\mu g/g$) and sodium (244 to 6,840 $\mu g/g$).

11.03.07 Groundwater Monitoring Results

Groundwater monitoring data from 1983 through 1986 are presented in Appendix I. Groundwater chemical characterization data since July 1984 are summarized in Table 11-7.

Well LAC 3 has had elevated pH (5.7 to 9.5) and sodium (22.8 to 78.6 mg/L) values relative to the other L-Area Acid/Caustic Basin wells (Figure 11-7), suggesting that well LAC 3 has been affected by leaching of the well's grout column. The elevated conductivity in well LAC 3, ranging from 155 to 322 μmhos/cm, is also indicative of the leaching of well grout. Figure 11-8 illustrates the relative difference in average conductivity levels between downgradient well LAC 3 and the other L-Area Acid/Caustic Basin wells. Elevated levels of sulfate were not found in downgradient well LAC 3, suggesting that this well has not been affected by basin seepage. Sulfate levels in well LAC 3 (5.0 to 27.3 mg/L) are consistent with sulfate levels reported for the other L-Area Acid/Caustic Basin wells and are well below the drinking water standard of 250 mg/L (Figure 11-8). These sulfate levels, in addition to the elevated pH, indicate that LAC 3 has been affected by well cement grout. Trichloroethylene levels in well LAC 3 (0.038 to 0.052 mg/L) have been above drinking water standards.

Comparisons of the monitoring results between upgradient well LAC 2 and downgradient wells LAC 1 and LAC 4 were used to evaluate the effect of the L-Area Acid/Caustic Basin on the groundwater. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. Indicator parameters for the site are sulfate, sodium, and conductivity because elevated levels of these parameters are indicative of basin seepage and because sulfate and sodium are soluble and migrate readily in soil or groundwater (Section 11.03.02).

The groundwater data summarized in Table 11-7 indicate that the L-Area Acid/Caustic Basin has had minimal effect on groundwater quality in downgradient well LAC 1 and upgradient well LAC 2. Groundwater from wells LAC 1 and LAC 2 has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards except for isolated excursions of iron in well LAC 1 and trichloroethylene in well LAC 2. These low dissolved chemical constituent levels are reflected by the low conductivity ranges of 20 to 41 μmhos/cm reported for LAC 1 and 20 to 37 μmhos/cm reported for LAC 2. Sulfate concentrations in downgradient well LAC 1 (<3.0 mg/L) and upgradient well LAC 2 (<2.0 to 23.0 mg/L) remained well below the drinking water standard of 250 mg/L. The groundwater pH ranged from 3.9 to 4.7 in downgradient well LAC 1 and from 4.0 to 4.9 in upgradient well LAC 2; pH values as low as 4.0 are consistent with the pH range reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Iron concentrations (0.078 to 1.39 mg/L) did not meet the drinking water standard of 0.3 mg/L in an isolated excursion in downgradient well LAC 1. Iron levels as high as 0.52 mg/L have been reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Trichloroethylene concentrations (0.048 to 0.083 mg/L) were elevated in upgradient well LAC 2. Trichloroethylene is not known to be related to past site activities.

Groundwater from downgradient well LAC 4 has consistently met drinking water standards for dissolved chemical constituents except for trichloroethylene (0.005 to 0.007 mg/L), which is not known to be related to past site activities. However, a comparison of average indicator parameter concentrations between downgradient wells LAC 4 and LAC 1 and upgradient well LAC 2 (Figures 11-7 and 11-8) indicates that the L-Area Acid/Caustic Basin has had some influence on groundwater quality in downgradient well LAC 4. Conductivity in downgradient well LAC 4 ranged from 98 to 180 μmhos/cm, while sodium concentrations ranged from 2.06 to 31.8 mg/L. Sulfate concentrations in downgradient well LAC 4 (<5.0 to 44.0 mg/L) remained below the drinking water standard of 250 mg/L, but were generally higher than the sulfate levels reported for the other site wells (below 28.0 mg/L). The groundwater pH in downgradient well LAC 4 ranged from 5.6 to 6.3. Although this pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B), it is slightly elevated compared to the pH values reported for downgradient well LAC 1 (3.9 to 4.7) and upgradient well LAC 2 (4.0 to 4.9).

The concentrations of the indicator parameters (conductivity, sulfate, and sodium) have not shown any consistent increasing or decreasing trends over the monitoring period in the site wells except for well LAC 4. Indicator parameter levels in well LAC 4 have shown an increasing trend since March 1986.

Well LCO 4, an L-Area Oil and Chemical Basin well, is approximately 250 ft downgradient of the L-Area Acid/Caustic Basin and about 100 ft downgradient of the L-Area Oil and Chemical Basin. Groundwater data from well LCO 4 suggest that the L-Area Acid/Caustic Basin has influenced groundwater quality in this well. Section 11.06.07 contains a more detailed discussion of the water-quality data for well LCO 4.

11.03.08 Planned Action

The L-Area Acid/Caustic Basin is inactive. As indicated in Section 16, a site assessment has been completed and a closure plan is to be developed in 1987. Groundwater monitoring will continue at this site.

11.04 L-AREA ASH BASIN

11.04.01 Summary

The L-Area Ash Basin (Building 188-L) received ash sluice water from the L-Area powerhouse from 1951 until 1968. The basin is currently open and inactive (Christensen and Gordon, 1983). Groundwater monitoring and soil characterization studies have not been conducted at the L-Area Ash Basin.

11.04.02 Waste-Site Description and Nature of Disposal

Electricity and steam at SRS are generated by burning coal in the powerhouses, which produces dry ash. Ash sluice water from the L-Area powerhouse was discharged to the L-Area Ash Basin from 1951 until 1968.

The L-Area Ash Basin (Building 188-L) is northwest of the L-Area perimeter fence (Figure 11-2). The ground surface elevation at the basin is approximately 250 ft msl and slopes to the west toward a tributary of Pen Branch. The nearest plant boundary is approximately 6.0 mi south of the site. The L-Area Ash Basin is currently open and inactive.

Ash sluice water contains fly and bottom ash. Horton, Dorsett, and Cooper conducted a study in 1977 to identify trace metals present in the fly and bottom ash disposed to the SRS ash basins and piles. Table 11-8 lists typical trace metal concentrations obtained for fly and bottom ash. These results indicate significant levels of barium, strontium, manganese, zinc, vanadium, cerium, and chromium (Horton et al., 1977).

11.04.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the L-Area Ash Basin.

11.04.04 Site-Specific Hydrology

No groundwater monitoring wells have been installed at the L-Area Ash Basin; therefore, groundwater conditions beneath the waste site are undefined.

11.04.05 Waste-Site Content Characterization Data

Sampling and analysis of the L-Area Ash Basin contents have not been conducted. Section 11.04.02 contains information on the nature of materials disposed at the site.

11.04.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the L-Area Ash Basin. The materials and nature of disposal into the L-Area Ash Basin are similar to those of the D-Area Ash Basin (Building 488-D). Extraction Procedure (EP) toxicity test results from analyses performed on the 488-D Ash Basin sludge are presented in Table 11-9, which shows that extractable metal concentrations in the D-Area Ash Basin sludge were below Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

11.04.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the L-Area Ash Basin.

11.04.08 Planned Action

The L-Area Ash Basin is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

11.05 L-AREA BURNING/RUBBLE PIT

11.05.01 Summary

Burnable wastes such as paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents were received and incinerated in the L-Area Burning/Rubble Pit (Building 131-L) from 1951 to 1973, at which time the pit was covered with a layer of soil. Rubble wastes (including paper, lumber, cans, scrap metal, batteries, and empty galvanized steel drums) were then disposed in the pit until 1978, when the site reached capacity and was covered with soil. The site is currently inactive (Huber et al., 1987c).

Groundwater monitoring data indicate that the L-Area Burning/Rubble Pit has had minimal influence on local groundwater quality. Groundwater quality in sidegradient well LRP 1, upgradient well LRP 2, and downgradient wells LRP 3 and LRP 4 has been characterized by low dissolved chemical constituent and radioactivity levels that have met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for isolated excursions of iron, lead, and nitrate. Levels of total organic carbon (TOC) and total organic halogens (TOH), which are related to past site activities, remained below 9 mg/L and 0.025 mg/L, respectively.

11.05.02 Waste-Site Description and Nature of Disposal

The L-Area Burning/Rubble Pit (Building 131-L) was constructed in 1951 to collect burnable waste generated in L Area. The wastes collected for monthly incineration at the pit included paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents. Disposal of chemically contaminated oils was not allowed at the L-Area Burning/Rubble Pit (Huber et al., 1987c).

In 1973 the plantwide procedure of burning waste ceased, and the L-Area Burning/Rubble Pit was converted to receive only rubble by placing a layer of soil over the incinerated waste. Rubble waste disposed in the pit included paper, lumber, batteries, scrap metal, cans, and empty galvanized steel drums. Rubble disposal continued until 1978, when the pit reached capacity and was covered with soil (Huber et al., 1987c).

The L-Area Burning/Rubble Pit (Building 131-L) is on a northeast-trending slope where ground surface elevations range approximately from 252 to 256 ft msl (Figure 11-9). The original pit was rectangular, with nominal dimensions of 230 ft long by 29 ft wide by 10 ft deep. The capacity of the pit was 66,700 ft^3. The nearest plant boundary is approximately 5.6 mi to the southeast.

11.05.03 Groundwater Monitoring Program

Four wells (LRP 1 through LRP 4) have been installed to monitor the water-table elevation and groundwater quality near the L-Area Burning/Rubble Pit. Wells LRP 1 through LRP 3 were installed in the last half of 1983, and well LRP 4 was installed during the third quarter of 1984. The wells were constructed using PVC casings and 30-ft screens.

L-Area Burning/Rubble Pit wells LRP 1 through LRP 3 were included in the SRS quarterly groundwater monitoring program in the last quarter of 1983, and well LRP 4 was included in the first quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

11.05.04 Site-Specific Hydrology

Measurements obtained from the L-Area Burning/Rubble Pit monitoring wells since December 1983 indicate that the water-table elevation has been declining since the last quarter of 1984. A hydrograph for the L-Area Burning/Rubble Pit monitoring wells (Figure 11-10) shows that the water-table elevation for the fourth quarter of 1986 was approximately 205 ft msl and that the vadose zone was approximately 45 to 50 ft thick. The rapid drop in the water-table elevation in well LRP 2 during the first quarter of 1986 is suspect given the consistent water-level trends observed in the other site wells.

A water-table elevation contour map for the second quarter of 1985 (Figure 11-9) indicates a horizontal groundwater flow direction to the west with a gradient of approximately 0.006 ft/ft. The hydrograph (Figure 11-10) indicates that minor fluctuations in direction and gradient have occurred. With respect to the basin, well LRP 2 has remained upgradient, well LRP 1 sidegradient, and wells LRP 3 and LRP 4 downgradient. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to

60 ft/yr per percent gradient, the near-surface groundwater flow velocity beneath the L-Area Burning/Rubble Pit has been approximately 9 to 36 ft/yr.

11.05.05 Waste-Site Content Characterization Data

The L-Area Burning/Rubble Pit contents have not been sampled. Section 11.05.02 contains information on the materials incinerated and disposed at the waste site.

11.05.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the L-Area Burning/Rubble Pit.

11.05.07 Groundwater Monitoring Results

The groundwater monitoring data from 1983 through 1986 are included in Appendix I. Groundwater chemical characterization data since July 1984 are summarized in Table 11-10.

Comparisons of monitoring data among downgradient wells LRP 3 and LRP 4 and the remaining L-Area Burning/Rubble Pit wells were used to evaluate the effect of the pit on the groundwater. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Based on the site chemical inventory (Section 11.05.02), the groundwater indicator parameters for the site are conductivity, total organic carbon (TOC), and total organic halogens (TOH).

The groundwater monitoring data summarized in Table 11-10 indicate that the L-Area Burning/Rubble Pit has had minimal influence on local groundwater quality. Groundwater from the site wells has been characterized by consistently low dissolved chemical constituent and radioactivity levels compared to South Carolina and federal drinking water standards except for an isolated excursion of lead in upgradient well LRP 2, of nitrate in sidegradient well LRP 1, and of iron in downgradient well LRP 3. Low conductivity values were reported for wells LRP 1 (17 to 42 μmhos/cm), LRP 2 (19 to 50 μmhos/cm), LRP 3 (22 to 48 μmhos/cm), and LRP 4 (20 to 40 μmhos/cm). The TOC and TOH levels, which remained below 9.0 mg/L and 0.025 mg/L, respectively, in all four site wells, provide further indication that the L-Area Burning/Rubble Pit has had minimal effect on local groundwater quality.

Lead levels in upgradient well LRP 2 (0.014 to 0.080 mg/L) ranged over the drinking water standard of 0.05 mg/L in an isolated excursion. Nitrate levels in sidegradient well LRP 1 (0.60 to 163.9 mg/L) remained well below the drinking water standard of 10 mg/L except for an isolated excursion in March 1985. Iron levels in downgradient well LRP 3 (0.052 to 0.312 mg/L) remained below the drinking water standard of 0.3 mg/L except for an excursion in March 1985. This iron range is consistent with iron concentrations reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

Groundwater pH in upgradient well LRP 2 and sidegradient well LRP 1 ranged from 3.8 to 5.4 and in the downgradient wells from 3.2 to 5.3; pH values as low as 4.0 are consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

11.05.08 Planned Action

The L-Area Burning/Rubble Pit is inactive. As indicated in Section 16, a closure plan will be developed from a site assessment proposed for 1988. Groundwater monitoring will continue at this site.

11.06 L-AREA OIL AND CHEMICAL BASIN

11.06.01 Summary

The L-Area Oil and Chemical Basin (LOCB; Building 904-83G) received a variety of oil and chemical wastes containing low levels of radioactivity. Opened in 1961, the basin received wastes from operating areas throughout the plant that were not appropriate for discharge to surface streams, regular seepage basins, or the Separations Areas waste management systems. Waste was discharged to the basin until 1979. The L-Area Oil and Chemical Basin is currently inactive and contains rainwater (Pekkala et al., 1987d).

Basin soil/sediments were sampled in 1984 and 1985. Of the parameters tested, chromium, manganese, zinc, and ^{60}Co were present at the highest levels in the basin soil/sediments. The levels of these parameters decreased substantially with depth. Extraction Procedure (EP) toxicity test results for metals and pesticides indicate that the concentrations in the basin sediment were less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

A comparison of water-quality data between upgradient well LCO 2 and the downgradient wells indicates that the LOCB has had some influence on groundwater quality in downgradient well LCO 4. The data also indicate elevated levels of tritium in both downgradient wells and nonvolatile beta in downgradient well LCO 1.

Levels of sodium, sulfate, and conductivity have been elevated in downgradient well LCO 4 over the monitoring period. These chemical constituents are not characteristic of previous L-Area Oil and Chemical Basin site activities, but are characteristic of the nearby L-Area Acid/Caustic Basin. The groundwater quality data from and location of well LCO 4 (approximately 250 ft downgradient from the L-Area Acid/ Caustic Basin) indicate influence from the L-Area Acid/Caustic Basin on groundwater in this well.

11.06.02 Waste-Site Description and Nature of Disposal

The L-Area Oil and Chemical Basin (LOCB; Building 904-83G) received a variety of oil and chemical wastes containing low levels of radioactivity. Opened in 1961, the basin received wastes from throughout SRS that were not appropriate for discharge into surface streams, regular seepage basins, or the Separations Areas waste management systems. An estimated 1,040,000 gal of wastewater were discharged to the basin. The amount of radioactivity released to the LOCB (decay corrected to December 1985) is shown in Table 11-11. The LOCB has been inactive since 1979 (Pekkala et al., 1987d).

The LOCB is an unlined earthen basin with nominal dimensions of 120 ft long by 80 ft wide by 11 ft deep, with a side slope ratio of 1:1. The maximum capacity of the basin is 105,600 ft^3 (790,000 gal). The ground surface elevation at the site is approximately 240 ft msl (Figure 11-3). The nearest plant boundary is approximately 6 mi to the south.

Vegetation within the basin perimeter fence is removed periodically and sent to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G).

11.06.03 Groundwater Monitoring Program

Four wells (LCO 1 through LCO 4) were installed around the LOCB during the fourth quarter of 1981 to monitor the water-table elevation and groundwater quality (Figure 11-3). The wells were constructed using PVC casings and 30-ft screens and were included in the SRS quarterly groundwater monitoring program in the first quarter of 1982. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

11.06.04 Site-Specific Hydrology

Measurements obtained from the LOCB wells since the first quarter of 1982 indicate that the water-table elevation has been gradually declining since the third quarter of 1982. A hydrograph for the LOCB wells (Figure 11-11) shows that the water-table elevation for the fourth quarter of 1986 ranged approximately from 212 to 208 ft msl and that the vadose zone was approximately 25 ft thick. A water-table elevation map for the second quarter of 1985 is shown in Figure 11-3. As shown, the near-surface groundwater flow direction was to the south, consistent with local topography. The water-level data indicate that this has been the predominant flow direction, although fluctuations in water levels indicate that minor changes in flow direction and gradient have occurred.

The water-level data indicate that wells LCO 1 and LCO 4 have been downgradient of the basin and wells LCO 2 and LCO 3 have been upgradient. The hydraulic gradient of the water table beneath the basin has been approximately 0.01 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the near-surface groundwater flow velocity beneath the basin has ranged approximately from 15 to 60 ft/yr.

11.06.05 Waste-Site Content Characterization Data

The LOCB contents were sampled in 1984 to characterize the levels of radioactive and nonradioactive chemical constituents present in the estimated 250,000 gal of impounded water. One composite sample, comprising one grab sample from four quadrants of the basin, was analyzed. Results from this study show that concentrations of all detected organic and inorganic chemical constituents were low except iron (1.04 mg/L; Table 11-12). Volatile organic chemical concentrations were less than detection limits in the basin water sample (Price, 1984).

Two of the tested radionuclides, ^{60}Co and ^{137}Cs, were found in the basin water at levels of approximately 45 and 21 pCi/L, respectively (Pekkala et al., 1987d). Because these isotopes tend to adsorb onto sediments, these activities may reflect predominately suspended sediments rather than dissolved materials.

11.06.06 Soil/Sediment Characterization Data

Soil/sediment sampling was performed at the LOCB in 1984 and 1985 to characterize levels of radioactive and nonradioactive constituents present in the basin sediment. Four grab samples were collected in January 1984 from the upper sediment layer. Nine sediment cores were collected in March 1985 and April 1985 to depths ranging from 32 to 75 in. below ground surface.

Sediments collected in January 1984 were analyzed for radioisotopes of cobalt, cesium, and europium. The analytical results, presented in Table 11-13, indicate that cobalt is the primary radioactive constituent present in the basin sediment. Cobalt activities in the LOCB sediment ranged from 88 to 1,727 pCi/g in January 1984 (Price, 1984).

Core samples from the 1985 soil/sediment sampling program were analyzed at various intervals for radioactive and nonradioactive parameters. As shown in Table 11-14, the maximum concentrations of inorganic chemical constituents found in the sediment were manganese (12,460 μg/kg), chromium (8,039 μg/kg), and zinc (1,135 μg/kg). The maximum radioisotope activities were found in the top 15 in. of sediment and decreased with depth. Cobalt-60 exhibited the highest activity (22,900 pCi/g) of the radioactive isotopes tested. Cesium-137 activity ranged around 1,100 pCi/g. Total radioactivity, both alpha and beta, decreased substantially beneath the top 15 in. of basin sediment (RPI, 1985).

Total organic carbon (TOC) and those organic parameters included in the Extraction Procedure (EP) toxicity tests were the only organic constituents analyzed for in the sediment. As presented in Table 11-14, the TOC concentrations ranged from 449 to 100,000 μg/kg in the upper sediments. The maximum TOC concentration found 30 in. below ground surface was 881 μg/kg (RPI, 1985). All EP toxicity test parameters were found at concentrations less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

11.06.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 for the LOCB wells are included in Appendix I. Groundwater characterization data since July 1984 are summarized in Table 11-15.

Comparisons of the monitoring data between upgradient well LCO 2 and downgradient wells LCO 1 and LCO 4 were used to evaluate the effect of the LOCB on local groundwater quality. Because of possible leaching of cement grout in well LCO 3 resulting in elevated conductivity and pH values for this well, data from this well were not used to establish background levels. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. The analytical results for likely indicator parameters (conductivity, gross alpha, nonvolatile beta, radium, and tritium) were used for these comparisons. The radionuclide parameters were chosen because they are related to past site activities (Section 11.06.02).

The monitoring data summarized in Table 11-15 indicate that groundwater quality from upgradient well LCO 2 has been characterized by low dissolved chemical constituent and radioactivity levels compared to drinking water standards, as reflected by the low average conductivity value of 40 μmhos/cm reported for well LCO 2 (Figure 11-12). All inorganic, organic, and radioactive parameters tested were below drinking water standards in this well.

Nonvolatile beta activity in downgradient well LCO 1 (30.7 to 120 pCi/L) was greater than the activities reported for the other site wells (0.4 to 9.3 pCi/L) as illustrated in Figure 11-13. Tritium activities in downgradient wells LCO 1 (1,091 to 2,550 pCi/mL) and LCO 4 (333 to 831 pCi/mL) were above the drinking water standard of 20 pCi/mL. Figure 11-13 shows a comparison of the average tritium values for these two wells with the drinking water standard. Detected gross alpha and total radium activities were below drinking water standards over the monitoring period. Radioactivity is related to past site activities.

A comparison of the groundwater quality data between upgradient well LCO 2 and the downgradient wells indicates that the LOCB has influenced groundwater quality in the downgradient wells with regard to organic and inorganic chemical constituents. Manganese in well LCO 4 exceeded the drinking water standard of 0.05 mg/L in one excursion (0.145 mg/L). Chromium was above the drinking water standard (0.05 mg/L) in downgradient wells LCO 1 (0.520 mg/L) and LCO 4 (0.100 mg/L) during the fourth quarter of 1984 but has not been detected since that time. Zinc was below detection limits over the monitoring period. Tetrachloroethylene concentrations were elevated in well LCO 4 (0.048 to 0.086 mg/L).

Conductivity in downgradient wells LCO 1 (65 to 115 μmhos/cm) and LCO 4 (50 to 1,250 μmhos/cm) was above the level reported for upgradient well LCO 2 (28 to 51 μmhos/cm) as shown in Figure 11-12, which also indicates that conductivity was higher in downgradient well LCO 4 than in downgradient well LCO 1. The higher conductivity in well LCO 4 may be attributable to elevated levels of sodium and sulfate in this well, which are not characteristic of past site activities. Sodium levels in well LCO 4 (10.1 to 258 mg/L) were greater than the sodium levels reported for the remaining site wells, as shown in Figure 11-14. Sulfate levels in well LCO 4 (143 to 620 mg/L) were greater than the levels reported for the remaining site wells and ranged above the drinking water standard of 250 mg/L (Figure 11-14). Well LCO 4 is approximately 250 ft downgradient from the L-Area Acid/Caustic Basin (Figure 11-3). As discussed in Section 11.03.02, sodium and sulfate were discharged to the L-Area Acid/Caustic Basin until 1968. Given the estimated horizontal flow velocity of the water table near the site of approximately 15 to 60 ft/yr, the distance between well LCO 4 and the L-Area Acid/Caustic Basin, and the downgradient position of well LCO 4 relative to the acid/caustic basin, well LCO 4 may be influenced by seepage from the L-Area Acid/Caustic Basin.

11.06.08 Planned Action

The L-Area Oil and Chemical Basin is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

11.07 L-AREA BINGHAM PUMP OUTAGE PITS

11.07.01 Summary

The L-Area Bingham Pump Outage Pits (Buildings 643-2G and 643-3G) received solid low-level radioactive waste in 1957 and 1958. Wastes with higher levels of radioactivity were sent to the Radioactive waste Burial Grounds (Building 643-G) during this period. The estimated maximum amount of activity buried in the two pits was approximately 1 Ci (Pekkala et al., 1987a). The L-Area Bingham Pump Outage Pits were deactivated and backfilled with clean soil: one in late 1957, the other in early 1958. The sites have remained inactive. Most of the radioactivity at the site has been eliminated by radioactive decay (Pekkala et al., 1987a). Groundwater monitoring and soil/sediment sampling have not been conducted at the L-Area Bingham Pump Outage Pits.

11.07.02 Waste-Site Description and Nature of Disposal

Normally, all radioactive solid waste generated in the reactor areas is sent to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G). An exception to this practice was made during 1957 and 1958 when major modifications were made to the primary and secondary cooling water systems in the reactor areas (Pekkala et al., 1987a). The L-Area pits were opened in September 1957; Pit 1 was closed in November 1957, and Pit 2 was closed in January 1958.

In L Area, the radioactive waste generated during the modifications was surveyed, and solid waste with low levels of surface contamination was buried in the two L-Area Bingham Pump Outage Pits. These waste pits were subsequently backfilled and covered with clean soil in 1957 and 1958. No pumps are buried in the waste pits. The waste pits do contain miscellaneous construction equipment such as pipes, cables, ladders, drums, concrete, rubble, and boxes of miscellaneous hardware (Fenimore and Horton, 1974). The measured radiation level of this waste was less than 25 mRad/hr, and no alpha activity was noted. Waste with higher levels of contamination was sent to the Radioactive Waste Burial Ground (Building 643-G). A conservative estimate of the total activity originally buried in the L-Area Bingham Pump Outage Pits is 1 Ci (Pekkala et al., 1987a).

The L-Area Bingham Pump Outage Pits (Buildings 643-2G and 643-3G) are north of the L-Area perimeter fence (Figure 11-2). The pits are on a gently southwest-trending slope leading to a tributary of Pen Branch, about 1,180 ft from the site. The elevation of the waste site is approximately 270 ft msl. The nearest plant boundary is about 5.6 mi south of the site.

The pits were rectangular with nominal dimensions of 425 ft long by 30 ft wide by 13 ft deep for the first pit and 470 ft long by 26 ft wide by 13 ft deep for the second pit. The combined volume capacity of the pits was 325,000 ft^3. Vegetation has been allowed to grow over the L-Area Bingham Pump Outage Pits since they were backfilled in 1958.

11.07.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the L-Area Bingham Pump Outage Pits.

11.07.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the L-Area Bingham Pump Outage Pits; therefore, groundwater conditions beneath the waste site are undefined.

11.07.05 Waste-Site Content Characterization Data

The contents of the L-Area Bingham Pump Outage Pits have not been sampled. Section 11.07.02 contains information on the materials disposed in the pits. The estimated radionuclide inventory in the L-Area Bingham Pump Outage Pits at the time of burial (1957 and 1958) and in December 1985 is listed in Table 11-16, which indicates that most of the radioactivity at the L-Area Bingham Pump Outage Pits has been eliminated by radioactive decay.

A comparison between radioactivity levels in vegetation samples from the surface of the L-Area Bingham Pump Outage Pits in 1970 and in vegetation samples taken from the SRS perimeter in the same year is presented in Table 11-17. The vegetation growing above the outage pits exhibited a measurable increase in activity above background levels, as demonstrated in Table 11-17 (Fenimore and Horton, 1974).

11.07.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the L-Area Bingham Pump Outage Pits.

11.07.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the L-Area Bingham Pump Outage Pits.

11.07.08 Planned Action

The L-Area Bingham Pump Outage Pits are inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

TABLE 11-1

Summary of Radioactive Releases to the L-Area Reactor Seepage Basin

Isotope	Release (Ci)
^{3}H*	3.3E+03
^{60}Co	2.4E-01
^{90}Sr	1.1E+00
$^{103,106}Ru$	5.6E-06
^{137}Cs	7.0E-01
^{147}Pm	1.9E-03

Note: Release values are cumulative through 1982. All values are decay corrected through 1982. Data are from Stone and Christensen (1983).

* Most of the tritium is believed to have left the basin via the atmosphere or groundwater.

TABLE 11-2

Radioactivity Levels in L-Area Reactor Seepage Basin Water

Radionuclide	Activity (pCi/mL) 1982	1983	1984	1985	1986
^{51}Cr	0.04	0.01	0.07	0.08	0.00
$^{58,60}Co$	0.01	0.04	0.00	0.00	0.00
$^{89,90}Sr$	---	0.09	0.02	0.01	0.00
$^{95}Zr, ^{95}Nb$	0.00	0.01	0.00	0.00	0.00
^{103}Ru	0.00	0.01	0.01	0.00	0.00
^{106}Ru	0.04	0.22	0.02	0.30	0.00
$^{124,125}Sb$	0.01	0.01	0.02	0.00	0.00
^{131}I	0.00	0.00	0.00	0.00	0.00
^{134}Cs	0.00	0.04	0.00	0.05	0.00
^{137}Cs	0.00	0.01	0.00	0.00	0.00
$^{141,144}Ce$	0.02	0.09	0.01	0.00	0.00
^{3}H	40	---	48	7.7	3,400
Gross alpha	0.0015	0.00028	0.00026	0.0017	0.00
Nonvolatile beta	0.041	0.022	0.01	0.015	2.000

TABLE 11-3

Radioactivity in L-Area Reactor Seepage Basin Soil

Core Site	Depth (cm)	Concentration (pCi/g--dry) ^{60}Co	^{137}Cs	^{90}Sr
1	0-15	80	5	NA
	15-30	5,930	400	NA
	285-300	20	<1	NA
2	0-15	12,800	300	112
	15-30	30	3	2
	30-45	6	2	<1
	45-60	15	1	1
	285-300	3	<1	<1
	585-600	30	2	<1
3	0-15	2,160	70	31
	15-30	35	<1	6
	30-45	24	<1	<1
	45-60	25	<1	<1
	285-300	1	<1	<1
	585-600	1	1	1
4	0-15	7	1	NA
	15-30	1,150	<1	NA
	30-45	40	<1	NA
	45-60	3	<1	NA
	285-300	5	<1	NA

Note: NA = no analysis. Data are from Ashley and Zeigler (1981).

TABLE 11-4

Summary of Groundwater Quality: Well Concentration Ranges for the L-Area Reactor Seepage Basin (7/84-12/86)

Constituent	SC and Federal DWS	LSB 1	LSB 2	LSB 3	LSB 4
pH (pH)	6.5-8.5	3.9-4.8	3.4-4.8	3.8-5.5	3.5-4.3
Conductivity (µmhos/cm)	NA	19-36	25-43	17-29	30-60
Silver (mg/L)	0.05	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.004-0.005	0.010-0.013	0.012	0.004-0.007
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride (mg/L)	0.005	<0.005	---	<0.005	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.005	---	<0.005	---
Chloride (mg/L)	250	1.9-2.4	1.5-2.7	1.5-3.0	1.9-3.0
Chromium (mg/L)	0.05	<0.004-0.005	<0.004	<0.004	<0.004
Copper (mg/L)	1	0.011-0.024	0.026-0.039	0.015-0.048	0.028-0.048
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	<0.005
DOC (mg/L)	NA	<5.0	<5.0	<5.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.16	<0.10-0.15	<0.10-0.16	<0.10-0.17
Iron (mg/L)	0.3	0.041-0.133	0.105-0.216	0.041-0.103	0.039-0.210
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.002-0.004	0.006-0.008	0.005-0.007	0.002-0.005
Sodium (mg/L)	NA	0.87-1.73	1.37-2.17	0.95-1.32	1.37-1.68
Nickel (mg/L)	NA	<0.004	0.006	<0.004	0.004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	1.00	1.43	0.78	2.03
Lead (mg/L)	0.05	0.012-0.050	0.042-0.192	0.023-0.048	0.042-0.202
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.005	---	<0.005	---
TDS (mg/L)	500	30-42	16-64	22-40	18-40
TOC (mg/L)	NA	0.484	0.744	<1.000-1.364	0.970-4.000
TOH (mg/L)	NA	<0.005-0.020	<0.005-0.009	<0.005-0.120	<0.005-0.006
Trichloroethylene (mg/L)	0.005	<0.005	---	<0.005	---
1,1,1-TCE (mg/L)	0.200	<0.005	---	<0.005	---
Zinc (mg/L)	5	0.008	0.025	0.018	0.029
Gross alpha (pCi/L)	15	0.720-5.00	<2.000-2.28	<2.000-2.18	0.870-1.74
Nonvol. beta (pCi/L)	NA	1.5-8.8	<3.0-9.0	<3.0-21.2	<3.0-14.4
Tritium (pCi/mL)	20	105-118	6-8	6-6	116-207
Total radium (pCi/L)	5	<1.0	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 11-5

Calculated Annual Quantities for Cation and Anion Exchange Units for the L-Area Acid/Caustic Basin

Calculated Annual Discharges from Cation Exchange Units

Acid Wastewater

Volume (L/yr)	Conc. Wt. % H_2SO_4	Total Excess H_2SO_4 (kg)	Total Cations (kg)
2,700,000	0.13	4,100	2,500

Calculated Annual Discharges from Anion Exchange Units

Basic Wastewater

Volume (L/yr)	Conc. Wt. % NaOH	Total Excess NaOH (kg)	Total Anions (kg)
3,000,000	0.30	10,100	3,100

Note: Data, from Ward et al. (1987), are extrapolated from K Area for 1974 and are representative of the total period. Values were calculated using assumed resin performance.

TABLE 11-6

Summary of Sediment and Soil Chemical Analyses for the L-Area Acid/Caustic Basin

Metals	Concentration Range (μg/g)*	EP Toxicity Results (mg/L)	EP Toxicity Standards (mg/L)**
Aluminum	5,070-21,400		
Arsenic	0.28-1.43	0.002	5.0
Barium	4.90-330	1.31	100.0
Cadmium	2.0	0.04	1.0
Chromium	4.0-73.3	0.08	5.0
Copper	4.0-814		
Iron	7,230-24,900		
Lead	6.2-612	0.10	5.0
Magnesium	206-22,800		
Manganese	2.0-812		
Mercury	0.2-5.66	0.0002	0.2
Nickel	4.0-38.5		
Selenium	0.25-0.26	0.002	1.0
Silver	2.0	0.20	5.0
Sodium	244-6,840		
Tin	15.0-31.2		
Zinc	2.0-330		
Inorganics			
Boron	0.25-23.41		
Sulfate	39.5-411.5		
Sulfide	5.3-25.0		
Nitrate	1.25-2.10		
Nitrite	0.5		
Ammonium	0.28-11.20		
Fluoride	0.25-1.25		
Chloride	3.8-95.0		
Phosphate	1.3-164		
Radioactivity			
Gross alpha	0-66.2 pCi/g		
Nonvolatile beta	Background levels		
Gross gamma	Background levels		

* Concentration range for samples taken at 0-0.5 ft, 0.5-1.0 ft, 1.5-2.0 ft, and 4.5-5.0 ft depth intervals.

** Federal Regulation 40 CFR 261.

TABLE 11-7

Summary of Groundwater Quality: Well Concentration Ranges for the L-Area Acid/Caustic Basin (7/84-12/86)

Constituent	SC and Federal DWS	LAC 1	LAC 2	LAC 3	LAC 4
pH (pH)	6.5-8.5	3.9-4.7	4.0-4.9	5.7-9.5	5.6-6.3
Conductivity (µmhos/cm)	NA	20-41	20-37	155-322	98-180
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004-0.005	0.010-0.016	<0.004	<0.004
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.002	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.001
Chloroform (mg/L)	0.100*	<0.001	<0.002	<0.001	<0.001
Chloride (mg/L)	250	3.4-3.6	1.6-2.9	2.9-3.4	1.7-4.4
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.002
Copper (mg/L)	1	0.018-0.038	0.020-0.143	<0.004	<0.004
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.12	<0.10-0.22	0.16-0.24	0.03-0.10
Iron (mg/L)	0.3	0.078-1.390	0.016-0.284	0.013-0.040	0.014-0.057
Mercury (mg/L)	0.002	<0.0002-0.0003	<0.0002-0.0002	<0.0002-0.0003	<0.0002-0.0003
Manganese (mg/L)	0.05	0.003-0.008	<0.002-0.015	<0.002	<0.001-0.006
Sodium (mg/L)	NA	1.75-22.70	1.53-23.40	22.80-78.60	2.06-31.80
Nickel (mg/L)	NA	<0.004-0.004	0.005-0.006	<0.004	---
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	0.53-0.60	0.67-1.15	<0.50	<0.50-0.53
Lead (mg/L)	0.05	0.015-0.038	<0.010-0.035	<0.004	<0.004-0.018
Phenols (mg/L)	NA	<0.002-0.006	<0.002-0.002	<0.002-0.005	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.002-0.008
Sulfate (mg/L)	250	<3.0	<2.0-23.0	5.0-27.3	<5.0-44.0
Tetrachloroethylene (mg/L)	NA	0.002	<0.005-0.006	0.025-0.029	0.004
TDS (mg/L)	500	40-278	<5-102	94-138	---
TOC (mg/L)	NA	0.819-1.56	0.290-1.18	0.490-2.00	0.340-1.220
TOH (mg/L)	NA	<0.005-0.007	<0.005-0.088	0.006-0.062	0.007-0.036
Trichloroethylene (mg/L)	0.005	0.002	0.048-0.083	0.038-0.052	0.005-0.007
1,1,1-TCE (mg/L)	0.200	<0.001	<0.002	<0.001	<0.001
Zinc (mg/L)	5	0.040-1.27	0.022-0.084	<0.002-0.086	<0.002
Gross alpha (pCi/L)	15	<2.00	<2.00-6.00	<2.00	<2.00-7.00
Nonvol. beta (pCi/L)	NA	<3.0-3.0	<3.0-7.0	<3.0-3.0	<3.0-6.0
Tritium (pCi/mL)	20	7	9	9	8
Total radium (pCi/L)	5	<1.0	<1.0	<1.0-2.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 11-8

Trace Elements in Different Types of Ash

Element	Ash Type (mg/L) Fly Ash (Electrostatic Precipitator)	Fly Ash (Mechanical Collector)	Bottom Ash
Barium	889	792	808
Strontium	579	589	333
Manganese	352	275	811
Zinc	280	116	95
Vanadium	218	166	140
Cerium	189	251	150
Chromium	171	140	160
Arsenic	164	55	4
Copper	130	93	67
Nickel	89	87	77
Gallium	72	32	20
Lanathanum	69	61	61
Cobalt	67	47	40
Lead	60	28	5
Bromine	47	12	3
Scandium	32	28	20
Thorium	23	24	25
Antimony	19	6	3
Molybdenum	18	11	7
Beryllium	16	12	9
Samarium	15	13	12
Selenium	15	6	3
Cesium	14	13	10
Uranium	13	8	8
Europium	11	12	8
Ytterbium	12	8	10
Terbium	2.5	2.1	2
Mercury	0.84	0.33	0.08
Cadmium	0.71	0.39	0.5

Note: Data, from Christensen and Gordon (1983), were collected in 1977.

TABLE 11-9

Trace Metal Analysis of 488-D Ash Basin Sludge Sample Extracts

Metal	Ash Basin Sludge (mg/L)	EPA Extract Level Limit (mg/L)
Chromium	<0.002	5.0
Cadmium	<0.001	1.0
Barium	1	100.0
Silver	<0.001	5.0
Mercury	<0.01	0.2
Lead	<0.002	5.0
Arsenic	<0.01	5.0
Selenium	<0.01	1.0

Note: Data, from Christensen and Gordon (1983), were collected in January 1980.

TABLE 11-10

Summary of Groundwater Quality: Well Concentration Ranges for the L-Area Burning/Rubble Pit (7/84-12/86)

Constituent	SC and Federal DWS	LRP 1	LRP 2	LRP 3	LRP 4
pH (pH)	6.5-8.5	3.8-5.3	4.2-5.4	4.3-5.3	3.2-5.1
Conductivity (µmhos/cm)	NA	17-42	19-50	22-48	20-40
Silver (mg/L)	0.05	<0.0020	<0.002-0.006	<0.0020-0.0030	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.008-0.010	0.013-0.014	0.012-0.013	0.008-0.010
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloride (mg/L)	250	2.5-6.3	2.9-4.0	2.4-4.0	2.9-4.0
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	0.010	0.006-0.014	0.010-0.017	---
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.20	<0.10-0.15	<0.10	0.02-0.21
Iron (mg/L)	0.3	0.020-0.156	0.014-0.076	0.052-0.312	0.007-0.048
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.014-0.017	0.018-0.024	0.021-0.032	0.005-0.011
Sodium (mg/L)	NA	1.57-2.34	2.19-3.29	1.97-4.86	1.74-2.45
Nickel (mg/L)	NA	<0.004-0.011	<0.004-0.014	<0.004-0.015	<0.004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	0.60-163.90	<0.50-0.90	<0.50-0.80	0.85-1.93
Lead (mg/L)	0.05	0.016-0.036	0.014-0.080	0.008-0.033	<0.005-0.039
Phenols (mg/L)	NA	<0.002-0.002	<0.002	<0.0C2	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0	<5.0
TDS (mg/L)	500	40	12-48	22-44	---
TOC (mg/L)	NA	0.430-8.80	0.200-0.525	0.340-0.800	0.250-3.960
TOH (mg/L)	NA	<0.005-0.007	<0.005-0.020	<0.005-0.024	<0.005-0.006
Zinc (mg/L)	5	0.010-0.012	0.028-0.030	0.023-0.029	---
Gross alpha (pCi/L)	15	1.00-3.00	<2.00-3.00	1.00-3.00	<2.00-5.00
Nonvol. beta (pCi/L)	NA	2.0-3.0	1.0-5.0	<3.0-3.0	<3.0
Total radium (pCi/L)	5	<1.0-1.3	<1.0-1.3	0.5	<1.0-3.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

TABLE 11-11

Radioactive Releases to the L-Area Oil and Chemical Basin (1961-1979)

Isotope	Original Activity (Ci)	Decay Corrected to December 1985 (Ci)
^{3}H	3.4556E+04	1.0922E+04
^{35}S	1.6000E-02	9.283E-08
^{54}Mn	6.7300E-01	0
^{60}Co	3.7915	2.450E-01
^{89}Sr	2.0000E-03	0
^{90}Sr	3.7039E-01	2.146E-01
^{91}Y	1.0600E-03	0
$^{95}Zr, ^{95}Nb$	2.2600E-01	0
$^{103,106}Ru$	3.5937E-01	3.2156E-05
^{125}Sb	8.0000E+04	0
^{131}I	4.0000E-04	0
^{134}Cs	1.0590E-03	3.1815E-05
^{137}Cs	1.6210	9.698E-01
$^{140}Ba, ^{140}La$	3.0000E-04	0
$^{141,144}Ce$	9.5232E-02	7.542E-07
^{147}Pm	1.9828	6.391E-03
Alpha (unidentified)	2.2852E-03	2.2852E-03
Beta-gamma (unidentified)	1.5550E-03	1.5550E-03

Note: Total liquid volume release = 1,040,000 gal.

TABLE 11-12

Chemical and Radioisotope Analytical Results for the L-Area Oil and Chemical Basin Water

Chemical	Concentration (mg/L)
Arsenic	<0.003
Barium	<0.1
Beryllium	<0.01
Cadmium	<0.001
Chloride	1.47
Chromium	0.007
Fluoride	<0.1
Iron	1.04
Lead	<0.001
Manganese	0.03
Mercury	<0.0002
Nickel	<0.003
Nitrate	0.78
Nitrite	<0.1
Selenium	<0.003
Silver	<0.001
Sodium	4.29
Sulfate	2.8
Zinc	0.024

Radionuclide	Concentration (pCi/L)
^{60}Co	45 $\pm$6
^{137}Cs	21 $\pm$2

Note: Data were collected in April 1984 and are from Price (1984).

TABLE 11-13

Radioisotope Analyses of the L-Area Oil and Chemical Basin Sediments

Sampling Location	Results (pCi/L) ^{60}Co	^{137}Cs	^{152}Eu	^{154}Eu	^{155}Eu	Total Eu
North end 1	1,727	349	51	63	---	---
North end 2	1,409	395	31	39	---	---
South end 1	88	110	---	---	---	---
South end 2	167	264	---	3.2	2.2	---

Note: Samples were collected in January 1984. Moisture content of samples is not known; sampling depths are approximately 1 to 3 in. below the surface. Data are from Price (1984).

TABLE 11-14

L-Area Oil and Chemical Basin Concentration Ranges for Sediment Cores L36 and L35

Constituent	Units	Concentration Range Minimum	Concentration Range Maximum	Maximum Below 30 in. Depth
Depth of core	inches	0	72	30-72
Chemical oxygen demand	µg/kg	233	10,900	400
Cyanide	µg/kg	0.125	0.317	0.125
Grain size		82	49,800	212
Moisture	%	11	86.5	28
Silica	µg/kg	247	925	925
Aluminum oxide	µg/kg	106	506	230
Antimony	µg/kg	0.317	45.92	1.72
Arsenic	µg/kg	0.654	8.5	1.7
Cadmium	µg/kg	1	9.7	1
Calcium oxide	µg/kg	0.75	659	0.75
Chromium	µg/kg	2	8,039	28.6
Ferric oxide	µg/kg	18	123	50
Lead	µg/kg	11.9	321	24.1
Mercury	µg/kg	0.1	0.85	0.1
Magnesium oxide	µg/kg	8.8	763	63
Manganese oxide	µg/kg	3.6	12,460	8.3
Nickel	µg/kg	1	373	6.3
Phosphorus pentoxide	µg/kg	0.165	51.4	0.9
Potassium oxide	µg/kg	0.95	2.6	2.4
Sodium oxide	µg/kg	86	528	221
Silver	µg/kg	0.021	0.62	0.044
Selenium	µg/kg	0.245	0.68	0.25
Titanium oxide	µg/kg	1.17	69	7.3
Uranium	µg/kg	1	177	3.19
Zinc	µg/kg	0.5	1,135	1.7
Total organic carbon	µg/kg	449	100,000	881
Gross alpha	pCi/g	1	51	2
Nonvolatile beta	pCi/g	14	15,350	360
^{125}Sb	pCi/g	20	133.5	---
^{60}Co	pCi/g	4.1	22,900	1,090
^{137}Cs	pCi/g	2.7	1,085	82
^{152}Eu	pCi/g	1.9	930	35
^{154}Eu	pCi/g	10	495	25
^{155}Eu	pCi/g	36	155	---
Total Eu	pCi/g	152	1,225	---

TABLE 11-15

Summary of Groundwater Quality: Well Concentration Ranges for the L-Area Oil and Chemical Basin (7/84-12/86)

Constituent	SC and Federal DWS	LCO 1	LCO 2	LCO 3	LCO 4
pH (pH)	6.5-8.5	4.2-5.5	3.5-4.5	7.1-9.8	3.9-5.2
Conductivity (μmhos/cm)	NA	65-115	28-51	115-380	50-1,250
Silver (mg/L)	0.05	<0.0005	<0.0005	<0.0005	<0.0020-0.0043
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002-0.002	<0.002
Barium (mg/L)	1.0	0.005	0.005	<0.004	<0.004-0.014
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.2-4.8	1.4-3.0	1.7-5.2	9.8-26.1
Chromium (mg/L)	0.05	<0.004-0.520	<0.004-0.022	<0.004-0.020	<0.004-0.100
Copper (mg/L)	1	---	0.020	<0.004	<0.004
DOC (mg/L)	NA	<5.0	<5.0	<5.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.21-0.23	<0.10-0.24	0.15-0.46	<0.10-0.59
Iron (mg/L)	0.3	0.025-0.256	0.032-0.113	0.056-0.410	0.169-0.224
Mercury (mg/L)	0.002	<0.0002-0.0004	<0.0002-0.0002	<0.0002	<0.0002-0.0038
Manganese (mg/L)	0.05	0.006-0.010	<0.002	<0.002	0.002-0.145
Sodium (mg/L)	NA	6.76-7.57	1.93-2.21	38.80-45.50	10.10-258.00
Nickel (mg/L)	NA	0.121	<0.004	<0.004	<0.004-0.013
Nitrate (as N) (mg/L)	10	1.25-1.30	1.70-1.75	<0.50	1.90-2.00
Lead (mg/L)	0.05	0.007	0.019-0.022	<0.004	<0.010-0.019
Phenols (mg/L)	NA	<0.002-0.002	<0.002	<0.002-0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002-0.003
Sulfate (mg/L)	250	<3.0-15.0	<3.0	12.0-27.0	143.0-620.0
Tetrachloroethylene (mg/L)	NA	0.004	0.002-0.003	0.006-0.015	0.048-0.086
TDS (mg/L)	500	4	30	12	104
TOC (mg/L)	NA	3.70-22.30	0.200-2.00	0.400-3.00	<1.000-8.500
TOH (mg/L)	NA	0.010-0.045	<0.005-0.024	<0.005-0.023	0.053-0.118
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.005-0.019	0.001
1,1,1-TCE (mg/L)	0.200	<0.001	---	<0.001	<0.001
Zinc (mg/L)	5	---	0.033	0.009	0.041
Gross alpha (pCi/L)	15	0.480-1.64	0.100-1.27	1.70-3.90	1.130-6.500
Nonvol. beta (pCi/L)	NA	30.7-120.0	0.4-4.0	1.0-9.3	4.9-9.0
Tritium (pCi/mL)	20	1,091-2,550	9-12	6-8	333-831
Total radium (pCi/L)	5	0.8-1.4	<0.2	0.1-2.0	4.4-6.4

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 11-16

Estimated Radionuclide Inventory in the L-Area Bingham Pump Outage Pits

Radionuclide	At Burial (Ci)	Decay Corrected Through 12/31/85 (mCi)
^{60}Co	0.172	5
^{90}Sr	0.112	60
$^{103,106}Ru$	0.130	1.0E-06
^{137}Cs	0.414	220
^{147}Pm	0.172	0.1

Note: Data are from Pekkala et al. (1987a).

TABLE 11-17

Radioactivity in Vegetation at the L-Area Bingham Pump Outage Pits Versus Radioactivity in Vegetation at Plant Boundary

	Alpha (pCi/g)				Nonvolatile Beta (pCi/g)			
	Pit		Plant Boundary		Pit		Plant Boundary	
Pit No.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
1	0.8	1.8	0.2	0.6	35	48	21	31
2	0.8	1.8	0.2	0.6	35	48	21	31

Note: Data are from Pekkala et al. (1987a).

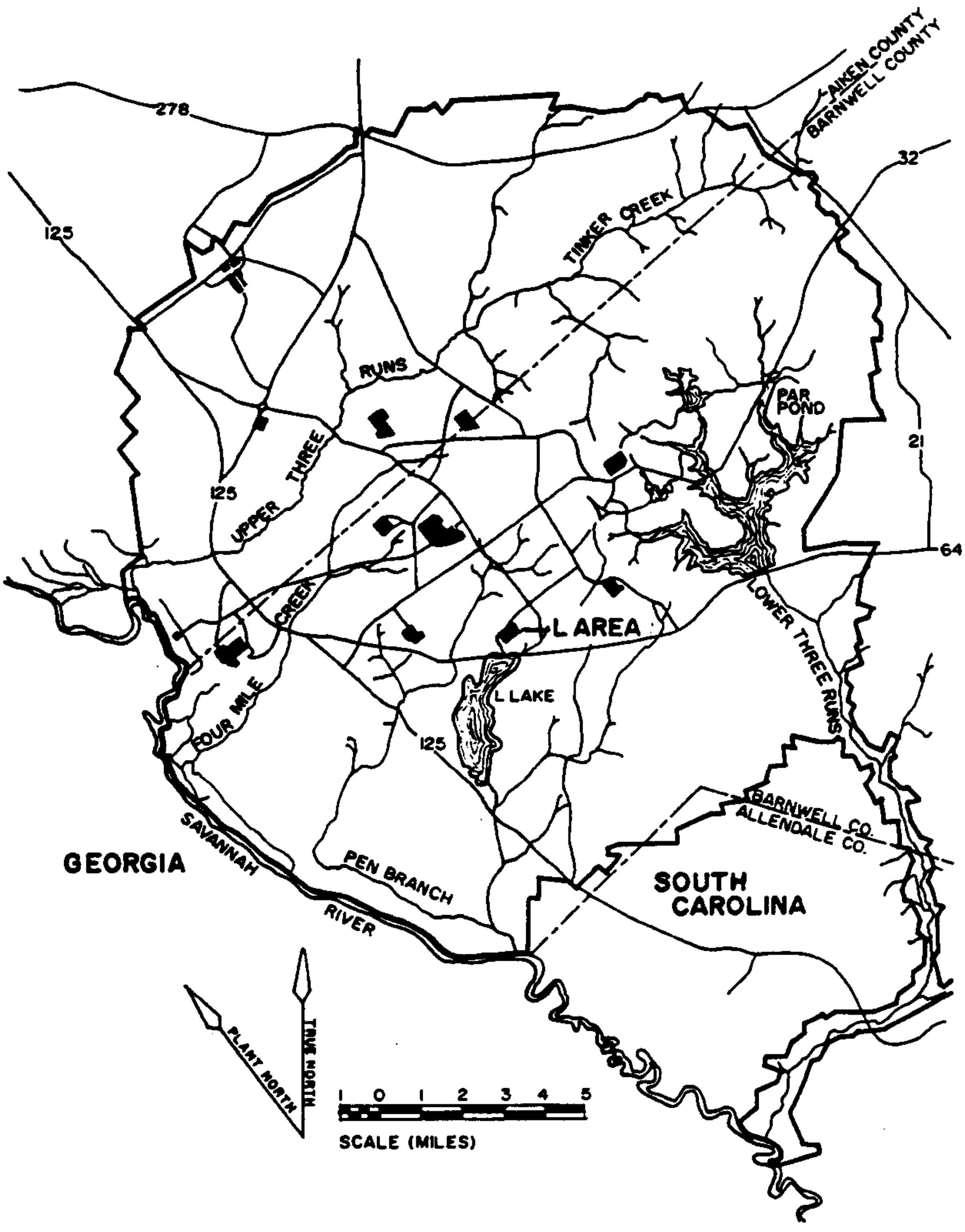


FIGURE 11-1. Location of L Area at SRS

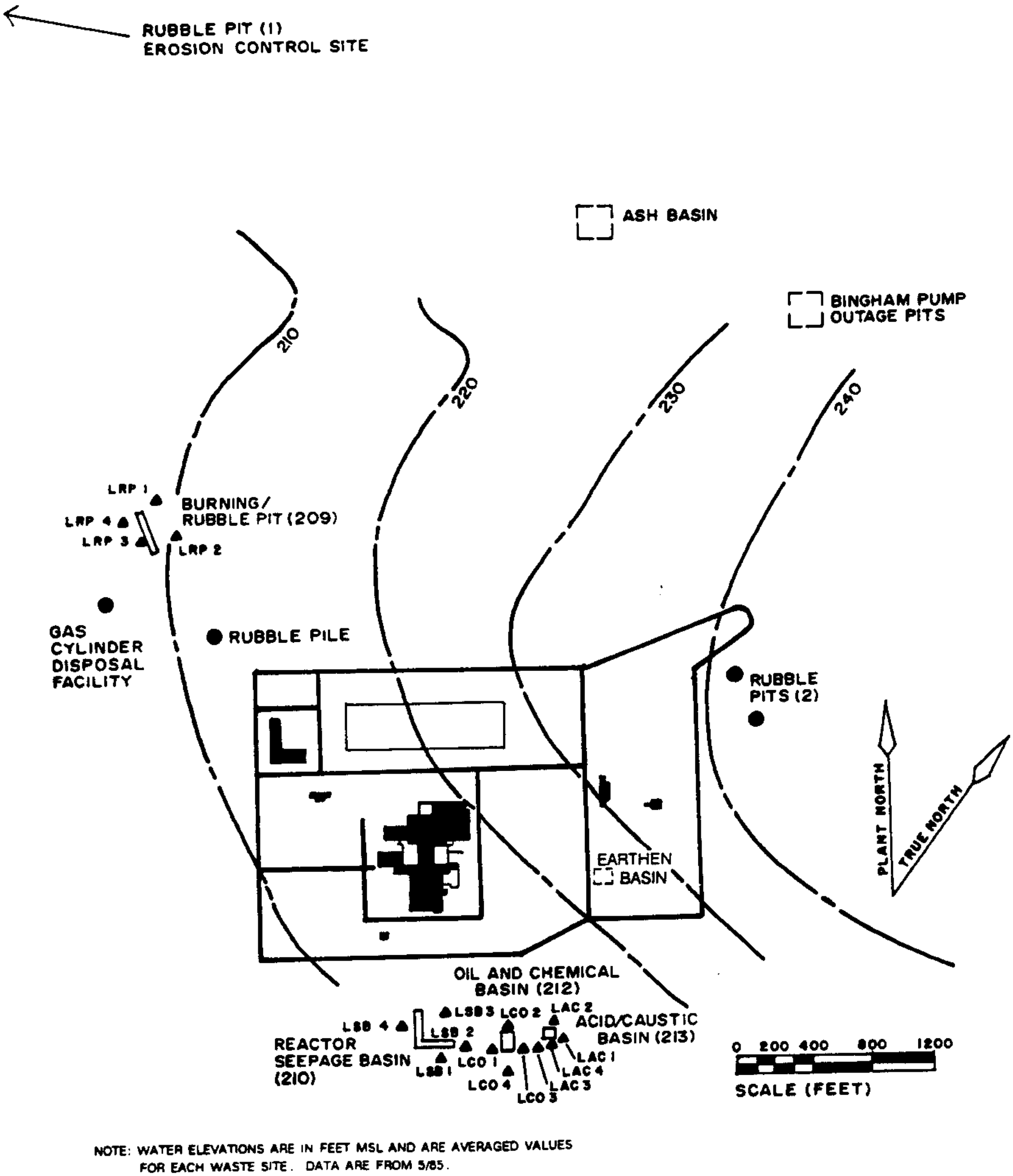


FIGURE 11-2. L-Area Water-Table Elevation Map

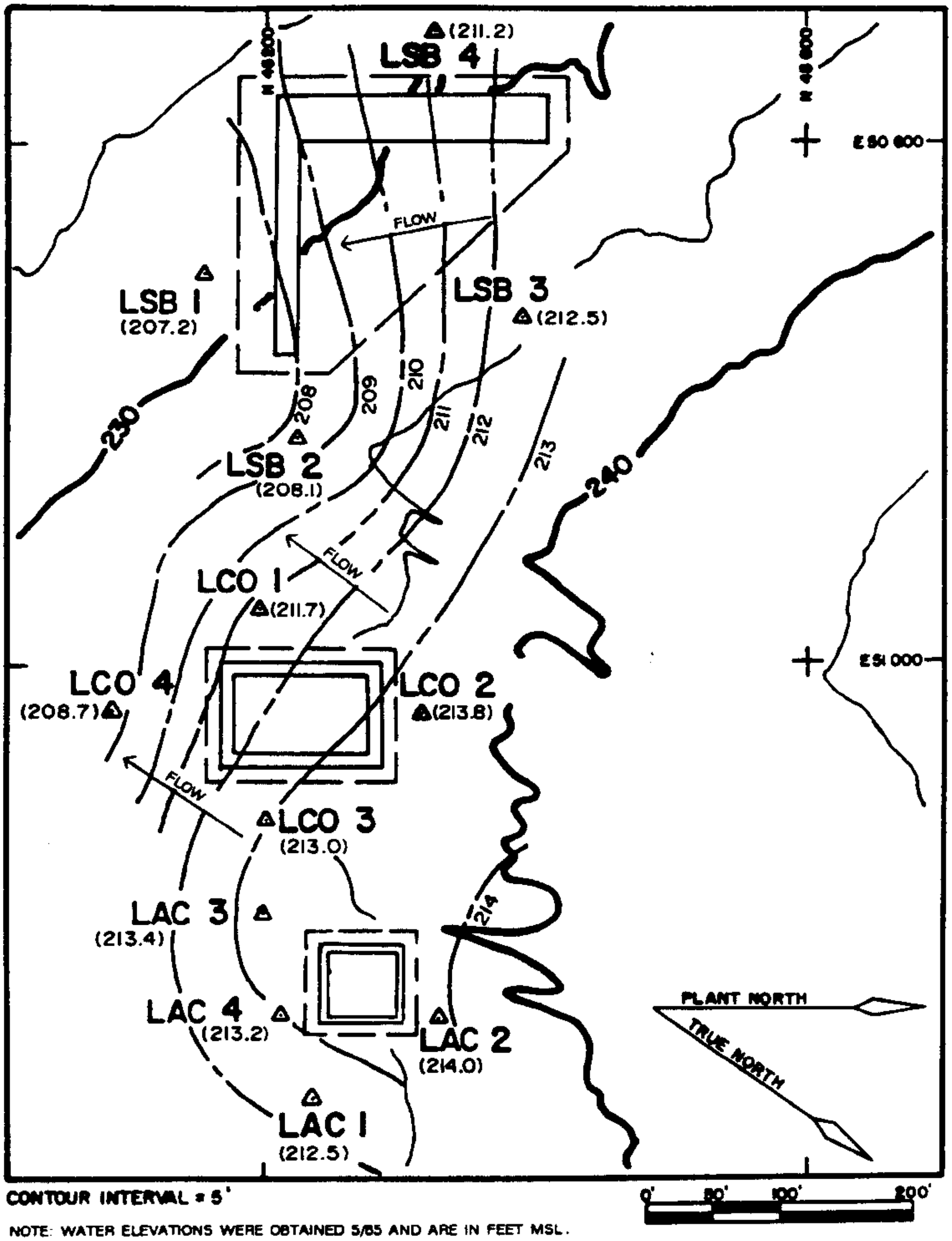


FIGURE 11-3. L-Area Reactor Seepage Basin, Oil and Chemical Basin (LOCB), and Acid/Caustic Basin Water-Table Elevation Map

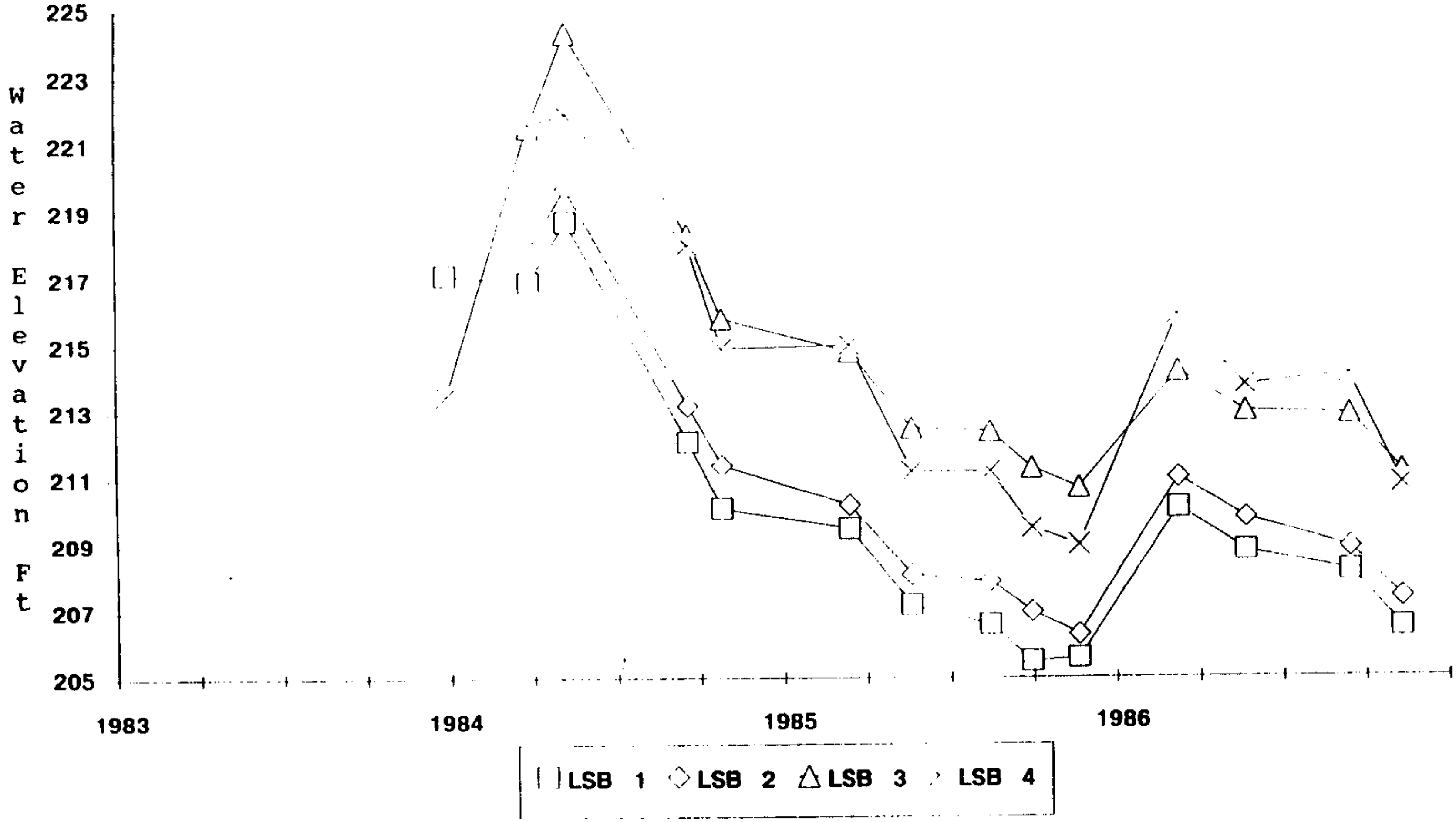
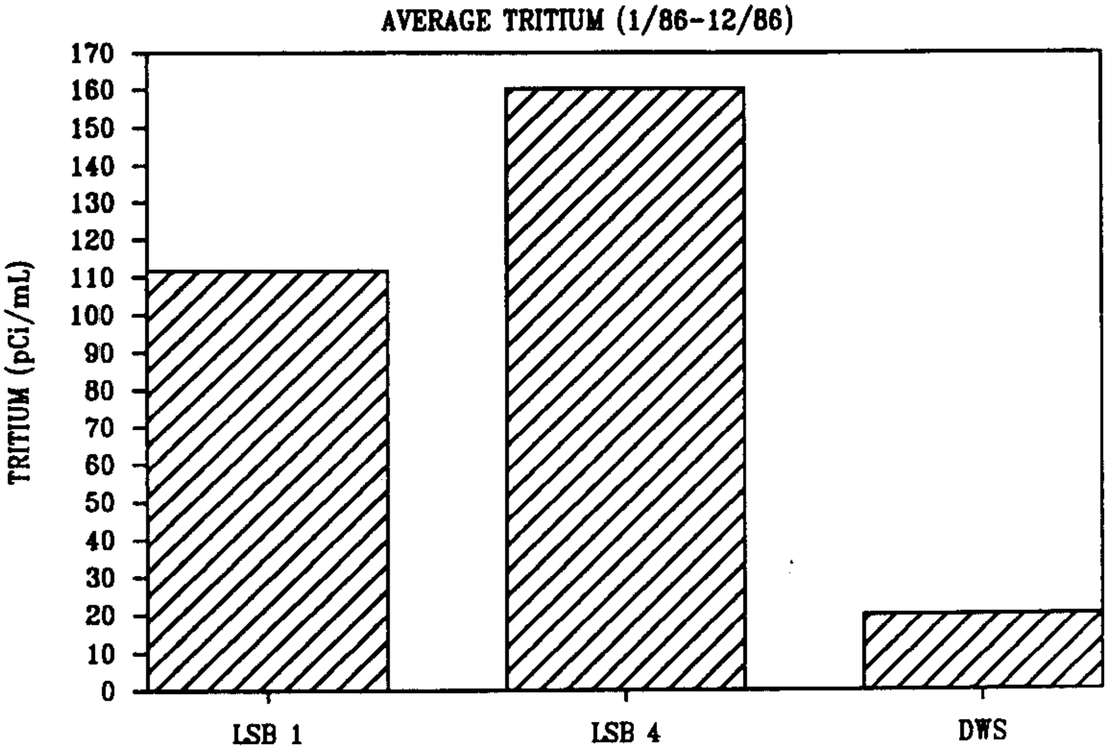


FIGURE 11-4. Hydrograph of the L-Area Reactor Seepage Basin Wells



Note: Reported tritium levels in wells LSB 2 and LSB 3 remained below the drinking water standard of 20 pCi/mL for the monitoring period.

FIGURE 11-5. Average Tritium Activities in L-Area Reactor Seepage Basin Wells

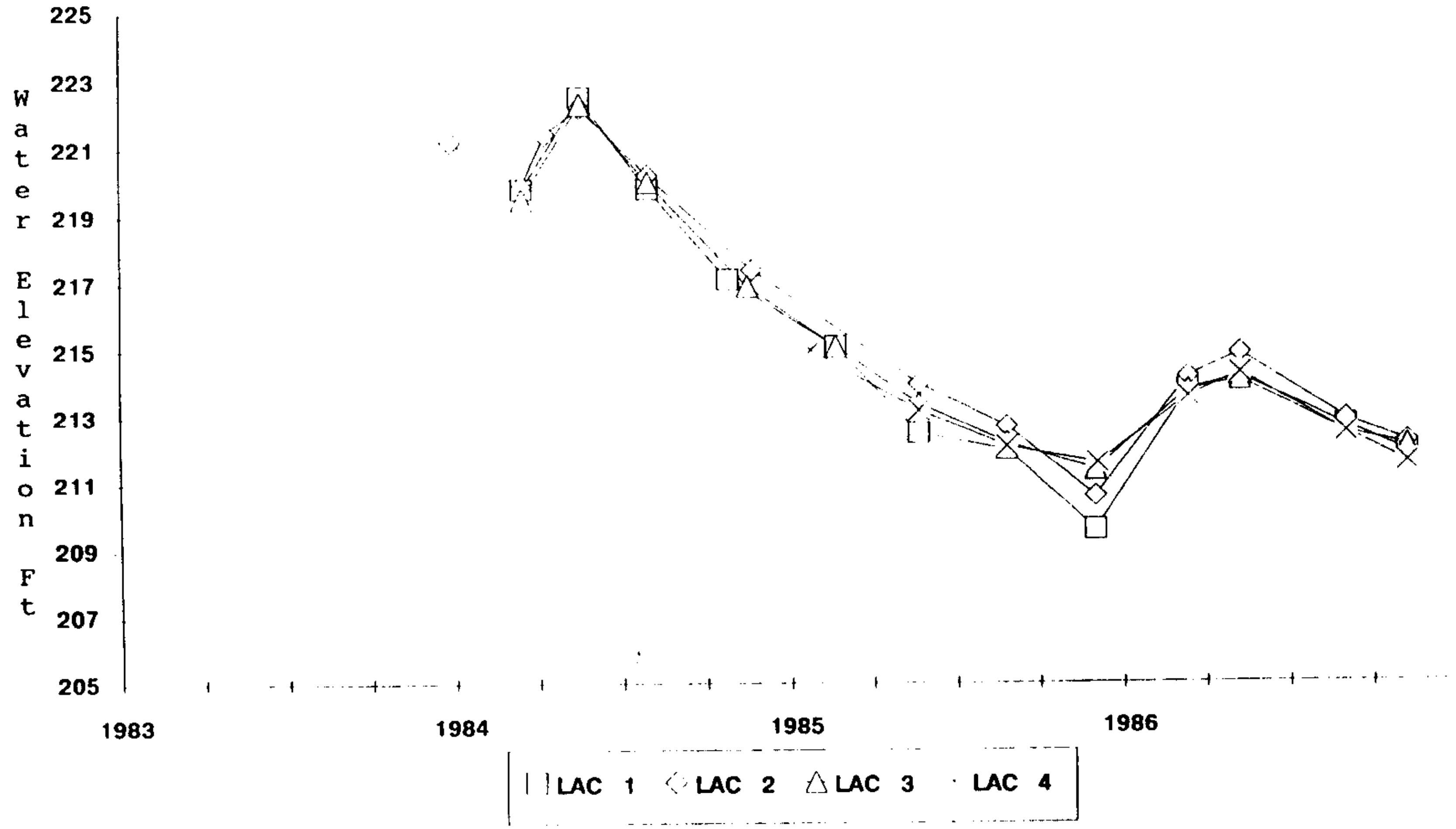


FIGURE 11-6. Hydrograph of the L-Area Acid/Caustic Basin Wells

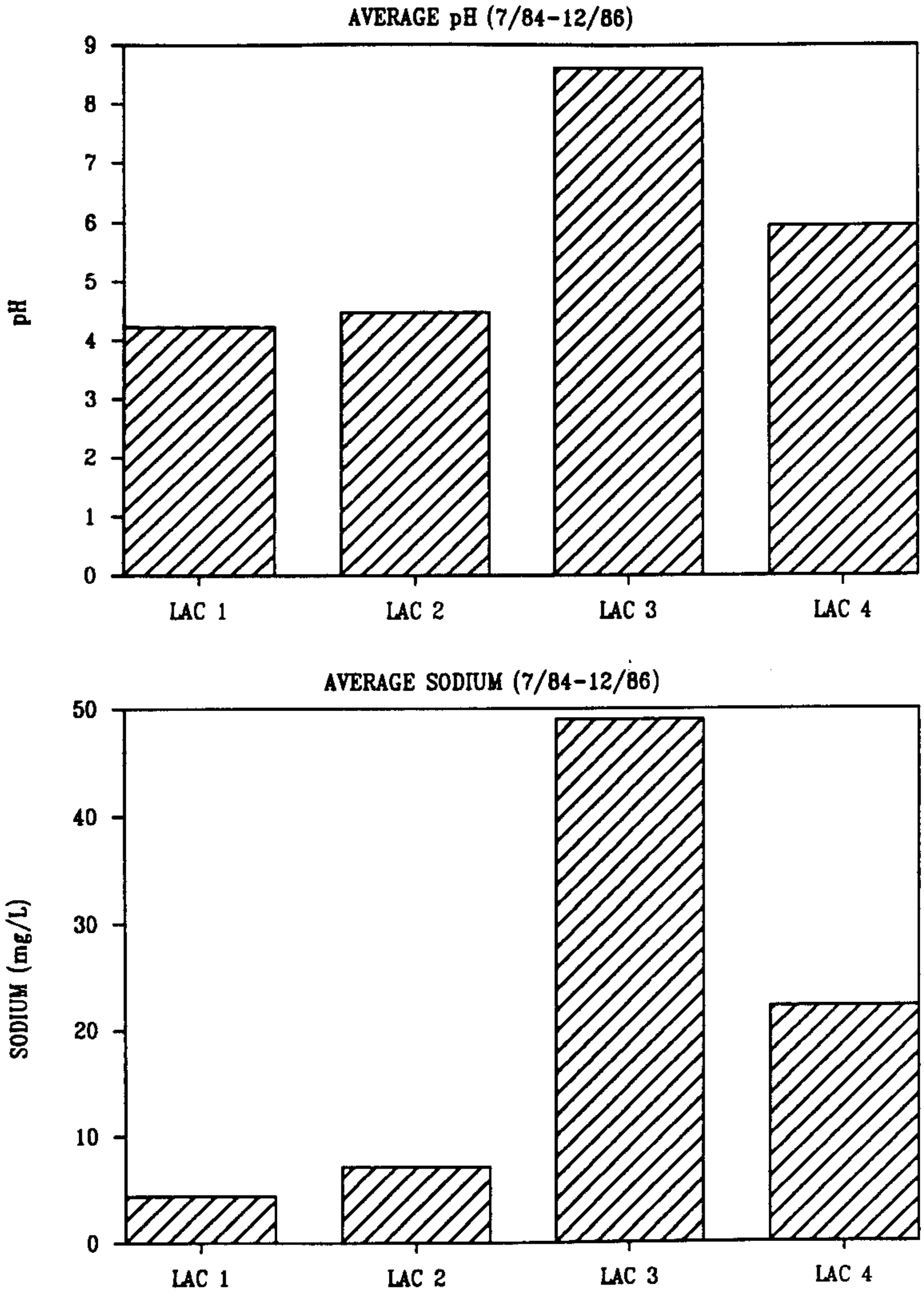


FIGURE 11-7. Average pH and Sodium Concentrations in the L-Area Acid/Caustic Basin Wells

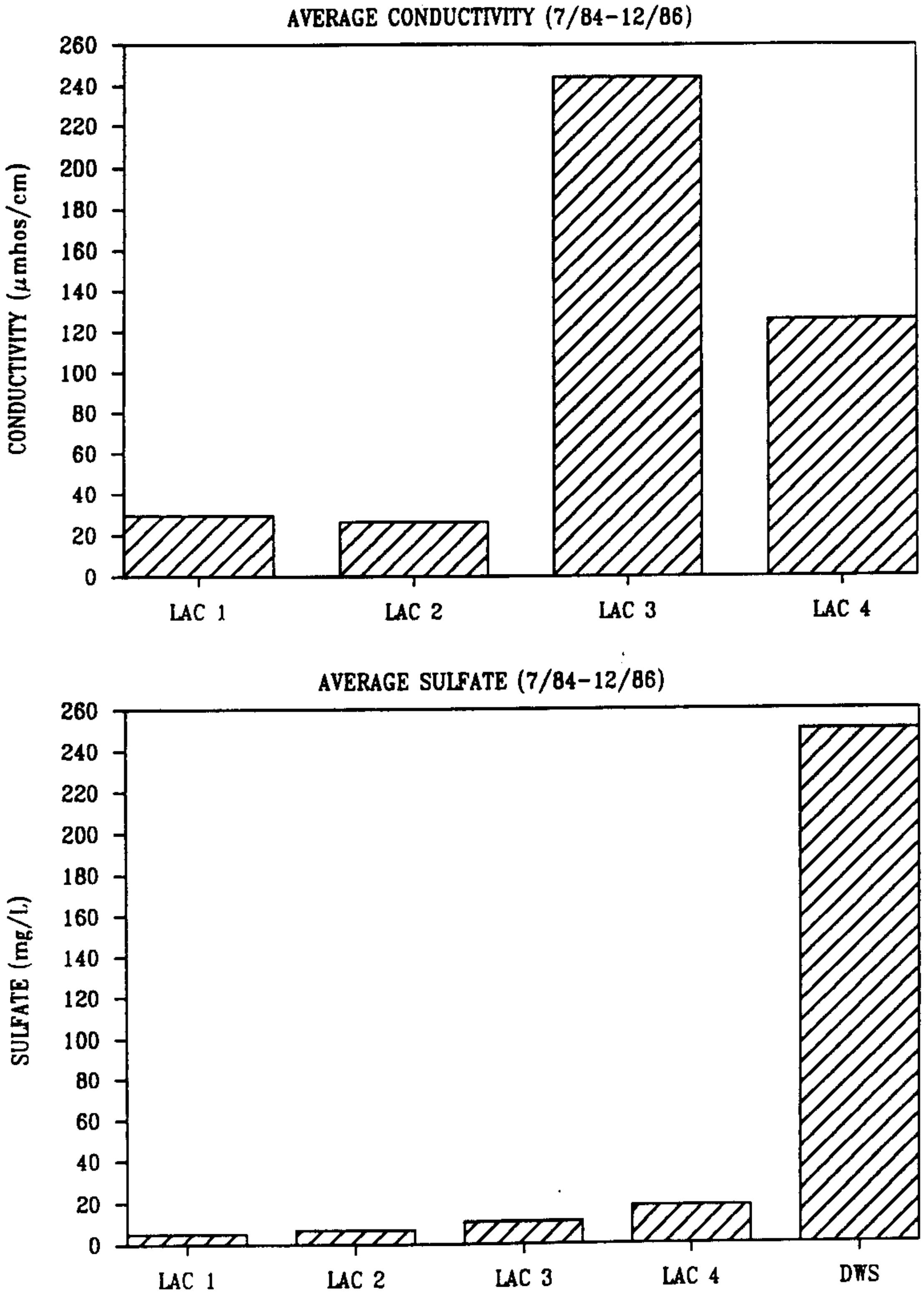
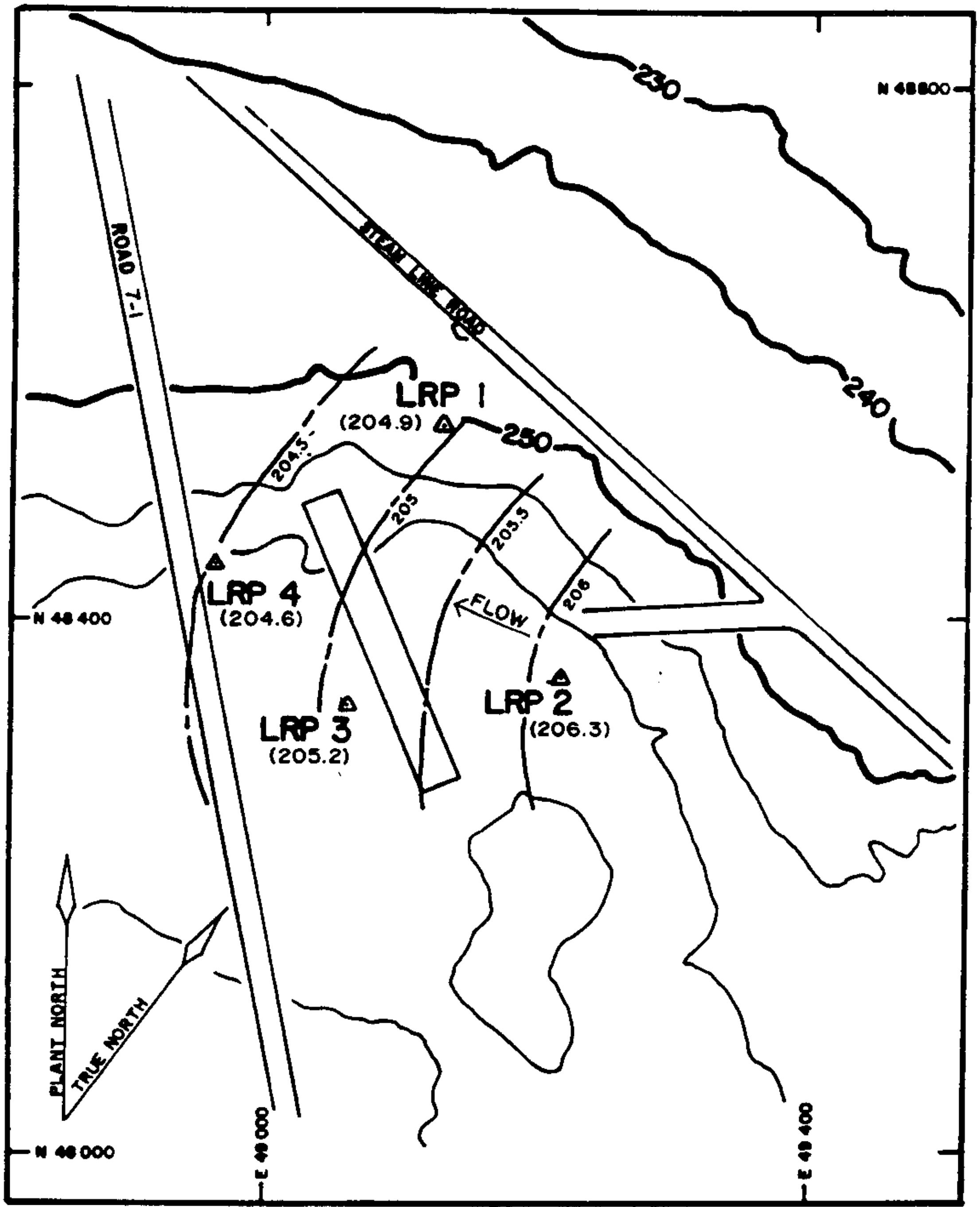


FIGURE 11-8. Average Conductivity and Sulfate Concentrations in the L-Area Acid/Caustic Basin Wells



CONTOUR INTERVAL = 2'

NOTE: WATER ELEVATIONS WERE OBTAINED 9/86 AND ARE IN FEET MSL.

0' 50' 100' 200'

FIGURE 11-9. L-Area Burning/Rubble Pit Water-Table Elevation Map

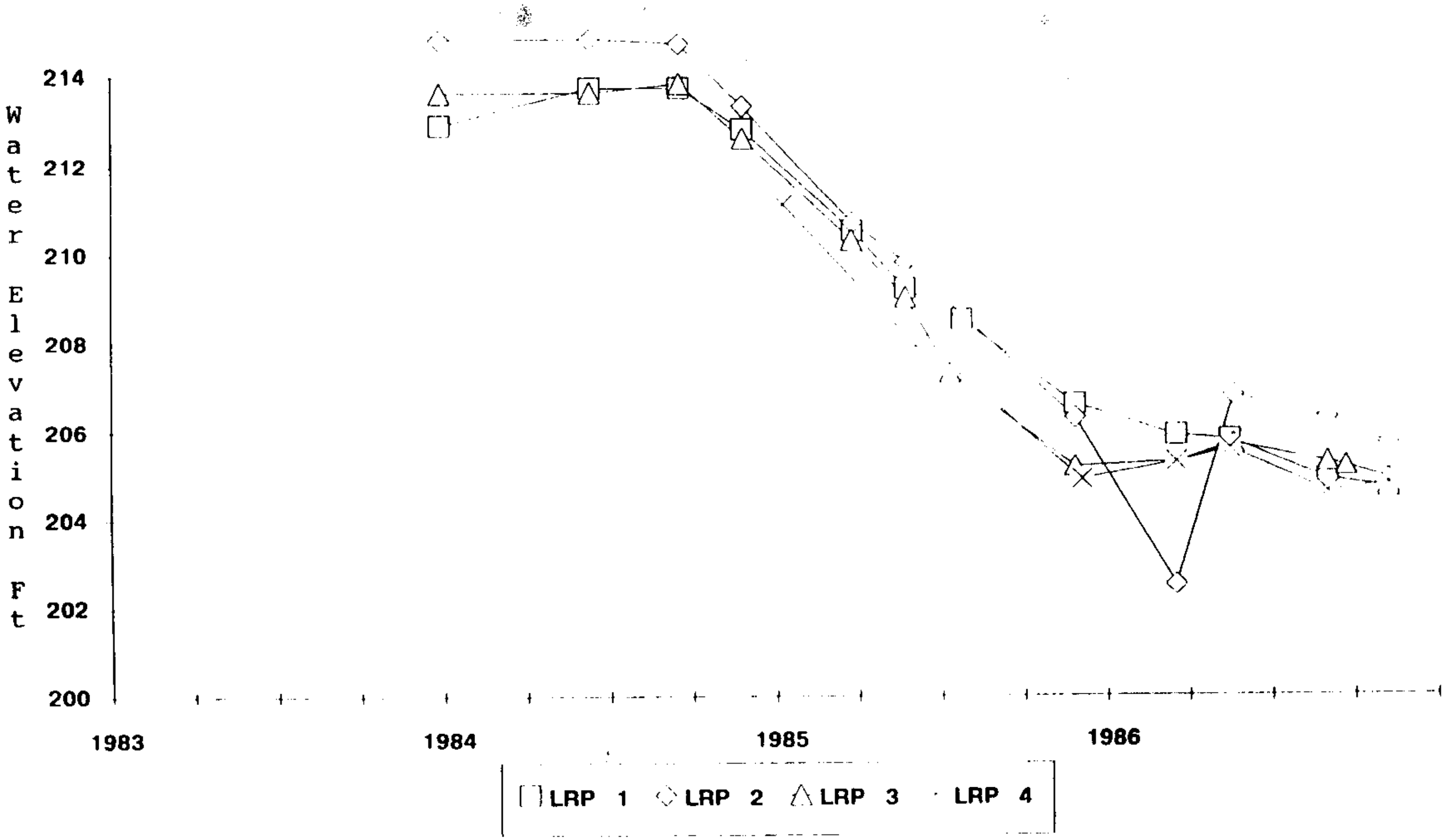


FIGURE 11-10. Hydrograph of the L-Area Burning/Rubble Pit Wells

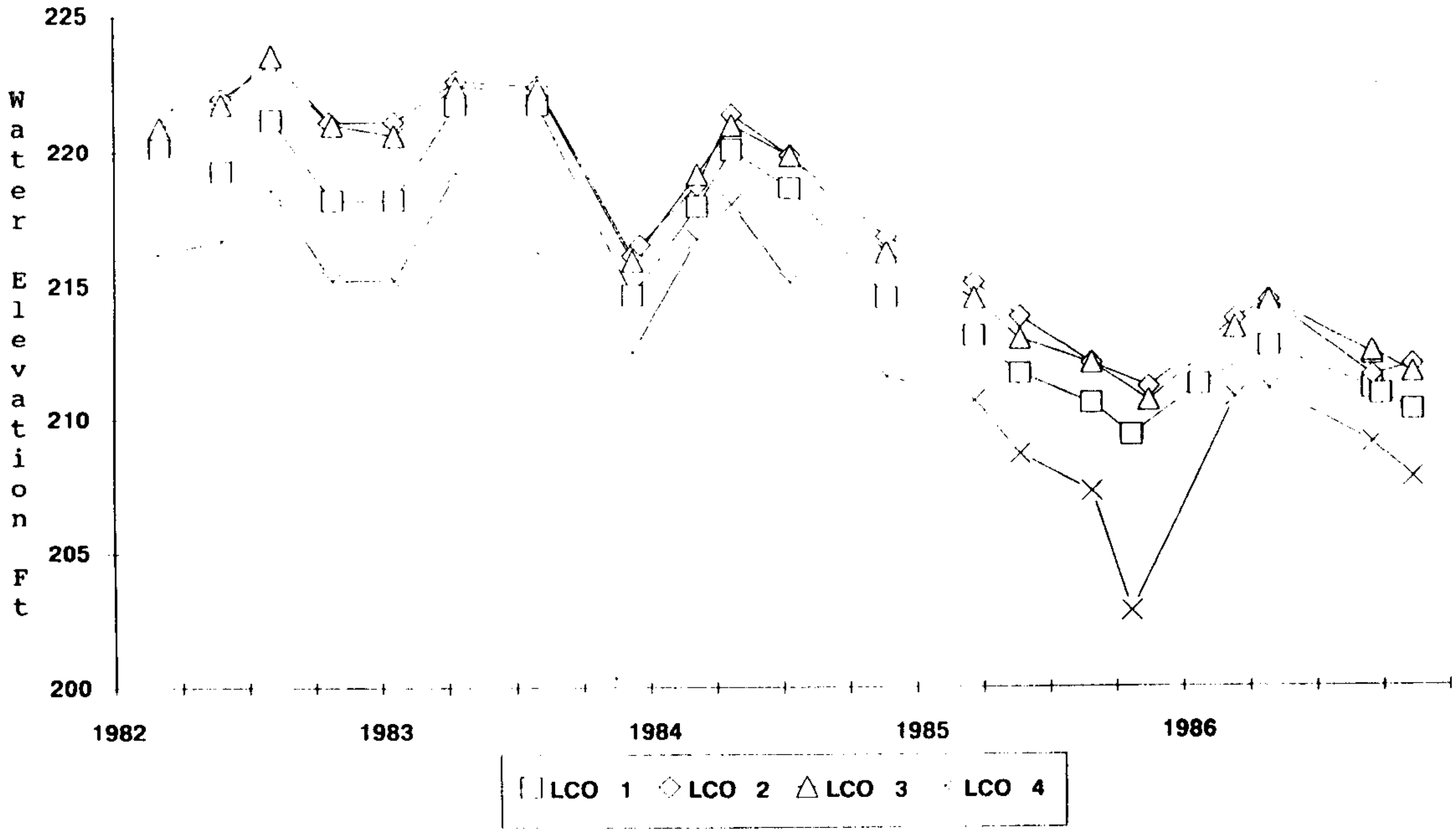


FIGURE 11-11. Hydrograph of the L-Area Oil and Chemical Basin (LOCB) Wells

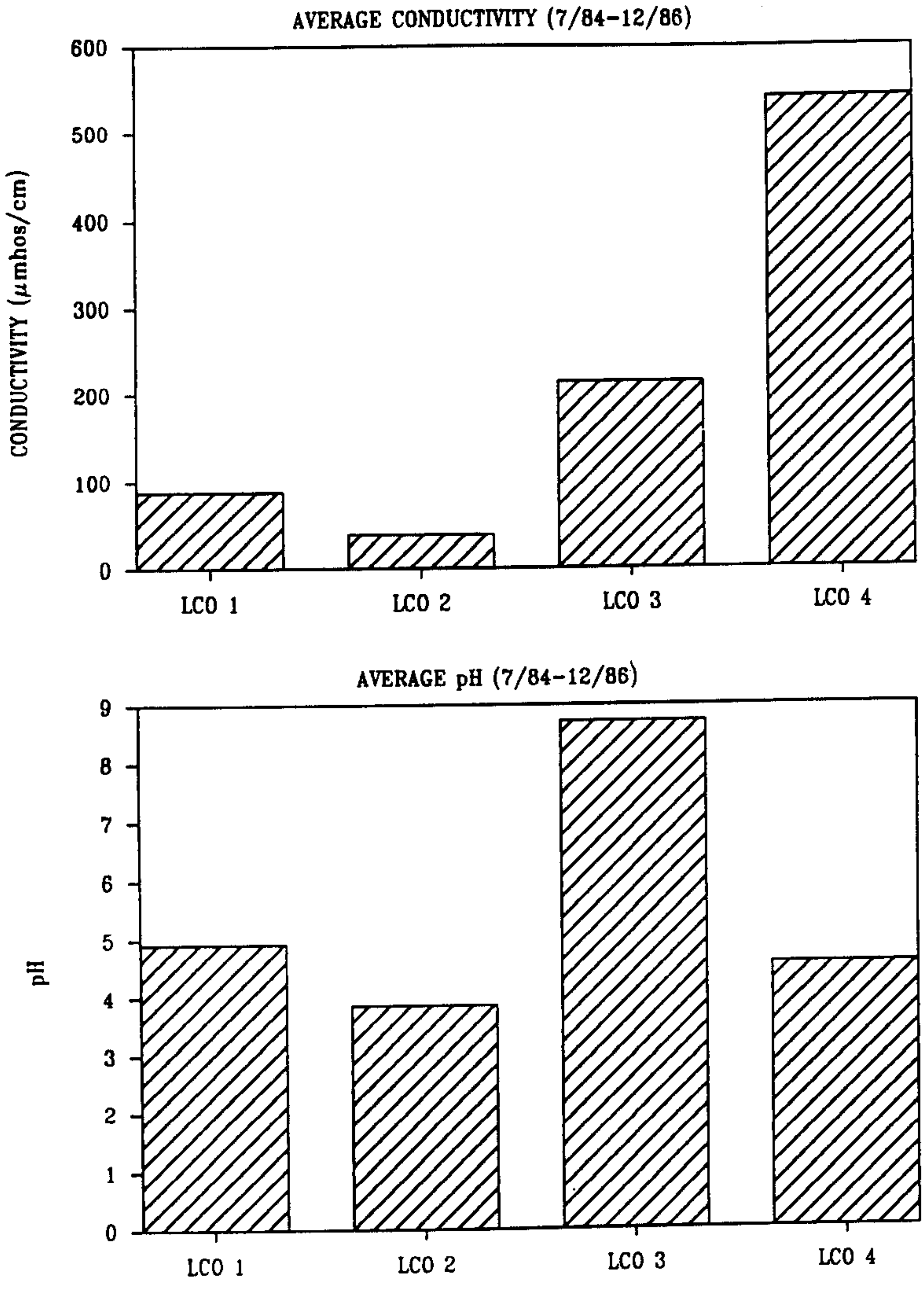


FIGURE 11-12. Average Conductivity and pH in the L-Area Oil and Chemical Basin Wells

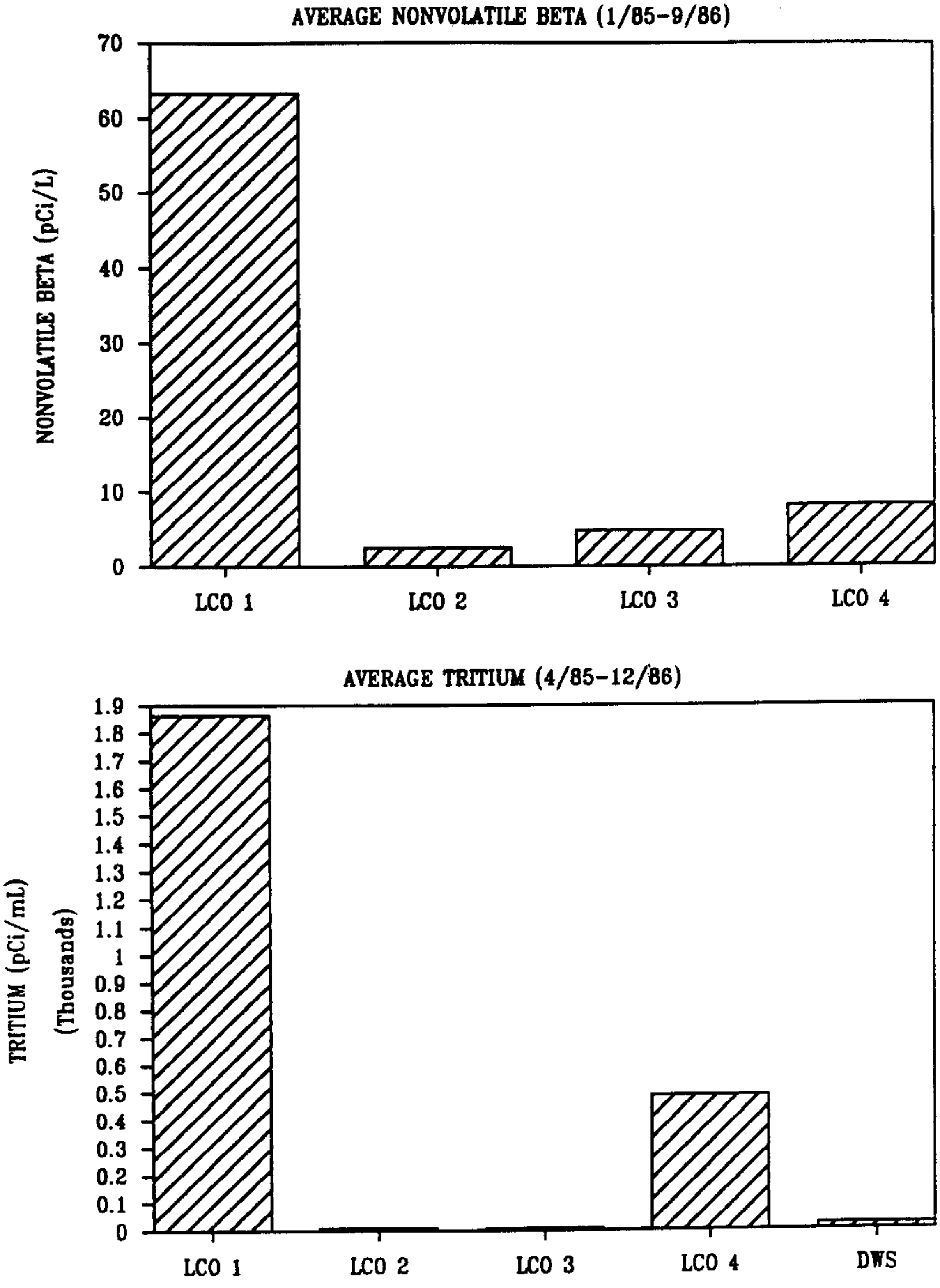


FIGURE 11-13. Average Nonvolatile Beta and Tritium Activities in L-Area Oil and Chemical Basin (LOCB) Wells

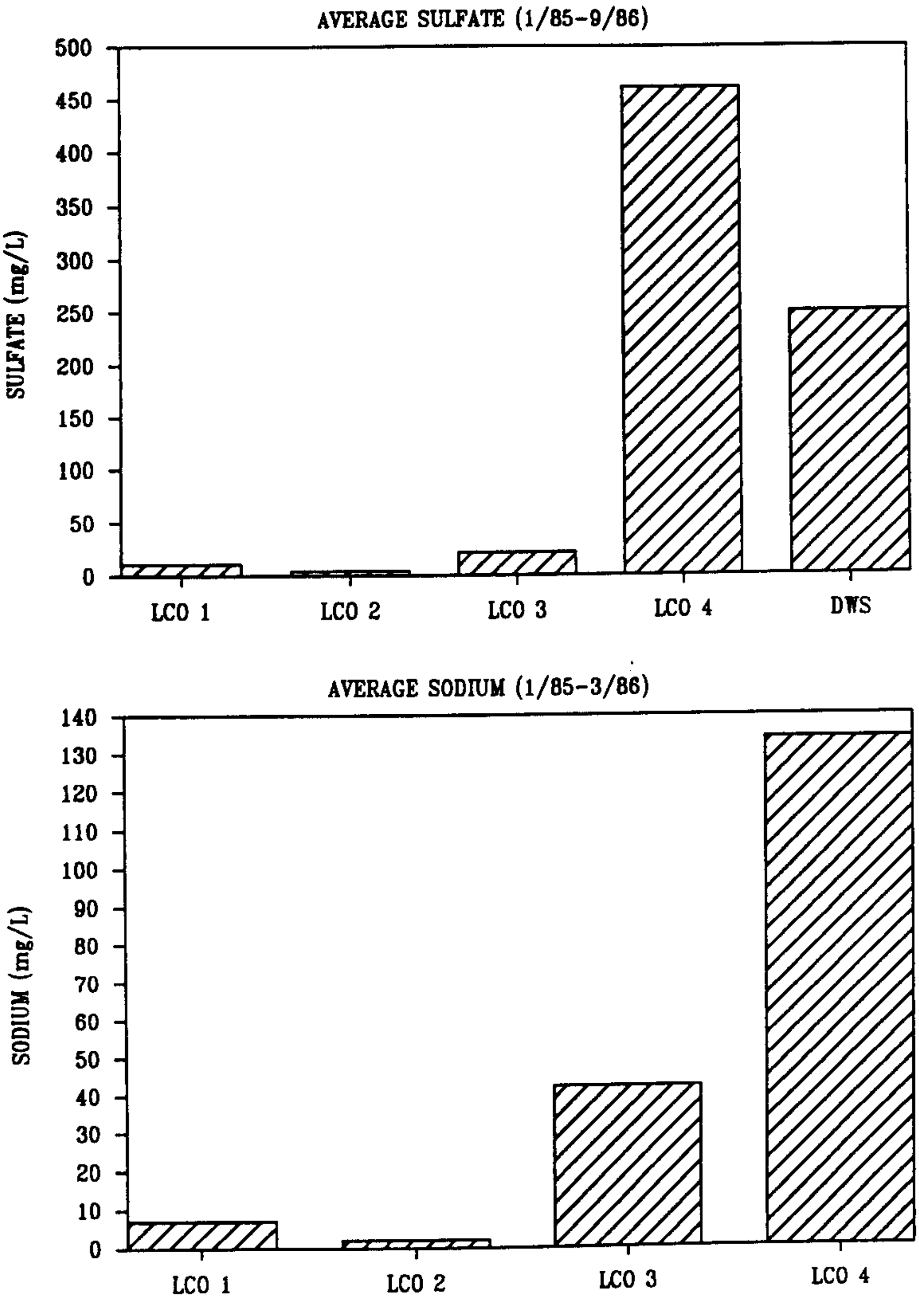


FIGURE 11-14. Average Sulfate and Sodium Concentrations in L-Area Oil and Chemical Basin (LOCB) Wells

SECTION 12 P AREA

12.01 GENERAL INFORMATION

12.01.01 General Area Description

P Area is located in the south-central part of SRS as shown in Figure 12-1. Surface elevations across P Area range approximately from 270 to 340 ft msl.

There are 10 P-Area waste sites as indicated in Figure 12-2:

L The P-Area Reactor Seepage Basins (3 basins)

L The P-Area Acid/Caustic Basin

L The P-Area Coal Pile Runoff Containment Basin

L The P-Area Ash Basin

L The P-Area Bingham Pump Outage Pit

L The P-Area Burning/Rubble Pit

L The P-Area Erosion Control Site (see Section 15)

L The P-Area Earthen Basin (see Section 15)

12.01.02 General Hydrologic Conditions

By the end of 1986, 31 monitoring wells had been installed around the P-Area waste sites to delineate subsurface conditions and to monitor the water-table elevation and groundwater quality. Nineteen of the 31 wells are currently being monitored. The remaining 12 wells have been abandoned, as discussed in the following specific waste-site sections. According to the surface geologic map presented by Siple (1967), the monitoring wells in P Area were installed in the Barnwell Formation. Section 3 contains a detailed discussion of the hydrostratigraphy beneath SRS.

The water-table elevation in P Area has ranged approximately from 290 to 250 ft msl, and the vadose zone has been about 20 to 40 ft thick. As shown in Figure 12-2, P Area is located near a groundwater divide, and horizontal near-surface groundwater flow is generally away from P Area. The near-surface groundwater beneath P Area discharges to a tributary of Par Pond, located approximately 1,000 ft to the northeast, and to a tributary of Steel Creek to the southwest.

Mathematical modeling of the Barnwell Formation near the center of the plant in the Separations Areas indicates that the horizontal groundwater flow velocity ranges approximately from 15 to 60 ft/yr per percent gradient (Duffield et al., 1986; Parizek and Root, 1986). As shown in Figure 12-2, the hydraulic gradient of the water table is variable across P Area. Therefore, the near-surface groundwater flow velocity across P Area will vary. The horizontal flow direction and estimated flow velocity for the water table at each P-Area waste site are discussed in the following specific waste-site sections.

12.01.03 Migration Potential of Dissolved Chemical Constituents from P Area

The potential for any dissolved constituents to be naturally discharged from a waste site to nearby surface water from the near-surface groundwater system depends on the location of the waste site, the hydraulic gradient, and the flow path between the waste site and the discharge point. Horizontal and vertical groundwater flow velocities depend upon the distribution and hydraulic properties of the medium through which the groundwater travels (i.e., sand, silt, or clay). Similarly, interactions with the soil/sediment medium (retardation) will affect the horizontal and vertical movements of dissolved chemical constituents.

The nearest plant boundary to P Area is approximately 5 mi to the east on the opposite side of Lower Three Runs Creek. Lower Three Runs Creek (to the east), Steel Creek (to the southwest), and Meyers Branch (to the south and southeast) create a groundwater island in P Area, and contamination is not likely to reach the plant boundary through groundwater flow in the Barnwell Formation.

12.02 P-AREA REACTOR SEEPAGE BASINS

12.02.01 Summary

The three P-Area Reactor Seepage Basins (Buildings 904-61G, 904-62G, and 904-63G) received low-level radioactive purge water from the P-Area Reactor Disassembly Basins from 1957 until 1970 and from 1978 until the present. A review of the radioactive releases to these basins shows that, although many radionuclides have been discharged to these basins, almost all the radioactivity is due to ^{3}H, ^{90}Sr, ^{137}Cs, and ^{60}Co. Trace quantities of aluminum, iron, sodium, chloride, nitrate, carbonate, phosphate, sulfite, sulfate, oil, and grease have been discharged to the basins. The P-Area Reactor Seepage Basins are currently active and receiving purge water (Stone and Christensen, 1983).

Basin water and soil/sediments have been analyzed for radioactive parameters only. Of the radionuclides detected in the basin water, ^{3}H, ^{51}Cr, and ^{137}Cs had the highest activity levels. The soil/sediment radioactivity data show that ^{137}Cs, ^{90}Sr, and ^{60}Co were the major radionuclides in the basin soil, with the maximum activities of these radionuclides generally occurring at a depth of 0.0 to 2.0 ft. Activities at depths of 2.0 to 20 ft were substantially lower than those from 0.0 to 2.0 ft.

Monitoring results from the P-Area Reactor Seepage Basins wells were compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess general groundwater quality. Groundwater in upgradient well PSB 5A has been characterized by low dissolved constituent levels compared to South Carolina and federal drinking water standards except for lead and tritium. Lead (0.007 to 0.129 mg/L) and tritium (31 to 36 pCi/mL) levels in upgradient well PSB 5A were above their respective drinking water standards of 0.05 mg/L and 20 pCi/mL.

Groundwater samples from all six downgradient wells met South Carolina and federal drinking water standards except for lead in wells PSB 2A, PSB 3A, PSB 4A, and PSB 6A; nitrate in well PSB 6A; and tritium in all the downgradient wells. Lead concentrations in downgradient wells PSB 2A, PSB 3A, PSB 4A, and PSB 6A (up to 0.096 mg/L) ranged above the drinking water standard of 0.05 mg/L. Nitrate levels in downgradient well PSB 6A (7.2 to 15.0 mg/L) were above the drinking water standard of 10 mg/L. Lead and nitrate are not known to be related to past site activities. Tritium levels in all six downgradient wells (4,357 to 236,364 pCi/mL) were above the drinking water standard of 20 pCi/mL. Gross alpha and total radium levels in all seven P-Area Reactor Seepage Basins wells remained below the drinking water standards of 15 pCi/L and 5 pCi/L, respectively.

12.02.02 Waste-Site Description and Nature of Disposal

P Area has used earthen seepage basins since 1957 to contain low-level radioactive water from the P-Area Disassembly Basin (Pekkala et al., 1987b). The three P-Area Reactor Seepage Basins (Buildings 904-61G, 904-62G, and 904-63G) are just west of the P-Area perimeter fence. As shown in Figure 12-3, the basins are on a west-trending slope where surface elevations range approximately from 310 to 327 ft msl. The nearest stream, Steel Creek, is approximately 1,500 ft north to northwest of the basins; the nearest plant boundary is approximately 5.6 mi east of the site.

The physical dimensions of the P-Area Reactor Seepage Basins and other installation data are presented in Table 12-1. The basins were constructed by excavating below grade and building earthen dikes around the sides at grade level. P-Area Reactor Seepage Basin 1 is L-shaped; P-Area Reactor Seepage Basins 2 and 3 are rectangular. Overflow is sequential from Basin 1 to Basin 2 to Basin 3 (Stone and Christensen, 1983).

In 1957, SRS began using the P-Area Reactor Seepage Basins for the disposal of low-level radioactive purge water from the P-Area Disassembly Basin. This water purge is necessary to keep the tritium activity in the disassembly basin water within a safe working range. Although many radionuclides have been discharged to the P-Area Reactor Seepage Basins, nearly all the radioactivity is attributable to ^{3}H, ^{90}Sr, ^{137}Cs, and ^{60}Co. The radionuclides enter the disassembly basin water as a film of liquid on the irradiated components as they are discharged from the reactor tank to the disassembly basin, in the oxide corrosion film on the irradiated components, and, infrequently, from leaks in porous components. The inventory of radionuclides discharged to the P-Area Reactor Seepage Basins (corrected for radioactive decay through 12/31/85) is given in Table 12-2. Annual purge volumes discharged to the P-Area Reactor Seepage Basins from 1957 to 1986 are given in Table 12-3.

In the late 1950s and early 1960s, purge water from the disassembly basins in the P-Area reactor buildings was pumped directly from the disassembly basins to the seepage basins. In the 1960s, mixed-bed deionizers were placed in service to reduce the ionic constituents in the water purged from the disassembly basins. The P-Area Reactor Seepage Basins were in use from 1957 until 1970. From 1970 to 1978, the disassembly purge water was released directly to plant streams after treatment using mixed-bed deionizers.

The reactor seepage basins in P Area were reactivated in 1978 and currently are receiving purge water from the disassembly basins. In normal practice, disassembly basin water is recirculated through sand filters to remove particulates. Particulates removed from the disassembly basin water are backwashed from the sand filter to a settler tank. Periodically, the particulate accumulation in the settler tank is transferred to a tank trailer and sent to the Separations Areas for concentration and storage.

After particulates in the recirculating disassembly basin water have been reduced by filtration, the basin water is pumped through mixed-bed deionizers and sand filters to reduce ionic concentrations to meet procedural limits. After the ionic concentrations have been reduced, the purge water is pumped to the reactor seepage basins.

During the purging operation, the deionizer effluents are monitored. Should radioactivity in the deionizer effluents approach the control limit, the deionizers are taken offline and regenerated.

In addition to purge water from the reactor disassembly basins, the seepage basins receive low-level radioactive wastewater from other sources in the reactor area. This discharged water must meet the same control limits as disassembly basin purge water before it is released to the seepage basins.

Trace quantities of aluminum, iron, sodium, chloride, nitrate, carbonate, phosphate, sulfite, sulfate, oil, and grease have been discharged to the basins. These chemicals enter the disassembly basin water in small amounts through additives for pH control, filter promotion, and algae treatment and through minimal additions of wastewater to the settler tank from other sources in the reactor buildings (Pekkala et al., 1987b). Typical concentrations of chemicals in P-Area Disassembly Basin purge water after deionization are shown in Table 12-4.

The P-Area Reactor Seepage Basins will continue in service until no longer needed for discharge of disassembly basin purge water. Vegetation at the site is checked periodically for radioactivity and removed to the Radioactive Waste Burial Ground (Building 643-7G) if elevated activity is found. Vegetation is controlled with herbicides.

12.02.03 Groundwater Monitoring Program

Fourteen wells (PSB Series) have been installed to monitor the water-table elevation and groundwater quality at the P-Area Reactor Seepage Basins. Seven wells (PSB 1 through PSB 7) were installed in 1978 using galvanized steel casings and screens. Because of possible water-quality interference from the galvanized steel, these wells were replaced by wells PSB 1A through PSB 7A (Figure 12-3) in the first quarter of 1984. Wells PSB 1A through PSB 7A were constructed using PVC casings and 30-ft screens. Wells PSB 1 through PSB 7 were abandoned in early 1984.

In 1978, wells PSB 1 through PSB 7 were added to the radioactive groundwater monitoring program at SRS, which monitors for gross alpha, nonvolatile beta, and tritium. Wells PSB 1A through PSB 7A remain under this program.

In December 1983, wells PSB 1 through PSB 7 were sampled to characterize the groundwater quality at the P-Area Reactor Seepage Basins; however, groundwater samples at this time were not filtered prior to analysis. In the first quarter of 1986, the P-Area Reactor Seepage Basins wells were included in the SRS quarterly groundwater monitoring program. The 1986 groundwater samples were filtered prior to analysis.

12.02.04 Site-Specific Hydrology

Measurements obtained from the P-Area Reactor Seepage Basins wells since May 1984 indicate that the water-table elevation has been declining since August 1984. A hydrograph for the P-Area Reactor Seepage Basins wells is presented in Figure 12-4. The water-table elevation for the fourth quarter of 1986 was approximately 275 ft msl, and the vadose zone was approximately 40 ft thick.

A water-table elevation contour map for the first quarter of 1986 (Figure 12-3) indicates that the near-surface groundwater flow direction was to the west, consistent with drainage toward Steel Creek. As the hydrograph for the P-Area Reactor Seepage Basins wells (Figure 12-4) shows, this horizontal flow direction has remained consistent over the monitoring period. Relative to the basins, well PSB 5A has been upgradient of the third basin, with wells PSB 1A, PSB 2A, PSB 3A, PSB 4A, PSB 6A, and, on occasion, well PSB 7A downgradient of one or more of the basins. Occasionally, well PSB 7A has been sidegradient of the basins.

The hydraulic gradient of the water table beneath the seepage basins has been approximately 0.008 ft/ft. Using an estimated horizontal groundwater flow velocity range for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the P-Area Reactor Seepage Basins has ranged approximately from 12 to 48 ft/yr.

12.02.05 Waste-Site Content Characterization Data

The P-Area Reactor Seepage Basins surface water has been analyzed for radioactive parameters only. Gross alpha, nonvolatile beta, and specific radionuclide activities in P-Area Reactor Seepage Basins water from 1981 through 1986 are listed in Table 12-5; which shows that the highest activities are those for ^{3}H, ^{51}Cr, and ^{137}Cs. Average activities for ^{3}H, ^{51}Cr, and ^{137}Cs from 1981 through 1986 were 177,667 pCi/mL, 0.99 pCi/mL, and 0.78 pCi/mL, respectively. Gross alpha activity in the basin water during this same period averaged 0.016 pCi/mL.

12.02.06 Soil/Sediment Characterization Data

Soil/sediment samples from the P-Area Reactor Seepage Basins were analyzed for radioactive constituents in 1972, 1976, and 1978.

In 1972 soil cores 1.5 ft deep were taken from the P-Area Reactor Seepage Basins for radioanalysis. A maximum activity of 7,100 pCi/g for ^{137}Cs was detected in Basin 1 at this depth (Fenimore and Horton, 1974). In 1976, five composite soil cores (approximately 0.3 ft deep) were collected from the P-Area Reactor Seepage Basins. Maximum activities of ^{90}Sr and ^{137}Cs (600 pCi/g and 120 pCi/g) in these composite soil cores were obtained from Basin 2 (Ashley and Zeigler, 1978).

The results of the 1978 study (Ashley and Zeigler, 1981) are presented in Table 12-6. The locations of the core samples are shown in Figure 12-5. Maximum levels of radioactivity found in the Basin 1 soil cores were 1,190 pCi/g for ^{137}Cs (0.0 to 0.5 ft below ground surface), 180 pCi/g for ^{90}Sr (1.5 to 2.0 and 9.5 to 10.0 ft below ground surface), and 150 pCi/g for ^{60}Co (3.5 to 4.0 ft below ground surface). The Basin 2 maximum soil core radioactivity levels were 710 pCi/g for ^{137}Cs, 200 pCi/g for ^{60}Co, and 140 pCi/g for ^{90}Sr in the 0.0 to 0.5 ft depth interval. Basin 3 maximum radioactivity levels were 2.0 pCi/g for ^{90}Sr and 1.0 pCi/g for ^{137}Cs in the 1.0 to 1.5 ft depth interval. The ^{137}Cs, ^{90}Sr, and ^{60}Co concentrations were generally highest in the 0.0 to 2.0 ft below ground surface interval and were substantially lower with depth.

12.02.07 Groundwater Monitoring Results

Groundwater monitoring data for the P-Area Reactor Seepage Basins from 1983 and 1986 are given in Appendix J. Groundwater characterization data are summarized in Table 12-7 and represent the results of four or fewer quarterly analyses. Because the P-Area Reactor Seepage Basins monitoring data base is limited, consistent trends in the data cannot be accurately identified. Instead, the monitoring results were compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) primary and secondary drinking water standards to assess general groundwater quality at the basins.

Monitoring well locations relative to the P-Area Reactor Seepage Basins are presented in Figure 12-3 along with the predominant near-surface groundwater flow direction. As shown in Figure 12-3 and discussed in Section 12.02.04, well PSB 5A has been upgradient of the third seepage basin, while wells PSB 1A, well PSB 2A, PSB 3A, PSB 4A, PSB 6A, and, occasionally, PSB 7A have been downgradient of one or more of the seepage basins.

Groundwater quality at upgradient well PSB 5A has been characterized by low dissolved constituent levels compared to South Carolina and federal drinking water standards except for lead and tritium. Low conductivity was reported for upgradient well PSB 5A (24 to 35 µmhos/cm). Lead concentrations in upgradient well PSB 5A (0.007 to 0.129 mg/L) were above the drinking water standard of 0.05 mg/L in the last three quarters of 1986. Tritium levels in upgradient well PSB 5A (31 to 36 pCi/mL) were above the drinking water standard of 20 pCi/mL. Gross alpha (<1.0 pCi/L) and total radium (<1.0 pCi/L) activities in well PSB 5A remained below their respective drinking water standards of 15 pCi/L and 5 pCi/L. Nonvolatile beta levels remained below 2.0 pCi/L. Groundwater pH in well PSB 5A ranged from 4.0 to 5.1. This pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

Dissolved chemical constituent levels in the downgradient wells have met South Carolina and federal drinking water standards except for lead in wells PSB 2A, PSB 3A, PSB 4A, and PSB 6A; nitrate in well PSB 6A; and tritium in all six downgradient wells. Lead concentrations in downgradient wells PSB 3A (<0.005 to 0.076 mg/L), PSB 4A (<0.005 to 0.096 mg/L), and PSB 6A (<0.005 to 0.058 mg/L) were above the drinking water standard of 0.05 mg/L in the last three quarters of 1986. The lead concentration in well PSB 2A (0.055 mg/L) exceeded the drinking water standard in the fourth quarter of 1986. As discussed above, lead levels in upgradient well PSB 5A were also above drinking water standards in the last three quarters of 1986. Lead levels in downgradient wells PSB 1A and PSB 7A remained below the drinking water standard of 0.05 mg/L. Nitrate concentrations in downgradient well PSB 6A (7.2 to 15.0 mg/L) were above the drinking water standard of 10 mg/L on two occasions. Nitrate levels in the other downgradient wells remained below or equal to drinking water standards. Nitrate and lead are not known to be related to past site activities. The elevated lead levels in the PSB wells may be attributable to the P-Area Coal Pile, which is upgradient of the wells and the seepage basin.

Tritium activity in the six downgradient wells, as measured in the nonradioactive monitoring program, was above the drinking water standard of 20 pCi/mL in 1986 (Table 12-7). Gross alpha and total radium activities in the downgradient wells remained below the drinking water standards of 15 pCi/L and 5 pCi/L, respectively, in 1986. Nonvolatile beta levels in the downgradient wells remained below 21.0 pCi/L in 1986.

Annual maximum and average gross alpha, nonvolatile beta, and tritium activities measured in the radioactive monitoring program for the P-Area Reactor Seepage Basins wells from 1982 through 1986 are given in Table 12-8. Average gross alpha activities in the P-Area Reactor Seepage Basins wells remained below the drinking water standard of 15 pCi/L. The annual tritium activity averages reported in this program are consistent with the values reported in the nonradioactive monitoring program from 1978 through 1986 and are above the drinking water standard of 20 pCi/mL.

Groundwater pH in the downgradient wells ranged from 3.6 to 7.6, excluding downgradient well PSB 1A; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Groundwater pH in downgradient well PSB 1A ranged from 6.3 to 8.7, which is slightly elevated compared to the pH range in the other P-Area Reactor Seepage Basins wells and may be attributable to leaching of the well grout.

12.02.08 Planned Action

The P-Area Reactor Seepage Basins are currently active, and continued use is planned. Groundwater monitoring will continue at this site. No other actions are planned.

12.03 P-AREA ACID/CAUSTIC BASIN

12.03.01 Summary

The P-Area Acid/Caustic Basin (Building 904-78G) received dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion-exchange units in the water purification process areas. This basin allowed for the mixing and neutralization of the dilute solutions before their discharge to a tributary of Par Pond. The basin was constructed between 1952 and 1954 and remained in service until new neutralization facilities became operational in 1982. The P-Area Acid/Caustic Basin is currently inactive and contains rainwater (Ward et al., 1987).

Basin surface water and soil/sediments were sampled in August 1985. Basin surface water data indicate that all tested parameters were low except for iron at 0.484 mg/L. Concentrations of tested parameters for the P-Area Acid/Caustic Basin soil/sediments, including sulfate and sodium, were generally consistent with background levels. Extraction Procedure (EP) toxicity test results for metals and pesticides indicate that concentrations in the basin soil/sediments were below Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

Chemical inventory records indicate that sulfate and sodium were discharged to the P-Area Acid/Caustic Basin. These ions serve as indicator parameters because they are soluble and migrate readily in soil or groundwater. Monitoring data indicate that the P-Area Acid/Caustic Basin has had minimal influence on groundwater quality near sidegradient well PAC 2 and upgradient well PAC 1, as demonstrated by the low sulfate, sodium, and conductivity levels reported for these two wells. Water quality in sidegradient well PAC 2 and upgradient well PAC 1 has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for iron. The iron levels reported in these wells are consistent with naturally occurring Barnwell Formation groundwater iron levels (Appendix B).

Monitoring data show that groundwater quality near downgradient well PAC 3 and upgradient well PAC 4 also has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards. However, the P-Area Acid/Caustic Basin has influenced water quality near well PAC 3 and well PAC 4, as demonstrated by relatively higher indicator parameter levels reported for these two wells. Well PAC 4 is located only 25 ft from the basin.

Concentrations of indicator parameters (conductivity, sulfate, and sodium) in the P-Area Acid/Caustic Basin wells have not shown any consistent increasing or decreasing trends over the monitoring period.

12.03.02 Waste-Site Description and Nature of Disposal

The P-Area Acid/Caustic Basin (Building 904-78G) was constructed between 1952 and 1954 (Ward et al., 1987) and is located within an area of relatively low topographic relief. Surface elevations around the basin range approximately from 283 to 294 ft msl (Figure 12-6).

The P-Area Acid/Caustic Basin is an unlined earthen depression with approximate dimensions of 50 ft long by 50 ft wide by 7 ft deep. The basin was formed by removing existing soils below grade and building sloped side walls. The soils in the area are composed predominantly of yellowish-brown sandy clay, with clay content ranging from 40 to 90%.

Dilute sulfuric acid and sodium hydroxide solutions were used to regenerate ion exchange units in the P-Area water purification process area. The P-Area Acid/Caustic Basin provided containment for the mixing and neutralization of the spent solutions before their discharge to a tributary of Par Pond. Effluent resulting from discharges and rainwater runoff intermittently flowed from the basin to the tributary through an overflow weir set to maintain a maximum working water depth of 3 ft in the basin. Effluent records for the P-Area Acid/Caustic Basin were not maintained.

Calculated annual acid and caustic discharge rates to the basin are summarized in Table 12-9. Discharges to the basin were terminated in 1982 when the influent process piping was deactivated and a new neutralization facility was installed in P Area.

The basin is currently inactive and contains water from direct rainfall and local runoff. Above the water line, vegetation grows on the side slopes and floor of the basin.

12.03.03 Groundwater Monitoring Program

Four wells (PAC 1 through PAC 4) were installed to monitor the water-table elevation and groundwater quality at the P-Area Acid/Caustic Basin (Figure 12-6). Wells PAC 1 through PAC 3 were installed in the fourth quarter of 1983, and well PAC 4 was installed in the third quarter of 1984, using PVC casings and 30-ft screens.

Wells PAC 1 through PAC 3 were included in the SRS quarterly groundwater monitoring program in the second quarter of 1984; well PAC 4 was included in the program in the first quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

12.03.04 Site-Specific Hydrology

Measurements obtained from the P-Area Acid/Caustic Basin wells since March 1984 indicate that the water-table elevation has ranged from 287 to 269 ft msl and that the vadose zone has been approximately 7 to 15 ft thick. A hydrograph for the P-Area Acid/Caustic Basin wells is presented in Figure 12-7. A water-table elevation contour map for the second quarter of 1985 is presented in Figure 12-6. As shown, near-surface groundwater flow direction for the second quarter of 1985 was to the north, consistent with local topography. The hydrograph (Figure 12-7) indicates that this has been the predominant flow direction, although water-level fluctuations suggest that minor changes in gradient and flow direction have occurred. Relative to the basin, wells PAC 1 and PAC 4 have been predominantly upgradient, well PAC 3 downgradient, and well PAC 2 sidegradient.

The hydraulic gradient across the basin has been approximately 0.15 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of 15 to 60 ft/yr per percent gradient, the horizontal near-surface groundwater flow velocity beneath the P-Area Acid/Caustic Basin has ranged approximately from 225 to 900 ft/yr.

12.03.05 Waste-Site Content Characterization Data

Data from analyses of P-Area Acid/Caustic Basin water samples collected in August 1985 are listed in Table 12-10. These data indicate that surface water dissolved chemical constituent concentrations were low except for iron at 0.484 mg/L. The pH of the basin water was 6.46. Concentrations of anticipated indicator parameters, such as calcium (7.77 mg/L), magnesium (0.706 mg/L), sodium (8.01 mg/L), and sulfate (30 mg/L), were low relative to surrounding groundwater concentrations (Section 12.03.07). Section 12.03.02 contains information on the basin influent data.

12.03.06 Soil/Sediment Characterization Data

P-Area Acid/Caustic Basin soil/sediments were sampled in August 1985 as part of a basin characterization program. Three 5-ft continuous borings were obtained near the basin inlet and outlet structures and along one side wall. Soil boring samples were separated into 0.5-ft intervals for analysis. Soil/sediment analytical results, including Extraction Procedure (EP) toxicity test results for metals, are summarized in Table 12-11. EP toxicity test results for metals and pesticides indicate that the concentrations were less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24). Concentrations of other soil/sediment parameters tested were generally consistent with background soil levels, including magnesium (30 to 917 $\mu g/g$), sulfate (105.5 to 1,450 $\mu g/g$), and sodium (151 to 4,100 $\mu g/g$).

12.03.07 Groundwater Monitoring Results

Groundwater monitoring data from 1984 through 1986 are presented in Appendix J. Groundwater chemical characterization data since July 1984 are summarized in Table 12-12.

Comparisons of the monitoring results among sidegradient well PAC 2, downgradient well PAC 3, and upgradient wells PAC 1 and PAC 4 were used to evaluate the effect of the P-Area Acid/Caustic Basin on groundwater. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Indicator parameters are sulfate, sodium, and conductivity because elevated levels of these parameters are indicative of basin seepage effect and because sodium and sulfate are soluble and migrate readily in soil or groundwater.

The groundwater data summarized in Table 12-12 indicate that the P-Area Acid/Caustic Basin has had minimal influence on groundwater quality in upgradient well PAC 1 and sidegradient well PAC 2. Groundwater quality in wells PAC 1 and PAC 2 has been characterized by low dissolved chemical constituent levels compared to drinking water standards and the levels in the other P-Area Acid/Caustic Basin wells. Groundwater monitoring results for wells PAC 1 and PAC 2 consistently met South Carolina and federal drinking water standards for all tested dissolved chemical constituents except for iron occasionally. Low total dissolved solids (TDS) concentrations were reported for sidegradient well PAC 2 (70 mg/L) and upgradient well PAC 1 (58 to 64 mg/L) compared to the drinking water standard of 500 mg/L. Sulfate levels in both sidegradient well PAC 2 (6.0 to 25.0 mg/L) and upgradient well PAC 1 (below the detection limit) remained well below the drinking water standard of 250 mg/L. Sodium levels in wells PAC 1 and PAC 2 remained below 11.5 mg/L. Conductivity in sidegradient well PAC 2 ranged from 43 to 98 μmhos/cm, with an average conductivity of 73.6 μmhos/cm. Similarly, conductivity in upgradient well PAC 1 was low, ranging from 31 to 60 μmhos/cm, with an average conductivity of 44 μmhos/cm.

Iron concentrations above the drinking water standard of 0.3 mg/L were reported occasionally in both sidegradient well PAC 2 (0.042 to 1.640 mg/L) and upgradient well PAC 1 (0.052 to 0.368 mg/L). Iron levels as high as 0.52 mg/L are generally consistent with naturally occurring Barnwell Formation groundwater iron levels (Appendix B). Groundwater pH in sidegradient well PAC 2 ranged from 5.0 to 5.4 and in upgradient well PAC 1 from 3.9 to 5.3; pH values as low as 4.0 are consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

Comparisons of indicator parameter concentrations among the P-Area Acid/Caustic Basin wells show that the basin has had some influence on local groundwater quality in wells PAC 3 and PAC 4. Figures 12-8 and 12-9 are comparisons of average sulfate, sodium, and conductivity levels in the P-Area Acid/Caustic Basin wells. These figures show the lower indicator parameter concentrations reported for sidegradient well PAC 2 and upgradient well PAC 1 compared to levels in downgradient well PAC 3 and upgradient well PAC 4. Figure 12-8 also shows the sulfate levels in the wells compared to the drinking water standard of 250 mg/L.

Groundwater quality in wells PAC 3 and PAC 4 met South Carolina and federal drinking water standards for dissolved chemical constituents. However, a comparison of average indicator parameter concentrations in the P-Area Acid/Caustic Basin wells (Figures 12-8 and 12-9) shows that indicator parameter levels in downgradient well PAC 3 and upgradient well PAC 4 have been higher relative to wells PAC 2 and PAC 1, with well PAC 4 having the highest levels. Sulfate levels in downgradient well PAC 3 (14.0 to 88.0 mg/L) and upgradient well PAC 4 (74.0 to 106 mg/L) have been consistently higher than those in wells PAC 2 and PAC 1, but have remained well below the drinking water standard of 250 mg/L. Similarly, sodium concentrations (3.1 to 25.3 mg/L for well PAC 3 and 20.70 to 52.62 mg/L for well PAC 4) have been consistently higher for downgradient well PAC 3 and upgradient well PAC 4 than for wells PAC 2 and PAC 1. Well PAC 4 is located only 25 ft from the basin.

Groundwater pH in downgradient well PAC 3 ranged from 4.1 to 5.5 and in upgradient well PAC 4 from 3.1 to 5.3. Barnwell Formation groundwater is naturally acidic, with pH levels as low as 4.0 (Appendix B). Sulfate, sodium, and conductivity levels in all P-Area Acid/Caustic Basin wells have not shown any consistent increasing or decreasing trends over the monitoring period.

12.03.08 Planned Action

The P-Area Acid/Caustic Basin is inactive. As indicated in Section 16, a site assessment has been completed, and a closure plan is to be developed in 1987. Groundwater monitoring will continue.

12.04 P-AREA COAL PILE RUNOFF CONTAINMENT BASIN

12.04.01 Summary

The P-Area Coal Pile Runoff Containment Basin (Building 189-P) receives runoff from the P-Area coal storage pile (Christensen and Gordon, 1983). The groundwater monitoring data indicate that the P-Area Coal Pile Runoff Containment Basin (CPRB) has had minimal effect on groundwater quality in wells PCB 2A and PCB 4A, as demonstrated by the consistently low dissolved chemical levels in these wells. Groundwater quality in well PCB 3A apparently has been affected by the basin as shown by the consistently higher indicator parameter levels measured in samples collected from this well. The monitoring data also indicate that coal pile runoff has influenced groundwater in well PCB 1A, although the water quality from this well has been characterized by relatively low levels of dissolved chemical constituents compared to drinking water standards. Although well PCB 1A has been predominantly upgradient of the P-Area CPRB since 1984, the water-level data indicate that the water-table elevation, flow direction, and velocity have fluctuated.

12.04.02 Waste-Site Description and Nature of Disposal

Electricity and steam at SRS are generated by burning coal in the powerhouses. The P-Area coal supply is stored in an open pile. The coal is generally moderate-to-low sulfur coal (1-2%) received by rail from Kentucky, Pennsylvania, and Virginia. Coal is placed on a hopper, sprayed with water to control dust, and loaded onto a pile at the P-Area facility (Christensen and Gordon, 1983).

The facility generally contains a 90-day reserve of coal. The coal pile is not rotated, resulting in long-term exposure of the unused coal to the environment. Weathering allows for the formation of sulfuric acid caused by the oxidation of sulfur materials in the coal. Rainfall then washes the acid from the coal pile into the coal pile runoff containment basin via gravity flow ditches and sewers.

Prior to construction of the coal pile runoff containment basins, rainfall runoff from the coal storage piles flowed to nearby streams onsite. The National Pollutant Discharge Elimination System (NPDES) permit issued in 1977 specifies limits on pH and suspended solids for coal pile runoff from rainfall up to the maximum 24-hr, 10-yr recurrence event (5.9 in. for SRS). Suspended solids are limited to 50 mg/L, and pH is limited to between 6 and 9. To achieve compliance, the P-Area CPRB was constructed in 1981 to contain coal pile runoff and prevent direct discharge to Meyers Branch. This containment basin allows for the passive equalization of runoff prior to its seepage into the subsurface where it can undergo natural renovation. There has been minimal discharge from the P-Area CPRB to Meyers Branch.

The P-Area CPRB is on a southeast-trending slope, and ground surface elevations across the basin range approximately from 300 to 308 ft msl (Figure 12-10). Surface drainage in the basin area is to the southeast toward Meyers Branch, a tributary of Steel Creek.

The basin is approximately 350 ft south of the P-Area coal storage pile area and about 5 mi east of the nearest plant boundary. The basin covers approximately 2 acres and has a maximum storage capacity of approximately 345,000 ft^3 (2.6 million gal). The coal pile that drains to this basin occupies approximately 2.6 acres and typically contains about 15,800 tons of low-sulfur coal (1-2%).

Coal pile runoff samples were collected on October 2, 1985, to characterize the P-Area CPRB influent and to establish indicator parameters for identifying the effects on the groundwater from the P-Area CPRB. The first individual grab sample was collected 15 to 30 min after the beginning of a storm and the second several hours after the end of the storm. In addition, a composite sample was collected during the entire period between the two individual sampling times.

The P-Area CPRB influent characterization data are presented in Table 12-13. These analytical results indicate that the dissolved metal concentrations were low. Elevated levels of conductivity, total dissolved solids (TDS), iron, and sulfate and low pH are typical of coal pile runoff and are the indicator parameters used to assess the effect of the basin on groundwater. Basin influent samples were not filtered prior to analysis and may have contained insoluble particulate matter.

12.04.03 Groundwater Monitoring Program

Eight wells (PCB Series) have been installed to monitor the water-table elevation and groundwater quality at the P-Area CPRB. Wells PCB 1 through PCB 4 were installed in the first half of 1980 and were constructed using galvanized steel casings and 20-ft screens. Because of possible water-quality interference from the galvanized steel, these wells were replaced by wells PCB 1A through PCB 4A in late 1983 and early 1984 (Figure 12-10). Wells PCB 1A through PCB 4A were constructed using PVC casings and 30-ft screens.

Wells PCB 1A through PCB 4A were included in the SRS quarterly groundwater monitoring program in the second quarter of 1984 after the older wells were abandoned. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

12.04.04 Site-Specific Hydrology

Measurements obtained from the P-Area CPRB wells from 1982 through 1984 indicate that the water-table elevation has been approximately 285 ft msl and that the vadose zone has been approximately 20 ft thick. A hydrograph for the P-Area CPRB wells (Figure 12-11) shows that the water-table elevation has fluctuated to a greater degree following the installation of the newer PVC-cased wells (March 1984). This increase in fluctuation may be caused by difference in well design or depth of installation. Water-level elevations indicate that a constant decline in water-table elevation has occurred since 1984. The water-level elevation data from well PCB 3A from March 1984 to August 1984 indicate a rise in the water-table elevation, although this rise was not reflected in any of the other site wells. The water level in well PCB 4A dropped sharply from March 1984 to August 1984. In addition, the water-table elevations for well PCB 3A during this period were about 2 ft below the top of the casing. Because the casing extends approximately 3 ft above ground level, if these data are correct, water-table elevations would be approximately 1 ft above grade. These data, therefore, are suspect.

A water-table elevation contour map for the second quarter of 1985 (Figure 12-10) shows that the near-surface groundwater flow direction was to the west to southwest, with an approximate gradient of 0.005 ft/ft. However, the low horizontal hydrologic gradient indicates that the horizontal flow paths in this area are poorly developed. These flow paths are consistent with the large swampy area to the southeast that drains into the upper reaches of Meyers Branch. The water-level data since 1985 indicate that the water-table elevation and flow direction have been fluctuating. However, with respect to the basin, well PCB 3A has been predominantly downgradient, well PCB 1A upgradient, and wells PCB 2A and PCB 4A sidegradient.

12.04.05 Waste-Site Content Characterization Data

Sampling and analysis of the P-Area CPRB contents have not been conducted. Section 12.04.02 contains information on the basin influent characterization data.

12.04.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the P-Area CPRB.

12.04.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix J. Groundwater chemical characterization data since July 1984 are summarized in Table 12-14.

The characterization data in Table 12-14 indicate that the P-Area CPRB has had minimal effect on groundwater quality in wells PCB 2A and PCB 4A. The only parameter consistently above drinking water standards in all the wells is manganese. Well PCB 3A apparently has been affected by seepage from the P-Area CPRB, as demonstrated by the elevated indicator parameter levels in this well. The data also indicate that seepage from the CPRB has influenced groundwater quality in well PCB 1A, although indicator parameter concentrations in this well have shown a consistent decreasing trend since the third quarter of 1984.

Groundwater quality from wells PCB 2A and PCB 4A has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for iron (Table 12-14). Low total dissolved solids (TDS) levels were reported for well PCB 2A (46 to 68 mg/L) and well PCB 4A (44 to 182 mg/L) compared to the drinking water standard of 500 mg/L. Sulfate levels in wells PCB 2A (<3 to 15 mg/L) and PCB 4A (<5 to 38 mg/L) consistently have been below the secondary drinking water standard of

250 mg/L. The low conductivity in wells PCB 2A (39 to 66 μmhos/cm) and PCB 4A (62 to 95 μmhos/cm) provide further indication that coal pile runoff has had a minimal effect on groundwater quality near these two wells. Groundwater pH in wells PCB 2A and PCB 4A ranged from 3.6 to 4.9; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Iron concentrations, which ranged from 0.04 to 0.482 mg/L in well PCB 2A and from 0.031 to 0.626 mg/L in well PCB 4A, generally met the drinking water standard of 0.3 mg/L. Iron concentrations as high as 0.52 mg/L are generally consistent with levels reported as naturally occurring in Barnwell Formation groundwater (Appendix B). The indicator parameter concentrations in wells PCB 2A and PCB 4A have not shown any consistent increasing or decreasing trends over the monitoring period.

The groundwater chemical characterization data (Table 12-14) show the effect of coal pile runoff on well PCB 3A, with TDS levels ranging from 78 to 1,276 mg/L and conductivity ranging from 410 to 2,600 μmhos/cm. The secondary drinking water standard for TDS is 500 mg/L. Sulfate levels in this well have remained above the secondary drinking water standard of 250 mg/L, ranging from 410 to 3,400 mg/L. Similarly, iron levels (0.120 to 25.9 mg/L) were generally above the secondary drinking water standard of 0.3 mg/L. Groundwater pH values in well PCB 3A ranged from 3.3 to 3.9, which is generally low compared to the pH values reported for the other site wells. These high TDS, conductivity, sulfate, and iron levels along with a low pH range are indicative of coal pile runoff contamination. In addition, these indicator parameter concentrations have been consistently high for the period of monitoring in both the older, steel-cased well (PCB 3) and the newer, PVC-cased well (PCB 3A). Other parameters that exceeded drinking water standards in well PCB 3A were cadmium (up to 0.019 mg/L), lead (up to 0.142 mg/L), manganese (up to 5.78 mg/L), and radioactivity (radium up to 6 pCi/L and gross alpha up to 45 pCi/L).

Seepage from the P-Area CPRB has influenced groundwater in well PCB 1A, although the water quality from this well has been characterized by generally low dissolved chemical constituent levels. Conductivity in well PCB 1A (88 to 595 μmhos/cm) was elevated compared to the range measured in wells PCB 2A and PCB 4A but was below the range reported for well PCB 3A. This same pattern is evident with the concentrations of TDS (214 to 398 mg/L), sulfate (<5.0 to 260 mg/L), and iron (0.106 to 7.39 mg/L) in well PCB 1A compared to the levels in the other site wells. TDS levels in well PCB 1A met the drinking water standard of 500 mg/L, although sulfate and iron levels occasionally did not meet the drinking water standards of 250 mg/L and 0.3 mg/L, respectively. Groundwater pH in well PCB 1A ranged from 3.9 to 5.2. Figures 12-12 through 12-14 are graphic comparisons of the average indicator parameter concentrations among the P-Area CPRB wells. Indicator parameter concentrations in well PCB 1A peaked in March 1985 and have been declining since. The peak sulfate and conductivity levels in March 1985 were 260 mg/L and 595 μmhos/cm, respectively. Monitoring data from the end of 1986 for well PCB 1A indicate sulfate and conductivity levels of 20.0 mg/L (September 1986) and 105 μmhos/cm (November 1986), respectively.

The concentrations of organics detected in the P-Area CPRB wells were generally low, as indicated by the relatively low levels of dissolved organic carbon (DOC; below 10 mg/L), total organic carbon (TOC; below 10 mg/L), total organic halogens (TOH; below 0.040 mg/L), phenols (below 0.005 mg/L), and extractable pesticides (all reported levels were less than detection limits). Isolated cases of high GC scan values were reported for well PCB 3A in May 1983 (1,110 μg/L) and November 1984 (3,190 μg/L). All other GC scan values in well PCB 3A for the period of monitoring were less than detection limits (40 μg/L).

12.04.08 Planned Action

The P-Area CPRB is currently active, and continued use is planned. A site assessment is planned for 1987. Groundwater monitoring will continue.

12.05 P-AREA ASH BASIN

12.05.01 Summary

The P-Area Ash Basin (Building 188-P) has received ash sluice water from the P-Area powerhouse since plant startup in 1951. The annual ash disposal rate into the P-Area Ash Basin has been about 18,000 yd^3/yr. The P-Area Ash Basin is currently active and receiving ash sluice water (Christensen and Gordon, 1983). Groundwater monitoring and soil characterization have not been conducted at the P-Area Ash Basin.

12.05.02 Waste-Site Description and Nature of Disposal

Electricity and steam at SRS are generated by burning coal in the powerhouses, which produces dry ash. Ash sluice water from the P-Area powerhouse has been discharged to the P-Area Ash Basin since plant startup in 1951. The annual ash disposal rate into the P-Area Ash Basin has been approximately 18,000 yd^3/yr (Christensen and Gordon, 1983).

The P-Area Ash Basin (Building 188-P) is southeast of the P-Area perimeter fence (Figure 12-2). The surface elevation in the vicinity of the basin is approximately 280 ft msl and decreases to the southeast. The P-Area Ash Basin is currently active and receiving ash sluice water.

Ash sluice water contains fly and bottom ash. Horton, Dorsett, and Cooper conducted a study in 1977 to identify trace metals present in the fly and bottom ash disposed to the SRS ash basins and piles. Table 12-15 lists typical trace metal concentrations obtained for fly and bottom ash. These results indicate significant levels of barium, strontium, manganese, zinc, vanadium, cerium, and chromium (Horton et al., 1977).

12.05.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the P-Area Ash Basin.

12.05.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the P-Area Ash Basin; therefore, near-surface groundwater conditions beneath the site are undefined.

12.05.05 Waste-Site Content Characterization Data

Sampling and analysis of the P-Area Ash Basin contents have not been conducted. Section 12.05.02 contains information on the materials disposed at the site.

12.05.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the P-Area Ash Basin. The materials and nature of disposal into the P-Area Ash Basin are similar to those of the D-Area Ash Basin (488-D); therefore, Extraction Procedure (EP) toxicity tests results from analyses performed on the 488-D Ash Basin sludge are presented in Table 12-16. The data in Table 12-16 demonstrate that extractable metal concentrations in the D-Area Ash Basin were less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

12.05.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the P-Area Ash Basin.

12.05.08 Planned Action

The P-Area Ash Basin is active, and continued use is planned. No other action is scheduled for this site.

12.06 P-AREA BINGHAM PUMP OUTAGE PIT

12.06.01 Summary

The P-Area Bingham Pump Outage Pit (Building 643-4G) received solid low-level radioactive waste during 1958. The estimated maximum amount of activity buried in the pit was approximately 1 Ci (Pekkala et al., 1987a). The P-Area Bingham Pump Outage Pit was deactivated and backfilled with clean soil in 1958, and the site has remained inactive since. Most of the radioactivity at the pit has been eliminated by radioactive decay. Groundwater monitoring has not been conducted at the P-Area Bingham Pump Outage Pit.

12.06.02 Waste-Site Description and Nature of Disposal

Normally, all radioactive solid waste generated in the reactor areas is sent to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G). An exception to this practice was made during 1957 and 1958 when major modifications were made to the primary and secondary cooling water systems in the reactor areas (Pekkala et al., 1987a).

In P Area, the radioactive waste generated during the modifications was surveyed, and solid waste with very low levels of surface contamination was buried in the P-Area Bingham Pump Outage Pit. No pumps are buried in the pit. The waste pit subsequently was backfilled with clean soil. The radiation level of the buried waste was less than 25 mRad/hr, and no alpha activity was noted. Waste with higher levels of contamination was sent to the Radioactive Waste Burial Ground (Building 643-7G). A conservative estimate of the activity buried in the P-Area Bingham Pump Outage Pit is 0.3 Ci (decay corrected through 12/31/85) (Pekkala et al., 1987a).

The P-Area Bingham Pump Outage Pit (Building 643-4G) is northwest of the P-Area perimeter fence (Figure 12-2), approximately 6.1 mi east of the nearest plant boundary. The pit was excavated on a gentle slope leading to an unnamed tributary of Par Pond, approximately 1,800 ft from the site. The ground surface elevation at the pit is approximately 320 ft msl. The pit had nominal dimensions of 470 ft long by 26 ft wide by 13 ft deep and a capacity of approximately 159,000 ft^3. Vegetation has been allowed to grow over the P-Area Bingham Pump Outage Pit since it was backfilled in 1958.

12.06.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the P-Area Bingham Pump Outage Pit.

12.06.04 Site-Specific Hydrology

No groundwater monitoring wells are located around the P-Area Bingham Pump Outage Pit. Therefore, groundwater conditions beneath the site are undefined.

12.06.05 Waste-Site Content Characterization Data

The P-Area Bingham Pump Outage Pit contents have not been sampled. Section 12.06.02 contains information on the materials disposed in the pit. The estimated radionuclide inventory in the P-Area Bingham Pump Outage Pit at the time of burial (1958) and in December 1985 is listed in Table 12-17. This table indicates that most of the radioactivity at the P-Area Bingham Pump Outage Pit has been eliminated by radioactive decay.

A comparison between radioactivity levels in vegetation samples from the surface of the P-Area Bingham Pump Outage Pit in 1970 and vegetation samples from the SRS perimeter in that same year is presented in Table 12-18. The vegetation growing above the outage pit exhibited little or no increase in activity compared to background levels, as shown in Table 12-18 (Fenimore and Horton, 1974).

12.06.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the P-Area Bingham Pump Outage Pit.

12.06.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the P-Area Bingham Pump Outage Pit.

12.06.08 Planned Action

The P-Area Bingham Pump Outage Pit is inactive. A site assessment is planned for 1988 from which a closure plan will be developed.

12.07 P-AREA BURNING/RUBBLE PIT

12.07.01 Summary

Burnable wastes such as paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents were received and incinerated in the P-Area Burning/Rubble Pit (Building 131-P) from 1951 to 1973, at which time the pit was covered with a layer of soil. Rubble wastes (including paper, wood, concrete, scrap metal, cans, and empty galvanized steel drums) were then disposed in the pit until it reached capacity and was capped with soil in 1978. The site is currently inactive (Huber et al., 1987c).

The groundwater monitoring data indicate that there has been no apparent effect on groundwater quality from the P-Area Burning/Rubble Pit except for influence from halogenated organics on water quality near sidegradient well PRP 3. Groundwater data for PRP 3 shows excursions of iron, lead, and manganese, which are not known to be related to past site activities. Groundwater near downgradient well PRP 1A, sidegradient well PRP 2, and upgradient well PRP 4 has been characterized by low dissolved chemical constituent and radioactivity levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for isolated excursions of iron and lead in well PRP 1A. Groundwater in sidegradient well PRP 3 has apparently been influenced by the pit, as indicated by the elevated levels of conductivity, total organic halogens (TOH), and specific halogenated organics reported for this well.

12.07.02 Waste-Site Description and Nature of Disposal

The P-Area Burning/Rubble Pit was constructed in 1951 to collect burnable waste generated at the plant. The wastes collected for monthly incineration at the P-Area pit included paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents. Disposal of chemically contaminated oils was not allowed at the P-Area Burning/ Rubble Pit (Huber et al., 1987c).

In 1973, the plantwide procedure of burning waste ceased, and the P-Area Burning/Rubble Pit was converted to receive only rubble by placing a layer of soil over the incinerated waste. Rubble waste disposed in the pit included paper, wood, concrete, scrap metal, cans, and empty galvanized steel drums. The practice of disposing of rubble continued until 1978, when the pit reached capacity and was capped with soil (Huber et al., 1987c).

The P-Area Burning/Rubble Pit (Building 131-P) is west of the P-Area perimeter fence (Figure 12-2). The surface elevation around the pit ranges approximately from 280 to 284 ft msl (Figure 12-15), and surface drainage is to the south toward Steel Creek. The pit was rectangular with nominal dimensions of 210 ft long by 60 ft wide by 10 ft deep, resulting in a capacity of 126,000 ft^3.

12.07.03 Groundwater Monitoring Program

Four wells (PRP 1 through PRP 4) were installed to monitor the water-table elevation and groundwater quality at the P-Area Burning/ Rubble Pit (Figure 12-15). Because of difficulties encountered while attempting to install the casing of well PRP 1, it was replaced by well PRP 1A, which was drilled at the same location as well PRP 1. Wells PRP 1A through PRP 3 were installed in the fourth quarter of 1983 using PVC casings and 30-ft screens. PRP 4 was installed during the third quarter of 1984 using the same construction methods.

Wells PRP 1A through PRP 3 were included in the SRS quarterly groundwater monitoring program in the second quarter of 1984. Well PRP 4 was included in this program during the first quarter of 1985. Plant-wide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

12.07.04 Site-Specific Hydrology

Measurements obtained from the P-Area Burning/Rubble Pit monitoring wells indicate that the water-table elevation has been declining since monitoring began in June 1984 (Figure 12-16). The water-table elevation for the fourth quarter of 1986 ranged approximately from 255 to 246 ft msl, and the vadose zone was approximately 30 to 35 ft thick.

A water-table elevation contour map for the third quarter of 1986 indicates that, although the P-Area Burning/Rubble Pit is just north of Steel Creek, the near-surface groundwater flow direction has been to the west (Figure 12-15). This groundwater flow is consistent with Steel Creek (at an elevation of approximately 275 ft msl) being a losing stream at this location. Although fluctuations in water levels indicate that minor changes in flow direction and gradient have occurred, there has been no apparent change in the flow direction since monitoring began. Relative to the pit, well PRP 4 has maintained an upgradient position, well PRP 1A has remained downgradient, and wells PRP 2 and PRP 3 have been sidegradient. The hydraulic gradient beneath the basin has been approximately 0.029 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of between 15 and 60 ft/yr per percent gradient, the near-surface groundwater flow velocity beneath the P-Area Burning/Rubble Pit has ranged approximately from 43.5 to 174 ft/yr.

12.07.05 Waste-Site Content Characterization Data

The contents of the P-Area Burning/Rubble Pit have not been sampled. Section 12.07.02 contains information on the materials incinerated and disposed at the waste site.

12.07.06 Soil/Sediment Characterization Data

In late 1985 and early 1986, soils were collected and analyzed for volatile organic constituents from twenty-four 18- to 24-in.-deep auger holes at the P-Area Burning/Rubble Pit (Figure 12-17). In addition, one 30-ft deep auger hole was drilled, and a sample from each 1-ft interval was analyzed for volatile organics. The maximum concentrations found in the samples were 20.9 µg/kg tetrachloroethylene and 24 µg/kg trichloroethylene (Price et al., 1987).

12.07.07 Groundwater Monitoring Results

The groundwater monitoring data from 1984 through 1986 are given in Appendix J. Groundwater chemical characterization data since July 1984 are summarized in Table 12-19.

Comparisons of groundwater monitoring data among the P-Area Burning/Rubble Pit wells were used to evaluate the effect of the pit on groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. Based on the site waste inventory (Section 12.07.02), the indicator parameters are conductivity, total organic carbon (TOC), and total organic halogens (TOH).

The groundwater monitoring data summarized in Table 12-19 indicate that the P-Area Burning/Rubble Pit has had minimal influence on local groundwater quality except in sidegradient well PRP 3, which contains elevated levels of halogenated organics.

Groundwater quality near downgradient well PRP 1A, sidegradient well PRP 2, and upgradient well PRP 4 has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards except for isolated excursions of iron and lead in well PRP 1A. Low conductivity values were reported for wells PRP 1A (25 to 46 μmhos/cm), PRP 2 (20 to 40 μmhos/cm), and PRP 4 (27 to 47 μmhos/cm). TOC levels in downgradient well PRP 1A, sidegradient well PRP 2, and upgradient well PRP 4 remained below 9.0 mg/L; TOH levels in these three wells remained below 0.042 mg/L. Chloroform, carbon tetrachloride, trichloroethylene, and 1,1,1-trichloroethane (1,1,1-TCE) levels in wells PRP 1A, PRP 2, and PRP 4 were consistently below drinking water standards. Iron levels in downgradient well PRP 1A (0.055 to 0.362 mg/L) were above the drinking water standard of 0.3 mg/L on one occasion. Iron at this level is consistent with levels reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Lead levels in downgradient well PRP 1A (0.022 to 0.080 mg/L) were above the drinking water standard of 0.05 mg/L in a single excursion.

Groundwater quality in sidegradient well PRP 3 has been influenced by the P-Area Burning/Rubble Pit. The following parameters were at concentrations above South Carolina and federal drinking water standards in sidegradient well PRP 3: trichloroethylene, iron, manganese, 1,1,1-trichloroethane (1,1,1-TCE), and lead. Higher conductivity values also were reported for sidegradient well PRP 3 (80 to 140 μmhos/cm) compared to the other P-Area Burning/Rubble Pit wells (Figure 12-18).

TOH levels in sidegradient well PRP 3 (0.161 to 0.917 mg/L) were consistently above the TOH levels reported for the other P-Area Burning/Rubble Pit wells (0.002 to 0.041 mg/L). Figure 12-18 illustrates the relative differences in average TOH concentrations between sidegradient well PRP 3 and the other Burning/Rubble Pit wells. Trichloroethylene levels in well PRP 3 (0.073 to 0.080 mg/L) remained above the drinking water standard of 0.005 mg/L and above the levels reported for the other site wells (0.002 mg/L or below). Similarly, 1,1,1-trichloroethane (1,1,1-TCE; 0.524 to 0.702 mg/L) levels in well PRP 3 remained above the drinking water standard (0.200 mg/L) and above levels reported for the other site wells (<0.001 mg/L). Chloroform (<0.005 to 0.048 mg/L) and tetrachloroethylene (0.055 to 0.065 mg/L) levels in sidegradient well PRP 3 were above the levels reported for the other site wells (0.002 mg/L or below for both parameters), although chloroform levels remained below the trihalomethane drinking water standard of 0.100 mg/L. TOC levels in sidegradient well PRP 3 (1.88 to 3.0 mg/L) were similar to the TOC levels reported for the other site wells (0.276 to 8.0 mg/L). As previously discussed, halogenated organics are known to be related to past site activities.

Iron levels in sidegradient well PRP 3 (0.092 to 0.800 mg/L) generally were above the drinking water standard of 0.3 mg/L. Iron concentrations as high as 0.52 mg/L are generally consistent with those reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Manganese (0.037 to 0.073 mg/L) and lead (0.035 to 0.052 mg/L) concentrations in sidegradient well PRP 3 ranged above their drinking water standards of 0.05 mg/L and 0.05 mg/L, respectively.

Groundwater pH values in the P-Area Burning/Rubble Pit wells ranged from 3.6 to 5.1; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Radioactivity levels in the P-Area Burning/Rubble Pit wells remained below the drinking water standards over the period of monitoring.

12.07.08 Planned Action

The P-Area Burning/Rubble Pit is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue.

TABLE 12-1

Approximate Physical Dimensions of the P-Area Reactor Seepage Basins

Basin	Shape	Area (acres)	Dimensions (ft) Length	Width	Depth	Volume (ft^3)
1	L-shaped	0.33	394	36	7	70,629
2	Rectangular	0.35	207	69	7	98,880
3	Rectangular	0.50	328	66	13	208,355

Note: Dimensions are given for the centerline of each basin. The volumes do not include the area above the overflow.

TABLE 12-2

Summary of Radioactive Releases to the P-Area Reactor Seepage Basins

Radionuclide	Radioactive Release (Ci)
^{3}H*	4.5E+05
^{35}S	2.4E-03
^{51}Cr	1.0E-03
^{60}Co	7.2E-02
^{89}Sr	5.1E-05
^{90}Sr	2.5E+00
^{95}Zr, ^{95}Nb	1.1E-03
$^{103,106}Ru$	1.1E-03
$^{124,125}Sb$	1.1E-02
^{134}Cs	8.9E-03
^{137}Cs	1.1E+01
$^{141,144}Ce$	3.9E-02
^{147}Pm	1.7E-02
Alpha emitters (unidentified)	9.4E-03

Note: Release values are cumulative through 1985. All values are decay corrected through December 31, 1985. Data are from Stone and Christensen (1983).

* Most of the tritium is believed to have left the basins via the atmosphere or groundwater.

TABLE 12-3

Total Volumes Purged to the P-Area Reactor Seepage Basins

Year	Volume Purged (L)
1957	7.570E+05
1958	2.271E+05
1959	7.570E+05
1960	7.570E+05
1961	1.136E+06
1962	8.500E+05
1963	1.136E+06
1964	6.580E+06
1965	2.225E+04
1966	9.840E+04
1967	1.533E+03
1968	4.152E+06
1970	5.020E+03
1978	8.880E+06
1979	2.291E+07
1980	1.196E+07
1981	1.846E+07
1982	2.562E+07
1983	2.002E+07
1984	2.468E+07
1985	2.365E+07
1986	1.169E+07
Total to 12/31/86	1.844E+08

TABLE 12-4

Typical Nonradioactive Analyses of Purge Water to the P-Area Reactor Seepage Basins (After Deionization)

Constituent	Concentration (mg/L)
Cyanide	<0.005
Chloride	1.3
Nitrite	<0.5
Nitrate	<0.5
Surfactants	0.03
Turbidity	0
Sulfate	<5
Sulfide	<1
Dissolved organic carbon	4
Total organic carbon	5
Fluoride	0.30
Phenols	<0.002
Odor	0
Color	0
Total organic halogens	0.006
Corrosivity	No
Total dissolved solids	14.0
Phosphate	<0.02
pH (pH units)	6.5
Grease and oil	<5
Aluminum	<0.3
Calcium	<0.02
Magnesium	<0.01
Potassium	<0.05
Silver	<0.001
Arsenic	<0.002
Barium	<0.1
Beryllium	<0.01
Cadmium	<0.001
Copper	<0.002
Iron	<0.04
Mercury	<0.0002
Manganese	<0.02
Sodium	0.28
Lead	0.006
Selenium	<0.002
Zinc	0.034
Chromium	<0.003
Nickel	<0.003
Silicon	NA

Note: NA = not available.

TABLE 12-5

Radioactivity Levels in P-Area Reactor Seepage Basins Water

Radionuclide	Concentration (pCi/mL) 1978	1979	1980	1981	1982	1983	1984	1985	1986
^{51}Cr	---	0.79	1.7	3.1	1.2	0.32	1.1	0.22	0.00
$^{58,60}Co$	---	0.09	0.47	0.23	0.10	0.12	0.07	0.00	0.00
$^{89,90}Sr$	---	---	---	---	---	---	---	---	---
$^{95}Zr, ^{95}Nb$	---	0.03	0.03	0.01	0.04	0.01	0.22	0.07	0.00
^{103}Ru	---	0.03	0.20	0.07	0.07	0.04	0.04	0.00	0.00
^{106}Ru	---	0.42	0.52	0.15	0.27	0.14	0.3	0.26	0.00
$^{124,125}Sb$	---	0.04	0.09	0.09	0.09	0.23	0.06	0.02	0.00
^{131}I	---	0.08	0.07	0.16	0.54	0.31	0.04	0.13	0.00
^{134}Cs	---	0.14	0.04	0.04	0.04	0.02	0.07	0.03	0.00
^{137}Cs	---	0.79	1.3	1.1	0.77	1.5	0.73	0.30	0.26
$^{141,144}Ce$	---	0.10	0.77	0.19	0.20	0.29	0.45	0.18	0.00
^{3}H	910	530	310	340,000	190,000	130,000	130,000	200,000	76,000
Gross alpha	4.4	5.0	4.5	0.02	0.023	0.027	0.018	0.0053	0.0047
Nonvolatile beta	1600	980	610	1.500	1.600	1.100	1.100	0.740	0.35

Note: Data are from SRS annual reports.

TABLE 12-6

Radioactivity in P-Area Reactor Seepage Basins Soil (1978)

Core Depth (ft)	Isotope	Test Hole Concentrations (pCi/g--dry) Basin 1: 1	2	3	4	5	6	7
0-0.5	^{137}Cs	10	10	70	120	1,190	10	12
	^{60}Co	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	11	NA	NA	NA	50	NA
0.5-1	^{137}Cs	12	7	13	5	110	15	20
	^{60}Co	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	15	NA	NA	NA	100	NA
1-1.5	^{137}Cs	7	4	NS	20	15	50	40
	^{60}Co	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	44	NA	NA	NA	100	NA
1.5-2	^{137}Cs	70	NA	NA	320	6	10	6
	^{60}Co	ND	NA	NA	ND	ND	ND	ND
	^{90}Sr	NA	NA	NA	NA	NA	180	NA
3.5-4	^{137}Cs	5	14	20	10	7	175	3
	^{60}Co	11	ND	150	ND	9	30	ND
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA
5.5-6	^{137}Cs	9	6	5	9	18	2	3
	^{60}Co	4	NA	10	ND	1	2	ND
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA
Co	137ND	ND	ND	ND	ND	ND	ND	
	^{90}Sr	NA	33	NA	NA	NA	180	NA
11.5-12	^{137}Cs	NA	NA	NA	NA	NA	0.6	NA
	^{60}Co	NA	ND	NA	NA	NA	ND	NA
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA
13.5-14	^{137}Cs	NA	1	NA	NA	NA	0.7	NA
	^{60}Co	NA	ND	NA	NA	NA	ND	NA
	^{90}Sr	NA	NA	NA	NA	NA	130	NA
15.5-16	^{137}Cs	NA	3	NA	NA	NA	2	NA
	^{60}Co	NA	ND	NA	NA	NA	ND	NA
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA
17.5-18	^{137}Cs	NA	2	NA	NA	NA	1	NA
	^{60}Co	NA	ND	NA	NA	NA	ND	NA
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA
19.5-20	^{137}Cs	NA	2	NA	NA	NA	1	NA
	^{60}Co	NA	ND	NA	NA	NA	ND	NA
	^{90}Sr	NA	16	NA	NA	NA	70	NA

TABLE 12-6 (cont.)

Core Depth (ft)	Isotope	Test Hole Concentrations (pCi/g--dry) Basin 2				Basin 3				
		8	9	10	11	12	13	14	15	16
0-0.5	^{137}Cs	35	710	12	400	0.2	0.2	0.7	0.3	0.2
	^{60}Co	ND	ND	ND	200	ND	ND	ND	ND	ND
	^{90}Sr	NA	140	NA	NA	NA	NA	0.9	NA	NA
0.5-1	^{137}Cs	40	160	133	410	<0.2	0.3	1	ND	<0.2
	^{60}Co	ND	ND	ND	200	ND	ND	ND	ND	ND
	^{90}Sr	NA	5	NA	NA	NA	NA	0.4	NA	NA
1-1.5	^{137}Cs	40	48	10	20	<0.2	0.5	1	0.3	<0.2
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	0.8	NA	NA	NA	NA	2	NA	NA
1.5-2	^{137}Cs	120	160	NA	NA	<0.2	0.5	1	0.3	<0.2
	^{60}Co	ND	ND	NA	NA	ND	ND	ND	ND	ND
	^{90}Sr	NA	0.8	NA	NA	NA	NA	0.2	NA	NA
3.5-4	^{137}Cs	5	310	12	14	<0.2	0.2	ND	0.3	<0.2
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA	NA	NA
5.5-6	^{137}Cs	4*	20*	8*	10*	<0.2	0.2	ND	0.2	<0.2
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA	NA	NA
7.5-8	^{137}Cs	10*	20*	6*	100*	<0.2	<0.2	ND	1	<0.2
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA	NA	NA
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA	NA	NA
9.5-10	^{137}Cs	20*	20*	90*	75*	<0.2	0.2	ND	0.2	<0.2
	^{60}Co	ND	ND	ND	ND	ND	ND	ND	ND	ND
	^{90}Sr	NA	3*	NA	NA	NA	NA	0.7	NA	NA
11.5-12	^{137}Cs	NA	240*	NA	NA	NA	NA	ND	NA	NA
	^{60}Co	NA	ND	NA	NA	NA	NA	ND	NA	NA
	^{90}Sr	NA	ND	NA	NA	NA	NA	NA	NA	NA
13.5-14	^{137}Cs	NA	60*	NA	NA	NA	NA	ND	NA	NA
	^{60}Co	NA	ND	NA	NA	NA	NA	ND	NA	NA
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA	NA	NA
15.5-16	^{137}Cs	NA	50*	NA	NA	NA	NA	ND	NA	NA
	^{60}Co	NA	ND	NA	NA	NA	NA	ND	NA	NA
	^{90}Sr	NA	NA	NA	NA	NA	NA	NA	NA	NA
17.5-18	^{137}Cs	NA	20*	NA	NA	NA	NA	ND	NA	NA
	^{60}Co	NA	ND	NA	NA	NA	NA	ND	NA	NA
	^{90}Sr	NA	ND	NA	NA	NA	NA	NA	NA	NA
19.5-20	^{137}Cs	NA	120*	NA	NA	NA	NA	ND	NA	NA
	^{60}Co	NA	ND	NA	NA	NA	NA	ND	NA	NA
	^{90}Sr	NA	1*	NA	NA	NA	NA	0.7	NA	NA

Note: Cores were measured in 15-cm intervals; therefore, depths in feet are approximate. NA = no analysis; ND = not detected. Data are from Ashley and Zeigler (1981).

TABLE 12-7

Summary of Groundwater Quality: Well Concentration Ranges for the P-Area Reactor Seepage Basins (7/84-12/86)

Constituent	SC and Federal DWS	PSB 1A	PSB 2A	PSB 3A	PSB 4A
pH (pH)	6.5-8.5	6.3-8.7	3.6-4.8	4.1-4.7	4.3-4.5
Conductivity (µmhos/cm)	NA	60-95	42-105	27-46	35-50
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004-0.006	0.056-0.093	0.006-0.019	0.014-0.024
Carbon tetrachloride (mg/L)	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001	<0.001
Chloroform (mg/L)	0.100*	<0.005	<0.005	<0.005	<0.005
Chloride (mg/L)	250	3.7-5.1	2.9-6.2	3.5-4.5	2.8-4.0
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.17	<0.10-0.12	<0.10-0.13	<0.10-0.41
Iron (mg/L)	0.3	<0.004-0.026	0.006-0.019	0.007-0.052	0.007-0.031
Mercury (mg/L)	0.002	<0.0002	<0.0002-0.0003	<0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002	0.030-0.046	0.002-0.034	0.002-0.005
Sodium (mg/L)	NA	3.80-5.66	3.41-8.74	1.89-3.52	3.98-5.88
Nitrate (as N) (mg/L)	10	1.86-2.22	3.09-10.00	1.10-2.92	2.55-2.94
Lead (mg/L)	0.05	<0.005	<0.005-0.055	<0.005-0.076	<0.005-0.096
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<3.0-6.0	<3.0-6.0	<3.0-5.0	<3.0-6.0
Tetrachloroethylene (mg/L)	NA	<0.005	<0.005	<0.005	<0.005
TOC (mg/L)	NA	1.900-9.90	6.00-23.6	1.80-8.40	<1.00-15.0
TOH (mg/L)	NA	<0.005-0.073	<0.005-0.053	<0.005-0.021	<0.005-0.110
Trichloroethylene (mg/L)	0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-TCE	0.200	<0.005	<0.005	<0.005	<0.005
Gross alpha (pCi/L)	15	1.0	1.0-1.8	1.2-2.0	0.7
Nonvol. beta (pCi/L)	NA	2.0-2.8	4.0-20.1	2.8-5.0	1.2-2.7
Tritium (pCi/mL)	20	223,000-236,364	148,101-181,000	42,591-53,000	4,357-12,200
Total radium (pCi/L)	5	<1.0	<1.0	<1.0-1.0	<1.0-1.0

TABLE 12-7 (cont.)

Constituent	SC and Federal DWS	PSB 5A	PSB 6A	PSB 7A
pH (pH)	6.5-8.5	4.0-5.1	3.9-4.4	5.8-7.6
Conductivity (μmhos/cm)	NA	24-35	77-155	72-105
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004-0.005	0.004-0.007	0.004-0.007
Carbon tetrachloride (mg/L)	0.005	<0.005	<0.005	<0.005
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001
Chloroform (mg/L)	0.100*	<0.005	<0.005	<0.005
Chloride (mg/L)	250	1.2-2.8	3.5-5.7	3.5-5.3
Chromium (mg/L)	0.05	<0.004-0.005	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.19	<0.10-0.14	<0.10-0.19
Iron (mg/L)	0.3	0.009-0.048	0.008-0.041	0.006-0.032
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002-0.0002
Manganese (mg/L)	0.05	<0.002-0.002	<0.002-0.002	<0.002
Sodium (mg/L)	NA	1.94-2.96	13.30-32.10	6.02-10.20
Nitrate (as N) (mg/L)	10	1.85-2.30	7.20-15.00	2.27-4.80
Lead (mg/L)	0.05	0.007-0.129	<0.005-0.058	<0.005
Phenols (mg/L)	NA	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<3.0-3.0	<3.0-10.0	<3.0-7.0
Tetrachloroethylene (mg/L)	NA	<0.005	<0.005	<0.005
TOC (mg/L)	NA	<1.000-5.620	<1.000-10.500	1.000-11.500
TOH (mg/L)	NA	<0.005-0.008	<0.005-0.088	<0.005-0.116
Trichloroethylene (mg/L)	0.005	<0.005	<0.005	<0.005
1,1,1-TCE (mg/L)	0.200	<0.005	<0.005	<0.005
Gross alpha (pCi/L)	15	<1.0	1.0-1.4	1.0
Nonvol. beta (pCi/L)	NA	<1.0-1.7	2.0-4.5	1.0
Tritium (pCi/mL)	20	31-36	152,000-206,263	29,463-43,600
Total radium (mg/L)	5	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 12-8

Radioactivity in the P-Area Reactor Seepage Basins Wells (Annual Averages)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
PSB 1						
1978	0.44	0.99	2.60	5.50	350	480
1979	0.38	0.67	3.50	7.80	21,000	49,000
1980	0.55	1.20	6.50	13.00	140,000	180,000
1981	0.60	0.99	3.30	11.00	260,000	280,000
1982	0.85	1.70	10.00	22.00	240,000	290,000
1983	0.32	0.88	1.90	3.80	32,000	48,000
PSB 1A						
1984	0.17	0.29	0.47	1.30	99,000	130,000
1985	0.41	0.52	1.10	2.10	320,000	370,000
1986	0.09	0.29	2.20	3.40	180,000	270,000
PSB 2						
1978	0.94	1.60	7.50	12.00	240	260
1979	1.10	1.90	19.00	26.00	120,000	150,000
1980	1.90	3.00	24.00	42.00	160,000	190,000
1981	1.30	1.50	13.00	26.00	180,000	200,000
1982	1.20	2.20	15.00	17.00	220,000	280,000
1983	1.30	2.00	12.00	15.00	130,000	150,000
PSB 2A						
1984	0.63	1.20	14.00	29.00	120,000	150,000
1985	0.64	0.73	69.00	86.00	170,000	200,000
1986	0.66	0.87	7.70	15.00	160,000	160,000
PSB 3						
1978	0.81	0.99	3.50	7.00	140	260
1979	0.50	0.82	0.29	2.70	100,000	240,000
1980	1.20	2.20	3.00	5.60	150,000	230,000
1981	0.38	0.41	0.88	1.20	160,000	190,000
1982	0.44	0.99	4.40	8.90	170,000	190,000
1983	0.23	0.67	1.00	2.60	120,000	170,000

TABLE 12-8 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
PSB 3A						
1984	0.65	1.50	1.60	2.20	140,000	160,000
1985	0.98	1.40	2.00	2.80	130,000	140,000
1986	0.68	0.97	1.80	2.60	49,000	74,000
PSB 4						
1978	0.44	0.82	5.10	5.60	4	5
1979	0.23	0.50	1.50	5.00	44	59
1980	0.51	1.20	1.20	2.50	52	70
1981	0.16	0.24	0.84	1.60	26	31
1982	0.70	1.20	0.14	8.60	34	50
1983	0.31	0.73	0.23	1.10	22	32
PSB 4A						
1984	0.22	0.29	0.97	1.40	91	180
1985	0.50	0.58	1.30	2.80	61	61
1986	0.45	0.62	1.50	2.40	3,400	7,600
PSB 5						
1978	0.22	0.66	2.00	3.00	28	29
1979	0.81	1.80	0.35	2.30	49	64
1980	0.66	1.50	1.30	7.50	1,900	1,600
1981	0.63	0.66	1.50	6.00	32	37
1982	0.50	1.10	3.00	7.10	37	55
1983	0.64	1.20	2.70	5.50	1,300	4,700
PSB 5A						
1984	0.24	0.39	0.80	1.50	1,200	3,100
1985	0.46	0.67	0.64	1.10	49	59
1986	0.46	0.68	0.63	1.20	40	46
PSB 6						
1978	0.39	0.75	0.23	4.00	15,000	20,000
1979	0.19	0.75	0.34	2.50	50,000	88,000
1980	0.41	0.82	0.06	3.30	160,000	230,000
1981	0.24	0.41	2.00	2.00	270,000	290,000
1982	0.35	0.58	2.50	6.90	190,000	290,000
1983	0.45	0.76	1.90	4.50	210,000	240,000

TABLE 12-8 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
PSB 6A						
1984	0.92	1.80	3.50	5.00	170,000	200,000
1985	0.62	0.77	3.00	5.20	170,000	190,000
1986	0.51	0.98	2.20	3.30	190,000	210,000
PSB 7						
1978	0.47	1.10	3.10	5.20	180	300
1979	0.33	0.42	0.80	2.30	110,000	210,000
1980	0.53	1.50	1.90	7.00	130,000	180,000
1981	0.41	0.49	4.40	0.00	160,000	160,000
1982	0.41	0.99	0.90	4.90	140,000	160,000
1983	0.30	0.58	1.30	2.00	76,000	110,000
PSB 7A						
1984	0.03	0.10	1.10	2.40	68,000	110,000
1985	0.31	0.41	2.00	2.90	150,000	210,000
1986	0.17	0.31	0.48	1.20	53,000	70,000

Note: Data are from SRS annual reports.

TABLE 12-9

Calculated Annual Discharges from Cation and Anion Exchange Units for the P-Area Acid/Caustic Basin

Calculated Annual Discharges from Cation Exchange Units

Acid Wastewater Volume (m^3/yr)	Conc. Wt. % H_2SO_4	Total Excess H_2SO_4 (kg)	Total Cations (kg)
2,600	0.13	3,800	2,500

Calculated Annual Discharges from Anion Exchange Units

Basic Wastewater Volume (m^3/yr)	Conc. Wt. % NaOH	Total Excess NaOH (kg)	Total Anions (kg)
3,600	0.32	12,700	2,700

Note: Data, from Ward et al. (1987), are for 1974 and are representative of the total period. Values were calculated using assumed resin performance.

TABLE 12-10

Selected Surface Water Chemical Analyses for the P-Area Acid/Caustic Basin

Parameter	Unit	Results
pH	SU	4.5
Calcium	mg/L	7.77
Chloride	mg/L	6.80
Dissolved organic carbon	mg/L	1.14
Fluoride	mg/L	<0.1
Iron	mg/L	0.484
Mercury	mg/L	0.00025
Potassium	mg/L	1.08
Magnesium	mg/L	0.706
Sodium	mg/L	8.01
Nitrate	mg/L	<0.5
Sulfate	mg/L	30
Odor	TON	0
Total organic carbon	mg/L	14.6
Turbidity	NTU	3
Specific conductance	μmhos/cm	97.2
Surfactants	mg/L	<10
Total organic halogens	mg/L	17

Note: Samples were collected August 1985.

TABLE 12-11

Summary of Sediment and Soil Chemical Analyses for the P-Area Acid/Caustic Basin

Metals	Concentration Range (µg/g)*	EP Toxicity Results (mg/L)	EP Toxicity Standards (mg/L)**
Aluminum	1,950-9,470	---	---
Arsenic	0.27-31.6	0.002	5.0
Barium	4.20-44.1	0.290	100.0
Cadmium	<2.0	0.04	1.0
Chromium	4.20-82.8	0.08	5.0
Copper	<4.0-53.5	---	---
Iron	2,620-46,000	---	---
Lead	7.40-41.60	<0.01	5.0
Magnesium	30-917	---	---
Manganese	9.1-37.2	---	---
Mercury	<0.2-0.39	<0.0002	0.2
Nickel	0.5-4.0	---	---
Selenium	<0.25-1.26	<0.002	1.0
Silver	<2.0	0.205	5.0
Sodium	151-4,100	---	---
Tin	<15.0	---	---
Zinc	44.6-421	---	---
Inorganics			
Boron	<0.25-99.03		
Sulfate	105.5-1,450		
Sulfide	<25.0		
Nitrate	<1.25-3.60		
Nitrite	<0.5-<2.50		
Ammonium	<2.8-11.2		
Fluoride	0.35-15.5		
Chloride	6.0-224.0		
Phosphate	1.3-80.0		
Radioactivity			
Gross alpha	0-66.24 pCi/g		
Nonvolatile beta	Background levels		
Gross gamma	Background levels		

* Concentration range for samples taken at 0-0.5 ft, 0.5-1.0 ft, 1.5-2.0 ft, and 4.5-5.0 ft depth intervals.
** Federal Regulation 40 CFR 261.

TABLE 12-12

Summary of Groundwater Quality: Well Concentration Ranges for the P-Area Acid/Caustic Basin (7/84-12/86)

Constituent	SC and Federal DWS	PAC 1	PAC 2	PAC 3	PAC 4
pH (pH)	6.5-8.5	3.9-5.3	5.0-5.4	4.1-5.5	3.1-5.3
Conductivity (µmhos/cm)	NA	31-60	43-98	116-260	181-300
Silver (mg/L)	0.05	<0.0005	<0.0020	<0.0005	0.0006-0.0046
Arsenic (mg/L)	0.05	<0.001-0.002	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.024-0.036	0.022-0.036	<0.004-0.131	<0.004-0.025
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Carbon tetrachloride (mg/L)	0.005	<0.005	<0.005	<0.005	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.005	<0.005	<0.005	---
Chloride (mg/L)	250	1.9-5.2	5.2-6.8	6.3-20.9	8.7-11.8
Chromium (mg/L)	0.05	<0.004-0.006	<0.004-0.005	<0.004	<0.004
Copper (mg/L)	1	0.005-0.006	<0.004-0.005	<0.004	---
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.0004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.16	<0.10-0.12	<0.10-0.36	<0.10-0.12
Iron (mg/L)	0.3	0.052-0.368	0.042-1.640	<0.004-0.278	0.049-0.173
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002-0.0002
Manganese (mg/L)	0.05	0.006-0.042	0.018-0.040	0.012-0.023	<0.002-0.005
Sodium (mg/L)	NA	2.45-4.89	4.08-11.40	3.10-25.30	20.70-52.62
Nickel (mg/L)	NA	<0.004-0.012	<0.004-0.005	0.008-0.010	<0.004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	<0.50-0.70	<0.50-0.80	<0.50-1.33	<0.50-0.70
Lead (mg/L)	0.05	<0.004-0.014	<0.004	<0.004-0.006	0.004
Phenols (mg/L)	NA	<0.002-0.010	<0.002-0.006	<0.002-0.006	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001-0.006
Sulfate (mg/L)	250	<3.0	6.0-25.0	14.0-88.0	74.0-106.0
Tetrachloroethylene (mg/L)	NA	<0.005	<0.005	<0.005	---
TDS (mg/L)	500	58-64	70	88-108	---
TOC (mg/L)	NA	0.490-3.061	0.870-10.19	0.370-0.491	0.820-2.34
TOH (mg/L)	NA	<0.005-0.016	0.005-0.046	<0.005-0.034	<0.005-0.010
Trichloroethylene (mg/L)	0.005	<0.005	<0.005	<0.005	---
Zinc (mg/L)	5	0.034-0.062	0.072-0.111	0.058-0.099	---
1,1,1-TCE (mg/L)	0.200	<0.005	<0.005	<0.005	---
Gross alpha (pCi/L)	15	<2.0	<2.0	<2.0	<2.0-7.0
Nonvol. beta (pCi/L)	NA	2.4-4.0	1.5-3.0	<2.0	<2.0-11.0
Total radium (pCi/L)	5	<1.0	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 12-13

P-Area Coal Pile Runoff Containment Basin Influent Characterization Data

Parameter	Units	Initial	Final	Composite
Time	NA	1245	1724	NA
Temp	°C	23.4	24.2	NA
Flow	gal/min	2-4	<1	NA
pH	pH	2.43	2.49	2.54
Conductivity	µmhos/cm	3,000	3,050	2,830
Sulfate (as SO_4)	mg/L	2,020	1,650	1,750
Total suspended solids	mg/L	155	1	690
Total dissolved solids	mg/L	2,551	2,236	3,217
Phenols	mg/L	0.002	0.002	0.002
Acidity (as $CaCO_3$)	mg/L	450	370	384
Beryllium	mg/L	0.0209	0.0197	0.0205
Cadmium	mg/L	0.019	0.018	0.012
Copper	mg/L	1.09	0.881	1.01
Chromium	mg/L	0.158	0.123	0.176
Iron	mg/L	166	80.8	136
Lead	mg/L	0.0025	<0.001	0.0021
Mercury	mg/L	0.00020	0.00013	0.00025
Nickel	mg/L	0.993	0.722	1.26
Selenium	mg/L	0.0123	0.0068	0.0095
Zinc	mg/L	0.213	0.206	0.194
Aluminum	mg/L	138	116	124
Manganese	mg/L	4.16	3.53	3.78
Magnesium	mg/L	45.3	29.6	29.9
Arsenic	mg/L	0.0258	0.0028	0.0182
Silver	mg/L	<0.001	<0.001	<0.001
Barium	mg/L	<0.03	<0.03	<0.03

Note: Samples were collected in October 1985. NA = not applicable.

TABLE 12-14

Summary of Groundwater Quality: Well Concentration Ranges for the P-Area Coal Pile Runoff Containment Basin (7/84-12/86)

Constituent	SC and Federal DWS	PCB 1A	PCB 2A	PCB 3A	PCB 4A
pH (pH)	6.5-8.5	3.9-5.2	4.0-4.9	3.3-3.9	3.6-4.5
Conductivity (µmhos/cm)	NA	88-595	39-66	410-2,600	62-95
Silver (mg/L)	0.05	<0.0005	<0.0005	0.0016-0.0040	<0.0005
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.027-0.098	0.010-0.030	0.018-0.037	0.010-0.014
Beryllium (mg/L)	NA	<0.002	<0.002	0.012-0.012	<0.002
Carbon tetrachloride (mg/L)	0.005	<0.005	<0.005	---	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002-0.019	<0.002
Chloroform (mg/L)	0.100*	<0.005	<0.005	---	---
Chloride (mg/L)	250	6.4-7.5	4.9-8.6	1.7-3.2	5.3-8.1
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004-0.014	<0.004
Copper (mg/L)	1	<0.004-0.012	<0.004-0.019	0.060-0.572	0.005-0.017
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	<0.005
DOC (mg/L)	NA	<5.0-9.0	<5.0	<5.0	<5.0
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.37	<0.10-0.12	0.84-1.11	<0.10-0.20
Iron (mg/L)	0.3	0.106-7.390	0.040-0.482	0.120-25.900	0.031-0.626
Mercury (mg/L)	0.002	<0.0002-0.0005	<0.0002-0.0005	<0.0002-0.0006	<0.0002-0.0002
Manganese (mg/L)	0.05	0.213-7.150	0.016-0.096	1.060-5.780	0.065-0.081
Sodium (mg/L)	NA	3.77-6.46	3.70-6.40	2.32-6.90	3.66-8.72
Nickel (mg/L)	NA	<0.004-0.110	<0.004	0.435-0.858	0.005-0.008
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	<0.50	<0.50	<0.50-1.43	<0.50
Lead (mg/L)	0.05	<0.005-0.024	0.009-0.026	<0.005-0.142	0.014-0.093
Phenols (mg/L)	NA	<0.002	<0.002-0.004	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001-0.008	<0.001
Sulfate (mg/L)	250	<5.0-260.0	<3.0-15.0	410.0-3,400	<5.0-38.0
Tetrachloroethylene (mg/L)	NA	<0.005	<0.005	---	---
TDS (mg/L)	500	214-398	46-68	78-1,276	44-182
TOC (mg/L)	NA	0.840-5.900	<1.000-9.540	1.000-9.000	0.610-2.294
TOH (mg/L)	NA	<0.005-0.029	<0.005-0.023	<0.005-0.020	0.006-0.038
Trichloroethylene (mg/L)	0.005	<0.005	<0.005	---	---
Zinc (mg/L)	5	0.046-0.290	0.034-0.064	0.653-1.620	0.042-0.061
1,1,1-TCE (mg/L)	0.200	<0.005	<0.005	---	---
Gross alpha (pCi/L)	15	<2.0-3.0	<2.0	<2.0-45.0	<2.0-3.0
Nonvol. beta (pCi/L)	NA	<3.0-8.0	<3.0	4.0-17.0	<3.0-3.0
Total radium (pCi/L)	5	<1.0-2.0	<1.0	2.0-6.0	<1.0-2.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 12-15

Trace Elements in Different Types of Ash

Element	Ash Type (mg/L) Fly Ash (Electrostatic Precipitator)	Fly Ash (Mechanical Collector)	Bottom Ash
Barium	889	792	808
Strontium	579	589	333
Manganese	352	275	811
Zinc	280	116	95
Vanadium	218	166	140
Cerium	189	251	150
Chromium	171	140	160
Arsenic	164	55	4
Copper	130	93	67
Nickel	89	87	77
Gallium	72	32	20
Lanthanum	69	61	61
Cobalt	67	47	40
Lead	60	28	5
Bromine	47	12	3
Scandium	32	28	20
Thorium	23	24	25
Antimony	19	6	3
Molybdenum	18	11	7
Beryllium	16	12	9
Samarium	15	13	12
Selenium	15	6	3
Cesium	14	13	10
Uranium	13	8	8
Europium	11	12	8
Ytterbium	12	8	10
Terbium	2.5	2.1	2
Mercury	0.84	0.33	0.08
Cadmium	0.71	0.39	0.5

Note: Data were collected in 1977. Source: Christensen and Gordon (1983).

TABLE 12-16

Trace Metal Analysis of 488-D Ash Basin Sludge Sample Extracts

Metal	Ash Basin Sludge (mg/L)	EPA Extract Level Limit (mg/L)
Chromium	<0.002	5.0
Cadmium	<0.001	1.0
Barium	1	100.0
Silver	<0.001	5.0
Mercury	<0.01	0.2
Lead	<0.002	5.0
Arsenic	<0.01	5.0
Selenium	<0.01	1.0

Note: Data, from Christensen and Gordon (1983), were collected in January 1980.

TABLE 12-17

Estimated Radionuclide Inventory in the P-Area Bingham Pump Outage Pit

Radionuclide	At Burial (Ci)	Decay Corrected through 12/31/85 (mCi)
^{60}Co	0.172	5
^{90}Sr	0.112	60
$^{103,106}Ru$	0.130	1.0E-06
^{137}Cs	0.414	220
^{147}Pm	0.172	0.1

Note: Data are from Pekkala et al. (1987a).

TABLE 12-18

Radioactivity in Vegetation at the P-Area Bingham Pump Outage Pit Versus Radioactivity in Vegetation at Plant Boundary

Alpha (pCi/g)				Nonvolatile Beta (pCi/g)			
Pit		Plant Boundary		Pit		Plant Boundary	
Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
0.4	0.6	0.2	0.6	23	27	21	31

Note: Data are from Pekkala et al. (1987a).

TABLE 12-19

Summary of Groundwater Quality: Well Concentration Ranges for the P-Area Burning/Rubble Pit (7/84-12/86)

Constituent	SC and Federal DWS	PRP 1A	PRP 2	PRP 3	PRP 4
pH (pH)	6.5-8.5	4.2-4.9	3.6-5.1	4.2-4.8	3.9-4.7
Conductivity (µmhos/cm)	NA	25-46	20-40	80-140	27-47
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.063-0.123	0.015-0.022	0.061-0.102	0.021-0.034
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Carbon tetrachloride (mg/L)	0.005	<0.001	0.004	<0.005	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	<0.001	<0.005-0.048	<0.001
Chloride (mg/L)	250	2.5-4.3	2.5-3.8	15.0-21.4	2.4-3.5
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	0.020-0.024	0.011-0.023	0.008-0.027	0.012
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.28	<0.10-0.20	<0.10-0.20	<0.10-0.13
Iron (mg/L)	0.3	0.055-0.362	<0.004-0.098	0.092-0.800	<0.004-0.100
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002-0.0003	<0.0002-0.0003
Manganese (mg/L)	0.05	0.004-0.033	0.003-0.005	0.037-0.073	<0.002-0.006
Sodium (mg/L)	NA	2.33-2.98	1.58-2.16	8.70-12.50	1.79-2.31
Nickel (mg/L)	NA	<0.004-0.010	<0.004-0.007	0.006-0.020	<0.004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	1.70-1.85	0.85-1.40	1.45-1.73	1.50-1.66
Lead (mg/L)	0.05	0.022-0.080	0.006-0.031	0.035-0.052	<0.005-0.024
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0-5.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.001-0.002	<0.001-0.002	0.055-0.065	<0.001
TDS (mg/L)	500	34-46	24-36	40-42	---
TOC (mg/L)	NA	0.840-8.000	0.460-5.500	1.880-3.000	0.276-3.700
TOH (mg/L)	NA	<0.005-0.008	0.002-0.041	0.161-0.917	<0.005-0.010
Trichloroethylene (mg/L)	0.005	<0.001-0.002	<0.001-0.002	0.073-0.080	<0.001
Zinc (mg/L)	5	0.035-0.037	0.020-0.028	0.017-0.047	---
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	0.524-0.702	<0.001
Gross alpha (pCi/L)	15	<2.0-4.0	1.3	1.9-13.0	<2.0-7.0
Nonvol. beta (pCi/L)	NA	<3.0-7.0	<3.0-3.0	<3.0-16.0	<3.0-8.0
Total radium (pCi/L)	5	<1.0	<1.0	<1.0-4.0	<1.0-2.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

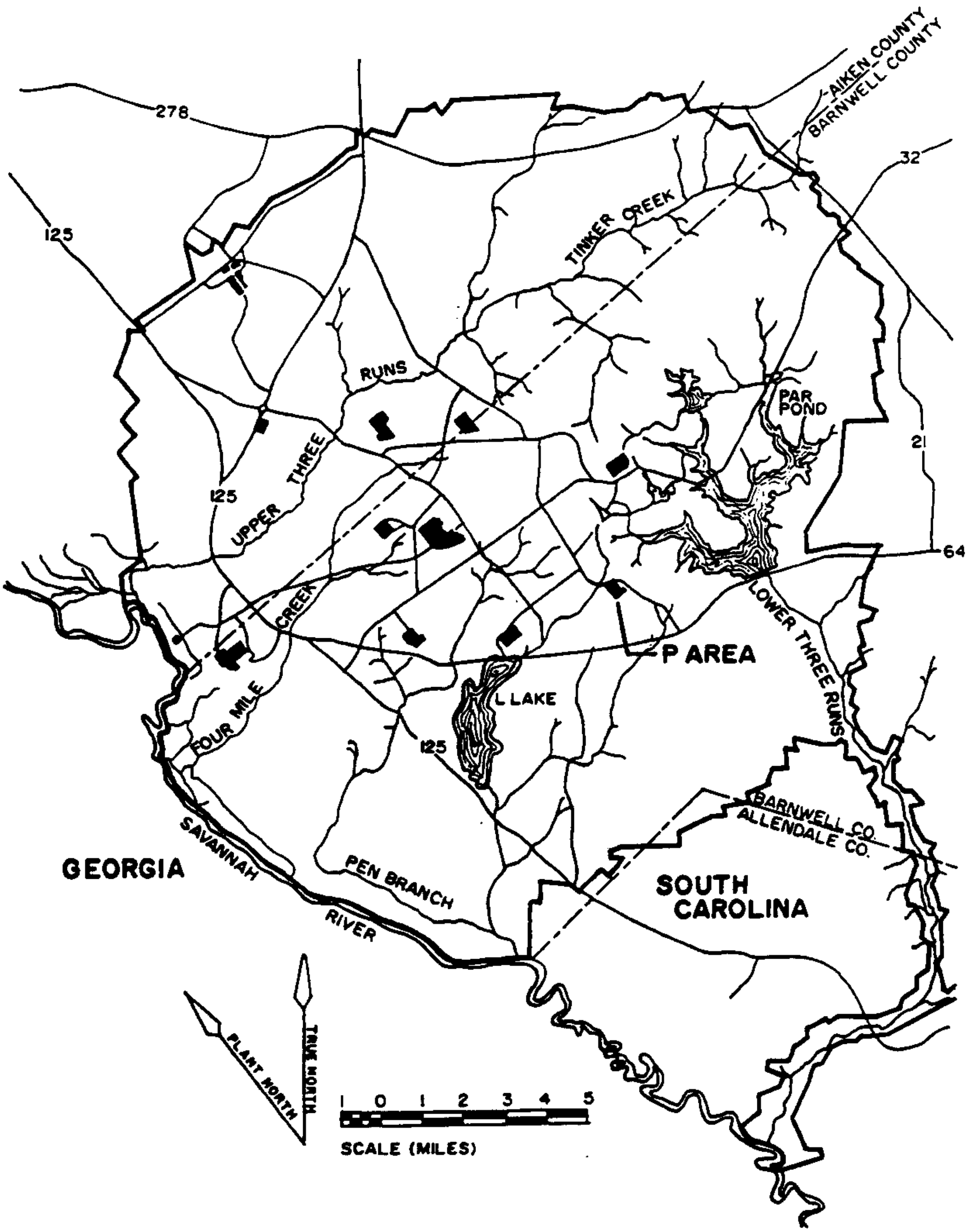


FIGURE 12-1. Location of P Area at SRS

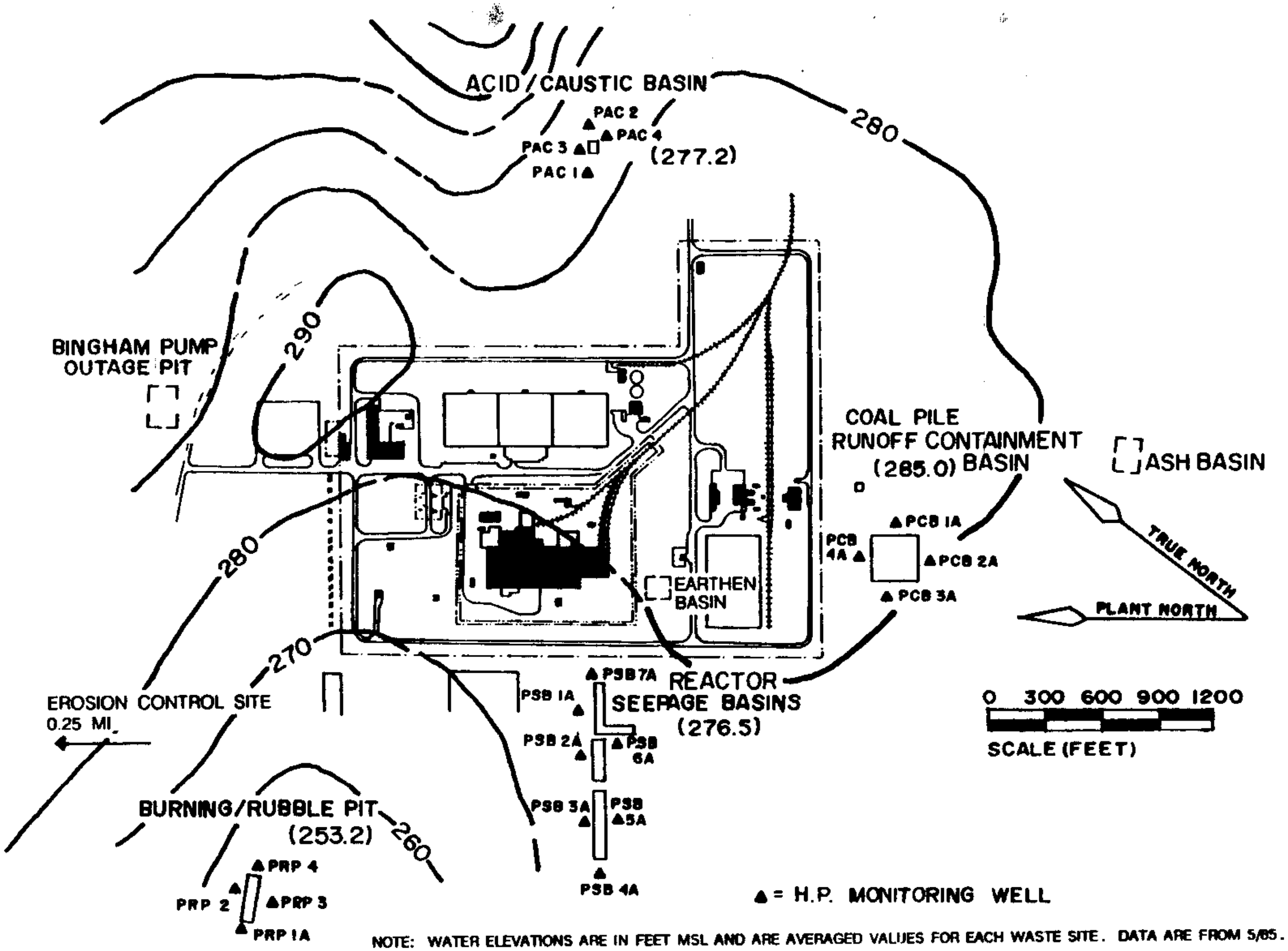


FIGURE 12-2. P-Area Water-Table Elevation Map

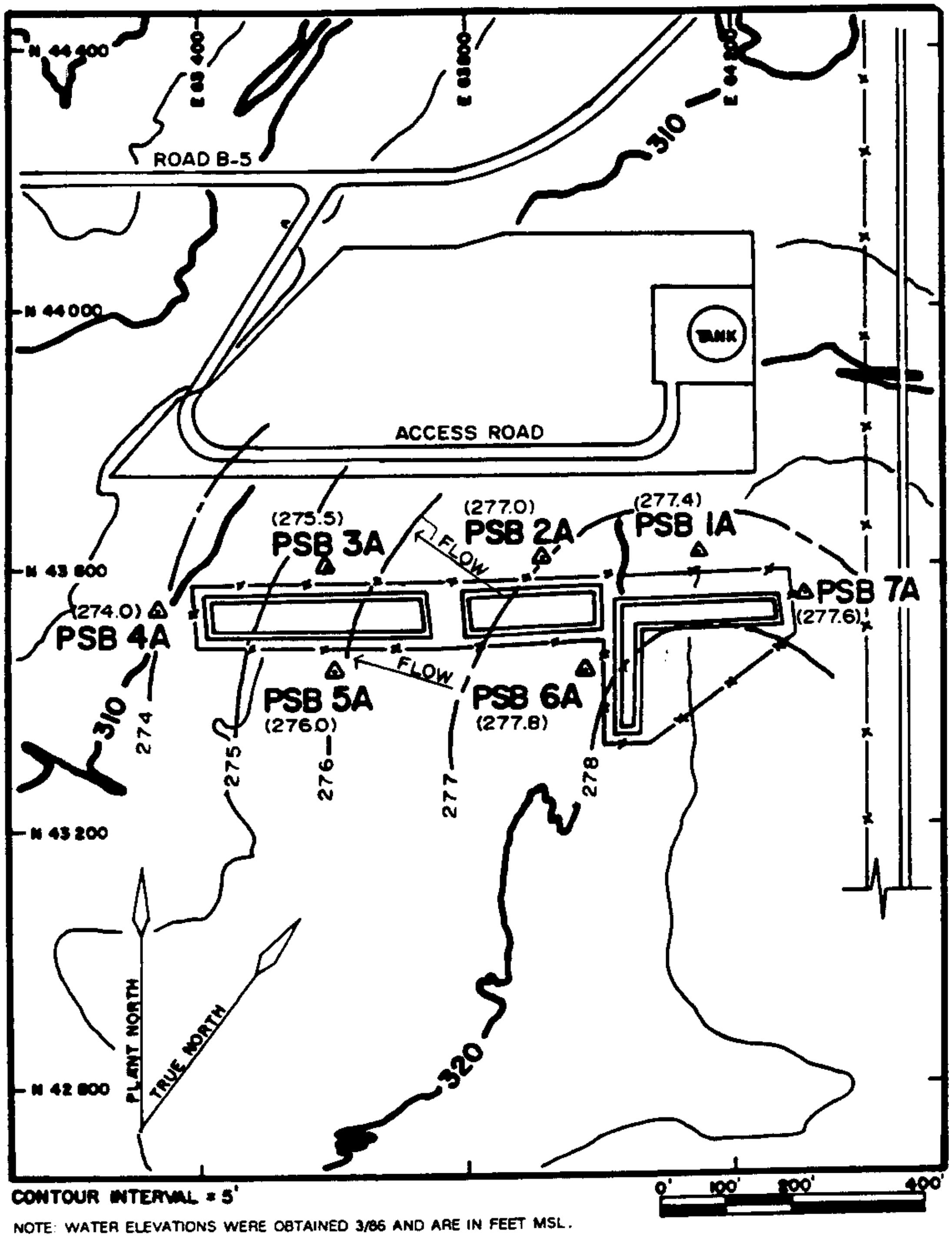


FIGURE 12-3. P-Area Reactor Seepage Basins Water-Table Elevation Map

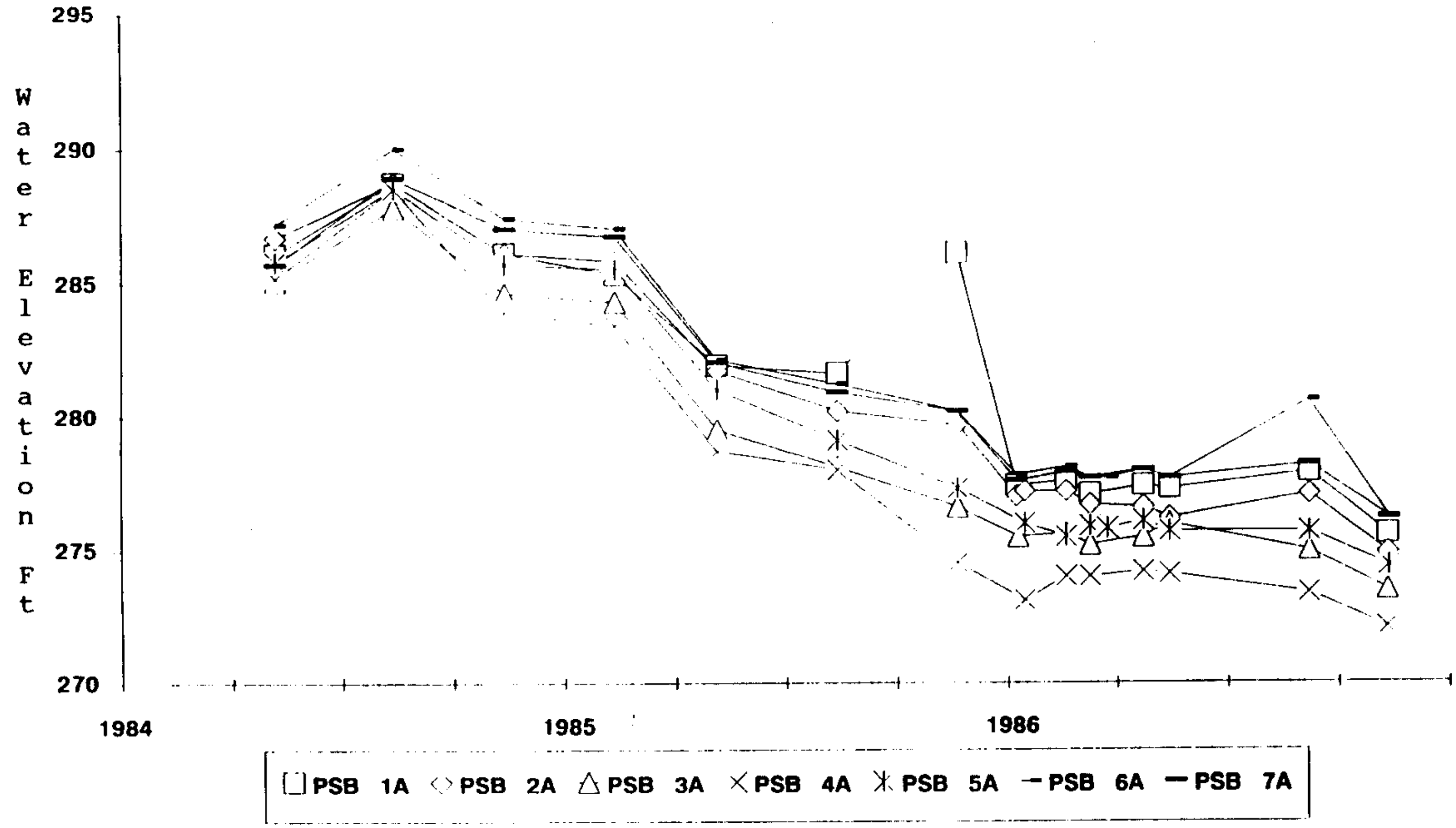


FIGURE 12-4. Hydrograph of the P-Area Reactor Seepage Basins Wells

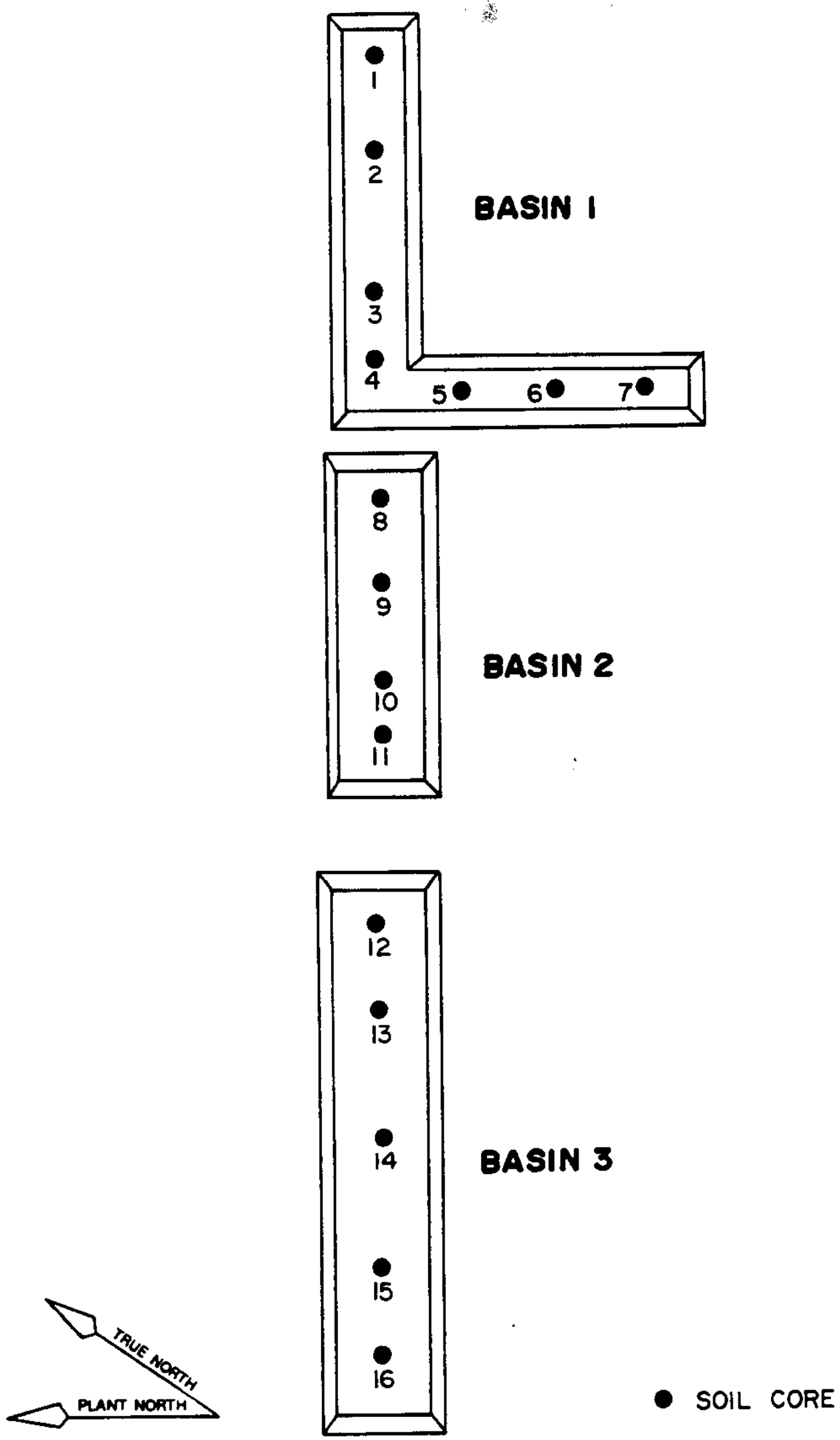


FIGURE 12-5. Soil Sampling Locations at the P-Area Reactor Seepage Basins

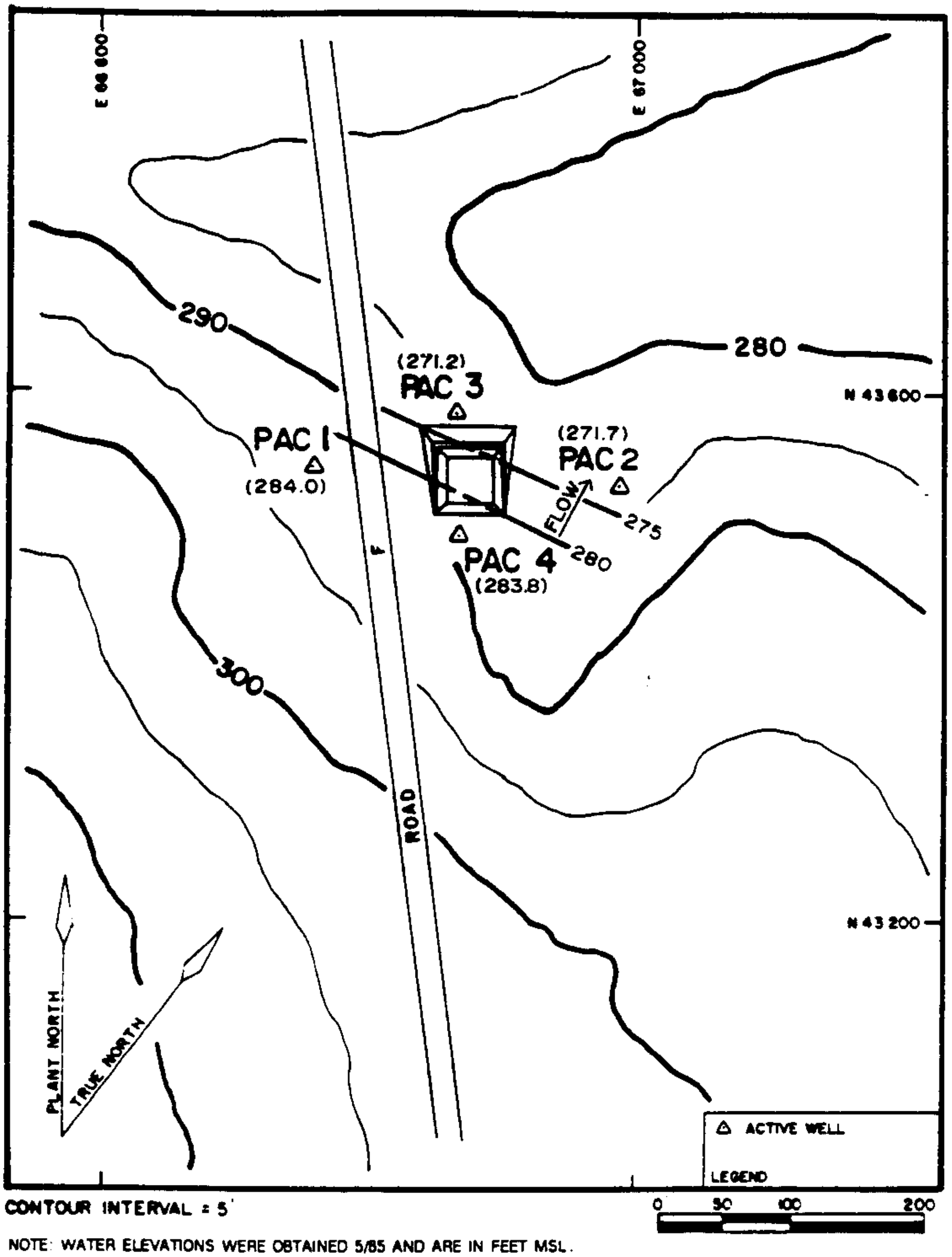


FIGURE 12-6. P-Area Acid/Caustic Basin Water-Table Elevation Map

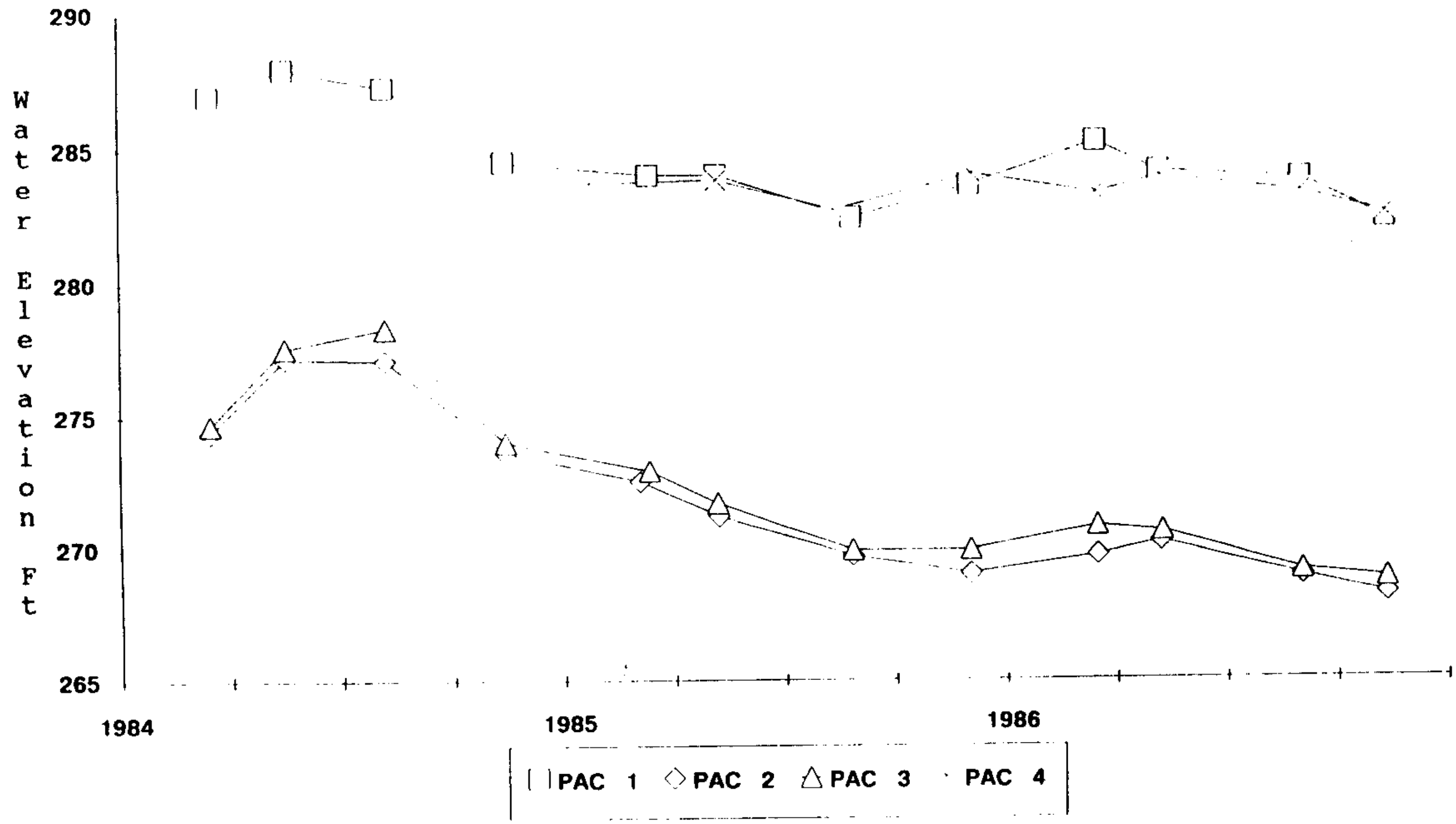


FIGURE 12-7. Hydrograph of the P-Area Acid/Caustic Basin Wells

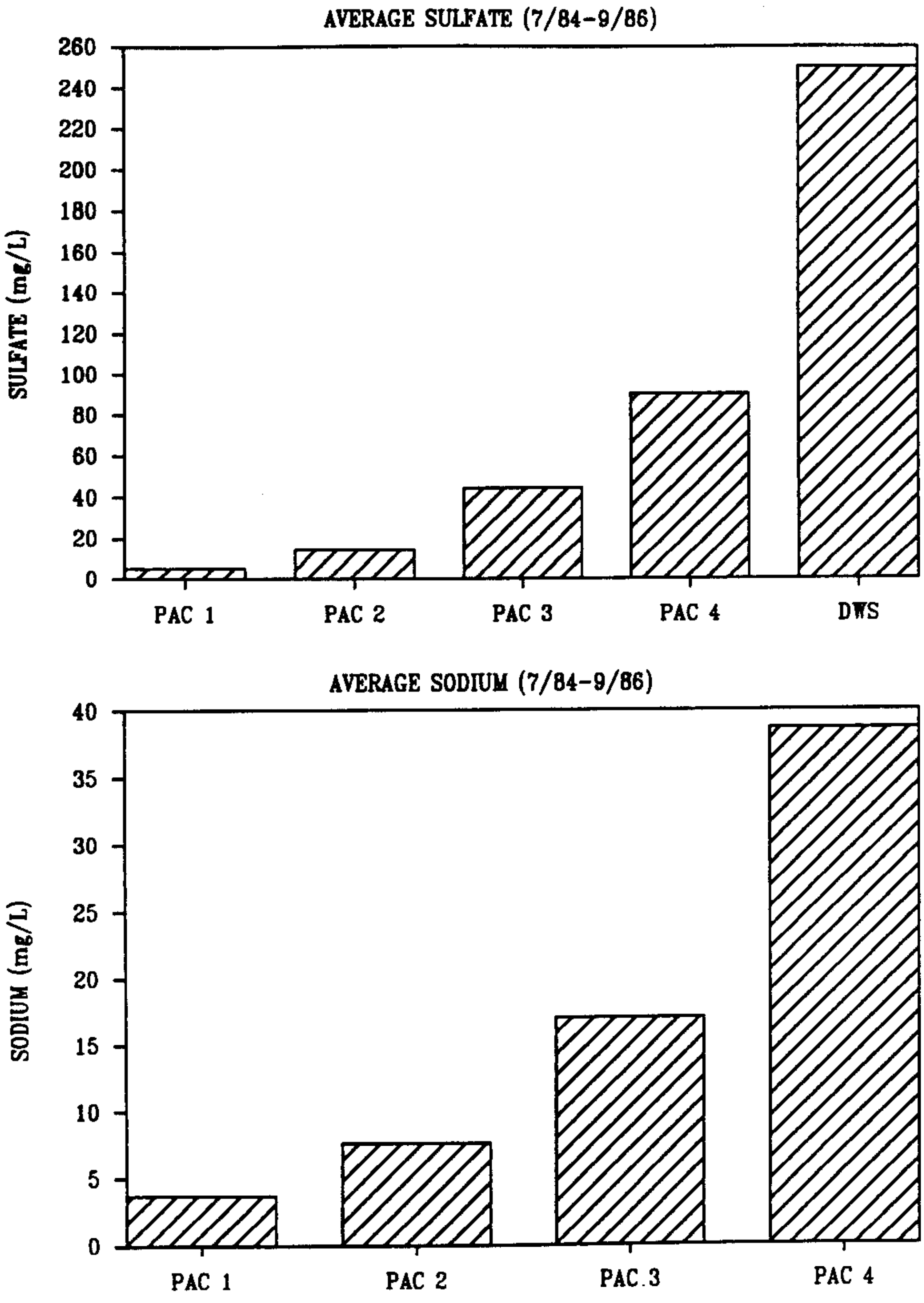


FIGURE 12-8. Average Sulfate and Sodium Concentrations in the P-Area Acid/Caustic Basin Wells

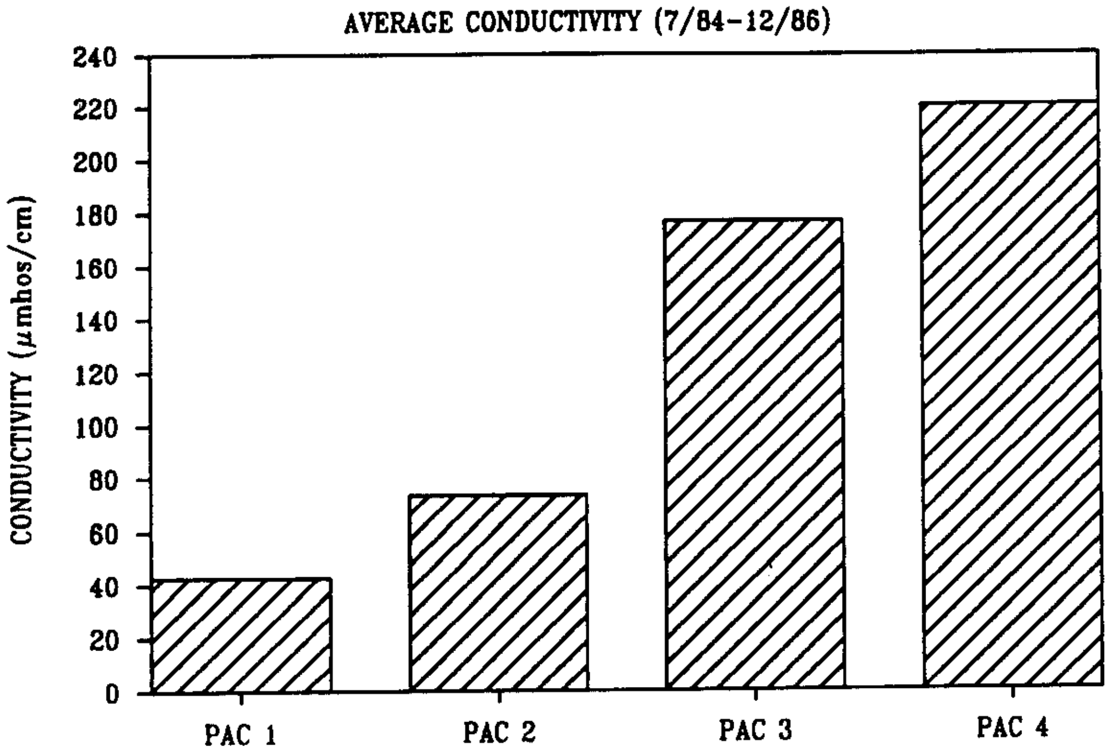
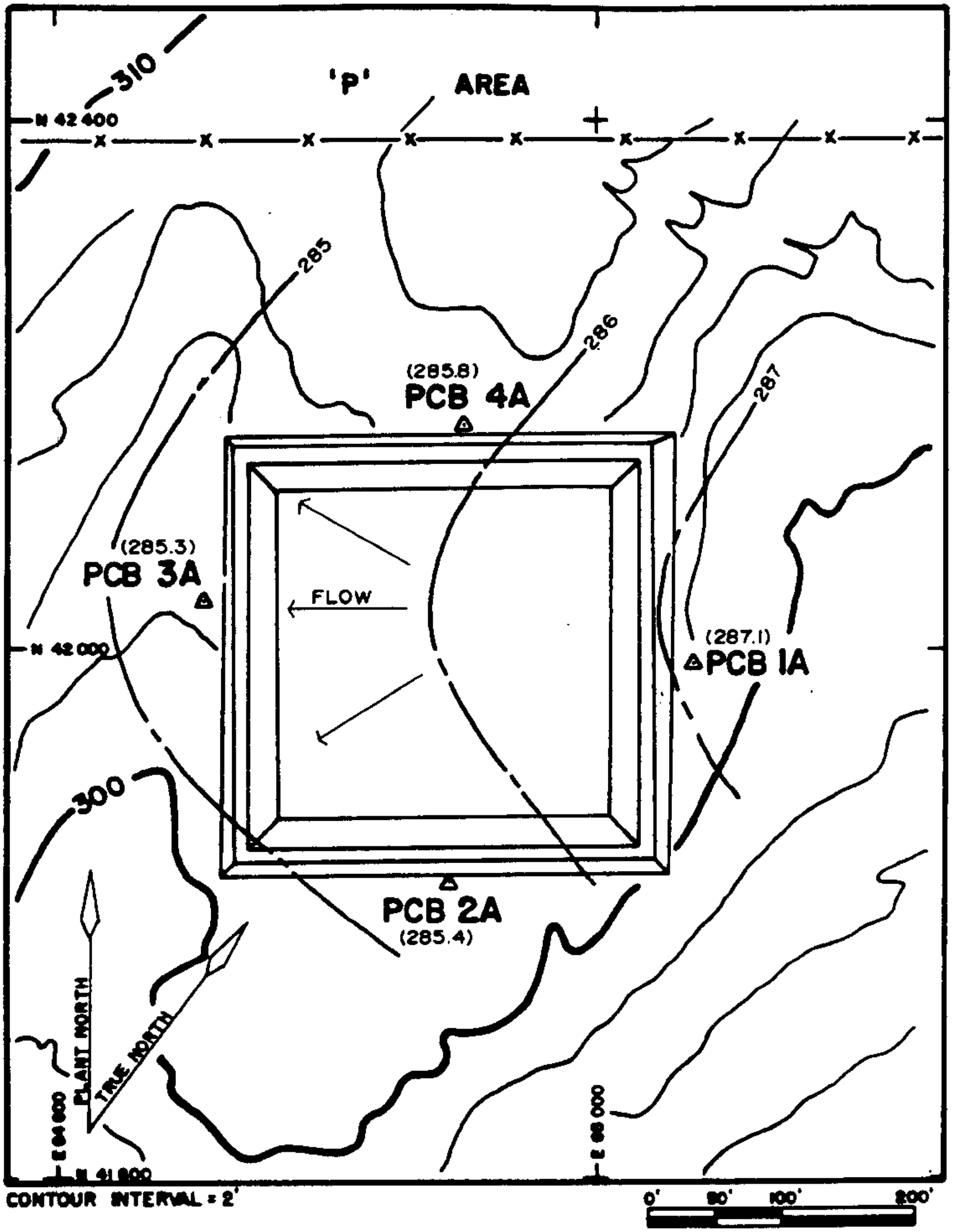


FIGURE 12-9. Average Conductivity in the P-Area Acid/Caustic Basin Wells



NOTE: WATER ELEVATIONS WERE OBTAINED 5/85 AND ARE IN FEET MSL.

FIGURE 12-10. P-Area Coal Pile Runoff Containment Basin (CPRB) Water-Table Elevation Map

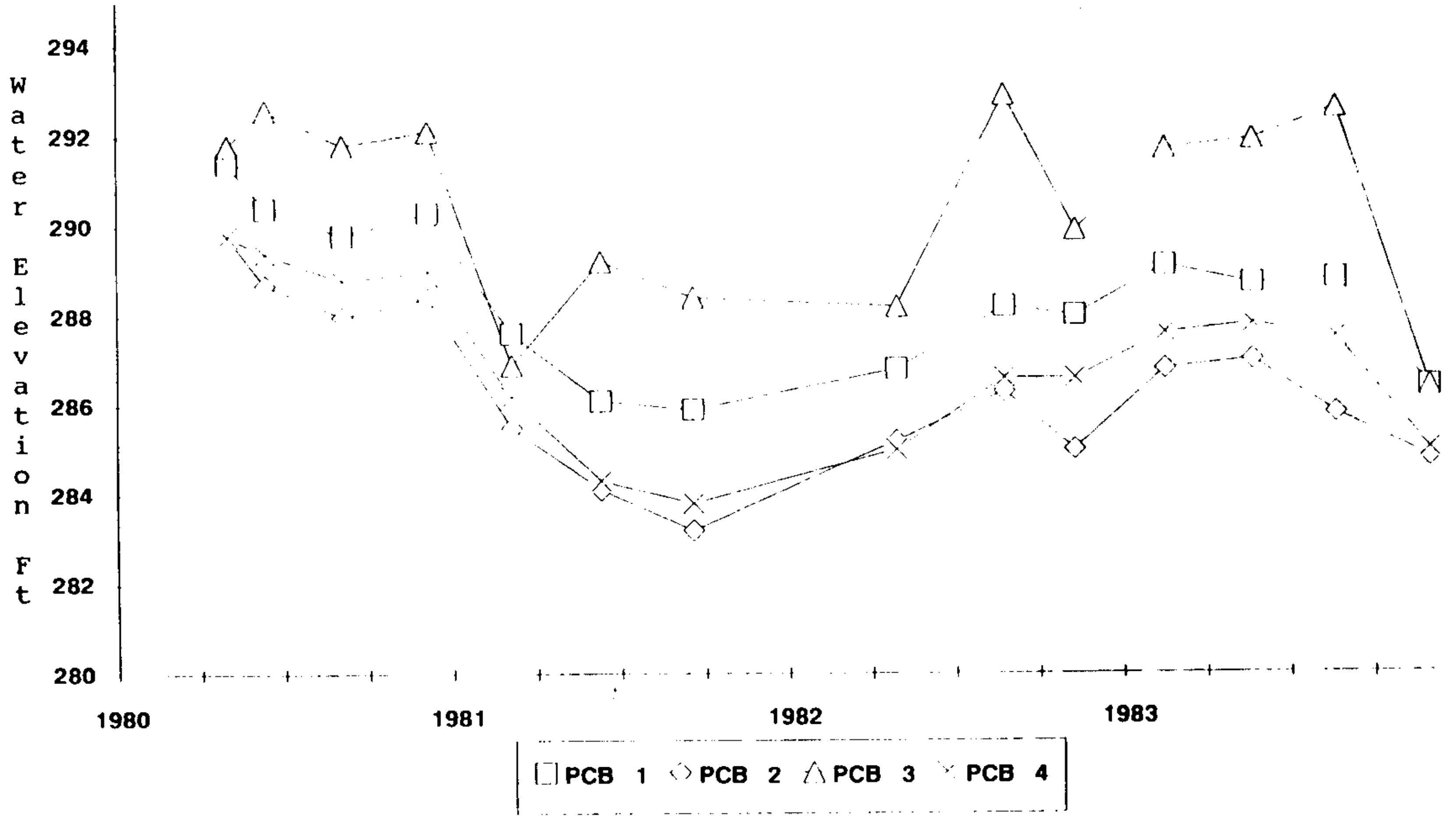


FIGURE 12-11. Hydrograph of the P-Area Coal Pile Runoff Containment Basin (CPRB) Wells

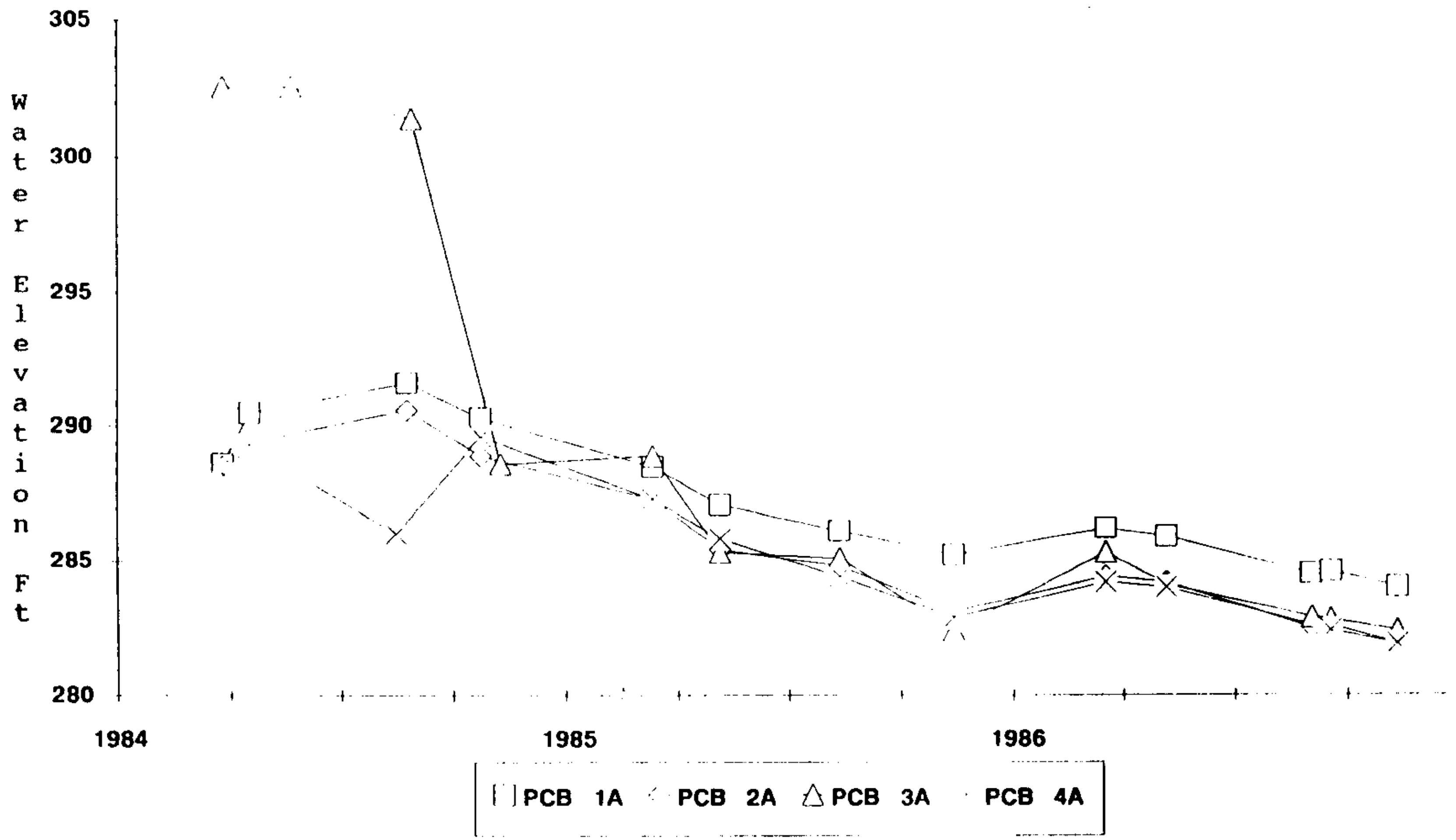


FIGURE 12-11 (cont.). Hydrograph of the P-Area Coal Pile Runoff Containment Basin (CPRB) Wells

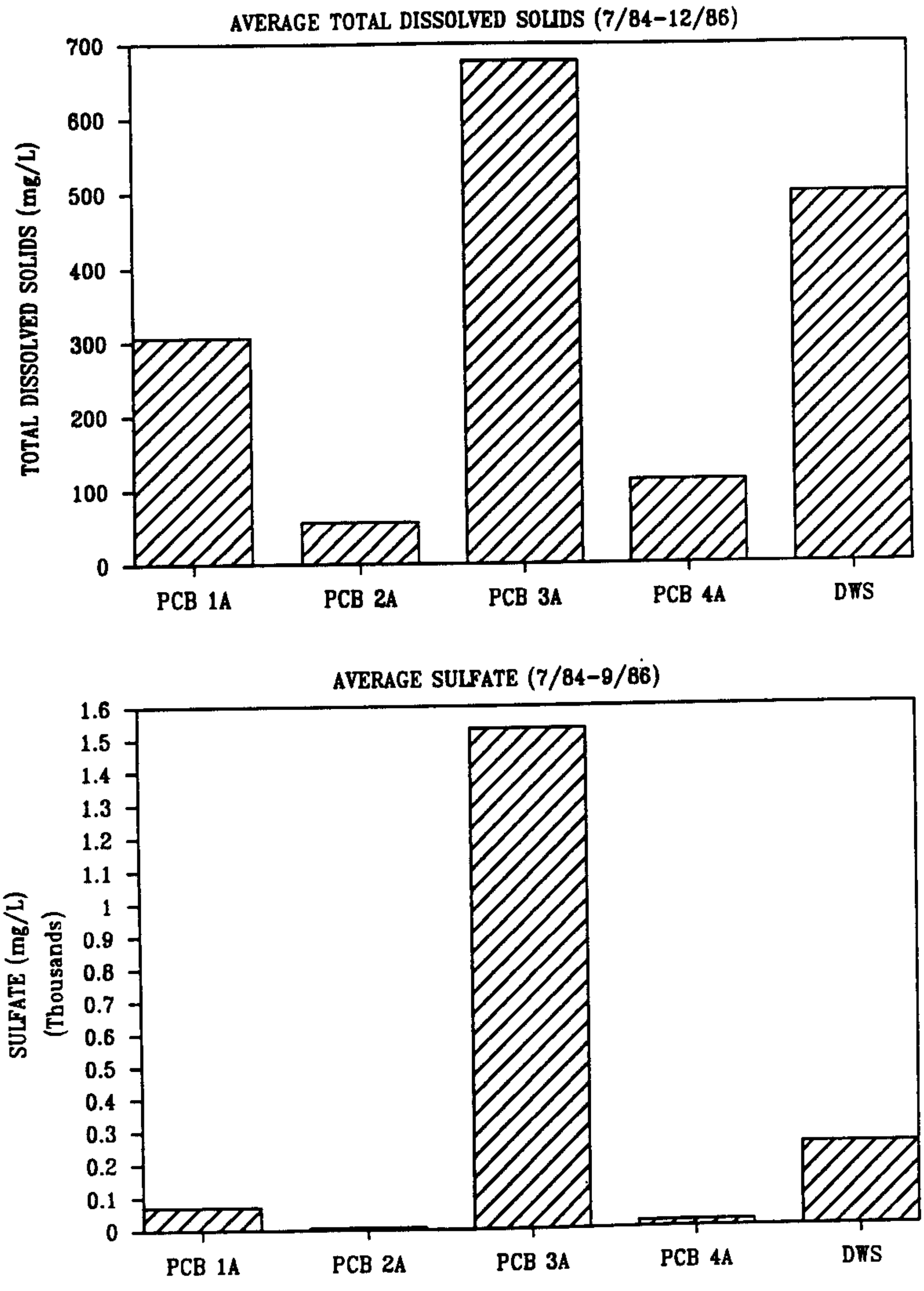


FIGURE 12-12. Average Total Dissolved Solids (TDS) and Sulfate Concentrations in the P-Area Coal Pile Runoff Containment Basin (CPRB) Wells

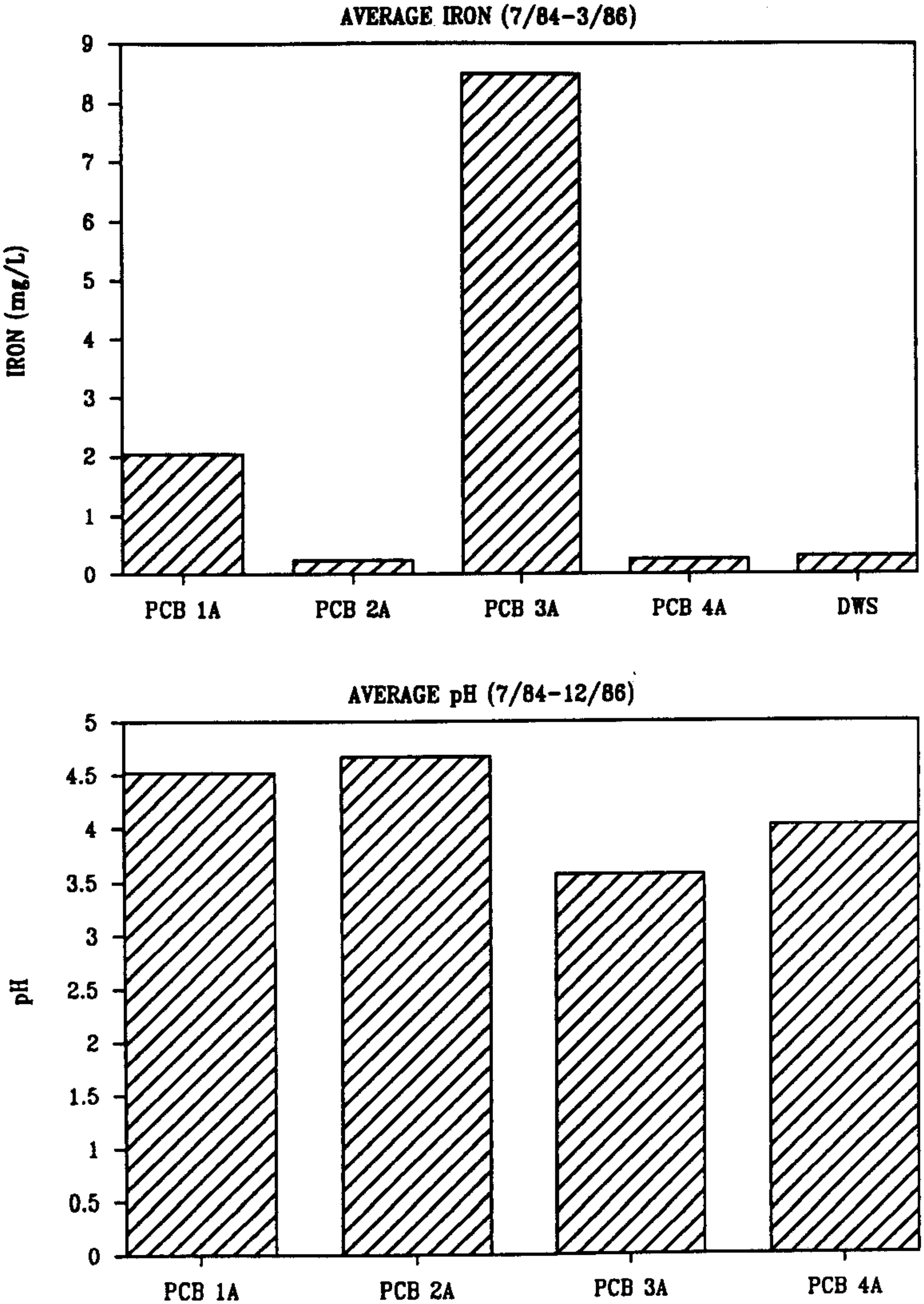


FIGURE 12-13. Average Iron Concentrations and pH in the P-Area Coal Pile Runoff Containment Basin (CPRB) Wells

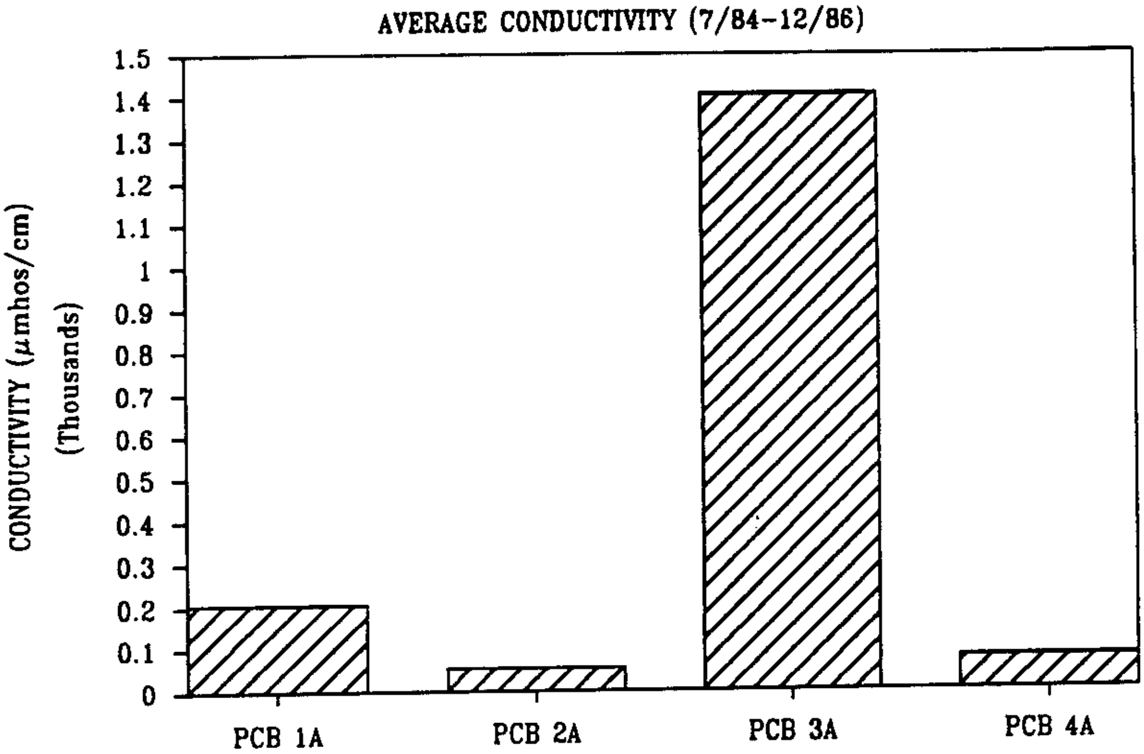


FIGURE 12-14. Average Conductivity in the P-Area Coal Pile Runoff Containment Basin (CPRB) Wells

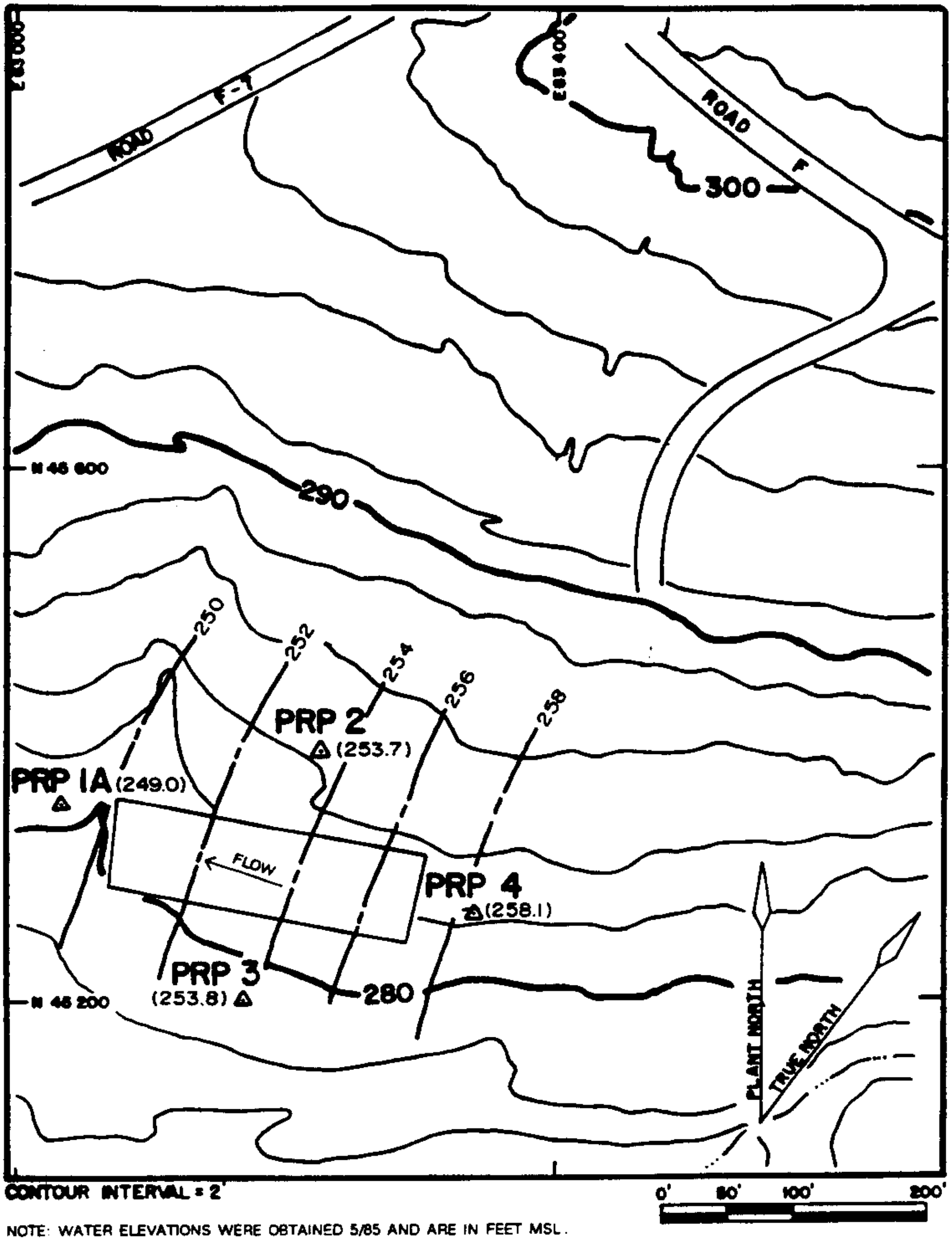


FIGURE 12-15. P-Area Burning/Rubble Pit Water-Table Elevation Map

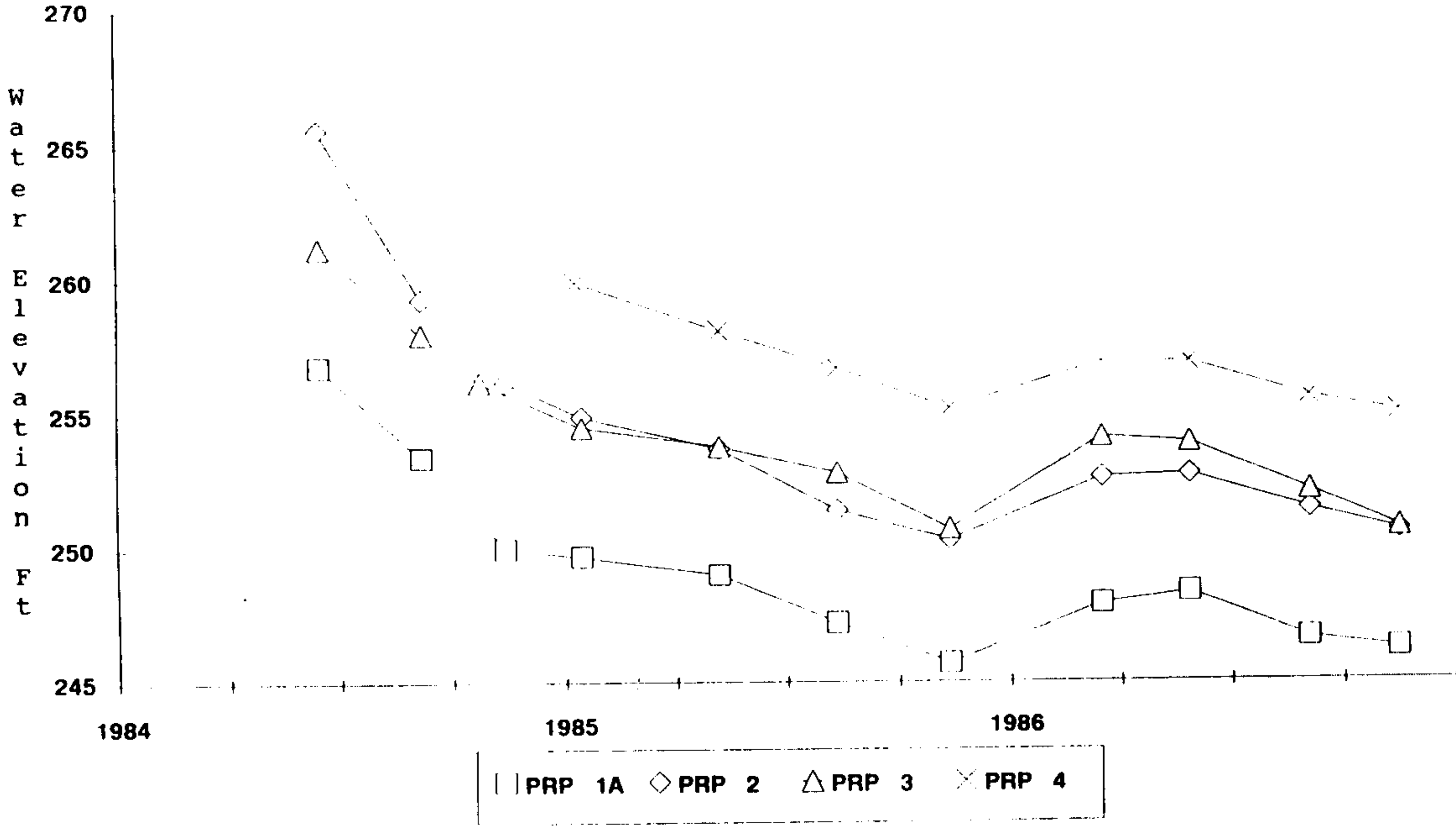


FIGURE 12-16. Hydrograph of the P-Area Burning/Rubble Pit Wells

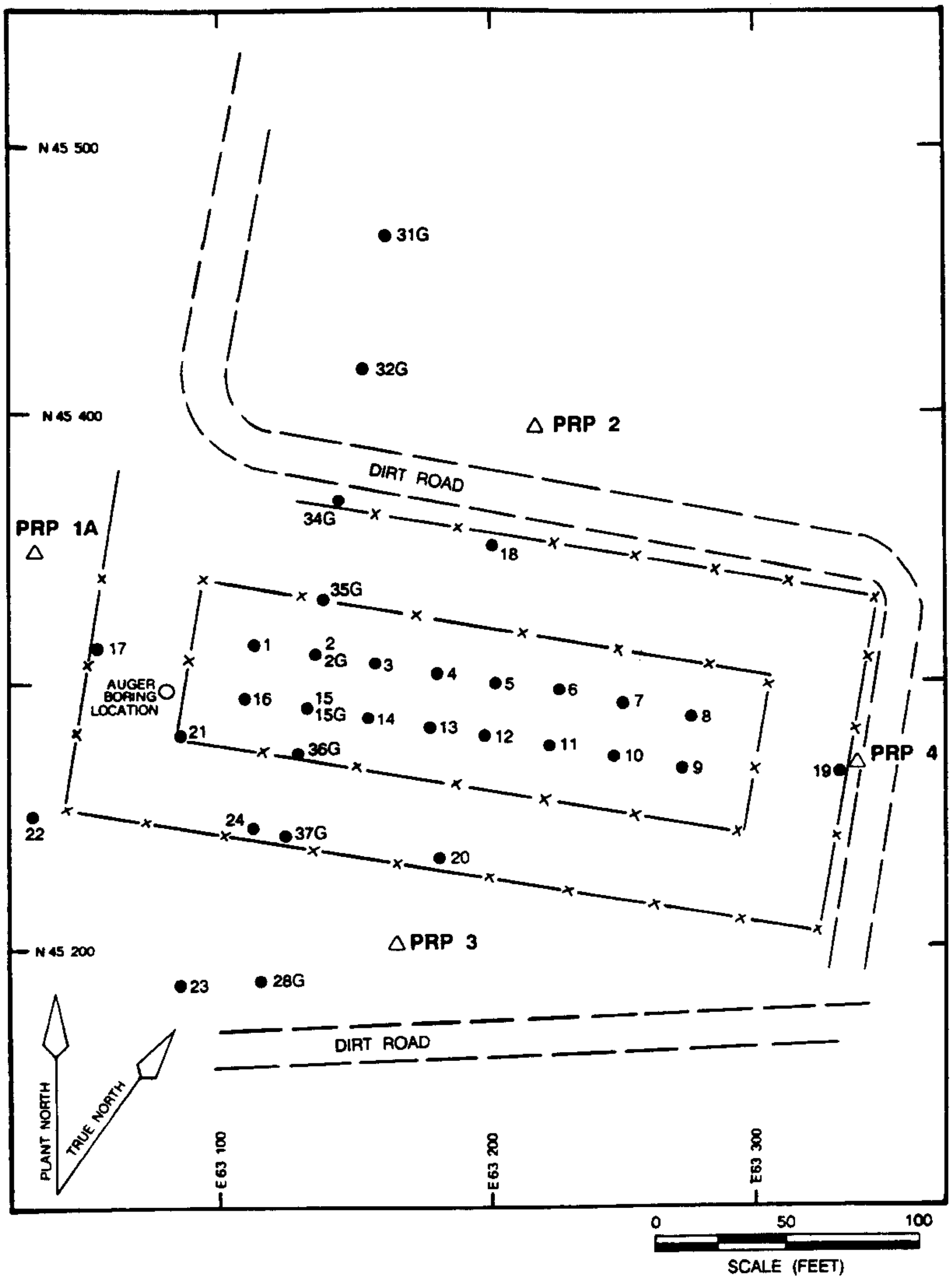
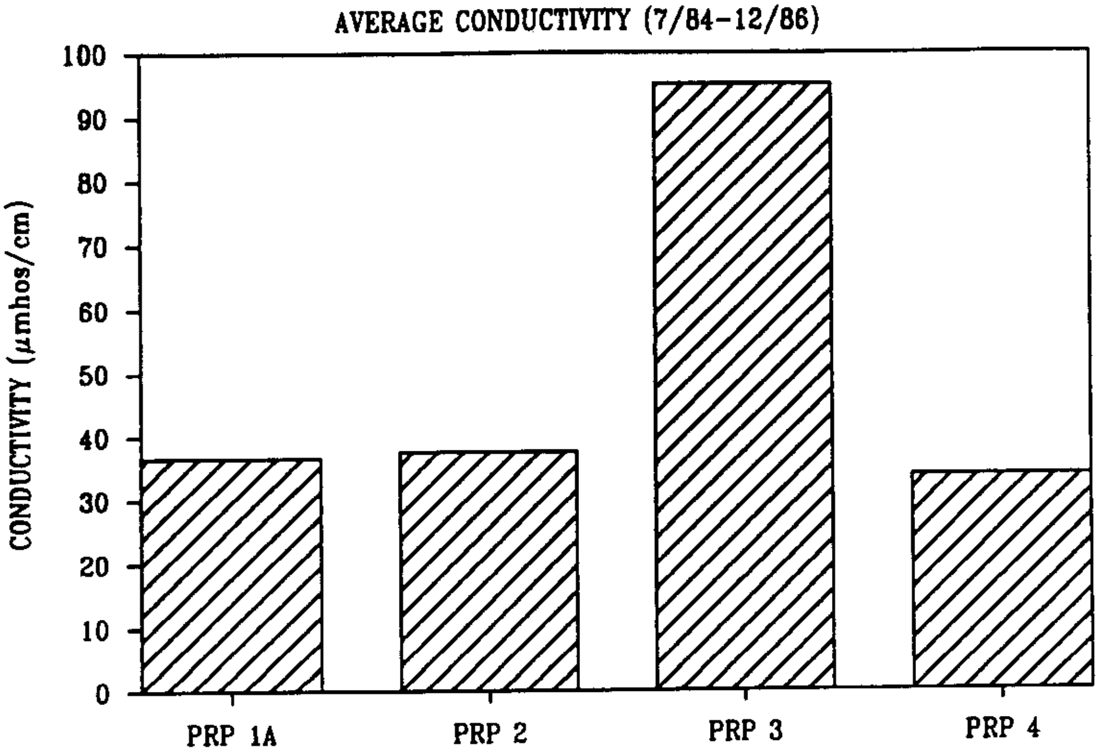


FIGURE 12-17. Soil Sampling Locations at the P-Area Burning/Rubble Pit



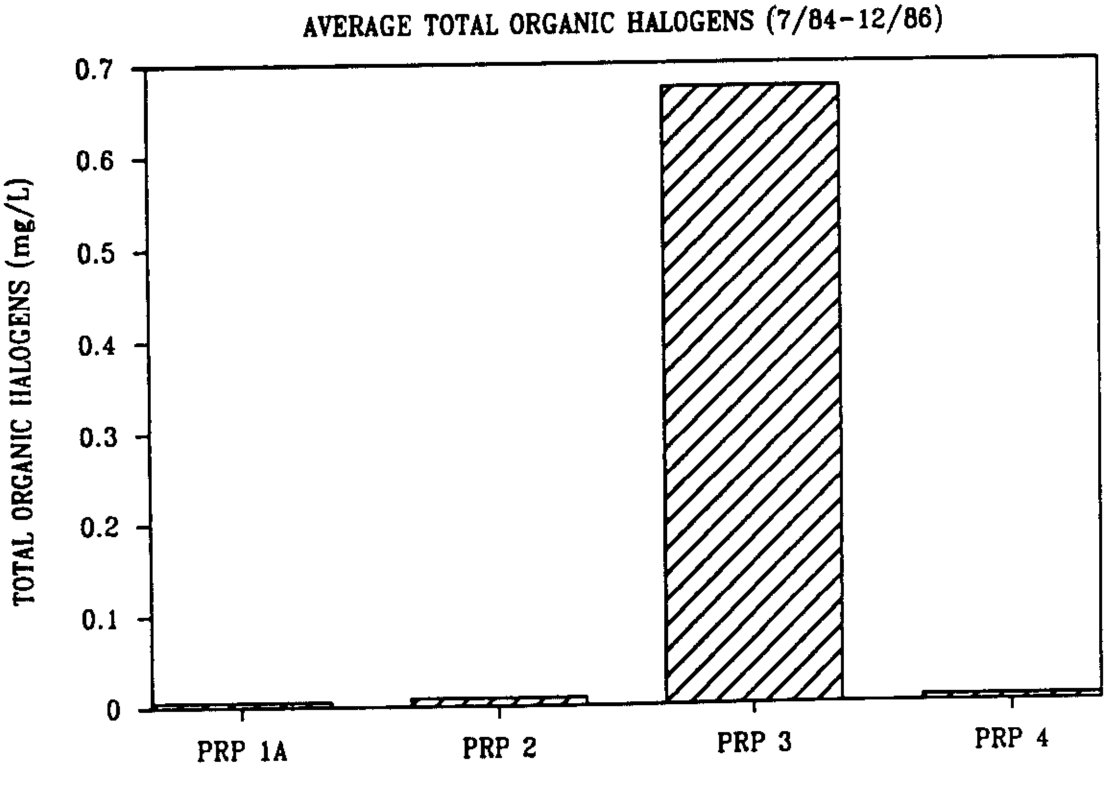


FIGURE 12-18. Average Conductivity and Total Organic Halogens (TOH) Concentrations in P-Area Burning/Rubble Pit Wells

SECTION 13 R AREA

13.01 GENERAL INFORMATION

13.01.01 General Area Description

R Area, located in the east-central part of SRS as shown in Figure 13-1, is on a topographic divide where surface elevations range approximately from 280 to 300 ft msl. Surface drainage is radial, flowing to the northwest and northeast toward Mill Creek and Pond A and to the southeast and southwest toward tributaries of Pond 4 and Pond 2.

There are 17 R-Area waste sites as indicated in Figure 13-2:

L The R-Area Acid/Caustic Basin

L The R-Area Ash Basin

L The R-Area Burning/Rubble Pits (2 pits)

L The R-Area Asbestos Pit

L The R-Area Bingham Pump Outage Pits (3 pits)

L The R-Area Reactor Seepage Basins (6 basins)

L The R-Area Rubble Pit (see Section 15)

L The R-Area Earthen Basin (see Section 15)

L The R-Area Rubble Pile (see Section 15)

13.01.02 General Hydrologic Conditions

By the end of 1986, 86 monitoring wells had been installed around the R-Area waste sites to delineate the subsurface conditions and to monitor the water-table elevation and groundwater quality. Fifty-seven wells are currently being monitored. The remaining 29 wells have been abandoned, as discussed in the following specific waste-site sections. According to the surface geologic map presented by Siple (1967), the water-table monitoring wells in R Area were installed in the Barnwell Formation. Section 3 contains a detailed discussion of the hydrostratigraphy beneath SRS.

The water-table elevation in R Area has ranged approximately from 290 to 260 ft msl, and the vadose zone has been about 10 to 40 ft thick. As shown in Figure 13-2, R Area is near a groundwater divide between Mill Creek and Par Pond. The groundwater north of R Area naturally discharges to Mill Creek, approximately 1,000 ft to the northwest, and to the P-Area Canal of Pond A to the northeast. The groundwater beneath R Area naturally discharges to a tributary of Pond 4, which is approximately 1,800 ft south of R Area.

Mathematical modeling of the Barnwell Formation near the center of the plant in the Separations Areas indicates that the horizontal groundwater flow velocity ranges approximately from 15 to 60 ft/yr per percent gradient (Duffield et al., 1986; Parizek and Root, 1986). As shown in Figure 13-2, the hydraulic gradient of the water table is variable across R Area. Therefore, the near-surface groundwater flow velocity across R Area will vary. The horizontal flow direction and estimated flow velocity for the water table at each R-Area waste site are discussed in the following specific waste-site sections.

13.01.03 Migration Potential of Dissolved Chemical Constituents from R Area

The potential for any dissolved constituents to be naturally discharged from a waste site to nearby surface water from the near-surface groundwater system depends on the location of the waste site, the hydraulic gradient, and the flow path between the waste site and the discharge point. Horizontal and vertical groundwater flow velocities also depend upon the medium through which the groundwater travels (i.e., sand, silt, or clay). Similarly, interactions with the soil/sediment medium (retardation) will affect the horizontal and vertical movements of dissolved chemical constituents.

The nearest plant boundary to R Area is approximately 4.8 mi to the east. A number of incised tributaries, streams, and Par Pond are located between R Area and the boundary, making migration of dissolved constituents through the near-surface groundwater system to the plant boundary unlikely.

13.02 R-AREA ACID/CAUSTIC BASIN

13.02.01 Summary

The R-Area Acid/Caustic Basin (Building 904-77G) received dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion-exchange units in the water purification process areas. This basin allowed for the mixing and neutralization of the dilute solutions before their discharge to a local stream. Constructed between 1952 and 1954, the R-Area Acid/Caustic Basin remained in service until deactivated in 1964. The R-Area Acid/Caustic Basin is currently dry, open, and inactive (Ward et al., 1987).

Basin soil/sediments were sampled in August 1985. Concentrations of tested soil/sediment parameters for the R-Area Acid/Caustic Basin, including sulfate and sodium, were generally consistent with background levels. Extraction Procedure (EP) toxicity test results for metals and pesticides indicate that the concentrations in the basin soil/sediments were less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

Chemical inventory records indicate that sulfate and sodium were discharged to the R-Area Acid/Caustic Basin. These ions serve as indicator parameters because they are soluble and migrate readily in soil or groundwater. Monitoring data indicate that the R-Area Acid/Caustic Basin has had minimal influence on groundwater quality at this site as demonstrated by the low sulfate and sodium concentrations and low conductivity reported for both the upgradient and downgradient wells. Water quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for lead in the downgradient wells. Gross alpha activity ranged over the drinking water standard in upgradient well RAC 1. Lead and radioactivity are not known to be related to past waste-site activities.

13.02.02 Waste-Site Description and Nature of Disposal

The R-Area Acid/Caustic Basin (Building 904-77G) was constructed between 1952 and 1954 and remained in service until deactivated in 1964 (Ward et al., 1987). The basin is within an area of relatively low topographic relief, with surface elevations ranging approximately from 275 to 280 ft msl (Figure 13-3).

The R-Area Acid/Caustic Basin is an unlined earthen depression with approximate dimensions of 50 ft long by 50 ft wide by 7 ft deep. The basin was formed by removing existing soils below grade and building sloped side walls. The basin was constructed in an area predominantly composed of gray-to-brown, fine-to-medium grained sand, with clay content varying from 5 to 95%.

Dilute sulfuric acid and sodium hydroxide solutions were used to regenerate ion exchange units in the R-Area water purification process area. The R-Area Acid/Caustic Basin provided containment for the mixing and neutralization of the spent solutions before their discharge to a local stream. After construction of the Par Pond system (1957-1961), release was to a tributary of the P-Area canal leading to Pond 5.

Calculated annual acid and caustic discharge rates to the basin are summarized in Table 13-1. Discharge to the basin was terminated in 1964, and the basin was deactivated. During basin operation, effluent resulting from discharges and rainwater runoff intermittently flowed from the basin through an overflow weir set to maintain a maximum working water depth of 3 ft in the basin. Effluent records for the R-Area Acid/Caustic Basin were not maintained.

Currently the basin is dry, open, and inactive. Vegetation grows on the side slopes and floor of the basin.

13.02.03 Groundwater Monitoring Program

Four wells (RAC 1 through RAC 4) were installed to monitor the water-table elevation and groundwater quality at the R-Area Acid/Caustic Basin (Figure 13-3). Wells RAC 1 through RAC 3 were installed in the fourth quarter of 1983; well RAC 4 was installed in the third quarter of 1984. All four wells were constructed using PVC casings and 30-ft screens.

The R-Area Acid/Caustic Basin wells are monitored under the SRS quarterly groundwater monitoring program. Monitoring began in the second quarter of 1984 for wells RAC 1 through RAC 3 and in the first quarter of 1985 for well RAC 4. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

13.02.04 Site-Specific Hydrology

Measurements obtained from the R-Area Acid/Caustic Basin wells since June 1984 indicate that the water-table elevation has ranged from 275 to 270 ft msl and that the vadose zone has been approximately 5 ft thick. A hydrograph for the R-Area Acid/Caustic Basin wells is presented in Figure 13-4. Except for the inconsistent water-level elevations reported for May 1986, the hydrograph indicates that the water-table elevation has remained relatively constant.

A water-table elevation contour map for the third quarter of 1985 is presented in Figure 13-3. As shown, the near-surface groundwater flow direction was to the southeast, and surface drainage was toward Par Pond, consistent with local topography. The hydrograph (Figure 13-4) indicates that this has been the predominant flow direction, although water-level fluctuations suggest that minor changes in gradient and flow direction have occurred. Relative to the basin, well RAC 1 has been upgradient, and wells RAC 2, RAC 3, and RAC 4 have been downgradient.

The hydraulic gradient across the basin has been approximately 0.015 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal near-surface groundwater flow velocity beneath the R-Area Acid/Caustic Basin has ranged approximately from 22.5 to 90 ft/yr.

13.02.05 Waste-Site Content Characterization Data

The R-Area Acid/Caustic Basin is dry and has not been sampled.

13.02.06 Soil/Sediment Characterization Data

R-Area Acid/Caustic Basin soil/sediments were sampled in August 1985 as part of a basin characterization program. Three 5-ft continuous borings were obtained near the basin inlet and outlet structures and along one side wall. Soil boring samples were separated into 0.5-ft intervals for analysis. Soil/sediment analytical results, including Extraction Procedure (EP) toxicity test results for metals, are summarized in Table 13-2. EP toxicity test results for metals and pesticides indicate concentrations less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24). Concentrations of the soil/sediment indicator parameters tested were generally consistent with SRS background soil concentrations, such as magnesium (55.6 to 4,630 $\mu g/g$), sulfate (144.5 to 930 $\mu g/g$), and sodium (156 to 4,880 $\mu g/g$).

13.02.07 Groundwater Monitoring Results

Groundwater monitoring data from 1984 through 1986 are presented in Appendix K. Groundwater chemical characterization data since July 1984 are summarized in Table 13-3.

Comparisons of the monitoring results among upgradient well RAC 1 and downgradient wells RAC 2, RAC 3, and RAC 4 were used to evaluate the effect of the R-Area Acid/Caustic Basin on groundwater. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Indicator parameters are sulfate, sodium, and conductivity because elevated levels of these parameters are indicative of basin seepage and because sulfate and sodium are soluble and migrate readily in soil or groundwater (Section 13.02.02).

The groundwater data summarized in Table 13-3 indicate that there has been minimal influence from the R-Area Acid/Caustic Basin on groundwater quality. Groundwater concentrations have consistently met South Carolina and federal drinking water standards for dissolved chemical constituents except for lead in both the upgradient and downgradient wells. Low TDS levels (22 to 58 mg/L) were reported for the site wells compared to the drinking water standard of 500 mg/L. The average conductivity values in both the upgradient well (55.0 μmhos/cm) and the downgradient wells (34.5 to 70.33 μmhos/cm) provide further indication that the R-Area Acid/Caustic Basin has had minimal effect on groundwater quality.

Sulfate levels in upgradient well RAC 1 (<5.0 to 40.0 mg/L) and the downgradient wells (<3.0 to 45.0 mg/L) remained well below the drinking water standard of 250 mg/L. The average sulfate concentrations in the downgradient wells (5.0 to 10.4 mg/L) were below the average sulfate value of 18.9 mg/L for the upgradient well. Average sodium concentrations in all of the R-Area Acid/Caustic Basin wells were below 5.5 mg/L, and groundwater pH ranged from 3.4 to 6.2; pH values as low as 4.0 are generally consistent with naturally occurring Barnwell Formation groundwater pH (Appendix B).

Lead levels in downgradient wells RAC 2 (0.009 to 0.054 mg/L) and RAC 3 (0.008 to 0.057 mg/L) did not meet the drinking water standard of 0.05 mg/L on a few occasions. Similarly, gross alpha (1.4 to 26.0 pCi/L) activities in upgradient well RAC 1 exceeded the drinking water standard of 15 pCi/L on a few occasions. Lead levels in upgradient well RAC 1 and downgradient well RAC 4 and radioactivity in all three downgradient wells remained below drinking water standards. Lead and radioactivity are not known to be related to past R-Area Acid/Caustic Basin site activities.

The concentrations of the indicator parameters (conductivity, sulfate, and sodium) have not shown any consistent increasing or decreasing trends with time.

13.02.08 Planned Action

The R-Area Acid/Caustic Basin is inactive. A site assessment has been completed, and a closure plan is to be developed in 1987. Groundwater monitoring will continue at the site.

13.03 R-AREA ASH BASIN

13.03.01 Summary

The R-Area Ash Basin (Building 188-R) received ash sluice water from the R-Area powerhouse from 1951 until 1964. The R-Area Ash Basin is currently open and inactive (Christensen and Gordon, 1983). Groundwater monitoring and soil characterization have not been conducted at the R-Area Ash Basin.

13.03.02 Waste-Site Description and Nature of Disposal

Electricity and steam at SRS are generated by burning coal in the powerhouses, which produces dry ash. Ash sluice water from the R-Area powerhouse was discharged to the R-Area Ash Basin from 1951 until 1964.

The R-Area Ash Basin (Building 188-R) is south of the R-Area perimeter fence (Figure 13-2). The surface elevation in the vicinity of the basin is approximately 295 ft msl, and the ground slopes to the south. The nearest plant boundary from the R-Area Ash Basin is approximately 4.8 mi to the east. The R-Area Ash Basin is currently open and inactive.

Ash sluice water contains fly and bottom ash. Horton, Dorsett, and Cooper conducted a study in 1977 to identify trace metals present in the fly and bottom ash disposed to the SRS ash basins and piles. Table 13-4 lists typical trace metal concentrations obtained for fly and bottom ash. These results indicate significant levels of barium, strontium, manganese, zinc, vanadium, cerium, and chromium (Horton et al., 1977).

13.03.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the R-Area Ash Basin.

13.03.04 Site-Specific Hydrology

Groundwater monitoring has not been conducted at the R-Area Ash Basin; therefore, near-surface groundwater conditions beneath the waste site are undefined.

13.03.05 Waste-Site Content Characterization Data

Sampling and analysis of the R-Area Ash Basin contents have not been conducted. Section 13.03.02 contains information on the nature of materials disposed at the site.

13.03.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the R-Area Ash Basin. The materials and nature of disposal into the R-Area Ash Basin are similar to those of the D-Area Ash Basin (488-D); therefore, Extraction Procedure (EP) toxicity test results from analyses performed on the 488-D Ash Basin sludge are presented in Table 13-5. The data in Table 13-5 demonstrate that extractable metal concentrations in the D-Area Ash Basin were less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

13.03.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the R-Area Ash Basin.

13.03.08 Planned Action

The R-Area Ash Basin is currently inactive. As discussed in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

13.04 R-AREA BURNING/RUBBLE PITS

13.04.01 Summary

Burnable wastes such as paper, plastics, rubber, oil, degreasers, and drummed solvents were received and incinerated in the two R-Area Burning/Rubble Pits (Buildings 131-R and 131-1R) from 1951 to 1973, at which time the pits were covered with a layer of soil. Rubble wastes (including paper, wood, concrete, cans, and empty galvanized steel barrels) were then disposed of in the pits. By 1981, one pit (131-R) was capped with soil. The other pit (131-1R), which received small quantities of rubble, was not backfilled. The pits are currently inactive (Huber et al., 1987c).

The groundwater monitoring data indicate that there has been minimal effect on groundwater quality from the R-Area Burning/Rubble Pits. Near-surface groundwater quality at the site has been characterized by low dissolved organic and inorganic chemical constituent levels that consistently have met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for an excursion of gross alpha (18.0 pCi/L) in well RRP 4.

13.04.02 Waste-Site Description and Nature of Disposal

The R-Area Burning/Rubble Pits (Buildings 131-R and 131-1R) were constructed in 1951 to collect burnable waste generated at the plant. The wastes collected for monthly incineration at the R-Area pits included paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents. Disposal of chemically contaminated oils was not allowed at the R-Area Burning/Rubble Pits (Huber et al., 1987c).

In 1973, the plantwide procedure of burning waste ceased, and the R-Area Burning/Rubble Pits were converted to receive only rubble by placing a layer of soil over the incinerated waste. Rubble waste disposed in the pits included paper, wood, concrete, cans, and empty galvanized steel barrels. By 1981, one pit (131-R) was capped with soil. The other pit (131-1R), which received small quantities of rubble, was not backfilled. The pits are currently inactive (Huber et al., 1987c).

The R-Area Burning/Rubble Pits are on a southeast-trending slope where elevations range from 280 to 285 ft msl (Figure 13-5). Surface drainage is toward Pond 4 on the P-Area effluent canal that leads to Par

Pond. Both pits were rectangular. Pit 131-R had nominal dimensions of 236 ft long by 20 ft wide by 10 ft deep and a volume capacity of approximately 50,000 ft^3; Pit 131-1R had nominal dimensions of 236 ft long by 32 ft wide by 10 ft deep and a volume capacity of about 76,000 ft^3.

13.04.03 Groundwater Monitoring Program

Four wells (RRP 1 through RRP 4) were installed to monitor the water-table elevation and groundwater quality at the R-Area Burning/Rubble Pits (Figure 13-5). Wells RRP 1 through RRP 3 were installed in the fourth quarter of 1983. Well RRP 4 was added to the monitoring network in the third quarter of 1984. All four wells were constructed using PVC casings and 30-ft screens.

Groundwater samples were obtained and analyzed from wells RRP 1 through RRP 3 beginning in the second quarter of 1984. Well RRP 4 was first sampled in the first quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

13.04.04 Site-Specific Hydrology

Measurements obtained from the R-Area Burning/Rubble Pits wells since June 1984 indicate there has been an overall decline in the water-table elevation beneath the R-Area Burning/Rubble Pits (Figure 13-6). The water-level data for the fourth quarter of 1986 indicate that the water-table elevation was 260 ft msl and that the vadose zone was approximately 20 ft thick.

A water-table elevation contour map for the second quarter of 1985 indicates that the near-surface horizontal groundwater flow direction was to the southeast, consistent with local topography (Figure 13-5). The hydrograph indicates that this has been the predominant flow direction, although minor changes in flow direction and gradient have occurred. Relative to the pits, well RRP 1 has been upgradient, wells RRP 3 and RRP 4 downgradient, and well RRP 2 sidegradient. The hydraulic gradient beneath the pits has been approximately 0.008 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the near-surface groundwater flow velocity beneath the pits has ranged approximately from 12 to 48 ft/yr.

13.04.05 Waste-Site Content Characterization Data

The R-Area Burning/Rubble Pits contents have not been sampled. Section 13.04.02 contains information on the materials incinerated and disposed at the site.

13.04.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the R-Area Burning/Rubble Pits.

13.04.07 Groundwater Monitoring Results

The groundwater monitoring data from 1984 through 1986 are included in Appendix K. Groundwater chemical characterization data since July 1984 are summarized in Table 13-6.

A comparison of groundwater quality data between upgradient well RRP 1 and the other R-Area Burning/Rubble Pits wells was used to evaluate the effect of the pits on groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. Based on the waste-site inventory (Section 13.04.02), the indicator parameters for the site are conductivity, total organic carbon (TOC), and total organic halogens (TOH).

The groundwater monitoring data summarized in Table 13-6 indicate that the R-Area Burning/Rubble Pits have had minimal influence on local groundwater quality. Groundwater samples from all four monitoring wells have consistently met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards for dissolved chemical constituents as reflected by the low conductivity levels reported for the R-Area Burning/Rubble Pits wells (9 to 54 μmhos/cm). The conductivity range in downgradient wells RRP 3 (9 to 21 μmhos/cm) and RRP 4 (16 to 33 μmhos/cm) was consistent with the range reported for upgradient well RRP 1 (22 to 40 μmhos/cm) and sidegradient well RRP 2 (21 to 54 μmhos/cm).

Similarly, TOC and TOH concentrations in the downgradient wells were in the same range as levels reported for the upgradient and sidegradient wells. TOC levels ranged from 0.350 to 10.38 mg/L in downgradient wells RRP 3 and RRP 4 and from 0.30 to 23.0 mg/L in upgradient well RRP 1 and sidegradient well RRP 2. TOH levels in the downgradient wells ranged from <0.005 to 0.020 mg/L and in the upgradient and sidegradient wells from <0.005 to 0.025 mg/L.

Except for an excursion of gross alpha in well RRP 4 (18.0 pCi/L), total radium and gross alpha activities remained below their respective drinking water standards of 5 pCi/L and 15 pCi/L in the R-Area Burning/Rubble Pits monitoring wells. There is no record of radioactive material being disposed in the R-Area Burning/Rubble Pits.

13.04.08 Planned Action

The R-Area Burning/Rubble Pits are inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at the site.

13.05 R-AREA ASBESTOS PIT

13.05.01 Summary

The R-Area Asbestos Pit (Building 080-1R) received asbestos-containing material consisting of used asbestos pipe insulation in polyethylene bags and asbestos-contaminated scrap piping. Opened in 1980, the pit received approximately 4,250 ft^3 of material over a 4-month period. The R-Area Asbestos Pit was closed in the first quarter of 1981 (Christensen and Gordon, 1983).

Surveillance and site maintenance for the closed pit have consisted of erosion control only. No groundwater monitoring has been conducted at the R-Area Asbestos Pit; asbestos is regulated as an inhalation hazard, not as a water contaminant.

13.05.02 Waste-Site Description and Nature of Disposal

The R-Area Asbestos Pit (Building 080-1R) is in the west corner of R Area (Figure 13-2). The pit covers approximately 19,600 ft^2, with original dimensions of 70 ft wide by 280 ft long. Opened in 1980, the R-Area Asbestos Pit received approximately 4,250 ft^3 of asbestos insulation in polyethylene bags and asbestos-contaminated steam pipe over a 4-month period. The pit stopped receiving waste in the first quarter of 1981 and was covered with soil, graded to minimize erosion, and seeded.

13.05.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the R-Area Asbestos Pit.

13.05.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the R-Area Asbestos Pit; therefore, groundwater conditions beneath the waste site have not been defined.

13.05.05 Waste-Site Content Characterization Data

The contents of the R-Area Asbestos Pit have not been sampled. Section 13.05.02 contains information on the materials disposed at the waste site.

13.05.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the R-Area Asbestos Pit.

13.05.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the R-Area Asbestos Pit.

13.05.08 Planned Action

The R-Area Asbestos Pit is inactive. A site assessment is planned for 1989 from which a closure plan will be developed. No additional studies or actions are scheduled for this site.

13.06 R-AREA BINGHAM PUMP OUTAGE PITS

13.06.01 Summary

The three R-Area Bingham Pump Outage Pits (Buildings 643-8G, 643-9G, and 643-10G) received solid, low-level radioactive waste during 1958. Wastes with higher levels of radioactivity (over 25 mRad/hr) or detectable alpha activity were sent to the Radioactive Waste Burial Ground (Building 643-G) during this period. The estimated maximum activity originally buried in all three pits is approximately 1 Ci (Pekkala et al., 1987a). The R-Area Bingham Pump Outage Pits were deactivated and backfilled with clean soil in 1958, and the site has remained inactive. Most of the radioactivity at the pits has been eliminated by radioactive decay. Surveillance and site maintenance have been minimal. Groundwater monitoring has not been conducted at the R-Area Bingham Pump Outage Pits.

13.06.02 Waste-Site Description and Nature of Disposal

Normally, all radioactive solid waste generated in the reactor areas is sent to the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G). An exception to this practice was made during 1957 and 1958 when major modifications were made to the primary and secondary cooling water systems in the reactor areas (Pekkala et al., 1987a). The R-Area pits were active from April 1958 to October 1958.

In R Area, the radioactive waste generated during the modification was surveyed, and solid waste with low levels of surface contamination was buried in the three R-Area Bingham Pump Outage Pits. These waste pits were subsequently backfilled with clean soil. No pumps were buried in the pits. The waste pits contain miscellaneous construction equipment such as pipes, cables, ladders, drums, and wooden boxes (Fenimore and Horton, 1974). The radiation level of the buried waste was less than 25 mRad/hr, and no alpha activity was noted. Waste with higher levels of contamination was sent to the Radioactive Waste Burial Ground (Building 643-G). A conservative estimate of the total activity buried in the R-Area Bingham Pump Outage Pits is 0.3 Ci (decay corrected through 1985) (Pekkala et al., 1987a).

The R-Area Bingham Pump Outage Pits (Buildings 643-8G, 643-9G, and 643-10G) are northeast of the R-Area perimeter fence (Figure 13-2). Joyce Branch, which drains to Pond C of Par Pond, is 1,800 ft northeast of the R-Area Bingham Pump Outage Pits. The elevation of the waste site is approximately 310 ft msl. The nearest plant boundary is approximately 4.5 mi east of the site.

The pits were rectangular, with nominal dimensions of 250 ft long by 20 ft wide by 13 ft deep for the first pit (643-8G), 250 ft long by 16 ft wide by 13 ft deep for the second pit (643-9G), and 520 ft long by 26 ft wide by 13 ft deep for the third pit (643-10G). The combined volume capacity of the three pits was approximately 293,000 ft^3. Vegetation has been allowed to grow over the R-Area Bingham Pump Outage Pits since they were backfilled in 1958.

13.06.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the R-Area Bingham Pump Outage Pits.

13.06.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the R-Area Bingham Pump Outage Pits; therefore, groundwater conditions beneath the waste site are undefined.

13.06.05 Waste-Site Content Characterization Data

The contents of the R-Area Bingham Pump Outage Pits have not been sampled. Section 13.06.02 contains information on the materials disposed at the waste site. The estimated radionuclide inventory in the R-Area Bingham Pump Outage Pits at the time of burial (1958) and in December 1985 is listed in Table 13-7. This table indicates that most of the radioactivity at the R-Area Bingham Pump Outage Pits has been eliminated by radioactive decay.

A comparison between radioactivity levels in vegetation samples from the surface of the R-Area Bingham Pump Outage Pits in 1970 and vegetation samples from the SRS perimeter in that same year is presented in Table 13-8. The vegetation growing above the outage pits exhibited a low but measurable increase in activity (Fenimore and Horton, 1974).

13.06.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the R-Area Bingham Pump Outage Pits.

13.06.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the R-Area Bingham Pump Outage Pits.

13.06.08 Planned Action

The R-Area Bingham Pump Outage Pits are inactive. As discussed in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

13.07 R-AREA REACTOR SEEPAGE BASINS

13.07.01 Summary

The R-Area Reactor Seepage Basins received radioactive purge water from the R-Area Reactor Disassembly Basins from 1957 until 1964. A review of the radioactive releases to the six seepage basins (Buildings 904-103G, 904-104G, and 904-57G through 904-60G) indicates that most of the radioactivity discharged to the basins during normal operations was due to ^{3}H, ^{90}Sr, and ^{137}Cs. In November 1957, an experimental fuel element failed during calorimeter testing in the R-Area Disassembly Basin, resulting in the release of approximately 2,700 Ci of nonvolatile beta activity to the seepage basins. Basin 1 was closed and backfilled in December 1957 because of surface outcrop and leakage to a nearby abandoned sewer system. In 1960, Basins 2 through 5 were closed and backfilled. Basin 6, which was active from 1958 until 1964, was backfilled in 1977 (Pekkala et al., 1987b).

Soil/sediments have been tested for radioactive parameters only. The data indicate that most of the radioactivity is due to ^{137}Cs, which was found at a maximum level of 8,000 nCi/g in a soil core segment taken near the inlet discharge of Basin 1. The highest ^{90}Sr activity (41 nCi/g) was also found in Basin 1.

Elevated nonvolatile beta activity has been reported in groundwater from wells in three specific regions within the R-Area Reactor Seepage Basins area. From 1984 through 1986, elevated annual average nonvolatile beta activities (up to 380 pCi/L) were detected in wells near the northwest corner of Basin 3. Elevated average nonvolatile beta activities (up to 9,500 pCi/L during the period) have also been reported within the enclosed area around Basin 1. However, the data indicate that the majority of the radioactivity surrounding Basin 1 has been contained within the kaolinite dike that was installed around the basin to restrict movement of radioactive constituents. Elevated average nonvolatile beta activities (100 to 1,100 pCi/L for 1984 through 1986) also have been reported in wells east of Basin 1. These levels are likely caused by the migration of materials containing ^{90}Sr through an abandoned construction sewer (Pekkala et al., 1987b) following seepage from the basin in 1957. Nonvolatile beta activities detected in wells 100 to 200 ft downgradient of the well cluster were substantially lower (up to 48.0 pCi/L).

Gross alpha activity remained below the drinking water standard of 15 pCi/L over the monitoring period in all of the site wells except for an excursion (18 pCi/L) in well RSD 2C in 1986.

13.07.02 Waste-Site Description and Nature of Disposal

R Area used earthen seepage basins from 1957 to 1964 to contain radioactive wastewater from the R-Area Disassembly Basin (Pekkala et al., 1987b). The six R-Area Reactor Seepage Basins (Buildings 904-103G, 904-104G, and 904-57G through 904-60G) are just outside the R-Area perimeter fence (Figure 13-2). The basins are on a topographic divide between the headwaters of Mill Creek and drainage to Par Pond. Mill Creek and Par Pond are approximately 1,440 ft and 3,740 ft from the area, respectively. The nearest plant boundary is approximately 4.8 mi east of the site.

The dimensions of the R-Area Reactor Seepage Basins and other installation data are presented in Table 13-9. The basins were constructed by excavating below grade and backfilling around the sides at grade level to form earthen dike walls. Basin 1 was L-shaped; the other basins were rectangular. Basin 1 discharged in cascade via overflow channels in series to Basins 2, 3, and 4. Basin 5 received water directly from the disassembly basin. Basin 6 received water pumped from Basins 2, 3, and 4; after Basin 2, 3, and 4 were backfilled, Basin 6 received water directly from the disassembly basin. Basins 4, 5, and 6 did not discharge by overflow; instead, water evaporated or seeped from these basins (Figure 13-7).

In 1957, SRS began using the R-Area Reactor Seepage Basins for the disposal of low-level radioactive purge water from the R-Area Reactor Disassembly Basin. This water purge is necessary to keep the tritium activity in the disassembly water within a safe working range. Although many radionuclides have been discharged to the R-Area Reactor Seepage Basins, most of the radioactivity discharged to the site during normal operations was due to ^{3}H, ^{90}Sr, and ^{137}Cs. The radionuclides entered the disassembly basin water as a film of liquid on the radiated components as they were discharged from the reactor tank to the disassembly basin, in the oxide corrosion film on the irradiated components, and, infrequently, from leaks in porous components (Pekkala et al., 1987b).

On November 8, 1957, an experimental fuel element failed during a calorimeter test in the emergency section of the R-Area Disassembly Basin. From November 1957 through 1959 the R-Area Reactor Seepage Basins received approximately 2,700 Ci of radionuclides including 200 Ci of ^{90}Sr and 1,000 Ci of ^{137}Cs. To assist in containing the radioactivity, Basins 2 through 4 were placed in service in November 1957, Basin 5 was added in January 1958, and Basin 6 was installed in March 1958. A large portion of the released radioactivity was contained in Basin 1, which was backfilled in December 1957. The inventory of radionuclides discharged to the R-Area Reactor Seepage Basins (corrected for radioactive decay through 1985) is shown in Table 13-10. Annual purge volumes discharged to the R-Area Reactor Seepage Basins from 1957 to 1964 are shown in Table 13-11.

In 1960, Basins 2 through 5 were closed and backfilled. The ground surface above Basins 1 through 5 was treated with an herbicide and covered with asphalt. In addition, kaolinite dikes were constructed down to a clay layer around Basin 1 and at the northwest end of Basin 3 (Figure 13-7) to minimize lateral movement of the radioactive contamination. Basin 6 was last used in 1964 and was backfilled in 1977. All six basins are inactive and backfilled.

13.07.03 Groundwater Monitoring Program

Seventy-eight wells (RSA, RSB, RSC, RSD, and RSE series) have been installed to monitor the water-table elevation and groundwater quality at the R-Area Reactor Seepage Basins. Forty-nine of the 78 wells are currently being monitored. The remaining 29 wells have been abandoned. The locations and designations of the currently monitored wells are shown in Figure 13-8. The majority of the monitoring wells for the R-Area Reactor Seepage Basins were constructed using galvanized steel casings, although recent additional or replacement wells have been constructed using PVC casings.

Groundwater monitoring at the R-Area Reactor Seepage Basins began in 1958. The wells are included in the radioactive groundwater monitoring program at SRS, which monitors for gross alpha, nonvolatile beta, and tritium. Monitoring for tritium was conducted at this site in 1962 and 1963 only.

13.07.04 Site-Specific Hydrology

Measurements obtained from the R-Area Reactor Seepage Basins wells indicate that the water-table elevation is about 280 ft msl and that the vadose zone is approximately 15 ft thick. The basins are near a hydraulic divide between Mill Creek (a tributary of Upper Three Runs Creek) to the north and Par Pond to the east (Pekkala et al., 1987b).

A water-table elevation contour map for the third quarter of 1985 is presented in Figure 13-9, which indicates that the gradient is variable and that a number of local divides cause divergent flow. In general, the water-table gradient in the northwest part of the site is to the north. To the south of Basin 6 and near Basin 1 and the nearby abandoned sewer line, the water-table horizontal flow direction is south to southeast. Areas of converging and diverging flow patterns appear to be associated with the kaolinite dikes, which were installed down to a clay layer to reduce migration of radioactive constituents in the subsurface.

13.07.05 Waste-Site Content Characterization Data

Analyses conducted November 8, 1957, following the failure of the experimental fuel element indicate that the nonvolatile beta activity in Basin 1 water comprised approximately 37% strontium, 37% cesium, 23% rare earths and yttrium, 0.8% ruthenium, and 3.6% zirconium/niobium. On November 13, 1957, the percentage composition of nonvolatile beta activity in Basin 1 water was about 54% strontium, 14% cesium, 26% rare earths and yttrium, 0.6% ruthenium, and 4% zirconium/niobium (Mealing et al., 1958). In January 1958, analyses of water in Basins 2 through 5 demonstrated the following average nonvolatile beta percentage composition: 37% strontium, 19% cesium, 33.5% rare earths and yttrium, 6.3% zirconium/niobium, and 4.5% other radionuclides (mainly ruthenium/rhodium and barium/lanthanum).

13.07.06 Soil/Sediment Characterization Data

In 1976, cores were collected from five of the six basins to assess radioactivity in the R-Area Reactor Seepage Basins soils. The sampling program concentrated on Basin 1 where five soil cores, each 4 ft in length, were collected. One similar core was collected from each of Basins 2, 3, 4, and 5. Except for Basin 3, the soil cores were centered on the zone beneath each basin that exhibited the greatest radiation levels in dry monitoring wells drilled in the basins. The maximum radiation level in each basin was found in a narrow zone near the bottom of the backfilled basin with minimal migration of radioactive constituents below this interface (Figure 13-10).

As shown in Table 13-12, maximum radioactivity levels were found in Basin 1. The data indicate that most of the radioactivity is due to ^{137}Cs, which was found at a level of 8,000 nCi/g in the soil in a segment of the core taken near the inlet of Basin 1. The highest ^{90}Sr activity was also found in Basin 1, peaking at 41 nCi/g in the soil. Based on radioassay results from a limited number of soil samples, Basin 1 contains approximately 90% of the ^{137}Cs and 50% of the ^{90}Sr in the basin system (Pekkala et al., 1987b).

13.07.07 Groundwater Monitoring Results

Groundwater monitoring data from 1962 through 1986 for the R-Area Reactor Seepage Basin wells are given in Table 13-13. These wells have been monitored for gross alpha, nonvolatile beta, and tritium (in 1962 and 1963 only). Past site activities indicate that nonvolatile beta activity is an indicator parameter for the site because cesium and strontium, which were released at the site, are beta emitters. Organic and inorganic chemical constituents have not been included in the R-Area Reactor Seepage Basins monitoring program.

R-Area Reactor Seepage Basins 2, 4, 5, and 6 have had no apparent effect on local groundwater quality as evidenced by the average nonvolatile beta levels reported for well series RSA (0.39 to 5.4 pCi/L), RSB (0.3 to 4.7 pCi/L), and RSC (0.28 to 3.5 pCi/L) from 1984 through 1986. The average nonvolatile beta activities in these wells have been declining since monitoring began. The hydraulic positioning of specific wells in the RSA, RSB, and RSC well series with respect to the site basins is indicated in Figure 13-9.

Groundwater quality near Basins 1 and 3 has been affected by the nonvolatile beta activity released to the basins. The migration of contamination at these sites was enhanced by the presence of permeable sand layers intersecting Basins 1 and 3. As shown in Figure 13-8 and discussed in Section 13.07.02, in 1960 a kaolinite dike was constructed down to a clay layer around the northwest end of Basin 3 to minimize lateral movement of the radioactivity. Wells RSE 18, RSE 19, and RSE 7 through RSE 12 were installed to monitor groundwater near the dike. Average nonvolatile beta activities in wells RSE 7 through RSE 10 (1.4 to 15 pCi/L) and RSE 18 (below 3 pCi/L) from 1984 through 1986 indicate no apparent effect on groundwater quality near these wells. Average nonvolatile beta activities from 1984 through 1986 in wells RSE 11 (310 to 380 pCi/L), RSE 12 (150 to 190 pCi/L), and RSE 19 (70 to 73 pCi/L) are elevated and demonstrate that Basin 3 has had an effect on local groundwater quality.

Elevated nonvolatile beta levels also have been detected downgradient of Basin 1. However, the radioactivity apparently has been largely contained within the kaolinite dike walls surrounding Basin 1. Well clusters RSE 1 (A-C) and RSD 2 (A-C) best illustrate the effect of the dike in controlling the migration of radioactivity. Monitoring well locations in these two clusters consist of a well positioned just inside the diked area (wells RSE 1A and RSD 2C) and a well positioned just outside the diked area (wells RSE 1C and RSD 2A). Wells RSE 1C (2.0 to 2.6 pCi/L) and RSD 2A (170 to 200 pCi/L), which are just outside the diked area, contained substantially lower average nonvolatile beta activities from 1984 through 1986 than wells RSE 1A (30 to 53 pCi/L) and RSD 2C (3,000 to 4,000 pCi/L), which are just inside the diked area (Figure 13-8). The highest annual average nonvolatile beta activity from 1984 through 1986 was detected in well RSE 6 (9,500 pCi/L), which is just downgradient of the R-Area Reactor Seepage Basin 1 inlet and within the diked area. The inlet to R-Area Reactor Seepage Basin 1 was the site of the highest ^{90}Sr and ^{137}Cs levels detected in the soil sampling analysis program (Section 13.07.06). Average annual nonvolatile beta activity in well RSE 6 peaked in 1976 at over 31,500 pCi/L and has been declining since that time.

From 1984 through 1986, elevated average nonvolatile beta levels were detected in wells RSE 4A through RSE 4C (110 to 1,100 pCi/L), RSD 4 through RSD 8 (100 to 750 pCi/L), and RSE 13 (140 to 260 pCi/L), which are in a cluster east of Basin 1. The uncharacteristically high nonvolatile beta activity in this area was first observed in well RSE 13. An investigation revealed that the source of the contamination was migration of materials containing ^{90}Sr through a construction sewer line, shown in Figure 13-8, that had been abandoned after the completion of R Area (Pekkala et al., 1987b). The migration of ^{90}Sr activity has been to the southeast, which is consistent with the local groundwater flow direction shown in Figure 13-8. Of the wells in this cluster area, wells RSE 4A through RSE 4C are closest to the sewer line, while wells RSD 4 through RSD 8 are furthest from the sewer line (Figure 13-8). Wells RSD 9 through RSD 11 are approximately 100 to 200 ft downgradient of wells RSD 4 through RSD 8. Average nonvolatile beta activities in wells RSD 9 (below 5 pCi/L), RSD 10 (21 to 55 pCi/L), and RSD 11 (11 to 14 pCi/L) were substantially lower than the values detected in wells RSD 4 through RSD 8.

Gross alpha levels in all of the site wells remained below the drinking water standard of 15 pCi/L over the monitoring period except for an isolated excursion (18 pCi/L) in well RSD 2C in 1986.

13.07.08 Planned Action

The R-Area Reactor Seepage Basins are currently inactive. As discussed in Section 16, additional monitoring wells are scheduled to be installed during 1987. A site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

TABLE 13-1

Calculated Annual Discharges from Cation and Anion Exchange Units for the R-Area Acid/Caustic Basin

Calculated Annual Discharges from Cation Exchange Unit

Acid Wastewater

Volume (m^3/yr)	Conc. Wt. % H_2SO_4	Total Excess H_2SO_4 (kg)	Total Cations (kg)
2,600,000	0.13	3,800	2,500

Calculated Annual Discharges from Anion Exchange Unit

Basic Wastewater

Volume (m^3/yr)	Conc. Wt. % NaOH	Total Excess NaOH (kg)	Total Anions (kg)
3,600,000	0.32	12,700	2,700

Note: Data, from Ward et al. (1987), are extrapolated from P Area for 1974 and are representative of the total period. Values were calculated using assumed resin performance.

TABLE 13-2

Summary of Sediment and Soil Chemical Analyses for R-Area Acid/Caustic Basin

Metals	Concentration Range (μg/g)*	EP Toxicity Results (mg/L)	EP Toxicity Standards (mg/L)**
Aluminum	954-16,700		
Arsenic	<0.25-0.54	0.002	5.0
Barium	9.50-103	2.22	100.0
Cadmium	<2.0	0.04	1.0
Chromium	<4.0-20.4	0.08	5.0
Copper	<4.0-171		
Iron	380-8,780		
Lead	<5.0-113	0.1	5.0
Magnesium	55.6-4,630		
Manganese	<2.0-167		
Mercury	<0.2-1.10	0.0002	0.2
Nickel	<4.0-6.10		
Selenium	<0.25	0.002	1.0
Silver	<2.0	0.2	5.0
Sodium	156-4,880		
Tin	<15.0-20.3		
Zinc	<2.0-733		
Inorganics			
Boron	<0.25-67.64		
Sulfate	144.5-930.0		
Sulfide	<25		
Nitrate	<1.25-7.30		
Nitrite	<0.50-<2.50		
Ammonium	2.8-17.0		
Fluoride	0.30-5.90		
Chloride	7.3-486.0		
Phosphate	<1.3-117		
Radioactivity			
Gross alpha	0-44.2 pCi/g		
Nonvol. beta	0-104 pCi/g		
Gross gamma	Background levels		

* Concentration range for samples taken at 0-0.5 ft, 0.5-1.0 ft, 1.5-2.0 ft, and 4.5-5.0 ft depth intervals.

** Federal Regulation 40 CFR 261.

TABLE 13-3

Summary of Groundwater Quality: Well Concentration Ranges for the R-Area Acid/Caustic Retention Basin (7/84-12/86)

Constituent	SC and Federal DWS	RAC 1	RAC 2	RAC 3	RAC 4
pH (pH)	6.5-8.5	3.7-4.9	3.5-5.2	3.4-6.2	3.6-4.8
Conductivity (µmhos/cm)	NA	35-105	29-69	27-125	29-41
Silver (mg/L)	0.05	<0.0020-0.0030	<0.0020-0.0060	<0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.008-0.009	0.011-0.026	0.012-0.046	0.013-0.021
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.001
Chloride (mg/L)	250	3.1-5.1	2.6-3.9	3.1-4.7	3.1-3.5
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.002
Copper (mg/L)	1	0.005-0.021	0.012-0.063	0.009-0.013	0.018
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0-6.0	<5.0-6.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10	<0.10-0.19	<0.10-0.17
Iron (mg/L)	0.3	0.028-0.104	0.048-0.080	0.050-0.090	0.017-0.119
Mercury (mg/L)	0.002	<0.0002-0.0005	<0.0002-0.0004	<0.0002-0.0004	<0.0002
Manganese (mg/L)	0.05	0.004-0.032	0.007-0.029	0.011-0.031	0.010-0.020
Sodium (mg/L)	NA	0.60-3.88	1.43-2.82	1.74-19.00	2.51-3.08
Nickel (mg/L)	NA	<0.004	<0.004-0.005	<0.004	---
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	1.35-1.48	1.12-1.70	0.68-1.15	<0.50-1.26
Lead (mg/L)	0.05	0.013-0.045	0.009-0.054	0.008-0.057	<0.005-0.016
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0-40.0	<3.0	<3.0-45.0	<3.0
TDS (mg/L)	500	42-44	52-58	22-32	---
TOC (mg/L)	NA	1.00-5.00	<1.00-14.0	<1.00-3.46	0.400-2.200
TOH (mg/L)	NA	<0.005-0.028	<0.005-0.066	<0.005-0.029	<0.005
Zinc (mg/L)	5	0.011-0.032	0.023-0.044	0.066-0.072	---
Gross alpha (pCi/L)	15	1.4-26.0	<2.0-13.0	1.4-5.0	<2.0
Nonvolatile beta (pCi/L)	NA	3.0-30.0	<3.0-12.0	<3.0-11.0	<3.0
Total radium (pCi/L)	5	<1.0-4.2	0.5-3.0	<1.0-3.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards.

TABLE 13-4

Trace Elements in Different Types of Ash

Element	Ash Type (mg/L) Fly Ash (Electrostatic Precipitator)	Fly Ash (Mechanical Collector)	Bottom Ash
Barium	889	792	808
Strontium	579	589	333
Manganese	352	275	811
Zinc	280	116	95
Vanadium	218	166	140
Cerium	189	251	150
Chromium	171	140	160
Arsenic	164	55	4
Copper	130	93	67
Nickel	89	87	77
Gallium	72	32	20
Lanathanum	69	61	61
Cobalt	67	47	40
Lead	60	28	5
Bromine	47	12	3
Scandium	32	28	20
Thorium	23	24	25
Antimony	19	6	3
Molybdenum	18	11	7
Beryllium	16	12	9
Samarium	15	13	12
Selenium	15	6	3
Cesium	14	13	10
Uranium	13	8	8
Europium	11	12	8
Ytterbium	12	8	10
Terbium	2.5	2.1	2
Mercury	0.84	0.33	0.08
Cadmium	0.71	0.39	0.5

Note: Data, from Christensen and Gordon (1983), were collected in 1977.

TABLE 13-5

Trace Metal Analysis of 488-D Ash Basin Sludge Sample Extracts

Metal	Ash Basin Sludge (mg/L)	EPA Extract Level Limit (mg/L)
Chromium	<0.002	5.0
Cadmium	<0.001	1.0
Barium	1	100.0
Silver	<0.001	5.0
Mercury	<0.01	0.2
Lead	<0.002	5.0
Arsenic	<0.01	5.0
Selenium	<0.01	1.0

Note: Data, from Christensen and Gordon (1983), were collected in January 1980.

TABLE 13-6

Summary of Groundwater Quality: Well Concentration Ranges for the R-Area Burning/Rubble Pits (7/84-12/86)

Constituent	SC and Federal DWS	RRP 1	RRP 2	RRP 3	RRP 4
pH (pH)	6.5-8.5	3.6-4.7	3.6-4.7	3.8-5.1	3.7-4.8
Conductivity (µmhos/cm)	NA	22-40	21-54	9-21	16-33
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020-0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.022-0.026	0.007-0.022	0.008-0.010	0.009-0.015
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.001
Chloride (mg/L)	250	3.0-3.9	2.0-48.8	1.7-2.3	2.1-3.0
Chromium (mg/L)	0.05	<0.004	<0.004-0.004	<0.004	<0.002
Copper (mg/L)	1	<0.004-0.005	0.006-0.008	0.007-0.010	---
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0-10.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.16	<0.10-0.14	<0.10-0.14	<0.10-0.17
Iron (mg/L)	0.3	0.012-0.095	0.015-0.163	0.024-0.111	0.021-0.139
Mercury (mg/L)	0.002	<0.0002-0.0005	<0.0002-0.0004	<0.0002-0.0005	<0.0002
Manganese (mg/L)	0.05	<0.002-0.010	<0.002-0.031	<0.002-0.004	<0.002-0.006
Sodium (mg/L)	NA	0.75-1.11	0.54-2.90	0.45-0.54	1.13-1.63
Nickel (mg/L)	NA	<0.004	<0.004	<0.004	---
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	1.25-1.50	0.50-0.60	0.06	0.40-0.51
Lead (mg/L)	0.05	0.010-0.046	0.018-0.035	<0.005-0.026	<0.006-0.020
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002-0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0-28.0	<5.0
TDS (mg/L)	500	12-38	10-32	<5-30	---
TOC (mg/L)	NA	<1.00-23.00	0.300-1.12	0.440-10.38	0.350-3.000
TOH (mg/L)	NA	<0.005-0.011	<0.005-0.025	<0.005-0.020	<0.005-0.013
Zinc (mg/L)	5	0.006-0.014	0.011-0.016	0.011-0.013	---
Gross alpha (pCi/L)	15	<2.0-5.0	1.7-2.3	<2.0	<2.0-18.0
Nonvolatile beta (pCi/L)	NA	1.8-6.0	1.9-9.0	<2.0-9.0	1.8-11.0
Total radium (pCi/L)	5	<1.0	<1.0	<1.0-2.0	<1.0-2.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards.

TABLE 13-7

Estimated Radionuclide Inventory in the R-Area Bingham Pump Outage Pits

Radionuclide	At Burial (Ci)	Decay Corrected through 12/31/85 (mCi)
^{60}Co	0.172	0.005
^{90}Sr	0.112	0.06
$^{103,106}Ru$	0.130	1.0E-09
^{137}Cs	0.414	0.22
^{147}Pm	0.172	1.0E-04

Note: Data are from Pekkala et al. (1987a).

TABLE 13-8

Radioactivity in Vegetation at the R-Area Bingham Pump Outage Pits Versus Radioactivity in Vegetation at Plant Boundary

	Gross Alpha (pCi/g)				Nonvolatile Beta (pCi/g)			
	Pit		Plant Boundary		Pit		Plant Boundary	
Pit No.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
1	0.2	0.5	0.2	0.6	37	51	21	31
2	0.2	0.5	0.2	0.6	37	51	21	31
3	0.2	0.5	0.2	0.6	37	51	21	31

Note: Data are from Pekkala et al. (1987a).

TABLE 13-9

Installation Data for the R-Area Reactor Seepage Basins

		In Use			Dimensions (ft)		
Basin	Building	From	To	Shape	Length	Width	Depth
1	904-103G	6/57	12/57	L	395	30	10
2	904-104G	1957	1960	Rectangular	130	45	10
3	904-57G	1957	1960	Rectangular	295	30	10
4	904-58G	1957	1960	Rectangular	305	35	6.5
5	904-59G	1957	1960	Rectangular	295	40	10
6	904-60G	1958	1964	Rectangular	490	45	15

Note: Data are from Pekkala et al. (1987b).

TABLE 13-10

Summary of Radioactive Releases to the R-Area Reactor Seepage Basins

Isotope	Release (Ci)
^{3}H*	2.0E+03
^{60}Co	7.6E-02
^{90}Sr	1.0E+02
$^{103,106}Ru$	5.5E-08
^{137}Cs	4.7E+02
^{147}Pm	2.0E-03
^{239}Pu	3.0E-01

Note: Release values cumulative through 1985. All values are decay corrected through 1985. Data are from Pekkala et al. (1987b).

* Most of the tritium is believed to have left the basin via the atmosphere or groundwater.

TABLE 13-11

Volumes Purged to the R-Area Reactor Seepage Basins

Year	Volume (L)
1957	6.81E+06
1958	6.02E+06
1959	7.57E+05
1960	7.57E+05
1961	1.14E+06
1962	8.50E+05
1963	1.14E+06
1964	7.57E+05
Total	1.82E+07

Note: Data are from Pekkala et al. (1987b).

TABLE 13-12

Cesium and Strontium Activity in R-Area Reactor Seepage Basins Soil

Basin	Concentration (nCi/g--dry) ^{137}Cs (max)	^{90}Sr (max)
1	8,000	41
2	810	12
3*	0.34	<0.1
4	23	0.07
5	27	2.1

Note: Data are from Pekkala et al. (1987b).

* Soil sampled above maximum zone of contamination.

TABLE 13-13

Radioactivity in the R-Area Reactor Seepage Basins Wells (Annual Averages)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSA 6						
1962	0.30	0.50	18.00	24.00	10	18
1963	0.40	0.70	26.00	48.00	12	22
RSA 7						
1962	0.30	0.40	16.00	30.00	16	32
1963	0.30	0.30	16.00	30.00	17	18
1964	0.60	1.20	350.00	980.00	---	---
1965	0.40	0.50	10.00	12.00	---	---
1966	0.60	0.90	9.00	13.00	---	---
1967	0.20	0.50	8.00	11.00	---	---
1970	0.20	0.20	75.00	75.00	---	---
1971	0.40	0.80	16.00	11.00	---	---
1972	0.30	0.30	17.00	30.00	---	---
1973	0.20	0.30	6.00	8.00	---	---
1974	0.20	0.49	67.53	108.44	---	---
1975	0.33	0.49	9.09	12.45	---	---
1976	0.30	0.33	6.24	6.76	---	---
1977	0.14	0.25	0.12	4.70	---	---
1978	0.14	0.25	0.86	0.29	---	---
1979	0.09	0.50	1.20	3.50	---	---
1980	0.03	0.00	1.80	0.00	---	---
1981	0.42	0.42	6.00	6.00	---	---
1982	0.19	0.49	5.50	7.40	---	---
1983	0.14	0.19	0.28	0.56	---	---
1984	0.49	0.68	5.40	9.80	---	---
1985	0.20	0.29	0.39	0.52	---	---
1986	0.21	0.22	1.30	1.30	---	---
RSA 8						
1962	0.20	0.30	7.00	10.00	15	22
1963	0.30	0.50	21.50	40.00	5	9
1964	0.40	0.40	24.00	35.00	---	---
1965	0.40	0.50	6.00	8.00	---	---
1966	0.20	0.30	7.00	9.00	---	---
1967	0.60	0.90	10.00	18.00	---	---
1970	2.00	2.00	82.00	82.00	---	---
1971	1.00	1.50	14.00	21.00	---	---
1972	0.80	1.20	11.00	14.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSA 8 (cont.)						
1973	0.80	1.00	5.00	7.00	---	---
1974	0.42	0.66	19.55	30.69	---	---
1975	0.33	0.41	10.14	12.30	---	---
1976	0.31	0.50	4.28	6.76	---	---
1977	0.36	1.20	4.90	14.00	---	---
1978	0.36	0.67	0.30	1.60	---	---
1979	0.16	0.00	2.90	3.70	---	---
1980	0.00	0.16	1.40	1.50	---	---
1982	0.08	0.16	7.80	10.00	---	---
1983	0.08	0.16	1.10	1.10	---	---
1984	0.15	0.19	1.80	2.30	---	---
1985	0.45	0.61	0.89	1.30	---	---
1986	0.10	0.19	1.30	1.90	---	---
RSA 9						
1962	0.40	0.50	24.00	42.00	19	23
1963	0.30	0.40	68.00	120.00	12	18
1964	0.40	0.60	30.00	46.00	---	---
1965	0.20	0.30	23.00	39.00	---	---
1966	0.10	0.20	18.00	19.00	---	---
1967	0.40	0.60	18.00	22.00	---	---
1971	0.40	1.30	14.00	20.00	---	---
1972	0.50	0.70	13.00	19.00	---	---
1973	0.50	0.70	8.00	11.00	---	---
1974	0.11	0.34	14.76	21.15	---	---
1975	0.25	0.41	9.52	13.07	---	---
1976	0.38	0.84	5.08	6.86	---	---
1977	0.15	0.25	3.40	5.00	---	---
1978	0.30	0.41	1.80	2.70	---	---
1979	0.03	0.08	3.50	6.50	---	---
1980	0.16	0.33	0.12	1.60	---	---
1982	0.54	0.66	0.85	1.70	---	---
1983	0.08	0.16	1.20	2.30	---	---
1984	0.25	0.49	2.70	3.30	---	---
1985	0.56	0.82	1.00	1.10	---	---
1986	0.18	0.58	1.00	1.50	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSA 10						
1962	0.20	0.30	19.00	27.00	6	9
1964	0.50	0.90	130.00	250.00	---	---
1965	0.30	0.60	11.00	13.00	---	---
1966	0.20	0.30	8.00	11.00	---	---
1972	0.70	1.20	14.00	14.00	---	---
1973	0.40	0.80	18.00	21.00	---	---
1976	0.42	0.75	---	---	---	---
1977	0.08	0.08	4.40	6.80	---	---
1978	0.59	0.92	1.10	2.10	---	---
1979	0.17	0.25	2.20	0.00	---	---
1980	0.12	0.00	4.40	0.00	---	---
1981	0.17	0.00	2.90	2.90	---	---
1982	0.37	0.41	2.80	6.10	---	---
1983	0.30	0.40	0.81	1.40	---	---
1984	0.05	0.10	1.20	1.50	---	---
1985	0.34	0.58	0.81	1.30	---	---
1986	0.05	0.10	0.89	1.40	---	---
RSB 7						
1963	---	---	11.00	14.00	---	---
1964	0.65	1.00	36.00	220.00	---	---
1965	0.60	0.90	18.50	39.00	---	---
1966	0.60	1.20	18.00	32.00	---	---
1967	0.55	1.20	21.50	43.00	---	---
1968	0.95	1.80	19.50	28.00	---	---
1969	1.20	1.70	21.50	50.00	---	---
1970	1.25	3.60	24.50	51.00	---	---
1971	1.00	2.40	75.50	630.00	---	---
1972	0.90	1.40	10.50	19.00	---	---
1973	1.00	2.00	16.00	36.00	---	---
1974	0.56	1.19	19.61	144.70	---	---
1975	0.55	1.65	9.48	43.69	---	---
1976	0.68	1.65	12.46	32.98	---	---
1977	0.50	1.00	8.00	19.00	---	---
1978	0.53	1.00	6.90	0.11	---	---
1979	0.57	1.50	8.90	15.00	---	---
1980	0.61	1.50	2.60	9.00	---	---
1981	0.29	0.67	9.50	11.00	---	---
1982	0.50	0.58	14.00	14.00	---	---
1983	0.80	1.50	3.40	6.50	---	---
1984	0.83	1.70	4.70	5.60	---	---
1985	0.05	0.20	0.30	0.34	---	---
1986	0.10	0.19	4.70	8.30	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSB 8						
1976	0.66	0.75	20.98	55.28	---	---
1977	1.00	2.40	12.00	25.00	---	---
1978	0.81	2.40	5.40	0.13	---	---
1979	0.63	1.20	5.30	17.00	---	---
1980	0.68	1.10	3.90	24.00	---	---
1981	0.50	1.00	7.40	18.00	---	---
1982	0.99	1.20	1.20	3.40	---	---
1983	0.99	0.99	2.10	2.10	---	---
1984	0.34	0.58	4.20	6.40	---	---
1985	0.29	0.48	1.70	2.00	---	---
1986	0.15	0.19	3.10	4.10	---	---
RSB 9						
1977	0.96	1.30	6.00	8.80	---	---
1978	0.59	1.30	3.60	8.60	---	---
1979	0.37	1.10	2.30	5.70	---	---
1980	0.40	1.10	1.20	3.70	---	---
1981	0.27	0.59	0.67	6.40	---	---
1982	0.33	0.74	6.00	6.00	---	---
1983	0.36	0.82	2.20	3.70	---	---
1984	0.34	0.39	0.49	0.55	---	---
1985	0.35	0.51	0.85	1.50	---	---
1986	0.04	0.29	0.52	0.91	---	---
RSC 2						
1962	0.30	0.50	19.00	45.00	22	28
1963	0.30	0.50	21.00	40.00	22	25
1977	0.50	0.50	7.80	7.80	---	---
1978	0.49	0.49	0.72	0.72	---	---
1979	0.08	0.08	2.40	2.40	---	---
1980	ND	0.00	ND	0.00	---	---
1981	0.51	0.51	1.50	1.50	---	---
1982	1.20	1.50	10.00	12.00	---	---
1983	0.82	1.70	1.60	3.40	---	---
1984	0.29	0.29	0.80	0.80	---	---
1985	0.15	0.19	1.20	1.40	---	---
1986	0.44	0.88	1.60	2.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSC 3						
1962	0.50	1.00	16.00	36.00	6	14
1963	0.40	0.60	16.50	25.00	7	13
1964	0.40	0.90	120.00	300.00	---	---
1965	0.20	0.30	17.00	19.00	---	---
1966	0.40	0.70	26.00	45.00	---	---
1967	0.30	0.50	14.00	22.00	---	---
1968	0.70	0.70	14.00	14.00	---	---
1969	0.50	0.50	10.00	11.00	---	---
1970	0.60	0.70	25.00	43.00	---	---
1971	0.40	0.50	30.00	48.00	---	---
1972	0.80	1.10	40.00	63.00	---	---
1973	0.20	0.40	38.00	47.00	---	---
1974	0.66	0.79	15.08	20.69	---	---
1975	0.63	1.07	16.30	22.90	---	---
1976	0.25	0.50	25.68	33.99	---	---
1977	0.96	3.10	12.00	20.00	---	---
1978	0.42	0.58	0.24	2.20	---	---
1979	0.41	0.57	1.40	2.90	---	---
1980	0.41	0.74	0.31	2.50	---	---
1981	0.08	0.08	2.10	0.00	---	---
1982	0.83	1.10	7.40	11.00	---	---
1983	0.16	0.50	4.20	6.00	---	---
1984	0.68	0.68	0.77	1.10	---	---
1985	0.86	1.30	0.94	1.20	---	---
1986	0.15	0.29	0.62	0.93	---	---
RSC 4						
1962	0.50	0.60	22.00	35.00	15	23
1963	0.30	0.60	17.00	24.00	17	24
1964	0.40	0.60	90.00	230.00	---	---
1965	0.30	0.40	32.00	70.00	---	---
1966	0.10	0.20	10.00	16.00	---	---
1967	0.50	0.50	12.00	14.00	---	---
1968	0.80	0.90	12.00	12.00	---	---
1969	1.10	2.20	34.00	57.00	---	---
1970	0.30	0.40	4.00	4.00	---	---
1971	0.10	0.30	8.00	11.00	---	---
1972	0.90	2.20	4.00	9.00	---	---
1973	0.50	0.50	10.00	11.00	---	---
1974	1.23	2.07	22.58	37.21	---	---
1975	0.36	0.41	4.68	7.81	---	---
1976	0.30	0.41	6.32	9.07	---	---
1977	1.80	2.60	20.00	33.00	---	---
1978	1.40	2.50	0.54	0.10	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSC 4 (cont.)						
1979	1.60	2.40	6.60	14.00	---	---
1980	1.40	1.60	6.20	9.70	---	---
1981	---	---	0.00	0.00	---	---
1982	0.91	0.91	46.00	0.00	---	---
1983	0.24	0.66	5.40	8.60	---	---
1984	0.29	0.39	0.28	0.61	---	---
1985	0.31	0.51	1.70	1.80	---	---
1986	0.25	0.39	0.98	1.20	---	---
RSC 5						
1962	0.50	0.90	31.00	87.00	22	42
1963	0.50	0.80	22.50	41.00	31	103
1964	0.60	0.90	33.00	75.00	---	---
1965	0.20	0.40	36.00	91.00	---	---
1966	0.40	0.70	17.00	28.00	---	---
1967	0.50	0.70	14.00	17.00	---	---
1968	2.80	2.80	48.00	48.00	---	---
1970	1.00	1.70	36.00	43.00	---	---
1971	0.30	0.40	10.00	12.00	---	---
1972	ND	ND	6.00	6.00	---	---
1973	0.60	0.80	79.00	130.00	---	---
1974	0.34	0.57	66.42	107.80	---	---
1975	0.64	0.67	21.64	28.12	---	---
1976	0.61	0.75	23.71	30.19	---	---
1977	0.19	0.25	8.20	19.00	---	---
1978	0.22	0.33	2.80	4.70	---	---
1979	0.16	0.24	1.80	3.10	---	---
1980	0.11	0.33	1.20	2.50	---	---
1981	0.08	0.08	5.70	5.70	---	---
1982	1.20	1.70	3.10	7.80	---	---
1983	0.13	0.16	6.40	11.00	---	---
1984	0.24	0.29	3.50	5.90	---	---
1985	0.15	0.20	2.60	2.70	---	---
1986	0.10	0.19	2.50	3.20	---	---
RSC 6						
1962	0.60	0.80	23.00	36.00	46	58
1963	0.60	0.80	18.50	44.00	59	72
1964	0.30	0.40	100.00	260.00	---	---
1965	0.20	0.30	12.00	13.00	---	---
1966	0.50	0.70	10.00	11.00	---	---
1967	0.20	0.30	15.00	26.00	---	---
1968	0.70	0.80	18.00	27.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSC 6 (cont.)						
1969	0.90	1.10	165.00	420.00	---	---
1970	0.40	0.40	6.00	6.00	---	---
1971	0.10	0.20	8.00	13.00	---	---
1972	0.30	0.60	7.00	8.00	---	---
1973	0.40	1.00	19.00	24.00	---	---
1974	0.52	1.06	9.51	14.63	---	---
1975	0.25	0.41	7.45	13.60	---	---
1976	0.53	0.59	6.82	9.24	---	---
1977	0.80	1.20	7.80	14.00	---	---
1978	0.89	1.30	1.40	5.00	---	---
1979	0.03	0.17	2.00	7.10	---	---
1980	0.08	0.16	1.60	2.50	---	---
1981	0.17	0.00	0.90	0.90	---	---
1982	0.62	0.66	9.90	10.00	---	---
1983	0.84	1.50	3.20	4.60	---	---
1984	0.34	0.58	1.90	2.10	---	---
1985	0.35	0.40	1.20	1.60	---	---
1986	0.10	0.19	2.70	4.00	---	---
RSC 7						
1962	0.30	0.50	15.00	26.00	9	26
1963	0.40	0.80	20.50	33.00	6	16
1964	0.80	1.30	90.00	230.00	---	---
1965	0.30	0.80	10.00	16.00	---	---
1966	0.20	0.40	6.00	10.00	---	---
1967	0.40	0.60	17.00	34.00	---	---
1968	0.30	0.30	17.00	23.00	---	---
1970	0.50	0.50	20.00	20.00	---	---
1971	0.30	0.50	14.00	15.00	---	---
1972	0.60	0.90	26.00	50.00	---	---
1973	0.60	0.80	25.00	34.00	---	---
1974	0.44	0.86	25.69	51.36	---	---
1975	0.38	0.49	12.49	17.75	---	---
1976	0.56	0.92	10.98	17.98	---	---
1977	0.78	1.40	15.00	34.00	---	---
1978	0.50	0.67	0.11	0.28	---	---
1979	0.25	0.33	6.40	8.60	---	---
1980	0.79	1.10	8.50	10.00	---	---
1981	0.76	0.76	5.10	5.10	---	---
1982	0.87	0.99	12.00	14.00	---	---
1983	0.55	0.99	5.50	8.10	---	---
1984	0.20	0.39	1.60	1.90	---	---
1985	0.35	0.38	2.30	3.30	---	---
1986	0.10	0.19	1.80	1.90	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSC 8						
1962	0.80	1.20	15.00	30.00	24	33
1963	0.80	1.00	14.00	16.00	44	60
1977	0.84	0.84	8.30	8.30	---	---
1978	0.08	0.08	6.50	6.50	---	---
1979	0.59	0.59	-0.85	0.00	---	---
1980	0.53	0.65	2.00	7.20	---	---
1981	0.25	0.25	0.00	0.00	---	---
1982	0.24	0.32	2.90	7.10	---	---
1983	0.54	0.82	3.80	4.60	---	---
1984	0.29	0.29	0.92	0.92	---	---
1985	0.29	0.58	0.44	0.48	---	---
1986	0.59	0.78	0.72	1.40	---	---
RSC 9						
1962	0.40	0.60	10.00	23.00	13	11
1963	0.20	0.30	15.00	19.00	24	33
1977	0.67	0.67	7.80	7.80	---	---
1978	0.49	0.49	2.90	2.90	---	---
1979	0.33	0.33	1.80	1.80	---	---
1980	ND	0.24	ND	0.00	---	---
1981	0.25	0.00	5.60	5.60	---	---
1982	1.40	1.70	3.60	7.50	---	---
1983	0.44	0.58	0.43	1.30	---	---
1984	1.10	1.10	0.67	0.67	---	---
1985	0.21	0.41	0.38	0.89	---	---
1986	0.63	1.10	1.90	2.90	---	---
RSC 10						
1962	0.20	0.40	10.00	17.00	16	34
1963	0.30	0.50	14.00	21.00	10	13
1977	1.40	1.40	6.80	6.80	---	---
1978	0.41	0.41	3.00	3.00	---	---
1979	0.33	0.33	4.80	4.80	---	---
1980	ND	0.65	ND	-3.20	---	---
1982	0.42	0.58	2.00	3.80	---	---
1983	0.25	0.49	3.70	5.00	---	---
1984	0.49	0.49	0.86	0.86	---	---
1985	0.20	0.20	1.20	1.20	---	---
1986	0.49	0.58	1.10	1.50	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSD 1						
1962	0.30	0.80	19.00	24.00	---	---
1963	0.50	0.70	23.00	75.00	36	45
1964	0.65	1.40	86.50	520.00	---	---
1965	0.50	1.40	105.00	170.00	---	---
1966	0.60	1.20	77.50	100.00	---	---
1967	0.55	0.80	45.50	61.00	---	---
1968	0.50	1.20	30.50	41.00	---	---
1969	0.35	0.90	23.00	68.00	---	---
1970	0.55	0.90	39.00	110.00	---	---
1971	0.55	1.30	19.00	30.00	---	---
1972	0.65	1.90	16.00	41.00	---	---
1973	0.60	1.00	26.00	100.00	---	---
1974	0.59	1.52	21.72	77.09	---	---
1975	0.52	1.00	25.18	37.45	---	---
1976	0.72	1.27	41.05	51.39	---	---
1977	0.75	1.80	39.00	50.00	---	---
1978	0.63	1.40	0.59	0.35	---	---
1979	0.27	0.66	30.00	37.00	---	---
1980	0.41	0.92	25.00	39.00	---	---
1981	0.31	0.66	27.00	41.00	---	---
1982	0.17	0.25	30.00	36.00	---	---
1983	0.30	0.49	39.00	49.00	---	---
1984	0.63	0.68	31.00	32.00	---	---
1985	0.71	1.10	24.00	28.00	---	---
1986	0.65	0.97	32.00	37.00	---	---
RSD 2						
1962	0.30	0.80	65.00	79.00	44	49
1963	0.30	0.40	49.00	81.00	42	49
1964	0.50	1.10	87.00	330.00	---	---
1965	0.40	0.80	82.00	320.00	---	---
1966	0.50	1.20	86.00	300.00	---	---
1967	0.60	1.10	90.50	120.00	---	---
1968	0.40	0.90	140.00	180.00	---	---
1969	0.30	0.70	125.00	210.00	---	---
1970	0.50	0.90	130.00	200.00	---	---
1971	0.35	0.80	127.00	170.00	---	---
1972	0.60	1.70	145.00	210.00	---	---
1973	0.40	0.80	210.00	260.00	---	---
1974	0.41	1.19	307.44	439.87	---	---
1975	0.37	1.40	330.86	448.29	---	---
1976	0.43	0.74	332.50	606.03	---	---
1977	0.41	0.70	270.00	350.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSD 2A						
1978	0.43	0.92	0.30	0.37	---	---
1979	0.25	0.91	280.00	320.00	---	---
1980	0.50	2.30	260.00	310.00	---	---
1981	0.19	0.34	290.00	370.00	---	---
1982	0.54	0.74	260.00	290.00	---	---
1983	1.40	2.40	340.00	440.00	---	---
1984	2.30	2.70	200.00	230.00	---	---
1985	0.29	0.38	170.00	210.00	---	---
1986	0.92	1.70	200.00	230.00	---	---
RSD 2B						
1964	1.00	1.50	41.00	110.00	---	---
1965	1.25	2.50	38.00	400.00	---	---
1966	0.90	1.10	14.00	18.00	---	---
1971	1.70	2.30	112.50	520.00	---	---
1972	3.25	10.00	49.00	120.00	---	---
1973	1.70	2.50	130.00	400.00	---	---
1974	1.68	2.21	58.54	71.92	---	---
1975	2.71	5.69	1,229.91	4,487.88	---	---
1976	1.63	2.80	728.23	1,212.22	---	---
1977	2.30	2.90	210.00	260.00	---	---
1978	1.70	2.90	0.13	0.23	---	---
1979	2.90	3.90	170.00	290.00	---	---
1980	2.50	4.40	140.00	240.00	---	---
1981	---	---	0.00	0.00	---	---
1982	1.40	1.90	54.00	68.00	---	---
1983	0.99	0.82	49.00	49.00	---	---
1984	3.50	3.50	220.00	220.00	---	---
RSD 2C						
1964	0.80	1.20	120.00	240.00	---	---
1965	1.00	1.30	575.00	1,400.00	---	---
1966	0.95	1.40	1,050.00	1,700.00	---	---
1967	1.05	3.20	800.50	1,150.00	---	---
1968	0.95	1.40	300.00	640.00	---	---
1969	0.75	1.00	160.00	270.00	---	---
1970	1.05	2.10	405.00	880.00	---	---
1971	1.85	2.50	1,170.00	2,090.00	---	---
1972	1.65	2.70	1,450.00	2,300.00	---	---
1973	1.70	2.80	2,700.00	5,400.00	---	---
1974	1.74	2.88	4,076.21	6,860.83	---	---
1975	1.43	2.38	4,679.35	6,838.19	---	---
1976	0.90	1.65	4,064.91	5,695.12	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSD 2C (cont.)						
1977	2.00	3.10	4,500.00	5,700.00	---	---
1978	1.70	2.50	2,900.00	4,600.00	---	---
1979	1.80	3.00	3,300.00	4,900.00	---	---
1980	1.70	2.80	5,000.00	7,800.00	---	---
1981	0.43	0.81	2,900.00	4,100.00	---	---
1982	1.60	1.70	3,100.00	3,400.00	---	---
1983	2.10	2.20	2,300.00	4,600.00	---	---
1984	1.80	2.00	4,000.00	4,700.00	---	---
1985	3.50	4.20	3,400.00	4,400.00	---	---
1986	13.00	18.00	3,000.00	4,000.00	---	---
RSD 3						
1962	0.30	0.50	17.00	24.00	29	36
1963	LS	0.20	28.00	86.00	31	36
1964	0.20	0.40	15.00	19.00	---	---
1965	0.40	0.50	24.00	30.00	---	---
1966	0.40	0.70	18.00	31.00	---	---
1967	0.50	0.80	8.00	18.00	---	---
1968	0.40	0.40	14.00	14.00	---	---
1969	0.80	1.50	28.00	70.00	---	---
1970	0.60	0.60	8.00	9.00	---	---
1971	0.50	---	---	---	---	---
1972	---	0.20	5.00	7.00	---	---
1973	0.40	0.50	9.00	15.00	---	---
1974	0.57	0.86	9.44	12.10	---	---
1975	0.86	1.24	14.11	16.33	---	---
1976	0.64	1.17	13.65	20.82	---	---
1977	0.11	0.42	9.30	13.00	---	---
1978	0.44	0.75	0.14	0.22	---	---
1979	0.30	0.50	6.30	7.30	---	---
1980	0.05	0.08	3.80	6.10	---	---
1981	0.08	0.00	3.80	3.80	---	---
1982	0.41	0.66	6.60	11.00	---	---
1983	0.08	0.16	4.20	4.60	---	---
1984	0.34	0.68	2.20	2.50	---	---
1985	0.30	0.30	1.80	2.70	---	---
1986	0.09	0.29	1.60	1.90	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSD 4						
1976	0.92	1.09	179.26	229.00	---	---
1977	1.30	2.60	290.00	620.00	---	---
1978	0.95	1.40	390.00	800.00	---	---
1979	0.84	1.50	270.00	570.00	---	---
1980	1.10	1.90	300.00	560.00	---	---
1981	0.55	1.10	240.00	320.00	---	---
1982	1.50	1.90	490.00	750.00	---	---
1983	2.20	3.30	170.00	240.00	---	---
1984	3.40	3.70	160.00	180.00	---	---
1985	0.74	0.87	180.00	220.00	---	---
1986	1.10	1.90	160.00	180.00	---	---
RSD 5						
1976	0.54	0.87	533.91	604.01	---	---
1977	0.96	1.90	530.00	1,500.00	---	---
1978	0.91	1.60	650.00	1,000.00	---	---
1979	0.73	1.60	780.00	990.00	---	---
1980	0.86	2.00	570.00	940.00	---	---
1981	0.51	1.20	610.00	770.00	---	---
1982	0.74	0.74	780.00	780.00	---	---
1983	1.60	1.80	250.00	430.00	---	---
1984	2.20	2.40	330.00	510.00	---	---
1985	1.10	1.50	330.00	480.00	---	---
1986	2.30	4.00	480.00	510.00	---	---
RSD 6						
1976	0.53	1.05	127.87	243.65	---	---
1977	0.64	1.50	250.00	520.00	---	---
1978	0.65	1.80	300.00	550.00	---	---
1979	0.68	1.50	290.00	390.00	---	---
1980	0.47	0.81	220.00	320.00	---	---
1981	0.32	0.74	250.00	300.00	---	---
1982	0.54	0.58	250.00	260.00	---	---
1983	1.20	2.10	250.00	340.00	---	---
1984	2.20	2.80	150.00	200.00	---	---
1985	0.81	1.10	120.00	140.00	---	---
1986	0.94	1.20	170.00	180.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
RSD 7						
1977	0.86	1.80	560.00	1,200.00	---	---
1978	0.70	1.10	740.00	1,600.00	---	---
1979	0.68	2.00	420.00	990.00	---	---
1980	0.54	1.40	360.00	710.00	---	---
1981	0.45	1.20	530.00	1,000.00	---	---
1982	0.96	3.80	1,200.00	1,700.00	---	---
1983	1.20	3.80	590.00	1,600.00	---	---
1984	2.00	4.60	100.00	170.00	---	---
1985	0.58	2.20	120.00	210.00	---	---
1986	1.00	1.70	130.00	180.00	---	---
RSD 8						
1977	0.78	1.20	160.00	370.00	---	---
1978	0.63	1.20	370.00	900.00	---	---
1979	0.52	1.10	970.00	2,800.00	---	---
1980	0.62	2.30	470.00	1,100.00	---	---
1981	0.36	0.57	350.00	530.00	---	---
1982	0.81	1.30	270.00	310.00	---	---
1983	1.10	3.10	270.00	450.00	---	---
1984	3.30	5.30	280.00	560.00	---	---
1985	1.90	4.40	640.00	1,100.00	---	---
1986	2.70	7.20	750.00	1,000.00	---	---
RSD 9						
1977	0.54	0.85	3.20	4.80	---	---
1978	0.58	1.20	3.50	9.70	---	---
1979	0.50	1.20	10.00	49.00	---	---
1980	0.41	0.99	3.10	34.00	---	---
1981	0.51	0.89	5.30	14.00	---	---
1982	0.60	1.10	6.10	22.00	---	---
1983	0.53	1.70	2.20	4.90	---	---
1984	0.35	0.76	3.50	11.00	---	---
1985	0.19	0.63	2.50	9.90	---	---
1986	0.50	0.88	4.30	11.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSD 10						
1977	0.25	0.51	47.00	52.00	---	---
1978	0.86	1.90	33.00	50.00	---	---
1979	0.65	1.50	37.00	62.00	---	---
1980	0.69	1.40	27.00	50.00	---	---
1981	0.60	1.30	47.00	72.00	---	---
1982	0.87	2.50	44.00	57.00	---	---
1983	0.55	0.96	48.00	97.00	---	---
1984	0.53	1.30	21.00	32.00	---	---
1985	0.36	0.87	55.00	320.00	---	---
1986	0.89	1.80	48.00	65.00	---	---
RSD 11						
1977	0.83	1.00	44.00	93.00	---	---
1978	0.46	0.91	25.00	36.00	---	---
1979	0.44	0.67	22.00	36.00	---	---
1980	0.44	0.91	18.00	32.00	---	---
1981	0.36	0.58	27.00	44.00	---	---
1982	0.34	0.51	17.00	28.00	---	---
1983	0.32	1.10	18.00	69.00	---	---
1984	0.56	1.10	11.00	17.00	---	---
1985	0.27	0.80	14.00	21.00	---	---
1986	0.48	0.92	14.00	26.00	---	---
RSE 1						
1963	---	---	520.00	690.00	---	---
1964	1.15	2.40	255.00	400.00	---	---
1965	1.05	2.20	290.00	520.00	---	---
1966	1.55	2.40	335.00	460.00	---	---
1967	1.65	2.60	391.50	520.00	---	---
1968	1.75	2.80	385.00	510.00	---	---
1969	1.60	2.90	175.00	260.00	---	---
1970	1.15	1.60	230.00	320.00	---	---
1971	1.50	2.60	215.00	280.00	---	---
1972	1.90	3.20	225.00	330.00	---	---
1973	1.80	3.70	220.00	490.00	---	---
1974	1.76	2.75	189.25	294.25	---	---
1975	1.82	3.38	113.26	157.92	---	---
1976	1.31	2.89	148.04	424.85	---	---
1977	1.20	2.30	67.00	98.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 1A						
1978	0.70	1.40	51.00	94.00	---	---
1979	0.80	2.20	36.00	58.00	---	---
1980	0.87	1.50	38.00	54.00	---	---
1981	0.52	0.84	63.00	100.00	---	---
1982	1.50	2.00	39.00	52.00	---	---
1983	0.55	0.63	29.00	57.00	---	---
1984	0.83	1.50	53.00	88.00	---	---
1985	0.44	0.58	44.00	55.00	---	---
1986	0.56	0.78	30.00	35.00	---	---
RSE 1B						
1964	1.10	1.60	16.00	27.00	---	---
1965	1.75	2.80	27.00	42.00	---	---
1966	1.25	1.60	20.50	33.00	---	---
1967	1.15	1.80	16.00	27.00	---	---
1968	2.30	2.30	65.00	65.00	---	---
1970	1.65	2.60	31.00	55.00	---	---
1971	1.90	2.50	29.50	44.00	---	---
1972	2.35	6.60	36.50	68.00	---	---
1973	1.90	3.90	46.00	160.00	---	---
1974	1.83	3.04	39.13	46.97	---	---
1975	2.49	4.04	20.29	40.80	---	---
1976	1.45	2.76	25.80	135.57	---	---
1977	1.80	4.10	17.00	32.00	---	---
1978	1.60	2.40	21.00	36.00	---	---
1979	1.30	2.80	11.00	23.00	---	---
1980	1.20	3.10	4.80	13.00	---	---
1981	0.08	0.08	8.30	8.30	---	---
1982	1.40	1.40	16.00	20.00	---	---
1983	0.27	0.82	5.10	7.30	---	---
1984	0.24	0.29	7.50	8.40	---	---
1985	0.41	0.41	15.00	15.00	---	---
1986	0.62	0.65	10.00	12.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 1C						
1964	1.20	2.40	56.00	83.00	---	---
1965	1.20	1.70	28.50	42.00	---	---
1966	1.30	2.00	28.00	53.00	---	---
1967	1.50	2.40	28.00	51.00	---	---
1968	1.15	1.80	56.00	91.00	---	---
1969	1.60	4.60	23.00	35.00	---	---
1970	1.65	3.50	28.00	54.00	---	---
1971	1.90	3.50	22.50	44.00	---	---
1972	1.35	2.40	18.00	43.00	---	---
1973	1.20	1.90	43.00	220.00	---	---
1974	1.20	2.59	43.64	230.71	---	---
1975	0.89	3.63	19.77	138.00	---	---
1976	0.65	3.30	21.66	118.59	---	---
1977	0.43	0.93	4.50	16.00	---	---
1978	0.51	1.70	7.80	38.00	---	---
1979	0.29	0.59	8.10	38.00	---	---
1980	0.32	0.66	2.70	16.00	---	---
1981	0.69	1.80	10.00	32.00	---	---
1982	0.87	1.20	4.40	5.50	---	---
1983	0.35	0.41	4.10	6.00	---	---
1984	0.15	0.19	2.60	2.60	---	---
1985	0.25	0.30	2.00	2.30	---	---
1986	0.21	0.22	2.20	2.80	---	---
RSE 2						
1963	---	---	36.00	46.00	---	---
1964	1.65	3.80	263.50	2,700.00	---	---
1965	2.05	3.00	115.00	230.00	---	---
1966	2.35	3.60	69.50	100.00	---	---
1967	2.30	3.30	40.00	68.00	---	---
1968	1.50	1.80	26.00	29.00	---	---
1969	1.40	2.30	14.50	26.00	---	---
1970	1.60	2.70	31.00	49.00	---	---
1971	1.80	3.10	39.50	110.00	---	---
1972	1.80	3.60	19.00	30.00	---	---
1973	1.40	3.20	42.00	140.00	---	---
1974	1.27	2.29	36.22	69.35	---	---
1975	0.69	1.32	21.95	68.68	---	---
1976	0.62	1.51	52.72	365.54	---	---
1977	1.10	2.00	10.00	17.00	---	---
1978	0.79	1.10	10.00	21.00	---	---
1979	0.56	1.10	6.50	15.00	---	---
1980	0.44	1.40	7.50	13.00	---	---
1981	0.31	0.51	22.00	35.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 2 (cont.)						
1982	0.99	1.20	10.00	12.00	---	---
1983	0.49	0.58	6.60	11.00	---	---
1984	0.53	0.76	3.40	5.40	---	---
1985	0.75	0.92	5.70	5.70	---	---
1986	0.15	0.19	5.70	6.10	---	---
RSE 3						
1963	---	---	10.00	13.00	---	---
1964	1.20	1.90	41.50	210.00	---	---
1965	1.00	1.40	35.50	100.00	---	---
1966	1.25	1.90	37.00	68.00	---	---
1967	1.40	2.10	27.00	38.00	---	---
1968	1.40	2.20	17.00	39.00	---	---
1969	1.75	4.40	15.50	25.00	---	---
1970	1.15	1.90	28.50	55.00	---	---
1971	1.30	2.00	53.00	130.00	---	---
1972	1.35	2.10	54.00	85.00	---	---
1973	1.70	3.50	52.00	89.00	---	---
1974	1.89	3.17	46.35	101.90	---	---
1975	1.82	3.60	45.23	77.29	---	---
1976	1.75	3.55	46.93	59.56	---	---
1977	1.90	2.50	35.00	43.00	---	---
1978	1.30	2.30	27.00	46.00	---	---
1979	0.86	2.20	29.00	45.00	---	---
1980	1.00	2.10	26.00	38.00	---	---
1981	0.69	1.00	20.00	31.00	---	---
1982	0.92	1.90	29.00	50.00	---	---
1983	1.20	2.60	24.00	43.00	---	---
1984	0.61	1.00	17.00	32.00	---	---
1985	0.36	1.10	10.00	30.00	---	---
1986	0.59	0.88	19.00	40.00	---	---
RSE 4						
1963	---	---	10.00	17.00	---	---
1964	1.05	2.40	465.00	340.00	---	---
1965	1.15	1.40	1,725.00	12,000.00	---	---
1966	1.25	1.50	485.00	1,800.00	---	---
1967	1.10	2.10	134.50	340.00	---	---
1968	0.85	1.40	26.00	45.00	---	---
1969	1.10	1.60	39.00	120.00	---	---
1970	1.30	2.30	128.00	460.00	---	---
1971	1.55	2.70	490.00	1,900.00	---	---
1972	1.65	3.30	590.00	2,600.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 4 (cont.)						
1973	2.20	4.30	1,600.00	4,400.00	---	---
1974	2.05	4.40	431.75	1,592.67	---	---
1975	2.12	4.25	1,535.68	4,526.36	---	---
1976	1.38	2.80	914.71	2,988.24	---	---
1977	2.30	4.20	1,100.00	3,000.00	---	---
RSE 4A						
1978	1.70	3.70	520.00	1,200.00	---	---
1979	2.00	3.40	1,000.00	3,600.00	---	---
1980	2.00	3.10	970.00	2,500.00	---	---
1981	1.50	2.70	210.00	250.00	---	---
1982	2.30	3.40	480.00	530.00	---	---
1983	1.50	2.20	520.00	830.00	---	---
1984	4.20	5.40	850.00	980.00	---	---
1985	0.83	1.00	120.00	160.00	---	---
1986	1.30	2.20	110.00	150.00	---	---
RSE 4B						
1964	1.10	1.80	170.00	460.00	---	---
1965	1.15	2.30	74.50	190.00	---	---
1966	1.25	1.80	86.00	130.00	---	---
1967	2.00	3.10	463.50	940.00	---	---
1968	2.70	5.10	1,175.00	1,800.00	---	---
1969	1.85	2.00	575.00	750.00	---	---
1970	2.10	3.10	2,410.00	4,900.00	---	---
1971	3.30	10.00	1,600.00	3,400.00	---	---
1972	2.60	4.80	2,500.00	3,200.00	---	---
1973	2.40	4.10	2,700.00	4,400.00	---	---
1974	1.72	2.90	2,147.05	3,518.53	---	---
1975	3.00	4.37	3,954.51	4,557.81	---	---
1976	2.18	3.22	3,779.03	4,979.20	---	---
1977	3.90	7.00	2,800.00	3,400.00	---	---
1978	3.40	4.90	2,100.00	2,900.00	---	---
1979	3.90	5.90	2,300.00	3,200.00	---	---
1980	3.90	9.70	2,200.00	3,100.00	---	---
1982	1.80	2.60	2,300.00	2,700.00	---	---
1983	1.70	2.10	1,800.00	2,100.00	---	---
1984	5.10	7.00	900.00	1,200.00	---	---
1985	10.00	10.00	690.00	690.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 4C						
1964	0.90	1.40	870.00	2,100.00	---	---
1965	1.65	2.90	2,850.00	8,800.00	---	---
1966	1.60	3.00	1,500.00	4,000.00	---	---
1967	1.25	2.00	293.50	530.00	---	---
1968	1.20	1.80	175.00	230.00	---	---
1969	1.35	1.80	145.00	290.00	---	---
1970	1.75	3.20	198.50	590.00	---	---
1971	1.80	3.00	790.00	2,600.00	---	---
1972	1.70	4.00	800.00	3,100.00	---	---
1973	2.60	4.00	5,000.00	9,700.00	---	---
1974	2.18	3.17	1,561.93	3,491.31	---	---
1975	2.02	3.46	3,754.59	7,434.12	---	---
1976	1.51	2.47	1,716.79	2,361.15	---	---
1977	1.90	3.40	3,100.00	8,100.00	---	---
1978	1.40	3.00	1,300.00	2,600.00	---	---
1979	2.20	7.10	1,400.00	3,300.00	---	---
1980	1.90	3.30	1,900.00	4,300.00	---	---
1981	0.52	0.73	610.00	690.00	---	---
1982	1.80	1.80	590.00	610.00	---	---
1983	3.90	6.50	920.00	1,100.00	---	---
1984	3.20	5.10	1,100.00	1,500.00	---	---
1985	1.50	2.30	590.00	800.00	---	---
1986	1.90	2.20	300.00	360.00	---	---
RSE 5						
1963	---	---	8.00	11.00	---	---
1964	1.20	1.90	77.00	110.00	---	---
1965	1.10	1.50	110.00	240.00	---	---
1966	1.40	2.80	544.00	6,000.00	---	---
1967	1.05	1.80	37.00	68.00	---	---
1968	1.15	1.50	28.00	55.00	---	---
1969	1.25	2.10	28.50	130.00	---	---
1970	1.80	4.90	36.50	59.00	---	---
1971	1.65	2.60	56.50	100.00	---	---
1972	1.60	2.70	77.50	130.00	---	---
1973	2.10	3.30	130.00	250.00	---	---
1974	1.48	2.93	100.82	191.85	---	---
1975	1.51	2.47	128.56	201.45	---	---
1976	0.99	1.93	100.36	153.55	---	---
1977	0.90	1.50	69.00	99.00	---	---
1978	0.78	1.90	57.00	89.00	---	---
1979	0.82	2.20	59.00	110.00	---	---
1980	0.95	1.40	66.00	95.00	---	---
1981	0.37	0.75	46.00	59.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 5 (cont.)						
1982	0.45	0.74	44.00	46.00	---	---
1983	0.65	0.97	120.00	130.00	---	---
1984	0.82	1.20	64.00	93.00	---	---
1985	0.10	0.10	9.40	9.40	---	---
1986	0.48	0.76	35.00	39.00	---	---
RSE 6						
1963	---	---	230.00	250.00	---	---
1964	1.65	2.80	845.00	3,900.00	---	---
1965	2.05	3.50	7,850.00	12,000.00	---	---
1966	2.20	4.40	3,300.00	5,000.00	---	---
1967	2.25	3.50	1,929.00	5,400.00	---	---
1968	1.85	3.30	510.00	810.00	---	---
1969	2.40	2.40	300.00	300.00	---	---
1970	2.10	2.60	640.00	720.00	---	---
1971	2.25	3.00	3,700.00	11,000.00	---	---
1972	2.35	4.40	7,900.00	13,000.00	---	---
1973	2.40	3.50	13,000.00	22,000.00	---	---
1974	2.64	3.52	20,125.14	38,202.11	---	---
1975	2.99	4.69	19,528.53	42,885.73	---	---
1976	2.59	4.78	31,563.27	58,200.70	---	---
1977	3.10	5.30	19,000.00	31,000.00	---	---
1978	2.80	5.90	16,000.00	23,000.00	---	---
1982	1.80	2.60	19,000.00	31,000.00	---	---
1983	1.40	1.60	17,000.00	20,000.00	---	---
1984	1.30	1.50	9,500.00	11,000.00	---	---
RSE 6B						
1981	---	0.51	---	28,600.00	---	---
RSE 7						
1963	---	---	5.00	9.00	---	---
1964	0.60	1.00	17.50	39.00	---	---
1965	0.60	1.00	21.50	48.00	---	---
1966	0.60	1.00	14.00	36.00	---	---
1967	0.50	1.20	17.00	80.00	---	---
1968	0.80	1.80	9.50	17.00	---	---
1969	0.75	1.00	10.00	28.00	---	---
1970	0.85	1.40	13.50	25.00	---	---
1971	0.75	1.30	13.00	26.00	---	---
1972	1.05	1.40	11.00	22.00	---	---
1973	0.90	1.80	12.00	19.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 7 (cont.)						
1974	0.92	2.61	91.38	361.88	---	---
1975	0.97	1.73	32.38	134.01	---	---
1976	0.80	1.32	8.69	22.04	---	---
1977	0.70	1.50	4.90	18.00	---	---
1978	0.59	1.50	5.90	10.00	---	---
1979	0.32	1.70	2.60	7.00	---	---
1980	0.42	1.10	1.20	5.20	---	---
1981	0.29	0.67	1.30	1.50	---	---
1982	0.46	0.74	4.80	18.00	---	---
1983	0.56	2.10	4.20	9.90	---	---
1984	0.43	0.85	3.20	7.50	---	---
1985	0.16	0.63	3.60	22.00	---	---
1986	0.48	1.10	2.00	5.00	---	---
RSE 8						
1963	---	---	5.00	10.00	---	---
1964	0.85	3.30	15.00	27.00	---	---
1965	0.80	1.30	16.50	30.00	---	---
1966	1.40	2.90	17.50	36.00	---	---
1967	1.10	2.50	13.00	22.00	---	---
1968	1.25	2.80	23.50	130.00	---	---
1969	1.05	1.40	11.00	16.00	---	---
1970	1.10	2.00	13.00	25.00	---	---
1971	1.60	2.20	21.50	45.00	---	---
1972	1.45	2.60	17.00	35.00	---	---
1973	1.60	2.50	26.00	73.00	---	---
1974	1.55	2.51	32.08	109.77	---	---
1975	1.23	1.76	42.17	253.65	---	---
1976	1.34	2.55	14.76	35.36	---	---
1977	1.50	2.00	7.80	10.00	---	---
1978	1.10	2.20	7.90	20.00	---	---
1979	0.81	2.60	3.80	12.00	---	---
1980	1.30	2.00	5.90	30.00	---	---
1981	0.92	1.80	8.60	16.00	---	---
1982	0.87	1.20	19.00	100.00	---	---
1983	0.92	2.50	5.20	18.00	---	---
1984	0.37	0.95	3.20	6.00	---	---
1985	0.35	0.69	15.00	160.00	---	---
1986	0.54	0.82	2.00	3.10	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 9						
1963	---	---	7.00	9.00	---	---
1964	0.55	1.00	18.50	110.00	---	---
1965	0.35	0.60	13.50	26.00	---	---
1966	0.50	1.10	8.00	19.00	---	---
1967	0.95	2.40	15.50	70.00	---	---
1968	1.10	2.40	13.50	39.00	---	---
1970	1.90	4.00	64.50	140.00	---	---
1971	1.45	4.90	34.50	70.00	---	---
1972	0.75	1.50	18.00	45.00	---	---
1973	0.70	2.00	36.00	130.00	---	---
1974	0.67	1.41	20.30	45.69	---	---
1975	1.15	2.34	7.90	22.03	---	---
1976	1.26	3.06	10.26	23.92	---	---
1977	1.10	2.40	6.40	14.00	---	---
1978	0.94	1.60	4.20	7.40	---	---
1979	0.82	3.10	0.94	8.70	---	---
1980	0.66	1.80	1.50	5.20	---	---
1981	0.73	2.10	3.20	7.80	---	---
1982	0.66	0.66	17.00	29.00	---	---
1983	0.58	0.66	2.70	3.90	---	---
1984	0.25	0.49	1.40	1.50	---	---
1985	0.39	0.48	1.90	1.90	---	---
1986	0.20	0.39	1.40	2.00	---	---
RSE 10						
1963	---	---	8.00	15.00	---	---
1964	0.80	1.30	20.50	67.00	---	---
1965	0.60	1.10	25.50	78.00	---	---
1966	0.65	1.00	15.00	34.00	---	---
1967	0.55	1.10	10.50	22.00	---	---
1968	1.15	3.10	20.50	44.00	---	---
1969	1.20	1.80	19.00	25.00	---	---
1970	1.45	3.30	17.00	55.00	---	---
1971	1.10	1.70	14.50	32.00	---	---
1972	0.95	1.80	15.00	36.00	---	---
1973	1.30	1.70	22.00	52.00	---	---
1974	0.79	1.27	53.32	243.75	---	---
1975	0.79	1.65	9.19	29.81	---	---
1976	0.64	1.65	11.17	32.91	---	---
1977	0.54	1.40	7.40	21.00	---	---
1978	0.52	1.40	5.60	11.00	---	---
1979	0.51	1.30	2.90	6.10	---	---
1980	0.59	1.10	1.80	13.00	---	---
1981	0.32	0.67	4.20	11.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 10 (cont.)						
1982	0.87	1.10	8.90	11.00	---	---
1983	0.43	0.66	3.30	4.00	---	---
1984	0.15	0.29	1.50	1.70	---	---
1985	0.50	0.51	6.00	6.20	---	---
1986	0.40	0.58	6.70	7.40	---	---
RSE 11						
1963	---	---	12.00	26.00	---	---
1964	0.90	2.20	60.00	200.00	---	---
1965	1.25	5.30	240.00	410.00	---	---
1966	1.60	2.20	450.00	800.00	---	---
1967	1.25	2.20	186.00	350.00	---	---
1968	1.35	2.30	250.00	370.00	---	---
1969	1.90	3.00	290.00	400.00	---	---
1970	1.90	2.50	240.00	340.00	---	---
1971	1.90	3.80	200.00	560.00	---	---
1972	1.75	2.50	505.00	920.00	---	---
1973	2.20	3.90	490.00	800.00	---	---
1974	1.66	2.76	619.60	1,326.66	---	---
1975	1.77	3.52	803.46	1,196.48	---	---
1976	1.27	2.39	793.39	1,581.96	---	---
1977	1.80	3.00	730.00	1,100.00	---	---
1978	1.40	2.30	730.00	1,100.00	---	---
1979	1.80	3.40	640.00	1,200.00	---	---
1980	1.30	2.30	690.00	1,100.00	---	---
1981	1.00	1.70	1,000.00	2,400.00	---	---
1982	1.70	1.70	680.00	870.00	---	---
1983	1.90	2.60	490.00	760.00	---	---
1984	1.20	1.70	310.00	590.00	---	---
1985	1.40	1.50	330.00	340.00	---	---
1986	1.90	2.90	380.00	440.00	---	---
RSE 12						
1963	---	---	69.00	96.00	---	---
1964	0.80	1.40	230.00	790.00	---	---
1965	0.90	0.90	220.00	310.00	---	---
1966	0.75	1.30	220.00	300.00	---	---
1967	0.85	2.10	152.50	310.00	---	---
1968	1.10	2.50	89.00	180.00	---	---
1969	1.25	1.90	141.00	74.00	---	---
1970	1.80	3.90	140.00	170.00	---	---
1971	1.35	1.80	205.00	340.00	---	---
1972	1.30	1.70	235.00	340.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 12 (cont.)						
1973	2.10	6.90	760.00	810.00	---	---
1974	0.94	1.54	227.91	387.55	---	---
1975	0.83	1.73	191.61	339.94	---	---
1976	0.67	2.01	71.40	86.13	---	---
1977	0.89	2.50	170.00	440.00	---	---
1978	0.63	1.80	100.00	140.00	---	---
1979	0.43	0.82	140.00	190.00	---	---
1980	0.65	1.10	150.00	220.00	---	---
1981	0.44	0.84	180.00	220.00	---	---
1982	0.91	1.20	160.00	160.00	---	---
1983	1.80	2.20	170.00	200.00	---	---
1984	1.80	2.30	190.00	200.00	---	---
1985	0.55	0.72	160.00	180.00	---	---
1986	0.69	1.10	150.00	160.00	---	---
RSE 13						
1964	1.80	3.60	90.00	140.00	---	---
1965	1.80	3.90	110.00	290.00	---	---
1966	1.60	3.00	125.00	170.00	---	---
1967	2.00	2.00	163.00	260.00	---	---
1968	1.95	2.70	115.00	200.00	---	---
1969	2.25	4.00	110.00	210.00	---	---
1970	2.20	4.20	170.00	280.00	---	---
1971	2.15	4.10	260.00	330.00	---	---
1972	1.70	3.00	240.00	300.00	---	---
1973	2.10	4.80	250.00	440.00	---	---
1974	2.64	4.14	382.62	787.25	---	---
1975	1.94	4.44	1,471.93	3,353.85	---	---
1976	1.61	3.38	776.88	1,367.61	---	---
1977	3.00	5.60	470.00	680.00	---	---
1978	2.40	4.70	390.00	800.00	---	---
1979	2.50	4.50	460.00	820.00	---	---
1980	1.90	3.70	660.00	1,200.00	---	---
1981	1.80	3.10	250.00	320.00	---	---
1982	2.10	3.80	330.00	510.00	---	---
1983	2.00	3.50	340.00	630.00	---	---
1984	3.60	11.00	260.00	380.00	---	---
1985	0.99	2.30	200.00	300.00	---	---
1986	1.20	2.20	140.00	250.00	---	---

TABLE 13-13 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
RSE 18						
1976	0.80	0.96	12.45	15.19	---	---
1977	0.83	2.10	3.50	12.00	---	---
1978	0.63	1.70	7.40	24.00	---	---
1979	0.51	0.92	5.50	17.00	---	---
1980	0.78	1.40	94.00	410.00	---	---
1981	0.17	0.34	3.10	10.00	---	---
1982	0.54	0.58	6.90	8.80	---	---
1983	0.66	0.66	2.40	2.40	---	---
1984	0.24	0.29	2.10	3.30	---	---
1985	0.51	0.92	1.60	2.30	---	---
1986	0.25	0.39	1.40	1.60	---	---
RSE 19						
1976	0.55	0.79	49.93	94.50	---	---
1977	1.20	1.70	200.00	560.00	---	---
1978	0.85	1.80	140.00	320.00	---	---
1979	0.93	2.10	75.00	200.00	---	---
1980	1.00	2.10	69.00	250.00	---	---
1981	0.96	1.60	68.00	75.00	---	---
1982	1.80	1.90	68.00	74.00	---	---
1983	2.20	3.10	150.00	280.00	---	---
1984	1.40	2.10	73.00	91.00	---	---
1985	0.44	0.59	70.00	78.00	---	---
1986	0.42	0.65	70.00	82.00	---	---

Note: These results are from SRS annual and semiannual reports. Omitted wells and years indicate the absence of data in these reports. Prior to 1973, means were reported for 6-month intervals. Means given in this table prior to 1973 are the average of the 6-month values.

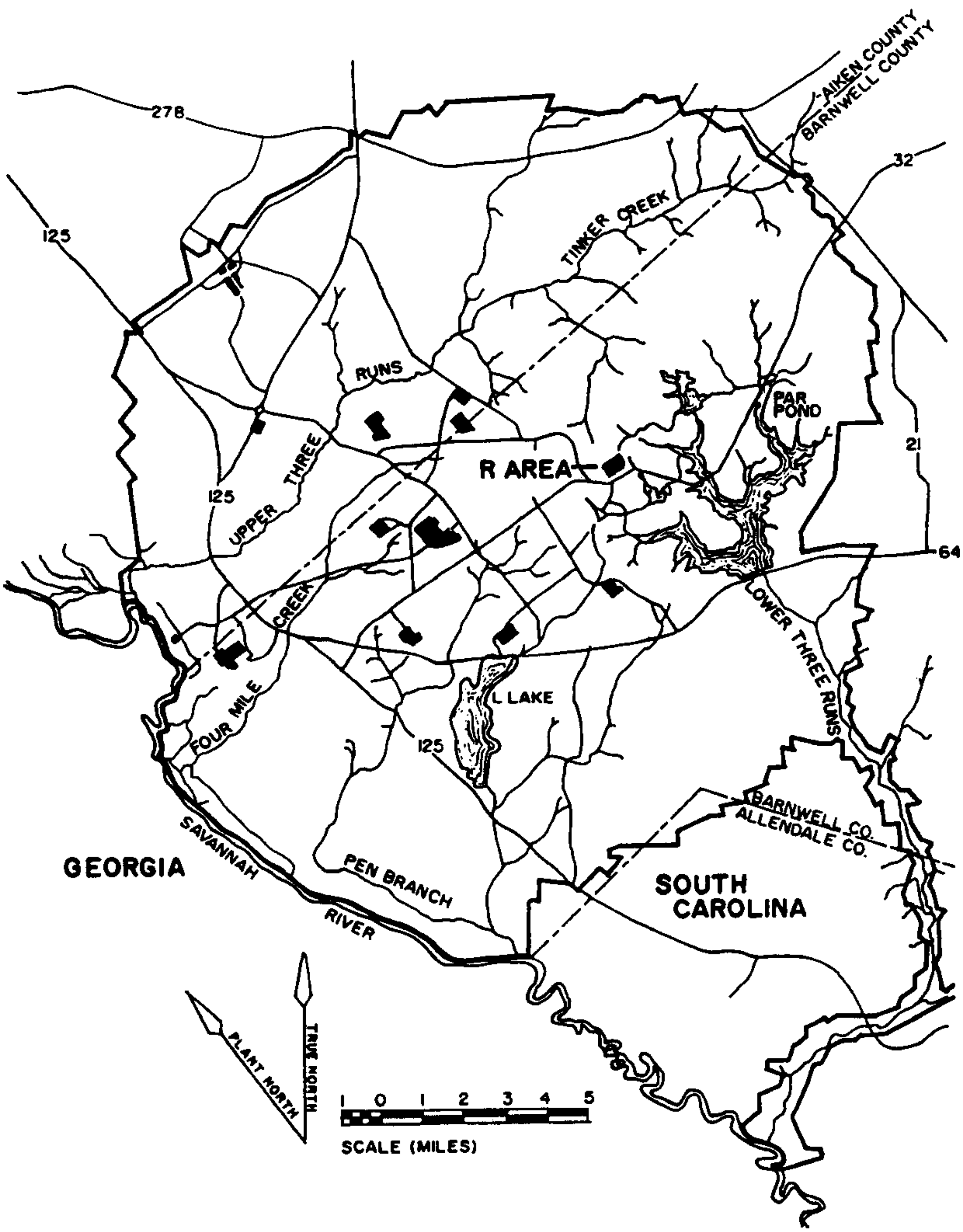


FIGURE 13-1. Location of R Area at SRS

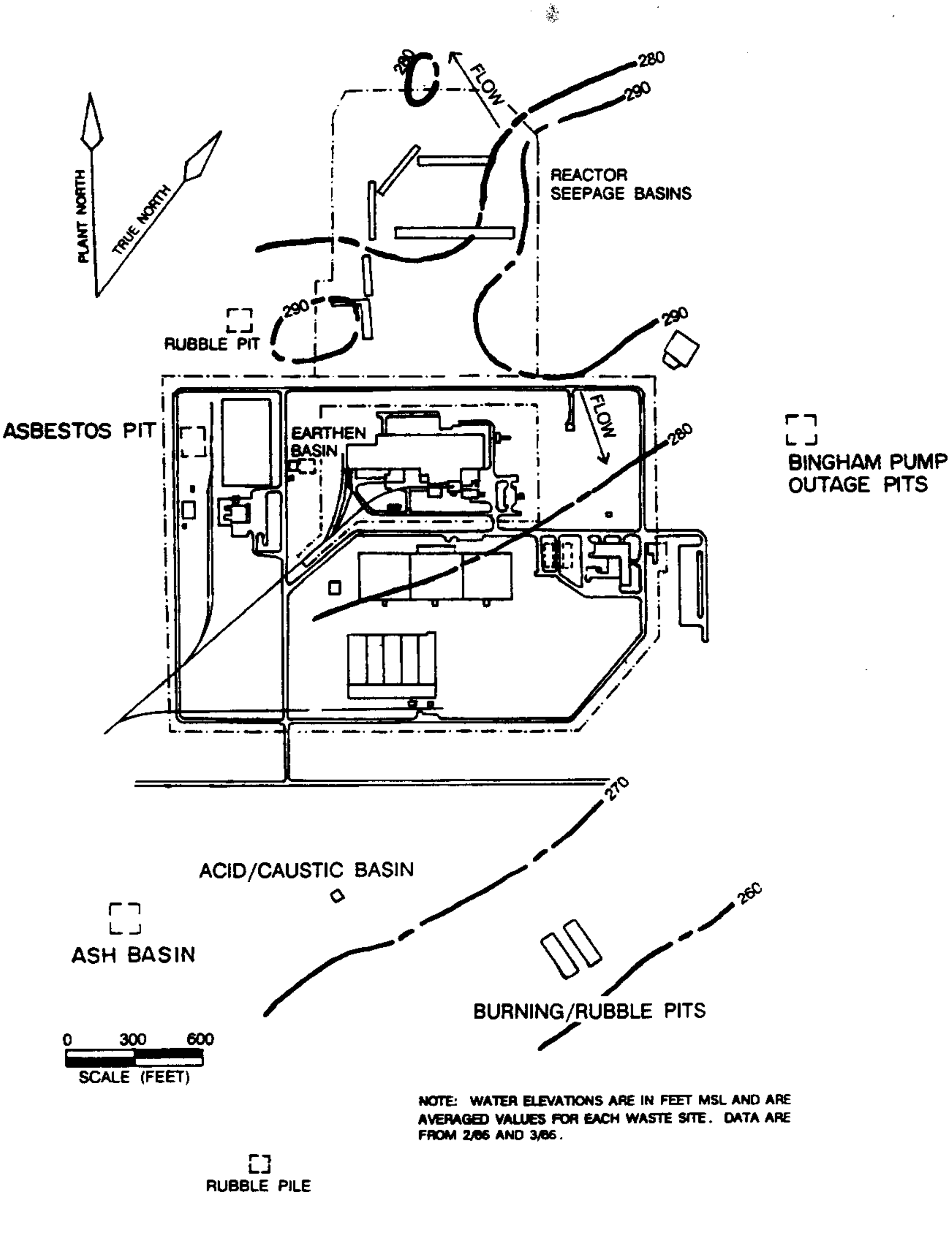


FIGURE 13-2. R-Area Water-Table Elevation Map

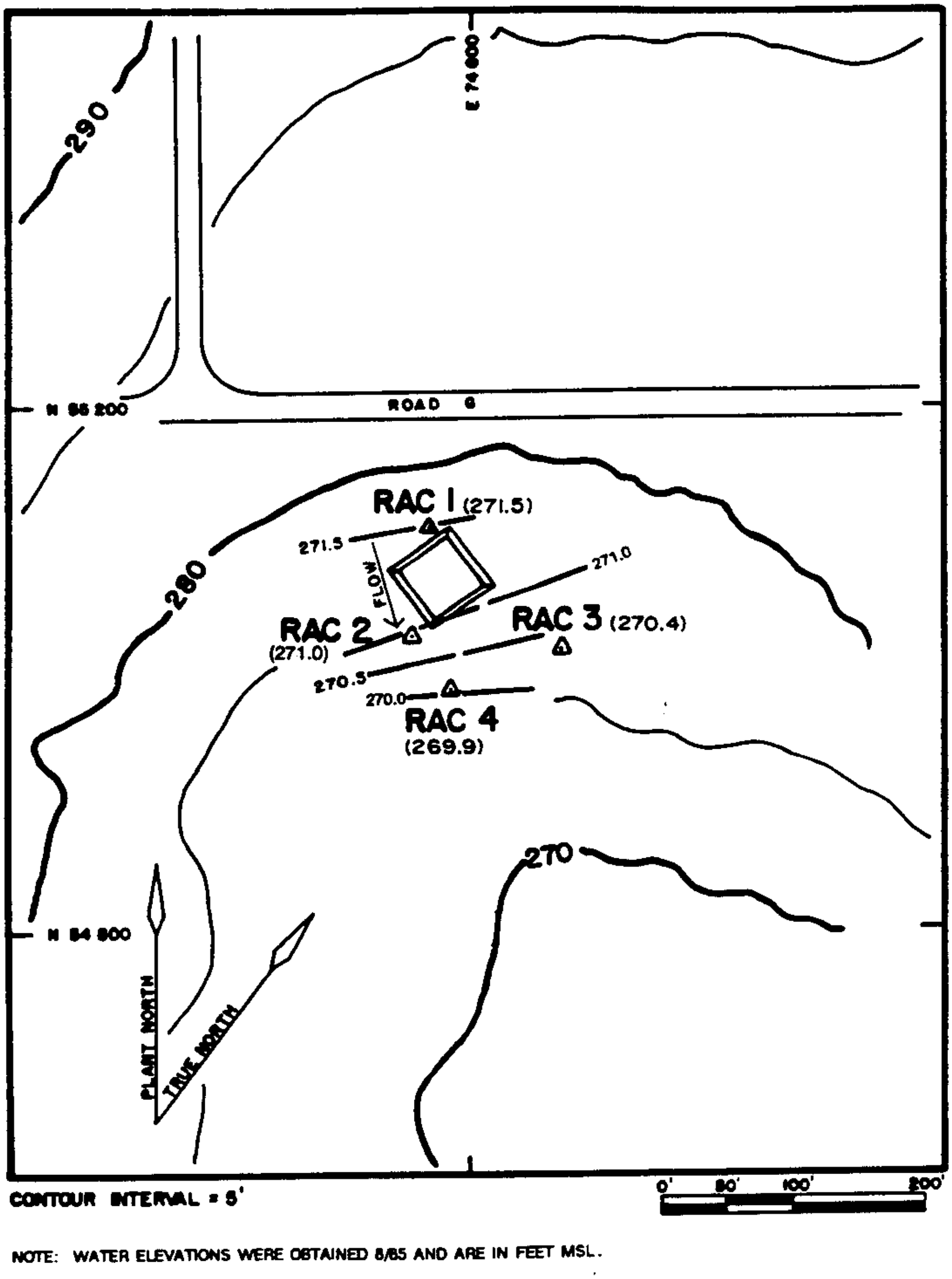
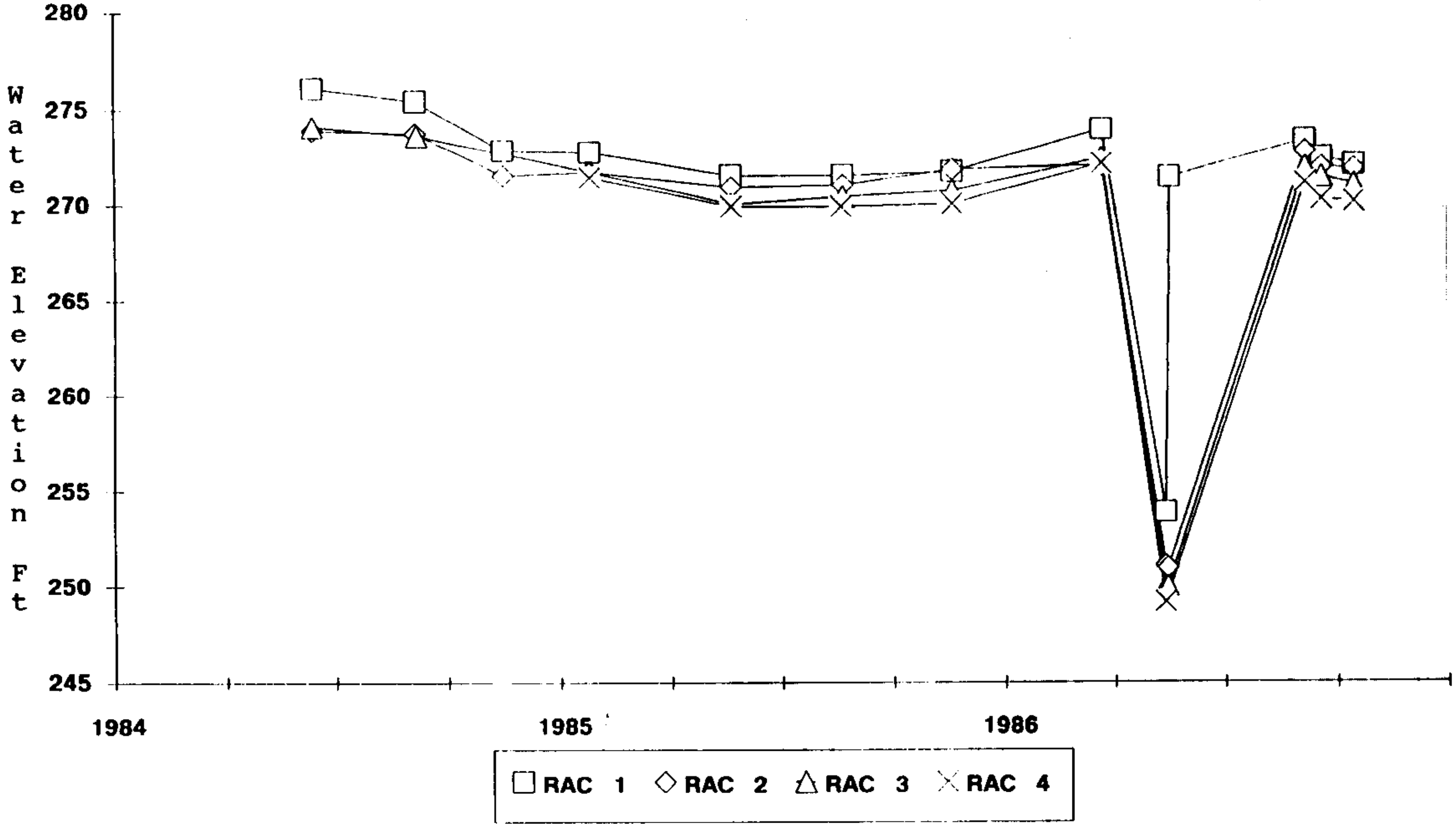


FIGURE 13-3. R-Area Acid/Caustic Basin Water-Table Elevation Map



NOTE: A WATER LEVEL OF 200.6 FEET OBTAINED FOR WELL RAC 3 ON 11/14/84 IS NOT PLOTTED.

FIGURE 13-4. Hydrograph of the R-Area Acid/Caustic Basin Wells

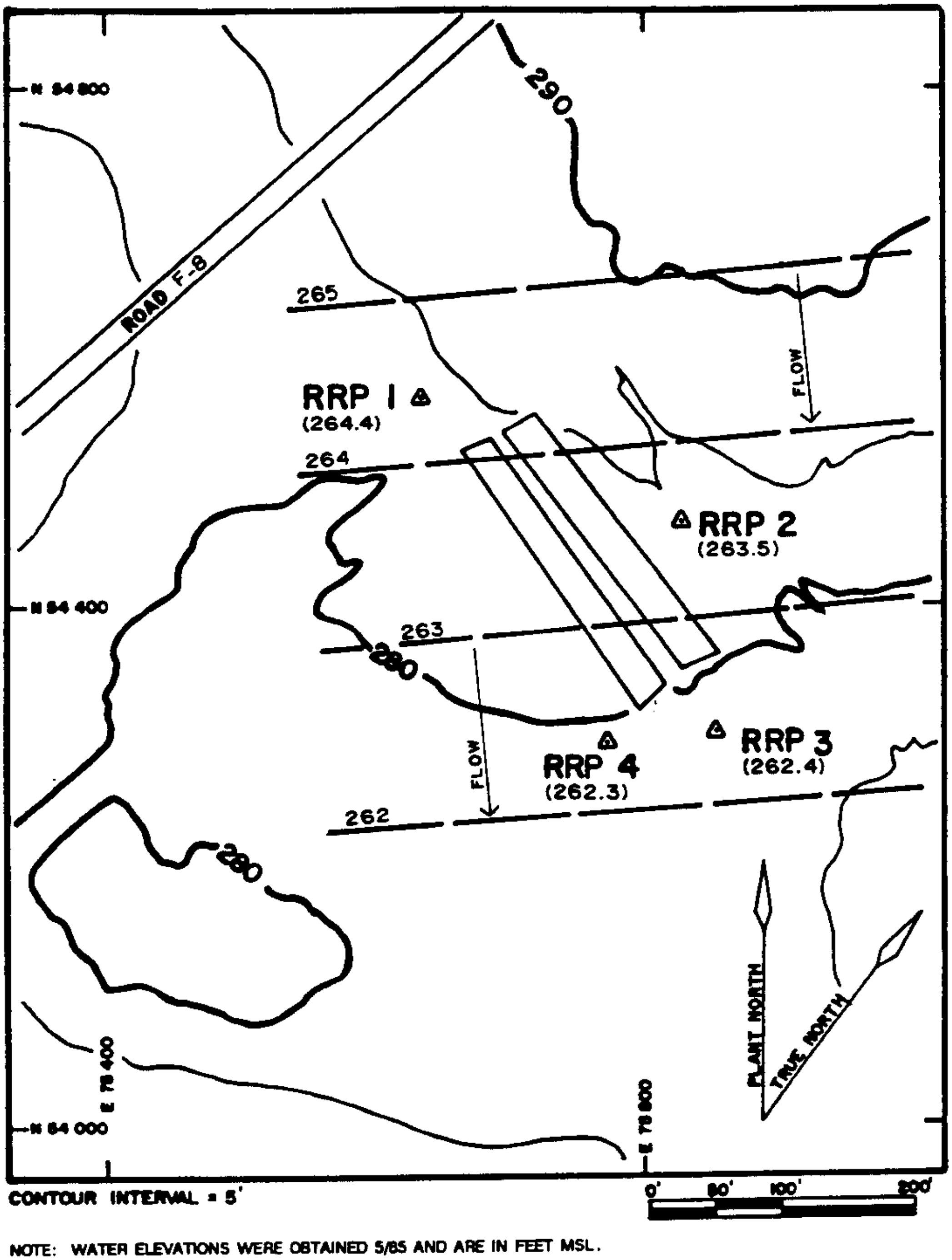


FIGURE 13-5. R-Area Burning/Rubble Pits Water-Table Elevation Map

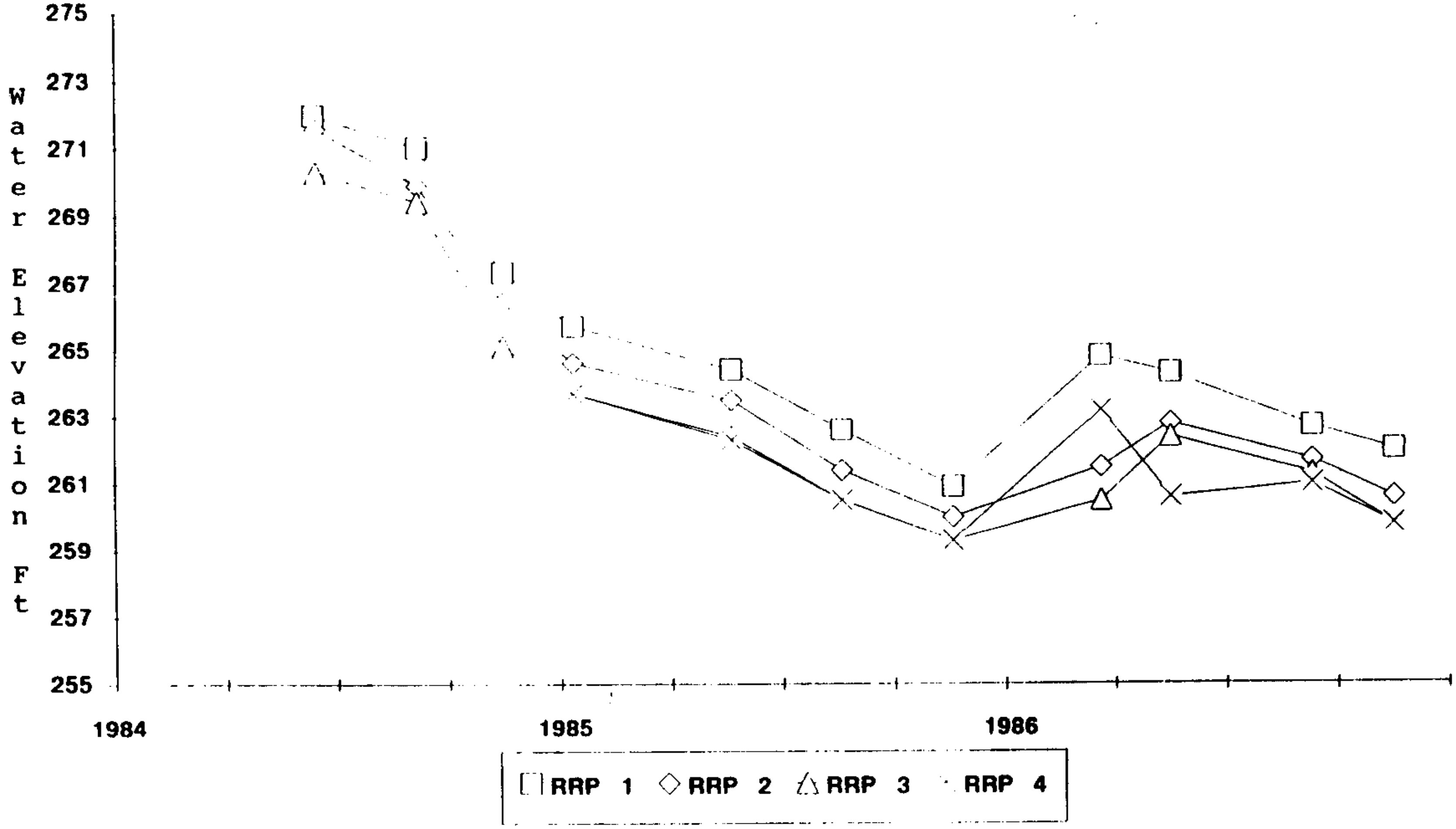


FIGURE 13-6. Hydrograph of the R-Area Burning/Rubble Pit Wells

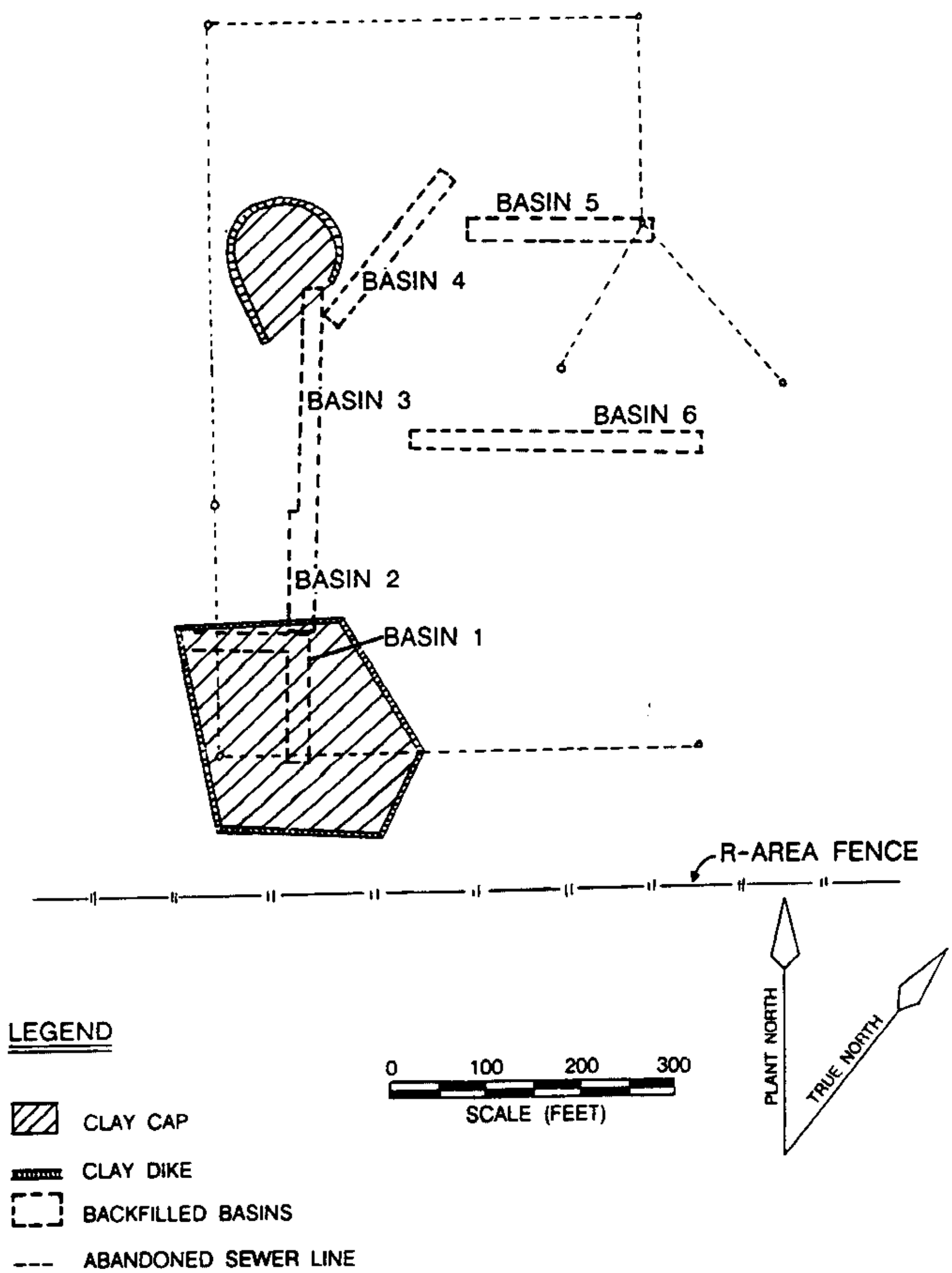


FIGURE 13-7. The R-Area Reactor Seepage Basins

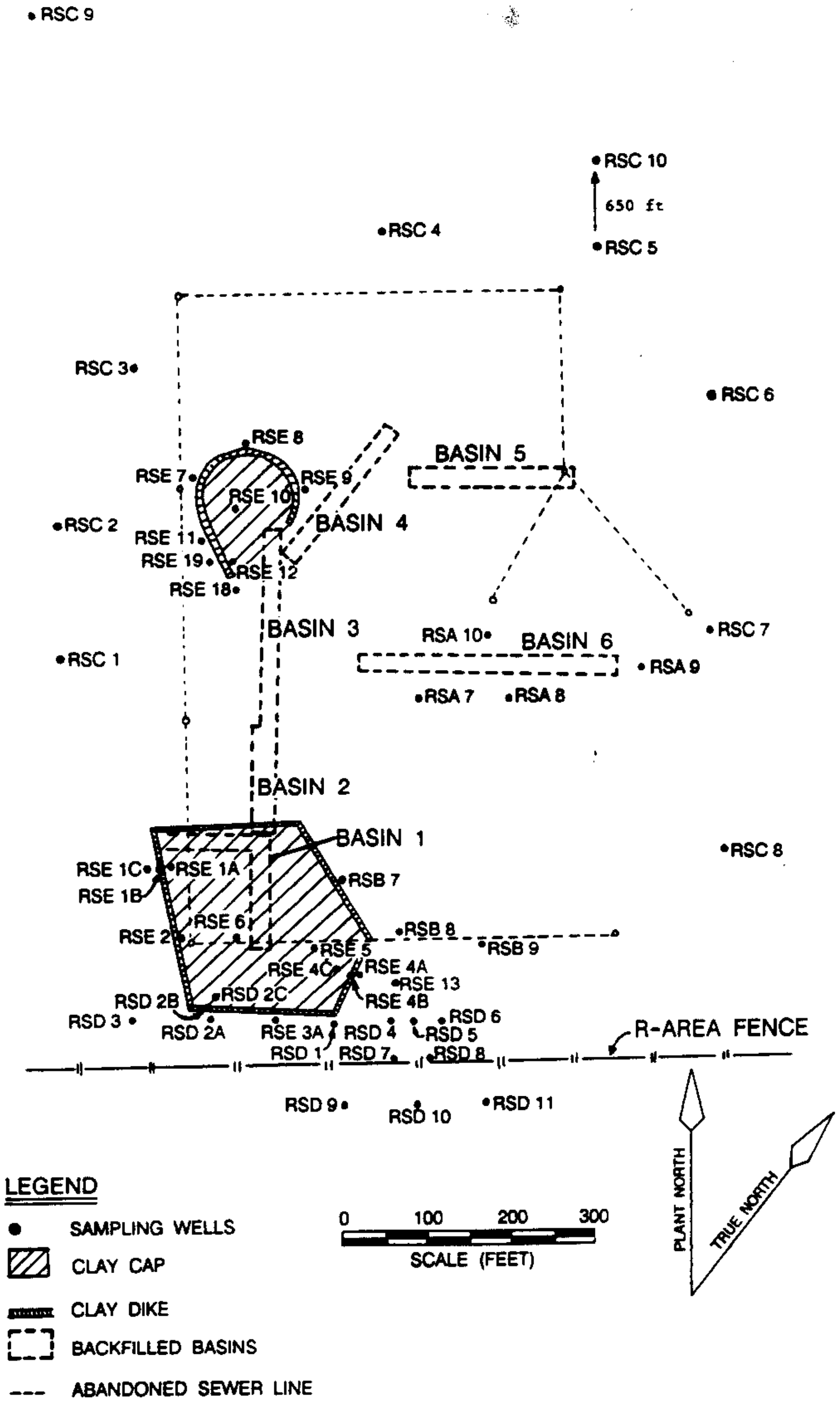


FIGURE 13-8. Monitoring Wells at the R-Area Reactor Seepage Basins

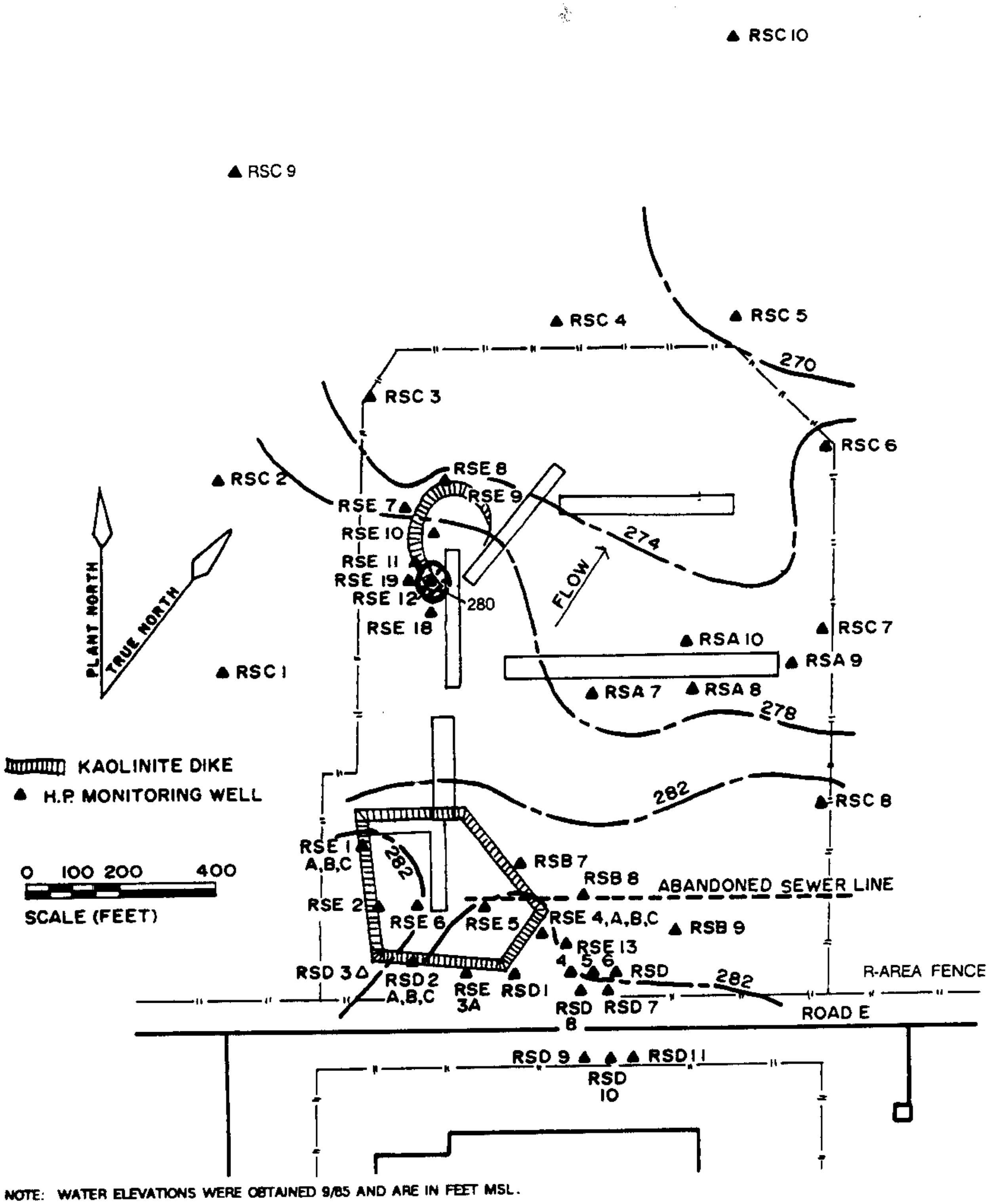


FIGURE 13-9. R-Area Reactor Seepage Basins Water-Table Elevation Map

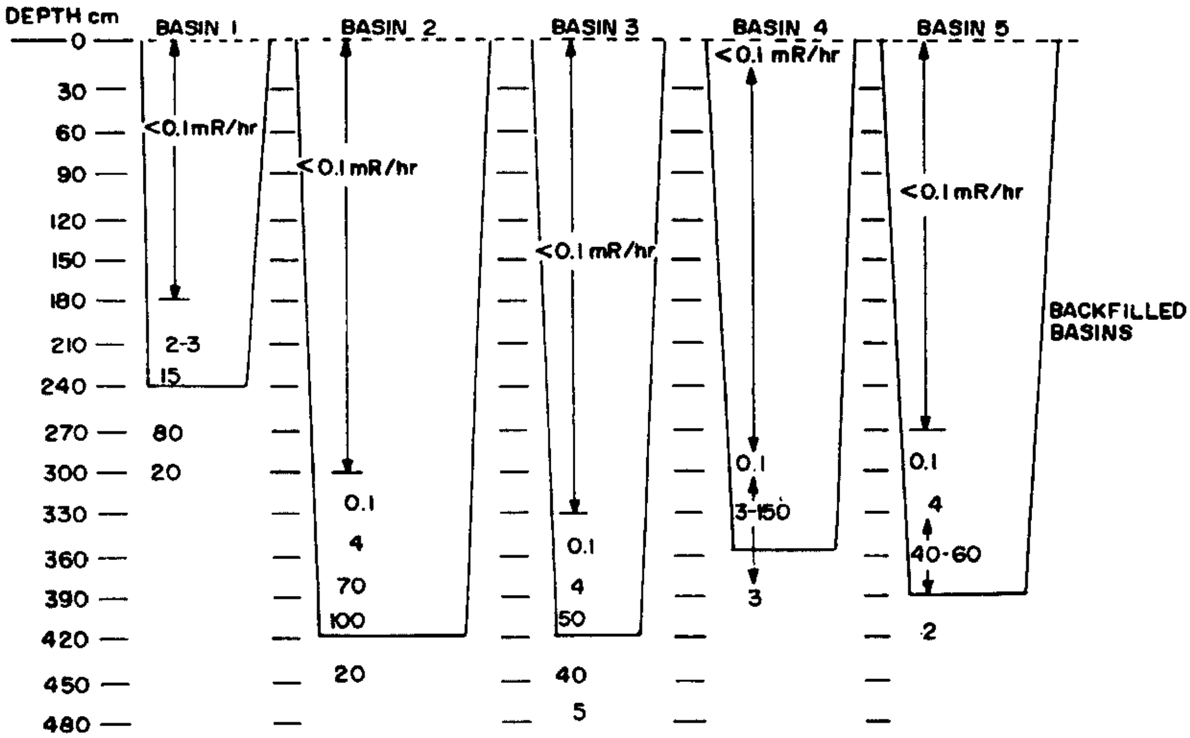


FIGURE 13-10. Dose Rate in the R-Area Reactor Seepage Basins Measured in Dry Monitoring Wells

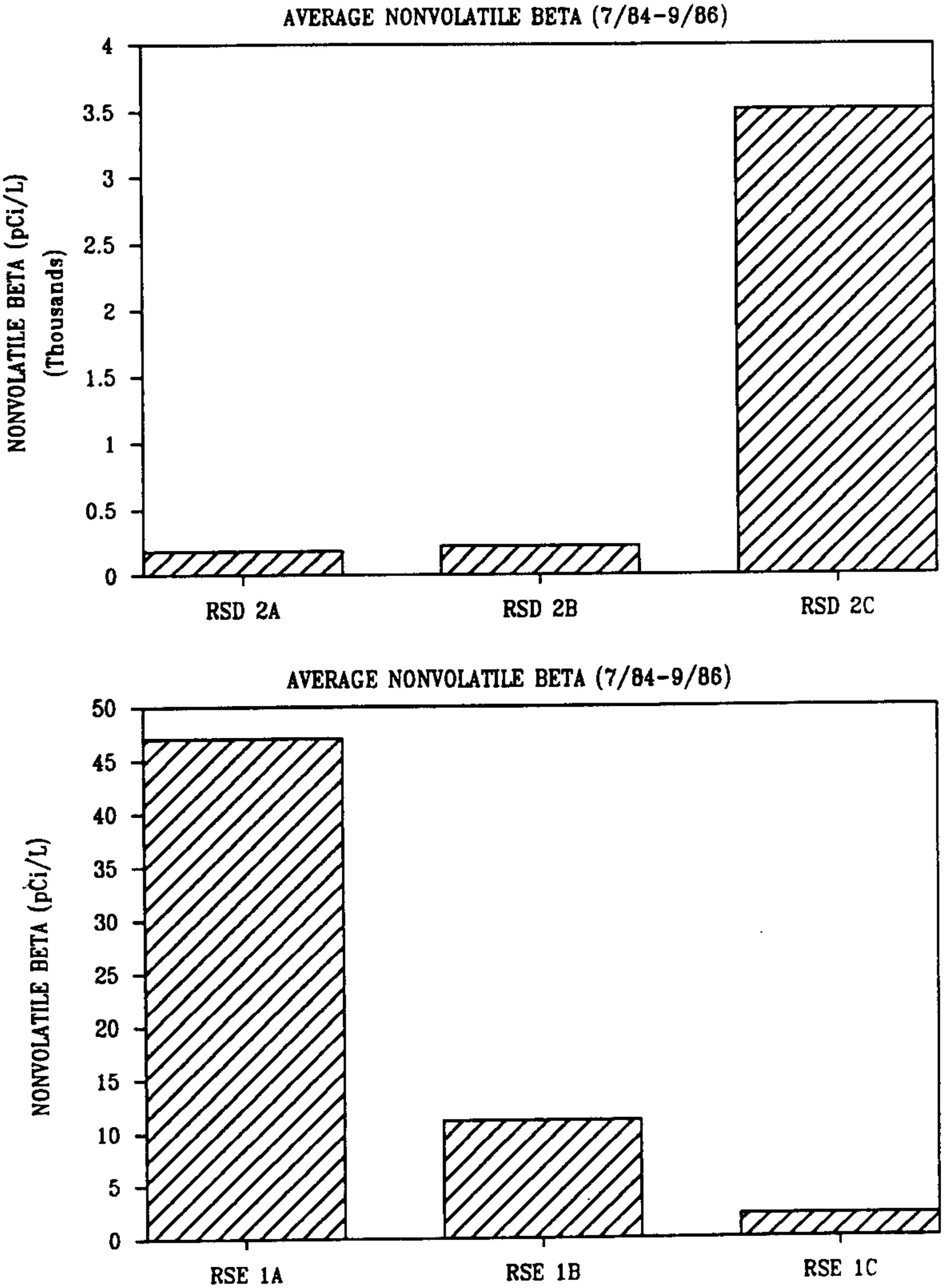


FIGURE 13-11. Average Nonvolatile Beta Activities in the RSD 2 and RSE 1 Well Clusters

SECTION 14 CENTRAL SHOPS AREA

14.01 GENERAL INFORMATION

14.01.01 General Area Description

Central Shops (CS) Area is located in the central part of SRS as shown in Figure 14-1. Surface elevations across CS Area range approximately from 280 to 300 ft msl. Surface drainage is to tributaries of Four Mile Creek to the north, west, and south and to tributaries of Pen Branch to the east.

There are 15 CS-Area waste sites as indicated in Figure 14-2:

L The Hydrofluoric Acid Spill Area

L The Ford Building Seepage Basin

L The Fire Department Training Facility

L The Hazardous Waste Storage Facility (2 buildings)

L The CS-Area Burning/Rubble Pits (3 pits)

L The Savannah River Laboratory (SRL) Oil Test Site

L The Ford Building Waste Site

L The Sanitary Sewage Sludge Lagoon

L The CS-Area Scrap Lumber Pile

L The Miscellaneous Rubble Pile (see Section 15)

L The CS-Area Rubble Pits (2 pits) (see Section 15)

14.01.02 General Hydrologic Conditions

By the end of 1986, 17 monitoring wells had been installed around the CS-Area waste sites to delineate the subsurface conditions and to monitor the water-table elevation and groundwater quality. Fifteen of the 17 wells are currently being monitored. The remaining two monitoring wells have been abandoned, as discussed in the following specific waste-site sections. According to the surface geologic map presented by Siple (1967), the monitoring wells in CS Area were installed in the Barnwell Formation. Section 3 contains detailed information concerning the hydrostratigraphy beneath SRS.

The water-table elevation in CS Area has ranged approximately from 260 to 240 ft msl, and the vadose zone is approximately 40 ft thick. As shown in Figure 14-2, the general horizontal, near-surface groundwater flow direction is to the west and southwest toward Four Mile Creek. Mathematical modeling of the Barnwell Formation near the center of the plant in the Separations Areas indicates that the horizontal groundwater flow velocity ranges approximately from 15 to 60 ft/yr per percent gradient (Duffield et al., 1986; Parizek and Root, 1986). The hydraulic gradient of the water table in the general CS Area has been approximately 0.13 ft/ft, resulting in a groundwater flow velocity across the area of approximately 2 to 8 ft/yr. The horizontal flow direction and estimated flow velocity for the water table at each CS-Area waste site are discussed in the following specific waste-site sections.

14.01.03 Migration Potential of Dissolved Chemical Constituents from CS Area

The potential for any dissolved constituents to be naturally discharged from a waste site to nearby surface water from the near-surface groundwater system depends on the location of the waste site, the hydraulic gradient, and the flow path between the waste site and the discharge point. Horizontal and vertical groundwater flow velocities depend upon the medium through which the groundwater travels (i.e., sand, silt, or clay). Similarly, the horizontal and vertical movements of dissolved chemical constituents will be affected by interactions with the soil/sediment medium (retardation).

The nearest plant boundary to CS Area is approximately 7 mi to the west. Four Mile Creek, Upper Three Runs Creek, and a number of other incised creeks are located between CS Area and the plant boundary. Therefore, migration of dissolved constituents from CS-Area waste sites through the near-surface groundwater system to the plant boundary is unlikely.

14.02 HYDROFLUORIC ACID SPILL AREA

14.02.01 Summary

The Hydrofluoric Acid Spill Area (Building 631-4G) covers approximately 900 ft^2 west of the cement plant in CS Area. It is uncertain whether a hydrofluoric acid spill took place at the site or if hydrofluoric acid-contaminated soil or containers are buried here. The spill or disposal occurred prior to 1970, and an identification sign is the only evidence that material was released at the site. No radioactive constituents and only minimal amounts of nonradioactive constituents are believed to be present at the site (Huber and Bledsoe, 1987b). The ground surface elevation at the site is approximately 290 ft msl, and the estimated local water-table elevation is 270 ft msl.

No sampling of the spill area has been performed. Because hydrofluoric acid may have contaminated the area prior to 1970, fluoride and pH were chosen as indicator parameters for the site. The groundwater monitoring data indicate that the Hydrofluoric Acid Spill Area has had no apparent effect on groundwater quality. All tested parameters have consistently met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards for dissolved chemical constituents and radioactivity in all of the site wells. Groundwater pH in the downgradient well ranged from 4.3 to 6.1 and from 4.1 to 5.9 in the other site wells. These pH values are consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B) and are not an indication of an effect from the spill area.

14.02.02 Waste-Site Description and Nature of Disposal

The Hydrofluoric Acid Spill Area (Building 631-4G) is west of the cement plant in CS Area at an elevation of about 290 ft msl. The area is between two intermittent streams: one a tributary to Four Mile Creek and the other a tributary to Pen Branch. The spill site is estimated to be 30 ft long by 30 ft wide, covering 900 ft^2.

It is uncertain whether a spill occurred at this site or if hydrofluoric acid-contaminated soil or containers are buried in the area. The disposal or spill, which occurred prior to 1970, was documented only by a site identification sign. There is no known inventory of substances released to the Hydrofluoric Acid Spill Area. No radioactive constituents and only minimal amounts of nonradioactive constituents are believed to be present at the site (Huber and Bledsoe, 1987b).

14.02.03 Groundwater Monitoring Program

Four wells (CSA 1 through CSA 4) were installed in June 1984 to monitor the water-table elevation and groundwater quality at the Hydrofluoric Acid Spill Area. Wells CSA 1 through CSA 4 were constructed using PVC casings and 30-ft screens. The locations of the monitoring wells are shown in Figure 14-3.

Quarterly monitoring of the groundwater in wells CSA 1 through CSA 4 began in January 1985. All groundwater samples collected for metals analyses from monitoring wells CSA 1 through CSA 4 were filtered prior to analysis.

14.02.04 Site-Specific Hydrology

Measurements obtained from the Hydrofluoric Acid Spill Area wells since the first quarter of 1985 indicate that the water-table elevation has declined over the period of monitoring. A hydrograph for the Hydrofluoric Acid Spill Area wells (Figure 14-4) shows that the water-table elevation for the fourth quarter of 1986 ranged approximately from 241 ft to 245 ft msl and that the vadose zone was approximately 45 ft thick.

A water-table elevation contour map for the first quarter of 1986 (Figure 14-3) indicates that the near-surface groundwater flow direction was to the southwest. The hydrograph for the Hydrofluoric Acid Spill Area wells (Figure 14-4) indicates that this horizontal groundwater flow direction has been relatively consistent, although flow direction and gradient changes have occurred. Relative to the site, well CSA 2 has been predominantly upgradient, wells CSA 1 and CSA 3 predominantly side-gradient, and well CSA 4 predominantly downgradient.

The hydraulic gradient of the water table beneath the site has been approximately 0.01 ft/ft. Using an estimated horizontal groundwater flow velocity range for the Barnwell Formation near the center of the plant of 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the Hydrofluoric Acid Spill Area has ranged approximately from 15 to 60 ft/yr.

14.02.05 Waste-Site Content Characterization Data

Sampling has not been conducted at the Hydrofluoric Acid Spill Area. Section 14.02.02 contains information on the nature of materials disposed at the site.

14.02.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the Hydrofluoric Acid Spill Area.

14.02.07 Groundwater Monitoring Results

Groundwater monitoring results from 1985 through 1986 are presented in Appendix L. Table 14-1 summarizes groundwater chemical characterization data collected since January 1985 for the Hydrofluoric Acid Spill Area.

Comparisons of the monitoring data between upgradient well CSA 2 and the remaining site wells were used to evaluate the effect on local groundwater quality from the spill area. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Because hydrofluoric acid may have contaminated the area (Section 14.02.02), fluoride and pH are the indicator parameters for the site.

The groundwater quality data summarized in Table 14-1 indicate that the Hydrofluoric Acid Spill Area has had no apparent effect on groundwater quality. Groundwater quality in all four site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards. Fluoride levels were below the South Carolina drinking water standard of 1.6 mg/L, ranging from <0.10 to 0.80 mg/L in all four site wells. Fluoride levels in the downgradient well were not elevated compared to the levels in the upgradient well. Conductivity in the upgradient (40 to 52 μmhos/cm), sidegradient (38 to 75 μmhos/cm), and downgradient (41 to 50 μmhos/cm) wells was low, providing further support that the spill area has not affected local groundwater quality.

Groundwater pH in the downgradient well ranged from 4.3 to 6.1 and from 4.1 to 5.9 in the remaining site wells. These pH values are consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B) and are not an indication of an effect from the spill area.

14.02.08 Planned Action

The Hydrofluoric Acid Spill Area is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

14.03 FORD BUILDING SEEPAGE BASIN

14.03.01 Summary

The Ford Building Seepage Basin (Building 904-91G) received wastewater from process equipment repairs performed in the nearby Ford Building (Building 690-G). The wastewater was drained to a retention tank adjacent to the Ford Building, analyzed for radionuclides, and then released either to the Ford Building Seepage Basin or to Waste Management Operations (WMO) for concentration and disposal. Because of reduced use of the seepage basin and the need to replace the existing retention tank, the basin and tank were retired in January 1984. Ford Building wastewater is now sent exclusively to WMO for disposal. The Ford Building Seepage Basin is currently inactive (Pekkala et al., 1987c).

Twelve soil borings were completed in and around the basin to evaluate subsurface soil conditions and to assess any environmental effects from the Ford Building Seepage Basin on the soil chemistry. Radionuclides found above background levels in the upper sediments were ^{60}Co, ^{90}Sr, and ^{137}Cs. At depths below 1 ft, all soil/sediment samples exhibited radioactivity less than 1 pCi/g for all tested radionuclides. Metals found in the basin soil/sediment samples at levels greater than twice background concentrations were aluminum, arsenic, cadmium, chromium, copper, iron, magnesium, mercury, nickel, selenium, and zinc. In general, metal concentrations were highest in the first 0.25 ft of sediment and then decreased rapidly with depth to background levels. Extraction Procedure (EP) toxicity test results for metals in the top 0.25 ft of the basin floor indicate concentrations less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24).

Monitoring data indicate that groundwater quality near the Ford Building Seepage Basin has been characterized by low dissolved chemical constituent and radioactivity levels compared to drinking water standards. Inorganic, organic, and radioactive constituent levels in the groundwater were less than half of their respective drinking water standards over the monitoring period except for total dissolved solids (TDS) levels in well HXB 1 (32 to 280 mg/L), which were still well under the drinking water standard of 500 mg/L.

14.03.02 Waste-Site Description and Nature of Disposal

The Ford Building Seepage Basin (Building 904-91G) was constructed in 1964 by excavating soils 10 ft below grade and building diked walls. The rectangular basin has bottom dimensions of 60 ft by 20 ft and ground-level dimensions of 80 ft by 40 ft, giving it an approximate capacity of 150,000 gal. The basin is on a southeasterly slope at a ground surface elevation of 308 ft msl (Figure 14-5).

The Ford Building Seepage Basin received wastewater from the nearby Ford Building (Building 690-G), where process equipment is repaired. The equipment was first decontaminated in the individual custodial areas. Wastewater was disposed to a retention tank adjacent to the Ford Building, analyzed for radionuclides, and then released either to the Ford Building Seepage Basin or to Waste Management Operations (WMO) for concentration and disposal.

In the 1960s much of the repair work centered on process water heat exchangers from the reactor areas. Wastewater generated from these operations typically contains low levels of radioactivity as well as nonradioactive organic and inorganic compounds (Pekkala et al., 1987c). The amount of radioactive materials released to the seepage basin decreased after the purchase of new heat exchanger heads reduced the need for heat exchanger repairs. Because of reduced use of the basin and the need to replace the existing retention tank, the basin and tank were retired in January 1984. Ford Building wastewater is currently sent to WMO for disposal.

The basin is generally dry except for occasionally impounded rainwater. Grass, brush, and tree seedlings are removed periodically and taken to the Radioactive Waste Burial Grounds (Building 643-7G) if necessary. Soil erosion is checked annually and is repaired as needed.

14.03.03 Groundwater Monitoring Program

Three wells (HXB 1 through HXB 3) were installed to monitor the water-table elevation and groundwater quality at the Ford Building Seepage Basin. Wells HXB 1 and HXB 2 were installed in June 1983 using PVC casings and 30-ft screens. The third monitoring well (HXB 3) was installed in June 1984 using the same well design.

During the first quarter of 1984, wells HXB 1 and HXB 2 were included in the SRS quarterly groundwater monitoring program. The third well (HXB 3) was incorporated into this program during the first quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

14.03.04 Site-Specific Hydrology

Interpretation of the hydrology of the water table beneath the Ford Building Seepage Basin is difficult because the HXB wells are screened below the water table and the water table in the area is fairly flat. Water-level elevation measurements obtained from the HXB wells since the first quarter of 1984 (Figure 14-6) indicate that the water-table elevation began declining in the second quarter of 1984. The water elevation for the fourth quarter of 1986 was approximately 252 ft msl, and the vadose zone was approximately 53 ft thick.

A water-table contour map for the third quarter of 1985 (Figure 14-5) indicates that the near-surface groundwater flow direction was to the south, consistent with groundwater flow toward Pen Branch. The hydrograph (Figure 14-6) indicates that this has been the predominant horizontal groundwater flow direction, although flow direction and gradient changes have occurred. Relative to the Ford Building Seepage Basin, well HXB 1 has been sidegradient, and wells HXB 2 and 3 have been upgradient.

The hydraulic gradient of the water table beneath the site has been approximately 0.005 ft/ft. Using an estimated horizontal groundwater flow velocity range for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the Ford Building Seepage Basin has ranged approximately from 7.5 to 30 ft/yr.

14.03.05 Waste-Site Content Characterization Data

The Ford Building Seepage Basin has been dry except for intermittent periods when impounded rainwater has been present. Therefore, the basin contents have not been sampled.

14.03.06 Soil/Sediment Characterization Data

Twelve soil borings were completed in and around the basin (Figure 14-7) to evaluate subsurface soil conditions and to assess the effect of the Ford Building Seepage Basin on soil chemistry. Nine soil samples were taken inside the basin, and three were taken outside the basin.

Three of the borings inside the basin were taken along the bottom of the basin and extended to a depth of 5 ft. The remaining six borings inside the basin were taken along the north and east walls and extended to a depth of 6 in. To evaluate potential pipeline leakage, two 8-in. cores were taken along the sewer pipeline that runs between the 6,000-gal storage tank and the basin. A core sample also was taken at a remote site to establish background concentrations.

As shown in Table 14-2, ^{60}Co, ^{90}Sr, and ^{137}Cs levels were above background in the upper layer of the basin soil/sediments. Below 1 ft in depth, soil/sediment samples exhibited radioactivity below 1.0 pCi/g for all tested radionuclides. The highest activities for ^{60}Co and ^{137}Cs were typically at a depth of 0.0 to 0.25 ft below ground surface, with levels decreasing substantially with depth. Levels of ^{60}Co in the basin soil/sediments ranged from a maximum of 21.10 pCi/g to less than background (0.190 pCi/g). Cesium-137 basin soil/sediment levels ranged from a maximum of 22.7 pCi/g to less than background (0.182 pCi/g).

A maximum radioactivity of 17.5 pCi/g for ^{90}Sr was found at a depth of 0.25 to 0.50 ft below ground surface in the basin soil/sediments. Levels of ^{90}Sr below 1 ft in the basin were at or below the background concentration of 0.03 pCi/g. Along the pipeline, only ^{90}Sr exhibited levels above background, with a maximum activity of 4.15 pCi/g. Below a depth of 0.33 ft from ground surface along the pipeline, levels of ^{90}Sr were equivalent to the background level of 0.03 pCi/g.

Activity of 399 pCi/g was reported for ^{3}H in the top layer of core FBB 110, taken from the middle of one of the side slopes. This value was discounted because it is inconsistent with the results from other cores taken within the area and with soil concentrations below the top layer of core FBB 110. The remaining layers of core FBB 110 exhibited ^{3}H levels similar to or less than background (0.05 pCi/g).

Metals present at greater than twice background concentrations in the basin sediment samples were aluminum, arsenic, cadmium, chromium, copper, iron, magnesium, mercury, nickel, selenium, and zinc (Table

14-3). Under the pipeline, those metals exceeding twice background levels were aluminum, arsenic, cadmium, chromium, copper, and iron. In general, metal concentrations were highest in the first 0.25 ft of sediment below ground surface, decreasing substantially with depth to background levels.

To further characterize the basin sediment, an Extraction Procedure (EP) toxicity test was performed. EP toxicity test results for metals from the top 3 in. of core FBB 102 indicate extractable metals at levels less than Resource Conservation and Recovery Act (RCRA) hazardous waste classification criteria (40 CFR 261.24), as presented in Table 14-4.

Organic chemical test results from the basin sediment are summarized in Table 14-5. All of the organic parameters analyzed were at concentrations below 1 mg/g.

14.03.07 Groundwater Monitoring Results

The monitoring data from 1984 through 1986 for the Ford Building Seepage Basin wells are included in Appendix L. Groundwater characterization data are summarized in Table 14-6.

A comparison of groundwater monitoring data with South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards was used to assess groundwater quality. Based on the nature of the materials disposed at the site (Section 14.03.02), the indicator parameters are conductivity and radioactivity.

Monitoring data summarized in Table 14-6 indicate that groundwater quality near the Ford Building Seepage Basin has been characterized by low dissolved chemical constituent and radioactivity levels compared to drinking water standards, as reflected by the low conductivity levels reported for the site wells (19 to 45 μmhos/cm). All tested inorganic, organic, and radioactive parameters have been at levels less than half their respective drinking water standards except for total dissolved solids (TDS) levels in well HXB 1, which ranged from 32 to 280 mg/L, far below the drinking water standard of 500 mg/L.

Groundwater pH ranged from 3.8 to 5.0 in all three site wells and is generally consistent with pH values as low as 4.0 reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

14.03.08 Planned Action

The Ford Building Seepage Basin is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

14.04 FIRE DEPARTMENT TRAINING FACILITY

14.04.01 Summary

The Fire Department Training Facility (Building 904-113G), also known as the Central Shops Burnable Oil Basin, was used from 1979 to 1982 by the SRS Fire Department to train personnel to fight waste oil fires. Burnable oil was poured into the basin, ignited, and then extinguished by Fire Department personnel (Christensen and Gordon, 1983).

Groundwater quality near wells CSO 1 and CSO 2 has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Indicator parameters based on the nature of materials disposed at the site are conductivity, total organic carbon (TOC), and total organic halogens (TOH). The levels of these parameters have not shown any consistent increasing or decreasing trends over the monitoring period.

14.04.02 Waste-Site Description and Nature of Disposal

The Fire Department Training Facility is a shallow pit surrounded by an 18-in.-high asphalt dike. This facility was used by the Fire Department from 1979 to 1982 to train personnel to fight waste oil fires. Burnable oil was poured into the pit, the oil was ignited, and the resulting fire was then extinguished by Fire Department personnel. In 1982, the use of this training facility was discontinued (Christensen and Gordon, 1983).

The Fire Department Training Facility is adjacent to the Ford Building Seepage Basin and occupies approximately 1,500 ft^2. The facility is at a surface elevation of approximately 300 ft msl on a northeasterly slope, where surface drainage is toward an unnamed tributary of Four Mile Creek.

14.04.03 Groundwater Monitoring Program

Two monitoring wells (CSO 1 and CSO 2) were installed to monitor the water-table elevation and groundwater quality beneath the Fire Department Training Facility (Figure 14-5). Monitoring wells CSO 1 and CSO 2 were installed in July 1983 and June 1984, respectively. Both wells were constructed using PVC casings and 30-ft screens.

In the first quarter of 1984, monitoring well CSO 1 was included in the SRS quarterly groundwater monitoring program. Well CSO 2 was incorporated into this program during the second quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

14.04.04 Site-Specific Hydrology

Measurements obtained from the Fire Department Training Facility wells since the first quarter of 1984 indicate that the water-table elevation began declining in the third quarter of 1984. A hydrograph for the Fire Department Training Facility wells (Figure 14-6) shows that the water-table elevation for the fourth quarter of 1986 was approximately 253 ft msl and that the vadose zone was approximately 50 ft thick.

Because only two wells are installed at the site and one of the wells (CSO 2) is screened below the water table, the horizontal groundwater flow direction cannot be determined. Measurements from these wells in conjunction with measurements from the nearby HXB wells, however, show a probable horizontal groundwater flow direction to the south toward Pen Branch.

14.04.05 Waste-Site Content Characterization Data

The contents of the training facility have not been sampled. Section 14.04.02 contains information on the nature of materials disposed at the site.

14.04.06 Soil/Sediment Characterization Data

In November 1986, soil and soil gas samples were taken at 51 sites in and around the Fire Department Training Facility. Samples were taken on a 15-ft-center grid to depths of 3 ft. Methane, ethylene, propylene, and hydrocarbons were detected in the samples. The major hydrocarbon present in the samples was toluene, at a maximum level of 59.5 μg/g (Price et al., 1987).

14.04.07 Groundwater Monitoring Results

Groundwater monitoring data from 1984 through 1986 are presented in Appendix L. Groundwater chemical characterization data since July 1984 are summarized in Table 14-7.

South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Based on the activities at this site (Section 14.04.02), the indicator parameters for the site are conductivity, total organic carbon (TOC), and total organic halogens (TOH).

As indicated in Table 14-7, all dissolved chemical constituent and radioactivity levels in groundwater samples from wells CSO 1 and CSO 2 have met South Carolina and federal drinking water standards. Conductivity in wells CSO 1 (27 to 45 μmhos/cm) and CSO 2 (27 to 42 μmhos/cm) was low. TOC levels in both site wells have been equal to or less than 1.00 mg/L except for a single observation of 9.69 mg/L in well CSO 2 in February 1985. TOH levels have been consistently below 0.05 mg/L in both monitoring wells. The pH in both site wells ranged between 4.0 and 5.1, which is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

14.04.08 Planned Action

The Fire Department Training Facility is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

14.05 HAZARDOUS WASTE STORAGE FACILITY

14.05.01 Summary

The Hazardous Waste Storage Facility (Buildings 709-G and 709-4G) has been used to store drummed hazardous wastes since November 1983. The wastes are stored in 55-gal drums placed on pallets. The site is currently active (Christensen and Gordon, 1983).

The groundwater monitoring data indicate that the Hazardous Waste Storage Facility has not had any effect on groundwater quality. Dissolved chemical constituent levels in the site wells have consistently met South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. The levels of likely indicator parameters (total organic halogens, total organic carbon, conductivity, and pH) have not shown any increase.

14.05.02 Waste-Site Description and Nature of Disposal

The Hazardous Waste Storage Facility (Buildings 709-G and 709-4G) began accepting hazardous wastes for storage in November 1983. The Hazardous Waste Storage Facility comprises two active enclosed metal buildings with concrete floors and diking to retain any leakage of hazardous waste. Waste is brought to the facility in 55-gal drums, placed on pallets, and stored in six defined zones: corrosive alkaline, corrosive acid, toxic, reactive, ignitable, and administrative decision (Christensen and Gordon, 1983).

The Hazardous Waste Storage Facility complies with South Carolina Department of Health and Environmental Control (SCDHEC) regulations regarding building design for hazardous waste storage facilities (Christensen and Gordon, 1983).

14.05.03 Groundwater Monitoring Program

Four monitoring wells (HWS Series) have been installed to monitor the water-table elevation and groundwater quality at the Hazardous Waste Storage Facility. Monitoring well HWS 1 was installed in March 1980 using galvanized steel casing and a 20-ft steel screen. Because of the possibility of groundwater quality interference resulting from the galvanized steel, this well was replaced by monitoring well HWS 1A in the third quarter of 1981, and well HWS 1 was subsequently abandoned. Well HWS 1A was constructed using PVC casing and a 30-ft screen. Two additional monitoring wells (HWS 2 and HWS 3) were installed at the site during the second quarter of 1984. These wells were also constructed using PVC casings and 30-ft screens. Well HWS 3 was abandoned in May 1985. The locations of the monitoring wells are shown in Figure 14-8.

Monitoring of the water table at the Hazardous Waste Storage Facility began during the second quarter of 1980, at which time monitoring well HWS 1 was the only existing well. In 1982, a program to monitor groundwater quarterly was initiated at SRS. Well HWS 1A was incorporated into the quarterly groundwater monitoring program at this time; wells HWS 2 and HWS 3 were incorporated into the program during the first quarter of 1985. Well HWS 3 was abandoned in May 1985. Plant-wide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

14.05.04 Site-Specific Hydrology

Measurements obtained from the Hazardous Waste Storage Facility wells since the first quarter of 1984 indicate that the water-table elevation began declining in the fourth quarter of 1984. A hydrograph for the Hazardous Waste Storage Facility wells (Figure 14-9) shows that the water-table elevation for the fourth quarter of 1986 was approximately 246 ft msl and that the vadose zone was about 70 ft thick. A water-table elevation contour map for the first quarter of 1985 is presented in Figure 14-8, which shows that the near-surface, horizontal groundwater flow direction was to the west. Although monitoring of water levels in well HWS 3 was discontinued in May 1985, the water-level data from wells HWS 2 and HWS 1A indicate that this has been the general flow direction. Fluctuations in water-level elevations indicate that minor changes in flow direction and gradient have occurred. Well HWS 1A has periodically been downgradient of part of the storage facility, but generally has remained sidegradient. Well HWS 2 has remained upgradient of the facility.

The approximate hydraulic gradient of the water table beneath the facility has been 0.006 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of approximately 15 to 60 ft/yr per percent gradient, the horizontal near-surface groundwater flow velocity beneath the facility has ranged approximately from 9 to 36 ft/yr.

14.05.05 Waste-Site Content Characterization Data

Section 14.05.02 contains information on the drummed wastes stored in the facility.

14.05.06 Soil/Sediment Characterization Data

The soil around the storage facility has not been sampled.

14.05.07 Groundwater Monitoring Results

The groundwater monitoring results from 1982 through 1986 are included in Appendix L. Groundwater chemical characterization data since July 1984 are summarized in Table 14-8.

As discussed in Section 14.05.04, the water-level data suggest that well HWS 1A has been predominantly sidegradient to the facility, although changing flow directions periodically may have placed this well downgradient. Well HWS 2 consistently has been upgradient of the facility. Because well HWS 3 was sampled only once (January 1985), comparisons of the monitoring results between upgradient well HWS 2 and well HWS 1A were used to evaluate the effect on the groundwater from the facility. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. Based on the nature of the materials stored at the facility (Section 14.05.02), the indicator parameters for the site are total organic halogens (TOH), total organic carbon (TOC), and conductivity.

The groundwater monitoring data indicate that the Hazardous Waste Storage Facility has not had any effect on groundwater quality near upgradient well HWS 2 and sidegradient to downgradient well HWS 1A. As shown in Table 14-8, all of the indicator parameters were at low levels. Conductivity in upgradient well HWS 2 (18 to 26 μmhos/cm) and well HWS 1A (17 to 31 μmhos/cm) remained low. TOH and TOC concentrations in wells HWS 2 and HWS 1A remained below 0.036 mg/L and 2.0 mg/L, respectively. The single reported values for conductivity, TOH, and TOC in well HWS 3 were 27 μmhos/cm, <0.005 mg/L, and 0.297 mg/L, respectively.

Groundwater pH in the site wells ranged from 3.6 to 5.0; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B). The levels of conductivity, TOH, TOC, and pH in the Hazardous Waste Storage Facility wells have not shown any consistent increasing or decreasing trends over the monitoring period.

Radioactivity levels were below drinking water standards except for an isolated excursion in well HWS 2 in June 1985. At that time gross alpha activity was 19 pCi/L and nonvolatile beta activity was 21 pCi/L. These parameter levels have been <2.0 pCi/L and <3.0 pCi/L, respectively, over the remainder of the monitoring period. Radioactivity is not known to be related to past site activities.

14.05.08 Planned Action

The Hazardous Waste Storage Facility is active, and continued use is planned. No other action is scheduled for this site.

14.06 CS-AREA BURNING/RUBBLE PITS

14.06.01 Summary

Burnable wastes such as paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents were received and incinerated in the CS-Area Burning/Rubble Pits (Buildings 631-1G, 631-5G, and 631-6G) from 1951 to 1973, at which time the pits were covered with a layer of soil. Rubble wastes (including paper, wood, cans, and empty galvanized steel barrels) were then disposed in the pits until each pit reached capacity and was capped with soil in 1978. All of the pits are currently inactive (Huber et al., 1987c).

There are no groundwater monitoring wells around Burning/Rubble Pit 631-6G. Wells CSR 1 through CSR 4 monitor Burning/Rubble Pits 631-1G and 631-5G, although the exact location of the pits relative to the wells has not been determined. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality near wells CSR 1 through CSR 4.

The monitoring data indicate that groundwater near wells CSR 1 through CSR 4 has met drinking water standards for dissolved chemical constituents and radioactivity except for isolated excursions of iron, chromium, and lead in well CSR 2. Conductivity in wells CSR 1 through CSR 4 ranged from 16 to 62 μmhos/cm. Total organic carbon (TOC) and total organic halogen (TOH) levels in all four site wells remained below 1.6 mg/L and 0.065 mg/L, respectively, over the monitoring period.

14.06.02 Waste-Site Description and Nature of Disposal

The CS-Area Burning/Rubble Pits (Buildings 631-1G, 631-5G, and 631-6G) were constructed in 1951 to collect burnable waste generated at the plant. The burnable waste collected for monthly incineration at the CS-Area pits included paper, plastics, wood, rubber, rags, cardboard, oil, degreasers, and drummed solvents. Disposal of chemically contaminated oils was not allowed at the CS-Area Burning/Rubble Pits (Huber et al., 1987c).

In 1973, the plantwide procedure of burning waste ceased, and the CS-Area Burning/Rubble Pits were converted to receive only rubble by placing a layer of soil over the incinerated waste. Rubble wastes disposed in the CS-Area Burning/Rubble Pits included paper, lumber, cans, and empty galvanized steel barrels. Rubble disposal continued until 1978, when the pits reached capacity and were backfilled.

The exact boundaries of Burning/Rubble Pits 631-1G and 631-5G have not been determined. The approximate northeast corner and center points for pits 631-1G and 631-5G (Huber et al., 1987c) are shown in Figure 14-10. Surface elevations in the area of these two pits range approximately from 265 to 275 ft msl. Pit 631-6G is located at the southeast corner of CS Area (Christensen and Gordon, 1983) at a surface elevation of approximately 295 ft msl. Approximate locations of the three burning/rubble pits are shown on the CS-Area waste-site map (Figure 14-2).

The pits were rectangular with approximate dimensions of 30 ft by 200 ft (631-1G), 35 ft by 385 ft (631-5G), and 30 ft by 290 ft (631-6G). All of the burning/rubble pits were approximately 10 ft deep at the time of construction. The capacities of the pits were 60,000 ft^3 (631-1G), 134,750 ft^3 (631-5G), and 87,000 ft^3 (631-6G). The nearest plant boundary to any of the CS-Area Burning/Rubble Pits is approximately 7 mi to the west.

14.06.03 Groundwater Monitoring Program

Three wells (CSR 1 through CSR 3) were installed in July 1983 to monitor the water-table elevation and groundwater quality near CS-Area Burning/Rubble Pits 631-1G and 631-5G. In June 1984, a fourth monitoring well (CSR 4) was added (Figure 14-10). The wells were constructed using PVC casings with 30-ft screens.

In the first quarter of 1984, wells CSR 1 through CSR 3 were included in the SRS quarterly groundwater monitoring program. Well CSR 4 was incorporated into this program in the first quarter of 1985. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

14.06.04 Site-Specific Hydrology

Measurements obtained from the CS-Area Burning/Rubble Pits wells since the first quarter of 1984 indicate that the water-table elevation in the area has been declining since the second quarter of 1984. A hydrograph for the CS-Area Burning/Rubble Pits wells (Figure 14-11) shows that the water-table elevation for the fourth quarter of 1986 ranged approximately from 257 to 255 ft msl and that the vadose zone was approximately 20 to 38 ft thick.

A water-table elevation contour map for the second quarter of 1986 is shown in Figure 14-10. This map indicates that horizontal near-surface groundwater flow was to the west and south. The water-level data indicate that this has been the predominant flow direction, although minor changes in flow direction and gradient have occurred. All four of the site monitoring wells apparently maintained upgradient or sidegradient positions with respect to Burning/Rubble Pit 631-1G, although the location of the pit will have to be accurately defined to confirm this positioning. The hydraulic gradient of the water table in the area of these wells has been approximately 0.01 ft/ft. Using an estimated groundwater flow velocity range for the Barnwell Formation near the center of the plant of 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the pits (631-1G and 631-5G) has ranged approximately from 15 to 60 ft/yr.

14.06.05 Waste-Site Content Characterization Data

The contents of the CS-Area Burning/Rubble Pits have not been sampled. Section 14.06.02 contains information on the materials incinerated and discharged at the waste site.

14.06.06 Soil/Sediment Characterization Data

The CS-Area Burning/Rubble Pits soil/sediments have not been sampled.

14.06.07 Groundwater Monitoring Results

The groundwater monitoring data from 1984 through 1986 for the CS-Area Burning/Rubble Pits wells are included in Appendix L. Groundwater characterization data are summarized in Table 14-9.

Monitoring well locations are presented in Figure 14-10, along with the predominant near-surface groundwater flow direction. As discussed in Section 14.06.04, the location of CS-Area Burning/Rubble Pits 631-1G and 631-5G with respect to monitoring wells CSR 1 through CSR 4 has not been established. It is believed that the four wells are either upgradient or sidegradient relative to the pits. Because the hydraulic positioning of wells CSR 1 through CSR 4 relative to the pits is unknown, South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality near wells CSR 1 through CSR 4. Based on the site inventory (Section 14.06.02), the indicator parameters for the CS-Area Burning/Rubble Pits are conductivity, total organic carbon (TOC), and total organic halogens (TOH).

The monitoring data summarized in Table 14-9 indicate that groundwater quality near wells CSR 1 through CSR 4 met drinking water standards for dissolved chemical constituents and radioactivity except for isolated excursions of iron, chromium, and lead in well CSR 2. Conductivity in wells CSR 1 through CSR 4 (16 to 62 μmhos/cm) was low. TOC and TOH levels remained below 1.6 mg/L and 0.065 mg/L, respectively, in all four site wells.

Iron levels in well CSR 2 (0.084 to 0.902 mg/L) exceeded the drinking water standard (0.3 mg/L) in a single excursion. Iron levels as high as 0.52 mg/L are generally consistent with iron levels reported as naturally occurring in Barnwell Formation groundwater (Appendix B). Chromium levels in well CSR 2 (<0.004 to 0.232 mg/L) exceeded the drinking water standard of 0.05 mg/L in a single excursion. Lead levels in well CSR 2 (0.011 to 0.080 mg/L) exceeded the drinking water standard of 0.05 mg/L in two excursions. Groundwater pH in wells CSR 1 through CSR 4 ranged from 3.7 to 5.6; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

14.06.08 Planned Action

The CS-Area Burning/Rubble Pits are inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

14.07 SAVANNAH RIVER LABORATORY (SRL) OIL TEST SITE

14.07.01 Summary

The Savannah River Laboratory (SRL) Oil Test Site (Building 080-16G) is approximately 2,000 ft south of the Central Shops complex. The SRL Oil Test Site was used to study the biodegradation of machine cutting oil with a viscosity similar to that of heavy automotive engine oil. In 1975, 2,630 gal of waste oil were spread over 12 test plots, covering approximately 5,000 ft^2. Soil tests were conducted in 1975, 1976, 1977, and 1980 to define the vertical migration and biodegradation rates of the oil. Additional soil testing is planned for 1987. In 1976, hydraulic fluid and paint thinner were applied to two additional test plots. A total of 1,930 gal of hydraulic fluid and paint thinner was spread over approximately 1,200 ft^2 (Johnson et al., 1987b).

Soil tests conducted between 1975 and 1980 indicate that the waste oil had not migrated below 12 in. from ground surface. Nearly 50% of the oil was lost to volatilization and biodegradation after 2 yr (Johnson et al., 1987b). There are no groundwater monitoring wells installed at this waste site.

14.07.02 Waste-Site Description and Nature of Disposal

The SRL Oil Test Site (Building 080-16G) was used to evaluate the biodegradation rate of waste oil, hydraulic fluid, and paint thinner. In 1975, 24 plots (12 test and 12 control) received machine cutting oil with a viscosity similar to that of heavy automobile engine oil. In 1976, two additional plots received hydraulic fluid and paint thinner (Johnson et al., 1987b).

Each oil test plot measures approximately 35 ft long by 12 ft wide. The 12 test plots cover approximately 5,040 ft^2. The 12 control plots have similar dimensions. The test and control plots are separated by 20-ft buffer zones, as shown in Figure 14-12. Waste oil, purchased offsite, was sprayed on the 12 test plots in July 1975. Each oil plot had 110 gal of oil applied, was tilled to a depth of 6 in., had an additional 110 gal of oil applied, and was tilled again. The final oil concentration was approximately 1.0 gal/ft^3 of soil. Commercial fertilizers were applied to the oil and control sites at four rates to assess the effect of fertilizer on the residual oil concentration (Johnson et al., 1987b).

In April 1976, two new plots were established to study the biodegradation of hydraulic fluid and paint thinner. Each new plot measured about 230 ft long by 10 ft wide. The soil was tilled, and 1,100 gal of paint thinner (which included some paint brush rinses) and 825 gal of used hydraulic fluid were poured randomly on the two plots. These two plots are located about 15 ft north of the original oil test site plots (Johnson et al., 1987b).

The SRL Oil Test Site is approximately 2,000 ft south of CS Area and 2,000 ft east of the intersection of SRS Roads 3 and 5. Additional application of oils at the site is not planned. Low-growing weeds and grass cover the site, and asphalt rubble is present along the edges of the area.

14.07.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the SRL Oil Test Site.

14.07.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the SRL Oil Test Site; therefore, groundwater conditions beneath the site are undefined.

14.07.05 Waste-Site Content Characterization Data

Section 14.07.02 contains information regarding the nature of the materials applied to the site.

14.07.06 Soil/Sediment Characterization Data

The SRL Oil Test Site plots were sampled immediately prior to oil application, immediately after oil application, 1 month after application, every 3 months after application for 2 yr, and 5 yr after application.

Two soil cores were taken from each oil test plot and were analyzed at depths of 0 to 0.5 ft, 0.5 to 1.0 ft, and 1.0 to 1.5 ft. The results of the tests indicate that about 50% of the applied oil was lost from the soil profile through biodegradation and volatilization after 2 yr. Little degradation (an additional 2-3%) occurred in the following 3 yr. The data also indicate that little vertical migration of the oil occurred. The applied oil was found in low concentrations at depths of 0.5 to 1.0 ft below ground surface but was not detected at depths of 1.0 to 1.5 ft below ground surface during the 5-yr characterization period (Johnson et al., 1987b).

As discussed in Section 14.07.02, commercial fertilizer was applied to the site to assess its effect on the concentration of residual oil. There was no significant statistical effect of the different fertilizer treatment amounts on the residual oil content in any of the test plots (Johnson et al., 1987b).

14.07.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the SRL Oil Test Site.

14.07.08 Planned Action

The SRL Oil Test Site is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

14.08 FORD BUILDING WASTE SITE

14.08.01 Summary

The Ford Building Waste Site (Building 643-11G) is north of the Ford Building (Building 690-G) in CS Area. The origin and history of the site are uncertain. It is possible that work involving exposure to radioactive contaminants (regulated) was performed in the area, and protective clothing worn by site personnel was disposed at the site. The Ford Building Waste Site is currently inactive (Huber et al., 1987a).

Soil/sediment sampling at the Ford Building Waste Site has not been conducted. Soil analyses are planned prior to site closure. There are no groundwater monitoring wells at this waste site.

14.08.02 Waste-Site Description and Nature of Disposal

Detailed records of materials disposed to the Ford Building Waste Site were not maintained. It is believed that the site contains old clothing, lumber, and scrap metal from regulated work performed in the area (Huber et al., 1987a). During the 1970s, an oil line from the Ford Building ruptured, and oil was discharged to the area (Christensen and Gordon, 1983).

The Ford Building Waste Site (Building 643-11G) is north of the Ford Building (Building 690-G) in an area of relatively low topographic relief, and the ground surface elevation is approximately 300 ft msl. The waste site is rectangular, with approximate dimensions of 170 ft by 22 ft (3,740 ft^2). Vegetation at the waste site consists of low-lying tufts of grass and a few pine trees.

14.08.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the waste site.

14.08.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the Ford Building Waste Site; therefore, groundwater conditions beneath the site are undefined.

14.08.05 Waste-Site Content Characterization Data

An inventory of materials disposed at the Ford Building Waste Site was not maintained. Information concerning the nature of materials disposed at the site is presented in Section 14.08.02.

14.08.06 Soil/Sediment Characterization Data

Characterization studies of the soil/sediments have not been performed. Soil analyses are planned prior to site closure.

14.08.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the Ford Building Waste Site.

14.08.08 Planned Action

The Ford Building Waste Site is inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

14.09 SANITARY SEWAGE SLUDGE LAGOON

14.09.01 Summary

The Sanitary Sewage Sludge Lagoon (Building 080-24G) has received SRS sewage treatment sludge since 1955. Sludge and sediment samples collected and analyzed in 1986 showed that metals concentrations generally increased with depth in the sludge and decreased with depth in the sediments. Pesticides concentrations were below detection limits in both the sludge and sediments. Groundwater monitoring has not been conducted at the site. The lagoon is currently active and receiving sewage sludge (Christensen and Gordon, 1983).

14.09.02 Waste-Site Description and Nature of Disposal

The Sanitary Sewage Sludge Lagoon (Building 080-24G) has received all of the sanitary sewage sludge from the various sewage treatment plants at SRS since 1955. The lagoon is southwest of CS Area near the SRL Oil Test Site and had original dimensions of 40 ft by 60 ft by 5 ft deep.

The sludge is trucked to the lagoon monthly. The typical loading is approximately 100,000 gal/yr. In 1983 an asphalt film appeared on the lagoon fluid as a result of the inadvertent dumping of an asphalt solution into the lagoon (Christensen and Gordon, 1983). The lagoon is currently receiving sewage treatment sludge, and no asphalt is observable except by gas chromatograph analysis.

14.09.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the Sanitary Sewage Sludge Lagoon.

14.09.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the Sanitary Sewage Sludge Lagoon; therefore, groundwater conditions beneath the site remain undefined.

14.09.05 Waste-Site Content Characterization Data

The lagoon contents were sampled in May 1980. Chemical analyses of the sludge showed that all metals and pesticides were below detection limits. Sludge samples also were obtained from two locations within the lagoon in November 1986. Average concentrations for each tested depth interval are given in Table 14-10. Metals concentrations generally increased with depth; pesticides were below detection limits. Asphalt was detected in the samples.

14.09.06 Soil/Sediment Characterization Data

Two soil/sediment cores were also obtained in November 1986. Averaged concentrations are presented in Table 14-11. Average concentrations of all the analytes decreased with depth. Pesticide concentrations were below detection limits.

14.09.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the Sanitary Sewage Sludge Lagoon.

14.09.08 Planned Action

The Sanitary Sewage Sludge Lagoon is active, but closure is planned in the near future. The closure plan calls for the sludge to be spread on sites permitted for that use.

14.10 CS-AREA SCRAP LUMBER PILE

14.10.01 Summary

The CS-Area Scrap Lumber Pile (Building 631-2G) has received approximately 100 yd^3 of scrap lumber per month for burning since 1975. Groundwater monitoring and content characterization have not been conducted at this site. The CS-Area Scrap Lumber Pile is currently receiving scrap lumber (Christensen and Gordon, 1983).

14.10.02 Waste-Site Description and Nature of Disposal

Approximately 200 yd^3 of scrap lumber (including poles, crates, pallets, and scrap wooden furniture) accumulate at SRS each month. Plant policy requires that all scrap lumber be disposed onsite because of the expense of monitoring all such material for possible radioactive contamination before it can be disposed offsite.

Two sites were established in 1975 for the burning of scrap lumber. These sites (Buildings 231-3F and 631-2G) are in F Area and CS Area, respectively. The scrap lumber piles have been burned periodically, subsequent to notification to the South Carolina Department of Health and Environmental Control (SCDHEC) (Christensen and Gordon, 1983).

The CS-Area Scrap Lumber Pile is north of the Central Shops perimeter fence and south of SRS Road 5, as shown in Figure 14-2. The ground surface elevation at the site is approximately 280 ft msl. Surface drainage from the pile is to the west, toward a tributary of Four Mile Creek. Access to the CS-Area Scrap Lumber Pile has been restricted since May 1983. The site is currently active and receiving scrap lumber.

14.10.03 Groundwater Monitoring Program

Groundwater monitoring has not been conducted at the CS-Area Scrap Lumber Pile.

14.10.04 Site-Specific Hydrology

There are no groundwater monitoring wells at the CS-Area Scrap Lumber Pile; therefore, groundwater conditions beneath the pile are undefined.

14.10.05 Waste-Site Content Characterization Data

No radioactive or hazardous chemical constituents have been identified as having been discharged to the CS-Area Scrap Lumber Pile. The CS-Area Scrap Lumber Pile contents have not been sampled. Section 14.10.02 contains information on the nature of materials disposed at the site.

14.10.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the CS-Area Scrap Lumber Pile.

14.10.07 Groundwater Monitoring Results

Groundwater monitoring has not been conducted at the CS-Area Scrap Lumber Pile.

14.10.08 Planned Action

The CS-Area Scrap Lumber Pile is active, and continued use is planned. No other action is scheduled for this site.

TABLE 14-1

Summary of Groundwater Quality: Well Concentration Ranges for the Hydrofluoric Acid Spill Area (7/84-12/86)

Constituent	SC and Federal DWS	CSA 1	CSA 2	CSA 3	CSA 4
pH (pH)	6.5-8.5	4.1-4.8	4.2-5.2	4.2-5.9	4.3-6.1
Conductivity (µmhos/cm)	NA	42-75	40-52	38-55	41-50
Silver (mg/L)	0.05	<0.0000-0.0020	<0.0000	<0.0000	<0.0000
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.016-0.021	0.009-0.011	0.007-0.012	0.028-0.035
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.3-4.2	2.9-3.8	2.9-3.8	2.7-3.8
Chromium (mg/L)	0.05	<0.004-0.018	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.80	<0.10-0.80	<0.10-0.80	<0.10-0.80
Iron (mg/L)	0.3	0.014-0.049	0.008-0.047	0.016-0.118	0.009-0.062
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002-0.0003
Manganese (mg/L)	0.05	0.002-0.004	<0.002	<0.002-0.002	0.009-0.013
Sodium (mg/L)	NA	3.64-4.67	3.47-3.99	2.88-4.42	3.11-3.92
Nitrate (as N) (mg/L)	10	3.05-3.20	2.62-3.22	2.82-3.05	2.75-2.95
Lead (mg/L)	0.05	<0.004-0.035	<0.004-0.025	<0.004-0.024	<0.005-0.022
Phenols (mg/L)	NA	<0.002	<0.002-0.016	<0.002-0.003	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002-0.005	<0.002	<0.002
Sulfate (mg/L)	250	<5.0	<5.0	<5.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.001	<0.001	<0.001	<0.001
TOC (mg/L)	NA	0.370-1.880	0.430-13.200	0.550-21.900	0.400-2.170
TOH (mg/L)	NA	<0.005-0.013	<0.005-0.040	<0.005-0.195	<0.005-0.007
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001	<0.001
Gross alpha (pCi/L)	15	<2.0	<2.0-8.0	<2.0-8.0	<2.0-5.0
Nonvol. beta (pCi/L)	NA	<3.0-3.0	<3.0-6.0	<3.0-11.0	<3.0-5.0
Total radium (pCi/L)	5	<1.0	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 14-2

Summary of Radionuclide Concentrations in Core Samples from the Ford Building Seepage Basin

	Maximum Activity (pCi/g) in Each Core											
Isotope	1	2	3	4	5	6	7	8	9	10	11	BKGD
^{54}Mn	ND	ND	0.13	ND	ND	ND	0.15	0.80	ND	ND	ND	ND
^{60}Co	6.33	11.60	21.10	<0.40	<0.10	<0.20	8.46	<0.20	<0.40	<0.20	<0.20	0.190
^{152}Eu	<0.40	<0.80	<0.50	<0.60	<0.40	<0.50	<0.50	<0.50	<0.90	<0.60	<0.60	0.400
^{154}Eu	<0.80	<0.70	<0.50	<0.60	<0.20	<0.40	<0.30	<0.40	<0.70	<0.30	<0.30	0.280
^{155}Eu	<0.40	<0.45	0.75	<0.20	<0.20	ND	0.54	<0.20	<0.30	0.29	0.49	0.287
^{89}Sr	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.60	<0.06	<0.06	<0.06	0.060
^{90}Sr	6.40	17.50	<0.03	<0.03	4.15	<0.03	0.03	<0.03	<0.03	<0.03	<0.03	0.030
Tritium	<0.05	<0.05	<0.05	<0.05	<0.05	0.22	<0.50	0.61	<0.05	<0.05	<0.05	0.050
^{235}U	0.22	0.21	0.30	0.28	0.18	0.32	0.18	0.15	0.55	0.22	0.22	0.150
^{134}Cs	ND	ND	ND	0.33	ND	0.27	ND	ND	ND	ND	ND	ND
^{137}Cs	5.17	10.80	22.70	<0.30	<0.10	<0.20	3.71	<0.20	<0.30	0.33	0.38	0.182

Note: Concentrations given are for the top 12 in. of soil in each core; samples were collected in August 1985. BKGD = background; ND = not detected. Data are from Pekkala et al. (1987c).

TABLE 14-3

Metals Above Twice Background Levels in the Ford Building Seepage Basin and Vicinity

In Basin	Background Concentration (mg/kg)	Sediment Concentration (mg/kg--wet)
Aluminum	8,792.40	34,860.00
Arsenic	0.948	5.38
Cadmium	0.680	1.70
Chromium	7.820	43.90
Copper	2.680	9.40
Iron	8,346.00	38,410.00
Mercury	0.200	7.69
Magnesium	128.62	347.00
Nickel	3.000	8.50
Selenium	0.250	0.60
Zinc	11.440	83.10

Under Pipeline	Background Concentration (mg/kg)	Sediment Concentration (mg/kg--wet)
Aluminum	8,792.40	22,740.00
Arsenic	0.948	5.64
Cadmium	0.680	1.80
Chromium	7.820	43.10
Copper	2.680	7.10
Iron	8,346.00	33,070.00

Note: Concentrations in the basin are from FBB 103; concentrations under the pipeline are from FBB 105.

TABLE 14-4

EP Toxicity Test Data for Ford Building Seepage Basin Sediments

	Concentration (mg/L)		
Constituent	Detection Limit	EPA Guidelines (100 x DWS*)	Toxicity Test Result
Arsenic	0.002	5.0	ND
Barium	0.1	100.0	0.12
Cadmium	0.001	1.0	<0.01
Chromium	0.002	5.0	<0.04
Endrin	0.00004	0.02	<0.00006
Lead	0.01	5.0	<0.10
Lindane	0.001	0.4	<0.001
Mercury	0.0002	0.2	<0.0002
Methoxychlor	0.020	10.0	<0.020
Selenium	0.002	1.0	<0.00
Silver	0.002	5.0	<0.02
Silvex	0.002	1.0	<0.002
Toxaphene	0.001	0.5	<0.001
2,4-D	0.020	10.0	<0.020

Note: The test was performed on 0- to 0.25-ft interval for Core FBB 102. Data are from Pekkala et al. (1987c). ND = not detected.

* DWS are federal primary drinking water standards (40 CFR 141).

TABLE 14-5

Organic Chemicals Found in Ford Building Seepage Basin Sediment Above Detection Limits

Chemical	Concentration ($\mu g/g$)
Bis(2-ethylhexyl)phthalate	270.00
Decafluorobiphenyl	3.60
Methylene chloride	16.00 (ng/g)
Naphthalene-D8	5.30
Nitrobenzene-D5	5.40
Pentafluorophenol	4.10
Phenol-D6	5.20
2-Fluorobiphenyl	6.00
2-Fluorophenol	4.00

Note: The sample was taken from 0- to 0.25-ft intervals in Core FBB 102. Data are from Pekkala et al. (1987c).

TABLE 14-6

Summary of Groundwater Quality: Well Concentration Ranges for the Ford Building Seepage Basin (7/84-12/86)

Constituent	SC and Federal DWS	HXB 1	HXB 2	HXB 3
pH (pH)	6.5-8.5	3.8-4.7	3.9-4.6	4.0-5.0
Conductivity (µmhos/cm)	NA	20-34	20-35	19-45
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.019-0.022	0.019-0.022	0.020-0.024
Beryllium (mg/L)	NA	<0.002	<0.002	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002
Chloride (mg/L)	250	1.9-3.2	1.2-3.2	1.7-5.8
Chromium (mg/L)	0.05	<0.004-0.024	<0.004-0.016	<0.004
Copper (mg/L)	1	<0.004-0.013	<0.004-0.009	<0.004
Cyanide (mg/L)	0.2	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.13	<0.10-0.14	<0.10-0.29
Iron (mg/L)	0.3	0.013-0.146	0.030-0.112	<0.004-0.037
Mercury (mg/L)	0.002	<0.0002-0.0004	<0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002-0.011	0.002-0.005	<0.002-0.004
Sodium (mg/L)	NA	2.07-2.52	2.21-2.62	1.85-2.49
Nickel (mg/L)	NA	<0.004-0.013	<0.004-0.008	<0.004
Nitrite (as N)(mg/L)	NA	<0.50	<0.50	---
Nitrate (as N)(mg/L)	10	1.20-1.30	0.95-1.15	0.67-1.12
Lead (mg/L)	0.05	<0.010-0.017	0.004-0.013	<0.005-0.012
Phenols (mg/L)	NA	<0.002-0.005	<0.002-0.005	<0.002-0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0
TDS (mg/L)	500	32-280	<5-22	---
TOC (mg/L)	NA	0.300-0.799	0.240-1.142	0.184-0.560
TOH (mg/L)	NA	<0.005-0.028	<0.005-0.062	<0.005-0.005
Zinc (mg/L)	5	0.013-0.058	0.006-0.034	0.010
Gross alpha (pCi/L)	15	<2.0	<2.0-3.0	<2.0-5.0
Nonvolatile beta (pCi/L)	NA	<3.0-4.0	<3.0-3.0	<3.0-7.0
Tritium (pCi/mL)	20	7-9	3-5	4-6
Total radium (pCi/L)	5	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 14-7

Summary of Groundwater Quality: Well Concentration Ranges for the Fire Department Training Facility (7/84-12/86)

Constituent	SC and Federal DWS	CSO 1	CSO 2
pH (pH)	6.5-8.5	4.0-4.9	4.0-5.1
Conductivity (μmhos/cm)	NA	27-45	27-42
Silver (mg/L)	0.05	<0.0020	<0.0004-0.0008
Arsenic (mg/L)	0.05	<0.001	<0.001
Barium (mg/L)	1.0	0.040-0.047	0.036-0.046
Beryllium (mg/L)	NA	<0.002	---
Cadmium (mg/L)	0.010	<0.002	<0.002
Chloride (mg/L)	250	2.9-3.8	2.6-3.9
Chromium (mg/L)	0.05	<0.004-0.006	<0.004
Copper (mg/L)	1	0.006-0.018	---
Cyanide (mg/L)	0.2	<0.005	---
DOC (mg/L)	NA	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.20	<0.10-0.15
Iron (mg/L)	0.3	0.028-0.133	0.011-0.046
Mercury (mg/L)	0.002	<0.0002-0.0002	<0.0002
Manganese (mg/L)	0.05	0.011-0.020	0.004-0.010
Sodium (mg/L)	NA	2.17-2.92	2.09-2.47
Nickel (mg/L)	NA	0.006-0.007	---
Nitrite (as N) (mg/L)	NA	<0.50	---
Nitrate (as N) (mg/L)	10	1.00-1.25	<0.50-1.48
Lead (mg/L)	0.05	0.009-0.015	<0.006-0.028
Phenols (mg/L)	NA	<0.002-0.006	<0.002
Selenium (mg/L)	0.01	<0.001	<0.002
Sulfate (mg/L)	250	<5.0	<5.0
TDS (mg/L)	500	30-96	---
TOC (mg/L)	NA	0.460-1.000	0.110-9.690
TOH (mg/L)	NA	<0.005-0.045	<0.005-0.013
Zinc (mg/L)	5	0.186-0.216	---
Gross alpha (pCi/L)	15	<2.0	<2.0
Nonvol. beta (pCi/L)	NA	<3.0-3.0	<3.0-3.0
Total radium (pCi/L)	5	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 14-8

Summary of Groundwater Quality: Well Concentration Ranges for the Hazardous Waste Storage Facility (7/84-12/86)

Constituent	SC and Federal DWS	HWS 1A	HWS 2	HWS 3
pH (pH)	6.5-8.5	3.8-5.0	3.6-4.8	3.7
Conductivity (µmhos/cm)	NA	17-31	18-26	27
Silver (mg/L)	0.05	<0.0005	<0.0004	<0.0005
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.010	0.012-0.015	0.018
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002
Chloride (mg/L)	250	1.7-2.7	1.1-3.9	2.4
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004
DOC (mg/L)	NA	<5.0	---	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10-0.18	0.13
Iron (mg/L)	0.3	0.054-0.063	<0.004-0.132	0.030
Mercury (mg/L)	0.002	<0.0002	<0.0002-0.0002	0.0002
Manganese (mg/L)	0.05	0.002-0.003	<0.002-0.010	0.007
Sodium (mg/L)	NA	1.06-1.23	0.95-1.45	1.35
Nitrate (as N)(mg/L)	10	0.70	0.67-0.90	0.80
Lead (mg/L)	0.05	<0.005-0.015	<0.005-0.034	0.024
Phenols (mg/L)	NA	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	<5.0
TDS (mg/L)	500	<5	---	---
TOC (mg/L)	NA	0.563-1.530	0.307-1.800	0.297
TOH (mg/L)	NA	<0.005-0.035	<0.005-0.006	<0.005
Zinc (mg/L)	5	0.029	0.053	0.025
Gross alpha (pCi/L)	15	<2.0	<2.0-19.0	<2.0
Nonvolatile beta (pCi/L)	NA	<3.0-4.0	<3.0-21.0	<3.0
Total radium (pCi/L)	5	<1.0	<1.0-2.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 14-9

Summary of Groundwater Quality: Well Concentration Ranges for the Central Shops Burning/Rubble Pits (7/84-12/86)

Constituent	SC and Federal DWS	CSR 1	CSR 2	CSR 3	CSR 4
pH (pH)	6.5-8.5	3.7-4.8	4.0-4.8	3.9-4.8	4.1-5.6
Conductivity (µmhos/cm)	NA	27-62	16-28	17-52	17-30
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.014-0.023	0.019-0.023	0.008-0.011	0.007-0.026
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002-0.003	<0.002	<0.002	<0.001
Chloroform (mg/L)	0.100*	0.002	<0.001	<0.001	<0.001
Chloride (mg/L)	250	4.1-6.8	2.9-4.6	3.4-5.3	2.6-3.5
Chromium (mg/L)	0.05	<0.004	<0.004-0.232	<0.004	<0.002
Copper (mg/L)	1	<0.004-0.007	0.010-0.024	<0.004-0.012	---
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.10	<0.10-0.11	<0.10-0.13	<0.10-0.13
Iron (mg/L)	0.3	0.046-0.290	0.084-0.902	<0.004-0.113	<0.004-0.046
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.016-0.021	0.006-0.037	0.003-0.007	<0.001-0.011
Sodium (mg/L)	NA	2.33-3.22	1.60-1.87	1.55-2.19	2.04-3.14
Nickel (mg/L)	NA	<0.004-0.004	0.018-0.123	<0.004	<0.004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	<0.50	<0.50	<0.50-4.90	<0.50-1.05
Lead (mg/L)	0.05	0.007-0.040	0.011-0.080	<0.004-0.022	<0.005-0.007
Phenols (mg/L)	NA	<0.002-0.005	<0.002-0.007	<0.002-0.010	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0-7.0	<5.0-20.0	<5.0-24.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.001	<0.001	<0.001	<0.001
TDS (mg/L)	500	62-106	14-52	8-22	---
TOC (mg/L)	NA	0.440-1.570	0.740-1.200	0.800-1.250	0.340-1.000
TOH (mg/L)	NA	<0.005-0.031	<0.005-0.064	<0.005-0.044	<0.005
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001	<0.001
Zinc (mg/L)	5	0.014-0.072	0.066-0.148	0.013-0.112	---
Gross alpha (pCi/L)	15	0.5	1.1	0.4-11.0	<2.0
Nonvol. beta (pCi/L)	NA	<3.0-3.0	2.0	2.0-9.5	<3.0
Total radium (pCi/L)	5	0.4	0.2	0.4-4.0	<1.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 14-10

Average Chemical Concentrations in Sanitary Sewage Sludge Lagoon Sludge Samples

Analyte	Concentration (mg/kg) 0 to 2 ft	2 to 4 ft	4 to 5 ft
Nitrate	8.27	4.5	5.81
Total Kjeldahl nitrogen	22,400	18,900	12,800
Total phosphates	24,800	24,900	43,500
Calcium	9,990	7,240	6,750
Silver	215	285	217
Potassium	581	526	642
Magnesium	1,070	1,350	1,090
Iron	11,100	14,900	25,200
Lead	143	211	168
Copper	528	784	743
Barium	211	240	243
Selenium	0.967	1.20	1.52
Sodium	735	858	921
Zinc	703	1,160	1,120
Cadmium	11.0	12.0	137
Chromium	89.6	103	142
Nickel	795	757	1,440

Note: Samples were collected in November 1986. Concentrations are the average of two values, rounded to three significant digits.

TABLE 14-11

Average Chemical Concentrations in Sanitary Sewage Sludge Lagoon Sediment Samples

Analyte	Concentration (mg/kg) 0 to 2 ft	2 to 4 ft
Nitrate	29.5	2.56
Total Kjeldahl nitrogen	21,900	1,970
Total phosphates	22,000	4,580
Calcium	5,870	1,036
Silver	114	6.33
Potassium	478	237
Magnesium	1,210	333
Iron	15,700	4,370
Lead	60.3	54.1
Copper	518	40.8
Barium	207	109
Selenium	1.27	0.208
Sodium	747	138
Zinc	828	64.8
Cadmium	4.99	2.93
Chromium	5,610	21.7
Nickel	130	73.4

Note: Samples were collected in November 1986. Concentrations are the average of two values, rounded to three significant digits.

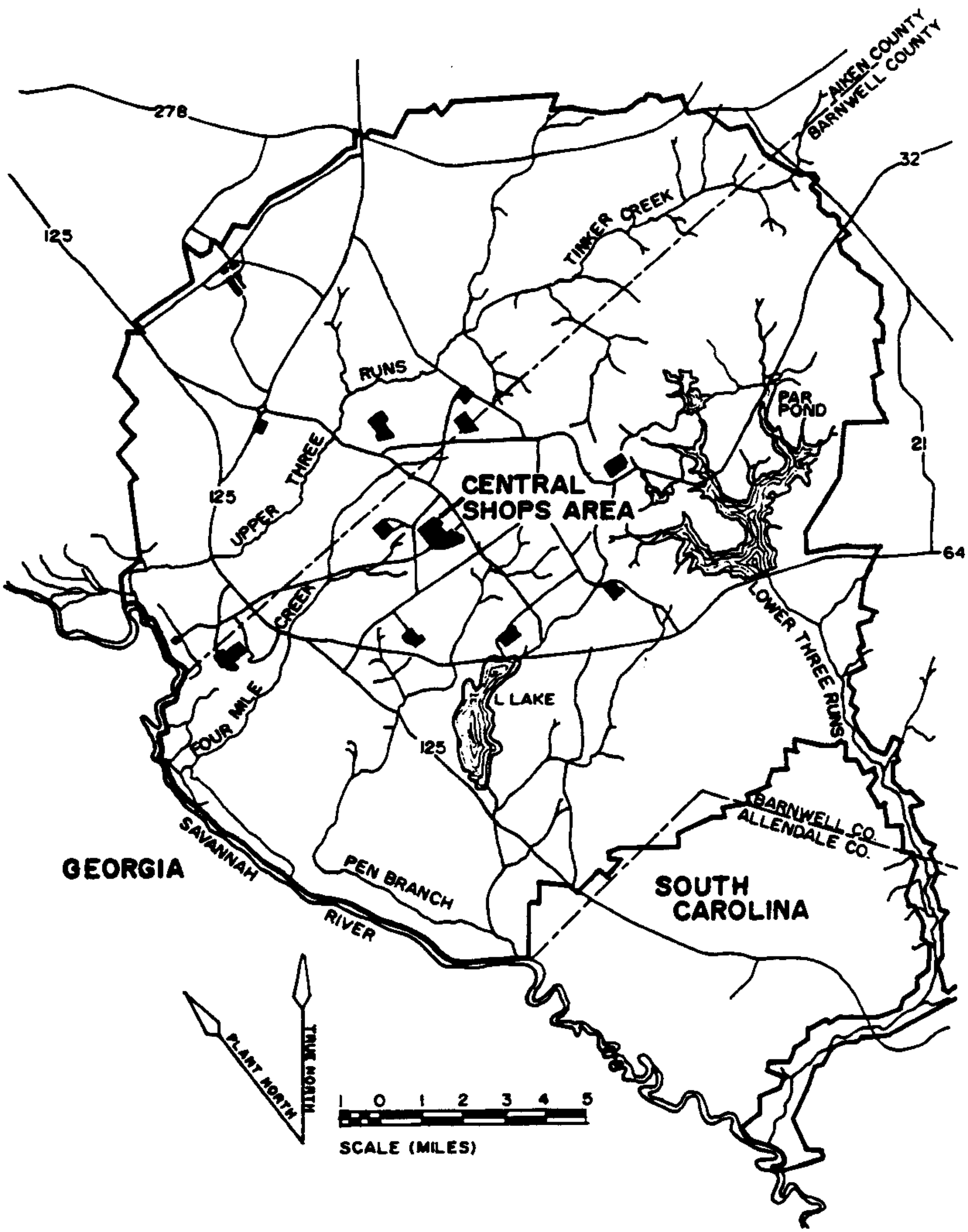


FIGURE 14-1. Location of Central Shops (CS) Area at SRS

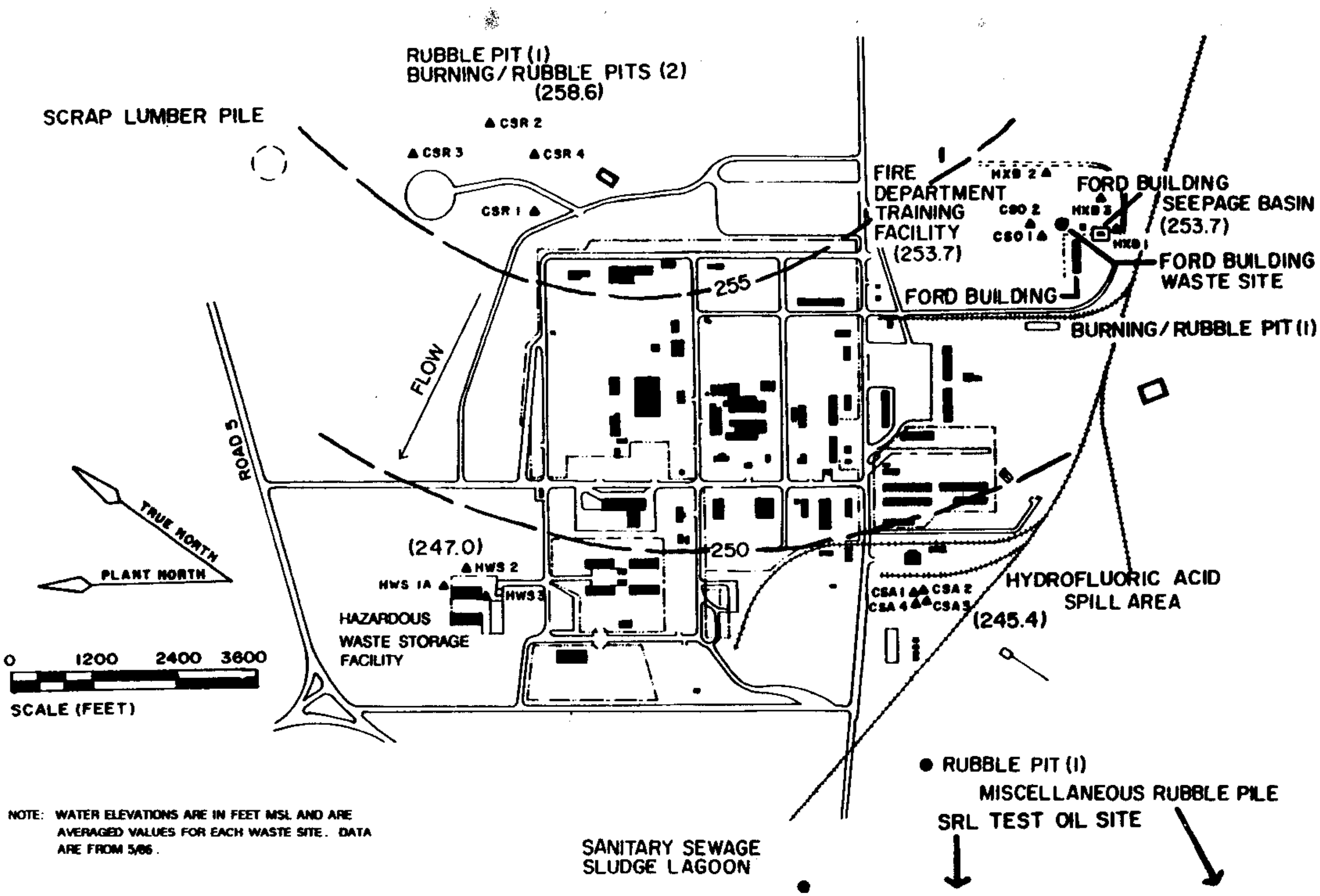


FIGURE 14-2. Central Shops (CS) Area Water-Table Elevation Map

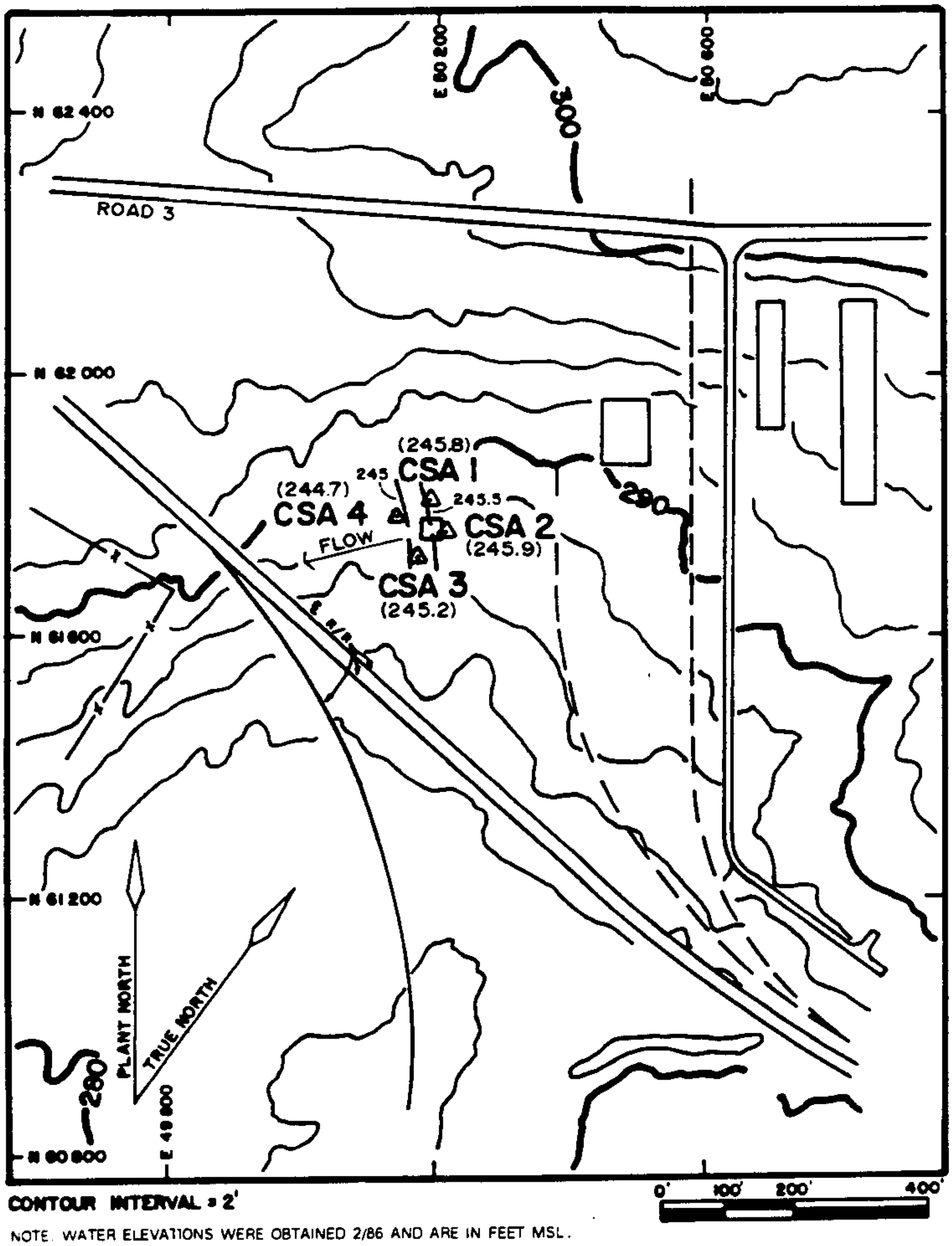


FIGURE 14-3. Hydrofluoric Acid Spill Area Water-Table Elevation Map

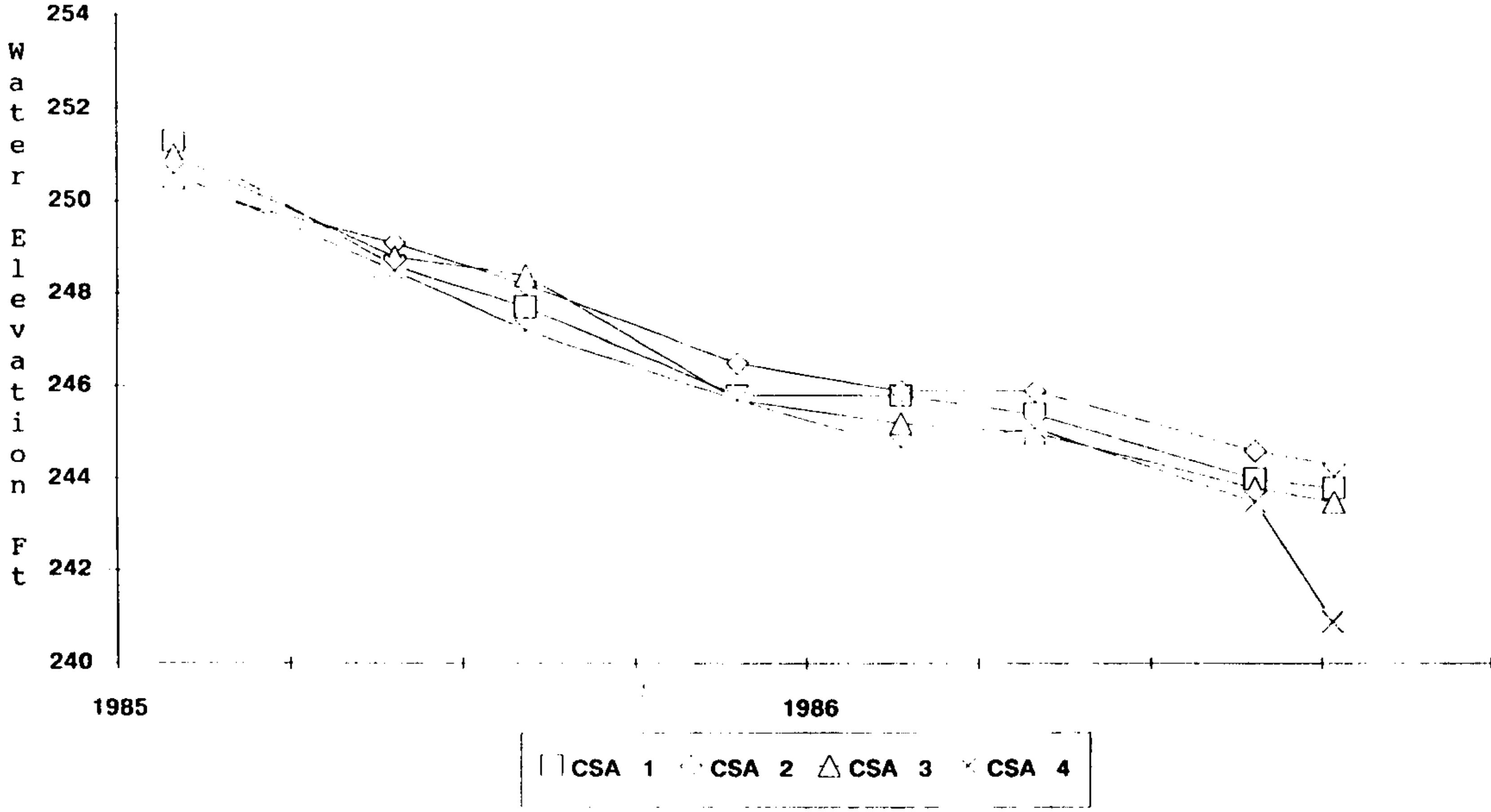


FIGURE 14-4. Hydrograph of the Hydrofluoric Acid Spill Area Wells

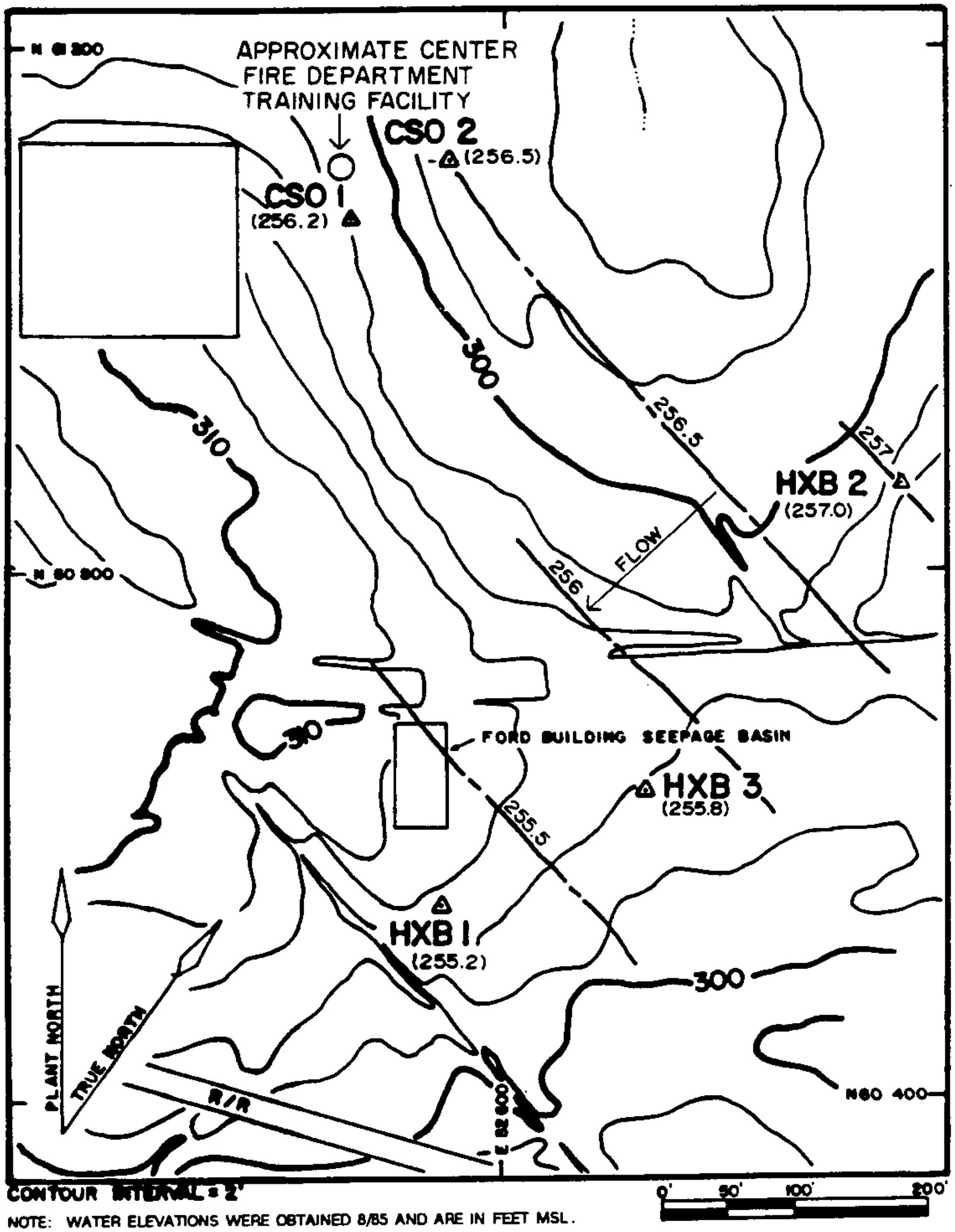
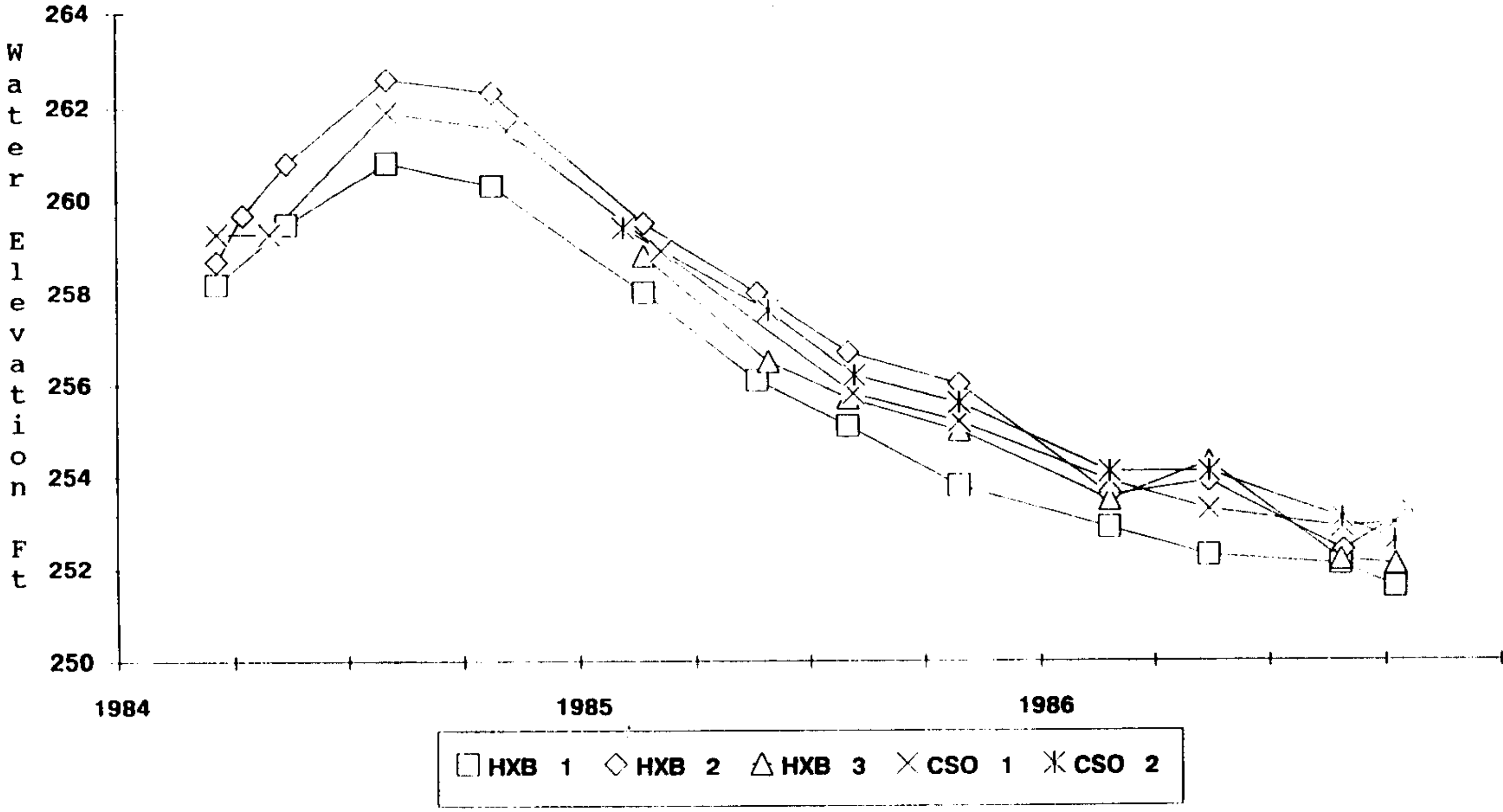


FIGURE 14-5. Ford Building Seepage Basin and Fire Department Training Facility Water-Table Elevation Map



NOTE: A WATER LEVEL OF 241.4 FT OBTAINED FOR WELL CSO 1 ON 5/28/85 IS NOT PLOTTED.

FIGURE 14-6. Hydrograph of the Ford Building Seepage Basin and Fire Department Training Facility Wells

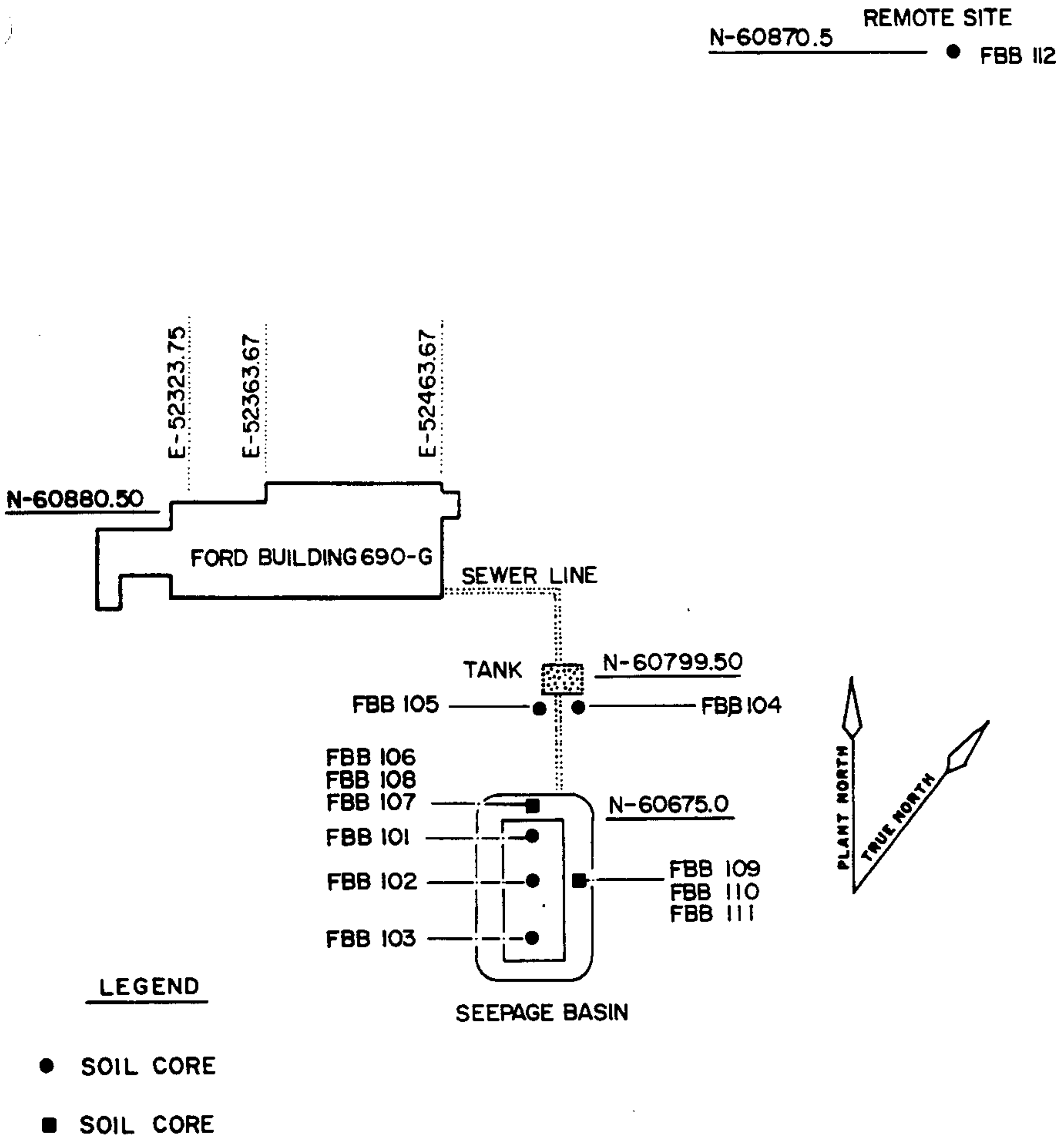


FIGURE 14-7. Soil Sampling Locations at the Ford Building Seepage Basin

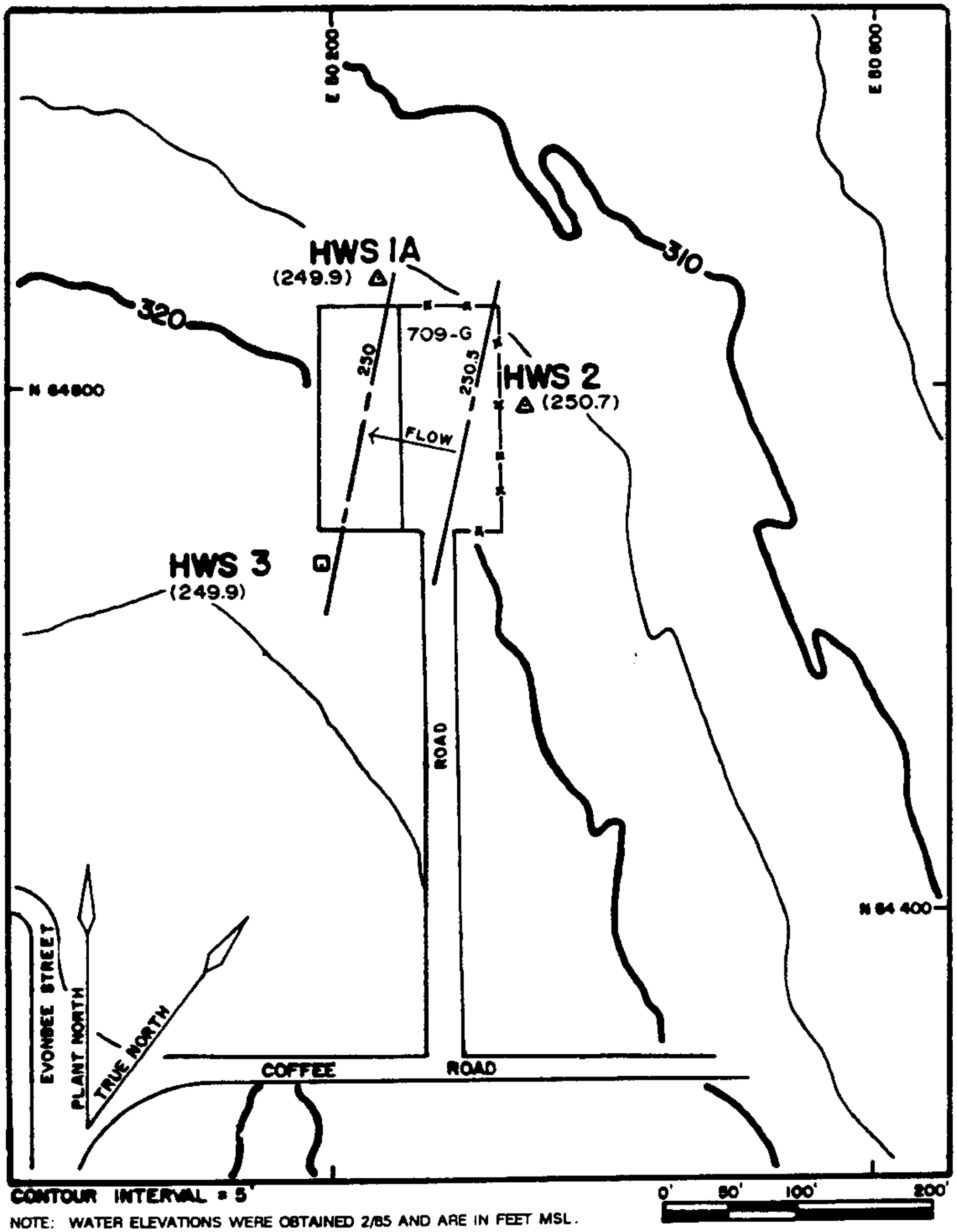


FIGURE 14-8. Hazardous Waste Storage Facility Water-Table Elevation Map

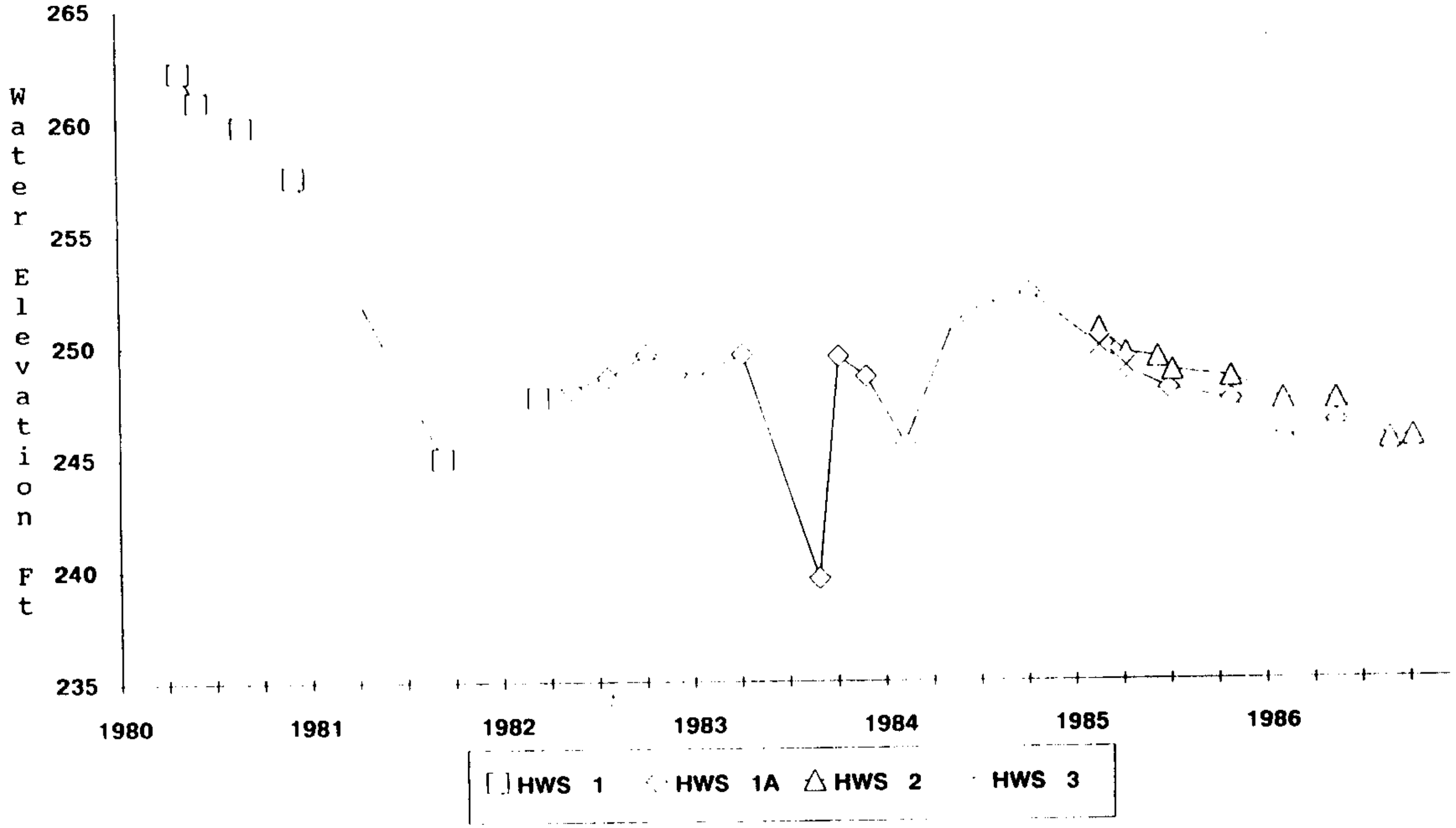


FIGURE 14-9. Hydrograph of the Hazardous Waste Storage Facility Wells

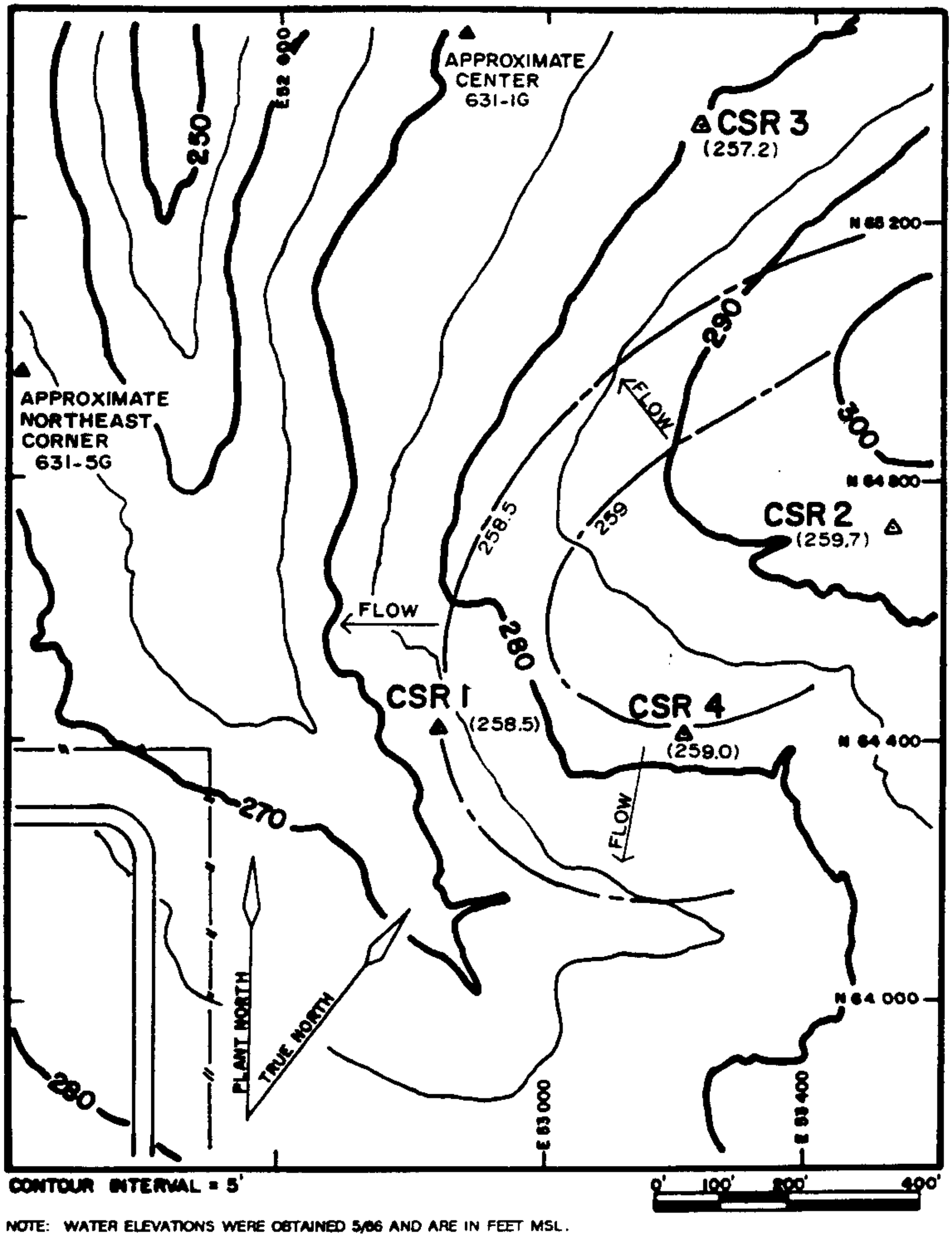


FIGURE 14-10. Central Shops (CS) Area Burning/Rubble Pits Water-Table Elevation Map

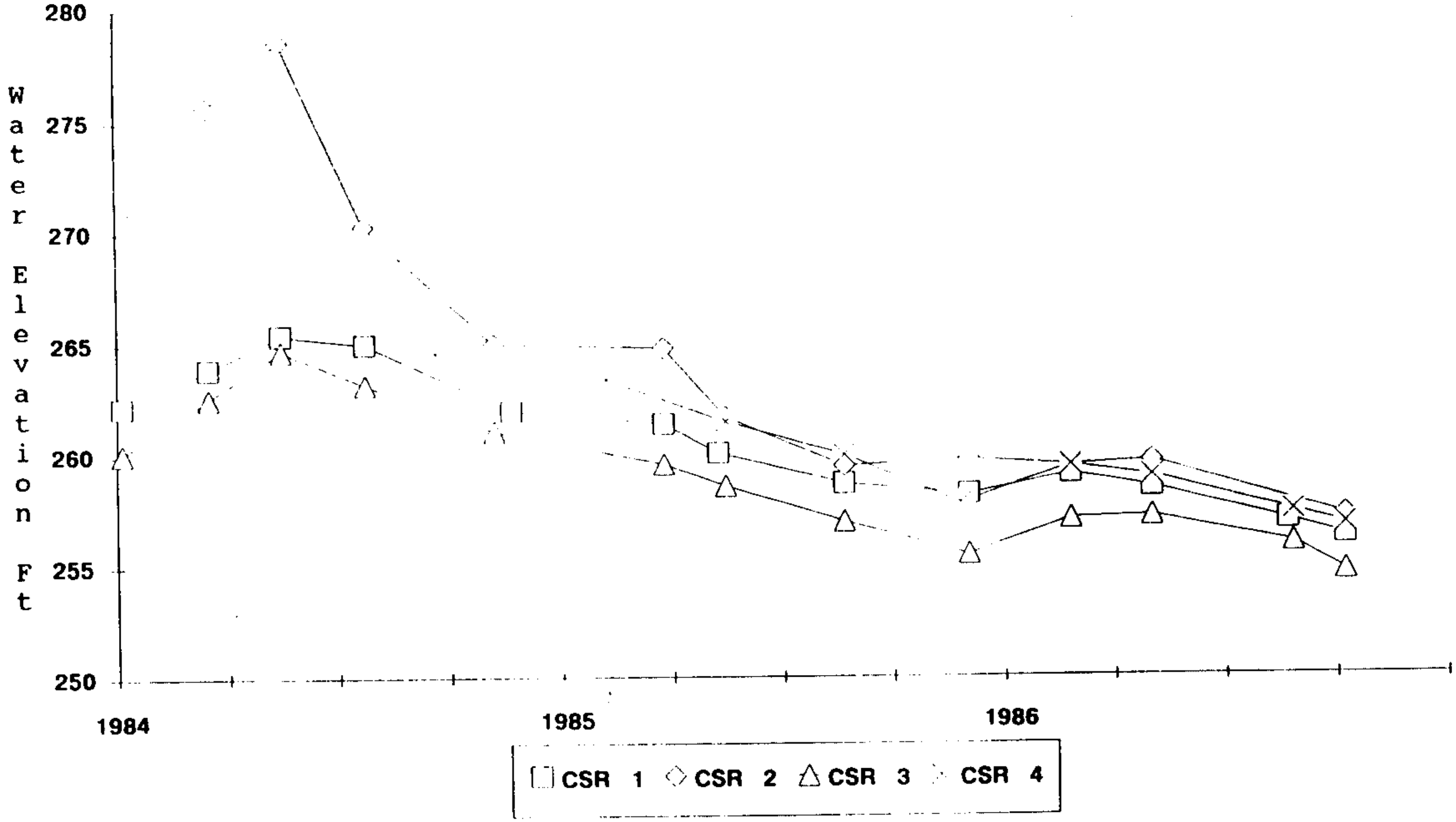


FIGURE 14-11. Hydrograph of the Central Shops (CS) Area Burning/Rubble Pits Wells

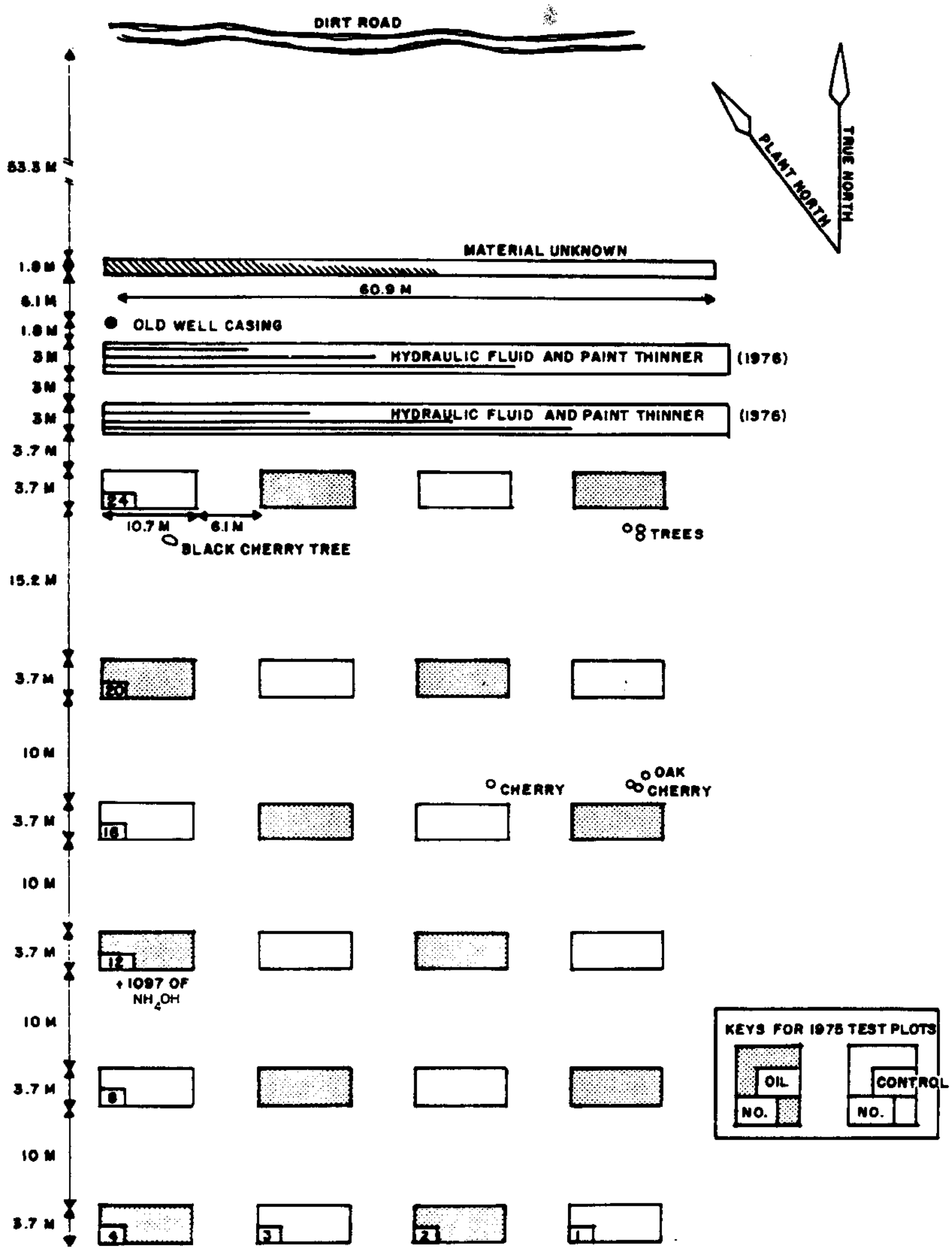


FIGURE 14-12. The Savannah River Laboratory (SRL) Oil Test Site

SECTION 15 MISCELLANEOUS SITES

15.01 ROAD A (BAXLEY ROAD) CHEMICAL BASIN

15.01.01 Summary

The Road A (Baxley Road) Chemical Basin (Building 904-111G) received miscellaneous radioactive and chemical aqueous wastes (Ross and Green, 1983). No qualitative or quantitative data exist regarding the materials disposed to the basin, and the initial date of waste receipt at the site is unknown. The basin was closed and backfilled in 1973, and a 150,600-ft^2 area extending beyond the surface boundaries of the basin was graded and seeded. The site is currently inactive (Pickett et al., 1987b).

Soil/sediment sampling has not been conducted at the Road A Chemical Basin. The groundwater monitoring data indicate that the Road A Chemical Basin has had no apparent effect on local groundwater quality. Groundwater quality in all four site wells has been characterized by low dissolved chemical constituent and radioactivity levels compared to drinking water standards except for manganese in wells BRD 1 and BRD 3 and single, isolated excursions of lead in wells BRD 1 and BRD 2. Low conductivity values have been reported for sidegradient well BRD 2 (25 to 58 μmhos/cm), upgradient well BRD 3 (25 to 46 μmhos/cm), and side- to downgradient wells BRD 1 and BRD 4 (7 to 41 μmhos/cm).

15.01.02 Waste-Site Description and Nature of Disposal

The Road A Chemical Basin is located approximately 0.5 mi west of the intersection of Road A and Road 6 (Figure 15-1) at a ground surface elevation of approximately 205 ft msl. The ground surface slopes to the southwest toward a swampy area. The Savannah River is approximately 4 mi west of the basin and is the closest plant boundary.

The Road A Chemical Basin was irregularly shaped, with original dimensions of approximately 170 ft long by 100 ft wide by 10 ft deep and a maximum storage capacity of 170,000 ft^3 (1.27 million gal). The basin received miscellaneous radioactive and chemical aqueous wastes (Ross and Green, 1983), but detailed records of materials disposed to the basin were not maintained. Pictures taken in 1973 show a surface depression containing water. The initial date of waste receipt at the site is unknown. The Road A Chemical Basin was closed and backfilled in 1973, and an area significantly larger than the original basin (150,600 ft^2) was graded and seeded. The site is currently inactive and surrounded by pine and hardwood trees (Pickett et al., 1987b).

15.01.03 Groundwater Monitoring Program

Four wells (BRD 1 through BRD 4) were installed to monitor the water-table elevation and groundwater quality at the Road A Chemical Basin. Wells BRD 1 through BRD 3 were installed in May 1983, and well BRD 4 was installed in July 1984. All four wells were constructed using PVC casings and 30-ft screens. Wells BRD 1 through BRD 3 were included in the SRS quarterly groundwater monitoring program in the second quarter of 1984. Well BRD 4 was included in the quarterly monitoring program in the first quarter of 1985.

15.01.04 Site-Specific Hydrology

Based on the surface geologic map presented by Siple (1967), the basin is located in sediments of the Barnwell/McBean Formations. Measurements obtained from the Road A Chemical Basin wells since June 1984 indicate that the water-table elevation has been constantly declining since the first quarter of 1985 (Figure 15-2). A water-table elevation contour map for the second quarter of 1986 (Figure 15-3) shows that the near-surface, horizontal groundwater flow direction was to the southwest. The water-level data indicate that this has been the predominant flow direction, with well BRD 3 upgradient, well BRD 2 sidegradient, and wells BRD 1 and BRD 4 side- to downgradient of the basin. Fluctuations in the water-table elevation suggest that minor changes in flow direction have occurred.

Well BRD 4 is screened below the water table, but the water-table elevations shown in Figure 15-3 are consistent with a southwesterly horizontal groundwater flow toward the swampy area, which is approximately 1,000 ft away at an elevation of about 155 ft msl. The gradient beneath the basin is approximately 0.008 ft/ft and averages 0.015 ft/ft between the basin and the swamp.

15.01.05 Waste-Site Content Characterization Data

The Road A Chemical Basin has been closed and backfilled since 1973. Neither qualitative nor quantitative characterization information exists for the waste placed in the basin.

15.01.06 Soil/Sediment Characterization Data

The Road A Chemical Basin soil/sediments have not been sampled.

15.01.07 Groundwater Monitoring Results

Groundwater monitoring results from 1984 through 1986 are presented in Appendix M. The four groundwater monitoring wells installed at the

Road A Chemical Basin have been sampled quarterly since 1984. Groundwater samples for metals analyses have been filtered since August 1984. Table 15-1 summarizes the groundwater chemical characterization data from the Road A Chemical Basin wells.

Monitoring results from sidegradient well BRD 2, upgradient well BRD 3, and side- to downgradient wells BRD 1 and BRD 4 were compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess local groundwater quality. Comparisons of groundwater quality data between upgradient well BRD 3 and the remaining site wells were made to evaluate the effect of the site on the groundwater.

The data summarized in Table 15-1 indicate that the Road A Chemical Basin has had no apparent influence on local groundwater quality. Groundwater quality in all four site wells has been characterized by low dissolved chemical constituent and radioactivity levels compared to drinking water standards except for manganese in wells BRD 1 and BRD 3 and single excursions of lead in wells BRD 1 and BRD 2. Low conductivity values were reported for sidegradient well BRD 2 (25 to 58 μmhos/cm), upgradient well BRD 3 (25 to 46 μmhos/cm), and the side- to downgradient wells BRD 1 and BRD 4 (7 to 41 μmhos/cm).

Manganese levels in downgradient well BRD 1 (0.046 to 0.098 mg/L) and upgradient well BRD 3 (0.031 to 0.135 mg/L) ranged over the drinking water standard of 0.05 mg/L. Lead levels in downgradient well BRD 1 (0.012 to 0.120 mg/L) and sidegradient well BRD 2 (<0.004 to 0.114 mg/L) exceeded the drinking water standard of 0.05 mg/L in an isolated excursion for each well. Because no indicator parameters can be ascertained for the site and because some of the excursions occurred in the background wells, the manganese and lead concentrations cannot be positively correlated to the basin. The radiological parameters for all four monitoring wells were consistently below applicable drinking water standards, indicating that if any radioactive wastes were placed in the basin, they have not affected groundwater quality.

Groundwater pH in the four site wells ranged from 3.9 to 6.4; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in SRS groundwaters (Appendix B).

15.01.08 Planned Action

The Road A Chemical Basin is inactive. As indicated in Section 16, a site assessment is planned for 1989 from which a closure plan will be developed. Groundwater monitoring will continue at this site.

15.02 40-ACRE HARDWOOD SITE

15.02.01 Summary

The 40-Acre Hardwood Site (Building 761-G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. In October 1980, the site was prepared to receive sludge. In December 1980, sewage sludge from the Wastewater Treatment Plant in Augusta, GA, was applied as an experimental soil conditioner and slow-release fertilizer. Five species of hardwood trees were machine-planted on the site in February 1981 and their subsequent growth measured (Gordon et al., 1987).

The groundwater monitoring data indicate that the 40-Acre Hardwood Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 2 and SSS 3 were consistent with levels reported for upgradient well SSS 1. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Low total dissolved solids (TDS) concentrations (11 to 71 mg/L) and conductivity (15 to 30 μmhos/cm) were reported for the three site wells.

15.02.02 Waste-Site Description and Nature of Disposal

The 40-Acre Hardwood Site (Building 761-G) is about 3,000 ft southeast of the intersection of SRS Road 6 and Road A (Figure 15-4). The ground surface elevation at the site ranges approximately from 210 to 250 ft msl. Surface drainage is to the southwest toward a marshy area.

The 40-Acre Hardwood Site is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, forests are managed primarily for sustained-yield timber production. In 1980 and 1981, approximately 150 acres of forest were treated with sewage sludge. The 40-Acre Hardwood Site was a Savannah River Laboratory (SRL) project designed to test the amount of biomass that could be achieved from coppice growth on selected hardwood species.

In October 1980, the site was prepared to receive sludge. In December 1980, liquid sludge from the Wastewater Treatment Plant in Augusta, GA, was injected into the soil at a depth of approximately 5 to 8 in.

The sludge was applied at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre. In February 1981, five species of hardwood trees were machine-planted on the site (Gordon et al., 1987).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.02.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 1 through 3) were installed at the 40-Acre Hardwood Site to monitor the water-table elevation and groundwater quality (Figure 15-5). The wells were constructed using 2-in. PVC casings. Groundwater monitoring at the 40-Acre Hardwood Site began in the first quarter of 1981, prior to sludge application.

15.02.04 Site-Specific Hydrology

Measurements obtained from the 40-Acre Hardwood Site monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged from 163 to 149 ft and that the vadose zone has been approximately 60 to 87 ft thick. A hydrograph for these wells is shown in Figure 15-6. The horizontal water-table flow direction for the first quarter of 1985 is presented in Figure 15-5. As indicated, the flow direction was southerly, with well SSS 1 upgradient and wells SSS 2 and 3 downgradient relative to the sludge application site. The water-level data indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. The hydraulic gradient at the site has been approximately 0.004 ft/ft, reflecting the relatively flat nature of the water table in the area.

15.02.05 Waste-Site Content Characterization Data

Sampling and analysis of the 40-Acre Hardwood Site contents have not been conducted. Section 15.02.02 contains information on the nature of the materials at the site.

15.02.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the 40-Acre Hardwood Site.

15.02.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.02.03). Groundwater characterization data from 1984 through 1986 are summarized in Table 15-3.

Comparisons of the groundwater monitoring data from upgradient well SSS 1 and downgradient wells SSS 2 and SSS 3 were used to evaluate the effect of the 40-Acre Hardwood Site on local groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality.

The data summarized in Table 15-3 indicate that the 40-Acre Hardwood Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 2 and SSS 3 were consistent with levels reported for upgradient well SSS 1. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina and federal drinking water standards, as evidenced by the low TDS values of 11 to 71 mg/L compared to the drinking water standard of 500 mg/L. The low conductivity values reported for the site wells (15 to 30 µmhos/cm) provide further evidence that the 40-Acre Hardwood Site has had no apparent effect on groundwater quality.

Concentrations of tested chemical constituents in the downgradient wells were consistent with levels reported for the upgradient well. TDS concentrations ranged from 11 to 71 mg/L in the downgradient wells and from 21 to 36 mg/L in the upgradient well. Conductivity ranged from 15 to 30 µmhos/cm in the downgradient wells and from 15 to 24 µmhos/cm in the upgradient well. Chloride (1.50 to 4.00 mg/L), nitrate/nitrite (0.14 to 1.24 mg/L), and sodium (1.09 to 3.12 mg/L) concentrations in the site wells were consistently low.

Concentrations of cadmium, copper, iron, and nickel were less than detection limits in the wells. Mercury was detected once in each well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well.

Groundwater pH ranged from 3.7 to 5.5 in the site wells; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.02.08 Planned Action

The 40-Acre Hardwood Site is inactive. As indicated in Section 16, an ongoing site assessment is scheduled for completion in 1988, from which a closure plan will be developed. Groundwater monitoring will continue at this site.

15.03 K-AREA BORROW PIT

15.03.01 Summary

The K-Area Borrow Pit (Building 761-4G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. In spring 1980, the soil of the K-Area Borrow Pit was disked and limed, inorganic fertilizer applied, and the area seeded with grasses. In December 1980, sewage sludge from the Wastewater Treatment Plant in Augusta, GA, was applied as an experimental soil conditioner and slow-release fertilizer. Pines, hardwoods, and native trees were machine-planted on the site in January 1981 and their subsequent growth measured (Hollod and Christensen, 1983).

The groundwater monitoring data indicate that the K-Area Borrow Pit has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 14 and SSS 15 were consistent with levels reported for upgradient well SSS 13. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Low total dissolved solids (TDS) concentrations (4 to 34 mg/L) and conductivity (11 to 31 μmhos/cm) were reported for these wells.

15.03.02 Waste-Site Description and Nature of Disposal

The K-Area Borrow Pit (Building 761-4G) covers 17 acres southeast of K Area on the west bank of Pen Branch above its confluence with Indian Grave Branch (Figure 15-4). Surface elevation at the site ranges approximately from 180 to 220 ft msl. Surface drainage is to the south toward Pen Branch.

The K-Area Borrow Pit is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, borrow pits are areas where soil has been removed for construction projects. These pits often have hardpan soils that do not support vegetation, making them subject to erosion. In 1980 and 1981, approximately 55 acres of borrow pits were treated with 650,000 gal of sewage sludge.

In spring 1980, the soil of the K-Area Borrow Pit was disked and limed, graded to a slope of no more than 5%, inorganic fertilizer applied, and the area seeded with grasses. In December 1980, 350,000 gal of liquid sewage sludge from the Wastewater Treatment Plant in Augusta, GA, was injected into the soil at a depth of approximately 5 to 8 in. The sludge was applied at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre (Wells et al., 1986). In January 1981, loblolly pine, hardwoods, and native tree species were machine-planted on the site (Figure 15-7), and their subsequent growth was measured (Hollod and Christensen, 1983).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.03.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 13 through 15), constructed using 2-in. PVC casings and 10-ft screens, were installed at the K-Area Borrow Pit to monitor the water-table elevation and groundwater quality (Figure 15-7).

15.03.04 Site-Specific Hydrology

Measurements obtained from the K-Area Borrow Pit monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 178 ft to 161 ft msl and that the vadose zone had been approximately 19 to 42 ft thick. A hydrograph for these wells is shown in Figure 15-8. The horizontal water-table flow direction for the first quarter of 1985 was southwesterly, as shown in Figure 15-7. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. Wells SSS 14 and SSS 15 have been downgradient and well SSS 13 upgradient relative to the sludge application site. The hydraulic gradient beneath the pit has been approximately 0.016 ft/ft.

15.03.05 Waste-Site Content Characterization Data

Sampling and analysis of the K-Area Borrow Pit site have not been conducted. Section 15.03.02 contains information on the nature of the materials at the site.

15.03.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the K-Area Borrow Pit.

15.03.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.03.03). Groundwater characterization data from 1984 through 1986 are summarized in Table 15-4.

Comparisons of the groundwater monitoring data between upgradient well SSS 13 and the downgradient wells (SSS 14 and SSS 15) were used to evaluate the effect of the K-Area Borrow Pit on local groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality.

The monitoring data summarized in Table 15-4 indicate that the K-Area Borrow Pit has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 14 and SSS 15 were consistent with levels reported for upgradient well SSS 13. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards, as reflected by the low TDS (4 to 34 mg/L) and conductivity (11 to 31 μmhos/cm) values reported for the wells.

TDS levels ranged from 4 to 27 mg/L in the downgradient wells and from 19 to 34 mg/L in the upgradient well. TKN concentrations ranged from <0.1 to 0.18 mg/L in upgradient well SSS 13; TKN levels were below the detection limit in the downgradient wells. Orthophosphate (<0.002 to 0.058 mg/L), chloride (1.75 to 5.00 mg/L), nitrate/nitrite (0.10 to 0.78 mg/L), and sodium (1.11 to 3.62 mg/L) concentrations were consistent among the upgradient and downgradient wells.

Concentrations of iron, cadmium, copper, nickel, and manganese were below detection limits in all samples. Mercury was detected once in each well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Groundwater pH ranged from 3.9 to 5.4 in the site wells; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.03.08 Planned Action

The K-Area Borrow Pit currently is inactive. Groundwater monitoring will continue at this site. The closure plan for the Central Shops Sanitary Sewage Sludge Lagoon calls for sludge from that site to be spread as a one-time application on the K-Area Borrow Pit. Pending SCDHEC permitting, new monitoring wells will be constructed and quarterly monitoring instituted prior to new sludge application.

15.04 SANDY (LUCY) SITE

15.04.01 Summary

The Sandy (Lucy) Site (Building 761-3G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The Sandy Site, covering 8 acres, was planted in 1953 with loblolly pines. In July 1981, sewage sludge from the Wastewater Treatment Plant in

Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied as an experimental soil conditioner and slow-release fertilizer, and the subsequent tree growth was measured (Wells et al., 1986).

The groundwater monitoring data indicate that the Sandy Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 11 were consistent with levels reported for sidegradient wells SSS 10 and SSS 12. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-59) and federal (40 CFR 141-143) drinking water standards except for single excursions of mercury in sidegradient wells SSS 10 and SSS 12. Low TDS (10 to 83 mg/L) and conductivity (13 to 115 µmhos/cm) values were reported for the three site wells.

15.04.02 Waste-Site Description and Nature of Disposal

The Sandy Site (Building 761-3G) is a stand of loblolly pines planted in 1953 in predominantly sandy soil. The site covers 8 acres about 1,000 ft east of SRS Road 2 just north of SRS Road F-1 (Figure 15-9). The ground surface elevation ranges approximately from 310 to 330 ft msl, and surface drainage is to the southeast toward a marshy creek.

The Sandy Site is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, forests are managed primarily for sustained-yield timber production. In 1980 and 1981, approximately 150 acres of forest were treated with sewage sludge. The Sandy Site was designed to test the amount of biomass that could be produced using sewage sludge on a mature pine stand grown on light-textured, sandy soil typical of the Upper Coastal Plain.

In July 1981, sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied to the site. The liquid Augusta sludge was sprayed onto the soil at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre. The solid Horse Creek sludge was applied by manure spreader at rates of 0 and 60 tons/acre, which correspond to 0 and 560 lb of nitrogen per acre (Figure 15-10) (Wells et al., 1986).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2.

The Horse Creek Pollution Control Facility receives 80% of its wastewater from industrial sources. The sewage is aerobically digested, and the solids are then heated under pressure. The heat-treated sludge is dewatered, resulting in an approximate 30% solids content. A chemical analysis of the Horse Creek Plant sludge is given in Table 15-5. As shown on the table, Kjeldahl nitrogen, calcium, and iron are major components of the Horse Creek sludge. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.04.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three monitoring wells (SSS 10 through 12) with 10-ft screens were installed at the Sandy Site in 1980 to monitor the water-table elevation and groundwater quality (Figure 15-9). Groundwater monitoring at the site began in the first quarter of 1981, prior to sludge application.

15.04.04 Site-Specific Hydrology

Measurements obtained from the Sandy Site monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 242 to 230 ft msl and that the vadose zone has been approximately 80 to 90 ft thick. A hydrograph for these wells is shown in Figure 15-11. The horizontal water-table flow direction for the first quarter of 1985 was southeasterly, as shown in Figure 15-10. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. Relative to the site, well SSS 11 has been downgradient and wells SSS 10 and SSS 12 sidegradient. The hydraulic gradient beneath the site has been approximately 0.015 ft/ft.

15.04.05 Waste-Site Content Characterization Data

Sampling and analysis of the Sandy (Lucy) Site contents have not been conducted. Section 15.04.02 contains information on the nature of the materials at the site.

15.04.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis were performed at the Sandy (Lucy) Site to monitor the presence and movement of nutrients and metals found in the sewage sludges. Results of soil analyses performed 6 months after sludge application are presented in Table 15-6.

As indicated in Table 15-6, the soil properties varied widely among the plots. The highest application rate of liquid sludge had the most effect on soil properties, including lowering the pH and increasing the nitrogen and phosphorus concentrations. Exchangeable bases (Ca, Mg, K, Na) in the soil typically were reduced in the sludge application plots compared to those in the control plots. Soil degradation was not noted at any of the experimental plots at the site (Wells et al., 1982).

15.04.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.04.03). Groundwater chemical characterization data from 1984 through 1986 are summarized in Table 15-7. Groundwater monitoring data were compared with South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess groundwater quality.

The monitoring data summarized in Table 15-7 indicate that the Sandy Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 11 were consistent with concentrations reported for sidegradient wells SSS 10 and SSS 12. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards, as evidenced by the low TDS (10 to 83 mg/L) and conductivity (13 to 115 µmhos/cm) values reported for the wells.

TDS levels ranged from 21 to 47 mg/L in the downgradient well and from 10 to 83 mg/L in the sidegradient wells. TKN concentrations ranged from <0.1 to 0.21 mg/L in the site wells. Orthophosphate (0.002 to

0.153 mg/L), sodium (1.83 to 10.8 mg/L), and nitrate/nitrite (0.61 to 3.55 mg/L) concentrations were also low. Chloride concentrations ranged from 2.75 to 13.3 mg/L in the site wells except for a single reading of 27.5 mg/L in sidegradient well SSS 10, well below the drinking water standard of 250 mg/L. Iron levels were consistently below the detection limit in downgradient well SSS 11 and sidegradient well SSS 12; sidegradient well SSS 10 had an iron concentration of 0.018 mg/L, which is below the secondary drinking water standard (0.3 mg/L).

Concentrations of cadmium, copper, and nickel were below detection limits in all samples. Mercury was detected once in each well, with concentrations in sidegradient wells SSS 10 (0.0020 mg/L) and SSS 12 (0.0044 mg/L) above the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Groundwater pH ranged from 4.1 to 4.9 in the site wells. This pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.04.08 Planned Action

The Sandy (Lucy) Site is closed. Groundwater monitoring will continue. No other action is scheduled for this site.

15.05 ORANGEBURG (SANDY CLAY) SITE

15.05.01 Summary

The Orangeburg (Sandy Clay) Site (Building 761-2G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The Orangeburg Site, covering 8 acres, was planted in 1953 with loblolly pines. In July 1981, sewage sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied as an experimental soil conditioner and slow-release fertilizer, and the subsequent tree growth was measured (Wells et al., 1986).

The groundwater monitoring data indicate that the Orangeburg Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in upgradient well SSS 7 and downgradient wells SSS 8 and SSS 9 were similar. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Low total dissolved solids (TDS) concentrations (11 to 58 mg/L) and conductivity (5 to 45 μmhos/cm) were reported for the three site wells.

15.05.02 Waste-Site Description and Nature of Disposal

The Orangeburg Site (Building 761-2G) is a stand of loblolly and longleaf pines planted in 1953 in predominantly sandy clay soil. The site covers 8 acres about 2,000 ft east of SRS Road 2 and 1 mi south of the intersection of SRS Roads 2 and C (Figure 15-12). The ground surface elevation ranges approximately from 210 to 240 ft msl, and surface drainage is to the southeast toward an intermittent tributary to Upper Three Runs Creek.

The Orangeburg Site is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, forests are managed primarily for sustained-yield timber production. In 1980 and 1981, approximately 150 acres of forest were treated with sewage sludge. The Orangeburg Site was designed to test the amount of biomass that could be produced using sewage sludge on a mature pine stand grown on heavy-textured, sandy clay soil typical of the Upper Coastal Plain.

In July 1981, sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied to the site. The liquid Augusta sludge was sprayed onto the soil at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre. The solid Horse Creek sludge was applied by manure spreader at rates of 0 and 60 tons/acre, which correspond to 0 and 560 lb of nitrogen per acre (Figure 15-13) (Wells et al., 1986).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2.

The Horse Creek Pollution Control Facility receives 80% of its wastewater from industrial sources. The sewage is aerobically digested, and the solids are then heated under pressure. The heat-treated sludge is dewatered, resulting in an approximate 30% solids content. A chemical analysis of the Horse Creek Plant sludge is given in Table 15-5. As shown in the table, Kjeldahl nitrogen, calcium, and iron are major components of the Horse Creek sludge. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.05.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 7 through 9) with 10-ft screens were installed at the Orangeburg Site in 1980 to monitor the water-table elevation and groundwater quality (Figure 15-13). Groundwater monitoring at the Orangeburg Site began in the first quarter of 1981, prior to sludge application.

15.05.04 Site-Specific Hydrology

Measurements obtained from the Orangeburg Site monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 168 to 153 ft msl and that the vadose zone has been approximately 57 to 72 ft thick. A hydrograph for these wells is shown in Figure 15-14. The horizontal water-table flow direction for the first quarter of 1985 was to the east, as shown in Figure 15-15. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. Relative to the site, well SSS 7 has been upgradient and wells SSS 8 and SSS 9 downgradient. The hydraulic gradient beneath the site has been approximately 0.017 ft/ft.

15.05.05 Waste-Site Content Characterization Data

Sampling and analysis of the Orangeburg Site contents have not been conducted. Section 15.05.02 contains information on the nature of the materials at the site.

15.05.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analyses have been performed at the Orangeburg Site to monitor the presence and movement of nutrients and metals found in the sewage sludges. Results of soil analyses performed 6 months after sludge application are presented in Table 15-8.

As indicated in Table 15-8, the soil properties varied widely among the plots. The pH of the Horse Creek sludge plots was apparently unaffected by the sludge application, whereas the pH of the Augusta sludge plots was lowered by as much as 0.8. Total nitrogen was lowest in the Augusta sludge plots with the higher rate of application, possibly attributable to a high mineralization rate and nitrogen leaching. Exchangeable bases (Ca, Mg, K, Na) in the soil typically were reduced in the sludge application plots compared to those in the control plots. Soil degradation was not noted at any of the experimental plots at the site (Wells et al., 1982).

15.05.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.05.03). Groundwater characterization data from 1984 through 1986 are summarized in Table 15-9.

Comparisons of the groundwater monitoring data between upgradient well SSS 7 and downgradient wells SSS 8 and SSS 9 were used to evaluate the effect of the Orangeburg Site on local groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality.

The monitoring data summarized in Table 15-9 indicate that the Orangeburg Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 8 and SSS 9 were consistent with levels reported for upgradient well SSS 7. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina and federal drinking water standards, as reflected by the low TDS (11 to 58 mg/L) and conductivity (5 to 45 μmhos/cm) values reported for the wells.

TDS concentrations ranged from 11 to 36 mg/L in the downgradient wells and from 31 to 58 mg/L in the upgradient well. TKN concentrations were less than detection limits in the upgradient well and ranged from <0.1 to 0.80 mg/L in the downgradient wells. Orthophosphate (0.002 to 0.173 mg/L), chloride (1.0 to 5.51 mg/L), sodium (0.67 to 3.29 mg/L), and nitrate/nitrite (0.32 to 3.00 mg/L) concentrations were consistently low in all site wells.

Concentrations of iron, cadmium, copper, nickel, lead, and manganese were below detection limits in all samples. Mercury was detected once in each well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Groundwater pH ranged from 3.8 to 5.3 in the site wells; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.05.08 Planned Action

The Orangeburg Site is closed. Groundwater monitoring will continue. No other action is scheduled for this site.

15.06 KATO ROAD SITE

15.06.01 Summary

The Kato Road Site (Building 761-6G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. In January 1981, the Kato Road Site, covering 35 acres, was disked and treated with sewage sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC. The sludge was applied as an experimental soil conditioner and slow-release fertilizer. In March 1981, pine seedlings were planted. Different herbicides and various amounts of pesticide were then applied and the subsequent tree growth measured (Wells et al., 1986).

The groundwater monitoring data indicate that the Kato Road Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 19 and SSS 20 were consistent with levels reported for upgradient well SSS 21. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for a single excursion of manganese (0.076 mg/L) in downgradient well SSS 19. Low total dissolved solids (TDS) levels (25 to 123 mg/L) and conductivity (18 to 38 μmhos/cm) were reported for the three site wells.

15.06.02 Waste-Site Description and Nature of Disposal

The Kato Road Site (Building 761-6G) is a stand of loblolly pines planted in 1981 in predominantly sandy clay soil. The site covers

35 acres directly east of SRS Road 2, approximately 1 mi south of the intersection of SRS Roads C and 2 (Figure 15-12). The ground surface elevation ranges approximately from 225 to 285 ft msl, and surface drainage is to the southeast toward Upper Three Runs Creek.

The Kato Road Site is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, forests are managed primarily for sustained-yield timber production. In 1980 and 1981, approximately 150 acres of forest were treated with sewage sludge. The Kato Road Site was a complex experiment using different subsurface preparations, fertilizers (including sewage sludge), herbicides, and various amounts of pesticide on a pine seedling stand grown in a sandy clay soil (Figure 15-16).

In January 1981, sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied to the site. A total of 600,000 gal of liquid Augusta sludge was applied at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre. A total of 300 tons of solid Horse Creek sludge was applied at rates of 0 and 60 tons/acre, which correspond to 0 and 560 lb of nitrogen per acre (Figure 15-16). Some of the treatment plots were also disked as part of the soil preparation. In March 1981, pine seedlings were planted in the plots. Different herbicides and various amounts of pesticide then were applied and the subsequent seedling growth measured (Wells et al., 1986).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2.

The Horse Creek Pollution Control Facility receives 80% of its wastewater from industrial sources. The sewage is aerobically digested, and the solids are then heated under pressure. The heat-treated sludge is dewatered, resulting in an approximate 30% solids content. A chemical analysis of the Horse Creek Plant sludge is given in Table 15-5. As shown in the table, Kjeldahl nitrogen, calcium, and iron are major components of the Horse Creek sludge. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.06.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 19 through 21) were installed at the Kato Road Site in 1980 to monitor the water-table elevation and groundwater quality (Figure 15-16). Groundwater monitoring at the Kato Road Site began in the first quarter of 1981, prior to sludge application.

15.06.04 Site-Specific Hydrology

Measurements obtained from the Kato Road Site monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 199 to 176 ft msl and that the vadose zone has been approximately 49 to 86 ft thick. A hydrograph for these wells is shown in Figure 15-17. The horizontal water-table flow direction for the first quarter of 1985 was to the east, as shown in Figure 15-15. Relative to the site, wells SSS 19 and SSS 20 have been downgradient and well SSS 21 upgradient. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. The hydraulic gradient beneath the site has been approximately 0.01 ft/ft.

15.06.05 Waste-Site Content Characterization Data

Sampling and analysis of the Kato Road Site contents have not been conducted. Section 15.06.02 contains information on the nature of the materials at the site.

15.06.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the Kato Road Site.

15.06.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.06.03). Groundwater characterization data from 1984 through 1986 are summarized in Table 15-10.

Groundwater monitoring data were compared with South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess local groundwater quality. The monitoring data summarized in Table 15-10 indicate that the Kato Road Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 19 and SSS 20 were consistent with levels reported for upgradient well SSS 21. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards, as evidenced by the low TDS (25 to 123 mg/L) concentrations and conductivity (18 to 38 μmhos/cm) reported for the wells.

TDS levels ranged from 25 to 42 mg/L in the upgradient well and from 26 to 123 mg/L in the downgradient wells. TKN concentrations ranged from <0.1 to 0.97 mg/L in the site wells. Orthophosphate (<0.002 to 9.44 mg/L), chloride (1.75 to 7.50 mg/L), sodium (0.67 to 8.04 mg/L), and nitrate/nitrite (0.15 to 2.12 mg/L) concentrations were also low. Iron concentrations were consistently below the detection limit in downgradient well SSS 20 and upgradient well SSS 21; downgradient well SSS 19 had an iron concentration of 0.173 mg/L, which is below the secondary drinking water standard (0.3 mg/L). A single excursion of manganese (0.076 mg/L) occurred in downgradient well SSS 19.

Concentrations of cadmium, copper, and nickel were below detection limits in all samples. Mercury was detected once in well SSS 19 at a concentration below the drinking water standard. This data point is suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled. Wells SSS 20 and SSS 21 were dry at that time.

Groundwater pH ranged from 4.0 to 6.5 in the site wells. This pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.06.08 Planned Action

The Kato Road Site is closed. Groundwater monitoring will continue. No other action is scheduled for this site.

15.07 LOWER KATO ROAD SITE

15.07.01 Summary

The Lower Kato Road Site (Building 761-1G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The Lower Kato Road Site, covering 50 acres, was planted in 1978 with loblolly pines. In November 1981, sewage sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied as an experimental soil conditioner and slow-release fertilizer, and the subsequent growth of the young pines was measured (Wells et al., 1986).

The groundwater monitoring data indicate that the Lower Kato Road Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 4 and SSS 6 were consistent with levels reported for upgradient well SSS 5. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for a single excursion of lead (0.468 mg/L) in downgradient well SSS 6. Low total dissolved solids (TDS) concentrations (4 to 43 mg/L) and conductivity (10 to 47 μmhos/cm) were reported for the three site wells.

15.07.02 Waste-Site Description and Nature of Disposal

The Lower Kato Road Site (Building 761-1G) is a stand of loblolly pines planted in 1978 in sandy and sandy clay soil. The site covers 50 acres directly east of SRS Road 2, approximately 1.3 mi south of the intersection of SRS Roads C and 2 (Figure 15-12). The ground surface elevation ranges approximately from 210 to 270 ft msl, and surface drainage is to the southeast toward Upper Three Runs Creek.

The Lower Kato Road Site is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, forests are managed primarily for sustained-yield timber production. In 1980 and 1981, approximately 150 acres of forest were treated with sewage sludge. The Lower Kato Road Site was designed to test the effectiveness of sewage sludge as a fertilizer on loblolly pines planted in both sandy soil and sandy clay soil.

In November 1981, sludge from the Wastewater Treatment Plant in Augusta, GA, and from the Horse Creek Pollution Control Facility in North Augusta, SC, was applied to the site. The liquid Augusta sludge was sprayed on the site at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre. The solid Horse Creek sludge was applied by manure spreader at rates of 0 and 60 tons/acre, which correspond to 0 and 560 lb of nitrogen per acre (Figure 15-17). The subsequent growth of the young trees was measured (Wells et al., 1986).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2.

The Horse Creek Pollution Control Facility receives 80% of its wastewater from industrial sources. The sewage is aerobically digested, and the solids are then heated under pressure. The heat-treated sludge is dewatered, resulting in an approximate 30% solids content. A chemical analysis of the Horse Creek Plant sludge is given in Table 15-5. As shown in the table, Kjeldahl nitrogen, calcium, and iron are major components of the Horse Creek sludge. Sewage sludge is not classified as a hazardous material by either Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.07.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 4 through 6) were installed at the Lower Kato Road Site in 1980 to monitor the water-table elevation and groundwater quality (Figure 15-18). Groundwater monitoring at the Lower Kato Road Site began in the first quarter of 1981, prior to sludge application.

15.07.04 Site-Specific Hydrology

Measurements obtained from the Lower Kato Road Site monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 204 to 178 ft msl and that the vadose zone has been approximately 32 to 66 ft thick. A hydrograph for these wells is shown in Figure 15-19. Relative to the site, well SSS 5 has been upgradient and wells SSS 4 and SSS 6 downgradient. The horizontal water-table flow direction for the first quarter of 1985 was to the east, as shown in Figure 15-15. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. The hydraulic gradient beneath the site has been approximately 0.008 ft/ft.

15.07.05 Waste-Site Content Characterization Data

Sampling and analysis of the Lower Kato Road Site have not been conducted. Section 15.07.02 contains information on the nature of the materials at the site.

15.07.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the Lower Kato Road Site.

15.07.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.07.03). Groundwater characterization data from 1984 through 1986 are summarized in Table 15-11.

Groundwater monitoring data were compared with South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess groundwater quality. The monitoring data summarized in Table 15-11 indicate that the Lower Kato Road Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient wells SSS 4 and SSS 6 were consistent with levels reported for upgradient well SSS 5. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards, as evidenced by the low TDS (4 to 43 mg/L) concentrations and conductivity (10 to 47 μmhos/cm) reported for the wells.

TDS levels ranged from 4 to 24 mg/L in the downgradient wells and from 28 to 43 mg/L in the upgradient well. TKN concentrations ranged from <0.1 to 0.20 mg/L in the site wells. Orthophosphate (<0.002 to 0.156 mg/L), chloride (1.75 to 4.12 mg/L), sodium (1.24 to 3.23 mg/L), and nitrate/nitrite (0.32 to 2.16 mg/L) concentrations were also low. One lead concentration (0.468 mg/L) in downgradient well SSS 6 was above the drinking water standard. All other lead concentrations from this well were below detection limits, making this data point suspect.

Concentrations of cadmium, copper, iron, nickel, and manganese were below detection limits in all samples. Mercury was detected once in each well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Groundwater pH ranged from 3.8 to 5.4 in the site wells; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.07.08 Planned Action

The Lower Kato Road Site is closed. Groundwater monitoring will continue. No other action is scheduled for this site.

15.08 PAR POND BORROW PIT

15.08.01 Summary

The Par Pond Borrow Pit (Building 761-5G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. In spring 1980, the soil of the Par Pond Borrow Pit was disked and limed, inorganic fertilizer applied, and the area seeded with grasses. In November 1980, sewage sludge from the Wastewater Treatment Plant in Augusta, GA, was applied as an experimental soil conditioner and slow-release fertilizer. Pines, hardwoods, and native trees were machine-planted on the site in January 1981 and their subsequent growth measured (Hollod and Christensen, 1983).

The groundwater monitoring data indicate that the Par Pond Borrow Pit has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 16 were consistent with levels reported for upgradient wells SSS 17 and SSS 18. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Low total dissolved solids (TDS) (8 to 29 mg/L) and conductivity (11 to 23 μmhos/cm) values were reported for the three site wells.

15.08.02 Waste-Site Description and Nature of Disposal

The Par Pond Borrow Pit (Building 761-5G) covers 22 acres south of Par Pond, approximately 1.3 mi north-northeast of the intersection of SRS Roads B and F. The ground surface elevation at the site ranges approximately from 215 to 230 ft msl. Surface drainage is to the south-southeast toward a tributary of Lower Three Runs Creek (Figure 15-20).

The Par Pond Borrow Pit is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, borrow pits are areas where soil has been removed for construction projects. These pits often have hardpan soils that do not support vegetation, making them subject to erosion. In 1980 and 1981, approximately 55 acres of borrow pits were treated with over 650,000 gal of sewage sludge.

In spring 1980, the soil of the Par Pond Borrow Pit was disked and limed, graded to a slope of no more than 5%, inorganic fertilizer applied, and the area seeded with grasses. In November 1980, 300,000 gal of liquid sewage sludge from the Wastewater Treatment Plant in Augusta, GA, were injected into the soil at a depth of approximately 5 to 8 in. The sludge was applied at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre (Wells et al., 1986). In January 1981, loblolly pines, hardwoods, and native tree species were machine-planted on the site (Figure 15-21) and their subsequent growth measured (Hollod and Christensen, 1983).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by both conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averaged 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are generally low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.08.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to the permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 16 through SSS 18), constructed using 2-in. PVC casings and 10-ft screens, were installed at the Par Pond Borrow Pit to monitor the water-table elevation and groundwater quality (Figure 15-21).

15.08.04 Site-Specific Hydrology

Measurements obtained from the Par Pond Borrow Pit monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 204 to 190 ft msl and that the vadose zone has been approximately 25 ft thick. A hydrograph for these wells is presented in Figure 15-21. The horizontal water-table flow direction for the first quarter of 1985 was southerly, as shown in Figure 15-21. The water-level data presented in the hydrograph show that this has been the predominant flow direction, although minor changes in flow direction have occurred. Monitoring well SSS 16 has been downgradient and wells SSS 17 and SSS 18 have been upgradient relative to the sludge application site. The hydraulic gradient beneath the pit has been approximately 0.007 ft/ft.

15.08.05 Waste-Site Content Characterization Data

Sampling and analysis of the Par Pond Borrow Pit site have not been conducted. Section 15.08.02 contains information on the nature of the materials at the site.

15.08.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the Par Pond Borrow Pit.

15.08.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175. Groundwater chemical characterization data from 1984 through 1986 are summarized in Table 15-12.

Comparisons of the groundwater monitoring data between downgradient well SSS 16 and upgradient wells SSS 17 and SSS 18 were used to evaluate the effect of the Par Pond Borrow Pit on local groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality.

The monitoring data summarized in Table 15-12 indicate that the Par Pond Borrow Pit has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 16 were consistent with levels reported for upgradient wells SSS 17 and SSS 18. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina and federal drinking water standards, as evidenced by the low TDS (8 to 29 mg/L) and conductivity (11 to 23 μmhos/cm) values reported for the wells.

Concentrations of tested chemical constituents in the downgradient well were generally consistent with levels reported for the upgradient wells. TDS levels in the downgradient well ranged from 13 to 29 mg/L and from 8 to 27 mg/L in the upgradient wells. Conductivity ranged from 11 to 22 μmhos/cm in the downgradient well and from 12 to 23 μmhos/cm in the upgradient wells. Chloride, sodium, and nitrate concentrations in the site wells followed a similar concentration and distribution pattern.

Concentrations of TKN, cadmium, copper, iron, nickel, and manganese were below detection limits in all samples. Mercury was detected once in each well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Groundwater pH ranged from 3.7 to 5.3 in the site wells; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.08.08 Planned Action

The Par Pond Borrow Pit currently is inactive. Groundwater monitoring will continue at this site. The closure plan for the Central Shops Sanitary Sewage Sludge Lagoon calls for sludge from that site to be spread as a one-time application on the Par Pond Borrow Pit. Pending SCDHEC permitting, new monitoring wells will be constructed and quarterly monitoring instituted prior to new sludge application.

15.09 ROAD F SITE

15.09.01 Summary

The Road F Site (Building 761-7G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The Road F Site, covering 9 acres, was planted in 1974 with loblolly pines. In September 1981, sewage sludge from the Wastewater Treatment Plant in Augusta, GA, was applied as an experimental soil conditioner and slow-release fertilizer, and the subsequent growth of the pines was measured (Wells et al., 1986).

The groundwater monitoring data indicate that the Road F Site has had no apparent effect on local groundwater quality. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards. Low total dissolved solids (TDS) levels (11 to 37 mg/L) and conductivity (12 to 30 μmhos/cm) were reported for the three site wells.

15.09.02 Waste-Site Description and Nature of Disposal

The Road F Site (Building 761-7G) is a stand of loblolly pines planted in 1974 in sandy and sandy clay soil. The site covers 9 acres directly east of SRS Road F and approximately 3,500 ft north of the intersection of SRS Roads F and F-2 (Figure 15-9). The ground surface elevation ranges approximately from 290 to 315 ft msl, and surface drainage is to the south toward a marshy area.

The Road F Site is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, forests are managed primarily for sustained-yield timber production. In 1980 and 1981, approximately 150 acres of forest were treated with sewage sludge.

In September 1981, sludge from the Wastewater Treatment Plant in Augusta, GA, was applied to the site. The liquid Augusta sludge was sprayed on the site at 0, 25,000, and 50,000 gal/acre rates, which correspond to 0, 360, and 720 lb of nitrogen per acre, and the subsequent growth of the trees was measured (Figure 15-23) (Wells et al., 1986).

The Augusta Wastewater Treatment Plant receives 80% of its wastewater from domestic sources. Sewage treatment is by conventional aerobic and anaerobic processes, which produce a liquid sludge with 2 to 3% suspended solids. The pH of the sludge averages 7.3 to 7.4. Concentrations of Kjeldahl nitrogen, ammonia, and phosphorus are high. Metals concentrations are low, with the exceptions of calcium, sodium, and iron. An analysis of the sludge is given in Table 15-2. Sewage sludge is not classified as a hazardous material by either the Environmental Protection Agency (EPA) or the South Carolina Department of Health and Environmental Control (SCDHEC).

15.09.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of SCDHEC Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 22 through SSS 24) were installed at the Road F Site to monitor the water-table elevation and groundwater quality (Figure 15-23). Groundwater monitoring at the Road F Site began in the first quarter of 1981, prior to sludge application.

15.09.04 Site-Specific Hydrology

Measurements obtained from the Road F Site monitoring wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 260 to 240 ft msl and that the vadose zone has been approximately 50 to 55 ft thick. A hydrograph for these wells is shown in Figure 15-24. Because the wells at this site were installed almost in a line, a precise horizontal water-table flow direction is difficult to determine. It appears, however, that relative to the site wells SSS 23 and SSS 24 have been upgradient and well SSS 22 downgradient. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred.

15.09.05 Waste-Site Content Characterization Data

Sampling and analysis of the Road F Site have not been conducted. Section 15.09.02 contains information on the nature of the materials at the site.

15.09.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the Road F Site.

15.09.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175 (see Section 15.09.03). Groundwater characterization data from 1984 to 1986 are summarized in Table 15-13.

Groundwater monitoring data were compared with South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess groundwater quality. The monitoring data summarized in Table 15-13 indicate that the Road F Site has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 22 were consistent with levels reported for upgradient wells SSS 23 and SSS 24. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent concentrations compared to South Carolina and federal drinking water standards, as evidenced by the low TDS (11 to 37 mg/L) concentrations and conductivity (12 to 30 μmhos/cm) reported for the wells.

TDS levels ranged from 19 to 37 mg/L in the downgradient well and from 11 to 26 mg/L in the upgradient wells. TKN concentrations were below detection limits in the downgradient well and in upgradient well SSS 24; TKN concentrations ranged from <0.1 to 0.12 mg/L in upgradient well SSS 23. Orthophosphate (<0.002 to 0.108 mg/L), chloride (1.25 to 2.25 mg/L), sodium (0.93 to 3.15 mg/L), and nitrate/nitrite (0.57 to 2.27 mg/L) concentrations were also low.

Concentrations of cadmium, copper, iron, and nickel were below detection limits in all samples. Mercury was detected once in each well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Groundwater pH ranged from 4.1 to 7.0 in the site wells. This pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.09.08 Planned Action

The Road F Site is closed. Groundwater monitoring will continue. No other action is scheduled for this site.

15.10 SECOND PAR POND BORROW PIT

15.10.01 Summary

The Second Par Pond Borrow Pit (Building 761-8G) is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. In August 1981, solid sewage sludge from offsite was applied as an experimental soil conditioner. Loblolly pines and grasses were then planted on the site and their subsequent growth measured (Gordon et al., 1987).

The groundwater monitoring data indicate that the Second Par Pond Borrow Pit has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 27 were consistent with levels reported for upgradient wells SSS 25 and SSS 26. Groundwater quality in the three site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards except for anomalously high iron and manganese concentrations in upgradient well SSS 25. Low total dissolved solids (TDS) concentrations (19 to 48 mg/L) and conductivity (20 to 90 μmhos/cm) were reported for the site wells.

15.10.02 Waste-Site Description and Nature of Disposal

The Second Par Pond Borrow Pit (Building 761-8G) covers 15 acres east of Par Pond and north of Road B. The ground surface elevation at the site ranges from 210 to 230 ft msl. Surface drainage is to the west toward Par Pond (Figure 15-20).

The Second Par Pond Borrow Pit is part of a research program developed in 1980 under the Department of Energy (DOE) Biomass Fuels Program to evaluate the effectiveness of sewage sludge application to enhance forest productivity and reclaim borrow pits at SRS. The objectives of the project were to evaluate the cost effectiveness and environmental safety of sewage sludge application and to compare the ability of sewage sludge to act as a soil conditioner and slow-release fertilizer with that of commercial, inorganic fertilizers.

At SRS, borrow pits are areas where soil has been removed for construction projects. These pits often have hardpan soils that do not support vegetation, making them subject to erosion. In 1980 and 1981, approximately 55 acres of borrow pits were treated with over 650,000 gal of sewage sludge.

In August 1981, solid sewage sludge from offsite was applied with a manure spreader over the site at rates of up to 400 lb of nitrogen per acre. The sludge was then disked to various depths over the site. In winter 1981, loblolly pines and grasses were planted on the site, and their growth was measured. This site was managed by the Southeastern Forest Experiment Station in Athens, GA (Gordon et al., 1987).

15.10.03 Groundwater Monitoring Program

The sewage sludge application sites are managed under the terms of South Carolina Department of Health and Environmental Control (SCDHEC) Permit No. IWP-175 issued in July 1980. Provisions for additional sites were added to this permit in 1981. The permit requires that three groundwater monitoring wells be installed at each site prior to sludge application and that the wells be analyzed quarterly for pH, nitrates, total dissolved solids (TDS), sodium, and chloride. Analyses for orthophosphates, total Kjeldahl nitrogen (TKN), cadmium, copper, iron, nickel, lead, calcium, magnesium, manganese, and potassium are required annually. The permit was amended to allow annual sampling only for all analytes beginning in 1986.

Three wells (SSS 25 through SSS 27) were installed at the Second Par Pond Borrow Pit to monitor the water-table elevation and groundwater quality (Figure 15-25). Groundwater monitoring at the site began in the first quarter of 1981, prior to sludge application. Well SSS 27 was accidentally covered and lost in early 1985 during reforestation of the site.

15.10.04 Site-Specific Hydrology

Measurements obtained from the Second Par Pond Borrow Pit wells since the first quarter of 1983 indicate that the water-table elevation has ranged approximately from 198 to 175 ft msl and that the vadose zone has been approximately 35 ft thick. A hydrograph for these wells is shown in Figure 15-26. The horizontal water-table flow direction for the first quarter of 1985 was easterly, as shown in Figure 15-25. The water-level data presented in the hydrograph indicate that this has been the predominant flow direction, although minor changes in flow direction have occurred. Relative to the sludge application site, wells SSS 25 and SSS 26 have been upgradient and well SSS 27 downgradient. The hydraulic gradient beneath the pit has been approximately 0.015 ft/ft.

15.10.05 Waste-Site Content Characterization Data

Sampling and analysis of the Second Par Pond Borrow Pit contents have not been conducted. Section 15.10.02 contains information on the nature of the materials at the site.

15.10.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been performed at the Second Par Pond Borrow Pit.

15.10.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 are given in Appendix M. The groundwater at the sewage sludge application sites has been monitored according to the terms outlined in SCDHEC Permit No. IWP-175. Groundwater chemical characterization data from 1984 through 1986 are summarized in Table 15-14.

Comparisons of the groundwater monitoring data among upgradient wells SSS 25 and SSS 26 and downgradient well SSS 27 were used to evaluate the effect of the Second Par Pond Borrow Pit on local groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality.

The monitoring data summarized in Table 15-14 indicate that the Second Par Pond Borrow Pit has had no apparent effect on local groundwater quality. Concentrations of the tested parameters in downgradient well SSS 27 were consistent with levels reported for upgradient wells SSS 25 and SSS 26. Groundwater quality in the site wells has been characterized by low dissolved chemical constituent levels compared to South Carolina and federal drinking water standards except for anomalously high iron and manganese concentrations in upgradient well SSS 25. Low TDS (19 to 48 mg/L) and conductivity (20 to 90 µmhos/cm) values were reported for the wells.

TDS levels ranged from 26 to 34 mg/L in the downgradient well and from 19 to 48 mg/L in the upgradient wells. TKN concentrations were below detection limits in the downgradient well and ranged from <0.1 to 0.68 mg/L in the upgradient wells. Orthophosphate (<0.002 to 0.017 mg/L), chloride (2.50 to 7.25 mg/L), sodium (2.35 to 8.08 mg/L), and nitrate/nitrite (0.02 to 1.68 mg/L) concentrations were also low.

Concentrations of cadmium, copper, and nickel were below detection limits in all samples. Mercury was detected once in each upgradient well at concentrations below the drinking water standard. These data are suspect, however, because mercury has been below its detection limit in all samples from all 27 SSS wells except in December 1985, when it was detected in every SSS well sampled.

Consistently high iron (2.54 to 7.48 mg/L) and manganese (0.438 to 0.655 mg/L) levels have been determined for upgradient well SSS 25. These concentrations are well above the drinking water standards for these two constituents (0.3 mg/L and 0.05 mg/L, respectively). The source of these elevated values is not known.

Groundwater pH ranged from 4.1 to 6.3 in the site wells. This pH range is consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

15.10.08 Planned Action

The Second Par Pond Borrow Pit is inactive. Groundwater monitoring will continue at this site, and a replacement for well SSS 27 is scheduled for installation.

15.11 OTHER WASTE SITES

15.11.01 D-Area Waste Oil Facility

The D-Area Waste Oil Facility is a powerhouse (Building 484-D) that began burning waste oil in 1973 when open burning at SRS stopped. Only waste oil that has a flash point greater than 100° F, contains no toxic chemicals, and has low solids concentrations is accepted for burning at this facility. Waste oil is brought to the powerhouse in 55-gal drums and pumped to a 2,000-gal mixing and storage tank. The oil is then pumped from the tank to the boiler and burned with coal (Christensen and Gordon, 1983).

The powerhouse is in the western part of D Area at an elevation of approximately 130 ft msl. Surface drainage is to the west-southwest toward the Savannah River and Savannah River Swamp (Figure 15-27).

Groundwater monitoring wells have not been installed at the site, and soil/sediment sampling has not been conducted. No further action is planned for this site at this time.

15.11.02 Gas Cylinder Disposal Facility

The Gas Cylinder Disposal Facility (Building 131-2L) covers approximately 380 ft^2 near the L-Area Burning/Rubble Pit at an elevation of approximately 250 ft msl (Figure 15-28). The nearest plant boundary is approximately 8 mi to the west. Horizontal groundwater flow beneath the nearby burning/rubble pit is to the west.

The facility contains 28 empty gas cylinders. In 1977 and 1982, partially full cylinders were placed in the ground, fastened by concrete, the tops removed, and the gas vented to the atmosphere. Once emptied, the cylinders were covered with concrete, and the area was backfilled with dirt (Christensen and Gordon, 1983). Table 15-15 summarizes the gases vented at the facility. The site is currently inactive.

Soil/sediment sampling and groundwater monitoring have not been conducted at this site because all waste materials were released to the atmosphere. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

15.11.03 Rubble Pits

From 1973 to 1983, 11 unlined earthen pits were used for the disposal of inert material such as concrete, brick, tile, asphalt, hard plastics, glass, rubber products, and non-returnable empty drums (Christensen and Gordon, 1983). A waste inventory for the rubble pits is given in Table 15-16.

The A-Area Rubble Pit (Building 731-2A) is west of Road D and adjacent to the A-Area Burning/Rubble Pits (Figure 15-29). The ground surface elevation at the site is approximately 345 ft msl, and surface drainage is to the east toward Tims Branch. The horizontal groundwater flow direction at the nearby burning/rubble pits is to the west-northwest. The nearest plant boundary is approximately 1.5 mi to the northwest.

Central Shops Rubble Pit 631-3G is northeast of Central Shops Area by the northern two Central Shops Burning/Rubble Pits (Figure 15-30). The ground surface elevation at the site ranges from 262 to 272 ft msl. Central Shops Rubble Pit 631-7G is south of the Central Shops Area near the SRL Oil Test Site at an elevation of approximately 280 ft msl. Surface drainage from both sites is toward Four Mile Creek. The nearest plant boundary is approximately 5.5 mi to the west.

The D-Area Rubble Pit (Building 431-2D) is west of D Area and south of the burning/rubble pits, approximately 4,000 ft to the east of the nearest plant boundary (Figure 15-27). The ground surface elevation at the site ranges from 125 to 131 ft msl, and surface drainage is west and south toward the Savannah River. The horizontal, near-surface groundwater flow direction at the nearby burning/rubble pits is to the south.

The two F-Area Rubble Pits are west of F Area on either side of Road C, about 5 mi from the nearest plant boundary (Figure 15-31). Located between Upper Three Runs Creek and Four Mile Creek, the pits are at elevations of 300 ft msl (Building 231-2F) and 280 ft msl (Building 231-4F). The near-surface, horizontal groundwater flow direction at pit 231-4F is believed to be to the west toward Upper Three Runs Creek.

The Forestry Rubble Pit (Building 761-9G) is off Road 2 by the Forestry and Ecology Headquarters (Figure 15-32). The nearest plant boundary is approximately 1.5 mi northwest of the site. Surface drainage is to the southeast toward Upper Three Runs Creek.

L-Area Rubble Pits 131-1L and 131-4L are north of L Area between Steel Creek and Pen Branch at an elevation of 260 ft msl (Figure 15-28).

The third L-Area Rubble Pit (Building 131-3L) is north of Road 7-1 on the east bank of Pen Branch at an elevation of 190 ft msl. The pits are approximately 6 mi northwest of the nearest plant boundary.

The R-Area Rubble Pit (Building 131-2R) is just outside the west corner of the R-Area perimeter fence at an elevation of 308 ft msl (Figure 15-33). The pit is near the hydraulic divide between the headwaters of Mill Creek to the north and Par Pond to the east, about 4.8 mi to the west of the nearest plant boundary.

After 1983, the rubble pits were backfilled and seeded, and all of the pits are currently inactive. Soil/sediment sampling and groundwater monitoring have not been conducted. As indicated in Section 16, the Rubble Pits are scheduled for site assessments in 1988 from which closure plans will be developed.

15.11.04 Rubble Piles

Rubble piles are used at SRS for disposing of industrial debris from specific areas. The wastes consist mostly of inert material such as concrete, brick, lumber, asphalt, and empty drums (Christensen and Gordon, 1983). There are 13 known rubble piles at SRS: 9 contain general construction rubble; 4 are gunsite rubble piles resulting from the dismantling and abandonment of gun emplacements and support facilities in 1961.

The A-Area Rubble Pile (Building 731-6A) covers about 0.3 acre just south of the A-Area perimeter fence (Figure 15-29). Surface drainage is to the southeast toward Tims Branch.

The Miscellaneous (Central Shops) Rubble Pile is south of the Central Shops Area and west of the railroad line (Figure 15-30). A marshy area and unnamed tributary to Four Mile Creek are close to the site.

The Cemetery Road Rubble Pile (Building 631-11G), Brag Bray Road Rubble Pile (Building 631-14G), Rubble Pile at Road 781.1 (Building 631-13G), and Rubble Pile between Cemetery and Brag Bray roads (Building 631-12G) are in the north part of SRS by Highway 278 (Figure 15-32). All of these sites are closed except Building 631-12G.

The SREL Rubble Pile (Building 631-10G) and the Forestry Rubble Pile (Building 631-9G) are east and southeast, respectively, of the Forestry and Ecology Headquarters (Figure 15-32). Both of these sites are closed.

The L-Area and R-Area rubble piles have not been assigned building numbers. The L-Area Rubble Pile is west of L Area, just outside the perimeter fence (Figure 15-28). An unnamed tributary of Pen Branch runs close to the site. The R-Area Rubble Pile is south of R Area at an elevation of approximately 300 ft msl (Figure 15-33). Surface drainage is to the east toward Pond 5 of Par Pond.

The Gunsite 51 Rubble Pile (Building 080-29G) covers 4.1 acres south of K Area and northeast of Road A on a ridge between Pen Branch and Steel Creek (Figure 15-34). The elevation of the site is approximately 255 ft msl, and surface drainage is to the west toward Pen Branch. The rubble has been removed from this site, and only concrete pads remain.

The Gunsite 72 Rubble Pile (Building 080-31G) is northwest of D Area at the end of Road A-2 and covers 6.4 acres (Figure 15-35). The elevation of the site is 130 ft msl, and surface drainage is to the south toward Upper Three Runs Creek. The rubble has been removed from this site, and it has been revegetated.

The Gunsite 102 Rubble Pile (Building 080-30G) covers 6.4 acres north of R Area and south of Road 2-1 (Figure 15-36). The site is on a ridge between Reedy Branch and Mill Creek at an elevation of 310 ft msl. Surface drainage is to these two creeks.

The Gunsite 113 Rubble Pile (Building 631-15G) is just inside the northeast plant boundary east of Road 8 (Figure 15-37). The site is at an elevation of 325 ft msl in an area of relatively flat topography.

Groundwater monitoring and characterization studies have not been conducted at these sites. As indicated in Section 16, the rubble piles at SRS are either closed, currently undergoing site assessment, or have assessments planned for 1988.

15.11.05 Gunsite 720 Rubble Pit

The Gunsite 720 Rubble Pit (Building 631-16G) covers approximately 375 ft^2 and contains eight empty drums of unknown origin. The pit is in an open area north of D Area, approximately 550 ft north of Road A-2 (Figure 15-38). The surface elevation at the site is 150 ft, and surface drainage is to the west-southwest.

The site is currently inactive. As indicated in Section 16, a site assessment is planned for 1988 from which a closure plan will be developed.

15.11.06 Erosion Control Sites

Seven sites at SRS received inert material only (i.e., waste concrete, asphalt, bricks, roofing materials, and stumps) for slope stabilization and erosion control (Christensen and Gordon, 1983). The sites are currently active.

The C-Area Erosion Control Site (Building 131-1C) covers approximately 25,000 ft^2 on the west side of the 100-C effluent canal, directly southwest of the C-Area perimeter fence (Figure 15-30). The ground surface elevation at the site is 285 ft msl, and surface drainage is to the west toward a tributary of Four Mile Creek.

The P-Area Erosion Control Site (Building 131-1P) is on the north side of the 100-P effluent canal to Steel Creek, northwest of the P-Area perimeter fence (Figure 15-39). The ground surface elevation at the site is 290 ft msl, and surface drainage is to the northwest.

The Substation 51 Erosion Control Site (Building 080-27G) is north of Substation 51, which is approximately 2.1 mi north-northeast of the D-Area perimeter fence (Figure 15-40). The site covers 4,000 ft^2 and is at an elevation of 240 ft msl. Surface drainage is to the southwest toward the Savannah River.

The F-Area Erosion Control Site (Building 080-28G) covers about 80,900 ft^2 approximately 4,000 ft west of the F-Area perimeter fence and south of SRS Road C (Figure 15-31). Surface elevation is 215 ft msl, and surface drainage is to the west toward a tributary of Four Mile Creek.

The H-Area Erosion Control Site (Building 080-25G) is south of Road E and west of Road E-1, approximately 2,000 ft southwest of the H-Area perimeter fence (Figure 15-41). The site covers over 650,000 ft^2. The ground surface elevation at the site is 270 ft msl, and surface drainage is to the west toward a tributary of Four Mile Creek.

The L-Area Erosion Control Site (Building 080-26G) covers approximately 260,500 ft^2 and is approximately 3,000 ft northwest of the L-Area perimeter fence (Figure 15-28). The site is at an elevation of 230 ft msl, and surface drainage is to the west-southwest toward a tributary of Pen Branch.

The 3G-Pumphouse Erosion Control Site (Building 631-8G) covers about 463,000 ft^2 directly west of SRS Road A-4.7, which is approximately 3,000 ft west-northwest of the D-Area perimeter fence (Figure 15-27). The site is at an elevation of 110 ft msl, and surface drainage is to the northwest toward a tributary of the intake canal.

The D-F Steamline Erosion Control Site is located northeast of D Area along the steamline between D and F areas (Figure 15-27). This site has been officially established but has not received any fill material to date (Gordon et al., 1987).

Soil/sediment sampling and groundwater monitoring have not been conducted at these sites. As indicated in Section 16, continued use is planned.

15.11.07 Central Shops Oil Storage Pad

The Central Shops Oil Storage Pad (Building 080-15G) is a concrete pad surrounded by curbing that was used from 1975 to 1979 to store 55-gal drums of oil and solvents. In February 1979, all the material stored on the pad was deposited in the CMP Pits (Christensen and Gordon, 1983). The site is currently inactive.

Groundwater monitoring and soil/sediment characterization have not been conducted at this waste site. No further action is planned for this site at this time.

15.11.08 Earthen Basins

Earthen basins were constructed adjacent to the fuel unloading facilities (108 Buildings) in the reactor areas to contain overflow oil and water from the fuel oil loading pads and tanks. The earthen basins in C, K, and L areas were constructed by placing an asphalt berm around an aboveground oil tank. These basins were never used. The P-Area Earthen Basin was constructed adjacent to an underground storage tank. The site was closed under South Carolina Department of Health and Environmental Control (SCDHEC) approval in 1984. The R-Area Earthen Basin was constructed near the oil storage tank and reportedly received some oil. The basin currently contains liquid (Gordon et al., 1987).

The C-Area Earthen Basin is south of C Reactor at an elevation of approximately 290 ft msl (Figure 15-30). The general horizontal groundwater flow direction beneath C Area is to the west.

The K-Area Earthen Basin is south of K Reactor at an elevation of approximately 275 ft msl (Figure 15-34). The general horizontal groundwater flow direction beneath the basin is to the southwest toward Indian Grave Branch.

The L-Area Earthen Basin is east of L Reactor at an elevation of approximately 280 ft msl (Figure 15-28). The general horizontal groundwater flow direction beneath L Area is to the southeast toward Steel Creek.

The P-Area Earthen Basin is southeast of P Reactor at an elevation of approximately 330 ft msl (Figure 15-39). P Area is on a groundwater divide, with the horizontal groundwater flow direction beneath the area being both to the southwest and to the northeast.

The R-Area Earthen Basin is southwest of R Reactor at an elevation of approximately 330 ft msl (Figure 15-33). The horizontal groundwater flow direction beneath the basin is to the south.

Groundwater monitoring and soil/sediment sampling have not been performed at the earthen basins. As indicated in Section 16, a site assessment is planned for the R-Area Earthen Basin in 1988, from which a closure plan will be developed.

15.11.09 Risher Road Metal Pit

The Risher Road Metal Pit (Building 631-17G) is an earthen pit covering approximately 400 ft^2 containing 5 to 10 yd^3 of lumber and some scrap metal (Gordon et al., 1987). The site is approximately 0.4 mi west-northwest of the intersection of Roads 2 and 2-1 at a ground surface elevation of 355 ft msl (Figure 15-32). Surface drainage is to the west.

The site is currently inactive. Soil/sediment sampling and groundwater monitoring have not been conducted at this site. As indicated in Section 16, an assessment is planned for 1988, from which a closure plan will be developed.

15.11.10 Scrap Metal Pile

The Scrap Metal Pile (Building 631-18G) covers about 500 ft^2 and contains three Ford Model A car bodies and miscellaneous scrap metal (Gordon et al., 1987). The site is adjacent to Road A-18, approximately 1.7 mi from Road A (Highway 125; Figure 15-42). The surface elevation at the site is 220 ft msl, and surface drainage is to the southwest toward a tributary of Steel Creek. The site is currently inactive.

Soil/sediment sampling and groundwater monitoring have not been conducted at this site. As indicated in Section 16, an assessment is planned for 1988, from which a closure plan will be developed.

15.12 SANITARY LANDFILL

15.12.01 Summary

The Sanitary Landfill (Building 740-G) is southeast of the intersection of SRS Roads C and 2 in the northwest part of SRS. It has been in use since 1973 for the disposal of nonhazardous, nonradioactive waste. These wastes typically consist of paper and paper products, plastics, scrap metal, miscellaneous construction debris, rubber, food waste, glass, packing material, non-reusable drums and containers, empty paint cans, and aerosol cans (Christensen and Gordon, 1983).

The landfill originally covered 32 acres of cleared land and was subdivided into four phases. Phases 1 and 2 of the landfill are complete and were closed in 1980 and 1984, respectively. Phases 3 and 4 are currently open and receiving waste. Two expansion sites were cleared in 1986 and are available for future use. The Sanitary Landfill operates under South Carolina State Domestic Waste Permit No. 87A.

The groundwater monitoring data indicate that the Sanitary Landfill has had no apparent effect on groundwater quality in wells LFW 10A, LFW 16, and LFW 19 through LFW 25. Groundwater in wells downgradient of landfill phases 1 and/or 2 (LFW 6, LFW 7, LFW 8, LFW 9, LFW 17, and LFW 18) has apparently been influenced by the landfill as evidenced by the elevated levels of conductivity, chloride, total organic carbon (TOC), and total organic halogens (TOH) in these wells. Dissolved chemical constituent levels in all of the site wells have been less than South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards since filtering was included in the sampling protocol in August 1984.

15.12.02 Waste-Site Description and Nature of Disposal

The Sanitary Landfill (Building 740-G) was opened in 1973 for the disposal of nonhazardous, nonradioactive waste generated at SRS. The landfill originally covered 32 acres of cleared land and was subdivided into four phases. Phases 1 and 2 of the landfill are complete and were closed in 1980 and 1984, respectively. Phases 3 and 4 of the landfill are currently open and receiving waste. Two expansion sites were grubbed and cleared in 1986 and are available for future use. Figure 15-43 shows the landfill divisions.

The SRS Sanitary Landfill is operated under South Carolina State Domestic Waste Permit No. 87A. Trenches in the landfill are excavated to approximately 10 to 15 ft in depth and 20 ft in width then filled with waste. The waste in the open trenches is compacted daily by repeated passes of a bulldozer or front-end loader. At the completion of each operating day, a layer of cover soil approximately 1 ft thick is placed over the waste and compacted.

The waste typically consists of paper and paper products, plastics, scrap metal, miscellaneous construction debris, rubber, food waste, glass, packing material, non-reusable drums or containers, empty paint cans, and aerosol cans. Waste oils, coolants, solvents, paints, and radioactive materials are not disposed of at the landfill but are put in containers, labeled, and sent to designated areas for storage, burning, or disposal (Christensen and Gordon, 1983).

The Sanitary Landfill is located in the northwest part of SRS, southeast of the intersection of SRS Roads C and 2, at an elevation of approximately 175 ft msl. Surface drainage is to the south-southeast toward Upper Three Runs Creek.

15.12.03 Groundwater Monitoring Program

Thirty-eight wells (LFW Series) have been installed at the Sanitary Landfill to monitor the water-table elevation and groundwater quality;

seven of these wells have been abandoned. Wells LFW 1 through LFW 10 were constructed between 1975 and 1981 using steel casings and 20-ft screens. Three of these wells (LFW 6 through LFW 8) are still active. Wells LFW 16 through LFW 20 and wells LFW 21 through LFW 25 were constructed in 1981 and 1984, respectively, using PVC casings and 30-ft screens. Also in 1984, well LFW 10A, constructed using the same materials, replaced well LFW 10. Wells LFW 26 through LFW 42 were installed in the fourth quarter of 1986 using PVC casings and 20-ft screens. These wells were not sampled in 1986, but their locations are shown in Figure 15-43.

In accordance with permit requirements, groundwater monitoring well analytical data have been transmitted to the South Carolina Department of Health and Environmental Control (SCDHEC) since 1980. Early monitoring results indicate that the presence of metals in the groundwater samples probably resulted from the galvanized steel casings in the wells. Plantwide, samples for metals analyses were unfiltered through the second quarter of 1984, after which time filtering was included in the sampling and analysis program.

15.12.04 Site-Specific Hydrology

Measurements obtained from the Sanitary Landfill wells since the first quarter of 1981 indicate that the water-table elevation has ranged approximately from 162 to 147 ft msl and that the vadose zone has been 10 to 15 ft thick. Hydrographs of the Sanitary Landfill wells are presented in Figures 15-44 through 15-46. Certain data points for the third quarter 1985 and second quarter 1986 are suspect and are not plotted on the hydrographs.

A water-table elevation contour map for the first quarter of 1986 (Figure 15-47) shows that the near-surface, horizontal groundwater flow direction for the first quarter of 1986 was to the south. The hydrographs indicate that this has been the predominant flow direction, although water-level fluctuations suggest that minor changes in flow direction have occurred.

As shown in Figure 15-47, well LFW 20 has been predominantly upgradient, and wells LFW 19, LFW 24, and LFW 25 have been predominantly sidegradient of the landfill. Wells LFW 6, LFW 7, LFW 8, LFW 9, LFW 17, and LFW 18 have been predominantly downgradient of landfill phases 1 and/or 2; wells LFW 10A, LFW 16, LFW 21, LFW 22, and LFW 23 have been downgradient of landfill phases 3 and/or 4.

Based on Figure 15-47, the hydraulic gradient across the landfill is approximately 0.006 ft/ft. Using a horizontal groundwater flow velocity range estimated for the Barnwell Formation near the center of the plant of 15 to 60 ft/yr per percent gradient, the horizontal groundwater flow velocity beneath the landfill has been approximately 9 to 36 ft/yr.

15.12.05 Waste-Site Content Characterization Data

The contents of the Sanitary Landfill have not been sampled. Section 15.12.02 contains information on the nature of the materials disposed at the site.

15.12.06 Soil/Sediment Characterization Data

Soil/sediment sampling and analysis have not been conducted at the Sanitary Landfill.

15.12.07 Groundwater Monitoring Results

The groundwater monitoring data from 1982 through 1986 for the landfill wells are given in Appendix M. Groundwater chemical characterization data are summarized in Table 15-17.

Comparisons of the monitoring results among the downgradient wells and the upgradient wells were used to evaluate the effect of the Sanitary Landfill on local groundwater quality. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess groundwater quality. Indicator parameters for the Sanitary Landfill are conductivity, pH, chloride, sulfate, total organic carbon (TOC), and total organic halogens (TOH). Conductivity, pH, chloride, and sulfate were chosen as indicator parameters because these parameters are associated with leachate from sanitary waste disposal facilities. TOC and TOH were chosen as potential indicator parameters because of their previously elevated levels in some of the groundwater samples obtained from site wells.

The groundwater monitoring data summarized in Table 15-17 show that the Sanitary Landfill has had no apparent effect on groundwater quality in wells LFW 10A, LFW 16, LFW 19, LFW 20, LFW 21, LFW 22, LFW 23, LFW 24, and LFW 25. Groundwater in wells downgradient of landfill phases 1 and/or 2 (LFW 6, LFW 7, LFW 8, LFW 9, LFW 17, and LFW 18) has apparently been influenced by the Sanitary Landfill, as evidenced by the elevated levels of conductivity, chloride, TOC, and TOH in these wells. Dissolved chemical constituent levels in all of the landfill wells have been less than South Carolina and federal primary and secondary drinking water standards since filtering was included in the sampling protocol in August 1984.

Groundwater quality in wells LFW 10A, LFW 16, and LFW 19 through LFW 25 has been characterized by low dissolved chemical constituent levels compared to drinking water standards. Low conductivity levels were reported for these wells (10 to 48 μmhos/cm), excluding a single value of 81 μmhos/cm in upgradient well LFW 20. Chloride levels in these wells remained below 5.5 mg/L; the drinking water standard for chloride is 250 mg/L. TOC levels in these wells ranged from 0.217 to 22.0 mg/L, and TOH levels ranged from <0.005 to 0.025 mg/L. Groundwater pH in these wells ranged from 3.6 to 5.7; pH values as low as 4.0 are generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

Although groundwater quality in wells LFW 6, LFW 7, LFW 8, LFW 9, LFW 17, and LFW 18 (located downgradient of landfill phases 1 and/or 2) has met drinking water standards since the filtering of metals samples began, these wells have apparently been affected by the Sanitary Landfill as evidenced by the elevated indicator parameter levels reported. Conductivity levels in wells LFW 6 (94 to 260 μmhos/cm), LFW 7 (421 to 1,120 μmhos/cm), LFW 8 (120 to 580 μmhos/cm), LFW 9 (35 to 115 μmhos/cm), LFW 17 (264 to 1,900 μmhos/cm), and LFW 18 (200 to 722 μmhos/cm) have been elevated relative to the conductivity levels reported for the other site wells. Chloride concentrations in wells LFW 6 (9.06 to 23.1 mg/L), LFW 7 (21.6 to 45.6 mg/L), LFW 8 (16.0 to 42.8 mg/L), LFW 9 (2.9 to 8.7 mg/L), LFW 17 (3.3 to 46.5 mg/L), and LFW 18 (12.8 to 43.3 mg/L) also have been elevated relative to the remaining site wells. TOH concentrations (0.085 to 0.40 mg/L) in wells LFW 6 through LFW 9, LFW 17, and LFW 18 remained above concentrations reported for the remaining site wells (<0.005 to 0.025 mg/L). Figures 15-48 through 15-51, graphic comparisons of average indicator parameter concentrations among the landfill site wells, demonstrate the relative differences in water quality between the wells that are located directly downgradient of landfill phases 1 and/or 2 and the other site wells.

Groundwater pH in wells LFW 6, LFW 7, LFW 8, LFW 9, LFW 17, and LFW 18 ranged from 4.1 to 7.2. This pH range is generally consistent with pH values reported as naturally occurring in Barnwell Formation groundwater (Appendix B).

The groundwater quality at the landfill is apparently related to the length of time the waste has been in the ground. Wells LFW 6, LFW 7, LFW 8, and LFW 9 are downgradient of phase 1, which was the first section to be filled and was closed in 1980. Wells LFW 17 and LFW 18 are downgradient of phase 2, which was the next section to be opened (1980) and was closed in 1984. Groundwater from these six wells exhibited indicator parameter concentrations that were elevated compared to background levels. Wells LFW 21 and LFW 22 are downgradient of landfill phase 3, which is currently receiving waste. Groundwater samples from these wells have not shown elevated indicator parameter levels.

15.12.08 Planned Action

The Sanitary Landfill is active, and continued operation is planned under South Carolina State Domestic Waste Permit No. 87A. Groundwater monitoring will continue at the site.

15.13 CHEMICALS, METALS, AND PESTICIDES (CMP) PITS

15.13.01 Summary

The Chemicals, Metals, and Pesticides (CMP) Pits (Buildings 080-17G, 080-17.1G, 080-18G, 080-18.1G, 080-18.2G, 080-18.3G, and 080-19G) were seven unlined earthen pits used for the disposal of a variety of nonradioactive chemical wastes from August 1971 through February 1979. Waste placed in the CMP Pits included drums of solvents (i.e., trichloroethylene and tetrachloroethylene), oil, paint thinner, acid, Freon[R], metals, and pesticides. In September and October 1984, recoverable wastes and contaminated soil were removed from the pits, and the site was closed by backfilling with clean soil and installing a compacted fill cap, an impermeable membrane, and a soil cover. All excavated wastes and contaminated soil were put in containers and transported to an onsite permitted hazardous waste storage facility (Scott et al., 1987c).

The groundwater monitoring data indicate that the water-table quality at the CMP Pits has been characterized by low dissolved chemical and radiological constituent levels compared to drinking water standards except for isolated excursions of iron, manganese, lead, zinc, trichloroethylene, gross alpha, and total radium in the upgradient, sidegradient, and downgradient wells. Monitoring data from wells screened in the McBean and Congaree formations indicate that the CMP Pits have had no apparent effect on groundwater quality in these lower aquifers.

15.13.02 Waste-Site Description and Nature of Disposal

The Chemicals, Metals, and Pesticides (CMP) Pits, located on a hilltop approximately 1 mi north of L Area (Figure 15-52), were seven unlined pits used for the disposal of a variety of nonradioactive wastes from August 1971 through February 1979. Of the seven disposal pits at this site, two were designated to receive pesticides (Buildings 080-17G and 080-17.1G), four were designated to receive other types of chemicals (Buildings 080-18G, 080-18.1G, 080-18.2G, and 080-18.3G), and one was designated to receive metals (Building 080-19G). Chemical waste placed in the CMP Pits consisted of drums of solvents (i.e., trichloroethylene and tetrachloroethylene) and other wastes such as oil, paint thinner, Freon[R], acid, and pesticides. Metals disposed in the CMP Pits included beryllium, titanium, calcium, and cadmium. A summary of the available waste disposal records for the CMP Pits is presented in Table 15-18.

The CMP Pits were closed temporarily in February 1979 to review safety aspects of waste transportation and handling. The pits remained closed until December 1979, at which time all open trenches were covered with clay and graded. In September and October 1984, recoverable wastes and contaminated soil from the pits were removed to a permitted hazardous waste storage facility. By December 1984, all of the CMP Pits were closed permanently by backfilling with clean soil and installing a compacted fill cap, an impermeable membrane, and a minimum of 4 ft of soil cover. The site was then seeded to prevent erosion. A leach field for flushing the unsaturated zone underlying the pits was installed prior to backfilling.

The CMP Pits were constructed in two parallel trenches with 10 to 25 ft between the ends of each pit. Each pit was about 10 to 16 ft wide by 50 to 75 ft in length (Figure 15-53). Depths ranged from 10 to 16 ft below ground surface. The area is bounded to the north and west by Pen Branch and to the south by an ephemeral tributary to Pen Branch. The ground surface elevation at the CMP Pits ranges approximately from 300 to 320 ft msl.

15.13.03 Groundwater Monitoring Program

Twenty-nine wells (CMP Series) have been installed to monitor the groundwater quality at the CMP Pits. Water-table wells CMP 1 through CMP 4 were installed in 1975. Wells CMP 5 through CMP 7, additional water-table wells, were installed in 1978 and 1979 (Figure 15-54). These seven wells had steel casings and 20-ft screens except for well CMP 2, which had a steel casing and 4-ft brass screen. Prior to 1980, wells CMP 1 through CMP 7 were sampled and analyzed annually for pesticides. Periodic monitoring of these wells for an expanded range of constituents began in the second quarter of 1980 and continued through the fourth quarter of 1983 (excluding 1981). Wells CMP 1 through CMP 7 were grouted and abandoned in 1984 when the waste material in the pits was removed and the pits backfilled.

Water-table monitoring wells CMP 8 through CMP 13 were installed in 1982. In 1984, well clusters were constructed at water-table wells CMP 8 and CMP 10 through CMP 13. Two additional well clusters (CMP 14 and CMP 15) also were added in 1984, and well CMP 9 was abandoned. In 1985, well clusters CMP 9, consisting of wells CMP 9B and CMP 9C, and CMP 16, consisting of wells CMP 16B and CMP 16C, were installed in the areas of greatest soil contamination (Figure 15-54). The well clusters provide monitoring data for the water-table (wells with no letter designator, C-designated wells, and well CMP 15B), McBean (B-designated wells except CMP 15B), and Congaree (A-designated wells) aquifers. The water-table wells were constructed using PVC casings and 30-ft screens. The wells monitoring the underlying aquifers were constructed using PVC casings and 10-ft screens. Well clusters CMP 8 through CMP 16 are sampled as part of the SRS quarterly groundwater monitoring program; wells CMP 9C and CMP 16C have been dry, and sampling results for these wells are not available.

Well CMP 11TA was installed as part of the CMP 11 well cluster. Screened in the Tuscaloosa Formation, this well is used for water-level measurements only. It was constructed using carbon steel casing and a 10-ft screen.

15.13.04 Site-Specific Hydrology

Hydrographs for the CMP monitoring wells are presented in Figures 15-55 through 15-59. Water-table elevations in wells CMP 1 through CMP 7 ranged approximately from 225 to 200 ft msl (Figure 15-55). Clay layers in the Barnwell Formation complicate the water table at this site. Well CMP 4 may have penetrated a significant clay layer, yielding a head below the water table. Wells CMP 5 and CMP 6 may have sampled perched water.

The hydrograph of wells CMP 8 through CMP 15C (Figure 15-56) shows that changes in water-table elevations have occurred over the monitoring period; however, the positioning of the wells with respect to hydraulic gradient has remained relatively consistent. A water-table map for the CMP Pits based on measurements obtained in March 1985 (Figure 15-54) indicates that the flow is complex in this area but that the general horizontal flow direction has been to the north. Wells CMP 8, CMP 12, and CMP 13 have been downgradient of the pits; well CMP 8 is farther removed from the pits than the other two wells. Wells CMP 10 and CMP 15C have been upgradient, and wells CMP 11 and CMP 14C have been sidegradient to the CMP Pits.

Because of stratigraphic variations, some of the near-surface monitoring wells may not be measuring the water table. Well CMP 11 has been interpreted (Scott et al., 1987c) as being semiconfined, although it was installed as a water-table monitoring well in the Barnwell Formation. Well CMP 15C has been interpreted (Scott et al., 1987c) as sampling a separate water-table body than that monitored by the other water-table wells. Wells CMP 9C and CMP 16C have been dry. The vadose zone is up to 85 ft thick under the CMP Pits and decreases in thickness with distance from the pits.

The B-designated wells were installed to monitor the McBean Formation (Figures 15-57 and 15-58). It is suspected that well CMP 15B is screened in the Barnwell Formation where it was deposited in a low area on the post-McBean erosional surface. Well CMP 15B has been interpreted (Scott et al., 1987c) as sampling groundwater that is hydrologically connected with the water table existing between wells CMP 8 and CMP 9. A contour map of the piezometric surface for the remaining B-designated wells in the first quarter of 1986 (Figure 15-60) shows that the flow direction was to the south. Many void spaces were encountered in the upper part of the McBean Formation during drilling, and little horizontal gradient exists in this zone under the CMP Pits, suggesting that this zone is highly transmissive. Because of the complexity of the groundwater flow at the site, the hydraulic positioning of the wells monitoring the lower aquifers relative to the pits cannot be determined.

Three monitoring wells (wells CMP 8A, CMP 12A, and CMP 15A) were installed with screens in the Congaree Formation, and water-level elevations have ranged between XX and XX ft msl (Figure 15-59). The general groundwater flow direction at this location has been to the southwest; however, a flow gradient and velocity cannot be derived because the wells were installed in a line.

One monitoring well (CMP 11TA) is screened in the Tuscaloosa Formation. The measured hydraulic head in this well indicates that there is a downward hydraulic gradient between the lower Congaree and the Tuscaloosa formations. However, significant flow across these two zones does not appear likely because the upper zone approaching the contact contains a large proportion of clay (Scott et al., 1987c).

15.13.05 Waste-Site Content Characterization Data

Solid and liquid waste materials were removed from the CMP Pits in September and October 1984 by excavating two trenches along the axes of the pits. In the north trench (Figure 15-53), buried drums of chemicals were found in the eastern portion of chemical pit 080-18.3G. Limited wastes were found in pesticides pit 080-17G. In the south trench, wastes were encountered in pesticides pit 080-17.1G, and limited wastes were found in the remaining three pits (Scott et al., 1987c).

15.13.06 Soil/Sediment Characterization Data

Following excavation of the waste materials and contaminated soil from the CMP Pits, 183 shallow soil samples (0 to 6 in. deep) were collected from the trench floors and analyzed for five volatile organics and six pesticides. The analytical results were used to locate preferential test borings for obtaining deep soil core samples (11 to 77 ft deep). Based on the results of the core samples, the total amount of contamination remaining in the soil beneath the pits was estimated to be approximately 13,300 lb (Scott et al., 1987c). In the north trench, volatile organic contamination remained in pit 18.3G; in the south trench, volatile organic contamination remained in pit 18.1G, and pesticide contamination remained in pit 17.1G. Approximately 12,250 lb of additional contaminated soil was removed, resulting in an estimated 99.5% removal of the wastes at the site. Trench samples taken after the second excavation indicate that the total volatile organic concentrations in the remaining soil are less than 100 mg/g, with the majority of the tested parameters being less than 1 mg/g. All of the pesticide-contaminated soil above 25 mg/g was removed from the site.

Following the second excavation, a leach field was installed, and the site was capped with compacted fill, a welded plastic sheet, and a minimum of 4 ft of soil cover. The site was subsequently seeded to prevent erosion. The estimated 1,000 lb of organics that remain at the site are believed to be dispersed at low concentrations in the soil beneath the cap (Scott et al., 1987c).

15.13.07 Groundwater Monitoring Results

The groundwater monitoring data from the CMP wells from 1982 through 1986 are included in Appendix M. Groundwater characterization data from 1984 through 1986 are summarized in Tables 15-19 through 15-21. Monitoring well locations relative to the CMP Pits are shown in Figure 15-54.

As discussed in Section 15.13.04, the water-table surface and flow direction is complex at this site, with considerable stratigraphic variations in the near-surface sediments. Well CMP 15B was installed to monitor the McBean Formation, but as discussed in Section 15.13.04, it is believed that this well actually monitors the water table at the site. For this reason, the monitoring results from this well are included with the water-table monitoring well results in Table 15-19.

The monitoring data summarized in Table 15-19 demonstrate that groundwater from the CMP Pits water-table monitoring wells has met drinking water standards except for isolated excursions of iron, manganese, lead, zinc, trichloroethylene, gross alpha, and total radium in the upgradient, sidegradient, and downgradient wells. Iron levels remained less than the drinking water standard of 0.3 mg/L in all water-table wells except for a single excursion of 1.74 mg/L in sidegradient well CMP 11 in February 1986. Manganese (0.054 mg/L) was over the drinking water standard of 0.05 mg/L in an isolated occurrence in July 1984 in upgradient well CMP 10. The lead drinking water standard (0.05 mg/L) was exceeded in single excursions in upgradient well CMP 15C (<0.005 to 0.290 mg/L), sidegradient well CMP 11 (<0.004 to 0.110 mg/L), and downgradient well CMP 12 (0.008 to 0.157 mg/L). These lead excursions occurred on different sampling dates. A zinc concentration of 5.94 mg/L was recorded for downgradient well CMP 13 in November 1984. This excursion above the drinking water standard (5 mg/L) was also a single, isolated case. Trichloroethylene above the drinking water standard of 0.005 mg/L was reported for well CMP 13 in October 1986 (0.009 mg/L).

Radiological parameters (gross alpha, nonvolatile beta, and total radium) were elevated in October 1985 in downgradient well CMP 13 and in November 1984 and October 1985 in sidegradient well CMP 11. Gross alpha activity ranged over the drinking water standard (15 pCi/L) in wells CMP 11 (up to 182 pCi/L) and CMP 13 (362 pCi/L). Total radium activity in these two wells (<1.0 to 41.0 pCi/L) ranged over the drinking water standard of 5 pCi/L. Nonvolatile beta activity ranged from <3.0 to 77.0 pCi/L in well CMP 11 and from 2.8 to 86.0 pCi/L in well CMP 13. Radioactive wastes are not known to have been disposed at this site.

Conductivity levels in wells CMP 11 (25 to 105 μmhos/cm), CMP 13 (90 to 115 μmhos/cm), and CMP 15B (105 to 520 μmhos/cm) were generally higher than conductivity levels in the other water-table monitoring wells (12 to 62 μmhos/cm). Groundwater pH in the water-table wells was consistently below 7.0, except for well CMP 15B, in which pH ranged from 8.9 to 11.3. Barnwell Formation groundwater is naturally acidic (Appendix B). The elevated pH in well CMP 15B may be attributable to leaching of the surrounding grout column or may reflect the large amount of calcium carbonate in the soils of the area.

The McBean Formation monitoring wells (CMP 8B through CMP 14B and CMP 16B) had higher pH ranges (6.1 to 7.7) and conductivity levels (88 to 200 µmhos/cm) than the water-table wells (Table 15-20). Concentrations of organics (carbon tetrachloride, chloroform, tetrachloroethylene, trichloroethylene, and 1,1,1-trichloroethane) were below detection limits in all of the McBean Formation monitoring wells except for a tetrachloroethylene concentration of 0.008 mg/L in well CMP 9B. The total organic halogens (TOH) range for the McBean Formation monitoring wells was <0.005 to 0.038. All constituents were below drinking water standards except for a single excursion of total radium (6.2 pCi/L) in well CMP 10B. The drinking water standard for total radium is 5 pCi/L.

The water chemistry in the Congaree Formation monitoring wells was similar to that of the McBean Formation monitoring wells, with groundwater pH ranging from 5.7 to 6.8 in wells CMP 8A and 12A and from 6.2 to 10.0 in well CMP 15A and conductivity ranging from 94 to 210 µmhos/cm in these wells (Table 15-21). The measured concentrations of all constituents were below drinking water standards except for manganese (0.122 to 0.128 mg/L) in well CMP 12A. The drinking water standard for manganese is 0.05 mg/L. The concentrations of organic constituents were below detection limits. All radioactive parameters were also less than detection limits in these wells except for a single reading of 9.1 pCi/L for nonvolatile beta in well CMP 15A.

15.13.08 Planned Action

The CMP Pits were closed under South Carolina Department of Health and Environmental Control (SCDHEC) observation and approval. Groundwater monitoring will continue at this site. As indicated in Section 16, no other action is planned for this site.

15.14 RADIOACTIVE WASTE BURIAL GROUNDS

15.14.01 Summary

The Radioactive Waste Burial Grounds store radioactive solid waste produced at SRS as well as periodic waste shipments from other U.S. Department of Energy (DOE) facilities and offsite sources. The Burial Grounds comprise three defined sites covering 195 acres between F and H areas. The original area (Building 643-G, Old Burial Ground) occupies approximately 76 acres and received waste from 1953 until 1974, when the site was filled. The current burial site

(Building 643-7G, New Burial Ground) was opened in 1972 and covers approximately 119 acres. The New Burial Ground is active and receiving radioactive waste. The Mixed Waste Management Facility (MWMF, Building 643-28G) was designated as a separate closure area within the new Burial Ground in 1986. The MWMF received materials that may be defined as hazardous by the Resource Conservation and Recovery Act (RCRA). A closure plan for the MWMF was filed on November 23, 1985, with the South Carolina Department of Health and Environmental Control (SCDHEC) (Jaegge et al., 1987).

Soil core tests performed in the Old Burial Ground in 1963 demonstrated little downward migration of most radionuclides through the soil (Fenimore, 1963). Soil cores taken from the New Burial Ground in 1983 and analyzed for tritium show that high concentrations of tritium were present below the water table and that measurable quantities of tritium were present at depths of approximately 150 ft (Emslie et al., 1984). A comprehensive soil coring program was conducted in 1985 to monitor for mercury in the Burial Grounds. Results demonstrate that localized areas of mercury contamination exist, with the highest concentrations found in the western section of the Old Burial Ground (Price and Cook, 1988).

The groundwater monitoring data indicate that the Radioactive Waste Burial Grounds have influenced groundwater quality, particularly in the Old Burial Ground. Groundwater monitoring results from the 64 Old Burial Ground wells, 23 New Burial Ground wells, and 35 perimeter wells were compared to South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards to assess local groundwater quality. The 1986 monitoring data show that the highest 1986 per well tritium activities were 4,300,000 pCi/mL in the Old Burial Ground, 142,000 pCi/mL in the New Burial Ground, and 29,000 pCi/mL in the perimeter wells, exceeding the drinking water standard of 20 pCi/mL. Tritium activity in the grid wells within the Radioactive Waste Burial Grounds has declined from a 1984 average of 18,000 pCi/mL to a 1986 average of 15,800 pCi/mL. Average 1986 nonvolatile beta activities ranged up to 3,837 pCi/L in the Old Burial Ground wells, up to 27 pCi/L in the New Burial Ground wells, and up to 9.00 pCi/L in the perimeter wells. Average gross alpha activities for 1986 were below the drinking water standard of 15 pCi/L except for two wells (MGG 15 and MGG 21) in the Old Burial Ground.

In the Old Burial Ground, 19 wells contained lead in concentrations exceeding the drinking water standard, and 52 wells experienced cadmium excursions. In the New Burial Ground, groundwater from one well exceeded the drinking water standard for lead, and groundwater from two wells exceeded the cadmium drinking water standard. From 1984 to 1986, only well MGA 5, located in the Old Burial Ground, contained mercury in excess of the drinking water standard. Mercury was detected at levels below the drinking water standard in 12 Burial Grounds wells in 1986.

15.14.02 Waste-Site Description and Nature of Disposal

The Radioactive Waste Burial Grounds comprise three defined sites (Buildings 643-G, 643-7G, and 643-28G) covering 195 acres between F Area and H Area to the west and east and Upper Three Runs Creek and Four Mile Creek to the north and south (Figure 15-61). Located in the central part of SRS, the nearest plant boundary is approximately 6.5 mi to the west. The topography is fairly flat, with ground surface elevations ranging from 280 to 310 ft msl. Surface drainage is through engineered ditches (Figure 15-62).

The original burial site, known as the Old Burial Ground (Building 643-G), is quadrilateral and covers 76 acres, with approximate dimensions of 3,700 ft long and 1,100 ft wide on the west side and 800 ft wide on the east side (Figure 15-63). Construction began in 1952; the Old Burial Ground began receiving waste in 1953 and was filled to capacity about 1974 (Fenimore, 1984).

Main storage operations shifted in 1972 to a contiguous site, the New Burial Ground (Building 643-7G). The New Burial Ground is polygonal, covering approximately 119 acres (Figure 15-63). A Mixed Waste Management Facility (MWMF, Building 643-28G) was designated within the New Burial Ground in 1986 (Figure 15-63).

A paved entrance road and interior unpaved roads provide access for trucks transporting solid waste. A spur of the F-Area railroad runs between the Old and New Burial Grounds, allowing shipment of large process equipment into the area.

Radioactive solid waste produced at SRS as well as periodic shipments of similar waste from other U.S. Department of Energy (DOE) facilities and other offsite sources are stored in the Radioactive Waste Burial Grounds in compliance with DOE orders regarding radioactive waste disposal. Materials in storage include contaminated equipment, reactor hardware and resins, spent lithium-aluminum targets, tritiated pump oil, mercury from gas pumps, incidental laboratory and production waste, and shipments from offsite. Offsite shipments include tritiated waste from Mound Laboratory, ^{238}Pu process waste from Los Alamos Scientific Laboratory and Mound Laboratory, debris from two U.S. military airplane accidents in foreign countries, and U.S. Navy submarine components (Jaegge et al., 1987). The estimated volume and curie content of nonretrievable solid radioactive waste buried from 1952 through May 1985 are shown in Table 15-22.

The Burial Grounds are divided into sections for disposal of various radioactive waste materials: transuranic (TRU) alpha waste, low-level waste (alpha and beta-gamma), intermediate-level beta-gamma waste, and waste generated offsite (Figure 15-63). Computerized records are kept of the contents, radiation level, and approximate storage location of each waste shipment. A 100-ft grid, subdivided into 20-ft squares, was established in 1962 to define the storage area for each waste shipment. Prior to this time, concrete markers delineated storage trenches.

Until 1965, TRU waste was buried in plastic bags and cardboard boxes in specifically designated earthen trenches. Between 1965 and 1974, TRU waste was segregated into two categories: waste containing less than 0.1 Ci per package was buried unencapsulated in alpha trenches; waste containing greater than 0.1 Ci per package was buried in retrievable concrete containers. Waste that did not fit into the prefabricated concrete containers was encapsulated in concrete (Jaegge et al., 1987).

In 1974, procedures were modified to reflect new criteria governing storage of retrievable solid TRU waste. TRU waste contaminated with greater than 10 nCi TRU/g is stored retrievably on surface concrete pads. Combustible wastes are stored separately. Polyethylene-lined, galvanized steel drums are the primary container; waste packages containing more than 0.5 Ci are additionally protected by enclosure in large concrete cylinders. Containers, including concrete cylinders, are stored on concrete pads equipped with a monitoring sump and covered with 4 ft of earth. In 1985, the soil cover was discontinued to facilitate recovery of TRU wastes. TRU waste contaminated with less than 10 nCi TRU/g is buried in the same trenches as other low-level radioactive wastes (Jaegge et al., 1987).

Bulky, intermediate-level onsite waste, low-level alpha and beta-gamma waste, and containerized offsite waste are stored in Shallow Land Burial (SLB) trenches. Since mid-1984, newly generated low-level radioactive waste has been placed in metal boxes or drums and stored in Engineered Low Level Trenches (ELLT). ELLTs are approximately 130 ft wider than the SLB trenches, allowing more efficient use of space. Waste forms placed in SLB trenches are covered with soil to maintain radiation control and to reduce the potential for contaminant migration (Jaegge et al., 1987).

Wastes contaminated with beta-gamma emitters are separated into two categories for burial: low-level beta-gamma and intermediate-level beta-gamma. Low-level beta-gamma waste is defined as waste radiating less than 300 mrem/hr at 30 in. from an unshielded container, and intermediate-level beta-gamma waste is defined as waste radiating greater than 300 mrem/hr at 30 in. from an unshielded container. Containerized low-level beta-gamma waste is buried in an ELLT; the noncontainerized fraction is placed in SLB trenches. The intermediate-level waste is buried in segregated SLB trenches. Demonstration projects entitled Greater Confinement Disposals (GCD) provide an improved method for disposing of intermediate-level waste. The waste is placed in cells and encapsulated in concrete grout, and the solidified waste forms are monitored for radionuclide leaching (Jaegge et al., 1987).

Most offsite waste is buried in separate SLB trenches. U.S. Navy submarine components are placed in specially designed disposal units.

Degraded solvents from the Separations Areas are also disposed of in the Burial Grounds. When the Old Burial Ground began operations, solvents were burned in shallow pans in open pits (Ryan, 1983). From 1955 to 1982, solvents were stored in 20 underground tanks in the Old Burial Ground. The tanks had a combined capacity of 150,000 gal. In 1971, approximately 200 gal of contaminated tributylphosphate (TBP) kerosene were accidentally pumped down a dry monitoring well standpipe when it was mistaken for a solvent storage tank header (Ryan, 1983). The spill took place near the current location of well MGC 17 (Figure 15-64). Subsequently, 250,000 gal of water were pumped from this well and sent to the H-Area Seepage Basins. In addition, about 400 gal of solvent are believed to have spilled or leaked in the Old Burial Ground from 1955 to 1982 (Hoeffner and Oblath, 1984).

Solvents stored in the Old Burial Ground were transferred to the New Burial Ground when it became operational. In the New Burial Ground, solvents and tritiated pump oil from reactor and tritium facilities are stored in ten 25,000-gal steel tanks, which were installed in 1975. Each tank is monitored weekly for leaks by measuring liquid levels. The approximate annual solvent and oil generation rates are 3,000 and 6,000 gal, respectively. A program is currently under way to incinerate the degraded solvents; about 173,000 gal have been burned, and 26,500 gal remain in inventory (Jaegge et al., 1987).

Other sources of organics in the Burial Grounds include scintillation solutions and decontamination operations. Approximately 11,000 gal of scintillation fluid are believed to be buried in the Old Burial Ground (Hoeffner and Oblath, 1984). An unknown amount of ethylenediamine tetraacetic acid (EDTA) and phosphates used to clean equipment seeped into the ground from an equipment decontamination station that operated in the northwest corner of the Old Burial Ground (Figure 15-65) during the first years of site operations (Ryan, 1983).

Wastes contaminated with hazardous substances have been stored within the Radioactive Waste Burial Grounds. Retired or failed equipment containing mercury and PCB-contaminated material are contained in welded stainless-steel containers or metal drums and are stored within large concrete cylinders. The Old Burial Ground contains an estimated 10 tons of mercury stored in 1-L bottles in polyethylene bags inside steel cans. The New Burial Ground contains only incidental amounts of mercury from sources such as thermometers and mercury salts (Oblath, 1984). Inorganic constituents such as lead (used for shielding) and cadmium (from control and safety rods) are also stored in the Burial Grounds. Oblath (1985) calculated the source term for lead in the Burial Grounds to be 42 tons and for cadmium to be 1 ton.

The Mixed Waste Management Facility (MWMF, Building 643-28G) was designated as a closure area within the New Burial Ground (Figure 15-63) because some of the wastes placed in this area prior to March 1986 contain materials that may be classified as hazardous under the Resource Conservation and Recovery Act (RCRA). The candidate mixed wastes include scintillation fluids, waste lubricating oil held on absorbent material and sealed in 55-gal drums, lead, cadmium, and silver. A closure plan was filed on November 23, 1985, with the South Carolina Department of Health and Environmental Control (SCDHEC) for the affected area. In the MWMF closure plan, mixed wastes are those wastes defined as hazardous by RCRA and also radioactive (Jaegge et al., 1987).

15.14.03 Groundwater Monitoring Program

Six well series, comprising 142 monitoring wells, have been installed to monitor the groundwater at the Radioactive Waste Burial Grounds. Of these 142 wells, 73 are BG series wells, 12 are MGA series wells, 16 are MGC series wells, 15 are MGE series wells, 18 are MGG series wells, and 8 are MGI series wells. The first 25 water-table monitoring wells (BG 1 through BG 25) were constructed between 1956 and 1962 using steel or aluminum casings. Wells BG 26 through BG 67 were installed in the second and third quarters of 1976 at the perimeter of the Burial Grounds using steel casings and 20-ft screens. Twenty-six steel-cased BG wells (BG 204GR through BG 824GR) were installed on 200-ft centers in the New Burial Ground in 1980 in filled burial areas. Additional BG series wells, located northeast of the Burial Grounds, serve as control wells for the site. Of the 73 BG series wells that monitor the Burial Grounds, 35 perimeter wells and 23 wells in the New Burial Ground are currently active (Figure 15-66).

In 1972 and 1973, as burial operations shifted to the New Burial Ground, 44 wells on 200-ft centers were installed in the central and eastern parts of the Old Burial Ground. In 1976 and 1977, 23 wells were added in the western section, completing the grid. These grid wells comprise the MGA, MGC, MGE, MGG, and MGI series. As shown in Figure 15-66, the letter designation (A-C-E-G-I) indicates the location north to south (A is farthest north, I is farthest south), and the number designates the well location west to east (1 is farthest west, 36 is farthest east).

The original 44 wells were constructed using PVC casings and 20-ft stainless steel screens except for well MGI 15, which was installed with a steel casing and 5-ft brass screen (Figure 15-67). In 1974 wells MGG 13 and MGG 28 were redrilled approximately 10 ft from their original sites because of contamination from waste and perched water, respectively. The original wells were grouted. The replacement wells were constructed with galvanized steel casings and 20-ft PVC screens (Fenimore, 1975). The 23 wells added in 1976 and 1977 were also constructed with galvanized steel casings and 20-ft PVC screens. Of the 69 grid wells, 64 are currently active.

Three well clusters of five wells each (BGC 1A-E through BGC 3A-E) were installed adjacent to the south fence of the Old Burial Ground in 1976 (Figure 15-68). These wells are screened at approximate 20-ft depth intervals and monitor the extent of tritium migration from the Burial Grounds. Figure 15-69 shows the screen placements of these wells in relation to major hydrostratigraphic units. South to southwest of the Burial Grounds, wells were installed on 400-ft centers in the early 1970s to monitor the flow path from the Burial Grounds to Four Mile Creek (Figure 15-68). In 1975, 14 wells (PDO and PDQ series) were also installed in this area as tritium plume definition wells (Fenimore, 1979). A Resource Conservation and Recovery Act (RCRA) compatible groundwater monitoring system has been approved by SCDHEC for installation around the New Burial Ground, and the wells are scheduled for installation in 1987 (Figure 15-70).

The Burial Grounds water-table monitoring wells have been sampled quarterly since 1958 for tritium, gross alpha, and gross beta as part of the SRS radioactive monitoring program. The Burial Grounds grid wells also have been sampled annually (except in 1980 and 1985) for mercury beginning in 1977.

15.14.04 Site-Specific Hydrology

Water-table elevation measurements at the Burial Grounds have been recorded since 1957. Historic water-level measurements indicate that the water-table elevation at the Burial Grounds is approximately 250 to 226 ft msl and that the vadose zone is approximately 40 ft thick. A water-table elevation contour map for May 1985 for the Burial Grounds is presented in Figure 15-71. As shown, a groundwater divide exists beneath the facility. Horizontal groundwater flow from the northern part of the New Burial Ground is to the north toward Upper Three Runs Creek at a gradient of approximately 0.02 ft/ft, and horizontal groundwater flow from the Old Burial Ground and the southern part of the New Burial Ground is to the south toward Four Mile Creek at a gradient of approximately 0.01 ft/ft.

Tritium tracer tests begun in 1957 and measured at intervals through 1970 defined the southern flow path to Four Mile Creek (Fenimore, 1979). In early 1976 inspection of the F-Area effluent stream determined that it coincided with the flow path from the Burial Grounds. Cooling water and storm runoff had eroded the stream bed, causing the lower reaches of the bed to incise the water table and shortening the flow path to Four Mile Creek by approximately 800 ft. To lengthen the flow path, work began in late 1979 on a new, engineered channel for the F-area effluent, and the original stream bed was replaced with low-permeability sandy clay (Fenimore, 1980). The repair was completed in November 1980.

Hydrographs of wells BG 1 through BG 67 are presented in Figures 15-72 through 15-79. Water levels vary up to 20 ft within individual wells, but the relative water levels among the wells remain fairly constant, indicating that no major shift in the horizontal flow direction has occurred. Based on the water-table elevation map (Figure 15-71) and the hydrographs, wells in the south and north sections of the Burial Grounds have been predominantly downgradient of the waste site. Wells within Burial Ground 643-7G appear to be near the groundwater divide, which runs west and east through the site. Perched water zones are also found in the Old Burial Ground, particularly on the west side. As shown on the hydrograph (Figure 15-72), well BG 4 was apparently screened in a perched water zone.

15.14.05 Waste-Site Content Characterization Data

Section 15.14.02 contains information regarding the nature of the waste placed in this site.

15.14.06 Soil/Sediment Characterization Data

A soil study of the Old Burial Ground was performed in 1963. Sixteen cores were taken in trenches through buried waste and into the soil below. Cores penetrating waste buried between 1953 and 1956 exhibited no radioactivity above natural background levels. A small amount of activity was detected in cores that penetrated waste buried in 1957, but no downward migration of contamination was evident. Two of four cores penetrating waste buried in 1958 exhibited downward migration of radioactivity. Core 14, one of two cores taken through waste buried in 1959, also penetrated perched water. This core showed the greatest downward migration of contamination, with elevated radioactivity measured up to 6.9 ft below the bottom of the waste. Two cores taken through waste buried in 1960 and 1961 exhibited no downward migration of radioactivity (Fenimore, 1963). Analysis of core 14 demonstrated that most of the radioactivity present in this sample was due to ^{60}Co, with traces of ^{137}Cs and $^{89,90}Sr$. Other radionuclides found in the cores were $^{141,144}Ce$, $^{103,106}Ru$, and ^{95}Zr,Nb (Fenimore, 1963).

In 1985, 952 soil samples, 2 in. in diameter and 1 ft deep, were collected from in and around the Old Burial Ground and analyzed for mercury (Price and Cook, 1988). The sampling traverses and known areas of mercury burial are shown in Figure 15-80. A total of 125 cores taken along the southern fence line exhibited background values except for two areas: one on the western side of the Old Burial Ground and one on the eastern side. Mercury concentrations in the cores from these areas ranged up to 37 $\mu g/g$.

In the western end of the Old Burial Ground, cores were taken along four traverses 100 ft apart in the southern half and on a 25-ft grid in the northern half. Mercury concentrations in cores from the southern traverses were consistent with background values, but cores from the northern grid revealed two zones of higher-than-background concentrations, with values ranging up to 673 $\mu g/g$.

The eastern side of the Old Burial Ground was cored along seven traverses 100 ft apart. Elevated mercury concentrations (up to 28 $\mu g/g$) were found in the northwest corner of this area and along the southernmost traverse.

In May and June 1983, nine cores, ranging from 40 to 130 ft deep, were taken near the buried tritiated waste from Mound Laboratory in the New Burial Ground (Figure 15-81). The cores were taken in a line, trending from northwest to southwest of the burial trench, to monitor for tritium migration (Figure 15-82). The analytical results of the coring are presented in Table 15-25. Tritium migration is apparent in core SB 24, taken closest to the burial trench. Cores SB 21 and SB 22, taken southwest of the Mound Laboratory burial, exhibited the highest tritium activity (up to 113,509 pCi/mL). The tritium in these cores is believed to be attributable to tritiated waste buried in the Burial Grounds other than the Mound Laboratory waste because of the depths at which the elevated tritium activity was found (Emslie et al., 1984).

15.14.07 Groundwater Monitoring Results

Annual summaries of the groundwater data from the radioactive monitoring program from 1958 through 1986 for the Radioactive Waste Burial Grounds monitoring wells are given in Table 15-26. These tables include yearly averages and maximum values for tritium, gross alpha, and nonvolatile beta for the 1984 through 1986 monitoring period.

Comparisons of groundwater monitoring data among the Burial Grounds wells were used to evaluate the effect of the site on the groundwater. South Carolina (R. 61-58) and federal (40 CFR 141-143) drinking water standards were used to assess local groundwater quality. Based on the nature of the materials disposed at the site (Section 15.14.02), the indicator parameters most likely to show the effect from the Burial Grounds are radioactivity, mercury, lead, and cadmium. Monitoring well locations relative to the Burial Grounds are presented in Figure 15-71, along with the water-table elevation map for May 1985. As shown in Figure 15-71 and discussed in Section 15.14.04, the water-level data indicate that a groundwater divide exists beneath the facility, with groundwater flow to the north toward Upper Three Runs Creek and to the south toward Four Mile Creek.

The monitoring data given in Table 15-26 indicate that the Old Burial Ground has influenced local groundwater quality. The groundwater data for tritium demonstrate that average 1986 tritium activities in 13 of the 64 active wells located within the Old Burial Ground exceeded

100,000 pCi/mL. An additional 17 of the 64 wells contained average 1986 tritium activity in excess of 10,000 pCi/mL. The drinking water standard for tritium is 20 pCi/mL.

Average 1986 tritium activities were used to formulate the isoconcentration map shown in Figure 15-83. Tritium activity (1986 averages) in excess of 100,000 pCi/mL was identified in the following grid wells: MGC 3 (407,000 pCi/mL), MGC 5 (678,000 pCi/mL), MGC 7 (410,000 pCi/mL), MGE 3 (263,670 pCi/mL), and MGE 5 (130,870 pCi/mL) located in the northwest corner of the site; well MGI 1 (159,400 pCi/mL) located in the southwest corner of the site; and wells MGE 32 (128,000 pCi/mL), MGE 36 (415,000 pCi/mL), MGG 32 (650,000 pCi/mL), MGG 34 (701,000 pCi/mL), and MGG 36 (130,000 pCi/mL) located in the southeast corner of the site. Average 1986 tritium activity in excess of 100,000 pCi/mL was also observed in wells MGG 13 (4,300,000 pCi/mL) and MGG 21 (201,000 pCi/mL) located in the central part of the site. As indicated in Figure 15-83, grid monitoring wells containing tritium activity between 10,000 and 100,000 pCi/mL are concentrated in the west and east parts of the Old Burial Ground.

Eight of the 64 active wells located within the Old Burial Ground contained average 1986 nonvolatile beta activity above 100 pCi/L. The monitoring data (1986 annual averages) were used to formulate the nonvolatile beta isoconcentration map shown in Figure 15-84. As shown in Figure 15-84, elevated 1986 average levels of nonvolatile beta were observed in several isolated wells throughout the grid formation. Well MGG 21 had an average 1986 nonvolatile beta activity over 1,000 pCi/L (3,837 pCi/L). Additionally, 7 of the 64 monitoring wells contained average 1986 nonvolatile beta activities in excess of 100 pCi/L. These wells were MGC 7 (123 pCi/L), MGC 34 (125 pCi/L), MGE 19 (103 pCi/L), MGG 30 (212 pCi/L), MGG 32 (165 pCi/L), MGI 1 (103 pCi/L), and MGI 17 (153 pCi/L). Thirty-two of the 64 monitoring wells contained average 1986 nonvolatile beta activities in excess of 10 pCi/L.

Only 2 of the 64 wells had average 1986 gross alpha activities above the drinking water standard of 15 pCi/L. As shown in Table 15-26, the 1986 average gross alpha activities in wells MGC 15 and MGG 21 were 20 pCi/L and 636 pCi/L, respectively.

Monitoring well MGG 21 has contained elevated gross alpha and nonvolatile beta activities since 1980 (Table 15-26). The data indicate that the higher activities of gross alpha and nonvolatile beta in well MGG 21 are localized to a small area because surrounding wells are unaffected. A study performed to identify the source of the higher radioactivity levels in well MGG 21 found that the alpha emitters are primarily ^{238}Pu and ^{239}Pu, and the beta emitters are mostly ^{90}Sr (Ryan, 1983).

The monitoring data from the BG series grid wells within the New Burial Ground, summarized in Table 15-26, indicate that tritium has influenced local groundwater quality. In 1986, three wells in the BG series within the New Burial Ground contained tritium activity over 10,000 pCi/mL (Figure 15-83 and Table 15-26): BG 208GR (94,100 pCi/mL), BG 408GR (142,000 pCi/mL), and BG 822GR (68,400 pCi/mL). An additional eight wells (BG 204GR, BG 206GR, BG 210GR, BG 222GR, BG 402GR, BG 404GR, BG 406GR, and BG 620GR) contained tritium activity in excess of 1,000 pCi/mL. As indicated in Figure 15-71, these wells are concentrated in the north and southwest parts of the New Burial Ground.

The annual average tritium activity of all grid wells in the New and Old Burial Grounds increased steadily from 1981 (600 pCi/mL) to 1984 (18,000 pCi/mL), after which levels dropped slightly to a 1986 average of 15,800 pCi/mL.

Gross alpha and nonvolatile beta activities in these wells have remained relatively low from 1984 to 1986 (Table 15-26). Figure 15-84 indicates that nonvolatile beta activity throughout the New Burial Ground has remained low in comparison to activity in the Old Burial Ground. Five wells (BG 204GR, BG 210GR, BG 220GR, BG 404GR, and BG 420GR) contained groundwater with 1986 average nonvolatile beta activities greater than or equal to 20 pCi/L (Table 15-26). The maximum 1986 nonvolatile beta activity was recorded in well BG 220GR (53.0 pCi/L).

Average gross alpha activities for the New Burial Ground wells are summarized in Table 15-26. As shown, gross alpha activity in the monitoring wells throughout the New Burial Ground remained less than the drinking water standard of 15 pCi/L from 1984 to 1986.

The analytical results for the 35 active BG series perimeter wells (BG 26 through BG 67), summarized in Table 15-26, indicate that tritium has influenced groundwater quality in some of the perimeter areas. As shown in Figure 15-83, elevated tritium activities (1986 averages) were found in well BG 56 (29,000 pCi/mL), located at the southwest corner of the Old Burial Ground, and in well BG 34 (28,000 pCi/mL), located at the north side of the New Burial Ground. These wells are directly downgradient of areas within the burial ground where water-table wells contained groundwater with tritium activity in excess of 100,000 pCi/mL (Figure 15-71). Wells BG 55 (6,400 pCi/mL) and BG 57 (1,200 pCi/mL) each contained average 1986 tritium activity in excess of 1,000 pCi/mL. Both of these wells are located sidegradient to downgradient of the west end of the Old Burial Ground.

The perimeter wells contained relatively low levels of nonvolatile beta and gross alpha throughout the 1984 to 1986 monitoring period, as shown in Table 15-26. Average annual nonvolatile beta activities remained below 10.0 pCi/L. Gross alpha activities remained below the drinking water standard of 15 pCi/L throughout the 1984 to 1986 monitoring period.

Tritium activities for BG wells 68 through 90, located northeast of the Burial Grounds, are also presented in Table 15-26. Four of these wells have 1986 average tritium activities over 10,000 pCi/mL: BG 69 (30,000 pCi/mL), BG 80 (15,000 pCi/mL), BG 81 (22,000 pCi/mL), and BG 82 (56,000 pCi/mL). As shown in Figures 15-66 and 15-71, these wells are adjacent to and downgradient of the New Burial Ground. Seven additional wells in this area contained 1986 average tritium activities greater than 1,000 pCi/mL, with averages ranging up to 8,500 pCi/mL. Wells BG 88 through BG 90, which are the farthest from the Burial Grounds, had average 1986 tritium activities ranging from 75 to 140 pCi/mL.

The 79 grid wells within the Burial Grounds have been sampled annually for mercury (except in 1980 and 1985). Sampling of the grid wells in the Old Burial Ground began in 1977; sampling of the New Burial Ground wells began in 1981. The analytical results are given in Table 15-24, which also contains results from two control wells northeast of the site (BG 109 and BG 110) and from two plume definition wells (PDO 5 and PDQ 5) south of the site.

From 1984 to 1986 only one well (MGA 5), located in the northwest section of the Old Burial Ground, exceeded the federal primary drinking water standard for mercury of 0.002 mg/L (2 μg/L). The high level of mercury determined for this well in 1986 (26.5 μg/L) is partially due to drought conditions existing at the time, resulting in a large amount of sediment brought up in the bailer with the sample (McIntyre and Wilhite, 1987).

In 1986, 12 wells contained mercury concentrations above the detection limit but below the drinking water standard ($\geq$0.1 μg/L to 2.0 μg/L). Eleven of these wells are located in the Old Burial Ground; in the New Burial Ground only well BG 222GR contained a detectable quantity of mercury. Figure 15-85 shows the distribution of mercury concentrations in the grid wells in 1986.

The analytical results in Table 15-24 demonstrate that no mercury was detected in either the control wells or plume definition wells for the site in 1986.

The 79 grid wells in the Burial Grounds were analyzed for lead and cadmium in November 1984 (Oblath, 1985). The analytical results are presented in Table 15-23. Analytical results are also presented for well BG 109, a control well northeast of the Burial Grounds. Lead concen-trations ranged from 4 to 398 μg/L. Twenty of the 79 wells exceeded the federal primary drinking water standard of 0.05 mg/L (50 μg/L). Four-teen of the 20 wells that exceeded the drinking water standard are located in the west section of the Old Burial Ground. Only one well (BG 410GR) in the New Burial Ground had a lead concentration exceeding the drinking water standard. The remaining five wells are scattered in the central and east parts of the Old Burial Ground.

Fifty-four of the 79 wells in the Burial Grounds had cadmium concentrations exceeding the federal primary drinking water standard of 0.01 mg/L (10 μg/L). Fifty-two of these wells are in the Old Burial Ground, with the highest cadmium concentrations (up to 365 μg/L) generally found in wells in the western half. Cadmium concentrations in New Burial Ground wells BG 216GR (14 μg/L) and BG 220GR (16 μg/L) exceeded the drinking water standard. These wells are centrally located within the New Burial Ground.

15.14.08 Planned Action

SCDHEC has approved a RCRA-compatible groundwater monitoring system to be installed in 1987. The Mixed Waste Management Facility (Building 643-28G) will be closed in accordance with SCDHEC regulations. The Old Burial Ground (Building 643-G) is inactive; continued use of the New Burial Ground (Building 643-7G) is planned.

TABLE 15-1

Summary of Groundwater Quality: Well Concentration Ranges for the Road A Chemical Basin (Baxley Road) (7/84-12/86)

Constituent	SC and Federal DWS	BRD 1	BRD 2	BRD 3	BRD 4
pH (pH)	6.5-8.5	4.2-5.2	4.7-6.4	4.3-5.5	3.9-5.0
Conductivity (µmhos/cm)	NA	25-41	25-58	25-46	7-33
Silver (mg/L)	0.05	<0.0004	<0.0005	<0.0005	<0.0004
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	0.019-0.026	0.006-0.015	0.023-0.025	0.004-0.006
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	---
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002-0.002	<0.002
Chloride (mg/L)	250	2.1-3.6	1.7-4.8	1.7-3.2	1.7-2.3
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	0.010	<0.004	0.004-0.007	---
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	---
DOC (mg/L)	NA	<5.0	<5.0	<5.0	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.07	<0.10-0.19	<0.10	0.03-0.07
Iron (mg/L)	0.3	0.031-0.055	0.011-0.272	0.020-0.048	0.010-0.095
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002-0.0002	<0.0002
Manganese (mg/L)	0.05	0.046-0.098	0.008-0.038	0.031-0.135	0.002-0.007
Sodium (mg/L)	NA	1.66-3.13	1.77-1.96	1.70-2.06	1.35-2.04
Nickel (mg/L)	NA	<0.004	<0.004	<0.004-0.006	---
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	---
Nitrate (as N) (mg/L)	10	1.70-1.75	1.08-1.15	1.70-1.75	1.23-1.32
Lead (mg/L)	0.05	0.012-0.120	<0.004-0.114	<0.004-0.026	<0.005-0.018
Phenols (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.002
Sulfate (mg/L)	250	<5.0	<5.0-17.0	<5.0	<5.0
TDS (mg/L)	500	40	36-48	16-38	---
TOC (mg/L)	NA	0.240-2.070	0.480-2.240	0.300-1.480	0.240-2.020
TOH (mg/L)	NA	<0.005-0.010	<0.005-0.005	<0.005-0.009	<0.005-0.009
Zinc (mg/L)	5	0.045	0.010-0.011	---	---
Gross alpha (pCi/L)	15	1.1-8.0	<2.0-5.0	<2.0-3.0	<2.0-3.0
Nonvol. beta (pCi/L)	NA	1.8-5.0	<2.0-9.0	1.7	1.3-4.0
Total radium (pCi/L)	5	<1.0-3.0	<1.0-4.0	<1.0	<1.0-2.0

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards.
NA = not applicable.

Table 15-2

Chemical Concentrations of Augusta Sewage Sludge

Constituent	Concentration µg/g wet	µg/g dry	lb/acre*
pH (pH)	7.32	NA	NA
Kjeldahl nitrogen	1,800	72,400	359
Ammonia (as N)	753	30,400	151
Nitrate (as N)	3.7	149	0.731
Phosphorus	402	16,200	80.3
Potassium	66	2,660	13.4
Calcium	361	14,600	72.3
Magnesium	61	2,460	12.5
Sodium	519	20,900	103
Manganese	3.4	137	0.678
Zinc	33	1,330	6.59
Copper	7.9	318	1.58
Lead	5.9	238	1.18
Nickel	1.1	44	0.214
Cadmium	1.1	44	0.214
Sulfur	148	5,970	29.4
Iron	2,530	10,800	504
Boron	6.3	254	1.26
Chromium	4.3	173	0.856
Antimony	0.2	8	0.036
Selenium	2.0	81	0.401
Arsenic	2.6	105	0.517
Tin	2.5	101	0.499
Cobalt	0.2	8	0.036
Mercury	0.1	4	0.018

Note: NA = not applicable. Data are from Wells et al. (1986).

* The concentrations given under lb/acre are for the 25,000 gal/acre sludge application rate. These values should be doubled for the 50,000 gal/acre application rate.

TABLE 15-3

Summary of Groundwater Quality: Well Concentration Ranges for the 40-Acre Hardwood Site (7/84-12/86)

Constituent	SC and Federal DWS	SSS 1	SSS 2	SSS 3
pH (pH)	6.5-8.5	4.1-5.4	3.7-5.0	4.4-5.5
Conductivity (µmhos/cm)	NA	15-24	25-30	15-28
Nitrate/nitrite (mg/L)	NA	0.49-1.24	0.78-0.96	0.14-0.83
Total Kjeldahl nitrogen (mg/L)	NA	<0.1-28	<0.1	<0.1-3.85
Orthophosphates (mg/L)	NA	0.005-0.048	<0.002-0.011	<0.002-0.140
Total dissolved solids (mg/L)	500	21-36	11-32	26-71
Sodium (mg/L)	NA	1.48-2.26	1.31-3.12	1.09-2.87
Chloride (mg/L)	250	1.75-2.75	3.62-4.00	1.50-2.00
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.001	<0.002-0.003	<0.002-0.0021
Calcium (mg/L)	NA	0.812-1.36	0.054-0.60	0.86-1.84
Magnesium (mg/L)	NA	0.254-0.32	0.576-0.577	0.20-0.511
Manganese (mg/L)	0.05	<0.006	<0.006	<0.006-0.034
Potassium (mg/L)	NA	0.164-0.53	0.170-0.959	0.146-0.787
Mercury (mg/L)	0.002	<0.00004-0.0012	<0.00004-0.0002	<0.00004-0.00005

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-4

Summary of Groundwater Quality: Well Concentration Ranges for the K-Area Borrow Pit (7/84-12/86)

Constituent	SC and Federal DWS	SSS 13	SSS 14	SSS 15
pH (pH)	6.5-8.5	4.0-5.4	4.1-5.4	3.9-5.2
Conductivity (µmhos/cm)	NA	25-31	13-21	11-18
Nitrate/nitrite (mg/L)	NA	0.60-0.78	0.50-0.57	0.10-0.20
Total Kjeldahl nitrogen (mg/L)	NA	<0.1-0.18	<0.1	<0.1
Orthophosphates (mg/L)	NA	<0.002-0.040	<0.002-0.058	<0.002-0.019
Total dissolved solids (mg/L)	500	19-34	16-27	4-26
Sodium (mg/L)	NA	2.17-3.62	1.11-2.58	1.23-2.45
Chloride (mg/L)	250	3.85-5.00	1.75-2.75	2.19-3.00
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.001	<0.001	0.0018
Calcium (mg/L)	NA	0.560-0.83	0.416-0.60	<0.02-0.20
Magnesium (mg/L)	NA	0.435-0.50	0.341-0.36	0.186-0.22
Manganese (mg/L)	0.05	<0.006	<0.006	<0.006
Potassium (mg/L)	NA	<0.02-1.78	0.092-0.44	0.084-0.615
Mercury (mg/L)	0.002	<0.00004-0.0009	<0.00004-0.0008	<0.00004-0.0011

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

Table 15-5

Chemical Concentrations of Horse Creek Sewage Sludge

Constituent	Concentration µg/g wet	µg/g dry	lb/acre
Kjeldahl nitrogen	7,070	12,700	564
Ammonium (as N)	134	240	10.7
Nitrate (as N)	0	0	0
Phosphorus	4,210	7,550	336
Potassium	170	305	13.4
Calcium	11,600	20,900	930
Magnesium	1,940	3,490	155
Sodium	1,640	2,940	131
Manganese	167	300	13.4
Zinc	1,200	2,160	96.3
Copper	696	1,250	55.3
Lead	98.0	176	7.84
Nickel	23.9	43	1.92
Cadmium	3.3	6	0.259
Sulfur	2,030	3,640	161
Iron	23,700	42,400	1890
Boron	150	268	11.6
Chromium	772	1,390	61.5
Antimony	0.9	2	0.08
Selenium	42.3	76	3.38
Arsenic	19.5	35	1.55
Tin	22.3	40	1.78
Cobalt	4.6	8	0.348
Mercury	17.2	31	1.38

Note: Data are from Wells et al. (1986).

Table 15-6

Soil/Sediment Chemical Analyses at the Sandy (Lucy) Site

Analyte	Unit	No Sludge	Augusta Sludge (360 lb N/acre)	Augusta Sludge (720 lb N/acre)	Horse Creek Sludge (560 lb N/acre)
pH		5.3	5.0	4.8	5.5
Total nitrogen	mg/L	345	335	390	330
Available phosphate	mg/L	35	21	55	32
Exchangeable calcium	meq/100g	0.88	0.43	0.33	0.67
Exchangeable magnesium	meq/100g	0.14	0.07	0.05	0.15
Exchangeable potassium	meq/100g	0.04	0.02	0.02	0.02
Exchangeable sodium	meq/100g	0.01	0.01	0.01	0.02
Potassium	mg/L	35	29	52	22
Carbon	mg/L	128	83	5,620	138
Magnesium	mg/L	74	71	269	60
Sodium	mg/L	0	0	97	1
Lead	mg/L	1	4	0	1
Copper	mg/L	1	1	1	1
Zinc	mg/L	2	3	3	2
Iron	mg/L	1,440	1,660	1,730	1,400
Nickel	mg/L	3	5	9	2
Cadmium	mg/L	1	1	1	1
Chromium	mg/L	1	2	6	1
Manganese	mg/L	124	72	95	75
Organic matter	%	1.78	1.48	1.44	1.48
Clay	%	8	9	8	8

Note: Soil/sediment samples were taken to a depth of 4 in.

TABLE 15-7

Summary of Groundwater Quality: Well Concentration Ranges for the Sandy (Lucy) Site (7/84-12/86)

Constituent	SC and Federal DWS	SSS 10	SSS 11	SSS 12
pH (pH)	6.5-8.5	4.2-4.8	4.1-4.9	4.1-4.9
Conductivity (µmhos/cm)	NA	50-115	25-34	13-30
Nitrate/nitrite (mg/L)	NA	2.32-3.55	0.81-1.41	0.61-1.19
Total Kjeldahl nitrogen (mg/L)	NA	<0.1	<0.1-0.21	<0.1-0.17
Orthophosphates (mg/L)	NA	0.003-0.094	0.002-0.060	0.002-0.153
Total dissolved solids (mg/L)	500	42-83	21-47	10-30
Sodium (mg/L)	NA	4.08-10.8	2.99-3.94	1.83-4.01
Chloride (mg/L)	250	5.06-27.5	3.50-4.38	2.75-4.25
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	0.018	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.001-0.0064	<0.001	<0.001
Calcium (mg/L)	NA	1.38-1.85	0.60-1.17	0.308-0.54
Magnesium (mg/L)	NA	0.86-1.13	0.208-0.51	0.285-0.41
Manganese (mg/L)	0.05	<0.01-0.025	<0.01-0.013	<0.01-0.018
Potassium (mg/L)	NA	0.054-0.526	0.43-0.589	0.236-0.28
Mercury (mg/L)	0.002	<0.00004-0.0020	<0.0001-0.0009	<0.0001-0.0044

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

Table 15-8

Soil/Sediment Chemical Analyses at the Orangeburg (Sandy Clay) Site

Analyte	Unit	No Sludge	Augusta Sludge (360 lb N/acre)	Augusta Sludge (720 lb N/acre)	Horse Creek Sludge (560 lb N/acre)
pH		5.3	4.5	4.9	5.3
Total nitrogen	mg/L	245	255	195	285
Available phosphate	mg/L	10.0	24	19	13
Exchangeable calcium	meq/100g	0.63	0.49	0.40	0.70
Exchangeable magnesium	meq/100g	0.16	0.12	0.07	0.25
Exchangeable potassium	meq/100g	0.03	0.03	0.02	0.03
Exchangeable sodium	meq/100g	0.05	0.04	0.03	0.02
Potassium	mg/L	53	32	49	58
Carbon	mg/L	88	75	63	95
Magnesium	mg/L	138	91	109	134
Sodium	mg/L	1.5	1	1	2
Lead	mg/L	9.0	3	5	12
Copper	mg/L	5	2	2	4
Zinc	mg/L	6	4	4	6
Iron	mg/L	2,020	1,580	1,710	2,000
Nickel	mg/L	5	1	1	4
Cadmium	mg/L	0	1	1	0
Chromium	mg/L	1	1	0	1
Manganese	mg/L	87	120	125	215
Organic matter	%	0.81	0.91	0.77	1.16
Clay	%	11	8	9	10

Note: Soil/sediment samples were taken to a depth of 4 in.

TABLE 15-9

Summary of Groundwater Quality: Well Concentration Ranges for the Orangeburg (Sandy Clay) Site (7/84-12/86)

Constituent	SC and Federal DWS	SSS 7	SSS 8	SSS 9
pH (pH)	6.5-8.5	3.8-5.1	3.8-5.3	3.9-4.9
Conductivity (μmhos/cm)	NA	5-45	15-45	12-18
Nitrate/nitrite (mg/L)	NA	1.52-3.00	0.62-1.15	0.32-0.967
Total Kjeldahl nitrogen (mg/L)	NA	<0.1	<0.1	<0.1-0.80
Orthophosphates (mg/L)	NA	0.017-0.088	0.002-0.173	0.007-0.092
Total dissolved solids (mg/L)	500	31-58	11-36	14-28
Sodium (mg/L)	NA	2.14-3.29	1.03-2.00	0.67-1.50
Chloride (mg/L)	250	3.12-5.51	1.25-1.88	1.0-1.75
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.001	<0.001	<0.001
Calcium (mg/L)	NA	1.74-2.15	0.254-0.36	0.336-0.54
Magnesium (mg/L)	NA	0.715-0.988	0.421-0.490	0.426-0.490
Manganese (mg/L)	0.05	<0.006	<0.006	<0.006
Potassium (mg/L)	NA	0.48-0.712	0.065-0.576	0.104-0.625
Mercury (mg/L)	0.002	<0.00004-0.0012	<0.00004-0.0006	<0.00004-0.0010

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-10

Summary of Groundwater Quality: Well Concentration Ranges for the Kato Road Site (7/84-12/86)

Constituent	SC and Federal DWS	SSS 19	SSS 20	SSS 21
pH (pH)	6.5-8.5	4.3-5.9	4.0-5.2	4.4-6.5
Conductivity (µmhos/cm)	NA	18-32	25-31	25-38
Nitrate/nitrite (mg/L)	NA	0.44-1.25	0.60-2.12	0.15-0.39
Total Kjeldahl nitrogen (mg/L)	NA	<0.1-0.97	<0.1-0.13	0.28
Orthophosphates (mg/L)	NA	0.026-9.44	<0.002-0.410	<0.002
Total dissolved solids (mg/L)	500	27-123	26-42	25-42
Sodium (mg/L)	NA	1.42-8.04	0.67-2.01	2.23-3.07
Chloride (mg/L)	250	2.75-5.50	1.75-2.50	6.00-7.50
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01-0.173	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	0.0016	<0.002	<0.008-0.0113
Calcium (mg/L)	NA	1.09-3.07	1.02-1.19	0.764-1.25
Magnesium (mg/L)	NA	0.446-0.60	0.931-1.45	0.381-0.53
Manganese (mg/L)	0.05	<0.006-0.076	0.021-0.035	<0.006
Potassium (mg/L)	NA	0.254-0.968	0.244-0.38	0.40-0.417
Mercury (mg/L)	0.002	<0.00004-0.0018	<0.00004	<0.00004

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-11

Summary of Groundwater Quality: Well Concentration Ranges for the Lower Kato Road Site (7/84-12/86)

Constituent	SC and Federal DWS	SSS 4	SSS 5	SSS 6
pH (pH)	6.5-8.5	3.8-4.6	4.2-5.4	3.9-5.3
Conductivity (µmhos/cm)	NA	10-29	19-47	15-29
Nitrate/nitrite (mg/L)	NA	0.32-0.62	0.86-2.16	0.55-0.71
Total Kjeldahl nitrogen (mg/L)	NA	<0.1-0.20	<0.1	<0.1
Orthophosphates (mg/L)	NA	<0.002-0.156	<0.002-0.069	<0.002-0.064
Total dissolved solids (mg/L)	500	12-22	28-43	4-24
Sodium (mg/L)	NA	1.26-2.53	1.57-3.23	1.24-2.67
Chloride (mg/L)	250	2.00-2.88	3.00-4.12	1.75-2.75
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	0.0014	<0.001-0.0064	<0.001-0.468
Calcium (mg/L)	NA	0.328-0.513	1.67-2.22	0.482-0.58
Magnesium (mg/L)	NA	0.267-0.41	0.57-0.696	0.338-0.48
Manganese (mg/L)	0.05	<0.006	<0.006	<0.006
Potassium (mg/L)	NA	<0.02-0.309	0.150-0.602	0.222-0.346
Mercury (mg/L)	0.002	<0.00004-0.0008	<0.00004-0.0005	<0.00004-0.0007

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-12

Summary of Groundwater Quality: Well Concentration Ranges for the Par Pond Borrow Pit (7/84-12/86)

Constituent	SC and Federal DWS	SSS 16	SSS 17	SSS 18
pH (pH)	6.5-8.5	3.9-5.0	3.7-5.3	3.9-5.1
Conductivity (µmhos/cm)	NA	11-22	12-23	12-22
Nitrate/nitrite (mg/L)	NA	0.68-1.60	0.50-1.13	0.538-1.36
Total Kjeldahl nitrogen (mg/L)	NA	<0.1	<0.1	<0.1
Orthophosphates (mg/L)	NA	<0.002-0.008	<0.002-0.029	0.005-0.067
Total dissolved solids (mg/L)	500	13-29	8-25	9-27
Sodium (mg/L)	NA	0.61-1.66	0.87-1.58	0.314-2.11
Chloride (mg/L)	250	1.25-2.00	1.62-3.00	1.47-3.25
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.001	<0.001	<0.002-0.0098
Calcium (mg/L)	NA	0.47-0.741	0.216-0.28	0.276-0.44
Magnesium (mg/L)	NA	0.45-0.793	0.39-0.533	0.36-0.388
Manganese (mg/L)	0.05	<0.006	<0.006	<0.006
Potassium (mg/L)	NA	0.164-0.451	0.259-0.408	0.356-2.26
Mercury (mg/L)	0.002	<0.00004-0.0014	<0.00004-0.0007	<0.00004-0.0002

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-13

Summary of Groundwater Quality: Well Concentration Ranges for the Road F Site (7/84-12/86)

Constituent	SC and Federal DWS	SSS 22	SSS 23	SSS 24
pH (pH)	6.5-8.5	4.2-5.2	4.2-7.0	4.1-5.0
Conductivity (µmhos/cm)	NA	20-30	12-26	15-19
Nitrate/nitrite (mg/L)	NA	1.90-2.27	0.64-1.68	0.57-0.906
Total Kjeldahl nitrogen (mg/L)	NA	<0.1	<0.1-0.12	<0.1
Orthophosphates (mg/L)	NA	<0.002-0.056	0.002-0.108	<0.002-0.030
Total dissolved solids (mg/L)	500	19-37	16-26	11-24
Sodium (mg/L)	NA	1.93-3.15	0.93-2.06	0.94-2.09
Chloride (mg/L)	250	1.25-2.00	1.39-2.25	1.25-1.50
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	<0.01	<0.01	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.008-0.0225	0.0013	0.0013
Calcium (mg/L)	NA	0.924-1.06	0.680-0.81	0.51-0.568
Magnesium (mg/L)	NA	0.516-0.65	0.319-0.338	0.32-0.403
Manganese (mg/L)	0.05	<0.006-0.034	<0.01-0.031	<0.006
Potassium (mg/L)	NA	0.408-0.543	0.42-0.828	0.34-0.421
Mercury (mg/L)	0.002	<0.00004-0.0002	<0.00004-0.0001	<0.00004-0.0009

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-14

Summary of Groundwater Quality: Well Concentration Ranges for the Second Par Pond Borrow Pit (7/84-12/86)

Constituent	SC and Federal DWS	SSS 25	SSS 26	SSS 27
pH (pH)	6.5-8.5	5.5-6.3	4.1-5.0	4.3-4.5
Conductivity (µmhos/cm)	NA	55-90	29-39	20-29
Nitrate/nitrite (mg/L)	NA	0.02-0.316	1.12-1.58	0.81-1.68
Total Kjeldahl nitrogen (mg/L)	NA	0.26-0.68	<0.1-0.15	<0.1
Orthophosphates (mg/L)	NA	<0.002-0.014	<0.002-0.017	<0.002
Total dissolved solids (mg/L)	500	26-48	19-37	26-34
Sodium (mg/L)	NA	5.14-8.08	3.21-4.35	2.35-2.47
Chloride (mg/L)	250	6.13-7.25	2.75-6.13	2.50-2.75
Cadmium (mg/L)	0.010	<0.006	<0.006	<0.006
Copper (mg/L)	1	<0.004	<0.004	<0.004
Iron (mg/L)	0.3	2.54-7.48	<0.02-0.049	<0.01
Nickel (mg/L)	NA	<0.02	<0.02	<0.02
Lead (mg/L)	0.05	<0.001-0.0017	<0.001	<0.008
Calcium (mg/L)	NA	1.33-1.73	0.208-0.54	0.25
Magnesium (mg/L)	NA	0.694-0.98	0.509-0.70	0.50
Manganese (mg/L)	0.05	0.438-0.655	<0.006	<0.006
Potassium (mg/L)	NA	0.837-1.32	0.312-2.28	0.24
Mercury (mg/L)	0.002	<0.00004-0.0002	<0.00004-0.0008	<0.0001

Note: DWS are the lower of South Carolina or federal primary and secondary drinking water standards. NA = not applicable.

TABLE 15-15

Inventory of Gases Released at the Gas Cylinder Disposal Facility

Gas	No. of Cylinders
HF	2
F	2
HBr	2
BrF_5	1
ClF_3	1
NH_4	1
HCL	4
BrF_3	1
Cl_2	5
NO_2	2
H_2S	1
SO_2	2
Acetylene, O_2, H_2O, argon	1
Unknown	3

Note: Data are from Christensen and Gordon (1983).

TABLE 15-16

Rubble Pits Inventories and Locations

Location	Building Number	Area (ft^2)	Type of Rubble Disposed
A Area	731-2A	58,712	Paper, wooden pallets, cans, drums, glass
CS Area	631-3G	20,000	Paper, cans, lumber, barrels, metal pipe and shavings, electrical switchgear
	631-7G	300,000	Miscellaneous materials
D Area	431-2D	90,016	Metal, concrete, lumber, poles
F Area	231-4F	80,000	Metal, concrete, lumber, poles, fluorescent light fixtures, glass
	231-2F	132,850	Concrete, lumber, cement, fence and telephone poles, rip rap, brick, tile, wallboard, paneling, metal shavings, drums, electrical conduit, furniture, firehose
Forestry	761-9G	22,800	Animal carcasses, lumber, light fixtures, concrete, metal drums, wire
L Area	131-1L	11,000	Metal, lumber, poles, concrete, transite
	131-3L	44,800	Miscellaneous rubble
	131-4L	3,080	Concrete and metal from powerhouse stack and silo
R Area	131-2R	21,160	Metal, concrete, lumber, poles

Note: Data are from Gordon et al. (1987).

TABLE 15-17

Summary of Groundwater Quality: Well Concentration Ranges for the Sanitary Landfill (7/84-12/86)

Constituent	SC and Federal DWS	LFW 6	LFW 7	LFW 8	LFW 9
pH (pH)	6.5-8.5	5.5-6.8	6.2-7.2	4.6-6.9	4.1-5.2
Conductivity (µmhos/cm)	NA	94-260	421-1,120	120-580	35-115
Silver (mg/L)	0.05	<0.0010	<0.0010	<0.0010	<0.0010
Arsenic (mg/L)	0.05	<0.001	<0.002-0.004	<0.001	<0.001
Barium (mg/L)	1.0	0.004	<0.010-0.011	0.009	0.007
Beryllium (mg/L)	NA	---	<0.002	---	---
Cadmium (mg/L)	0.010	<0.001-0.002	<0.001-0.019	<0.001-0.003	<0.001
Chloride (mg/L)	250	9.06-23.1	21.6-45.6	16.0-42.8	2.9-8.7
Chromium (mg/L)	0.05	<0.004-0.004	<0.004-0.037	<0.004-0.007	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10-0.16	<0.10	<0.10
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002-0.0004
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	<0.50-1.30	<0.50	<0.50	<0.50-6.30
Lead (mg/L)	0.05	<0.003	<0.003-0.011	<0.003-0.013	<0.010-0.037
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	2.1	<1.0-12.5	<5.0-7.9	<1.0-5.0
TDS (mg/L)	500	---	---	---	---
TOC (mg/L)	NA	1.51-144	8.00-52.9	6.50-43.0	2.00-15.0
TOH (mg/L)	NA	0.086-0.150	0.264-0.400	0.205-0.277	0.165-0.291
Zinc (mg/L)	5	---	0.013	---	---

TABLE 15-17 (cont.)

Constituent	SC and Federal DWS	LFW 10A	LFW 16	LFW 17	LFW 18
pH (pH)	6.5-8.5	3.9-5.1	4.0-5.1	5.5-6.7	6.2-6.8
Conductivity (μmhos/cm)	NA	15-29	21-44	264-1,900	200-722
Silver (mg/L)	0.05	<0.0010	<0.0010	<0.0010	<0.0010
Arsenic (mg/L)	0.05	<0.001	<0.001	0.002-0.007	0.006-0.010
Barium (mg/L)	1.0	<0.004-0.005	0.007-0.013	<0.010-0.064	<0.010-0.016
Beryllium (mg/L)	NA	---	---	<0.002	<0.002
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001-0.048	<0.001-0.019
Chloride (mg/L)	250	2.0-3.27	3.8-4.7	3.3-46.5	12.8-43.3
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004-0.095	<0.004-0.038
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10	<0.10	<0.10-0.10
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	---	<0.50
Nitrate (as N) (mg/L)	10	<0.50-1.88	0.55-3.30	<0.50-1.30	<0.50-1.24
Lead (mg/L)	0.05	0.004-0.012	0.006-0.012	0.007-0.008	0.003
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	1.0	<1.0	<1.0-32.0	<5.0-72.0
TDS (mg/L)	500	28	---	---	---
TOC (mg/L)	NA	0.217-10.0	0.39-6.00	6.00-534	3.00-160
TOH (mg/L)	NA	<0.005-0.008	0.006-0.010	0.119-0.186	0.085-0.197
Zinc (mg/L)	5	0.018	---	0.021	0.018

TABLE 15-17 (cont.)

Constituent	SC and Federal DWS	LFW 19	LFW 20	LFW 21	LFW 22
pH (pH)	6.5-8.5	4.3-5.5	3.6-5.7	3.7-5.2	3.9-5.4
Conductivity (µmhos/cm)	NA	17-31	12-81	11-48	10-29
Silver (mg/L)	0.05	<0.0010	<0.0010	<0.0010	<0.0010
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004	0.006	<0.004-0.005	<0.004-0.004
Beryllium (mg/L)	NA	---	---	---	---
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.0-3.27	2.3-3.06	2.5-4.0	2.3-5.24
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10	<0.10	<0.10
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	<0.50-2.90	<0.50-1.55	<0.50-1.30	<0.50-1.60
Lead (mg/L)	0.05	0.007-0.010	<0.006-0.008	0.005-0.007	<0.006-0.009
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	1.2	<1.0	1.0	<1.0
TDS (mg/L)	500	---	---	6	<5
TOC (mg/L)	NA	0.385-7.00	0.290-0.42	0.446-1.30	0.47-1.00
TOH (mg/L)	NA	<0.005-0.011	<0.005	0.005	0.006-0.009
Zinc (mg/L)	5	---	---	0.044	0.012

TABLE 15-17 (cont.)

Constituent	SC and Federal DWS	LFW 23	LFW 24	LFW 25
pH (pH)	6.5-8.5	3.8-5.1	3.8-5.4	3.6-4.9
Conductivity (µmhos/cm)	NA	13-28	12-22	11-29
Silver (mg/L)	0.05	<0.0010	<0.0010	<0.0010
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004-0.004	0.005-0.007	0.005-0.008
Beryllium (mg/L)	NA	---	---	---
Cadmium (mg/L)	0.010	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.9-4.0	1.8-4.6	1.8-4.36
Chromium (mg/L)	0.05	<0.004-0.010	<0.004-0.006	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10	<0.10	<0.10
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	<0.50-1.40	0.50-2.75	<0.50-3.20
Lead (mg/L)	0.05	0.006-0.010	0.009-0.010	0.005-0.014
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	1.3	<1.0	1.1
TDS (mg/L)	500	<5	92	14
TOC (mg/L)	NA	0.520-0.80	0.46-6.00	0.355-22.0
TOH (mg/L)	NA	0.013-0.025	<0.005	<0.005
Zinc (mg/L)	5	0.014	0.060	0.020

Note: DWS are the lower of South Carolina or federal primary drinking water standards.
NA = not applicable.

TABLE 15-18

Summary of Waste Disposal Records for the CMP Pits

	Pit 18.3G	Pit 18.2G	Pit 18.1G	Pit 19G	Pit 17.1G
Approximate Completeness of Records	100%	100%	10%	40%	45%
Total Number of Containers	712	Unknown	Unknown	Unknown	188
55-Gallon Drums					
Trichloroethylene	31	---	---	---	---
Tetrachloroethylene	71	---	---	---	---
Freon[R]	22	---	---	---	---
Safety Solvent; Klear-All-99*	71	---	---	---	---
Paint Thinner	4	---	---	---	---
Oil	262	---	---	---	---
Lithium Nitrate	16	---	---	---	---
Hydrazine (empty)	29	---	---	---	---
Spray Cans	3	---	---	---	---
Miscellaneous	16	---	---	---	---
Subtotal	525				
30-Gallon Drums					
Miscellaneous	2	---	---	---	---
5-Gallon Drums					
Spent Solvents	11	---	---	---	---
Paint	132	---	---	---	---
Miscellaneous	1	---	---	---	---
Subtotal	144				
1-Gallon Drums					
Trichloroethylene	20	---	---	---	---
Paint	3	---	---	---	---
Subtotal	23				

* Petroleum distillate 60-90%, dichloromethane 5-15%, tetrachloroethylene 5-30% (Christensen and Gordon, 1983).

TABLE 15-18 (cont.)

	Pit 18.3G	Pit 18.2G	Pit 18.1G	Pit 19G	Pit 17.1G
Small Boxes, Bags, Bottles					
Oil	13	---	---	---	---
Liquid Paper	6	---	---	---	---
Spray Cans	4	14 Cases	---	---	---
Perchloric Acid	---	1 Carton	---	---	---
Miscellaneous	17	---	---	---	---
Subtotal	40				
Unknown Container Sizes					
Solvents	---	2,267.6 kg	362.8 kg	---	---
Hydrazine Compounds	---	9.1 kg	---	---	---
Gas Cylinders	---	6	---	---	---
Beryllium, Titanium, Calcium, Cadmium	---	Unknown	---	Unknown	---
Nitric Acid	---	---	27.2 kg	---	---
Lighting Ballast	---	---	Unknown	Unknown	---
Pesticides	---	---	---	---	36.3 kg

Note: There are no records for pits 17G and 18G.

TABLE 15-19

Summary of Groundwater Quality: Well Concentration Ranges for the CMP Pits Water-Table Monitoring Wells (7/84-12/86)

Constituent	SC and Federal DWS	CMP 8	CMP 10	CMP 11	CMP 12
pH (pH)	6.5-8.5	4.8-5.9	4.5-5.7	5.1-5.8	4.3-5.4
Conductivity (μmhos/cm)	NA	22-62	18-42	25-105	17-34
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0004	<0.0004-0.0020
Arsenic (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001
Barium (mg/L)	1.0	<0.004-0.008	0.008-0.022	0.014-0.022	<0.004-0.008
Beryllium (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002-0.003	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001-0.002	<0.001-0.002	<0.001-0.005	0.003
Chloride (mg/L)	250	1.7-3.0	2.3-4.8	2.0-15.0	1.7-5.0
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Copper (mg/L)	1	0.006-0.007	0.005-0.007	<0.004	<0.040
Cyanide (mg/L)	0.2	<0.005	<0.005	<0.005	<0.005
DOC (mg/L)	NA	<5.0-5.0	<5.0-8.8	<5.0	4.2
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.14	<0.10-0.18	<0.10-0.26	<0.10-0.31
Iron (mg/L)	0.3	0.023-0.058	0.034-0.148	0.036-1.740	0.034-0.122
Mercury (mg/L)	0.002	<0.0002-0.0004	<0.0002-0.0003	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.012-0.030	0.009-0.054	0.021-0.043	0.005-0.022
Sodium (mg/L)	NA	1.27-1.67	1.44-1.88	1.54-1.92	1.20-1.49
Nickel (mg/L)	NA	<0.004-0.008	<0.004-0.004	<0.004	<0.004-0.010
Nitrite (as N) (mg/L)	NA	<0.50	<0.50	<0.50	<0.50
Nitrate (as N) (mg/L)	10	0.80-0.95	<0.50-0.73	<0.50	<0.50
Lead (mg/L)	0.05	<0.004-0.013	<0.004-0.034	<0.004-0.110	0.008-0.157
Phenol (mg/L)	NA	<0.002-0.005	<0.002-0.006	<0.002-0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.001	<0.001	<0.001
Sulfate (mg/L)	250	<5.0	<5.0	10.0-17.5	<5.0
Tetrachloroethylene (mg/L)	NA	<0.001	<0.001	<0.001	<0.001
TDS (mg/L)	500	20-28	16-48	80	30
TOC (mg/L)	NA	0.275-6.00	0.296-6.00	0.310-6.910	0.640-10.340
TOH (mg/L)	NA	<0.005-0.018	<0.005-0.013	<0.005-0.051	<0.005-0.093
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001	<0.001
Zinc (mg/L)	5	0.743-4.070	0.019-3.100	0.005-1.640	0.340-2.960
Gross alpha (pCi/L)	15	<2.0-3.0	1.3-10.0	<2.0-182.0	<2.0
Nonvol. beta (pCi/L)	NA	2.0	<2.0-7.0	<3.0-77.0	<2.0
Total radium (pCi/L)	5	<1.0-1.6	<1.0-2.0	<1.0-41.0	<1.0

TABLE 15-19 (cont.)

Constituent	SC and Federal DWS	CMP 13	CMP 14C	CMP 15B**	CMP 15C
pH (pH)	6.5-8.5	6.1-6.7	4.2-5.1	8.9-11.3	4.4-6.0
Conductivity (µmhos/cm)	NA	90-115	12-52	105-520	13-36
Silver (mg/L)	0.05	<0.0004	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.001	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.020-0.027	<0.004	0.055	0.005
Beryllium (mg/L)	NA	<0.002	---	---	---
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	0.003	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.3-10.0	2.3	2.3	2.3
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004-0.009	<0.004
Copper (mg/L)	1	0.010	---	---	---
Cyanide (mg/L)	NA	<0.005	---	---	---
DOC (mg/L)	NA	<5.0	---	---	---
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	<0.10-0.23	<0.10	0.22	<0.10
Iron (mg/L)	0.3	0.006-0.081	0.008-0.023	0.004-0.020	<0.004-0.020
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.011-0.040	0.003-0.004	<0.002-0.002	0.011-0.042
Sodium (mg/L)	NA	2.22-3.74	1.12	8.50	1.32
Nickel (mg/L)	NA	<0.004	<0.004	<0.004	0.004
Nitrite (as N) (mg/L)	NA	<0.50	---	---	---
Nitrate (as N) (mg/L)	10	<0.50	<0.50	<0.50	<0.50
Lead (mg/L)	0.05	<0.004-0.019	<0.005-0.010	<0.005-0.006	<0.005-0.290
Phenol (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.001	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<5.0	<5.0	<5.0	<5.0
Tetrachloroethylene (mg/L)	NA	0.004-0.006	<0.001	<0.001	<0.001
TDS (mg/L)	500	102	---	---	---
TOC (mg/L)	NA	0.330-6.32	0.840	<1.00-6.00	0.760
TOH (mg/L)	NA	0.008-0.024	<0.005	<0.005-0.015	<0.005-0.009
Trichloroethylene (mg/L)	0.005	0.003-0.009	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001	<0.001
Zinc (mg/L)	5	0.029-5.940	0.005-0.026	<0.002-0.006	0.026-0.127
Gross alpha (pCi/L)	15	<2.0-362.0	<2.0	<2.0	<2.0-2.6
Nonvol. beta (pCi/L)	NA	2.8-86.0	<2.0-3.0	7.0-9.9	<2.0-3.0
Total radium (pCi/L)	5	<1.0-8.0	<1.0	<1.0-1.1	<1.0-1.1

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

** Although installed as a McBean Formation monitoring well, well CMP 15B is believed to monitor the water table at this site.

TABLE 15-20

Summary of Groundwater Quality: Well Concentration Ranges for the CMP Pits McBean Monitoring Wells (10/85-12/86)

Constituent	SC and Federal DWS	CMP 8B	CMP 9B	CMP 10B	CMP 11B
pH (pH)	6.5-8.5	6.1-6.8	6.8	6.5-7.7	7.1-7.7
Conductivity (µmhos/cm)	NA	88-142	162	140-180	153-200
Silver (mg/L)	0.05	<0.0020	---	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	---	<0.002	<0.002
Barium (mg/L)	1.0	0.017	---	0.027	0.028
Carbon tetrachloride (mg/L)	0.005	<0.001	---	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	---	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	---	<0.001	<0.001
Chloride (mg/L)	250	2.3	---	2.3	2.3
Chromium (mg/L)	0.05	<0.004	---	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	---	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.34	---	<0.10	<0.10
Iron (mg/L)	0.3	0.006-0.018	---	<0.004-0.009	0.006-0.011
Mercury (mg/L)	0.002	<0.0002	---	<0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002	---	<0.002	<0.002
Sodium (mg/L)	NA	2.03	---	1.63	1.62
Nickel (mg/L)	NA	<0.004	---	<0.004	0.009
Nitrate (as N) (mg/L)	10	<0.50	---	<0.50	<0.50
Lead (mg/L)	0.05	<0.005	---	<0.005	<0.005
Phenol (mg/L)	NA	<0.002	---	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	---	<0.002	<0.002
Sulfate (mg/L)	250	<5.0	---	<5.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.001	0.008	<0.001	<0.001
TOC (mg/L)	NA	0.630-2.00	8.140	0.550-2.00	0.280
TOH (mg/L)	NA	<0.005	0.038	<0.005	<0.005-0.006
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	---	<0.001	<0.001
Zinc (mg/L)	5	0.003-0.014	---	0.003-0.013	0.003-0.807
Gross alpha (pCi/L)	15	<2.0	---	<2.0	<2.0
Nonvol. beta (pCi/L)	NA	2.6	---	<2.0	<2.0
Total radium (pCi/L)	5	<1.0-3.6	---	<1.0-6.2	<1.0

TABLE 15-20 (cont.)

Constituent	SC and Federal DWS	CMP 12B	CMP 13B	CMP 14B	CMP 16B
pH (pH)	6.5-8.5	6.9-7.7	6.6-7.7	6.8-7.6	6.2-7.6
Conductivity (µmhos/cm)	NA	120-190	145-195	132-180	138-180
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	<0.002	<0.002	<0.002
Barium (mg/L)	1.0	0.025	0.024	0.013	0.035
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.3	2.3	2.3	2.9
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	0.75	<0.10	0.14	<0.10
Iron (mg/L)	0.3	<0.004-0.005	0.004-0.009	0.007-0.034	0.006-0.014
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	<0.002	<0.002	<0.002	<0.002
Sodium (mg/L)	NA	1.61	2.20	1.35	2.45
Nickel (mg/L)	NA	<0.004	<0.004	<0.004	<0.004
Nitrate (as N) (mg/L)	10	<0.50	<0.50	<0.50	1.50
Lead (mg/L)	0.05	<0.005	<0.005	<0.005	<0.006-0.012
Phenol (mg/L)	NA	<0.002	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	<5.0	<5.0	<5.0	<5.0
Tetrachloroethylene (mg/L)	NA	<0.001	<0.001	<0.001	<0.001
TOC (mg/L)	NA	0.480-1.400	0.270	0.430-2.100	0.350-1.700
TOH (mg/L)	NA	<0.005	<0.005	<0.005-0.013	<0.005-0.007
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001	<0.001
Zinc (mg/L)	5	0.004-0.016	<0.002-0.038	<0.002-0.007	<0.002-0.007
Gross alpha (pCi/L)	15	<2.0	<2.0	<2.0	<2.0
Nonvol. beta (pCi/L)	NA	<2.0	<2.0	<2.0	<2.0-4.0
Total radium (pCi/L)	5	<1.0	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards. NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 15-21

Summary of Groundwater Quality: Well Concentration Ranges for the CMP Pits Congaree Monitoring Wells (10/85-12/86)

Constituent	SC and Federal DWS	CMP 8A	CMP 12A	CMP 15A
pH (pH)	6.5-8.5	5.7-6.3	6.4-6.8	6.2-10.0
Conductivity (µmhos/cm)	NA	94-135	165-190	120-210
Silver (mg/L)	0.05	<0.0020	<0.0020	<0.0020
Arsenic (mg/L)	0.05	<0.002	0.002	<0.002
Barium (mg/L)	1.0	0.024	0.032	0.021
Carbon tetrachloride (mg/L)	0.005	<0.001	<0.001	<0.001
Cadmium (mg/L)	0.010	<0.002	<0.002	<0.002
Chloroform (mg/L)	0.100*	<0.001	<0.001	<0.001
Chloride (mg/L)	250	2.3	2.3	2.9
Chromium (mg/L)	0.05	<0.004	<0.004	<0.004
Endrin (mg/L)	0.0002	<0.00004	<0.00004	<0.00004
Fluoride (mg/L)	1.6	1.24	0.30	0.45
Iron (mg/L)	0.3	0.248-0.298	0.132-0.154	0.100-0.149
Mercury (mg/L)	0.002	<0.0002	<0.0002	<0.0002
Manganese (mg/L)	0.05	0.025-0.039	0.122-0.128	0.021-0.025
Sodium (mg/L)	NA	2.18	2.06	9.19
Nickel (mg/L)	NA	<0.004	<0.004	<0.004
Nitrate (as N) (mg/L)	10	<0.50	<0.50	<0.50
Lead (mg/L)	0.05	<0.005	<0.005	<0.005
Phenol (mg/L)	NA	<0.002	<0.002	<0.002
Selenium (mg/L)	0.01	<0.002	<0.002	<0.002
Sulfate (mg/L)	250	15.0	15.0	15.0
Tetrachloroethylene (mg/L)	NA	<0.001	<0.001	<0.001
TOC (mg/L)	NA	0.40-3.00	<1.00-1.80	0.320
TOH (mg/L)	NA	<0.005-0.007	<0.005	<0.005-0.005
Trichloroethylene (mg/L)	0.005	<0.001	<0.001	<0.001
1,1,1-TCE (mg/L)	0.200	<0.001	<0.001	<0.001
Zinc (mg/L)	5	0.004-0.024	<0.002-0.043	<0.002-0.024
Gross alpha (pCi/L)	15	<2.0	<2.0	<2.0
Nonvol. beta (pCi/L)	NA	<2.0	<2.0	9.1
Total radium (pCi/L)	5	<1.0	<1.0	<1.0

Note: DWS are the lower of South Carolina or federal primary drinking water standards.
NA = not applicable.

* South Carolina and federal primary drinking water standard for trihalomethanes.

TABLE 15-22

Radionuclide Inventory for Waste Buried in Trenches at the Burial Grounds from 1952 Through 1985

Radionuclide	Volume (ft^3)	Amount Buried (Ci) Original	Decayed (1986)
^{3}H	848,000	4,090,000	1,830,000
Fission products	9,390,000	711,000	18,729
Induced activity	1,090,000	3,410,000	348,000
^{60}Co	174,000	1,110,000	413,000
^{137}Cs	NA	NA	-10,000
^{90}Sr	NA	NA	-10,000
Other alpha emitters	1,910,000	93	87

Other Alpha Emitters	Composition Percentage
^{233}U	0.788
Depleted U	62.74
Enriched U	0.32
Natural U	3.30
^{242}Pu	0.002
^{241}Am	6.69
^{252}Cf	25.93
^{237}Np	0.17
^{232}Th	0.06

Note: Data are based upon corrected and updated information from the Computerized Burial Ground Records (COBRA) as of February 5, 1986.
NA = data not available.

TABLE 15-23

Lead and Cadmium Concentrations in Burial Grounds Wells (1984)

Well	Concentration ($\mu g/L$) Lead	Cadmium
MGA 1	129	75
MGA 3	57	47
MGA 5	84	74
MGA 7	49	9
MGA 9	28	6
MGA 11	26	71
MGA 19	35	65
MGA 21	45	57
MGA 23	14	35
MGA 32	33	60
MGA 34	127	100
MGA 36	10	20
MGC 1	124	68
MGC 3	398	131
MGC 5	78	121
MGC 7	81	37
MGC 9	43	26
MGC 11	16	4
MGC 13	18	9
MGC 15	42	32
MGC 17	82	62
MGC 19	39	3
MGC 21	12	50
MGC 23	5	2
MGC 30	23	17
MGC 32	8	3
MGC 34	49	14
MGC 36	11	22
MGE 1	58	111
MGE 3	34	31
MGE 5	68	13
MGE 7	58	49
MGE 9	42	4
MGE 13	16	3
MGE 15	9	87
MGE 17	42	55
MGE 19	31	39
MGE 21	13	7
MGE 23	10	4
MGE 30	6	65
MGE 32	12	57
MGE 34	13	26
MGE 36	25	25

TABLE 15-23 (cont.)

Well	Concentration (μg/L) Lead	Cadmium
MGG 1	34	18
MGG 3	45	23
MGG 5	64	57
MGG 7	15	58
MGG 9	21	101
MGG 13	30	64
MGG 15	12	20
MGG 17	21	33
MGG 19	26	28
MGG 21	27	9
MGG 23	74	10
MGG 28	10	14
MGG 30	96	20
MGG 32	51	48
MGG 34	27	28
MGG 36	42	32
MGI 1	38	10
MGI 3	107	56
MGI 5	80	74
MGI 7	12	365
MGI 9	77	71
MGI 13	30	26
MGI 15	14	30
MGI 17	9	3
BG 204GR	35	3
BG 208GR	11	5
BG 212GR	16	9
BG 216GR	4	14
BG 220GR	17	16
BG 402GR	24	4
BG 406GR	46	6
BG 410GR	147	7
BG 422GR	16	9
BG 620GR	20	8
BG 818GR	6	1
BG 822GR	10	1
BG 109	1	8

Note: Data are from Oblath (1985).

TABLE 15-24

Mercury Concentrations in Burial Grounds Wells (1977-1986)

	Concentration (µg/L)								
	Nov.	Nov.	Nov.	Nov.	Mar.	Nov.	Nov.	Nov.	Nov.
Well	1977	1978	1979	1981	1982	1982	1983	1984	1986
MGA 1	<0.1	<0.02	0.6	<0.1	<0.05	<0.05	0.26	0.06	<0.1
MGA 3	<0.1	<0.02	0.7	<0.1	0.05	0.05	0.23	<0.02	0.6
MGA 5	1.2	<0.02	0.4	<0.1	0.32	0.35	0.58	2.86	26.5
MGA 7	<0.1	<0.02	0.6	<0.1	<0.05	<0.05	0.12	<0.02	<0.1
MGA 9	0.1	<0.02	0.4	<0.1	0.06	0.08	0.11	0.05	---
MGA 11	<0.1	<0.02	0.4	<0.1	0.15	<0.05	0.2	<0.02	<0.1
MGA 19	0.1	<0.02	0.6	<0.1	0.26	<0.05	0.06	0.12	<0.1
MGA 21	<0.1	<0.02	0.2	<0.1	<0.05	0.07	0.13	0.06	<0.1
MGA 23	---	<0.02	<0.2	<0.1	0.13	<0.05	<0.05	0.16	<0.1
MGA 32	1.0	0.74	0.9	0.7	0.42	0.32	0.13	0.2	0.35
MGA 34	<0.1	<0.02	0.4	<0.1	<0.05	0.05	0.1	<0.02	<0.1
MGA 36	0.11	<0.02	0.6	<0.1	0.07	<0.05	<0.05	<0.02	---
MGC 1	<0.1	<0.02	<0.2	<0.1	0.05	<0.05	0.09	<0.02	<0.1
MGC 3	<0.1	0.06	0.4	<0.1	0.1	<0.05	<0.05	0.08	<0.1
MGC 5	<0.1	<0.02	0.6	---	<0.05	<0.05	<0.05	<0.02	---
MGC 7	0.1	<0.02	0.7	0.3	0.43	0.19	<0.05	0.03	0.28
MGC 9	<0.1	<0.02	<0.2	<0.1	<0.05	<0.05	<0.05	<0.02	<0.1
MGC 11	0.15	<0.02	---	---	---	<0.05	<0.05	<0.02	---
MGC 13	<0.1	<0.02	<0.2	<0.1	0.05	<0.05	<0.05	0.09	<0.1
MGC 15	<0.1	<0.02	0.4	<0.1	<0.05	0.08	0.06	0.06	<0.1
MGC 17	---	---	---	<0.1	0.06	0.22	0.5	0.52	0.6
MGC 19	---	<0.02	0.4	<0.1	<0.05	<0.05	0.13	<0.02	<0.1
MGC 21	0.7	0.36	1.3	1.3	1.56	0.69	0.44	0.38	0.5
MGC 23	0.1	<0.02	0.3	0.4	0.76	0.79	0.07	0.07	---
MGC 30	0.1	<0.02	0.4	<0.1	0.22	0.11	0.14	0.15	<0.1
MGC 32	0.1	<0.02	<0.2	<0.1	<0.05	0.13	0.25	0.42	<0.1
MGC 34	1.0	<0.02	0.3	---	0.43	<0.05	0.21	0.11	---
MGC 36	<0.1	<0.02	0.3	<0.1	<0.05	0.15	<0.05	0.05	<0.1
MGE 1	<0.1	<0.02	<0.2	<0.1	<0.05	<0.05	0.09	0.02	<0.1
MGE 3	<0.1	<0.02	<0.2	<0.1	0.05	0.19	<0.05	0.06	<0.1
MGE 5	<0.1	<0.02	0.4	<0.1	0.06	0.05	<0.05	0.12	<0.1
MGE 7	<0.1	<0.02	0.3	<0.1	0.05	<0.05	0.11	0.02	<0.1
MGE 9	<0.1	<0.02	0.5	<0.1	0.05	<0.05	<0.05	0.03	<0.1
MGE 13	<0.1	<0.02	<0.2	<0.1	<0.05	<0.05	<0.05	0.16	<0.1
MGE 15	---	<0.02	0.8	---	---	---	---	0.1	---
MGE 17	---	<0.02	0.3	---	<0.05	<0.05	0.06	0.09	---
MGE 19	0.13	<0.02	<0.2	0.2	0.06	<0.05	0.1	0.21	<0.1
MGE 21	<0.1	<0.02	<0.2	<0.1	0.15	<0.05	<0.05	0.17	<0.1
MGE 23	<0.1	<0.02	0.4	0.2	<0.05	<0.05	<0.05	0.11	<0.1
MGE 30	<0.1	<0.02	<0.2	<0.1	<0.05	<0.05	<0.05	0.47	0.19
MGE 32	<0.1	<0.02	0.6	<0.1	<0.05	0.09	0.2	0.86	1.1
MGE 34	<0.1	<0.02	0.5	<0.1	<0.05	<0.05	0.07	0.14	<0.1
MGE 36	<0.1	<0.02	0.4	<0.1	<0.05	<0.05	<0.05	0.14	<0.1

TABLE 15-24 (cont.)

Well	Concentration (µg/L) Nov. 1977	Nov. 1978	Nov. 1979	Nov. 1981	Mar. 1982	Nov. 1982	Nov. 1983	Nov. 1984	Nov. 1986
MGG 1	<0.1	<0.02	0.4	<0.1	<0.05	<0.05	0.06	0.14	<0.1
MGG 3	<0.1	<0.02	0.3	<0.1	<0.05	<0.05	<0.05	0.19	<0.1
MGG 5	<0.1	<0.02	0.4	<0.1	0.07	0.09	0.11	0.16	0.3
MGG 7	<0.1	<0.02	0.3	<0.1	<0.05	0.06	<0.05	0.11	<0.1
MGG 9	<0.1	<0.02	0.4	<0.1	<0.05	0.08	<0.05	0.08	0.47
MGG 13	<0.1	<0.02	0.5	<0.1	<0.05	<0.05	0.12	0.08	---
MGG 15	<0.1	<0.02	0.5	<0.1	<0.05	<0.05	<0.05	0.1	---
MGG 17	0.1	<0.02	0.3	<0.1	0.78	0.2	0.13	0.18	<0.1
MGG 19	<0.1	<0.02	0.3	<0.1	<0.05	<0.05	<0.05	0.09	---
MGG 21	1.4	0.63	0.3	<0.1	<0.05	0.05	<0.05	<0.02	<0.1
MGG 23	2.4	0.57	0.5	0.1	0.33	<0.05	<0.05	0.11	---
MGG 28	---	<0.02	0.6	<0.1	0.07	0.49	0.27	0.47	---
MGG 30	---	<0.02	0.5	<0.1	<0.05	<0.05	0.08	0.07	<0.1
MGG 32	<0.1	<0.02	0.5	<0.1	<0.05	0.09	<0.05	0.09	<0.1
MGG 34	<0.1	<0.02	<0.2	<0.1	0.05	0.06	0.08	0.27	<0.1
MGG 36	<0.1	<0.02	0.5	<0.1	<0.05	<0.05	<0.05	0.15	<0.1
MGI 1	---	<0.02	0.5	1.4	0.2	0.08	<0.05	0.04	<0.1
MGI 3	---	<0.02	---	---	---	---	0.09	0.11	---
MGI 5	---	<0.02	0.4	<0.1	0.05	0.06	<0.05	<0.02	<0.1
MGI 7	---	<0.02	0.3	<0.1	<0.05	0.05	<0.05	<0.02	<0.1
MGI 9	---	<0.02	0.5	<0.1	0.06	0.06	0.12	0.13	0.35
MGI 13	---	<0.02	0.6	0.4	0.51	0.26	0.26	0.33	0.3
MGI 15	---	<0.02	0.6	<0.1	<0.05	<0.05	<0.05	0.14	<0.1
MGI 17	---	<0.02	0.2	<0.1	<0.05	<0.05	<0.05	0.17	<0.1
BG 204GR	---	---	---	0.3	0.06	0.12	<0.05	0.23	<0.1
BG 206GR	---	---	---	0.2	<0.05	<0.05	---	---	<0.1
BG 208GR	---	---	---	0.3	<0.05	0.07	<0.05	0.12	<0.1
BG 210GR	---	---	---	0.3	<0.05	<0.05	---	---	<0.1
BG 212GR	---	---	---	0.1	<0.05	0.08	<0.05	0.12	<0.1
BG 216GR	---	---	---	0.2	<0.05	<0.05	0.07	0.04	---
BG 218GR	---	---	---	0.5	<0.05	<0.05	---	---	<0.1
BG 220GR	---	---	---	<0.1	<0.05	<0.05	<0.05	0.11	<0.1
BG 222GR	---	---	---	0.5	<0.05	<0.05	---	---	0.1
BG 402GR	---	---	---	<0.1	<0.05	<0.05	0.18	0.08	<0.1
BG 404GR	---	---	---	0.2	0.1	0.13	---	---	<0.1
BG 406GR	---	---	---	<0.1	<0.05	<0.05	0.11	0.12	<0.1
BG 408GR	---	---	---	<0.1	<0.05	<0.05	---	---	<0.1
BG 410GR	---	---	---	<0.1	<0.05	0.08	0.08	0.08	<0.1
BG 420GR	---	---	---	0.2	0.05	0.11	----	---	<0.1
BG 422GR	---	---	---	<0.1	<0.05	<0.05	0.09	0.17	<0.1
BG 620GR	---	---	---	0.2	<0.05	0.06	<0.05	0.26	<0.1
BG 622GR	---	---	---	---	0.07	<0.05	---	---	---

TABLE 15-24 (cont.)

Well	Concentration (µg/L) Nov. 1977	Nov. 1978	Nov. 1979	Nov. 1981	Mar. 1982	Nov. 1982	Nov. 1983	Nov. 1984	Nov. 1986
BG 818GR	---	---	--	<0.1	0.05	<0.05	---	0.25	<0.1
BG 820GR	---	---	---	0.2	<0.05	<0.05	0.13	---	<0.1
BG 822GR	---	---	---	<0.1	<0.05	0.06	<0.05	0.19	<0.1
BG 109	---	---	---	<0.1	<0.05	<0.05	0.07	0.14	<0.1
BG 110	---	---	---	---	---	---	0.1	<0.02	<0.1
PDO 5	---	---	---	---	---	---	<0.2	---	<0.1
PDQ 5	---	---	---	<0.1	---	<0.1	<0.2	<0.02	<0.1

Note: Data are from Oblath (1982) and McIntyre and Wilhite (1987). --- Indicates data not available.

TABLE 15-25

Tritium Concentrations in Soil Cores from the New Burial Ground

Elevation (ft msl)	Concentration (pCi/mL) SB 31	SB 30	SB 21	SB 22	SB 23	SB 24	SB 25	SB 26	SB 27
252	358	NS	-	-	-	-	-	-	-
251	NA	25	NS	68	NS	NS	NS	NS	NS
250	34	28	NS	NA	NS	NS	NS	NS	19
249	338	NA	299	72	11	NS	38	65	21
248	NA	24	375	NA	23	41	31	47	13
247	NA	7	284	76	NA	48	12	30	14
246	36	25	333	56	22	206	17	56	12
245	42	18	153	31	24	105	25	56	10
244	45	NA	142	41	NA	829	34	72	11
243	38	NA	34	48	28	2,403	39	54	6
242	38	19	34	30	NA	6,037	37	50	NA
241	31	22	41	47	28	3,854	21	31	NA
240	27	22	61	190	NA	672	22	37	NA
239	35	24	636	138	60	1,237	24	24	NA
238	29	24	354	55	234	15,793	19	22	12
237	34	26	271	47	416	7,590	16	17	7
236	30	22	44,146	18,241	353	40,425	15	55	28
235	34	27	110,615	31,726	249	36,775	12	8	26
234	33	19	113,509	74,097	257	14,827	10	NA	5
233	32	27	80,256	85,559	259	27,664	13	8	13
232	35	25	52,196	26,762	222	2,049	21	18	1
231	35	19	11,941	31,579	159	6,301	124	26	66
230	33	22	6,215	50,577	75	847	192	14	32
229	28	28	2,139	53,155	94	2,200	102	24	30
228	26	15	708	7,058	217	334	282	138	22
227	27	19	797	30,341	277	894	497	242	28
226	27	15	1,208	22,233	138	199	492	77	22
225	13	22	1,102	16,011	NA	86	264	28	29
224	27	17	905	1,137	77	496	986	30	17
223	13	25	213	2,291	70	545	821	43	19
222	23	14	206	468	1,110	1,170	474	282	125
221	12	14	461	383	NA	951	48	314	171
220	11	9	324	2,093	447	642	10	51	174
219	22	NA	197	222	NA	1,789	11	43	203
218	16	15	61	65	78	633	7	22	70
217	14	21	75	77	32	262	369	15	48
216	18	16	37	969	NA	77	129	18	9
215	2	19	115	4,012	2,073	23	89	17	9
214	10	13	62	178	260	886	166	13	16
213	13	14	204	58	491	189	121	<1	7
212	11	4	78	NS	2,029	2,110	122	<1	NA
211	15	NA	131	NS	78	1,834	NA	<1	NA
210	19	5	529	NS	NA	188	NA	<1	6
209	14	5	34	NS	30	200	17	<1	9
208	12	2	227	NS	NA	98	30	6	20

TABLE 15-25 (cont.)

Elevation (ft msl)	Concentration (pCi/mL) SB 31	SB 30	SB 21	SB 22	SB 23	SB 24	SB 25	SB 26	SB 27
207	16	4	34	NS	22	135	18	4	13
206	17	2	29	NS	25	72	14	1	18
205	13	2	14	NS	20	131	13	1	13
204	7	NA	6	NS	16	157	13	1	13
203	7	NA	38	NS	18	148	22	<1	16
202	5	1	9	NS	15	146	19	<1	2
201	4	1	8	NS	NA	205	3	1	4
200	54	1	12	NS	6	97	3	1	<1
199	68	1	57	NS	4	<1	2	1	<1
198	3	1	13	NS	4	6	1	10	<1
197	3	1	111	NS	4	16	2	3	<1
196	12	1	NA	NS	2	41	1	26	<1
195	5	NA	NA	NS	1	6	1	11	3
194	2	1	57	NS	4	68	1	2	3
193	3	1	26	NS	4	9	6	5	<1
192	1	4	30	NS	NA	6	5	1	1
191	10	NA	118	NS	7	9	1	<1	2
190	NA	<1	114	NS	NA	NA	1	1	NA
189	NA	2	7	NS	NA	NA	3	<1	NA
188	1	1	9	NS	1	11	2	2	1
187	<1	1	9	NS	<1	20	3	2	1
186	1	NA	2	NS	<1	1	5	2	<1
185	2	NA	2	NS	<1	3	<1	NA	<1
184	NA	NA	6	NS	<1	4	<1	1	<1
183	NA	NA	25	NS	<1	30	<1	1	1
182	7	2	7	NS	1	4	2	1	1
181	4	2	2	NS	1	3	2	<1	2
180	3	4	8	NS	1	39	3	1	3
179	3	NA	12	NS	1	49	3	<1	2
178	23	4	8	NS	1	17	3	<1	6
177	24	NA	50	NS	NA	NA	NA	1	1
176	1	5	60	NS	2	41	NA	<1	1
175	3	1	7	NS	NA	36	4	1	<1
174	6	5	1	NS	2	41	4	1	3
173	2	3	40	NS	2	40	1	2	<1
172	10	2	41	NS	<1	13	<1	3	<1
171	15	1	44	NS	<1	21	1	1	1
170	10	1	37	NS	<1	NA	<1	<1	NS
169	5	1	14	NS	<1	NA	<1	NA	NS
168	5	1	18	NS	<1	37	<1	1	NS
167	6	1	22	NS	1	35	4	1	NS
166	5	<1	21	NS	<1	36	1	<1	NS
165	3	<1	NA	NS	3	35	2	1	NS
164	3	NA	NA	NS	<1	31	18	NA	NS
163	4	NA	1	NS	<1	9	1	4	NS
162	2	1	<1	NS	108	4	1	1	NS
161	2	2	1	NS	155	4	107	4	NS
160	1	1	<1	NS	NA	62	46	1	NS

TABLE 15-25 (cont.)

Elevation (ft msl)	Concentration (pCi/mL) SB 31	SB 30	SB 21	SB 22	SB 23	SB 24	SB 25	SB 26	SB 27
159	<1	NA	<1	NS	61	69	NA	1	NS
158	9	2	<1	NS	6	45	NA	1	NS
157	<1	3	1	NS	7	27	NA	1	NS
156	1	1	<1	NS	5	32	NA	1	NS
155	2	NA	1	NS	3	7	915	<1	NS
154	3	1	<1	NS	<1	3	19	2	NS
153	2	3	NA	NS	1	5	35	NA	NS
152	5	3	NA	NS	<1	32	382	NA	NS
151	4	NA	7	NS	3	81	1	NA	NS
150	NA	2	9	NS	<1	63	<1	2	NS
149	NA	<1	1	NS	<1	21	2	<1	NS
148	<1	1	<1	NS	<1	148	202	1	NS
147	<1	NS	3	NS	NA	47	<1	NA	NS
146	<1	NS	2	NS	1	46	104	<1	NS
145	2	NS	3	NS	6	44	NA	1	NS
144	1	NS	9	NS	1	58	NA	1	NS
143	1	NS	NS	NS	NA	20	759	<1	NS
142	<1	NS	NS	NS	NA	61	192	1	NS
141	<1	NS	NS	NS	3	182	NA	NS	NS
140	NS	NS	NS	NS	NA	5	180	NS	NS
139	NS	NS	NS	NS	NA	16	NS	NS	NS
138	NS	NS	NS	NS	<1	302	NS	NS	NS
137	NS	NS	NS	NS	NA	344	NS	NS	NS
136	NS	NS	NS	NS	1	NA	NS	NS	NS
135	NS	NS	NS	NS	<1	NA	NS	NS	NS
134	NS	NS	NS	NS	NS	478	NS	NS	NS
133	NS	NS	NS	NS	NS	401	NS	NS	NS
132	NS	NS	NS	NS	NS	195	NS	NS	NS
131	NS	NS	NS	NS	NS	127	NS	NS	NS
130	NS	NS	NS	NS	NS	212	NS	NS	NS
129	NS	NS	NS	NS	NS	94	NS	NS	NS
128	NS	NS	NS	NS	NS	NA	NS	NS	NS
127	NS	NS	NS	NS	NS	NA	NS	NS	NS
126	NS	NS	NS	NS	NS	29	NS	NS	NS
125	NS	NS	NS	NS	NS	112	NS	NS	NS
124	NS	NS	NS	NS	NS	16	NS	NS	NS
123	NS	NS	NS	NS	NS	22	NS	NS	NS

Note: NA = not analyzed. NS = not sampled. Data are from Emslie et al. (1984).

TABLE 15-26

Radioactivity in the Burial Grounds Wells (1958-1986)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
MGA 1						
1980	0.50	1.00	10.00	45.00	10,660	16,930
1981	0.50	1.00	7.00	7.00	3,660	8,430
1982	0.50	1.00	7.00	7.00	7,340	13,070
1983	1.00	2.00	4.00	11.00	46,930	93,550
1984	1.00	2.00	5.00	8.00	217,300	377,000
1985	1.00	1.00	6.00	8.00	150,000	230,000
1986	2.00	3.00	21.00	37.00	24,300	51,800
MGA 3						
1980	0.50	0.50	66.00	91.00	38,590	47,240
1981	1.00	5.00	61.00	102.00	31,930	47,120
1982	1.00	2.00	51.00	68.00	26,160	28,220
1983	1.00	1.00	176.00	402.00	30,630	34,350
1984	1.00	1.00	210.00	221.00	79,000	128,000
1985	1.00	1.00	54.00	114.00	150,000	470,000
1986	1.00	1.00	78.00	182.00	52,600	81,000
MGA 5						
1980	4.00	7.00	7.00	33.00	234,960	406,320
1981	5.00	10.00	9.00	24.00	120,780	229,790
1982	2.00	4.00	23.00	53.00	130,250	215,910
1983	1.00	2.00	5.00	9.00	221,680	253,730
1984	1.00	2.00	5.00	15.00	1,022,000	1,320,000
1985	1.00	2.00	15.00	33.00	490,000	1,200,000
1986	3.00	7.00	46.00	84.00	28,300	45,300
MGA 7						
1980	3.00	9.00	7.00	17.00	7,820	10,530
1981	3.00	5.00	17.00	56.00	4,000	5,580
1982	2.00	5.00	30.00	110.00	9,310	15,100
1983	1.00	2.00	9.00	14.00	10,280	12,040
1984	2.00	2.00	6.00	12.00	12,010	29,400
1985	1.00	2.00	8.00	10.00	72,000	11,000
1986	1.00	1.00	86.00	278.00	2,070	3,820

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCA 9						
1980	1.00	5.00	9.00	52.00	110	270
1981	1.00	3.00	7.00	37.00	30	60
1982	1.00	1.00	7.00	7.00	110	140
MCA 11						
1980	0.50	1.00	7.00	14.00	180	850
1981	2.00	4.00	7.00	41.00	90	250
1982	4.00	15.00	20.00	48.00	260	530
1984	3.00	5.00	1.00	1.00	1,090	2,980
1985	1.00	2.00	3.00	5.00	1,900	3,000
1986	1.00	1.00	5.00	8.00	1,820	4,140
MCA 19						
1980	1.00	3.00	7.00	23.00	120	220
1981	6.00	18.00	36.00	109.00	100	130
1982	1.00	2.00	12.00	22.00	210	910
1983	1.00	1.00	1.00	1.00	70	100
1984	1.00	1.00	1.00	2.00	70	120
1985	1.00	1.00	2.00	5.00	3,100	8,000
1986	2.00	4.00	9.00	30.00	950	2,560
MCA 21						
1980	1.00	1.00	7.00	27.00	70	90
1981	0.50	1.00	7.00	17.00	100	110
1982	0.50	1.00	7.00	7.00	100	110
1983	1.00	2.00	3.00	6.00	80	100
1984	1.00	3.00	1.00	1.00	100	190
1985	1.00	1.00	1.00	1.00	320	740
1986	1.00	1.00	7.00	24.00	2,220	6,160
MCA 23						
1980	0.50	1.00	11.00	41.00	260	410
1981	2.00	5.00	7.00	41.00	400	540
1982	1.00	3.00	7.00	7.00	200	770
1983	1.00	1.00	1.00	1.00	40	60
1984	1.00	1.00	1.00	1.00	140	380
1985	1.00	1.00	1.00	2.00	100	130
1986	1.00	1.00	8.00	12.00	2,920	8,410

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MGA 32						
1980	2.00	5.00	7.00	11.00	140	200
1981	2.00	6.00	10.00	46.00	90	110
1982	1.00	3.00	15.00	38.00	60	80
1983	2.00	4.00	4.00	9.00	370	1,100
1984	1.00	2.00	6.00	17.00	460	1,500
1985	1.00	2.00	2.00	5.00	490	890
1986	1.00	1.00	7.00	21.00	2,340	6,230
MGA 34						
1980	1.00	2.00	9.00	34.00	60	80
1981	2.00	3.00	15.00	41.00	60	70
1982	1.00	3.00	20.00	80.00	60	70
1983	1.00	2.00	4.00	9.00	70	70
1984	1.00	1.00	21.00	37.00	90	180
1985	1.00	1.00	45.00	93.00	160	230
1986	1.00	1.00	57.00	87.00	820	1,960
MGA 36						
1975	1.57	1.72	3.42	4.97	236	290
1976	1.86	3.85	3.79	8.34	266	360
1977	1.20	1.40	7.20	8.20	200	230
1978	1.20	1.80	1.00	4.70	250	320
1979	0.82	1.10	0.53	1.70	230	350
1980	1.30	2.10	1.30	5.50	420	540
1981	0.75	1.10	7.60	16.00	310	330
1982	0.93	1.80	2.70	12.00	540	750
1983	0.96	1.60	2.50	5.00	870	1,500
1984	0.65	1.20	2.40	3.60	6,800	12,000
1985	0.56	1.84	1.50	3.20	16,000	20,000
1986	0.52	0.87	0.79	0.84	8,500	13,000
MGC 1						
1980	0.50	1.00	28.00	99.00	21,690	47,680
1981	1.00	1.00	21.00	49.00	10,100	12,190
1982	1.00	3.00	42.00	74.00	1,960	4,420
1983	1.00	1.00	40.00	54.00	1,290	2,760
1984	1.00	1.00	20.00	23.00	6,230	11,500
1985	1.00	1.00	17.00	25.00	25,000	61,000
1986	1.00	2.00	15.00	25.00	20,250	37,200

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 3						
1980	1.00	2.00	17.00	101.00	998,860	1,150,820
1981	2.00	5.00	12.00	47.00	619,460	859,130
1982	1.00	3.00	12.00	51.00	295,640	422,250
1983	1.00	2.00	1.00	2.00	268,540	343,300
1984	1.00	1.00	11.00	40.00	165,000	333,000
1985	1.00	1.00	1.00	1.00	150,000	230,000
1986	1.00	1.00	14.00	31.00	407,000	732,000
MCC 5						
1980	1.00	4.00	7.00	17.00	213,060	850,460
1981	2.00	3.00	7.00	28.00	70,280	79,860
1982	2.00	5.00	23.00	50.00	166,300	783,400
1983	1.00	1.00	8.00	20.00	10,720	11,160
1984	1.00	2.00	12.00	26.00	138,000	202,000
1985	1.00	1.00	8.00	15.00	700,000	980,000
1986	2.00	3.00	24.00	40.00	678,000	763,000
MCC 7						
1980	1.00	3.00	11.00	33.00	242,930	285,550
1981	1.00	2.00	7.00	25.00	333,620	729,990
1982	1.00	3.00	23.00	64.00	126,570	277,600
1983	1.00	1.00	1.00	2.00	59,630	122,100
1984	1.00	2.00	2.00	6.00	642,000	1,130,000
1985	1.00	1.00	1.00	1.00	620,000	720,000
1986	1.00	1.00	123.00	247.00	410,000	538,000
MCC 9						
1975	0.14	0.43	1.71	2.79	7,780	8,002
1976	0.52	2.01	5.77	12.71	19,613	31,832
1977	1.50	3.20	13.00	15.00	34,000	36,000
1978	0.96	1.80	2.10	5.00	27,000	30,000
1979	0.53	0.81	2.70	3.80	20,000	24,000
1980	1.00	1.60	3.00	6.30	15,000	17,000
1981	0.67	1.20	3.80	7.90	10,000	13,000
1982	0.61	1.10	3.80	9.90	7,300	8,100
1983	0.25	0.44	4.40	5.00	8,900	12,000
1984	0.31	0.76	3.90	7.60	24,000	34,000
1985	0.18	0.23	4.10	5.30	36,000	38,000
1986	0.58	0.72	5.10	6.30	30,000	35,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 11						
1975	1.14	1.42	1.07	2.13	45	46
1976	0.97	1.09	1.38	2.65	32	38
1977	0.79	1.30	4.90	9.80	28	38
1978	1.30	2.20	1.00	4.70	32	50
1979	0.33	0.41	-0.78	0.00	25	43
1980	0.78	1.20	1.00	3.10	26	35
1981	1.00	2.00	4.40	18.00	15	21
1982	0.71	1.20	5.80	14.00	26	32
1983	0.47	0.73	2.00	3.50	25	25
1984	0.30	0.49	1.00	1.80	33	34
1985	0.72	0.92	1.90	2.60	35	46
1986	---	---	---	---	210	210
MCC 13						
1980	3.00	8.00	7.00	18.00	40	70
1981	5.00	8.00	28.00	118.00	40	50
1982	4.00	6.00	36.00	92.00	40	70
1983	1.00	2.00	3.00	5.00	120	220
1984	1.00	2.00	12.00	24.00	390	1,200
1985	1.00	2.00	24.00	42.00	320	630
1986	3.00	3.00	20.00	44.00	530	1,300
MCC 15						
1980	8.00	15.00	17.00	64.00	40	80
1981	7.00	11.00	26.00	58.00	30	40
1982	5.00	10.00	20.00	70.00	30	40
1983	1.00	1.00	7.00	13.00	30	40
1984	6.00	12.00	2.00	5.00	70	120
1985	7.00	13.00	1.00	1.00	71	91
1986	20.00	50.00	24.00	75.00	230	340
MCC 17						
1980	12.00	23.00	7.00	7.00	30	30
1981	7.00	12.00	7.00	37.00	30	40
1982	4.00	6.00	14.00	25.00	30	40
1983	2.00	4.00	1.00	1.00	30	30
1984	4.00	10.00	1.00	4.00	90	210
1985	2.00	7.00	1.00	1.00	110	240
1986	10.00	14.00	27.00	79.00	130	170

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L)		Nonvol. Beta (pCi/L)		Tritium (pCi/mL)	
	Mean	Max	Mean	Max	Mean	Max
MCC 19						
1975	1.39	2.43	4.00	7.99	33	34
1976	0.69	1.17	2.64	5.46	26	27
1977	0.42	0.50	7.00	11.00	17	43
1978	0.69	0.84	0.13	4.00	25	31
1979	0.86	0.91	1.80	5.30	67	83
1980	0.82	1.20	5.40	10.00	34	46
1981	0.57	1.20	1.50	6.80	35	45
1982	0.62	0.82	1.30	4.50	39	42
1983	0.59	1.60	4.10	9.00	27	30
1984	0.41	0.68	2.30	2.90	26	26
1985	0.35	0.58	1.70	2.10	34	41
1986	0.37	1.10	1.80	2.50	40	53
MCC 21						
1980	2.00	8.00	7.00	15.00	7,830	13,550
1981	3.00	7.00	23.00	137.00	4,770	6,170
1982	2.00	3.00	20.00	80.00	4,880	10,260
1983	1.00	2.00	2.00	4.00	2,450	3,180
1984	2.00	4.00	4.00	10.00	5,810	14,200
1985	1.00	1.00	1.00	1.00	8,800	11,000
1986	2.00	3.00	15.00	43.00	5,300	9,330
MCC 23						
1975	0.86	1.21	0.00	0.00	1,888	2,030
1976	0.55	0.84	1.45	4.03	1,047	1,251
1977	0.36	0.51	2.00	6.70	3,400	6,900
1978	0.53	0.92	0.43	6.30	4,700	6,100
1979	0.52	1.20	1.90	4.10	17,000	24,000
1980	0.67	0.81	0.12	7.60	25,000	39,000
1981	0.49	0.73	0.25	3.00	52,000	68,000
1982	0.56	1.10	1.00	5.50	44,000	62,000
1983	1.00	2.40	3.80	8.10	22,000	43,000
1984	1.00	1.90	1.60	2.50	15,000	25,000
1985	1.10	2.30	1.60	2.20	4,900	12,000
1986	1.00	1.10	2.10	2.80	25,000	32,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 30						
1980	2.00	7.00	7.00	27.00	340	440
1981	2.00	3.00	26.00	49.00	230	380
1982	3.00	5.00	7.00	26.00	110	140
1983	2.00	3.00	2.00	4.00	80	90
1984	2.00	2.00	2.00	7.00	100	200
1985	2.00	2.00	2.00	3.00	3,800	8,000
1986	2.00	4.00	50.00	109.00	4,290	12,300
MCC 32						
1975	1.53	1.76	11.94	12.66	1,383	1,647
1976	1.78	3.68	6.64	10.77	692	1,151
1977	1.70	2.00	8.40	11.00	2,200	2,600
1978	1.30	2.30	2.50	4.40	1,100	1,700
1979	1.00	1.80	2.10	5.80	5,300	18,000
1980	1.90	3.00	8.40	25.00	2,900	6,800
1981	1.60	2.20	11.00	22.00	720	800
1982	2.10	3.10	5.50	16.00	3,200	4,600
1983	1.10	1.70	4.50	8.40	27,000	72,000
1984	1.30	1.50	5.60	7.30	7,300	12,000
1985	1.10	1.50	4.90	7.20	3,700	6,600
1986	1.30	2.00	3.20	5.40	1,500	2,300
MCC 34						
1980	1.00	2.00	42.00	100.00	270	380
1981	1.00	1.00	112.00	167.00	200	280
1982	3.00	11.00	49.00	129.00	150	160
1983	1.00	3.00	48.00	102.00	220	350
1984	1.00	1.00	3,602.00	7,705.00	580	1,330
1985	1.00	1.00	89.00	134.00	690	820
1986	4.00	11.00	125.00	202.00	1,510	2,350
MCC 36						
1975	1.28	1.38	5.81	6.03	1,969	2,774
1976	0.47	0.99	8.41	16.33	555	1,124
1977	0.48	1.00	2.90	5.10	300	410
1978	1.20	1.50	0.92	2.20	320	350
1979	0.84	1.30	0.88	2.00	550	970

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MGC 36 (cont.)						
1980	0.61	0.66	1.00	4.50	550	920
1981	0.43	0.57	3.00	10.00	180	430
1982	0.87	1.20	3.90	8.30	890	1,600
1983	0.83	1.30	3.00	7.10	1,100	1,900
1984	0.89	2.00	2.00	4.00	3,100	5,000
1985	0.50	0.80	1.80	2.90	1,100	2,000
1986	0.70	0.98	1.60	2.40	650	1,000
MGE 1						
1980	2.00	4.00	17.00	49.00	1,180	1,530
1981	1.00	7.00	13.00	57.00	2,170	3,100
1982	3.00	11.00	11.00	26.00	2,120	3,040
1983	1.00	1.00	3.00	5.00	6,310	10,350
1984	1.00	1.00	7.00	16.00	25,400	61,600
1985	1.00	1.00	5.00	8.00	15,000	23,000
1986	1.00	1.00	14.00	29.00	87,900	216,000
MGE 3						
1980	1.00	3.00	21.00	95.00	40,270	52,070
1981	1.00	2.00	30.00	97.00	57,730	65,020
1982	1.00	3.00	15.00	22.00	45,200	62,100
1983	1.00	1.00	2.00	6.00	138,460	396,290
1984	2.00	2.00	4.00	15.00	639,000	1,330,000
1985	1.00	1.00	4.00	8.00	260,000	330,000
1986	1.00	2.00	9.00	24.00	263,670	291,000
MGE 5						
1980	2.00	6.00	7.00	23.00	12,450	18,660
1981	1.00	2.00	14.00	26.00	47,720	81,670
1982	1.00	2.00	16.00	51.00	41,620	87,930
1983	2.00	3.00	2.00	6.00	34,570	124,840
1984	1.00	2.00	2.00	5.00	19,100	55,800
1985	1.00	2.00	3.00	9.00	130,000	230,000
1986	4.00	6.00	14.00	45.00	130,870	203,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCE 7						
1980	1.00	3.00	7.00	18.00	3,420	6,560
1981	2.00	5.00	19.00	65.00	12,220	19,000
1982	1.00	3.00	23.00	72.00	5,490	18,980
1983	1.00	1.00	1.00	1.00	1,420	2,090
1984	1.00	3.00	1.00	2.00	9,830	21,900
1985	1.00	2.00	1.00	1.00	16,000	35,000
1986	1.00	2.00	9.00	26.00	90,620	241,000
MCE 9						
1975	1.03	1.21	1.74	2.05	37	37
1976	0.52	0.78	2.60	7.82	44	69
1977	0.25	0.59	5.00	10.00	36	43
1978	0.57	1.20	4.20	14.00	180	620
1979	0.43	0.66	1.30	3.10	120	340
1980	0.45	0.66	1.70	13.00	28	39
1981	0.28	0.81	1.90	0.41	110	360
1982	0.25	0.42	0.52	2.30	23	25
1983	0.25	0.88	0.10	0.69	29	42
1984	0.20	0.49	1.80	4.90	35	60
1985	0.10	0.41	0.25	1.30	25	29
1986	0.08	0.11	0.26	0.78	150	470
MCE 13						
1980	1.00	3.00	7.00	21.00	20	30
1981	3.00	6.00	16.00	72.00	20	30
1982	0.50	2.00	7.00	11.00	40	120
1983	1.00	1.00	1.00	1.00	100	340
1984	1.00	1.00	2.00	7.00	80	160
1985	1.00	1.00	1.00	1.00	260	370
1986	1.00	1.00	20.00	76.00	1,030	2,460
MCE 15						
1980	2.00	6.00	74.00	214.00	60	90
1981	2.00	3.00	25.00	50.00	50	60
1982	---	---	---	---	220	750

TABLE 15-26 (cont.)

	Gross Alpha (pCi/L)		Nonvol. Beta (pCi/L)		Tritium (pCi/mL)	
Year	Mean	Max	Mean	Max	Mean	Max
MCE 17						
1978	0.45	1.50	9.00	12.00	30	49
1980	0.50	1.00	22.00	111.00	60	70
1981	3.00	3.00	7.00	3.00	---	---
1982	1.00	2.00	38.00	128.00	---	---
1983	2.00	7.00	8.00	13.00	110	140
1984	1.00	2.00	8.00	12.00	110	210
1985	1.00	1.00	3.00	5.00	220	310
1986	1.00	1.00	9.00	10.00	320	420
MCE 19						
1980	0.50	0.50	9.00	33.00	600	630
1981	1.00	3.00	29.00	158.00	540	610
1982	1.00	3.00	22.00	60.00	440	480
1983	1.00	1.00	8.00	20.00	560	610
1984	1.00	1.00	6.00	10.00	610	980
1985	1.00	1.00	2.00	4.00	440	690
1986	1.00	1.00	103.00	344.00	730	1,630
MCE 21						
1975	1.60	2.51	2.93	3.72	29	29
1976	0.77	1.24	2.09	3.13	26	38
1977	1.20	1.30	4.90	8.10	13	16
1978	1.20	2.10	2.20	4.80	11	14
1979	0.80	1.20	0.46	3.30	12	17
1980	1.30	2.00	0.89	5.30	29	45
1981	0.67	0.97	1.60	8.90	28	36
1982	1.20	2.00	4.70	7.50	170	380
1983	0.76	1.60	2.10	3.70	1,300	3,100
1984	2.30	6.50	2.50	3.40	1,700	1,900
1985	0.32	0.43	1.80	3.40	990	2,000
1986	0.86	1.40	1.70	3.10	150	180
MCE 23						
1980	2.00	9.00	7.00	7.00	1,960	8,140
1981	1.00	2.00	9.00	45.00	180	250
1982	2.00	3.00	4.00	24.00	110	160
1983	3.00	3.00	6.00	10.00	310	590
1984	3.00	10.00	73.00	286.00	410	750
1985	1.00	2.00	2.00	5.00	56,000	120,000
1986	3.00	7.00	13.00	29.00	1,740	3,320

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCE 30						
1975	1.32	1.38	0.84	1.67	359	394
1976	1.40	1.72	5.14	16.59	520	891
1977	1.30	2.30	10.00	11.00	340	360
1978	1.50	1.90	4.70	7.60	330	360
1979	0.59	0.82	1.50	6.30	210	320
1980	1.40	2.00	8.00	16.00	130	160
1981	1.20	1.80	39.00	140.00	120	140
1982	1.10	1.70	9.70	17.00	130	150
1983	1.20	1.50	5.60	10.00	150	160
1984	0.84	1.10	3.60	4.70	220	280
1985	0.80	0.94	2.90	5.50	170	240
1986	1.10	1.60	2.50	3.80	130	140
MCE 32						
1980	4.00	6.00	37.00	182.00	500	920
1981	3.00	5.00	12.00	60.00	290	380
1982	2.00	5.00	30.00	67.00	2,660	8,570
1983	4.00	5.00	2.00	4.00	17,050	34,170
1984	1.00	1.00	34.00	108.00	73,500	112,000
1985	1.00	2.00	9.00	26.00	160,000	360,000
1986	2.00	3.00	13.00	23.00	128,000	153,000
MCE 34						
1975	1.01	1.76	124.44	200.96	795	987
1976	0.90	1.26	53.01	111.66	496	794
1977	0.82	0.85	33.00	36.00	340	420
1978	0.85	1.70	12.00	20.00	480	860
1979	0.55	0.73	21.00	26.00	380	640
1980	0.83	0.97	12.00	15.00	720	990
1981	0.57	1.10	23.00	32.00	350	550
1982	0.93	1.60	25.00	39.00	670	1,000
1983	0.85	1.30	12.00	22.00	32,000	92,000
1984	0.72	0.97	7.70	13.00	51,000	82,000
1985	0.35	0.58	5.50	6.60	66,000	88,000
1986	1.40	2.00	39.00	75.00	17,000	20,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
MCE 36						
1980	2.00	3.00	7.00	17.00	650	1020
1981	3.00	4.00	17.00	32.00	530	690
1982	1.00	4.00	9.00	24.00	2,430	5,900
1983	1.00	1.00	1.00	2.00	56,720	210,700
1984	1.00	1.00	4.00	9.00	725,000	1,610,000
1985	1.00	1.00	9.00	33.00	2,100,000	7,000,000
1986	2.00	3.00	13.00	41.00	415,000	628,000
MCC 1						
1980	0.50	1.00	7.00	7.00	500	880
1981	1.00	5.00	7.00	14.00	7,580	15,410
1982	1.00	5.00	11.00	45.00	2,660	5,580
1983	1.00	2.00	3.00	7.00	8,690	15,000
1984	1.00	1.00	3.00	6.00	53,800	95,600
1985	1.00	1.00	3.00	8.00	32,000	54,000
1986	1.00	1.00	35.00	130.00	14,370	24,500
MCC 3						
1980	2.00	3.00	7.00	7.00	790	1,360
1981	2.00	5.00	8.00	20.00	1,170	1,700
1982	3.00	10.00	19.00	91.00	1,370	1,720
1983	2.00	4.00	3.00	6.00	1,710	2,220
1984	2.00	3.00	1.00	3.00	4,310	10,000
1985	2.00	4.00	6.00	12.00	76,000	290,000
1986	3.00	3.00	15.00	38.00	4,660	10,500
MCC 5						
1980	1.00	1.00	7.00	7.00	1,000	1,710
1981	4.00	8.00	9.00	32.00	910	1,090
1982	2.00	4.00	21.00	66.00	880	1,050
1983	1.00	1.00	3.00	5.00	610	700
1984	1.00	1.00	1.00	1.00	320	380
1985	1.00	2.00	2.00	6.00	550	960
1986	4.00	6.00	28.00	84.00	9,750	27,300

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 7						
1980	1.00	3.00	15.00	50.00	27,170	32,440
1981	1.00	3.00	11.00	34.00	30,210	34,550
1982	2.00	3.00	8.00	45.00	17,130	25,700
1983	1.00	1.00	42.00	89.00	10,690	16,760
1984	1.00	1.00	192.00	508.00	32,300	43,100
1985	1.00	1.00	230.00	590.00	44,000	79,000
1986	1.00	1.00	94.00	128.00	35,300	40,100
MCC 9						
1980	2.00	6.00	7.00	22.00	35,210	57,900
1981	4.00	9.00	24.00	57.00	27,280	52,960
1982	4.00	10.00	31.00	106.00	39,680	57,540
1983	2.00	3.00	29.00	32.00	17,060	25,120
1984	1.00	3.00	28.00	31.00	17,700	21,800
1985	1.00	1.00	3.00	3.00	58,000	120,000
1986	2.00	2.00	16.00	34.00	22,110	45,800
MCC 13						
1980	4.00	9.00	14.00	37.00	401,830	761,970
1981	5.00	7.00	37.00	75.00	248,720	356,900
1982	5.00	9.00	20.00	115.00	117,480	168,870
1983	2.00	4.00	2.00	5.00	43,110	115,880
1984	1.00	2.00	1.00	1.00	130,400	285,000
1985	1.00	2.00	2.00	7.00	1,110,000	2,500,000
1986	5.00	10.00	22.00	44.00	4,300,000	4,530,000
MCC 15						
1975	1.16	1.64	3.43	6.52	10,495	12,018
1976	1.41	2.97	1.79	4.29	17,387	23,917
1977	1.20	1.70	10.00	24.00	26,000	35,000
1978	0.73	1.30	2.80	8.00	24,000	34,000
1979	0.66	0.81	0.29	2.10	60,000	180,000
1980	0.49	0.65	0.09	2.70	5,600	6,500
1981	0.57	0.73	-1.90	0.00	19,000	28,000
1982	0.50	0.75	2.70	9.40	13,000	30,000
1983	0.71	0.88	---	---	8,600	12,000
1984	0.51	1.10	1.70	3.60	20,000	26,000
1985	0.41	0.68	0.77	1.30	47,000	66,000
1986	0.84	1.20	2.00	2.60	61,000	80,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 17						
1980	1.00	2.00	13.00	42.00	9,570	14,320
1981	1.00	5.00	24.00	47.00	6,640	9,020
1982	1.00	7.00	25.00	92.00	4,740	5,850
1983	1.00	2.00	3.00	6.00	2,910	3,670
1984	1.00	1.00	2.00	3.00	4,230	10,300
1985	1.00	3.00	2.00	3.00	1,900	2,200
1986	2.00	2.00	33.00	94.00	25,810	70,200
MCC 19						
1975	5.26	9.13	6.92	10.29	129	132
1976	0.68	1.47	3.30	7.28	111	122
1977	0.93	1.30	11.00	15.00	73	95
1978	0.49	1.10	6.20	20.00	88	95
1979	0.54	1.10	1.60	2.60	76	86
1980	0.33	0.57	0.87	5.50	75	79
1981	0.61	0.97	4.40	13.00	59	69
1982	0.75	1.40	5.50	12.00	61	70
1983	0.47	0.91	10.00	19.00	60	86
1984	0.75	1.60	11.00	26.00	120	160
1985	0.21	0.42	14.00	21.00	61	69
1986	0.21	0.43	8.80	12.00	51	63
MCC 21						
1980	33.00	83.00	452.00	713.00	324,730	530,050
1981	63.00	157.00	3,226.00	10,633.00	291,950	480,000
1982	255.00	738.00	9,128.00	16,374.00	93,550	179,720
1983	116.00	390.00	8,774.00	15,247.00	46,440	76,200
1984	231.00	387.00	15,453.00	20,413.00	26,400	40,000
1985	141.00	360.00	720.00	1,900.00	110,000	170,000
1986	636.00	16.00	3,837.00	13,180.00	201,000	261,000
MCC 23						
1975	0.90	1.12	3.35	6.70	17,273	18,386
1976	0.58	1.21	14.20	27.55	13,900	18,297
1977	0.73	0.93	3.80	4.80	8,600	17,000
1978	0.65	1.40	0.48	3.80	8,100	14,000
1979	0.28	0.41	2.50	5.80	2,400	5.600

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 23 (cont.)						
1980	0.41	0.73	4.10	7.20	5,700	11,000
1981	0.35	0.73	1.50	5.30	1,100	2,100
1982	0.39	0.49	0.72	5.90	1,200	1,500
1983	0.28	0.58	1.20	3.30	1,200	1,800
1984	0.46	1.50	2.20	3.30	630	820
1985	0.22	0.45	0.53	1.60	210	290
1986	0.11	0.29	1.60	2.40	240	290
MCC 28						
1975	2.29	3.10	0.62	1.24	70	70
1976	1.74	4.44	4.52	7.92	114	180
1977	0.51	0.93	6.50	9.30	63	65
1978	1.10	2.40	1.30	3.30	63	77
1979	0.46	0.66	1.10	8.40	52	66
1980	0.67	1.10	3.10	6.10	64	71
1981	0.77	1.10	3.10	4.80	49	52
1982	0.19	0.66	1.50	6.10	75	120
1983	0.21	0.41	2.30	4.50	71	88
1984	0.31	0.49	1.60	1.80	110	150
1985	0.14	0.34	0.83	1.10	70	90
1986	0.23	0.29	0.48	0.78	58	60
MCC 30						
1980	1.00	4.00	7.00	23.00	5,030	5,410
1981	1.00	3.00	12.00	56.00	5,080	6,670
1982	1.00	4.00	11.00	35.00	2,860	5,480
1983	1.00	1.00	6.00	17.00	3,040	4,090
1984	1.00	3.00	1.00	3.00	5,530	9,390
1985	1.00	1.00	2.00	5.00	6,100	12,000
1986	2.00	4.00	212.00	812.00	39,980	100,000
MCC 32						
1980	2.00	3.00	14.00	41.00	213,880	249,330
1981	1.00	3.00	14.00	46.00	223,710	248,250
1982	4.00	18.00	8.00	28.00	175,400	260,110
1983	1.00	2.00	1.00	1.00	209,190	219,640
1984	1.00	1.00	100.00	260.00	445,000	573,000
1985	1.00	1.00	530.00	1,300.00	410,000	580,000
1986	1.00	2.00	165.00	347.00	650,000	696,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCC 34						
1980	1.00	3.00	19.00	66.00	2,990,810	6,624,390
1981	2.00	3.00	7.00	12.00	3,289,840	4,330,230
1982	1.00	3.00	7.00	15.00	2,188,740	5,150,000
1983	1.00	3.00	1.00	4.00	659,360	1,435,830
1984	1.00	2.00	6.00	9.00	353,000	648,000
1985	1.00	1.00	5.00	14.00	350,000	530,000
1986	2.00	5.00	15.00	30.00	701,000	1,120,000
MCC 36						
1975	0.85	1.03	0.65	1.30	347	363
1976	0.52	0.95	1.42	6.95	419	584
1977	0.25	0.59	5.90	8.10	380	380
1978	0.77	1.20	0.23	5.00	400	420
1979	0.08	0.16	0.56	1.50	380	520
1980	0.10	0.41	0.18	3.00	890	1,200
1981	0.26	0.32	4.80	0.00	750	870
1982	1.90	7.30	0.81	7.20	2,800	4,000
1983	0.15	0.29	2.60	7.50	8,600	16,000
1984	0.79	2.30	1.70	2.90	23,000	25,000
1985	0.05	0.10	0.21	1.60	69,000	84,000
1986	0.36	0.68	1.50	2.00	130,000	180,000
MCI 1						
1980	6.00	8.00	36.00	75.00	37,770	65,350
1981	7.00	12.00	37.00	55.00	50,310	80,410
1982	6.00	9.00	50.00	91.00	65,740	113,720
1983	5.00	6.00	54.00	77.00	33,110	36,830
1984	2.00	5.00	179.00	274.00	42,000	51,600
1985	1.00	3.00	110.00	240.00	102,000	140,000
1986	3.00	5.00	103.00	146.00	159,400	274,500
MCI 5						
1980	1.00	3.00	18.00	71.00	3,240	5,180
1981	1.00	2.00	7.00	22.00	1,570	3,210
1982	1.00	1.00	20.00	67.00	2,250	3,280
1983	1.00	3.00	10.00	38.00	20,600	47,870
1984	3.00	6.00	9.00	22.00	149,000	365,000
1985	3.00	7.00	10.00	26.00	120,000	170,000
1986	1.00	2.00	8.00	23.00	61,200	88,700

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
MCI 7						
1980	0.50	1.00	7.00	8.00	94,130	109,240
1981	1.00	2.00	9.00	27.00	87,560	469,230
1982	0.50	1.00	24.00	58.00	89,880	106,870
1983	1.00	1.00	836.00	3,289.00	92,930	192,420
1984	1.00	1.00	14.00	29.00	398,000	546,000
1985	1.00	1.00	3.00	5.00	450,000	580,000
1986	2.00	4.00	26.00	53.00	50,900	56,100
MCI 9						
1980	0.50	1.00	7.00	11.00	1,810	3,230
1981	1.00	3.00	7.00	37.00	1,100	2,780
1982	1.00	2.00	8.00	31.00	4,300	7,100
1983	1.00	1.00	1.00	1.00	4,970	5,930
1984	1.00	2.00	2.00	7.00	870	1,550
1985	1.00	3.00	5.00	12.00	600	720
1986	3.00	5.00	14.00	27.00	9,100	18,700
MCI 13						
1980	18.00	29.00	130.00	219.00	1,350	4,080
1981	35.00	66.00	221.00	337.00	40	5,480
1982	20.00	31.00	157.00	244.00	1,160	2,590
1983	6.00	13.00	78.00	100.00	610	1,820
1984	6.00	9.00	68.00	80.00	1,570	4,310
1985	8.00	17.00	46.00	64.00	15,000	41,000
1986	12.00	16.00	55.00	95.00	1,720	4,840
MCI 15						
1980	3.00	7.00	26.00	48.00	140	380
1981	5.00	10.00	30.00	62.00	40	530
1982	10.00	19.00	26.00	59.00	120	270
1983	17.00	21.00	25.00	29.00	80	160
1984	9.00	16.00	27.00	36.00	150	400
1985	8.00	16.00	20.00	39.00	990	2,700
1986	5.00	8.00	20.00	32.00	3,960	11,500

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
MCI 17						
1980	6.00	11.00	33.00	149.00	140	430
1981	7.00	13.00	18.00	40.00	40	90
1982	6.00	8.00	16.00	41.00	50	80
1983	4.00	6.00	21.00	43.00	300	1,070
1984	3.00	5.00	4.00	10.00	60	120
1985	4.00	7.00	8.00	13.00	170	370
1986	5.00	8.00	153.00	575.00	6,490	16,900
BG 204CR						
1981	11.00	57.00	60.00	306.00	830	2,340
1982	1.00	3.00	32.00	86.00	40	90
1983	1.00	2.00	3.00	6.00	90	280
1984	1.00	2.00	7.00	27.00	300	890
1985	1.00	1.00	3.00	5.00	1,500	4,800
1986	1.00	1.00	22.00	43.00	3,420	9,770
BG 206CR						
1981	3.00	6.00	20.00	52.00	1,590	4,430
1982	4.00	5.00	43.00	123.00	9,660	13,870
1983	3.00	4.00	3.00	6.00	13,250	14,040
1984	2.00	3.00	5.00	8.00	20,000	30,300
1985	1.00	2.00	5.00	10.00	3,300	5,300
1986	1.00	1.00	8.00	15.00	7,130	7,660
BG 208CR						
1981	3.00	6.00	8.00	31.00	5,390	10,810
1982	3.00	9.00	11.00	43.00	13,390	18,750
1983	1.00	2.00	1.00	2.00	20,660	25,600
1984	1.00	1.00	2.00	4.00	78,900	122,000
1985	1.00	3.00	4.00	7.00	175,000	300,000
1986	1.00	1.00	16.00	31.00	94,100	163,000
BG 210CR						
1981	2.00	4.00	10.00	28.00	140	310
1982	3.00	9.00	20.00	58.00	370	460
1983	2.00	3.00	6.00	11.00	510	540
1984	2.00	3.00	1.00	2.00	1,270	2,600
1985	1.00	2.00	3.00	7.00	1,400	3,000
1986	1.00	1.00	20.00	38.00	2,160	2,820

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 212GR						
1981	4.00	11.00	14.00	45.00	20	40
1982	2.00	5.00	7.00	27.00	50	60
1983	1.00	1.00	3.00	9.00	70	80
1984	1.00	1.00	2.00	5.00	170	340
1985	1.00	3.00	1.00	1.00	1,800	5,500
1986	1.00	1.00	11.00	21.00	450	650
BG 214GR						
1984	1.00	1.00	1.00	1.00	40	40
1985	1.30	1.30	2.00	2.00	39	39
1986	1.30	1.30	2.00	2.00	---	---
BG 216GR						
1981	3.00	8.00	31.00	85.00	20	30
1982	4.00	11.00	18.00	48.00	30	30
1983	3.00	6.00	3.00	7.00	30	30
1984	2.00	3.00	5.00	17.00	50	100
1985	1.00	1.00	3.00	6.00	130	290
1986	2.00	3.00	11.00	20.00	290	720
BG 218GR						
1981	8.00	20.00	44.00	152.00	30	40
1982	9.00	18.00	16.00	31.00	30	30
1983	7.00	14.00	5.00	12.00	30	30
1984	7.00	13.00	8.00	13.00	30	70
1985	9.00	13.00	17.00	45.00	480	1,800
1986	5.00	7.00	7.00	12.00	400	1,060
BG 220GR						
1981	1.00	4.00	17.00	62.00	30	30
1982	1.00	2.00	7.00	7.00	30	30
1983	1.00	2.00	3.00	11.00	20	30
1984	2.00	2.00	1.00	3.00	40	80
1985	1.00	3.00	7.00	15.00	61	79
1986	1.00	1.00	27.00	53.00	690	1,940

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 222GR						
1981	1.00	4.00	7.00	15.00	20	30
1982	0.50	1.00	7.00	13.00	20	30
1983	1.00	1.00	3.00	11.00	20	20
1984	1.00	3.00	1.00	4.00	30	70
1985	1.00	2.00	3.00	7.00	54	65
1986	1.00	1.00	5.00	8.00	1,220	3,530
BG 402GR						
1981	3.00	5.00	10.00	41.00	20	30
1982	2.00	6.00	16.00	93.00	50	60
1983	1.00	1.00	3.00	8.00	70	90
1984	1.00	2.00	1.00	3.00	160	300
1985	1.00	2.00	5.00	10.00	260	340
1986	2.00	3.00	16.00	31.00	1,870	4,780
BG 404GR						
1981	3.00	7.00	31.00	81.00	40	90
1982	3.00	13.00	7.00	9.00	190	340
1983	1.00	2.00	7.00	14.00	180	320
1984	1.00	1.00	2.00	3.00	680	1,490
1985	1.00	1.00	3.00	7.00	760	1,100
1986	1.00	1.00	22.00	43.00	2,618	6,520
BG 406GR						
1981	1.00	5.00	7.00	10.00	450	690
1982	2.00	5.00	14.00	41.00	740	1,030
1983	1.00	1.00	4.00	7.00	720	1,030
1984	1.00	1.00	1.00	4.00	1,690	4,100
1985	1.00	1.00	5.00	16.00	2,300	2,800
1986	2.00	4.00	12.00	22.00	3,300	5,490
BG 408GR						
1981	1.00	2.00	10.00	26.00	30	50
1982	2.00	3.00	18.00	54.00	90	130
1983	1.00	4.00	8.00	16.00	250	450
1984	2.00	3.00	2.00	6.00	10,430	32.600
1985	2.00	6.00	2.00	5.00	62,000	100,000
1986	2.00	2.00	19.00	37.00	142,000	157,000

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 410CR						
1981	2.00	4.00	16.00	67.00	20	30
1982	3.00	13.00	18.00	64.00	20	30
1983	1.00	3.00	4.00	11.00	20	20
1984	1.00	1.00	1.00	1.00	50	110
1985	1.00	1.00	3.00	6.00	73	120
1986	1.00	1.00	6.00	10.00	60	60
BC 420CR						
1981	2.00	5.00	7.00	3.00	110	230
1982	5.00	21.00	36.00	183.00	210	300
1983	1.00	1.00	1.00	4.00	280	300
1984	1.00	2.00	2.00	4.00	4,780	13,300
1985	1.00	2.00	7.00	7.00	850	1,200
1986	4.00	6.00	22.00	42.00	440	480
BC 422CR						
1981	5.00	8.00	22.00	57.00	60	240
1982	2.00	5.00	10.00	30.00	20	30
1983	1.00	2.00	4.00	12.00	40	70
1984	1.00	1.00	3.00	7.00	420	970
1985	1.00	3.00	2.00	4.00	470	790
1986	1.00	1.00	8.00	13.00	160	180
BC 620CR						
1981	4.00	8.00	11.00	36.00	80	300
1982	5.00	10.00	24.00	51.00	1,120	2,200
1983	1.00	1.00	8.00	18.00	1,270	1,940
1984	1.00	1.00	3.00	5.00	1,160	2,250
1985	1.00	1.00	5.00	15.00	2,000	2,900
1986	2.00	2.00	8.00	13.00	1,280	1,330
BC 622CR						
1981	5.00	12.00	7.00	7.00	40	140
1982	5.00	5.00	13.00	24.00	520	1,880
1983	1.00	2.00	4.00	8.00	70	160
1984	2.00	3.00	15.00	59.00	340	1,070
1985	1.00	1.00	1.00	2.00	190	250
1986	1.00	1.00	8.00	8.00	210	210

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 818GR						
1981	4.00	6.00	14.00	51.00	20	50
1982	3.00	3.00	33.00	102.00	90	120
1983	2.00	3.00	11.00	13.00	170	250
1984	3.00	3.00	9.00	12.00	160	190
1985	1.00	2.00	4.00	7.00	170	210
1986	1.00	1.00	19.00	28.00	230	230
BC 820GR						
1981	2.00	7.00	46.00	92.00	50	110
1982	2.00	3.00	80.00	297.00	470	810
1983	1.00	1.00	14.00	21.00	1,420	2,930
1984	1.00	1.00	15.00	22.00	1,940	2,540
1985	1.00	1.00	11.00	17.00	1,100	1,400
1986	1.00	1.00	9.00	9.00	350	540
BC 822GR						
1981	7.00	11.00	34.00	156.00	4,000	8,260
1982	8.00	17.00	20.00	51.00	34,260	57,160
1983	4.00	9.00	8.00	10.00	154,850	263,880
1984	4.00	7.00	10.00	16.00	292,000	556,000
1985	2.00	4.00	4.00	8.00	23,000	45,000
1986	1.00	1.00	11.00	12.00	68,400	141,000
BC 824GR						
1982	2.00	6.00	7.00	34.00	20	40
1983	2.00	2.00	1.00	2.00	1,010	3,960
1984	2.00	3.00	1.00	1.00	20	20
BC 1						
1958	0.45	0.45	11.00	23.00	---	---
1959	0.45	1.35	9.00	15.00	---	---
1960	0.40	0.50	7.00	7.00	7	27
1961	0.20	0.70	8.00	18.00	3	20
1962	0.35	0.90	8.00	14.00	---	5
1963	0.35	2.90	6.50	16.00	14	44
1964	0.45	1.90	10.50	37.00	5	12
1965	0.25	0.50	8.00	22.00	---	8
1966	0.25	0.50	3.50	6.00	---	1
1967	0.65	1.60	6.00	7.00	---	2

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 1 (cont.)						
1968	0.30	0.40	4.00	7.00	---	---
1969	0.85	1.40	12.50	21.00	2	3
1970	0.75	0.80	7.50	16.00	5	7
1971	0.85	1.20	8.00	17.00	4	20
1972	0.80	1.30	4.50	11.00	30	40
1973	0.40	0.70	4.00	6.00	60	82
1974	0.40	0.53	1.72	3.67	62	69
1975	0.19	0.50	2.80	4.66	67	71
1976	0.14	0.41	1.86	4.12	67	69
BG 2						
1958	0.45	0.45	11.00	23.00	---	---
1959	0.68	1.35	11.00	39.00	---	---
1960	0.50	1.40	8.00	15.00	8	44
1961	0.30	1.10	10.50	25.00	6	45
1962	0.30	1.00	8.00	14.00	---	9
1963	0.20	0.60	7.00	14.00	3	17
1964	0.25	1.10	9.50	30.00	7	13
1965	0.30	0.60	11.00	30.00	9	25
1966	0.35	0.80	13.00	8.00	15	24
1967	0.45	0.40	7.00	14.00	16	21
1968	0.40	0.60	4.50	9.00	16	18
1969	0.70	1.60	10.50	17.00	32	39
1970	0.65	1.00	11.00	13.00	66	77
1971	0.45	0.90	7.50	11.00	77	100
1972	0.20	0.30	4.50	8.00	87	110
1973	0.40	0.70	---	7.00	140	210
1974	0.34	0.67	2.28	5.05	122	155
1975	1.06	1.59	1.14	3.25	77	102
1976	0.16	0.17	1.93	4.87	59	64
BG 3						
1958	0.45	0.90	13.00	25.00	---	---
1959	0.45	0.45	8.00	14.00	---	---
1960	0.50	0.90	7.00	7.00	4	5
1961	0.20	0.70	11.50	83.00	5	30
1962	0.40	1.80	6.00	17.00	---	7
1963	0.30	0.80	8.00	21.00	3	17
1964	0.40	0.90	9.00	25.00	17	129
1965	0.50	1.10	10.50	25.00	30	120
1966	0.65	0.90	10.50	16.00	16	19

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 3 (cont.)						
1967	1.00	1.40	31.00	57.00	51	82
1968	0.35	0.60	10.00	17.00	102	120
1969	0.75	1.20	18.00	26.00	93	100
1970	0.75	1.00	10.50	15.00	99	100
1971	1.00	1.40	27.00	58.00	77	87
1972	1.35	1.60	13.00	23.00	57	65
1973	1.30	1.60	10.00	20.00	93	170
1974	0.78	0.94	5.37	12.24	54	60
1975	1.02	2.38	3.94	8.05	79	119
1976	0.91	1.32	3.65	4.78	74	82
BC 4						
1958	0.90	1.35	16.00	24.00	---	---
1959	0.68	1.35	9.00	20.00	---	---
1960	0.70	1.40	7.00	7.00	158	217
1961	0.50	1.00	12.50	24.00	220	310
1962	0.75	1.40	9.00	20.00	123	170
1963	0.70	1.30	8.50	24.00	87	108
1964	0.70	1.80	8.50	22.00	192	590
1965	0.85	1.40	11.00	18.00	860	1,600
1966	1.10	1.80	9.50	13.00	246	272
1967	0.90	1.40	9.00	16.00	111	200
1968	1.00	1.20	7.00	10.00	102	130
1969	1.40	1.80	13.00	18.00	140	170
1970	1.00	1.60	10.00	12.00	53	70
1971	1.40	2.00	11.00	13.00	48	60
1972	1.75	2.30	12.00	16.00	86	150
1973	0.80	1.00	4.00	5.00	200	350
1974	1.18	2.05	10.94	20.19	184	417
1975	1.06	1.53	2.89	7.20	57	192
1976	0.82	1.40	5.02	5.61	39	45
BC 5						
1958	0.45	0.45	10.00	16.00	---	---
1959	0.45	0.90	10.50	31.00	---	---
1960	0.40	0.70	7.00	8.00	37	45
1961	0.20	0.60	6.50	11.00	36	60
1962	0.55	3.30	7.00	12.00	20	25
1963	0.25	0.60	7.00	15.00	18	45
1964	0.55	1.80	12.50	43.00	29	49
1965	0.55	1.00	9.50	38.00	112	180

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 5 (cont.)						
1966	0.55	0.90	3.50	5.00	216	248
1967	0.65	1.10	12.50	16.00	261	273
BC 6						
1958	0.45	0.45	8.00	10.00	---	---
1959	0.45	0.45	9.00	17.00	---	---
1960	0.40	0.50	7.00	8.00	8	24
1961	0.25	0.90	10.00	20.00	6	44
1962	0.20	0.60	11.00	46.00	---	8
1963	0.15	0.50	6.00	17.00	4	22
1964	0.35	1.00	10.00	26.00	22	74
1965	0.15	0.50	8.50	19.00	11	23
1966	0.45	1.20	11.50	30.00	11	33
1967	0.75	1.90	9.50	21.00	87	200
1968	0.20	0.30	6.00	6.00	59	70
1969	0.60	1.00	7.00	12.00	74	83
1970	0.50	1.00	9.00	15.00	63	67
1972	0.45	0.80	77.00	160.00	43	58
1973	0.30	0.60	8.00	14.00	70	91
1974	0.49	0.99	5.13	7.31	66	70
1975	0.38	0.78	0.00	0.00	53	59
1976	0.46	0.59	0.96	1.92	40	41
BC 7						
1958	0.45	0.45	9.00	34.00	---	---
1959	0.45	0.45	8.50	18.00	---	---
1960	0.40	0.50	8.00	9.00	4	5
1961	0.20	0.40	9.50	34.00	2	23
1962	0.15	0.80	12.50	26.00	---	5
1963	0.25	0.80	7.00	14.00	26	38
1964	0.25	0.40	6.50	23.00	62	142
1965	0.25	0.40	20.00	36.00	11	45
1966	0.35	0.80	20.00	89.00	42	161
1967	0.40	0.70	13.50	22.00	35	49
1968	0.45	0.90	14.00	27.00	32	48
1969	0.60	1.10	8.50	15.00	17	20
1970	0.80	1.10	8.00	9.00	24	29
1971	0.90	1.30	10.50	23.00	29	30
1972	0.50	1.10	40.00	130.00	32	36
1973	0.50	1.20	8.00	14.00	56	124
1974	0.75	1.45	6.22	11.63	17	28

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 7 (cont.)						
1975	0.13	0.43	1.74	4.28	25	29
1976	0.25	0.25	48.21	81.57	28	29
BC 8						
1958	0.90	1.35	4.00	25.00	---	---
1959	0.90	2.25	11.50	26.00	---	---
1960	1.20	1.60	9.00	12.00	40	100
1961	0.55	1.20	11.00	50.00	35	61
1962	0.70	1.40	8.50	20.00	29	57
1963	0.90	2.00	6.50	16.00	33	48
1964	1.65	4.10	15.00	34.00	8	38
1967	---	---	---	---	4	4
BC 9						
1958	0.90	1.80	15.00	50.00	---	---
1959	0.45	0.90	9.50	13.00	---	---
1960	0.40	0.60	8.00	9.00	7	27
1961	0.30	0.50	10.00	20.00	3	13
1962	0.45	0.80	7.50	18.00	---	6
1963	0.45	1.00	5.50	10.00	3	20
1964	0.70	2.70	9.00	38.00	142	610
1965	0.40	0.60	8.50	28.00	4	13
1966	0.35	0.50	5.50	7.00	5	6
1967	0.35	0.60	7.00	10.00	12	28
1968	0.60	0.70	7.00	9.00	6	9
1969	0.90	1.40	9.00	13.00	11	17
1970	1.05	1.60	16.00	20.00	51	63
1971	1.45	1.80	11.00	14.00	68	83
1972	0.70	0.90	7.00	11.00	61	82
1973	0.70	0.90	6.00	20.00	77	100
1974	0.51	0.73	5.86	8.23	52	64
1975	0.40	0.59	4.07	5.21	46	53
1976	0.79	0.82	2.03	3.39	108	116
BC 12						
1962	0.75	1.20	11.00	29.00	---	8
1963	0.70	1.30	8.50	13.00	4	21
1964	0.70	1.80	10.50	26.00	15	36
1965	0.90	1.80	15.50	42.00	40	45
1966	1.25	1.80	12.00	22.00	40	46

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 12 (cont.)						
1967	1.70	2.40	17.00	20.00	41	54
1968	1.10	1.60	8.00	11.00	47	52
1970	---	---	---	---	1	1
1971	1.80	2.00	20.00	28.00	24	33
1972	1.95	2.60	9.00	14.00	46	55
1973	1.50	3.10	10.00	14.00	84	210
1974	1.78	2.04	11.54	13.99	46	77
1975	1.10	1.38	2.14	4.44	37	52
1976	1.16	1.40	3.78	6.40	20	23
BC 18						
1962	3.55	6.40	19.00	53.00	22	37
1963	2.05	5.40	17.00	30.00	28	50
1964	0.75	1.90	10.50	18.00	35	45
1965	2.00	5.90	30.50	53.00	40	54
1966	1.30	1.70	18.50	35.00	44	47
1967	1.35	1.70	44.00	41.00	41	60
1968	0.75	1.10	19.00	70.00	61	91
1969	2.10	3.20	32.00	66.00	43	46
1970	1.85	2.30	22.50	26.00	35	41
1971	1.70	2.40	24.50	39.00	31	28
1972	1.20	2.20	5.00	10.00	27	36
1973	0.90	1.40	6.00	12.00	46	58
1974	0.67	1.06	4.49	6.87	32	37
1975	1.85	3.79	5.05	6.70	24	32
1976	1.44	1.98	5.09	6.49	16	18
BC 23						
1962	1.20	1.40	11.00	12.00	10	25
1963	1.15	2.10	8.50	17.00	3	14
1964	1.35	3.40	18.50	120.00	9	44
1965	2.05	2.70	10.00	22.00	16	32
1966	2.60	3.70	21.50	44.00	2	3
1967	1.55	1.70	12.50	22.00	6	10
BC 24						
1962	2.00	2.20	12.00	14.00	5	14
1963	0.85	1.80	9.00	17.00	---	7
1964	0.75	1.80	19.50	63.00	---	11

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 24 (cont.)						
1965	0.80	1.60	20.50	38.00	13	28
1966	1.30	1.90	96.00	245.00	12	26
1972	5.45	15.00	195.00	490.00	77	110
1973	10.60	26.00	510.00	1,100.00	47	54
BG 25						
1962	1.90	2.00	11.00	14.00	50	74
1963	2.95	6.40	15.50	45.00	60	99
1964	2.25	6.10	14.50	40.00	52	70
1965	1.60	2.30	14.50	28.00	45	85
1966	2.05	2.70	16.50	34.00	80	76
1967	1.90	2.40	14.00	20.00	88	110
1968	1.45	2.80	47.50	182.00	62	79
1971	3.70	6.00	20.00	24.00	48	56
1972	2.00	3.20	15.50	22.00	42	49
1973	3.70	5.00	15.00	18.00	44	50
1974	3.17	4.09	49.37	86.02	54	59
1975	3.62	3.77	48.24	59.82	56	64
1976	3.56	4.87	88.34	104.58	52	53
BG 26						
1976	2.05	2.34	3.83	4.76	28	32
1977	2.90	3.70	7.30	12.00	27	45
1978	1.80	2.40	5.30	7.60	24	28
1979	1.60	1.90	0.43	3.00	25	29
1980	0.98	1.70	17.00	38.00	21	24
1981	1.80	2.60	13.00	28.00	24	26
1982	1.50	2.10	8.30	12.00	27	29
1983	1.10	1.80	1.20	1.80	27	29
1984	1.20	2.00	1.60	1.90	27	29
1985	0.94	1.50	1.10	1.60	29	31
1986	0.97	1.40	1.90	2.80	30	32
BG 27						
1976	0.80	1.00	0.00	0.00	36	37
1977	0.74	1.10	1.80	7.00	38	40
1978	0.91	1.30	1.10	2.30	38	40
1979	0.83	2.10	2.70	4.40	41	45
1980	0.47	0.81	3.60	9.40	41	47
1981	0.67	1.30	5.00	13.00	38	42

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 27 (cont.)						
1982	0.80	1.90	6.10	10.00	37	38
1983	0.45	1.20	1.90	1.40	34	35
1984	0.42	0.68	1.40	3.00	34	37
1985	0.25	0.48	0.80	1.40	33	34
1986	0.34	0.68	0.99	1.20	31	32
BG 28						
1976	0.29	0.33	1.67	2.74	47	52
1977	0.87	1.40	4.40	14.00	44	46
1978	0.89	1.10	2.80	5.30	39	45
1979	0.84	1.30	0.63	3.60	46	52
1980	0.90	1.30	2.20	5.60	36	40
1981	2.10	6.20	11.00	22.00	33	37
1982	0.74	1.20	1.00	0.60	35	37
1983	0.46	1.00	0.97	1.30	30	32
1984	1.10	1.70	3.70	13.00	29	30
1985	0.38	0.92	0.91	1.70	28	29
1986	0.72	1.10	1.30	1.90	27	28
BG 29						
1976	1.34	1.42	3.68	4.16	35	39
1977	0.91	1.10	12.00	38.00	35	36
1978	0.82	1.50	2.70	6.10	35	39
1979	0.87	1.60	1.60	6.60	37	41
1980	0.83	1.40	0.32	4.10	56	79
1981	0.98	1.50	9.00	19.00	45	61
1982	2.00	3.00	5.50	9.10	47	53
1983	0.25	0.39	0.79	0.80	68	72
1984	0.85	1.40	1.10	1.50	61	66
1985	0.20	0.29	0.68	1.40	61	61
1986	0.34	0.49	0.31	0.45	51	57
BG 30						
1976	1.84	2.26	2.90	1.17	5.65	8.54
1977	1.20	2.20	4.90	6.80	17	20
1978	1.10	1.40	2.50	7.00	16	18
1979	13.00	22.00	46.00	83.00	23	40
1980	7.50	14.00	29.00	55.00	26	49
1981	4.20	4.80	25.00	26.00	27	44
1982	3.10	4.30	24.00	40.00	21	30

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 30 (cont.)						
1983	1.30	1.90	5.60	9.90	18	19
1984	1.80	3.10	5.20	6.60	22	25
1985	0.78	2.00	4.90	5.80	18	22
1986	1.80	2.10	5.10	5.50	25	31
BG 31						
1976	0.59	0.59	3.20	6.40	8	8
1977	0.82	1.40	4.40	5.90	12	12
1978	1.20	2.20	3.40	7.50	20	26
1979	1.40	1.70	0.55	4.00	20	32
1980	1.20	1.80	3.80	9.70	22	23
1981	1.60	2.10	7.20	16.00	19	23
1982	1.50	1.80	12.00	19.00	110	220
1983	0.82	0.99	2.10	5.00	16	21
1984	1.00	1.50	1.50	2.30	22	28
1985	0.58	1.20	0.86	1.60	44	63
1986	0.55	0.83	1.00	1.40	550	1,200
BG 32						
1976	1.39	1.93	3.43	6.86	20	20
1977	1.40	1.80	5.60	9.00	26	26
1978	2.50	4.20	7.50	14.00	19	24
1979	1.50	2.20	2.80	8.00	26	40
1980	0.65	0.97	2.90	6.60	25	38
1981	1.70	2.00	6.40	9.40	19	25
1982	2.20	2.90	11.00	17.00	20	21
1983	1.40	2.60	2.30	4.10	20	21
1984	1.00	1.70	2.00	3.50	19	19
1985	0.74	1.30	1.50	2.50	18	20
1986	2.30	4.20	4.00	4.60	19	23
BG 33						
1976	0.97	1.09	2.48	3.27	31	34
1977	1.70	2.40	5.00	9.80	46	100
1978	1.30	1.40	3.00	4.10	29	40
1979	1.60	3.60	2.70	4.10	120	3,300
1980	0.85	1.40	0.51	6.40	25	41
1981	1.70	1.90	6.50	11.00	20	29
1982	1.30	2.40	3.70	8.50	21	23
1983	0.83	1.60	1.10	1.80	19	21

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
BC 33 (cont.)						
1984	0.97	1.20	0.94	1.90	20	22
1985	0.56	0.84	0.98	1.60	18	20
1986	0.73	1.20	1.70	1.90	150	320
BC 34						
1976	2.51	3.18	2.64	2.90	259	399
1977	2.00	2.70	6.90	13.00	2,330	60,700
1978	1.20	2.00	4.00	9.90	2,400	4,000
1979	0.71	1.70	1.00	5.10	1,200	3,500
1980	0.67	0.81	3.80	5.30	266	460
1981	1.40	1.70	9.00	20.00	99	170
1982	1.10	1.60	3.00	6.90	100	250
1983	0.79	1.60	2.80	7.80	6,100	14,000
1984	0.69	1.40	1.70	2.00	21,000	38,000
1985	0.50	0.92	1.20	1.30	15,000	25,000
1986	1.20	1.60	1.20	2.10	28,000	32,000
BC 35						
1976	1.05	1.09	3.73	6.86	34	39
1977	1.00	1.40	4.30	5.60	29	33
1978	0.70	0.79	2.40	5.20	65	170
1979	0.98	1.40	1.40	4.10	140	3,300
1980	0.65	0.73	3.00	8.90	45	95
1981	0.92	0.99	3.90	8.70	68	98
1982	1.00	1.30	4.90	9.90	57	71
1983	0.61	0.87	1.80	2.90	29	32
1984	0.95	1.30	3.30	7.00	27	27
1985	0.34	0.48	0.69	1.10	21	22
1986	0.45	0.49	0.87	1.20	33	51
BC 36						
1976	1.09	1.26	2.14	4.27	23	28
1977	1.00	1.30	3.10	6.80	22	23
1978	0.74	1.30	1.20	1.10	22	39
1979	1.30	2.10	4.30	9.80	49	980
1980	0.87	1.50	0.07	3.60	21	29
1981	0.81	0.89	1.30	5.90	18	22
1982	0.76	1.00	4.70	10.00	16	17
1983	0.24	0.39	0.61	0.91	16	17
1984	0.48	1.40	1.40	2.70	31	54

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 36 (cont.)						
1985	0.19	0.38	0.70	1.30	73	120
1986	0.27	0.49	0.76	1.40	32	39
BG 37						
1976	1.18	1.51	3.97	7.93	22	25
1977	3.00	4.10	15.00	30.00	21	27
1978	4.30	5.20	9.90	26.00	19	24
1979	4.20	4.70	7.10	13.00	22	24
1980	1.40	2.00	5.50	9.50	23	32
1981	3.10	3.60	14.00	21.00	19	22
1982	2.10	3.00	16.00	32.00	19	20
1983	1.50	3.10	2.20	5.60	60	120
1984	1.40	1.60	2.20	3.80	14	16
1985	0.70	1.20	1.10	1.70	15	16
1986	1.90	2.40	2.00	2.30	18	20
BG 38						
1976	1.30	1.76	0.00	0.00	21	22
1977	1.40	2.10	4.30	11.00	24	28
1978	1.60	2.00	0.15	3.90	23	25
1979	2.30	2.50	8.10	13.00	23	25
1980	0.73	1.10	5.20	14.00	22	24
1981	1.30	1.40	0.00	2.20	19	21
1982	0.62	1.10	2.70	5.90	19	19
1983	0.56	1.30	0.45	1.50	18	19
1984	0.72	1.20	0.85	1.30	15	17
1985	0.10	0.20	0.56	1.30	16	16
1986	0.37	0.68	1.40	2.40	20	23
BG 39						
1976	1.51	1.84	2.82	5.64	29	31
1977	2.20	2.80	8.20	10.00	22	25
1978	3.10	3.70	6.30	12.00	24	25
1979	3.70	6.50	8.90	19.00	25	27
1980	1.90	2.40	9.70	30.00	21	23
1981	2.70	3.70	19.00	38.00	17	20
1982	1.70	3.10	9.80	18.00	17	17
1983	1.10	2.20	1.40	2.10	14	15
1984	0.85	1.40	1.50	2.60	15	16
1985	0.76	1.10	0.70	1.20	14	15
1986	1.20	1.90	1.90	2.30	14	14

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 40						
1976	0.92	1.09	3.39	3.66	3	4
1977	0.76	1.70	5.40	10.00	3	7
1978	1.00	1.80	1.40	0.00	4	6
1979	0.48	0.67	4.50	6.40	3	4
1980	0.55	0.81	2.10	4.20	8	14
1981	0.71	1.10	4.60	6.50	5	12
1982	0.54	0.92	3.70	5.50	9	18
1983	0.35	0.58	1.20	2.30	9	21
1984	0.34	0.66	0.47	0.62	13	23
1985	0.13	0.21	0.44	0.91	1	2
1986	0.47	0.97	0.35	0.65	0	1
BG 41						
1976	1.34	1.76	2.75	5.49	7	8
1977	1.20	1.90	4.50	11.00	6	11
1978	1.40	1.90	3.00	9.90	8	10
1979	1.00	1.20	1.00	1.00	11	13
1980	0.65	1.30	0.23	2.30	16	20
1981	1.30	1.80	8.30	18.00	11	12
1982	1.30	2.10	7.80	18.00	14	15
1983	0.91	1.70	2.60	6.60	13	13
1984	0.60	0.68	1.20	2.40	19	23
1985	0.47	0.61	1.00	2.10	21	23
1986	0.51	1.10	9.00	34.00	10	11
BG 42						
1976	0.92	1.17	5.65	8.54	24	26
1977	1.20	2.20	4.90	6.80	17	20
1978	1.10	1.40	2.50	7.00	16	18
1979	13.00	22.00	46.00	83.00	23	40
1980	7.50	14.00	29.00	55.00	26	49
1981	4.20	4.80	25.00	26.00	27	44
1982	3.10	4.30	24.00	40.00	21	30
1983	1.30	1.90	5.60	9.90	18	19
1984	1.80	3.10	5.20	6.60	22	25
1985	0.78	2.00	4.90	5.80	18	22
1986	1.80	2.10	5.10	5.50	25	31

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 43						
1976	0.50	0.67	2.37	4.73	24	25
1977	0.65	1.20	3.90	8.00	20	21
1978	0.93	1.20	1.60	5.70	21	23
1979	0.79	1.50	1.20	2.60	23	25
1980	0.65	0.73	0.86	1.00	28	30
1981	0.97	1.10	4.00	6.30	41	46
1982	1.00	2.20	5.10	13.00	66	82
1983	0.79	1.60	0.54	3.80	74	90
1984	0.85	1.50	2.40	3.50	40	45
1985	0.32	0.45	0.45	1.20	32	35
1986	0.24	0.68	0.51	0.61	28	31
BG 51						
1976	1.13	1.76	4.87	7.78	21	22
1977	0.91	1.20	1.90	8.80	21	24
1978	0.12	0.57	0.34	4.10	26	30
1979	0.64	1.50	0.15	4.00	27	34
1980	0.22	0.41	2.60	0.00	32	34
1981	0.63	0.91	1.80	0.95	27	32
1982	0.91	1.80	4.60	9.20	23	29
1983	0.34	0.41	0.64	1.40	23	28
1984	0.33	0.49	1.40	2.00	29	35
1985	0.15	0.31	0.60	1.20	27	32
1986	0.31	0.58	0.02	0.19	25	25
BG 52						
1976	0.75	1.17	3.60	4.55	23	25
1977	1.20	2.00	5.30	9.40	21	25
1978	1.30	2.20	2.60	7.00	22	25
1979	0.92	2.10	1.30	5.00	24	55
1980	0.47	0.89	2.50	5.70	22	25
1981	0.92	1.30	11.00	21.00	23	140
1982	0.95	2.00	4.60	8.10	15	24
1983	0.89	2.20	5.70	8.10	17	25
1984	0.43	0.66	2.40	2.60	16	18
1985	0.40	0.73	1.80	3.00	17	20
1986	0.82	1.80	1.60	2.60	17	25

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 53						
1976	1.30	1.51	3.36	3.74	12	16
1977	1.10	1.40	3.60	5.40	26	51
1978	1.00	1.50	1.00	2.30	18	21
1979	1.10	3.30	1.40	7.60	100	2,700
1980	0.41	0.65	2.40	12.00	21	41
1981	1.00	1.50	3.70	10.00	17	26
1982	0.82	1.60	8.80	12.00	17	18
1983	0.33	0.49	1.60	2.90	16	17
1984	0.48	0.77	0.82	1.20	17	24
1985	0.46	0.72	0.57	1.50	15	16
1986	0.51	0.78	0.15	0.39	25	54
BG 54						
1976	0.84	1.09	0.00	0.00	16	18
1977	1.20	1.70	2.10	4.30	9	10
1978	0.77	1.10	0.56	4.60	4,600	8,100
1979	0.56	1.30	0.13	2.10	270	4,800
1980	0.59	1.10	3.40	11.00	1,600	3,900
1981	0.81	1.40	4.10	5.20	500	2,400
1982	1.00	1.40	6.90	13.00	610	870
1983	0.28	0.49	2.00	4.90	3,200	7,200
1984	0.58	0.97	2.00	3.00	530	1,200
1985	0.32	0.41	2.00	2.90	4,600	12,000
1986	0.39	0.68	1.30	1.80	160	320
BG 55						
1976	1.26	1.26	0.00	0.00	134	141
1977	3.00	3.70	11.00	19.00	200	480
1978	2.60	3.50	5.10	12.00	3,100	6,900
1979	1.90	4.70	5.10	6.60	930	6,400
1980	1.80	2.60	9.30	25.00	1,000	1,800
1981	3.50	4.10	23.00	26.00	1,500	4,200
1982	2.30	3.80	11.00	26.00	2,800	4,900
1983	0.89	1.90	2.10	5.00	3,400	4,100
1984	2.00	3.20	3.30	5.30	2,600	3,700
1985	1.00	1.30	2.00	3.60	3,500	5,800
1986	1.30	2.00	2.70	3.50	6,400	7,700

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 56						
1976	0.80	0.84	0.00	0.00	1,964	2,092
1977	1.50	2.00	1.60	5.00	1,100	1,600
1978	2.50	3.40	5.30	12.00	2,300	3,500
1979	0.99	2.40	0.30	3.10	2,400	14,000
1980	0.83	1.20	6.20	10.00	4,100	12,000
1981	2.20	2.90	7.30	13.00	3,600	15,500
1982	2.10	3.40	13.00	19.00	6,600	13,700
1983	1.00	2.50	2.10	4.10	860	2,300
1984	1.80	3.70	2.90	5.80	2,200	6,400
1985	0.88	2.40	1.20	2.30	4,200	9,100
1986	1.60	2.70	2.10	3.30	29,000	51,000
BC 57						
1976	0.42	0.50	0.65	0.81	110	143
1977	0.53	0.93	2.40	4.10	780	1,900
1978	0.58	0.73	0.42	4.70	6,300	14,000
1979	0.36	0.92	1.10	5.90	3,100	17,000
1980	0.43	0.57	0.61	4.00	2,800	7,400
1981	0.94	1.40	1.60	5.00	2,750	7,700
1982	0.87	1.20	1.70	5.90	1,440	2,400
1983	0.20	0.68	1.50	4.70	530	780
1984	0.93	1.20	1.70	2.60	140	180
1985	0.15	0.20	0.59	1.10	1,000	1,600
1986	0.27	0.49	0.63	1.40	1,200	1,400
BC 58						
1976	0.88	1.09	3.27	4.55	11	12
1977	1.10	1.50	4.40	5.40	9	12
1978	1.70	2.40	2.70	7.80	11	16
1979	1.10	2.90	3.40	6.60	540	18,000
1980	0.63	1.10	5.40	10.00	16	26
1981	1.50	1.90	12.00	19.00	40	820
1982	1.70	2.40	11.00	23.00	13	15
1983	0.95	1.40	0.77	1.70	13	15
1984	0.74	1.10	1.30	1.60	13	16
1985	0.52	0.87	0.95	1.60	16	18
1986	1.10	2.10	2.30	4.60	22	23

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 59						
1976	0.42	0.50	1.65	3.30	63	72
1977	0.82	1.40	2.60	5.00	50	55
1978	0.72	0.88	0.95	4.00	49	55
1979	0.58	1.30	1.80	6.10	82	100
1980	0.65	0.89	2.90	6.50	56	78
1981	0.43	0.65	1.20	4.80	45	60
1982	0.68	0.91	2.10	6.30	41	43
1983	0.62	0.96	0.27	1.60	35	40
1984	0.66	0.88	1.10	1.80	31	35
1985	0.38	0.72	1.00	1.30	32	34
1986	0.33	0.62	0.96	1.30	35	37
BG 60						
1976	0.88	1.09	2.95	3.63	47	50
1977	1.60	2.20	8.60	23.00	34	35
1978	2.20	2.40	1.70	3.90	38	43
1979	1.50	2.30	8.80	20.00	45	50
1980	1.50	2.00	2.70	9.00	45	49
1981	1.30	1.70	6.50	10.00	35	37
1982	1.90	2.70	4.00	12.00	28	33
1983	1.10	1.90	1.90	3.00	20	23
1984	1.50	2.50	1.80	2.40	22	25
1985	0.90	1.00	1.90	2.30	27	29
1986	0.89	1.10	1.20	2.00	27	29
BG 61						
1976	0.67	0.75	1.73	3.46	43	44
1977	0.44	0.85	2.20	5.50	28	37
1978	0.50	0.75	2.90	0.57	31	42
1979	1.30	1.80	0.86	1.50	58	71
1980	0.57	0.65	4.70	13.00	37	46
1981	1.00	1.50	3.40	11.00	25	28
1982	1.10	1.80	5.00	9.50	52	82
1983	0.18	0.38	1.70	3.20	32	33
1984	0.46	0.58	1.60	2.00	29	30
1985	0.08	0.20	1.20	1.90	30	35
1986	0.30	0.78	1.00	1.60	44	62

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 62						
1976	1.38	1.42	1.32	1.98	54	56
1977	1.10	1.40	4.70	8.00	35	41
1978	0.99	1.20	1.40	4.70	37	46
1979	1.10	2.20	1.50	2.90	53	72
1980	0.57	1.20	6.20	16.00	39	44
1981	1.00	1.70	5.80	11.00	33	39
1982	1.50	2.60	4.80	13.00	44	55
1983	0.71	1.60	1.70	3.40	34	40
1984	0.39	0.67	1.20	1.80	35	38
1985	0.18	0.31	1.50	2.30	33	34
1986	0.54	1.20	1.10	1.80	36	41
BC 63						
1976	0.59	0.67	3.69	4.62	60	63
1977	0.40	0.59	3.30	6.30	52	72
1978	0.45	0.92	1.70	4.30	55	76
1979	0.92	2.30	0.51	6.90	62	71
1980	0.47	1.10	0.74	5.00	55	96
1981	0.92	1.10	7.00	11.00	31	35
1982	0.91	1.30	7.60	18.00	49	69
1983	0.28	0.77	0.32	0.87	40	47
1984	0.35	0.78	0.40	1.50	39	41
1985	0.08	0.10	0.32	0.99	36	38
1986	0.45	0.73	0.87	1.90	44	60
BC 64						
1976	0.96	1.00	2.37	2.76	86	88
1977	1.30	1.50	3.90	5.00	76	82
1978	0.55	1.10	0.83	3.00	67	69
1979	0.78	1.30	0.93	4.00	69	78
1980	0.47	1.10	3.60	11.00	53	59
1981	0.96	1.20	9.80	11.00	47	51
1982	0.87	2.00	4.50	14.00	41	47
1983	0.74	1.00	3.00	8.20	36	39
1984	0.79	1.30	3.50	7.90	33	35
1985	0.50	0.72	1.80	2.90	30	31
1986	0.62	0.97	1.70	2.10	29	31

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
BG 65						
1976	0.63	1.00	2.23	4.45	66	68
1977	0.84	1.20	7.00	14.00	57	57
1978	0.51	1.10	1.00	4.50	56	62
1979	0.82	1.60	3.30	7.90	60	65
1980	0.49	0.81	0.43	1.70	42	54
1981	0.77	1.50	6.80	9.80	49	54
1982	1.20	2.10	6.40	15.00	44	52
1983	0.55	0.73	1.20	2.30	32	38
1984	0.92	1.40	1.40	2.00	34	37
1985	0.17	0.31	0.57	1.00	33	35
1986	0.22	0.49	0.65	0.78	33	34
BG 66						
1976	0.30	0.59	0.91	1.81	48	52
1977	0.80	1.50	2.90	6.40	54	70
1978	0.51	0.97	1.10	7.50	65	80
1979	0.67	1.70	1.10	2.70	63	65
1980	0.38	0.65	1.80	3.80	71	77
1981	0.67	0.89	4.80	9.00	62	67
1982	0.56	1.40	1.50	6.50	67	69
1983	0.19	0.41	0.11	0.62	63	69
1984	0.39	0.58	0.74	1.30	56	66
1985	0.23	0.51	0.56	1.20	55	57
1986	0.43	0.83	0.75	2.30	55	59
BG 67						
1976	0.84	1.26	4.51	4.95	91	96
1977	1.00	1.40	2.20	3.30	80	89
1978	0.82	1.20	1.30	1.90	75	82
1979	0.83	1.80	0.66	1.30	78	82
1980	0.54	0.73	1.20	5.50	81	92
1981	0.92	1.30	3.20	4.90	87	97
1982	0.93	1.20	6.40	11.00	90	99
1983	0.58	0.77	0.63	1.80	120	140
1984	0.79	1.40	0.99	2.30	200	280
1985	0.63	1.10	0.79	1.80	170	190
1986	0.44	0.78	0.44	0.65	100	130

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BC 68						
1979	---	---	---	---	27	41
1980	---	---	---	---	71	620
1981	---	---	---	---	20	22
1982	---	---	---	---	22	22
1983	---	---	---	---	19	19
1984	---	---	---	---	20	20
1985	---	---	---	---	25	25
1986	---	---	---	---	71	71
BC 69						
1979	---	---	---	---	5,800	7,900
1980	---	---	---	---	4,000	12,000
1981	---	---	---	---	4,100	19,000
1982	---	---	---	---	41	41
1983	---	---	---	---	1,600	1,600
1984	---	---	---	---	2,900	2,900
1985	---	---	---	---	22,000	22,000
1986	---	---	---	---	30,000	30,000
BC 70						
1979	---	---	---	---	9,500	15,000
1980	---	---	---	---	650	1,900
1981	---	---	---	---	370	910
1982	---	---	---	---	340	340
1983	---	---	---	---	1,100	1,100
1984	---	---	---	---	970	970
1985	---	---	---	---	2,300	2,300
1986	---	---	---	---	760	760
BC 71						
1979	---	---	---	---	40	58
1980	---	---	---	---	120	930
1981	---	---	---	---	23	25
1982	---	---	---	---	19	19
1983	---	---	---	---	25	25
1984	---	---	---	---	24	24
1985	---	---	---	---	26	26
1986	---	---	---	---	290	290

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 72						
1979	---	---	---	---	1,700	2,900
1980	---	---	---	---	690	2,000
1981	---	---	---	---	410	570
1982	---	---	---	---	82	82
1983	---	---	---	---	52	52
1984	---	---	---	---	19	19
1985	---	---	---	---	300	300
1986	---	---	---	---	6,900	6,900
BG 73						
1979	---	---	---	---	60	150
1980	---	---	---	---	50	240
1981	---	---	---	---	29	33
1982	---	---	---	---	23	23
1983	---	---	---	---	18	18
1984	---	---	---	---	22	22
1985	---	---	---	---	24	24
1986	---	---	---	---	1,300	1,300
BG 74						
1979	---	---	---	---	26	28
1980	---	---	---	---	340	2,300
1981	---	---	---	---	28	35
1982	---	---	---	---	29	29
1983	---	---	---	---	23	23
1984	---	---	---	---	20	20
1985	---	---	---	---	24	24
1986	---	---	---	---	8,500	8,500
BG 75						
1979	---	---	---	---	53	83
1980	---	---	---	---	73	210
1981	---	---	---	---	40	64
1982	---	---	---	---	63	63
1983	---	---	---	---	2,900	2,900
1984	---	---	---	---	6,200	6,200
1985	---	---	---	---	56	56
1986	---	---	---	---	95	95

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Gross Alpha (pCi/L) Max	Nonvol. Beta (pCi/L) Mean	Nonvol. Beta (pCi/L) Max	Tritium (pCi/mL) Mean	Tritium (pCi/mL) Max
BC 76						
1979	---	---	---	---	22	23
1980	---	---	---	---	99	410
1981	---	---	---	---	47	54
1982	---	---	---	---	170	170
1983	---	---	---	---	11,000	11,000
1984	---	---	---	---	1,800	1,800
1985	---	---	---	---	2,000	2,000
1986	---	---	---	---	5,500	5,500
BC 77						
1979	---	---	---	---	47	77
1980	---	---	---	---	1,000	3,300
1981	---	---	---	---	4,100	4,500
1982	---	---	---	---	1,300	1,300
1983	---	---	---	---	1,500	1,500
1984	---	---	---	---	320	320
1985	---	---	---	---	2,300	2,300
1986	---	---	---	---	4,900	4,900
BC 78						
1979	---	---	---	---	21	22
1980	---	---	---	---	1,500	2,500
1981	---	---	---	---	1,900	2,300
1982	---	---	---	---	240	240
1983	---	---	---	---	790	790
1984	---	---	---	---	3,200	3,200
1985	---	---	---	---	2,400	2,400
1986	---	---	---	---	2,000	2,000
BC 79						
1979	---	---	---	---	120	310
1980	---	---	---	---	84	240
1981	---	---	---	---	570	850
1982	---	---	---	---	750	750
1983	---	---	---	---	480	480
1984	---	---	---	---	310	310
1985	---	---	---	---	660	660
1986	---	---	---	---	5,800	5,800

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L)		Nonvol. Beta (pCi/L)		Tritium (pCi/mL)	
	Mean	Max	Mean	Max	Mean	Max
BG 80						
1979	---	---	---	---	290	800
1980	---	---	---	---	33	51
1981	---	---	---	---	59	85
1982	---	---	---	---	26	26
1983	---	---	---	---	110	110
1984	---	---	---	---	38	38
1985	---	---	---	---	23,000	23,000
1986	---	---	---	---	15,000	15,000
BG 81						
1979	---	---	---	---	32	44
1980	---	---	---	---	29	53
1981	---	---	---	---	27	53
1982	---	---	---	---	18	18
1983	---	---	---	---	23	23
1984	---	---	---	---	1,500	1,500
1985	---	---	---	---	18,000	18,000
1986	---	---	---	---	22,000	22,000
BG 82						
1979	---	---	---	---	200	490
1980	---	---	---	---	37	64
1981	---	---	---	---	40	52
1982	---	---	---	---	64	64
1983	---	---	---	---	23	23
1984	---	---	---	---	34	34
1985	---	---	---	---	44	44
1986	---	---	---	---	56,000	56,000
BG 83						
1979	---	---	---	---	28	32
1980	---	---	---	---	34	60
1981	---	---	---	---	22	27
1982	---	---	---	---	37	37
1983	---	---	---	---	19	19
1984	---	---	---	---	33	33
1985	---	---	---	---	20	20
1986	---	---	---	---	80	80

TABLE 15-26 (cont.)

Year	Gross Alpha (pCi/L) Mean	Max	Nonvol. Beta (pCi/L) Mean	Max	Tritium (pCi/mL) Mean	Max
BG 84						
1985	---	---	---	---	21	21
1986	---	---	---	---	22	22
BG 85						
1985	---	---	---	---	28	28
1986	---	---	---	---	57	57
BG 86						
1985	---	---	---	---	19	19
1986	---	---	---	---	22	22
BG 87						
1985	---	---	---	---	23	23
1986	---	---	---	---	33	33
BG 88						
1985	---	---	---	---	85	85
1986	---	---	---	---	75	75
BG 89						
1985	---	---	---	---	25	25
1986	---	---	---	---	140	140
BG 90						
1985	---	---	---	---	180	180
1986	---	---	---	---	140	140

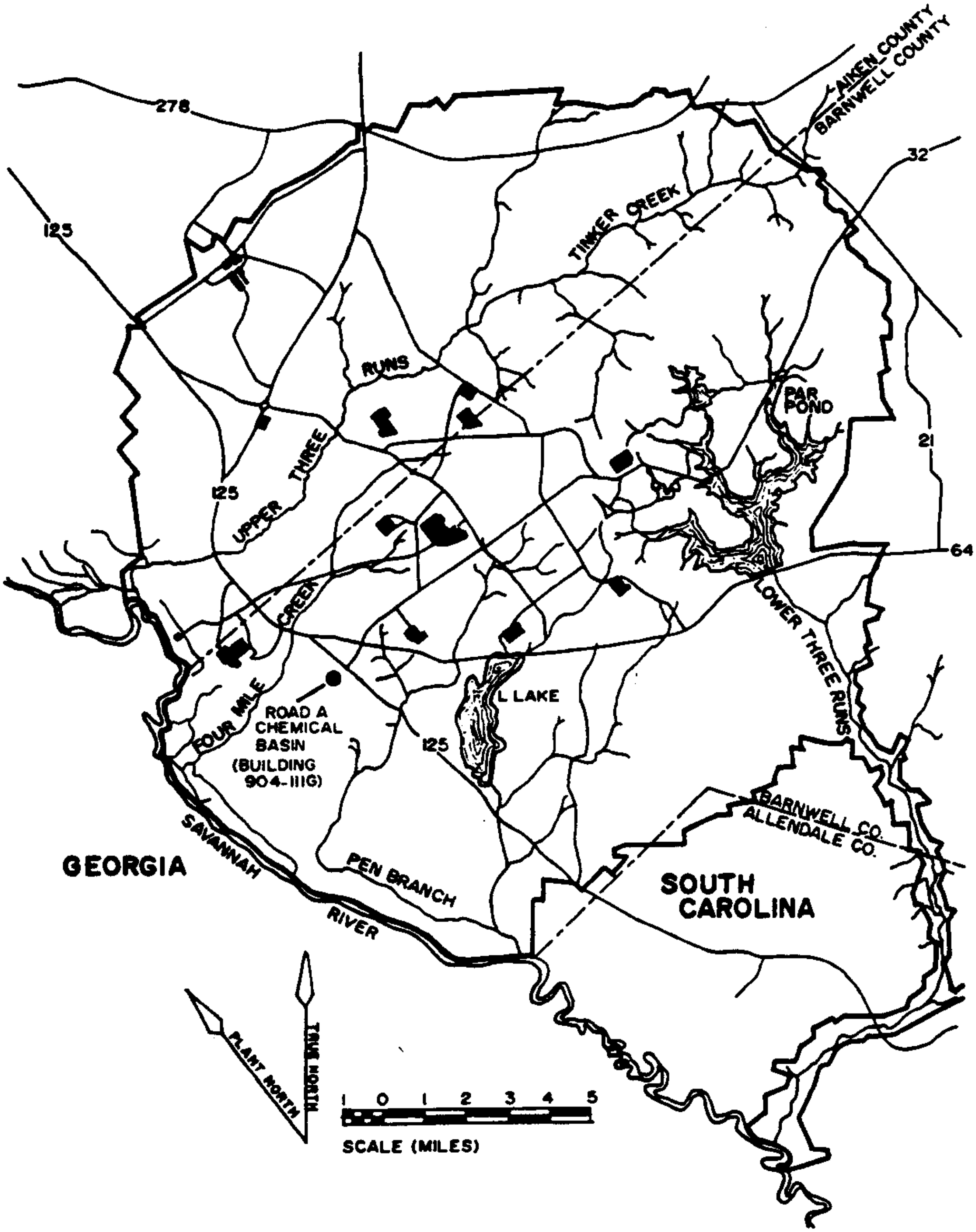


FIGURE 15-1. Location of the Road A Chemical Basin

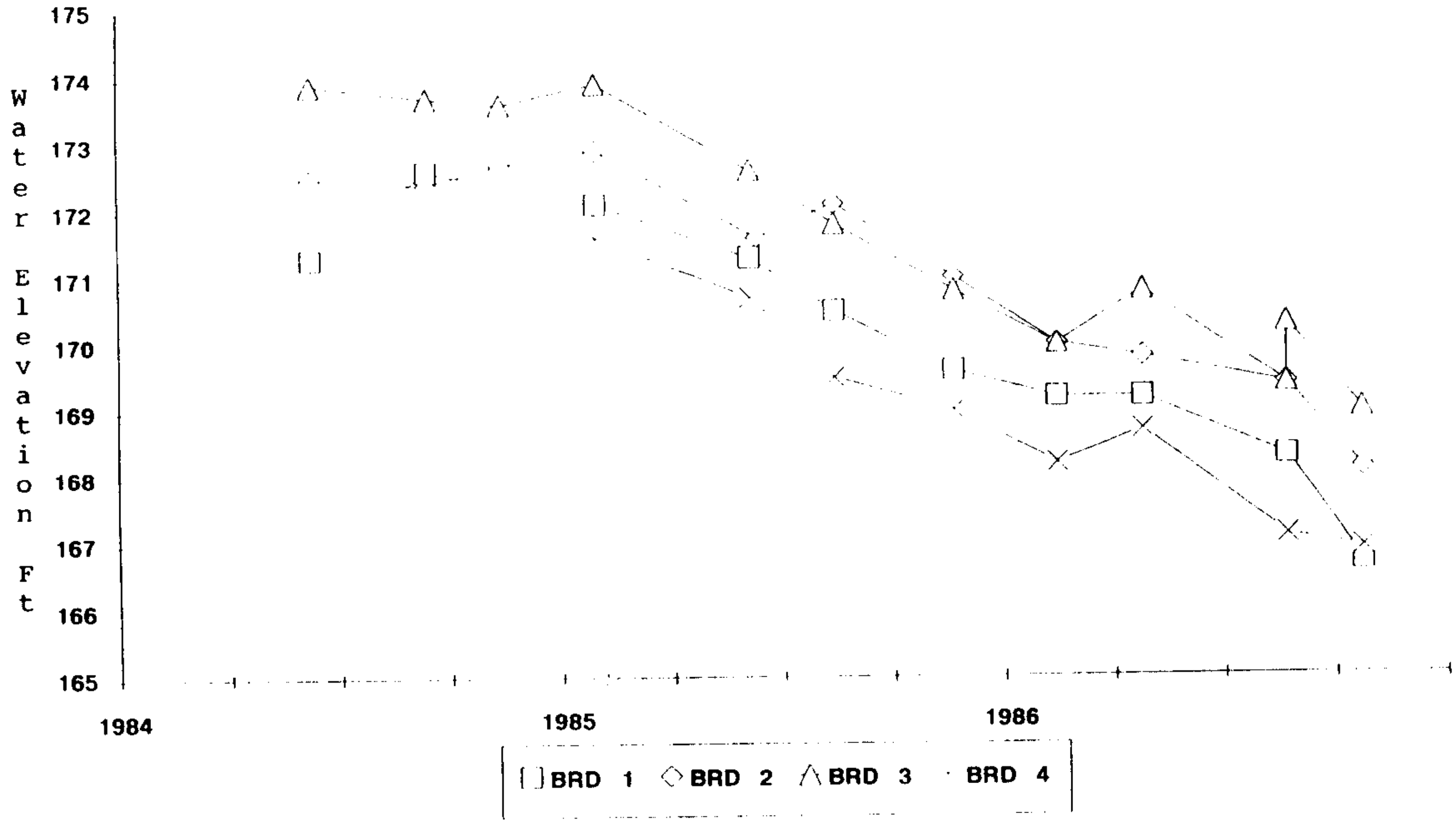


FIGURE 15-2. Hydrograph of the Road A Chemical Basin Wells

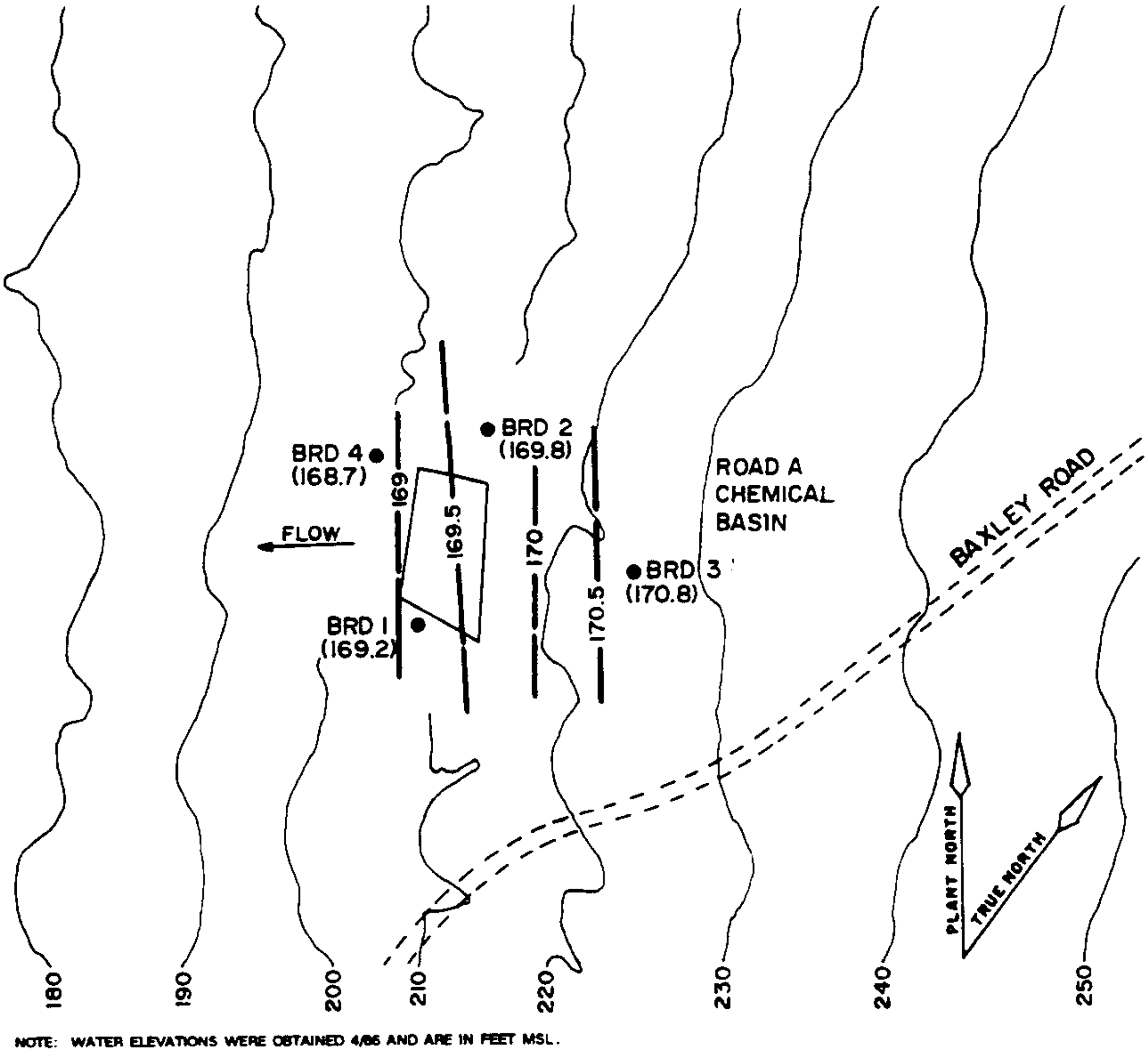


FIGURE 15-3. Road A Chemical Basin Water-Table Elevation Map

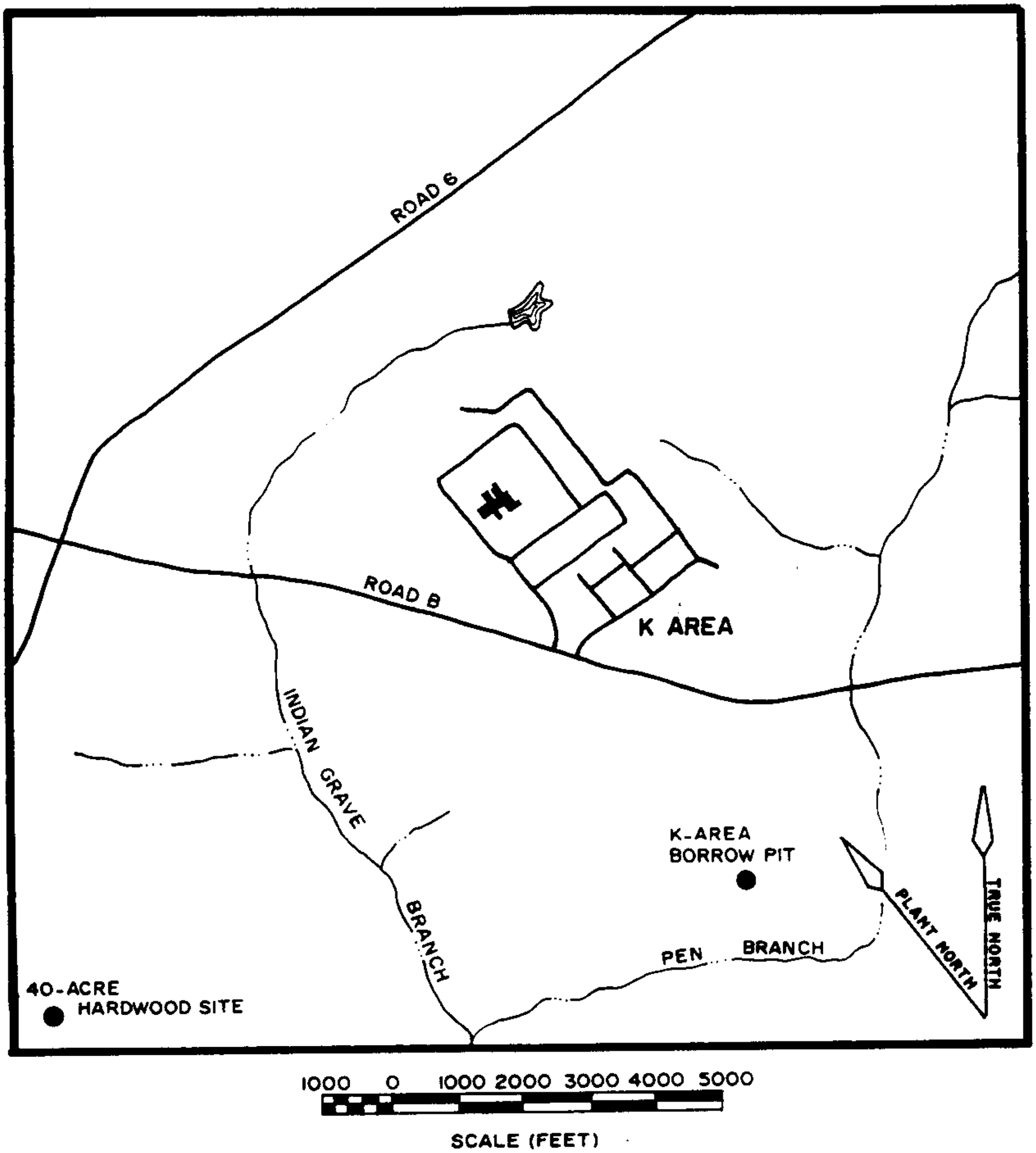
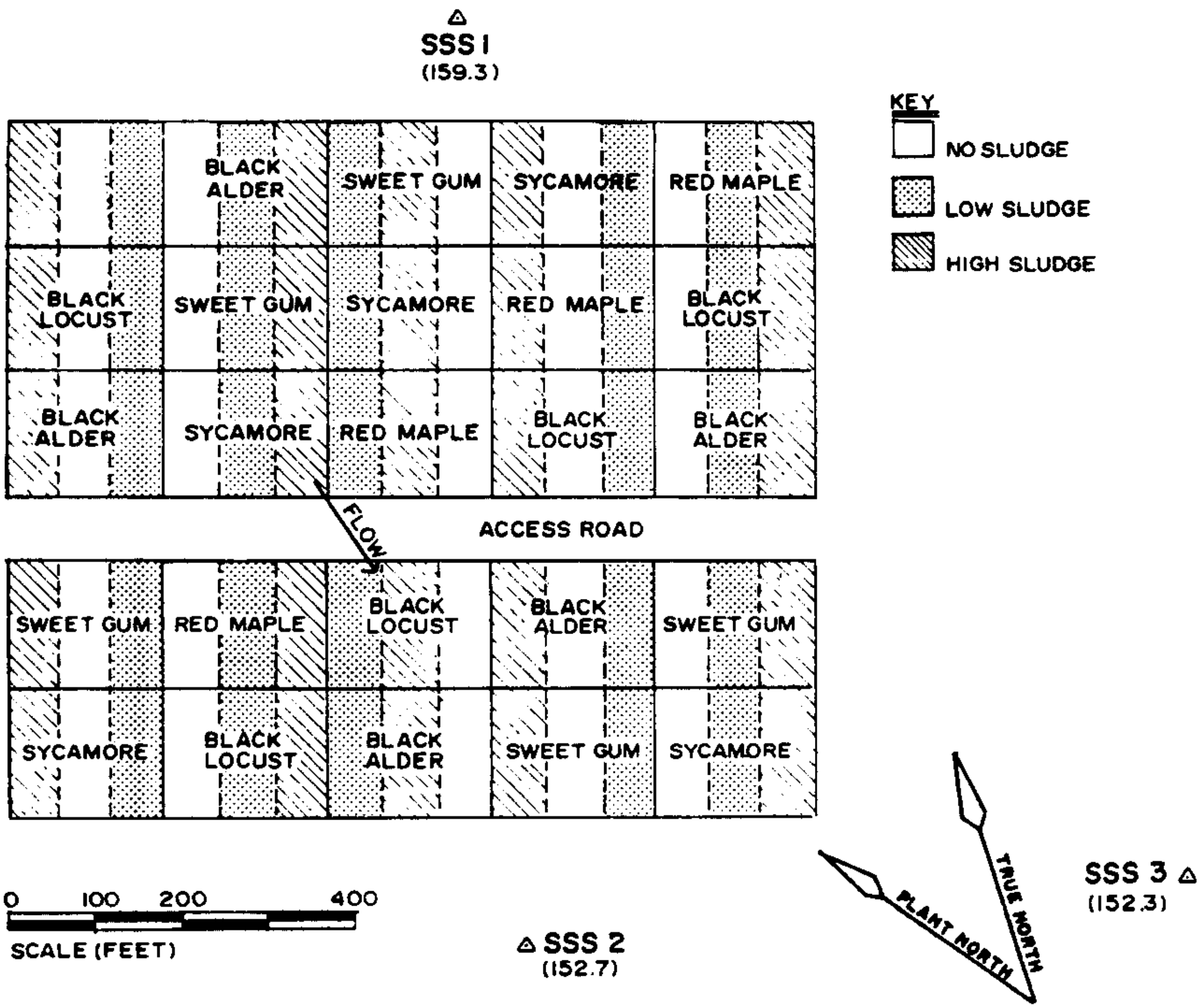


FIGURE 15-4. Locations of the 40-Acre Hardwood and K-Area Borrow Pit Sewage Sludge Application Sites



NOTE: WATER ELEVATIONS WERE OBTAINED 1/85 AND ARE IN FEET MSL.

FIGURE 15-5. 40-Acre Hardwood Sewage Sludge Application Site Water-Table Elevation Map

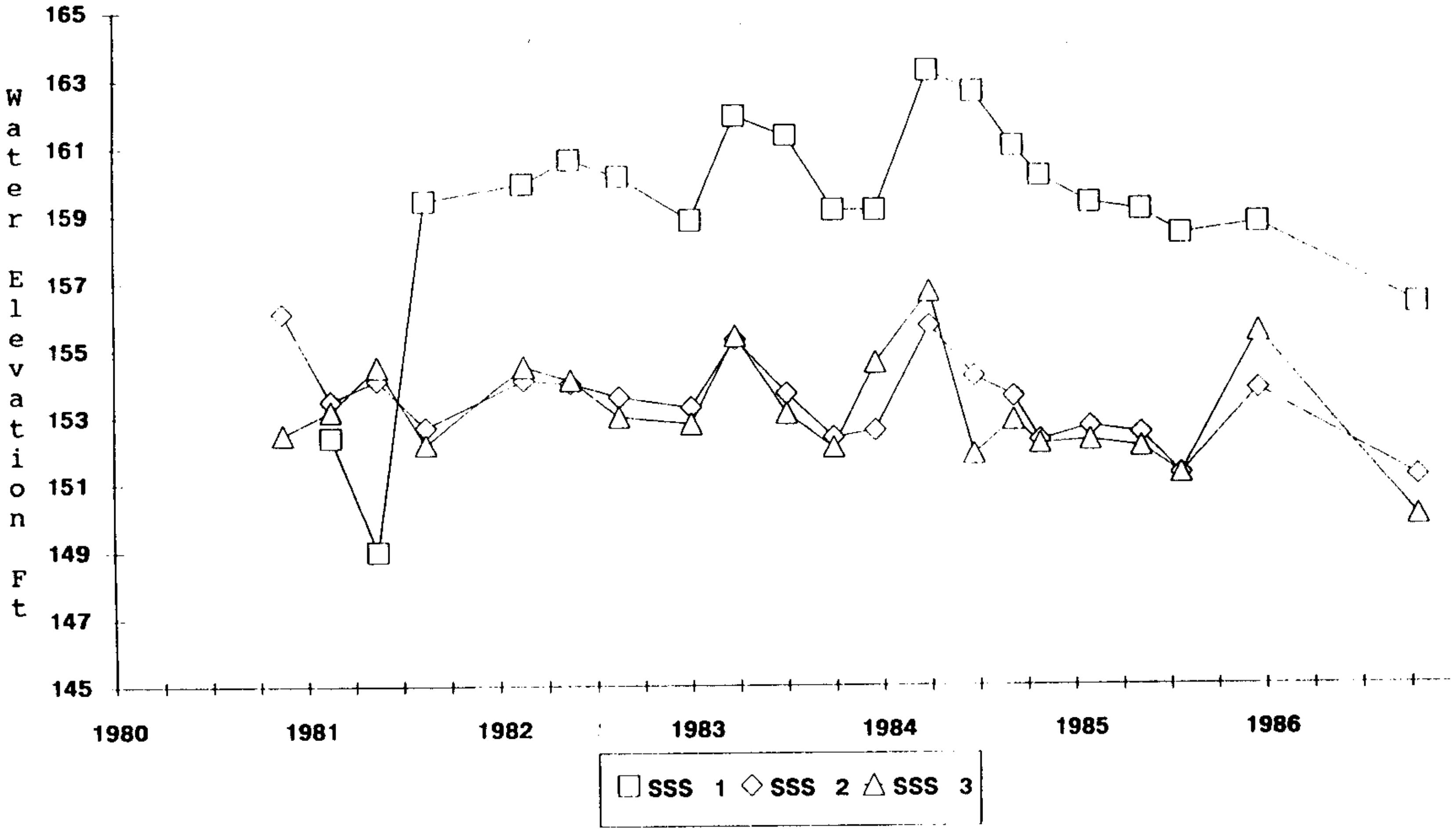


FIGURE 15-6. Hydrograph of the 40-Acre Hardwood Sewage Sludge Application Site

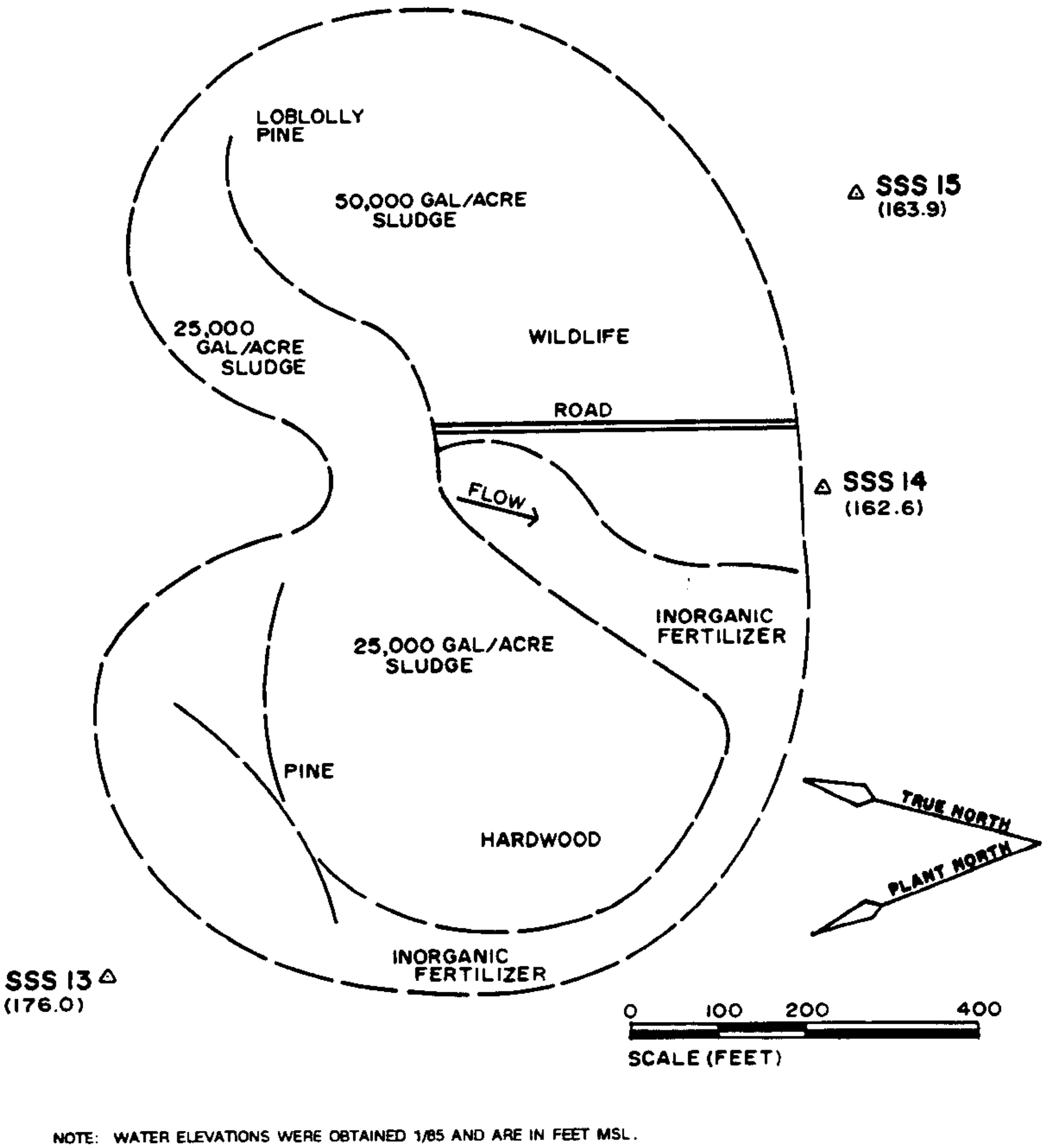


FIGURE 15-7. K-Area Borrow Pit Sewage Sludge Application Site Water-Table Elevation Map

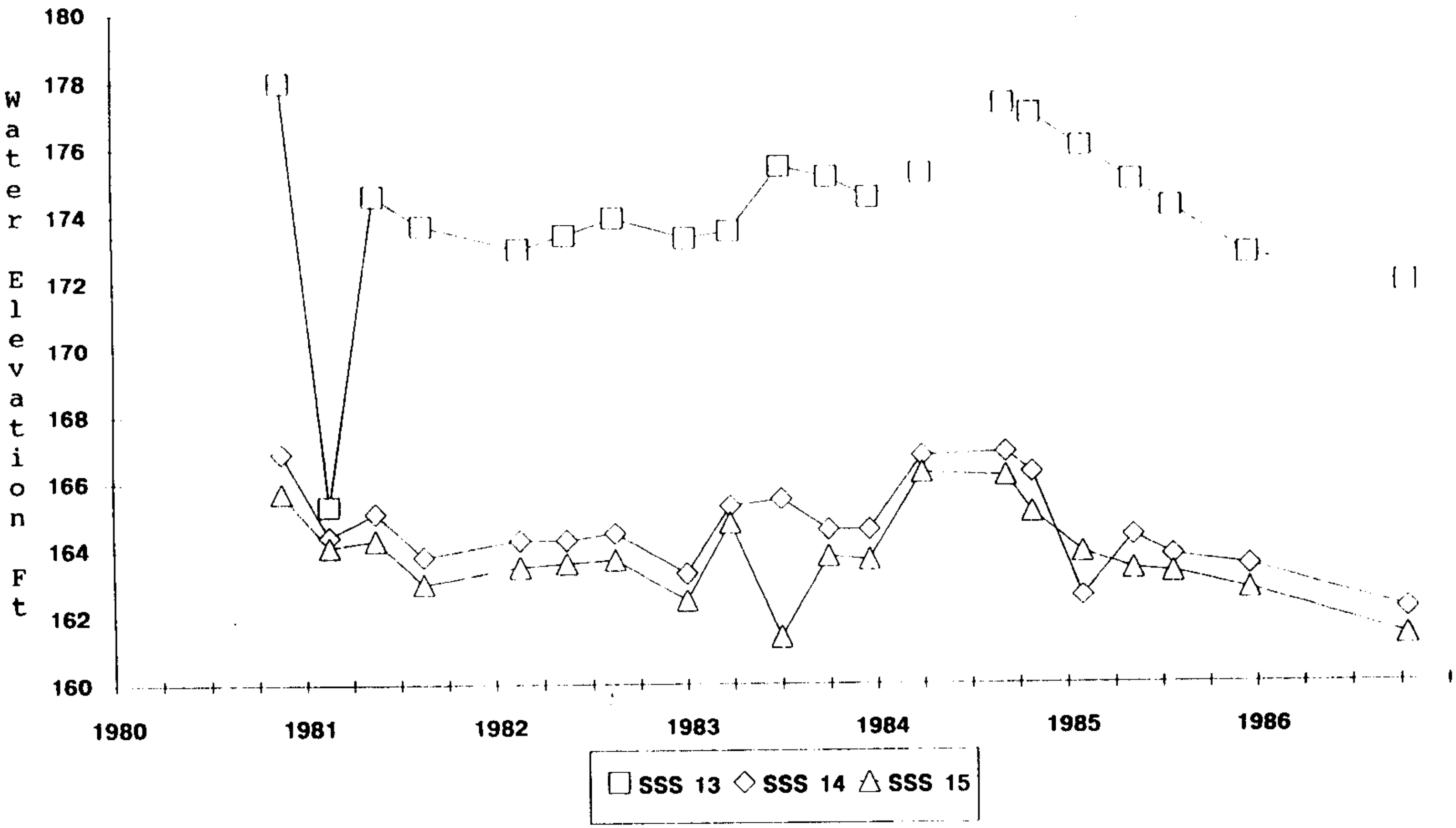


FIGURE 15-8. Hydrograph of the K-Area Borrow Pit Sewage Sludge Application Site

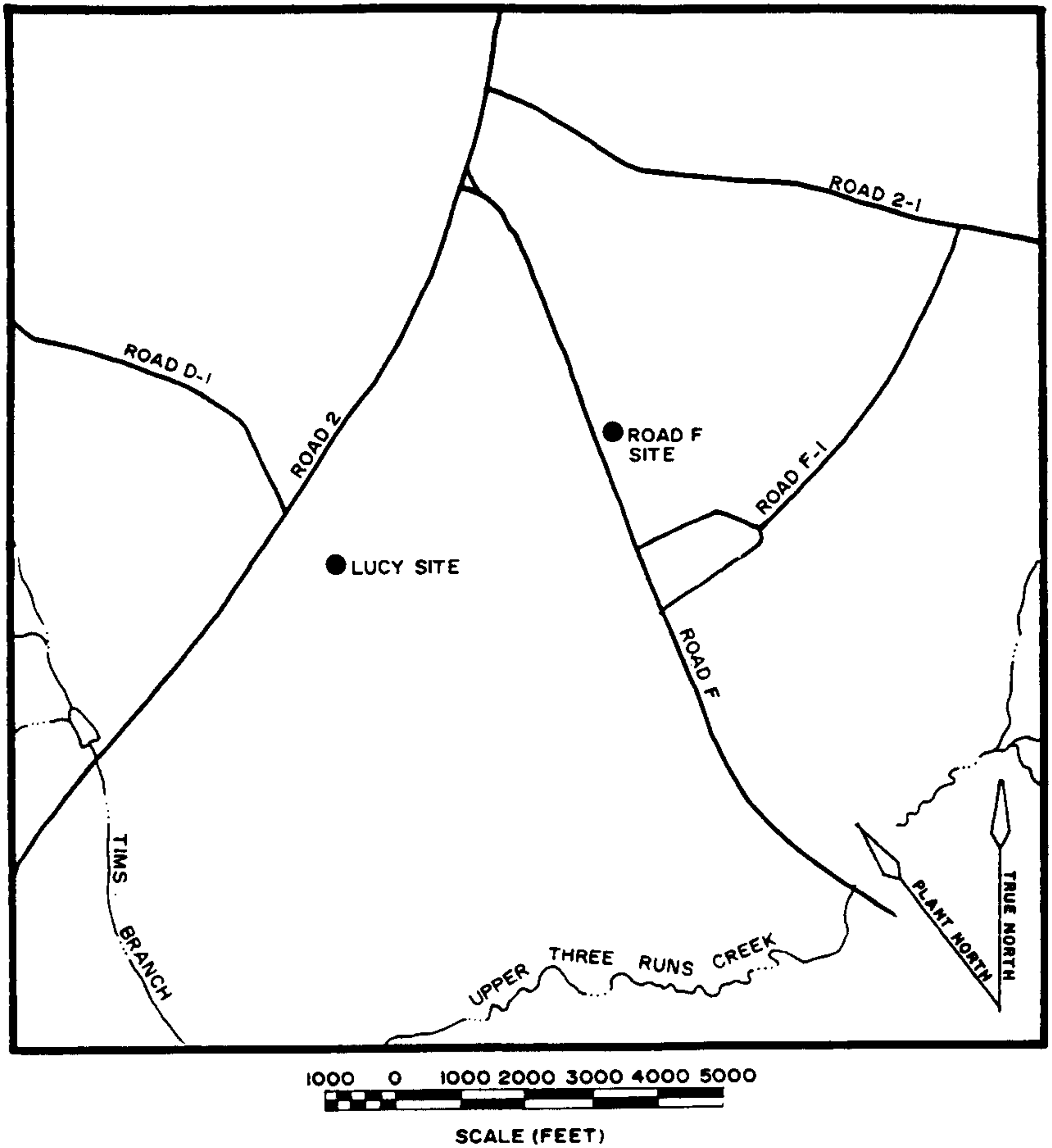
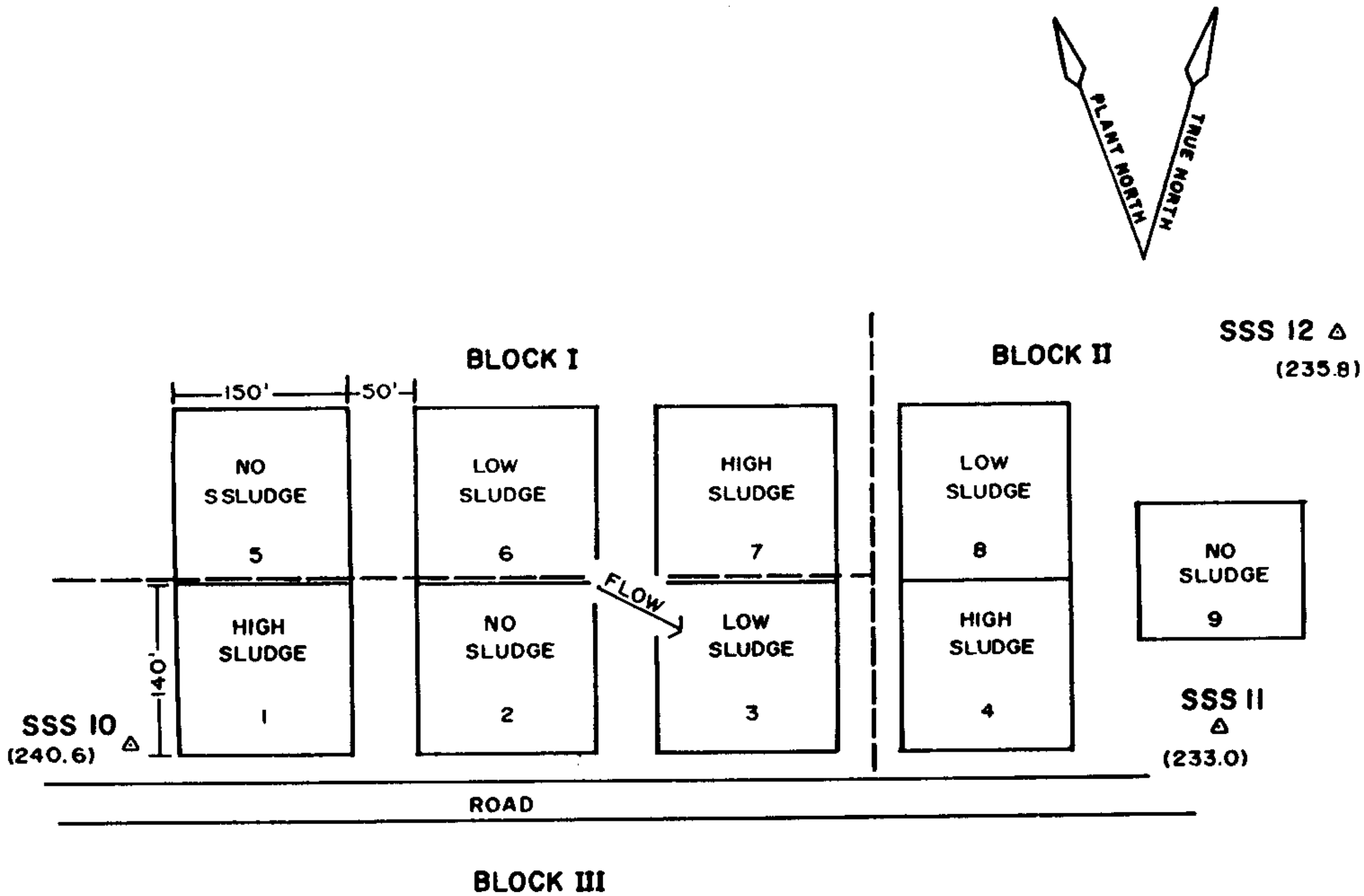


FIGURE 15-9. Locations of the Sandy (Lucy) and Road F Sewage Sludge Application Sites



NOTE: WATER ELEVATIONS WERE OBTAINED 1/85 AND ARE IN FEET MSL.

FIGURE 15-10. Sandy (Lucy) Sewage Sludge Application Site Water-Table Elevation Map

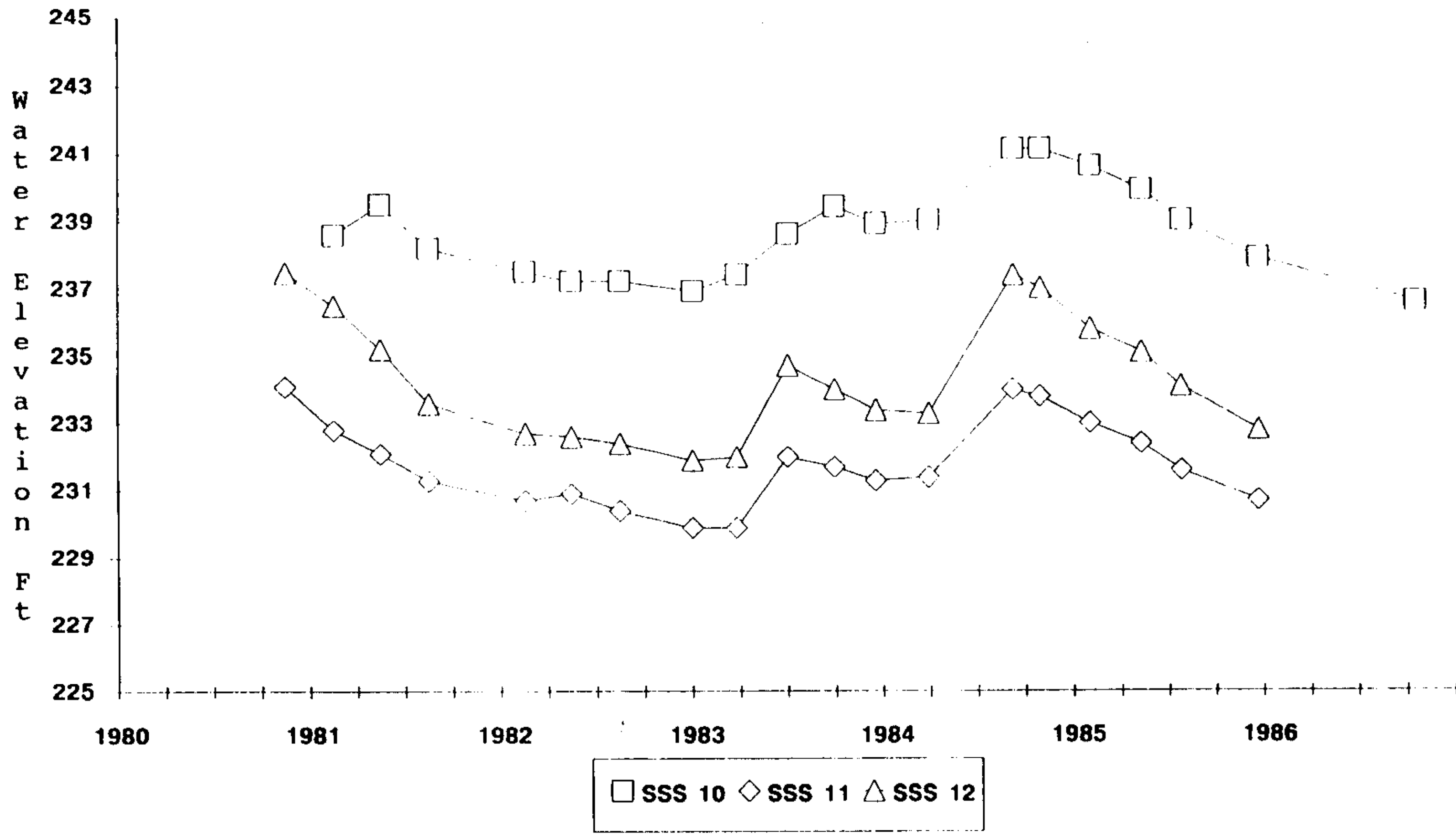


FIGURE 15-11. Hydrograph of the Sandy (Lucy) Sewage Sludge Application Site Wells

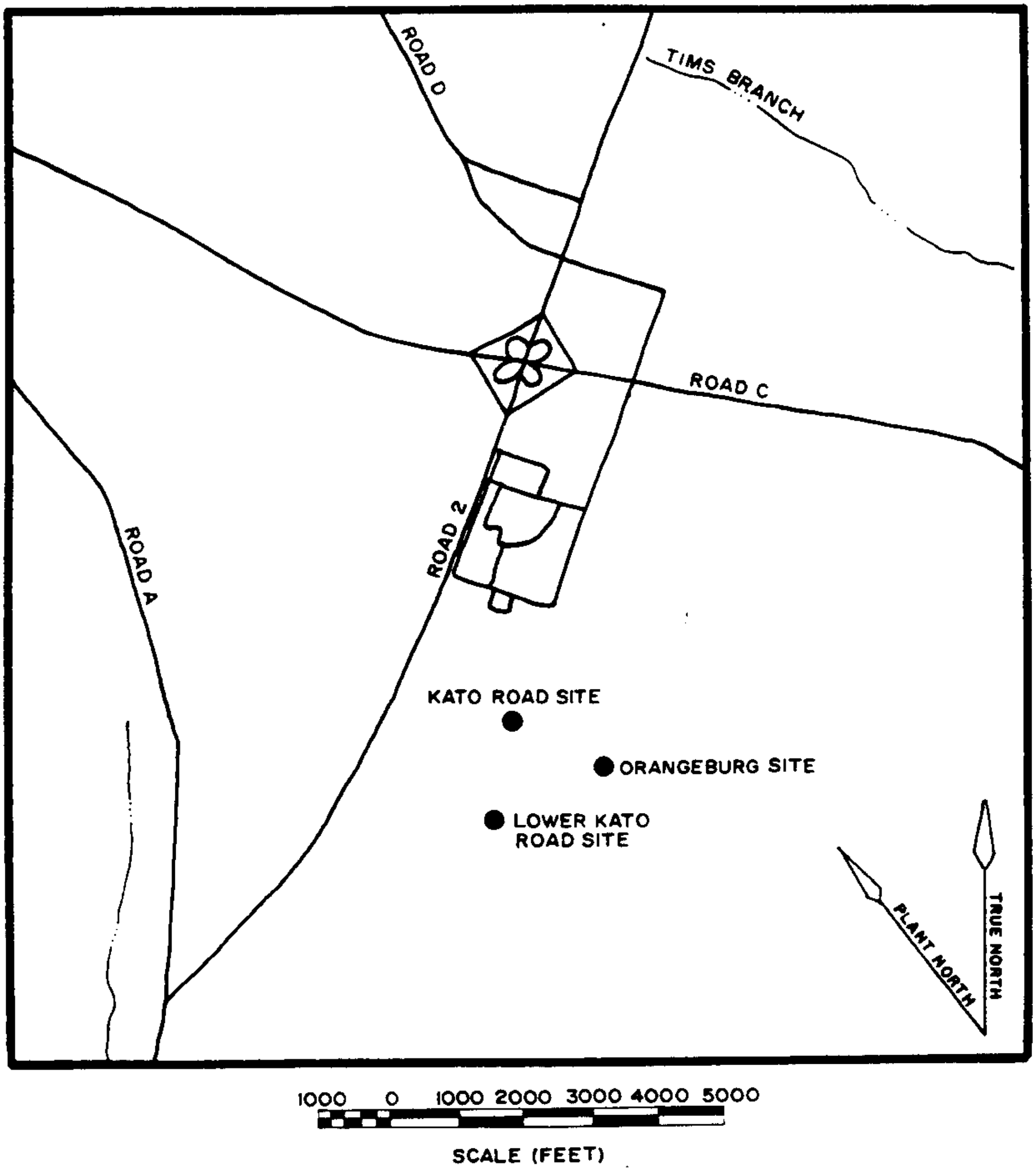


FIGURE 15-12. Locations of the Orangeburg, Kato Road, and Lower Kato Road Sewage Sludge Application Sites

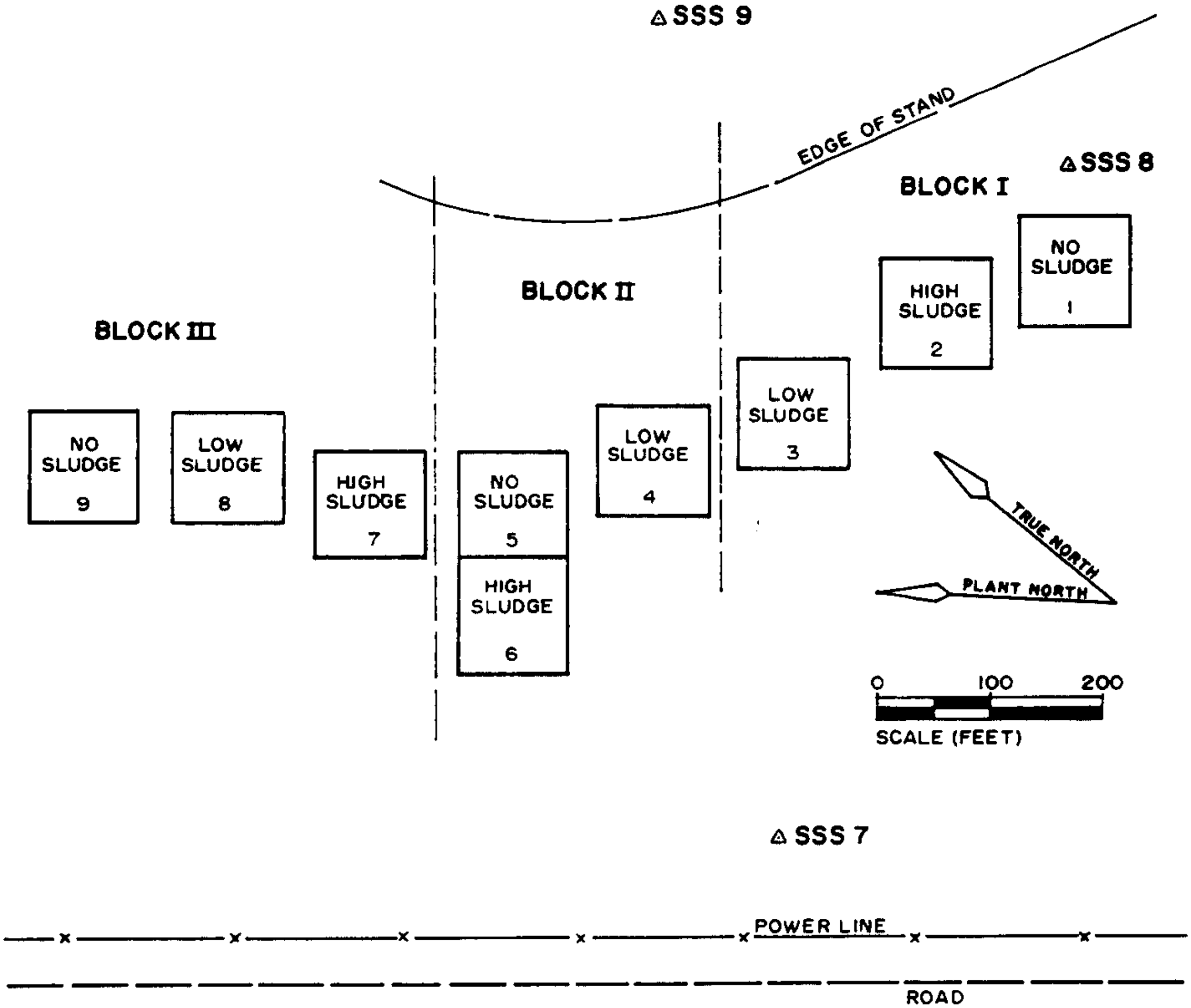


FIGURE 15-13. The Orangeburg Sewage Sludge Application Site

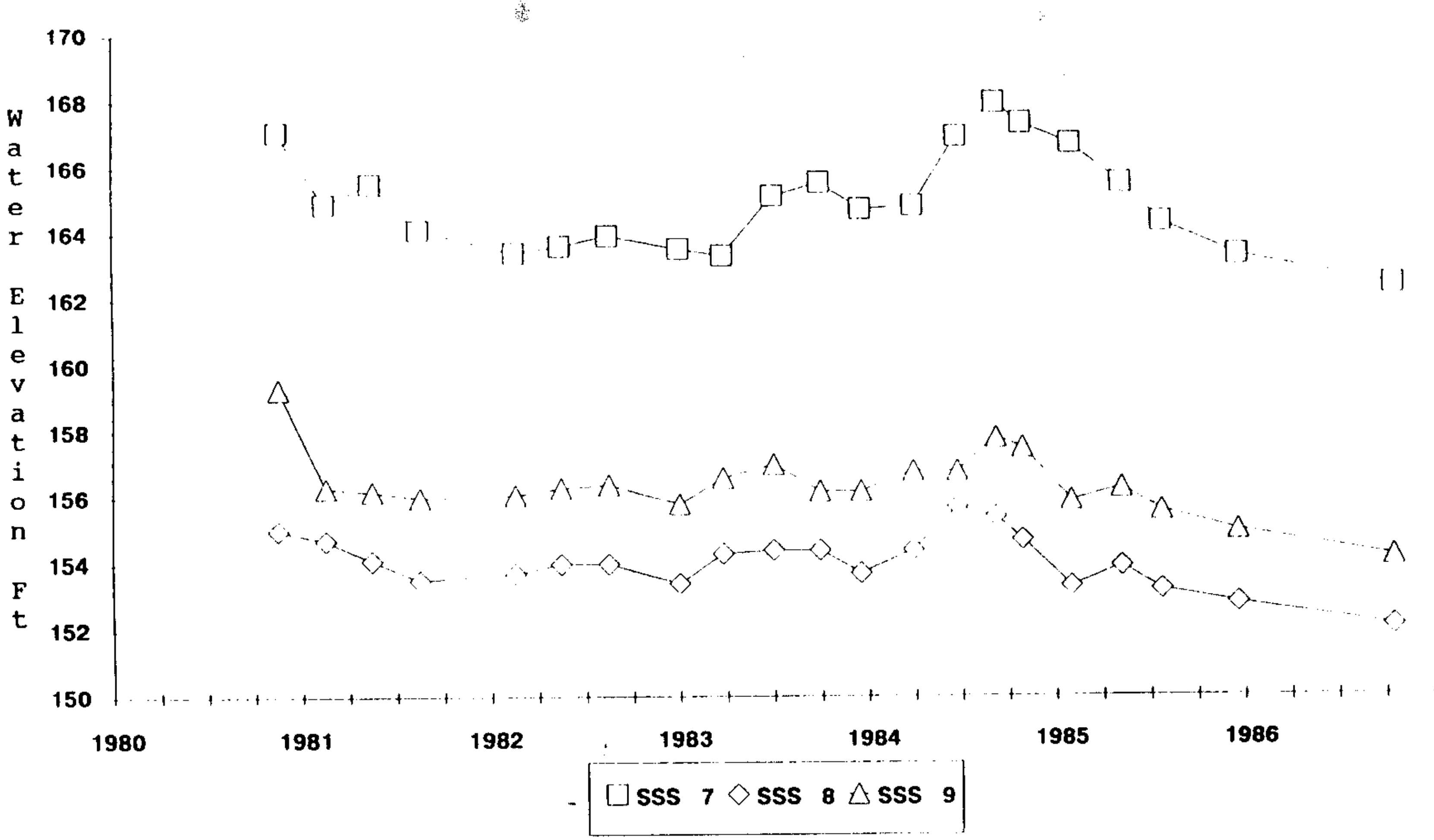
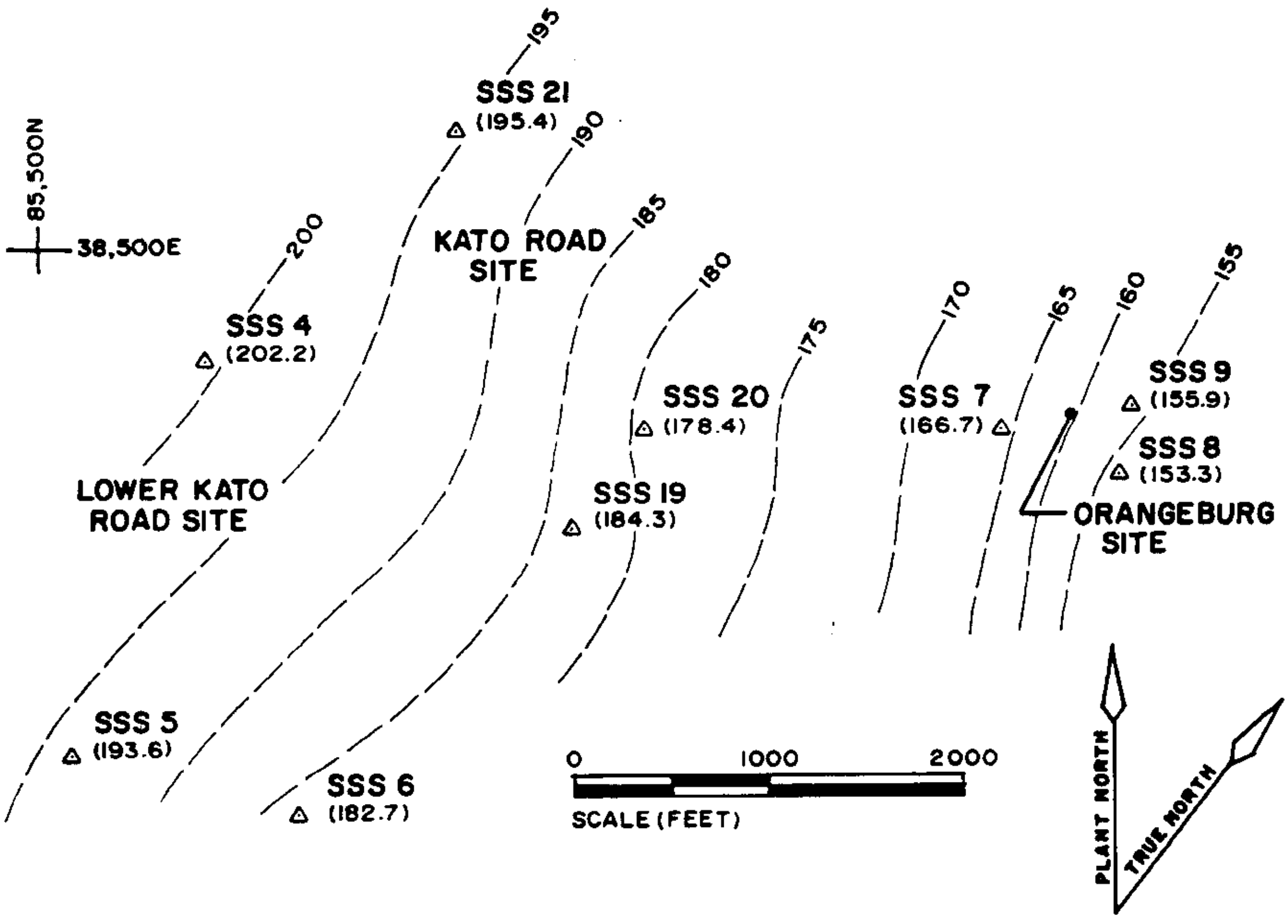


FIGURE 15-14. Hydrograph of the Orangeburg Sewage Sludge Application Site Wells



NOTE: WATER ELEVATIONS WERE OBTAINED 1/85 AND ARE IN FEET MSL.

FIGURE 15-15. Orangeburg, Kato Road, and Lower Kato Road Sewage Sludge Application Sites Water-Table Elevation Map

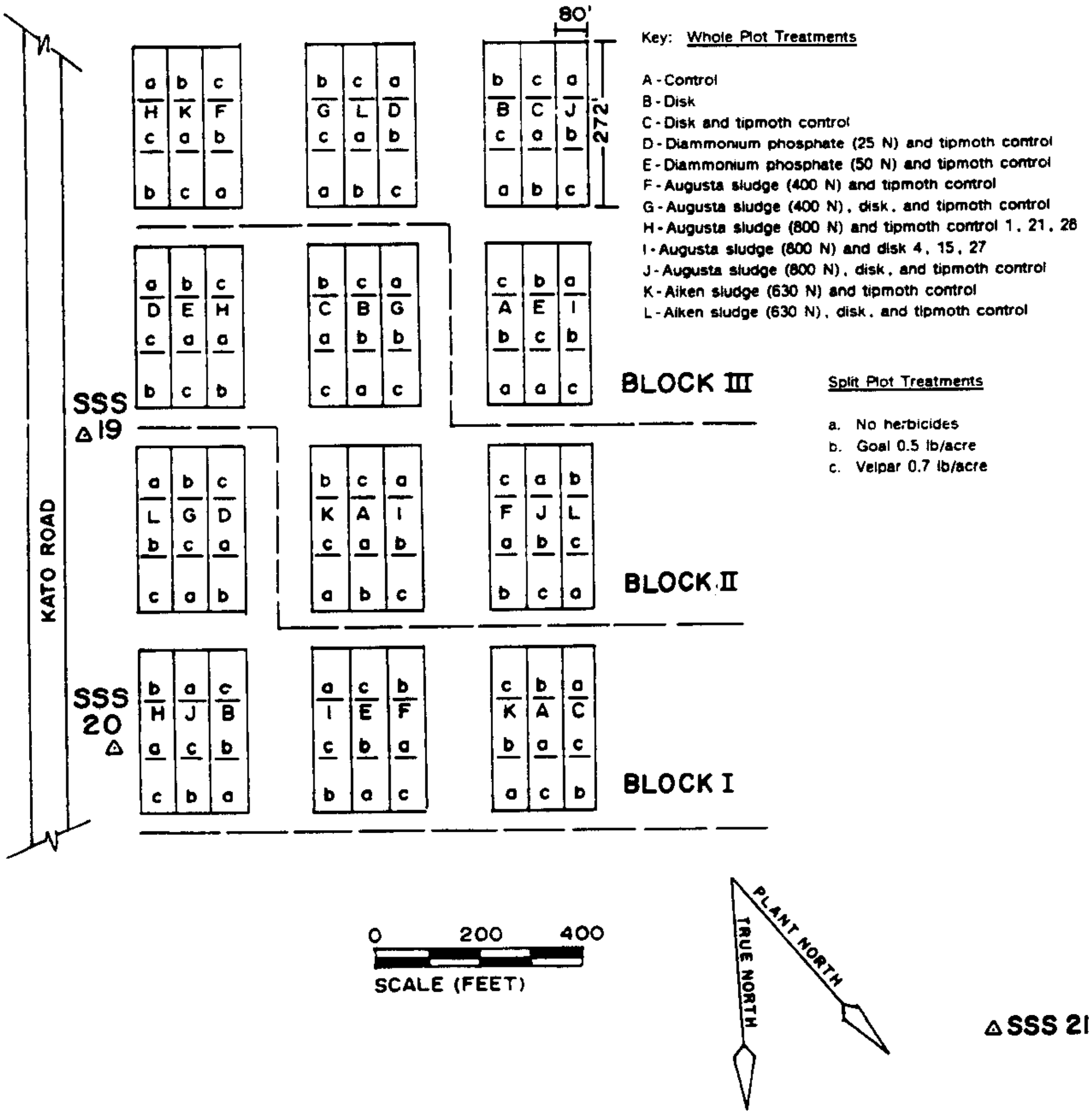


FIGURE 15-16. The Kato Road Sewage Sludge Application Site

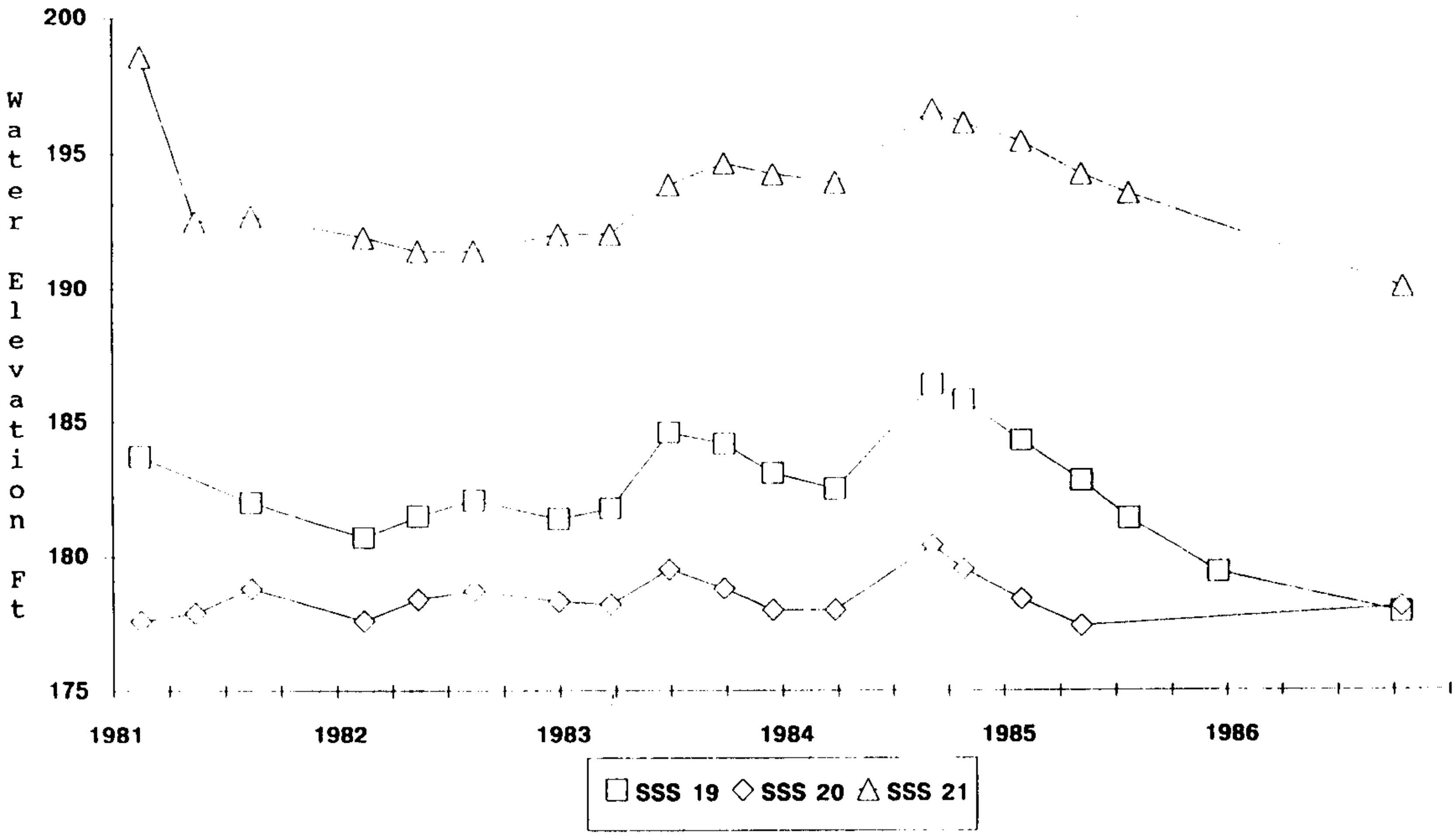


FIGURE 15-17. Hydrograph of the Kato Road Sewage Sludge Application Site Wells

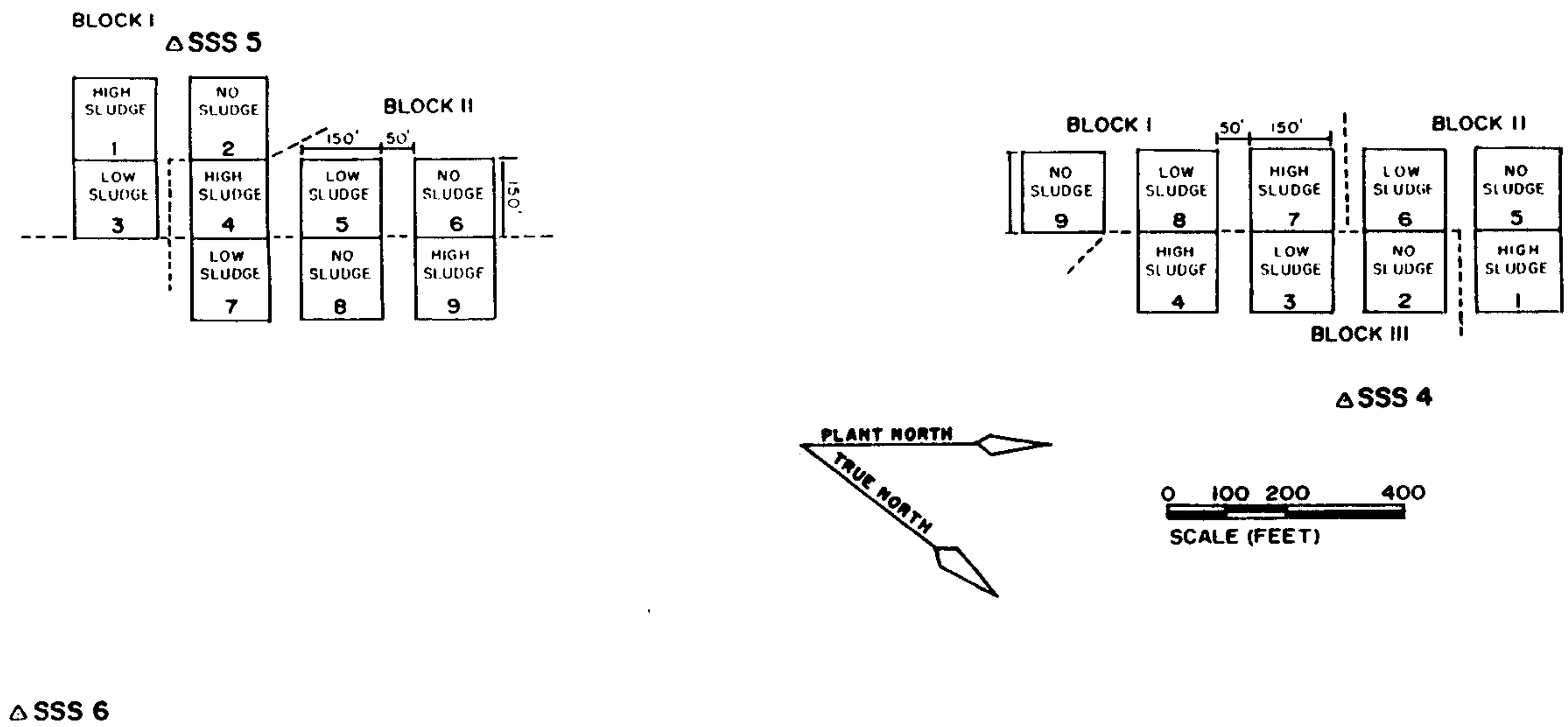


FIGURE 15-18. The Lower Kato Road Sewage Sludge Application Site

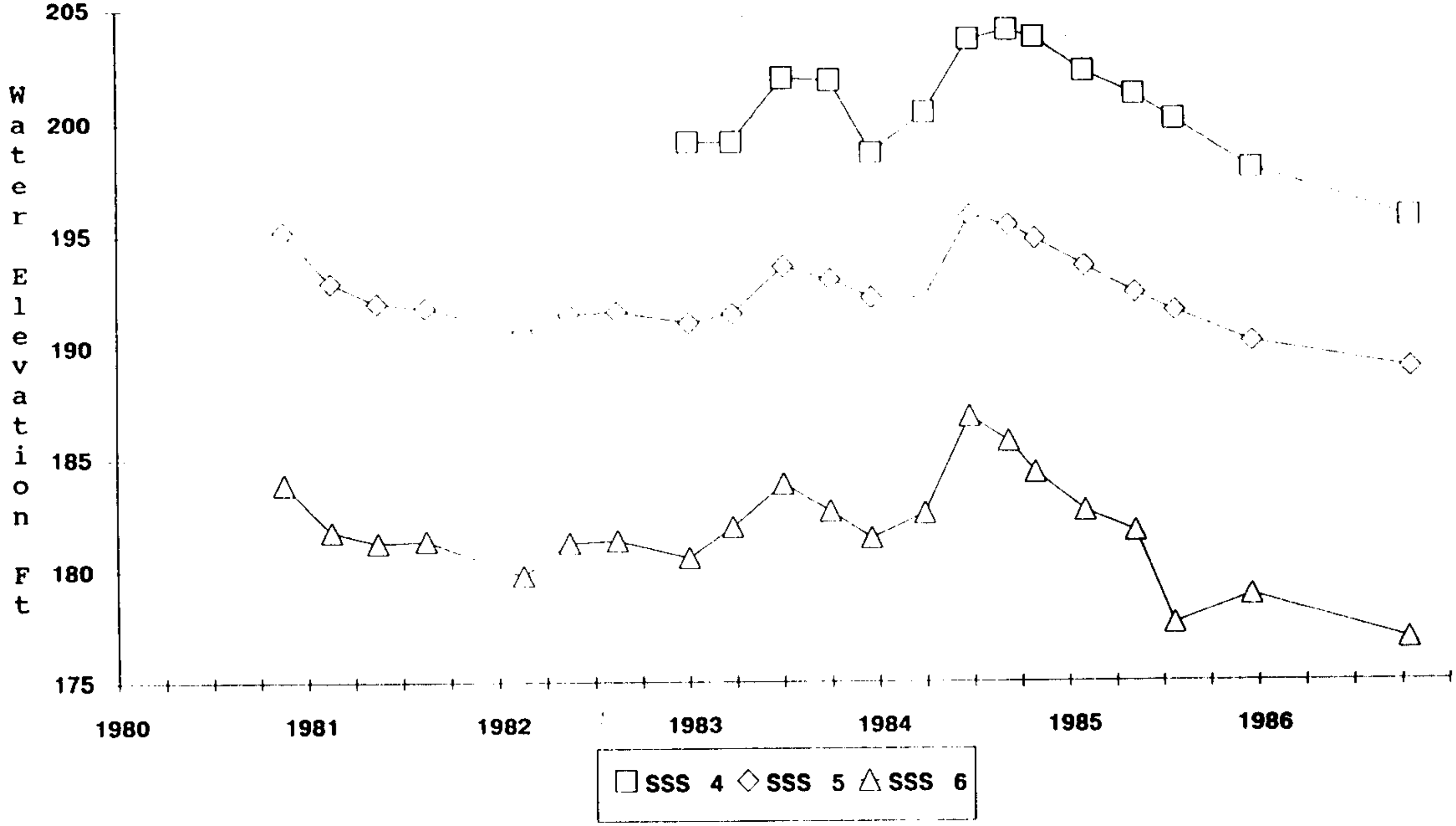


FIGURE 15-19. Hydrograph of the Lower Kato Road Sewage Sludge Application Site Wells

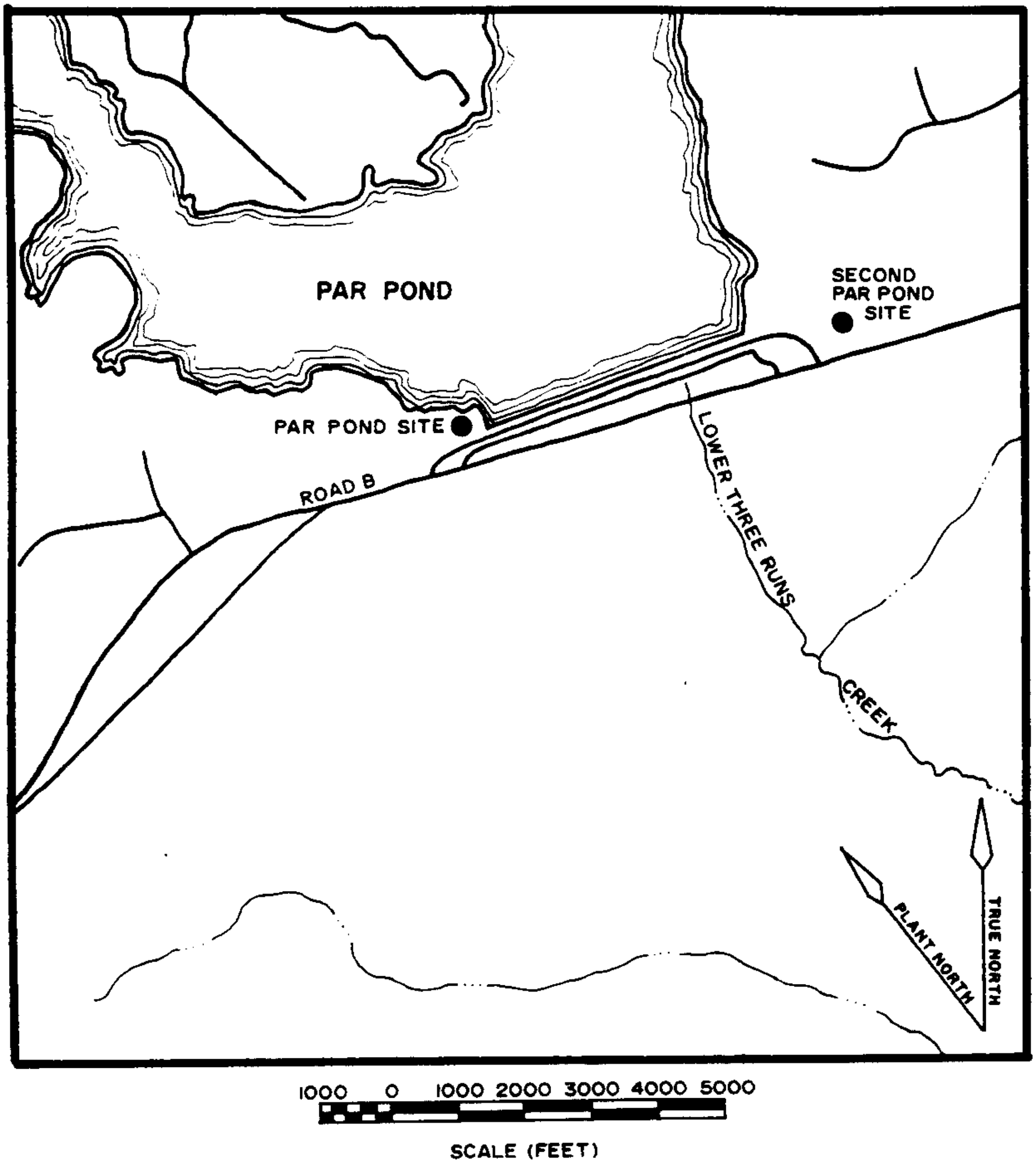
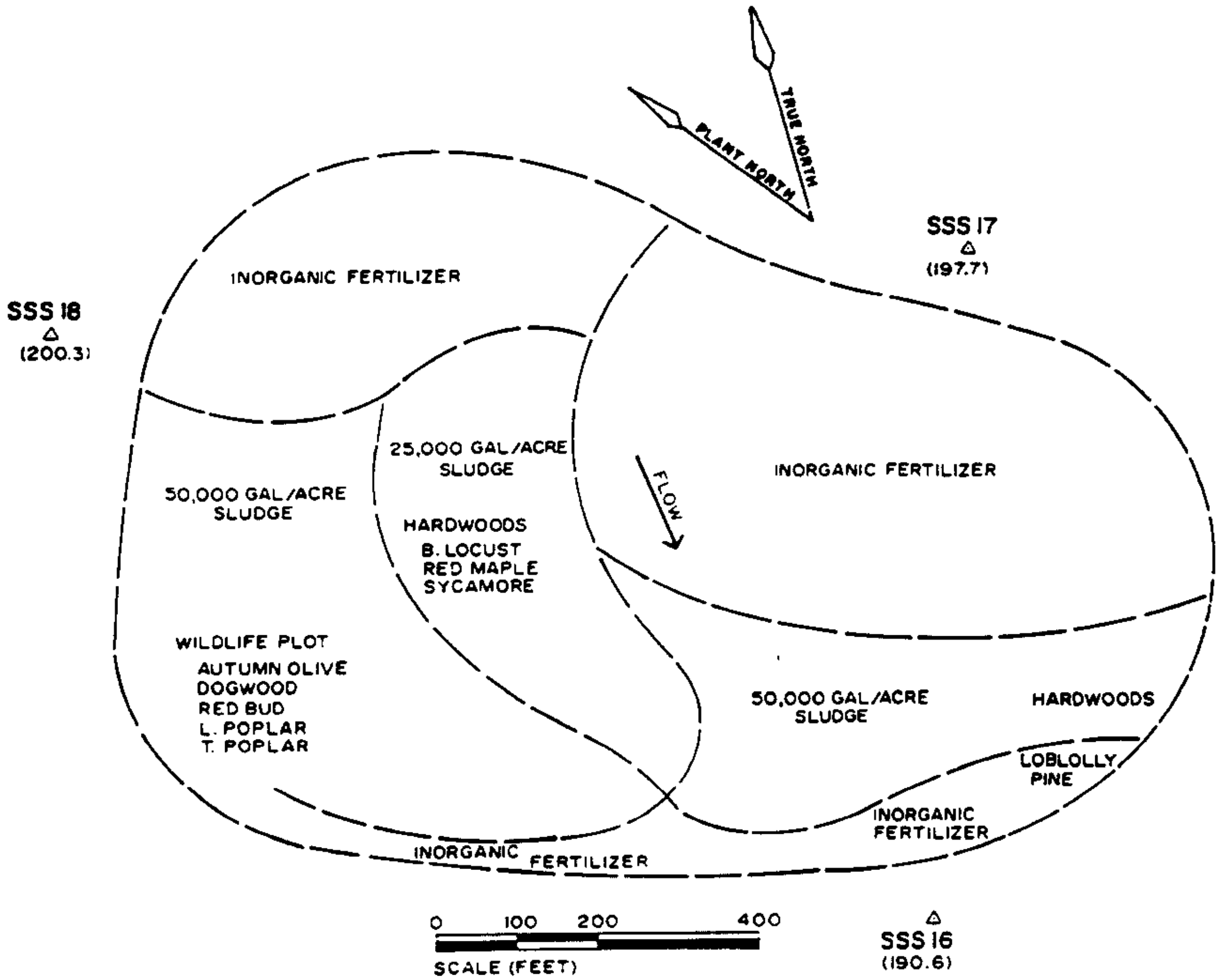
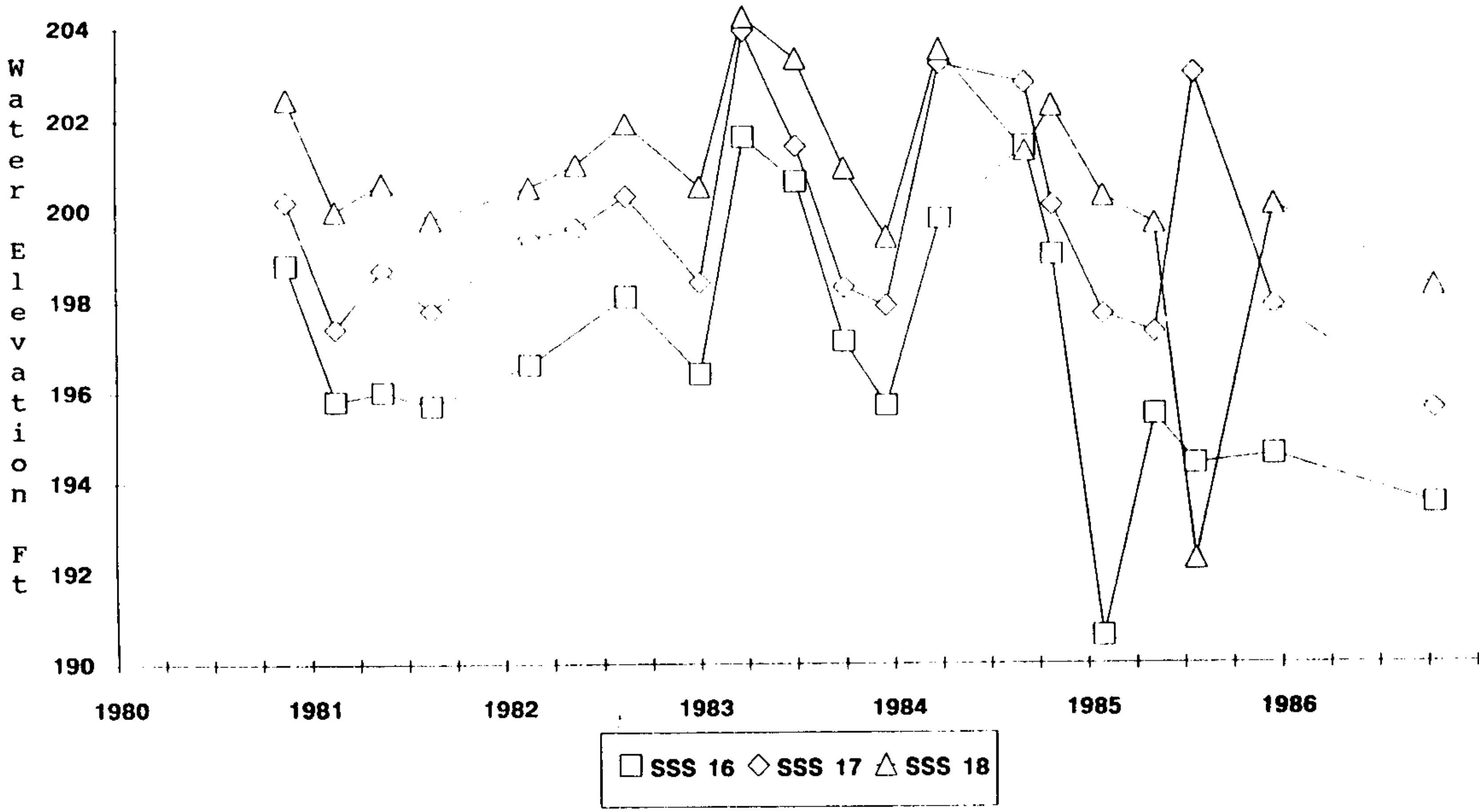


FIGURE 15-20. Locations of the Par Pond Borrow Pit and Second Par Pond Borrow Pit Sewage Sludge Application Sites



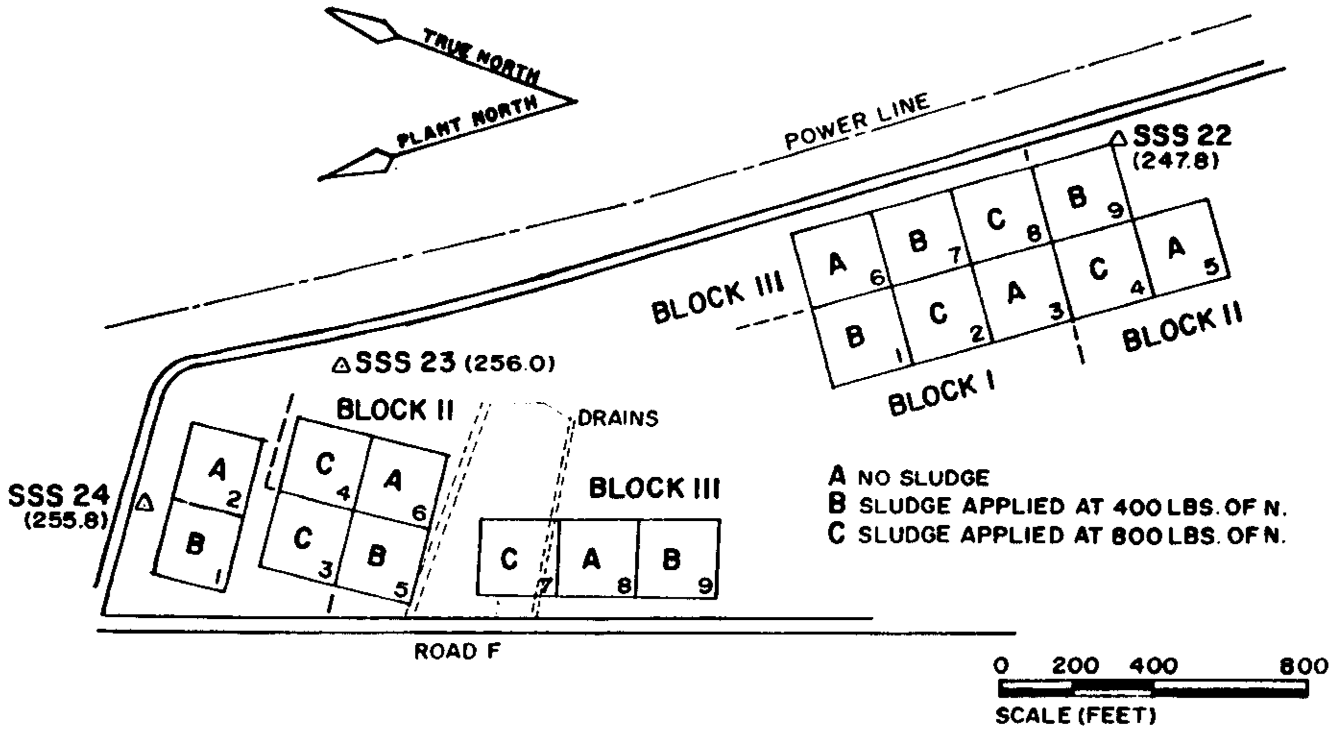
NOTE: WATER ELEVATIONS WERE OBTAINED 1/85 AND ARE IN FEET MSL.

FIGURE 15-21. The Par Pond Borrow Pit Sewage Sludge Application Site



NOTE: A WATER LEVEL OF 181.2 FEET OBTAINED FOR WELL SSS 16 ON 5/15/82 IS NOT PLOTTED.

FIGURE 15-22. Hydrograph of the Par Pond Borrow Pit Sewage Sludge Application Site Wells



NOTE: WATER ELEVATIONS WERE OBTAINED 1/85 AND ARE IN FEET MSL.

FIGURE 15-23. The Road F Sewage Sludge Application Site

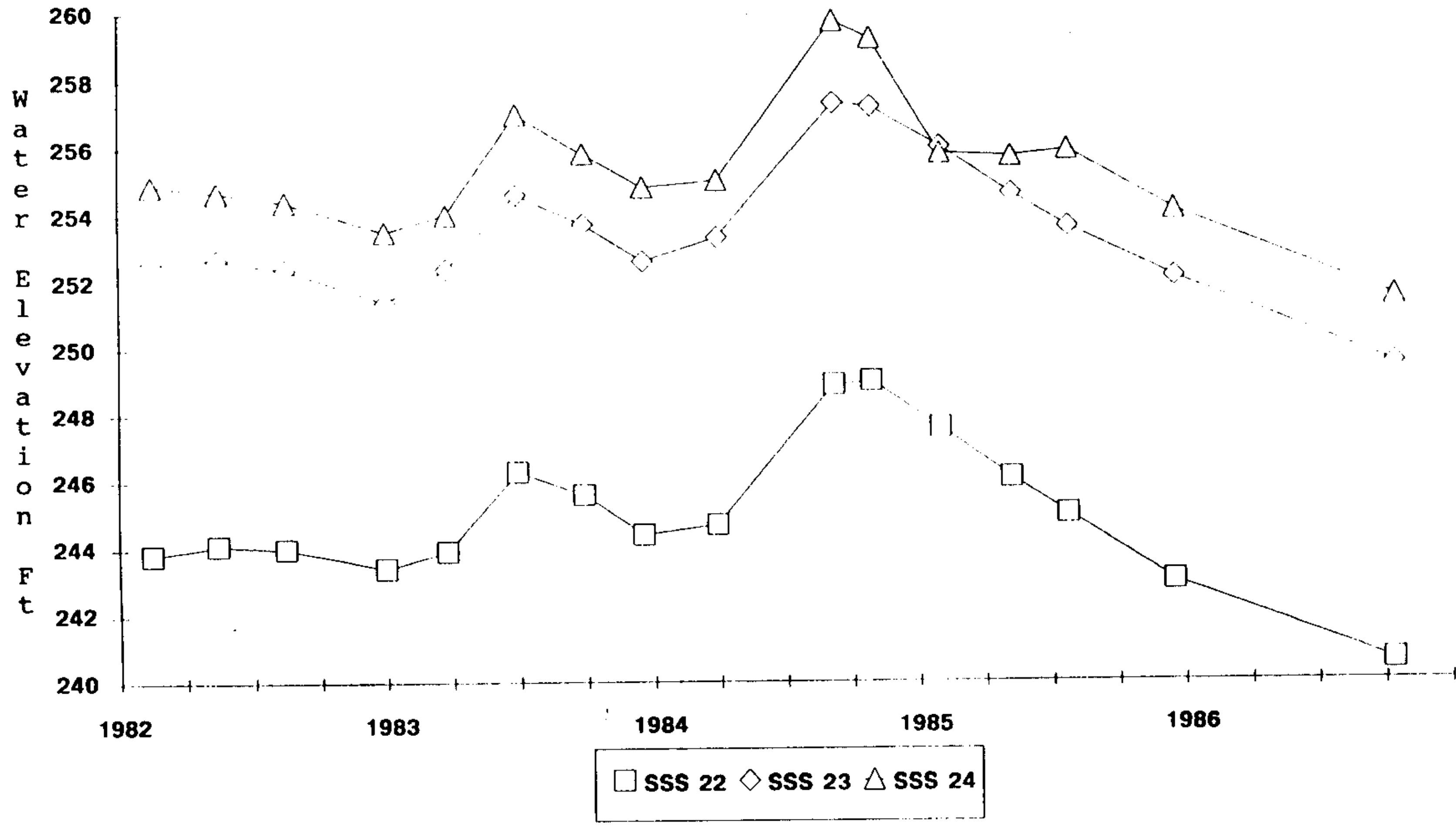


FIGURE 15-24. Hydrograph of the Road F Sewage Sludge Application Site Wells

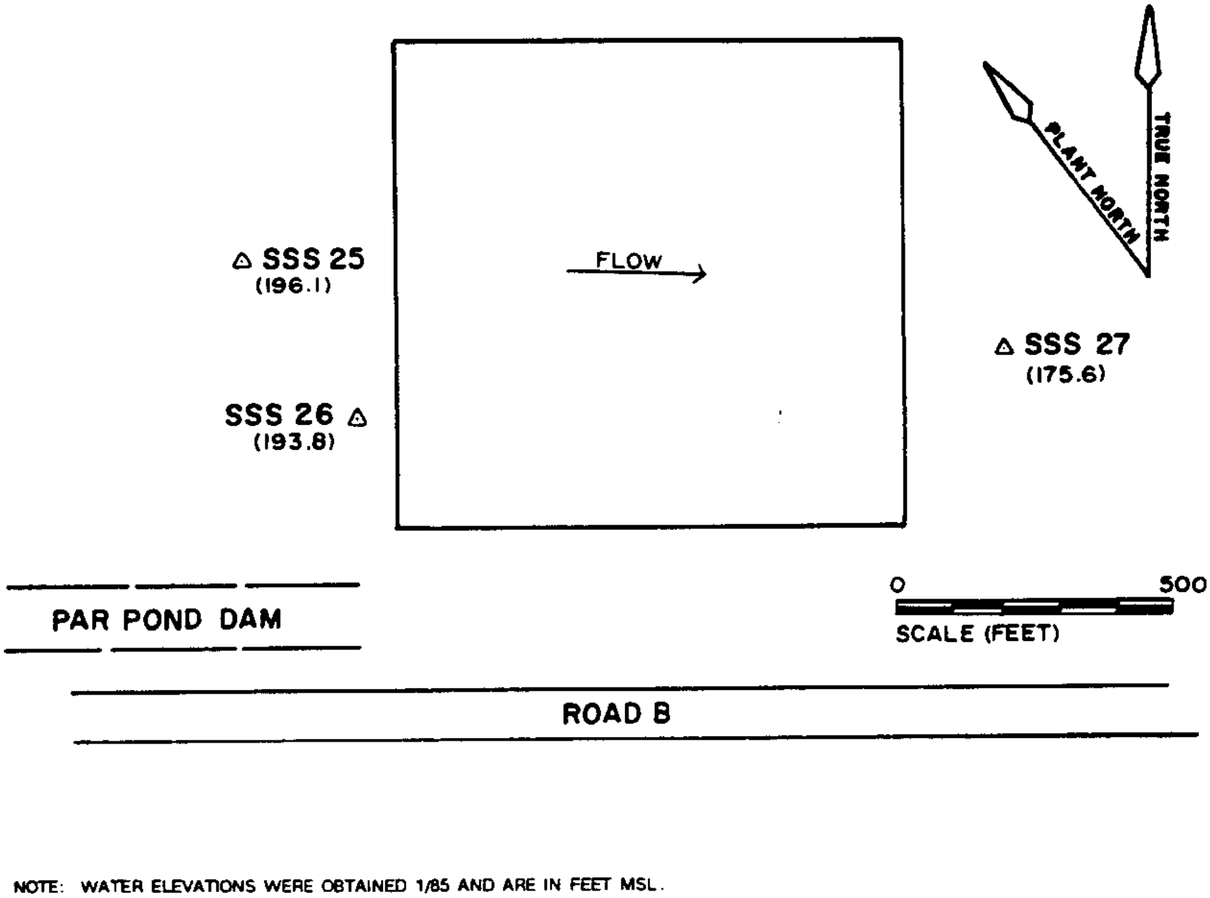


FIGURE 15-25. The Second Par Pond Borrow Pit Sewage Sludge Application Site

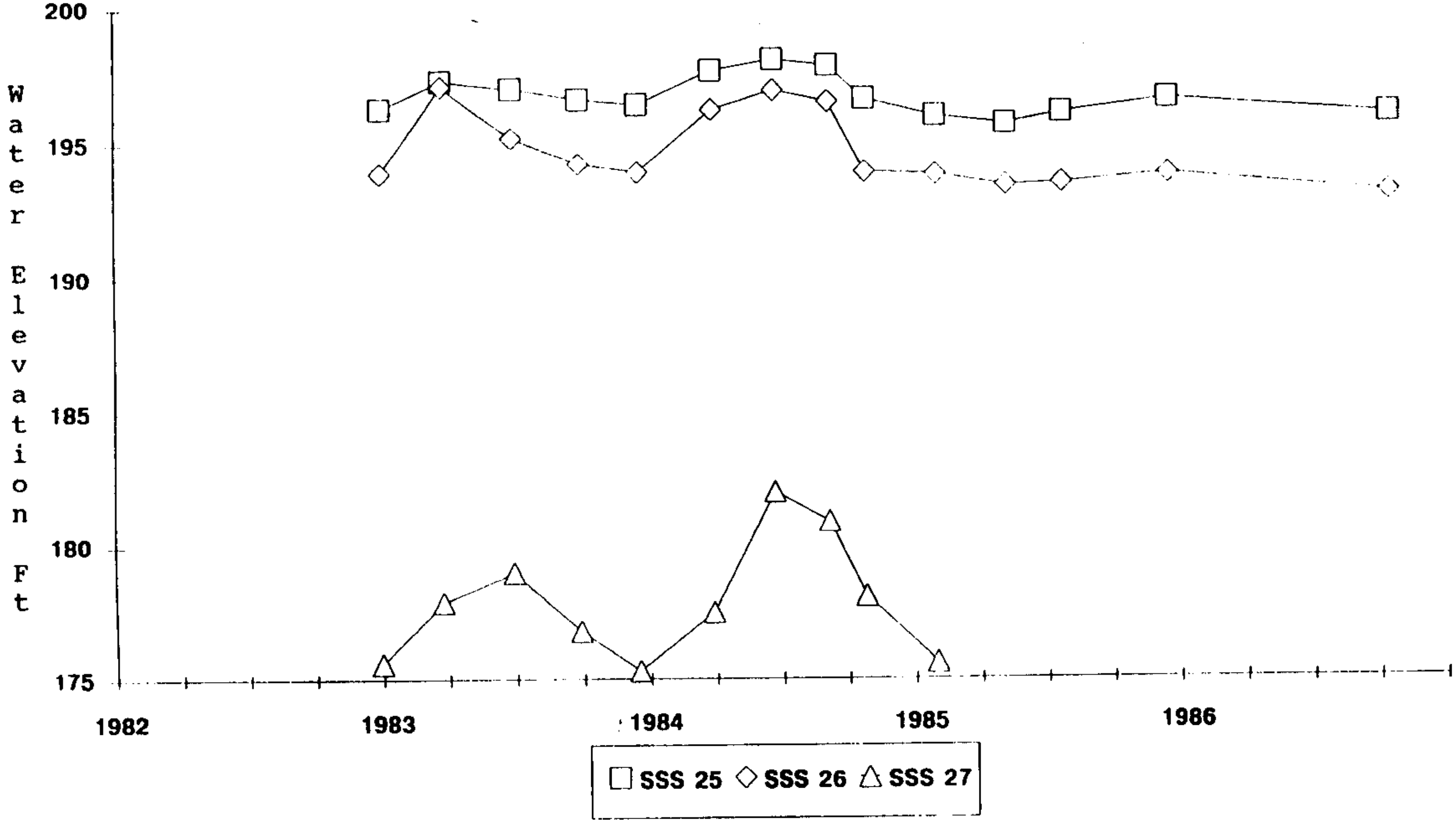


FIGURE 15-26. Hydrograph of the Second Par Pond Sewage Sludge Application Site Wells

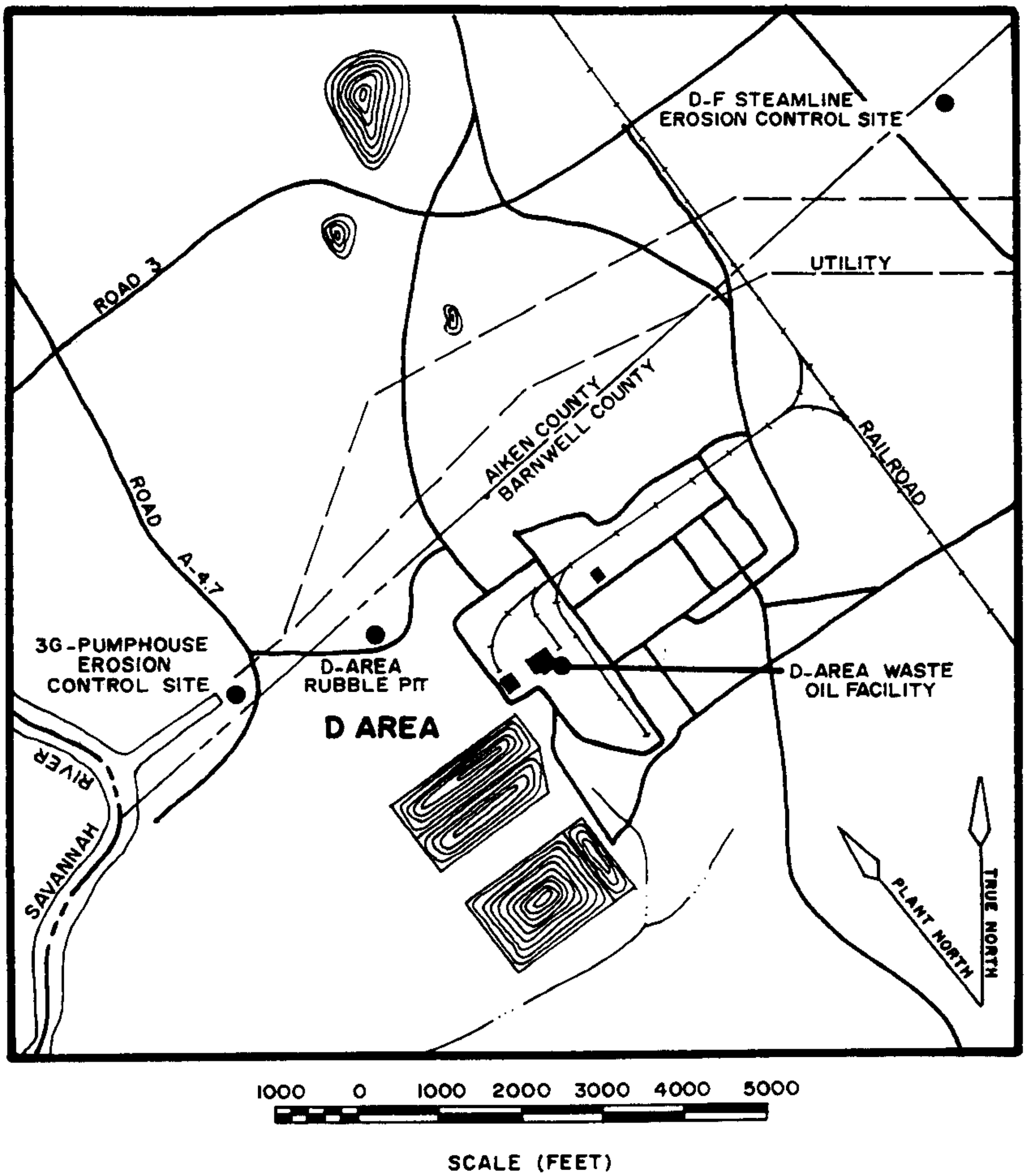


FIGURE 15-27. Locations of Other Waste Sites Around D Area

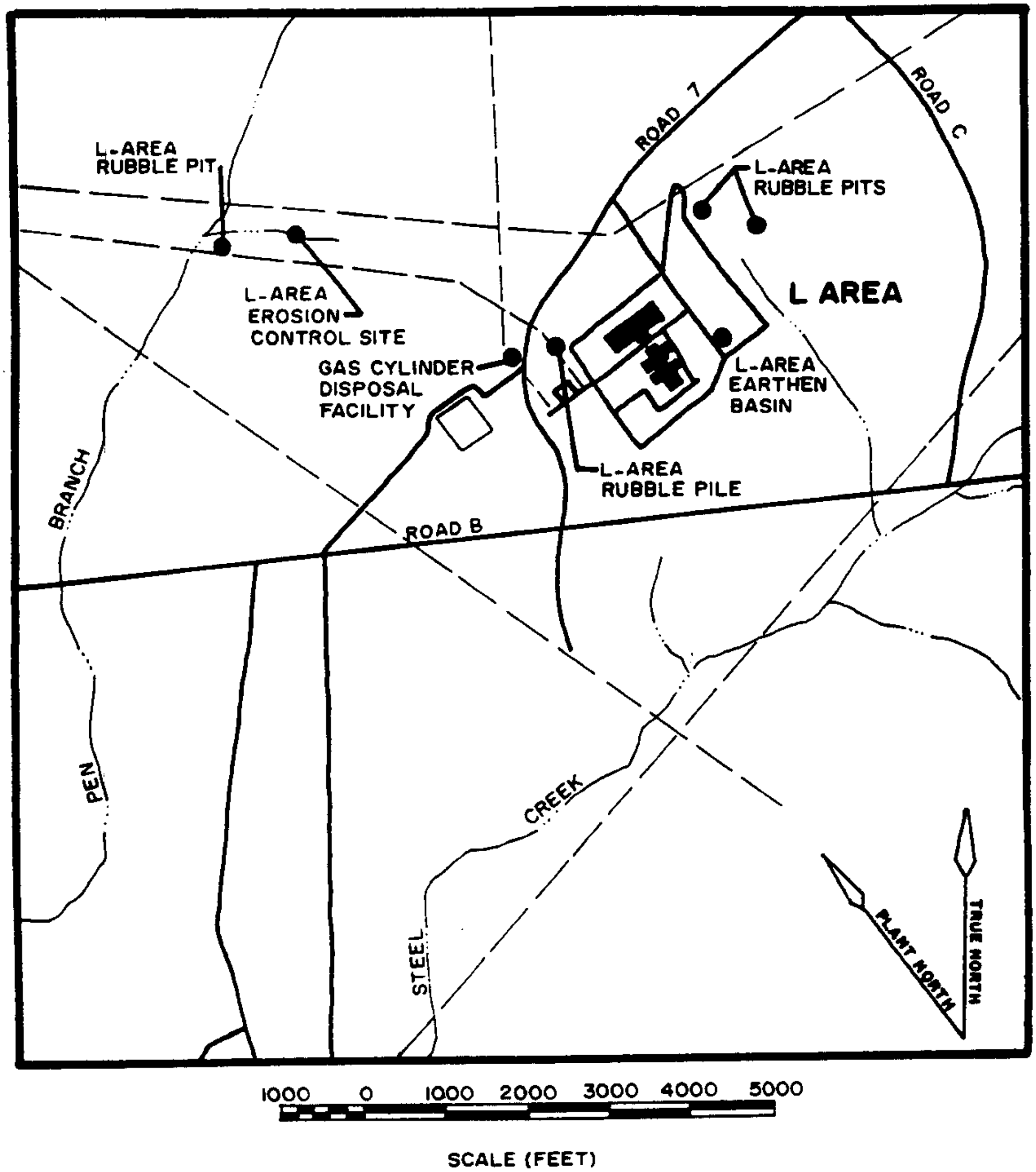


FIGURE 15-28. Locations of Other Waste Sites Around L Area

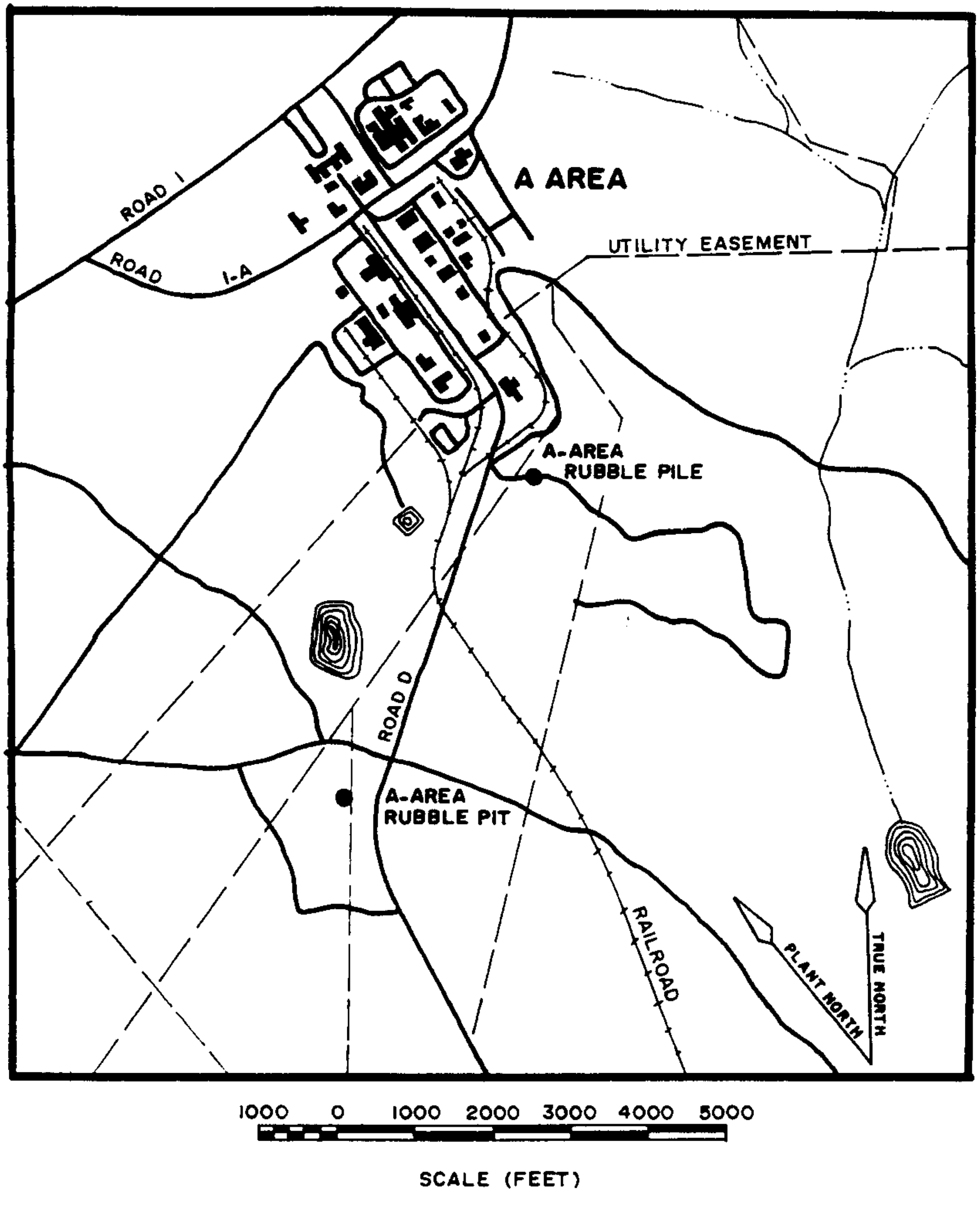


FIGURE 15-29. Locations of Other Waste Sites Around A Area

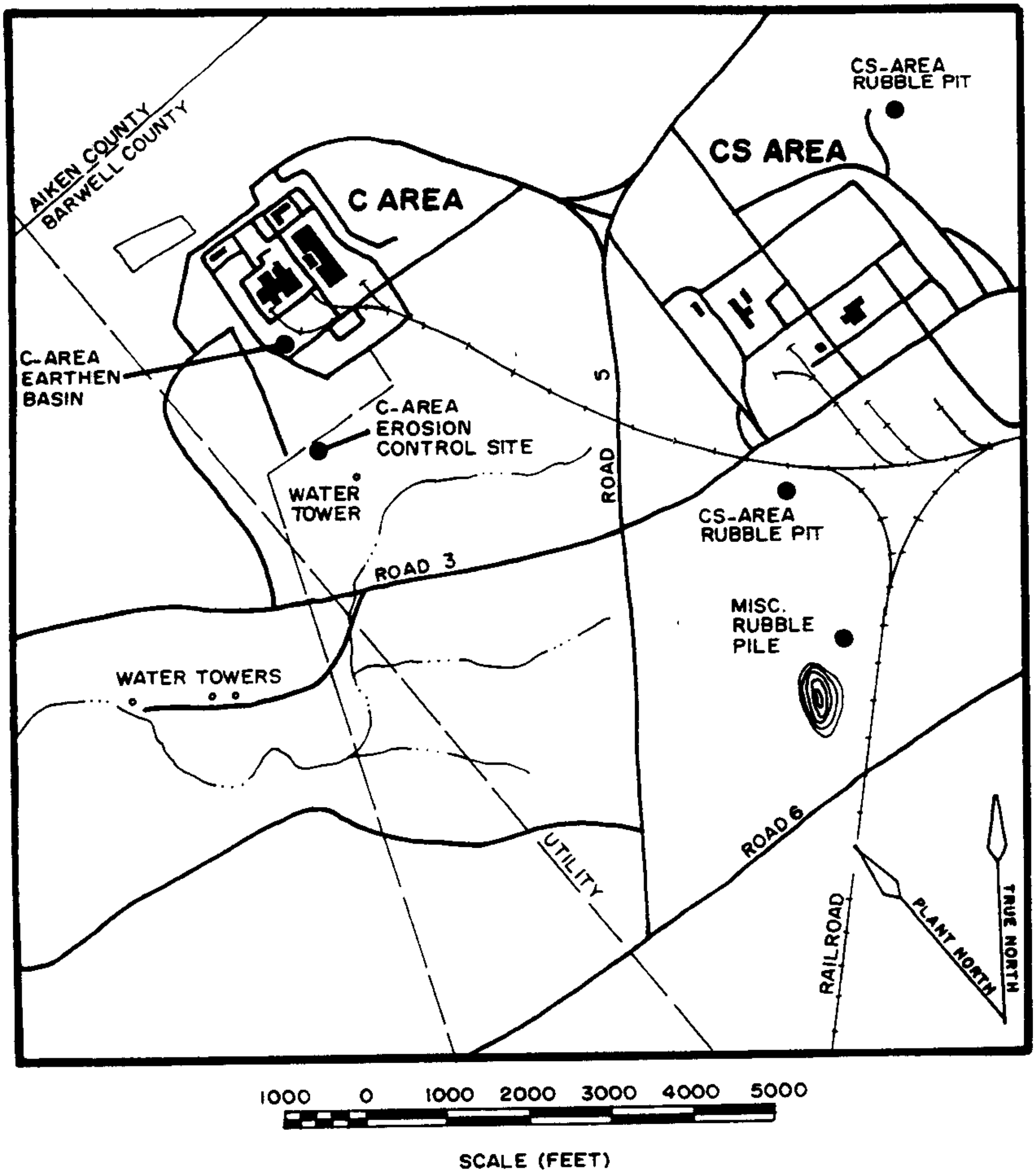


FIGURE 15-30. Locations of Other Waste Sites Around C and Central Shops (CS) Areas

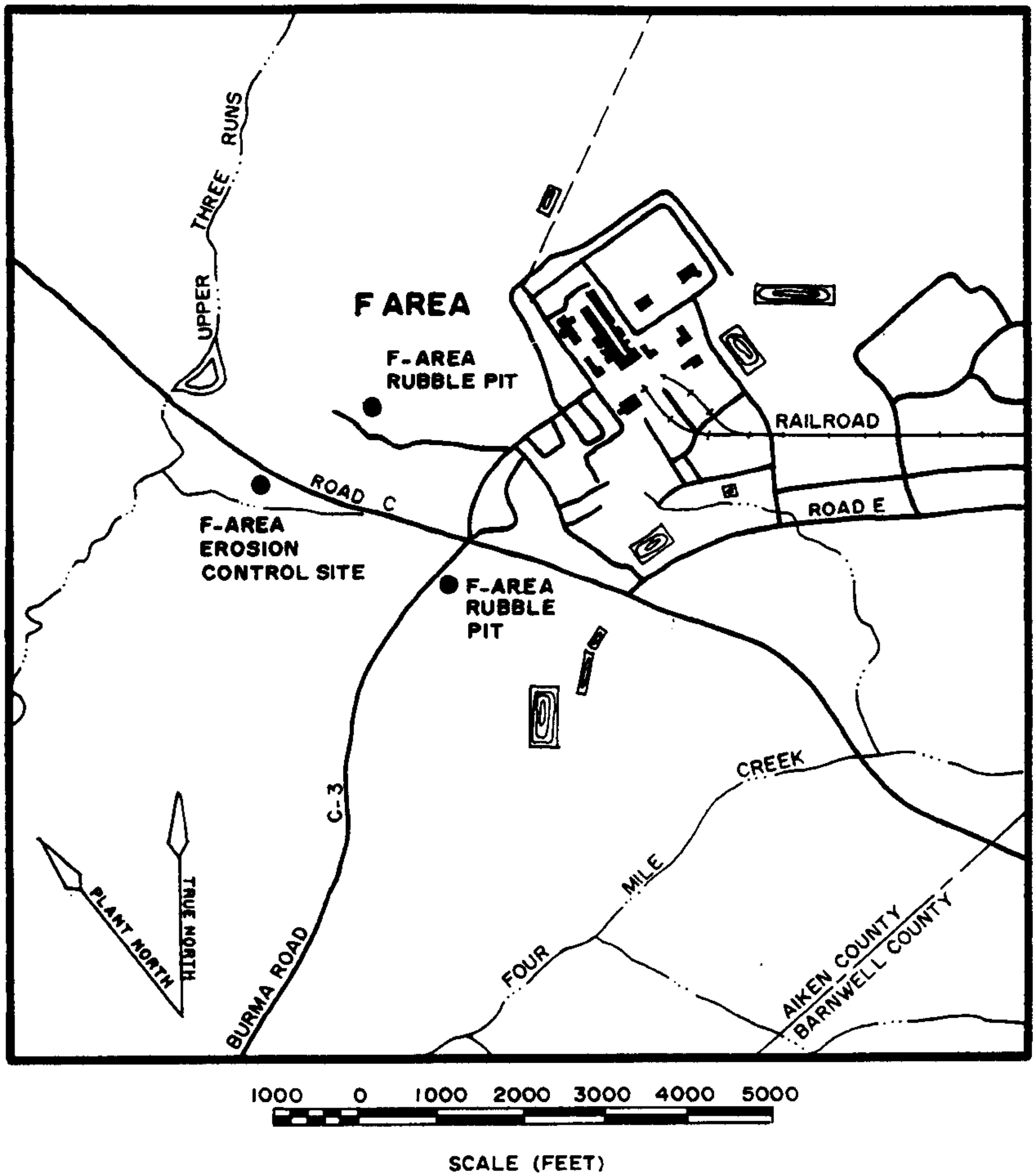


FIGURE 15-31. Locations of Other Waste Sites Around F Area

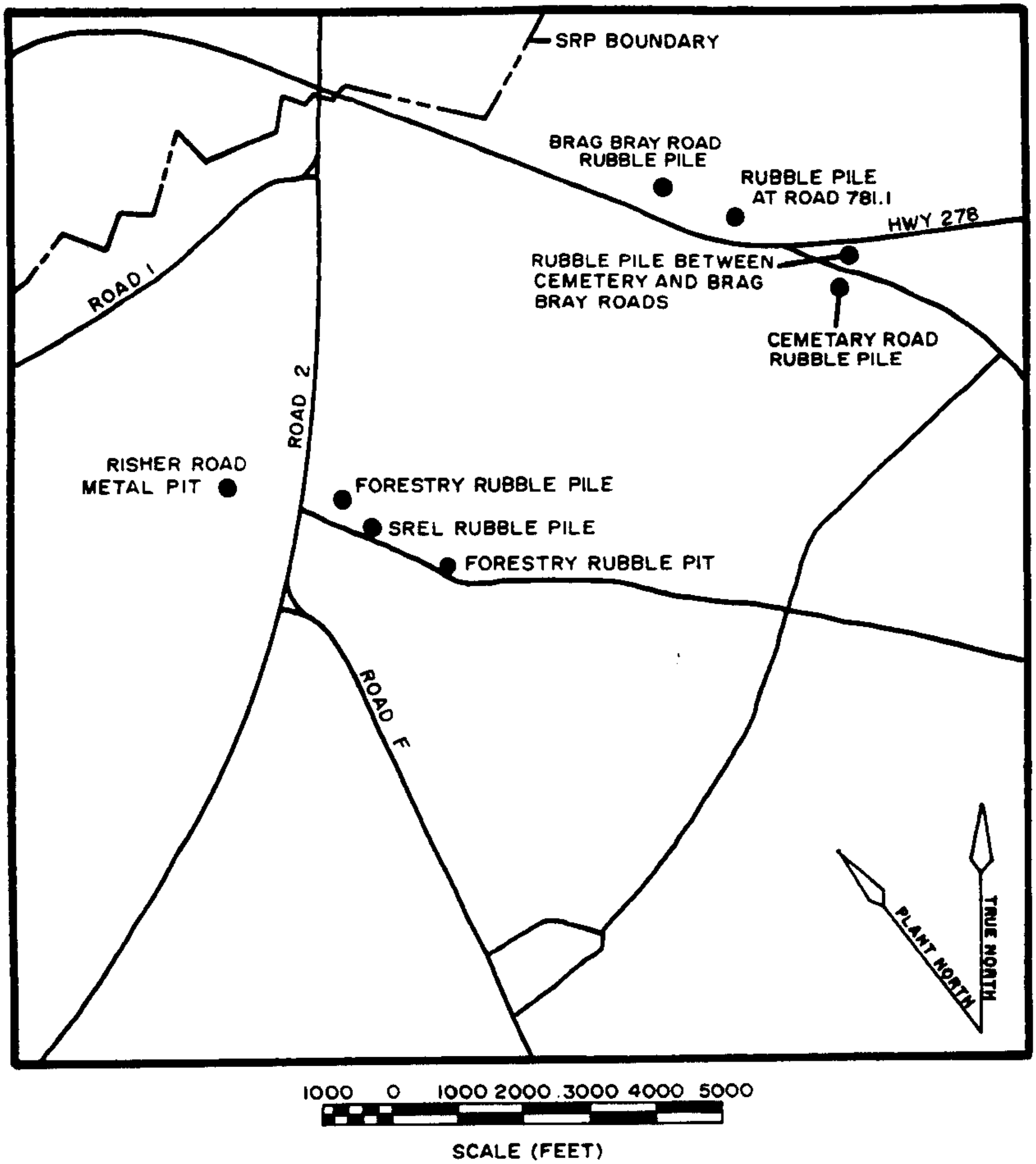


FIGURE 15-32. Locations of Other Waste Sites Around the Forestry Building

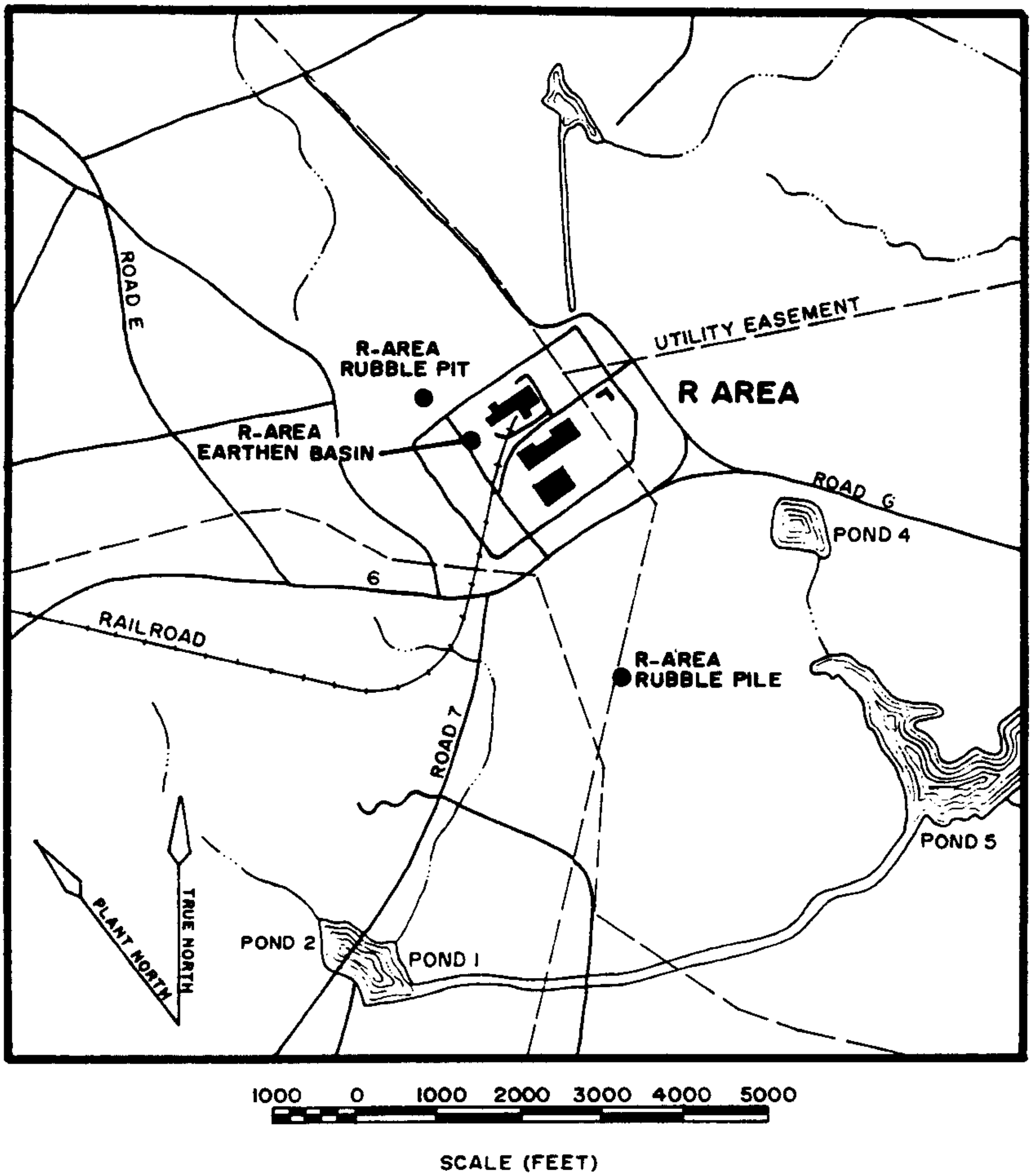


FIGURE 15-33. Locations of Other Waste Sites Around R Area

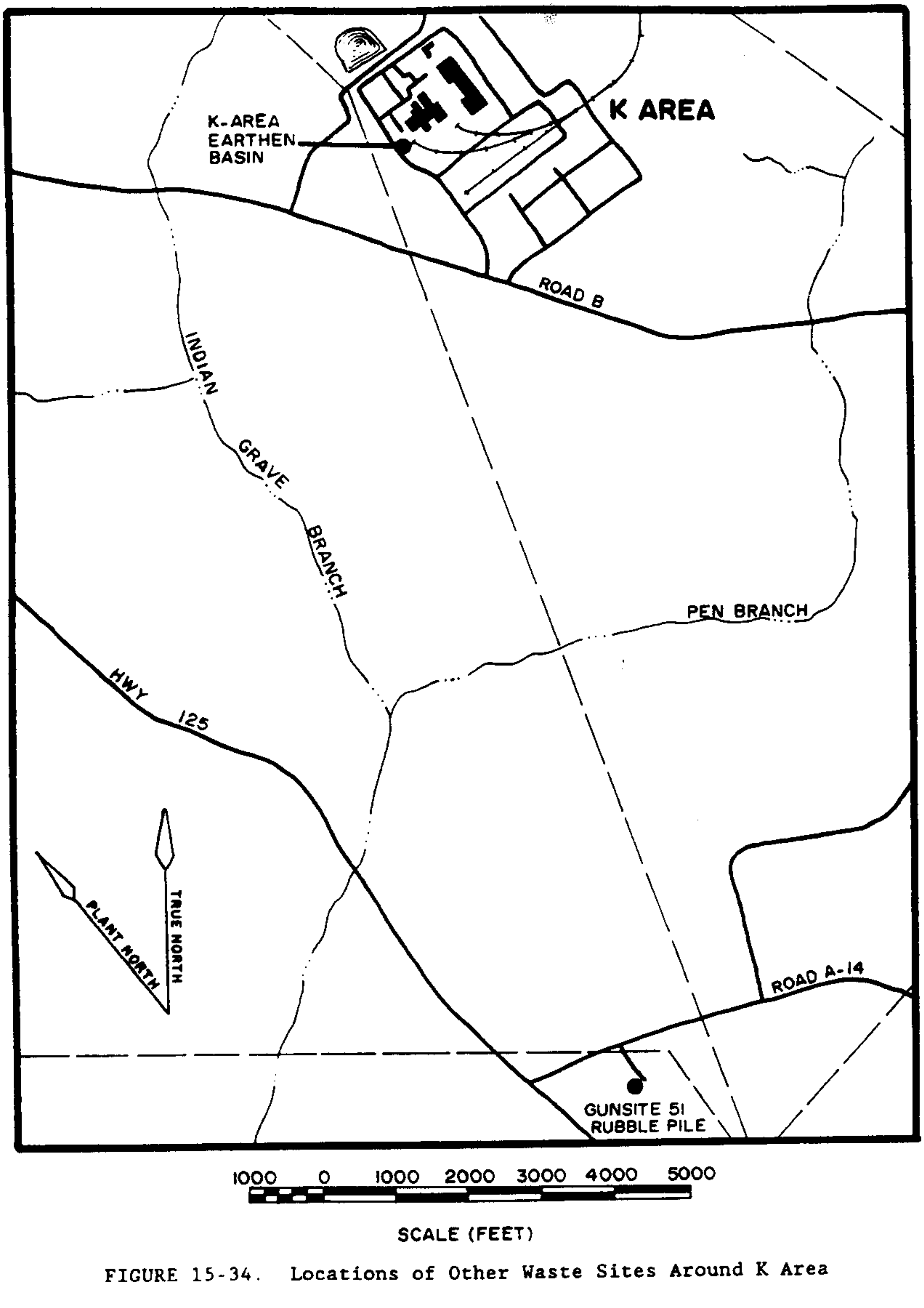


FIGURE 15-34. Locations of Other Waste Sites Around K Area

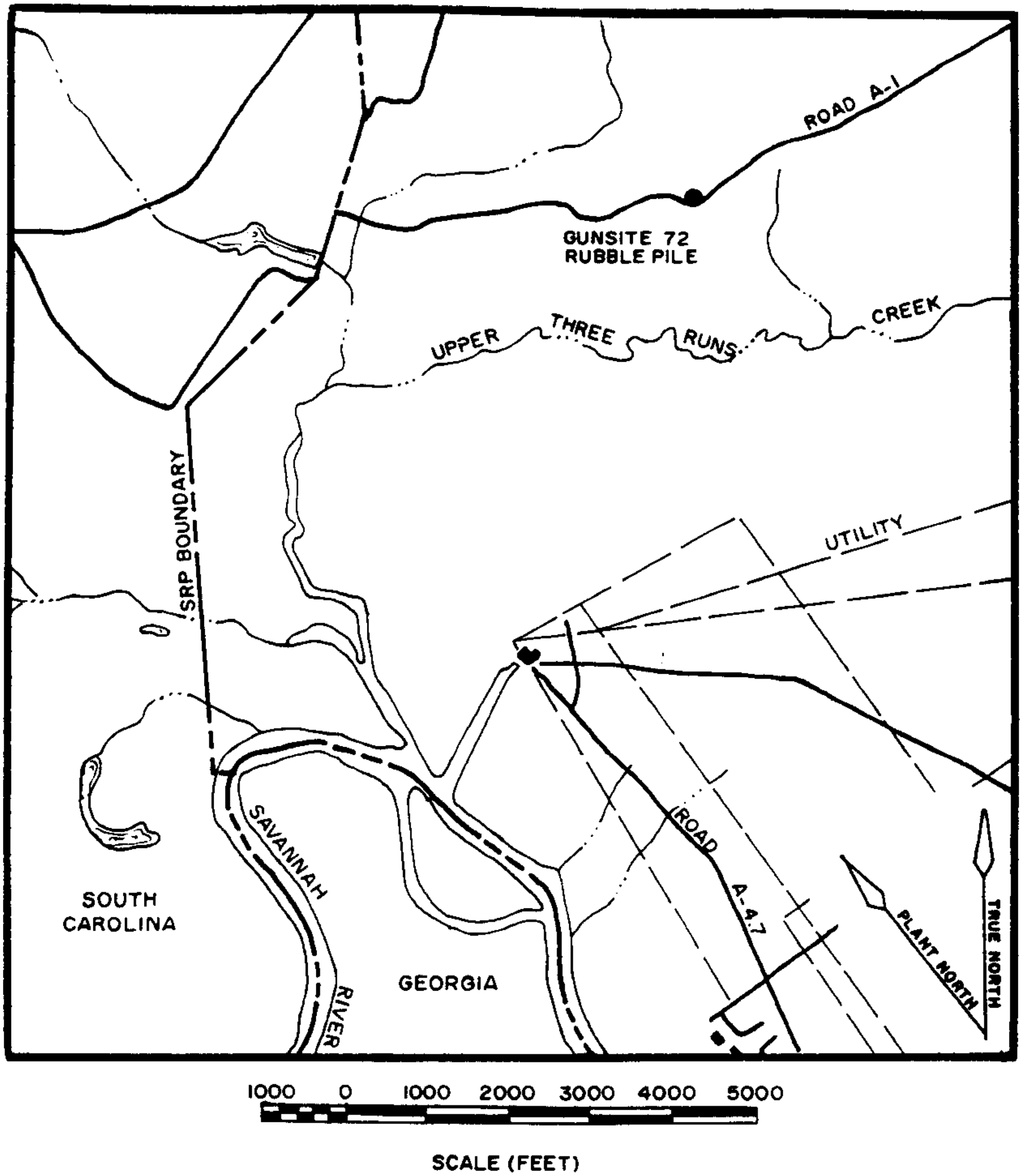


FIGURE 15-35. Location of the Gunsite 72 Rubble Pile

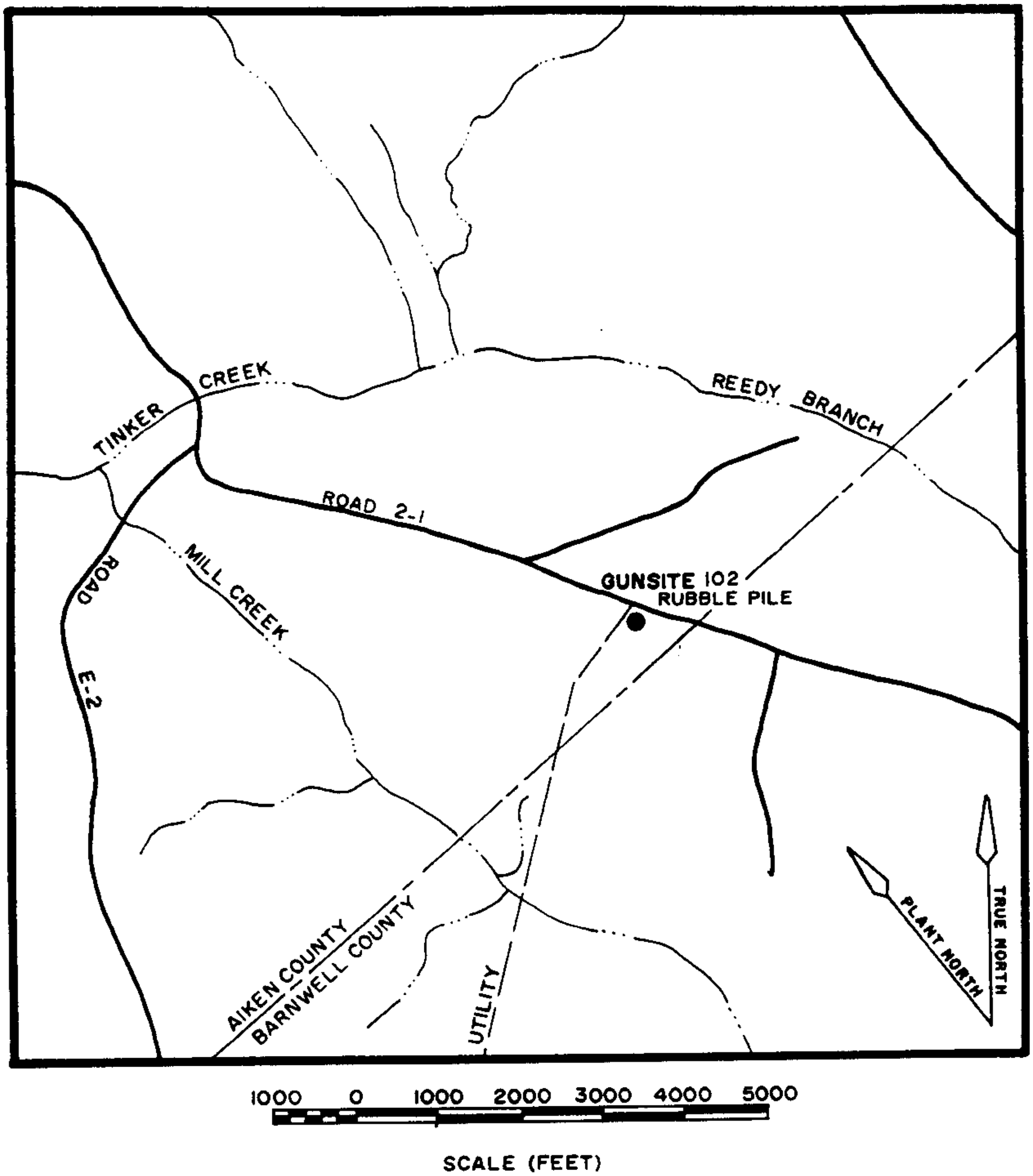


FIGURE 15-36. Location of the Gunsite 102 Rubble Pile

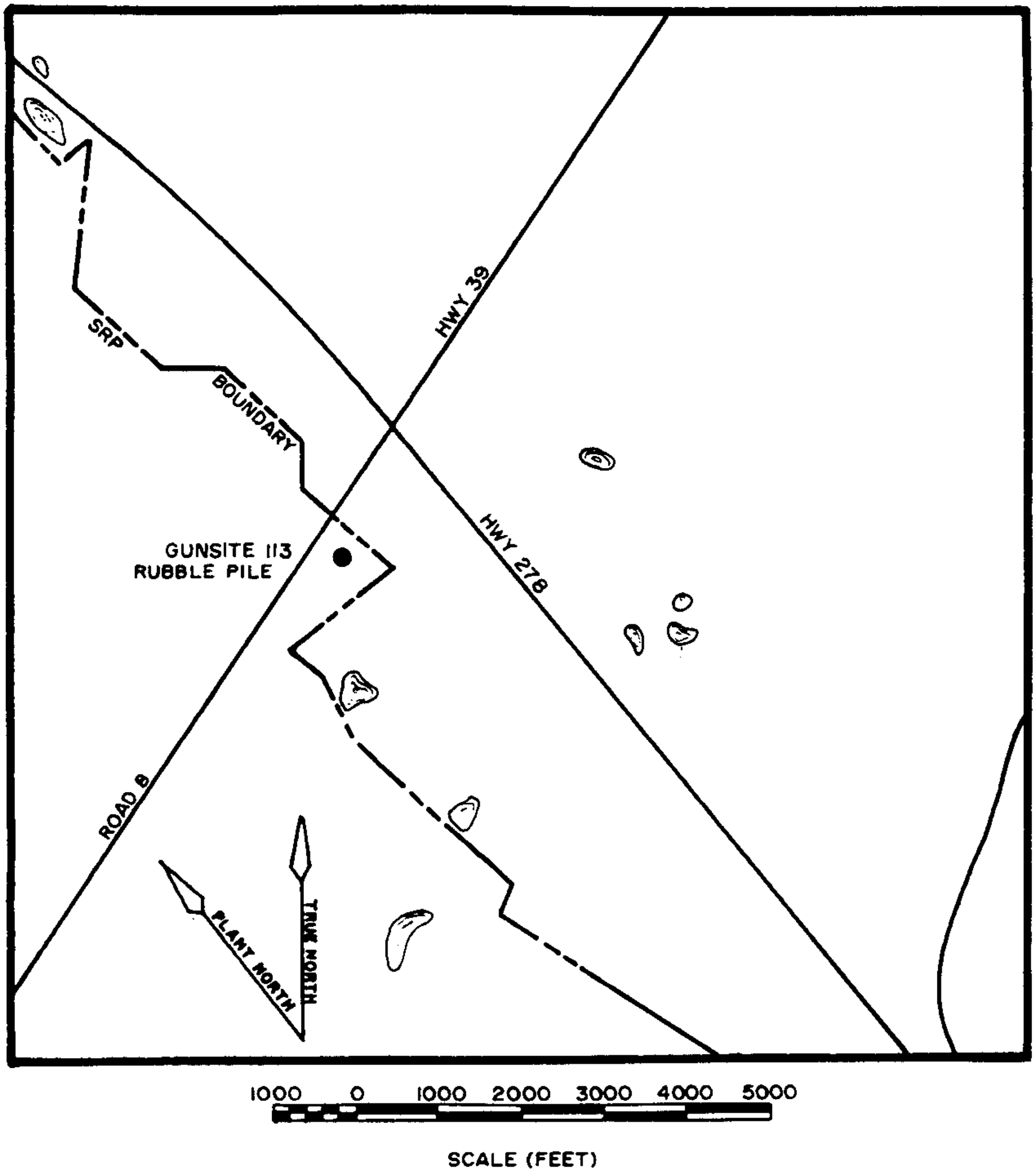


FIGURE 15-37. Location of the Gunsite 113 Rubble Pile

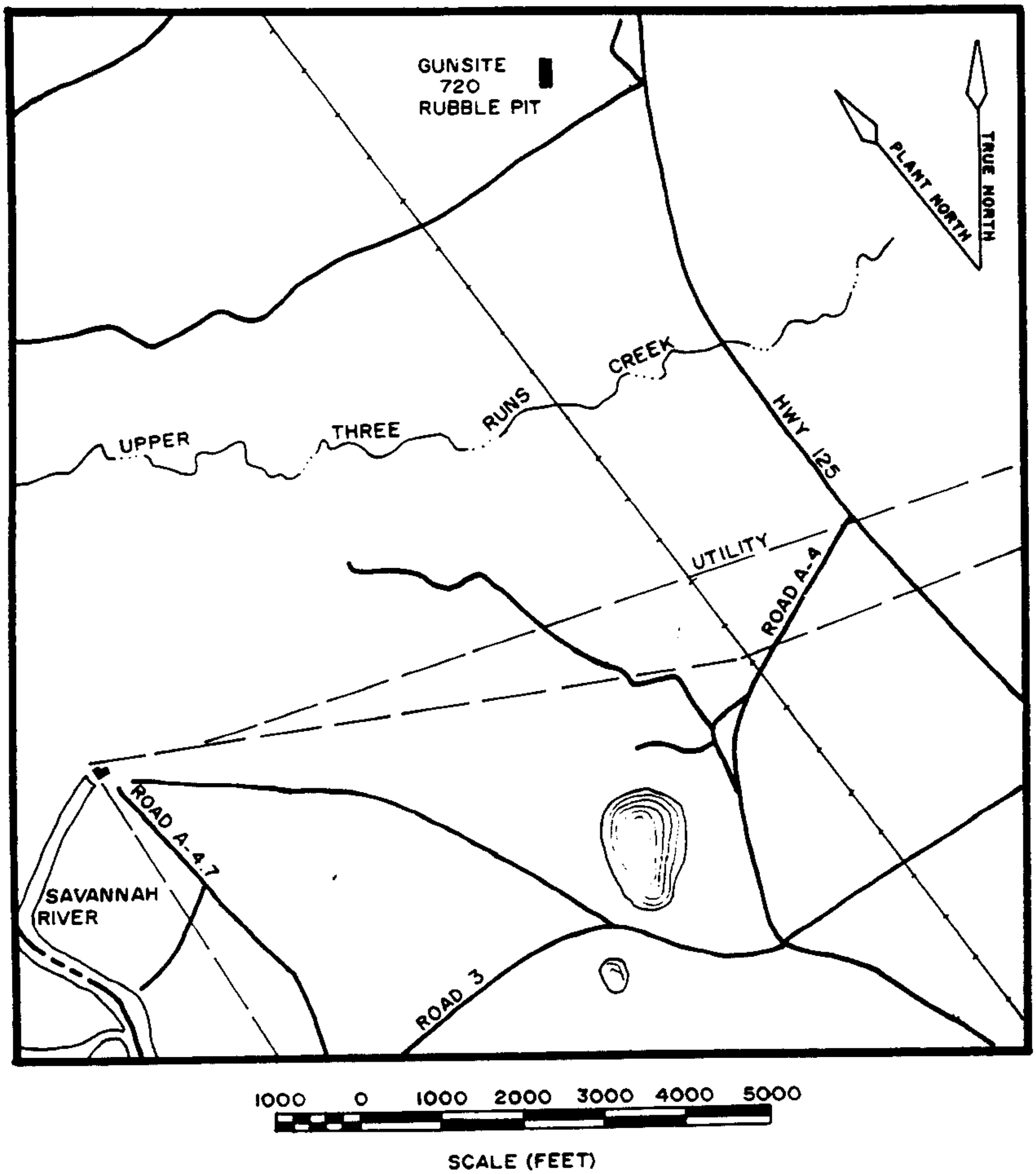


FIGURE 15-38. Location of the Gunsite 720 Rubble Pit

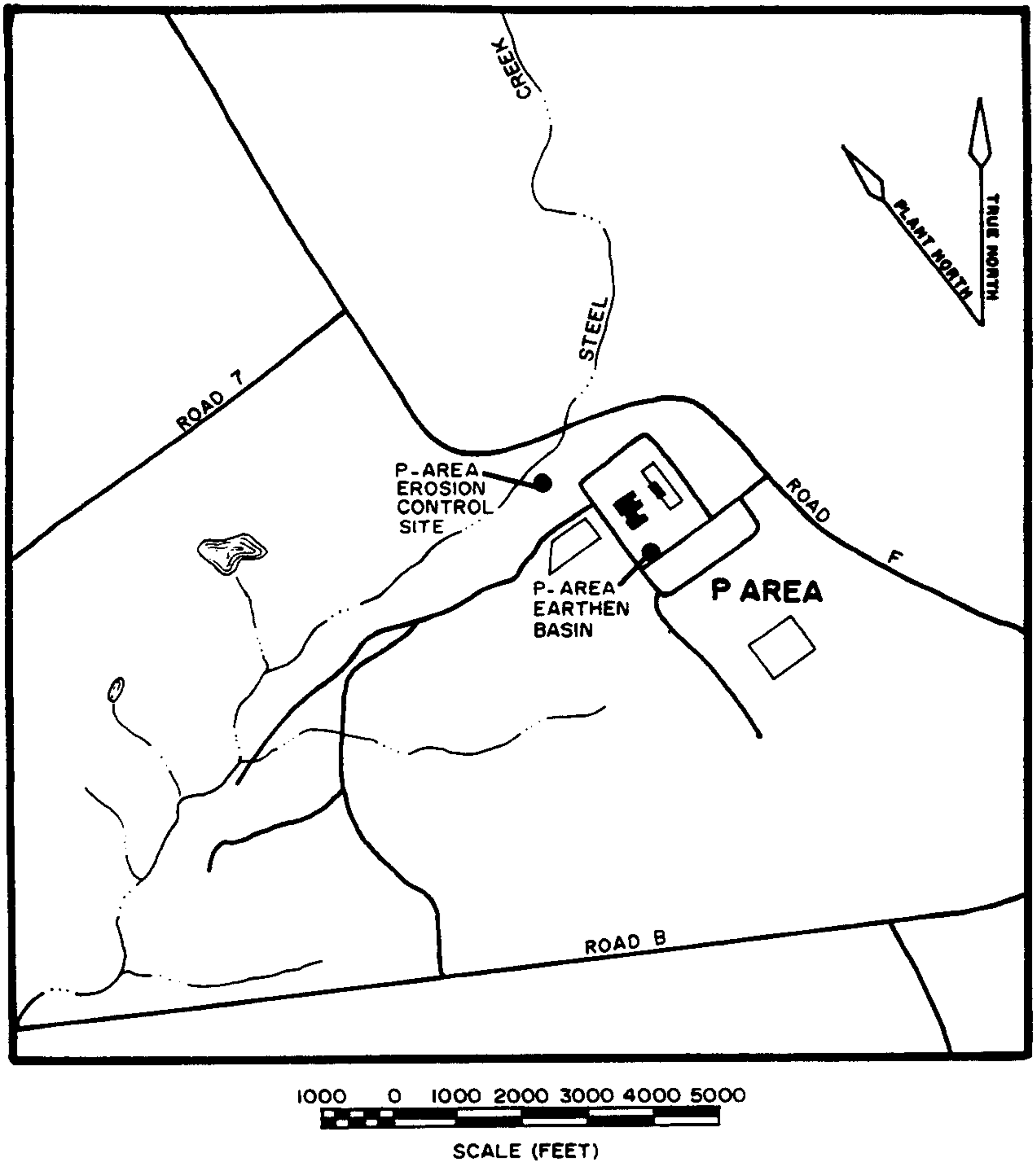


FIGURE 15-39. Locations of Other Waste Sites Around P Area

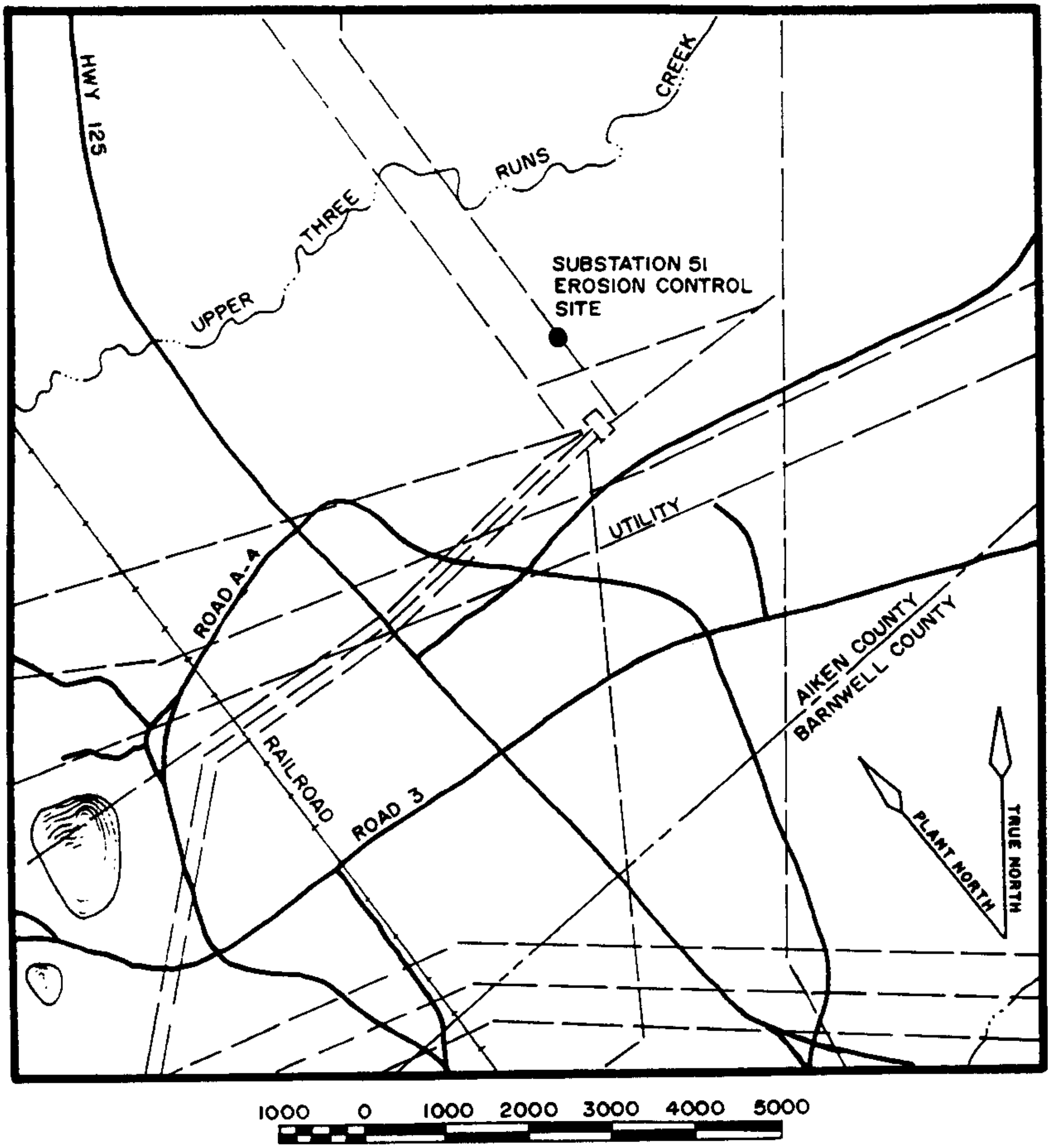


FIGURE 15-40. Location of the Substation 51 Erosion Control Site

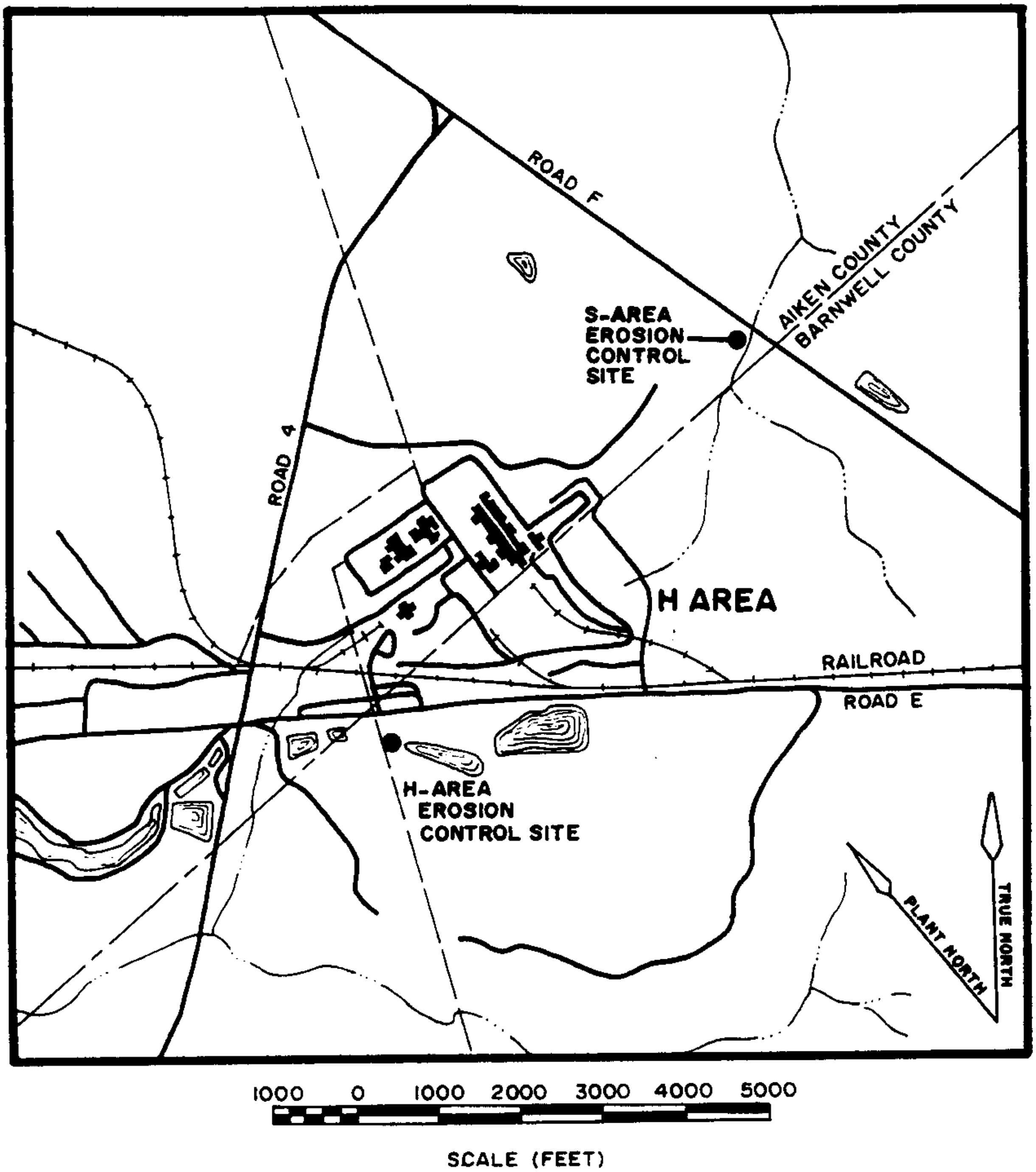


FIGURE 15-41. Locations of the S-Area and H-Area Erosion Control Sites

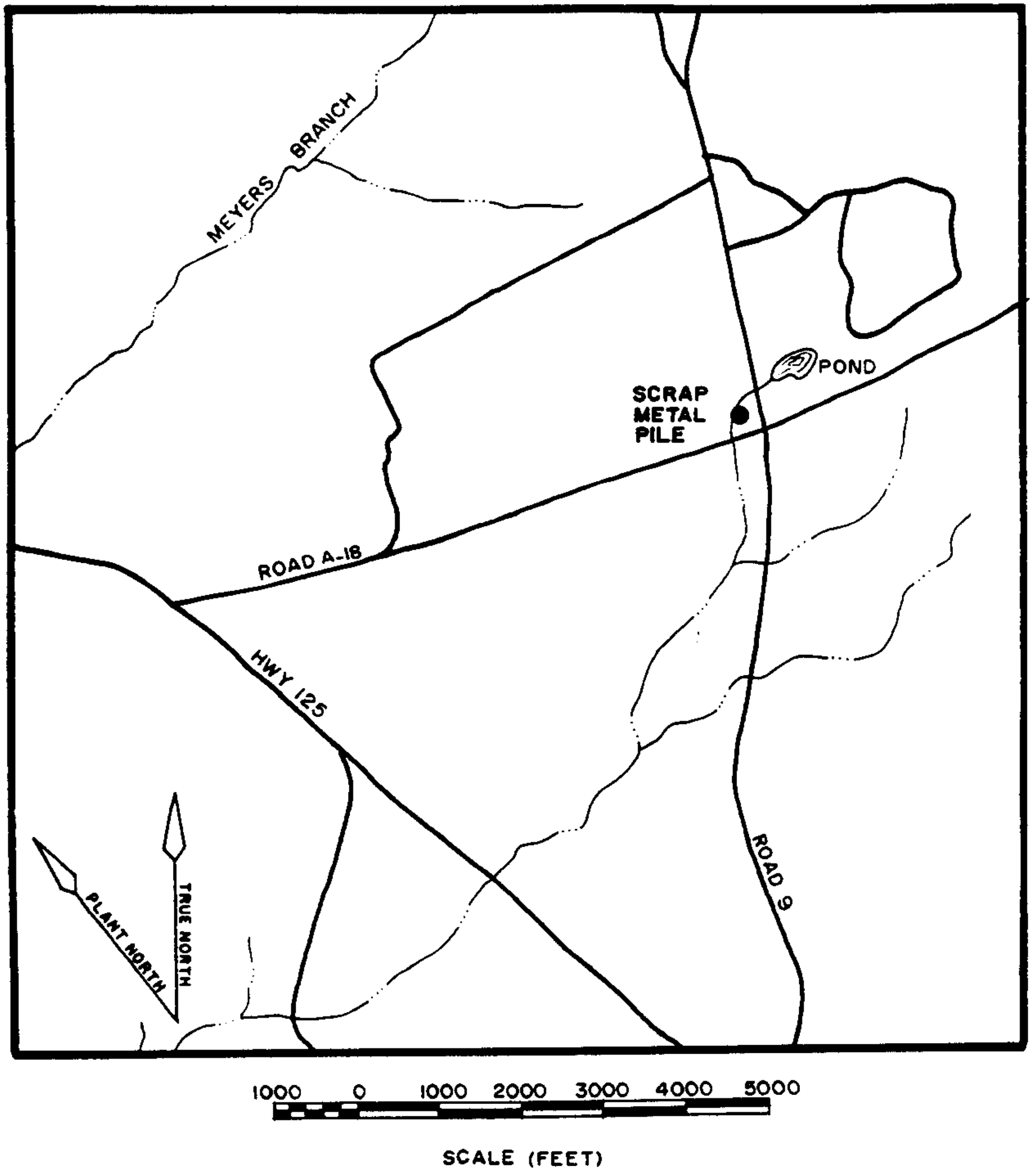


FIGURE 15-42. Location of the Scrap Metal Pile

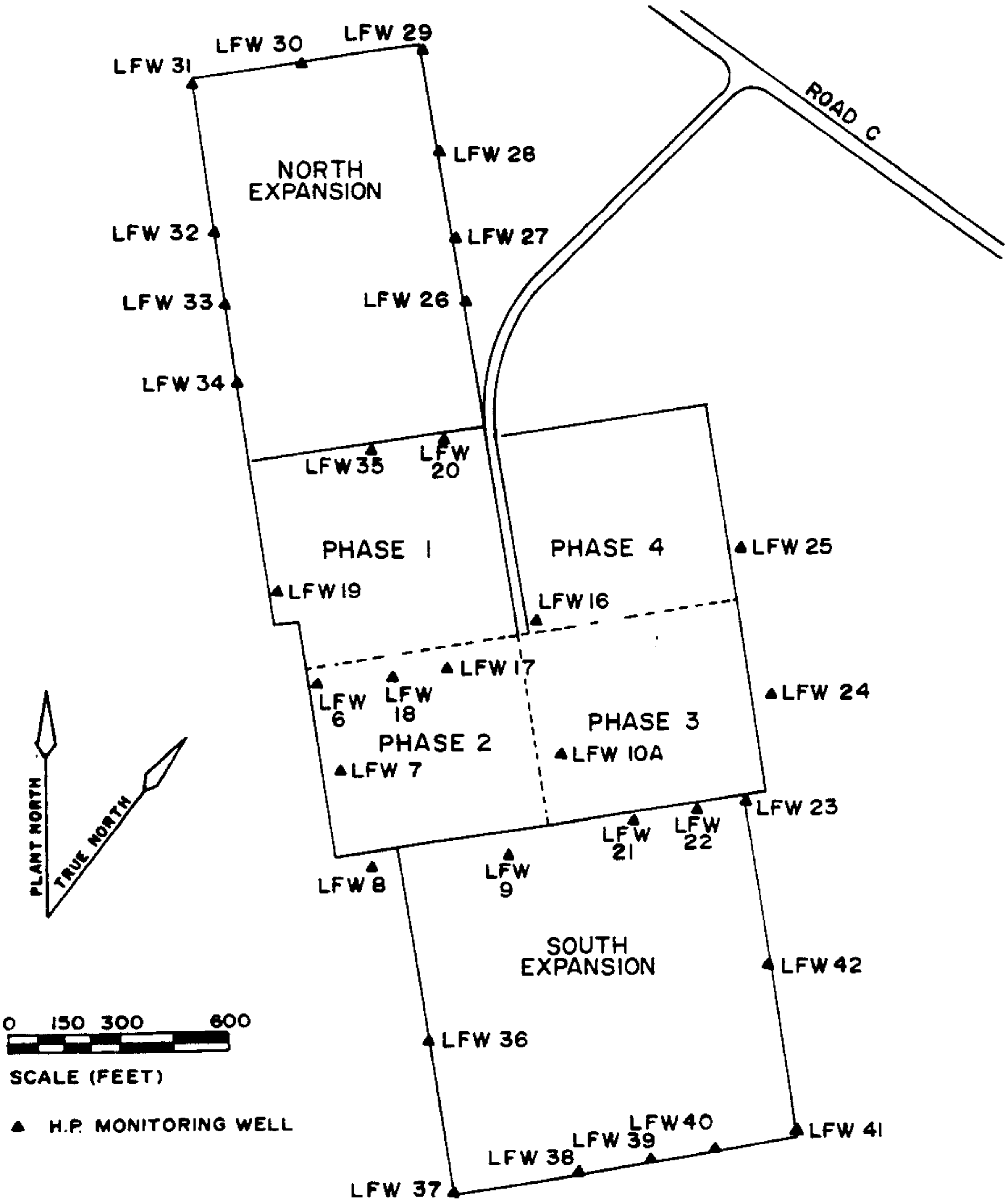
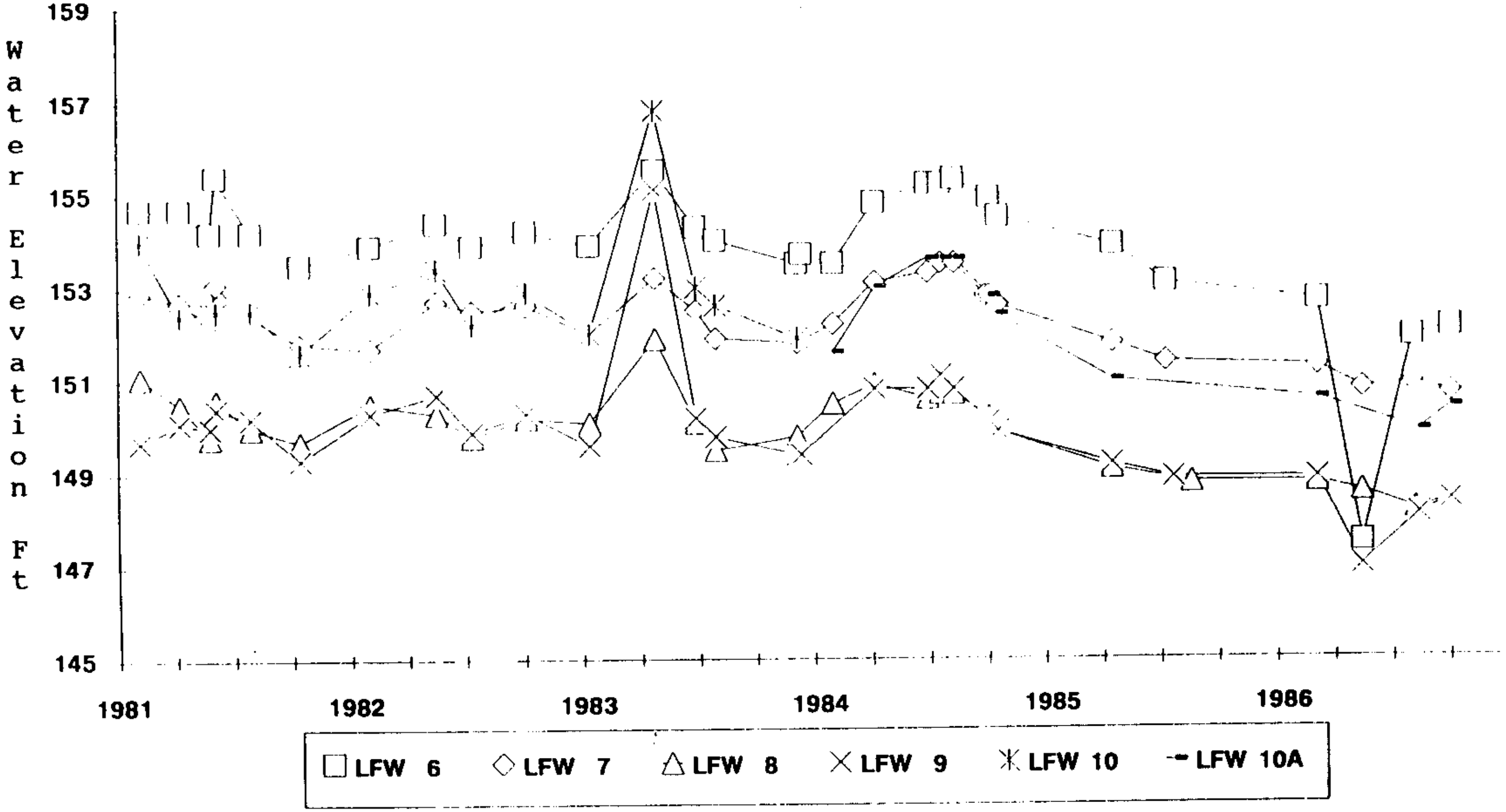
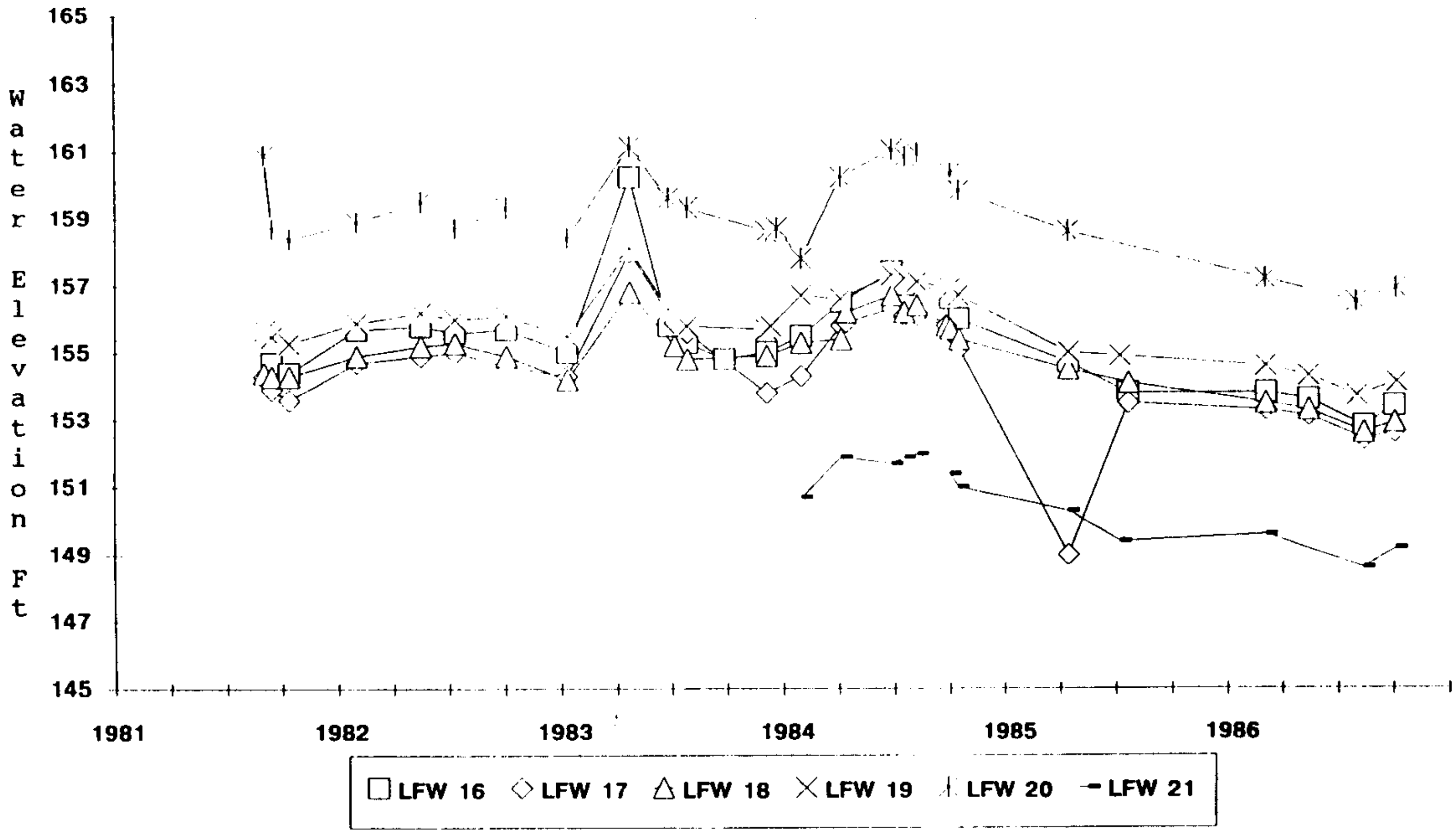


FIGURE 15-43. The Sanitary Landfill



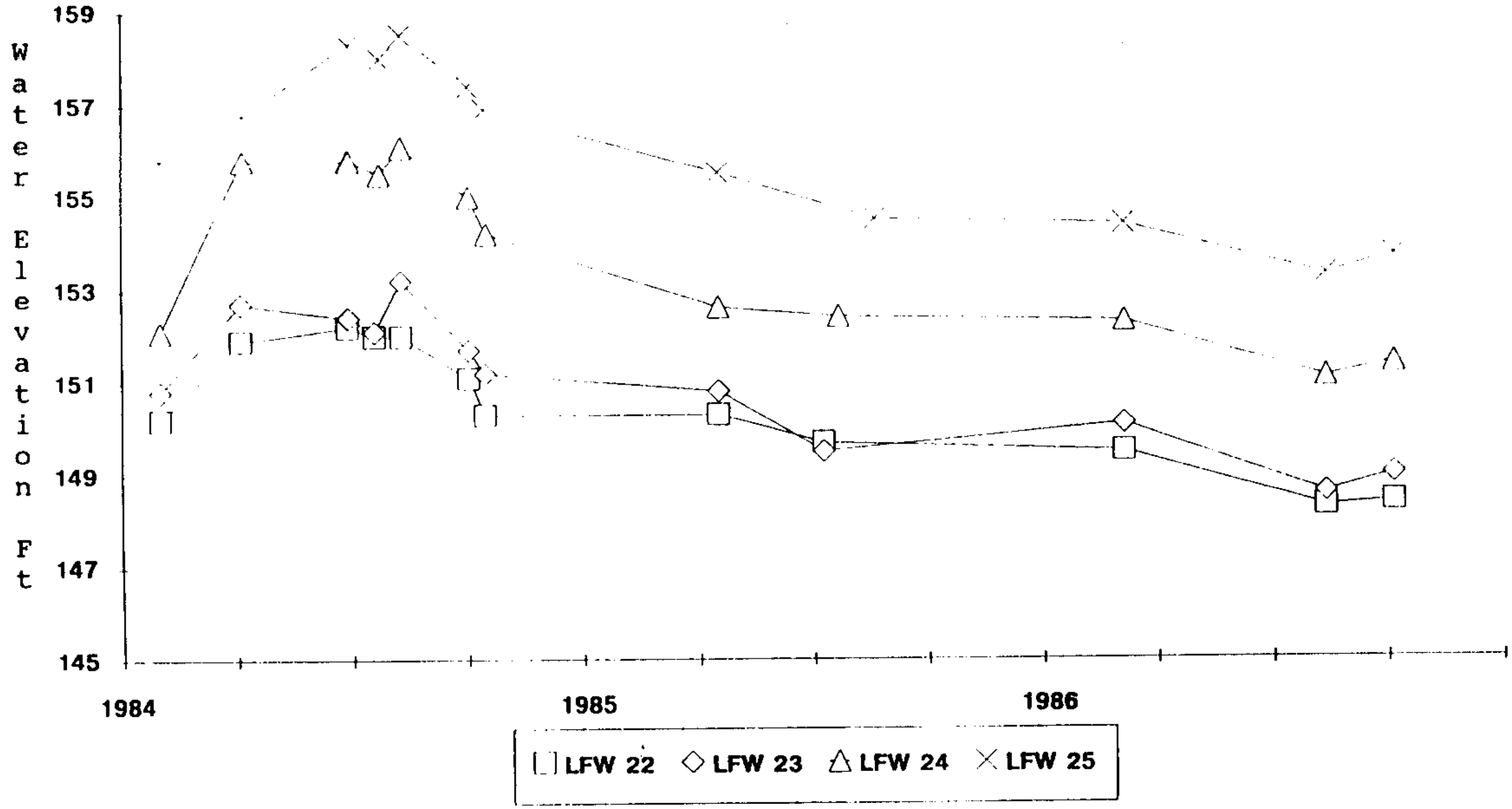
NOTE: A WATER LEVEL OF 145.5 FT OBTAINED FOR WELL LFW 10A ON 7/22/85 AND ON 5/14/86 IS NOT PLOTTED.

FIGURE 15-44. Hydrograph of Sanitary Landfill Wells LFW 6 through LFW 10A



NOTE: ANOMALOUS WATER LEVELS OBTAINED FOR WELL LFW 20 ON 7/10/85 AND 5/15/86 AND WELL LFW 21 ON 5/19/86 ARE NOT PLOTTED.

FIGURE 15-45. Hydrograph of Sanitary Landfill Wells LFW 16 through LFW 21



NOTE: ANOMALOUS WATER LEVELS OBTAINED ON 5/19/86 ARE NOT PLOTTED.

FIGURE 15-46. Hydrograph of Sanitary Landfill Wells LFW 22 through LFW 25

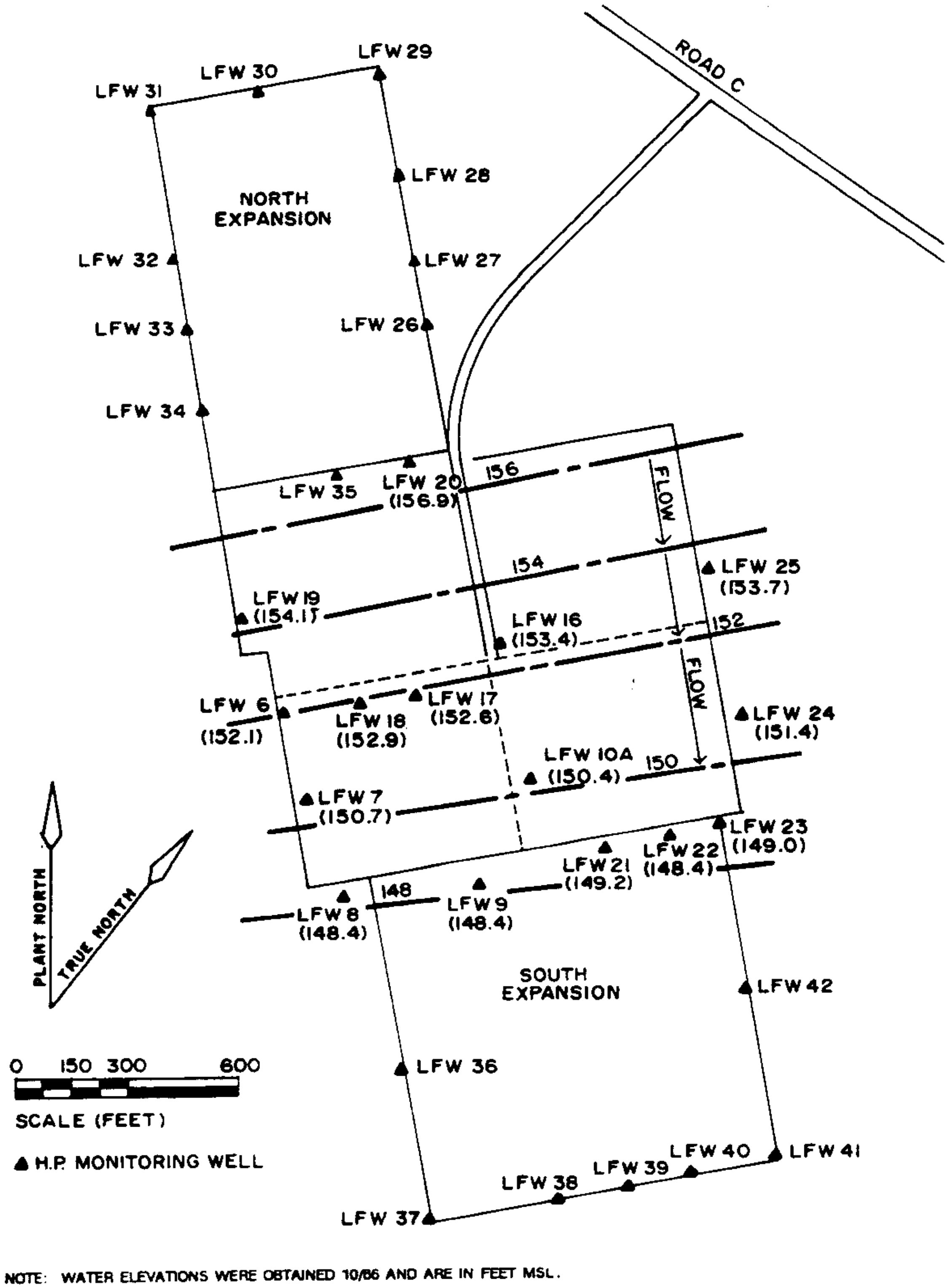


FIGURE 15-47. Sanitary Landfill Water-Table Elevation Map

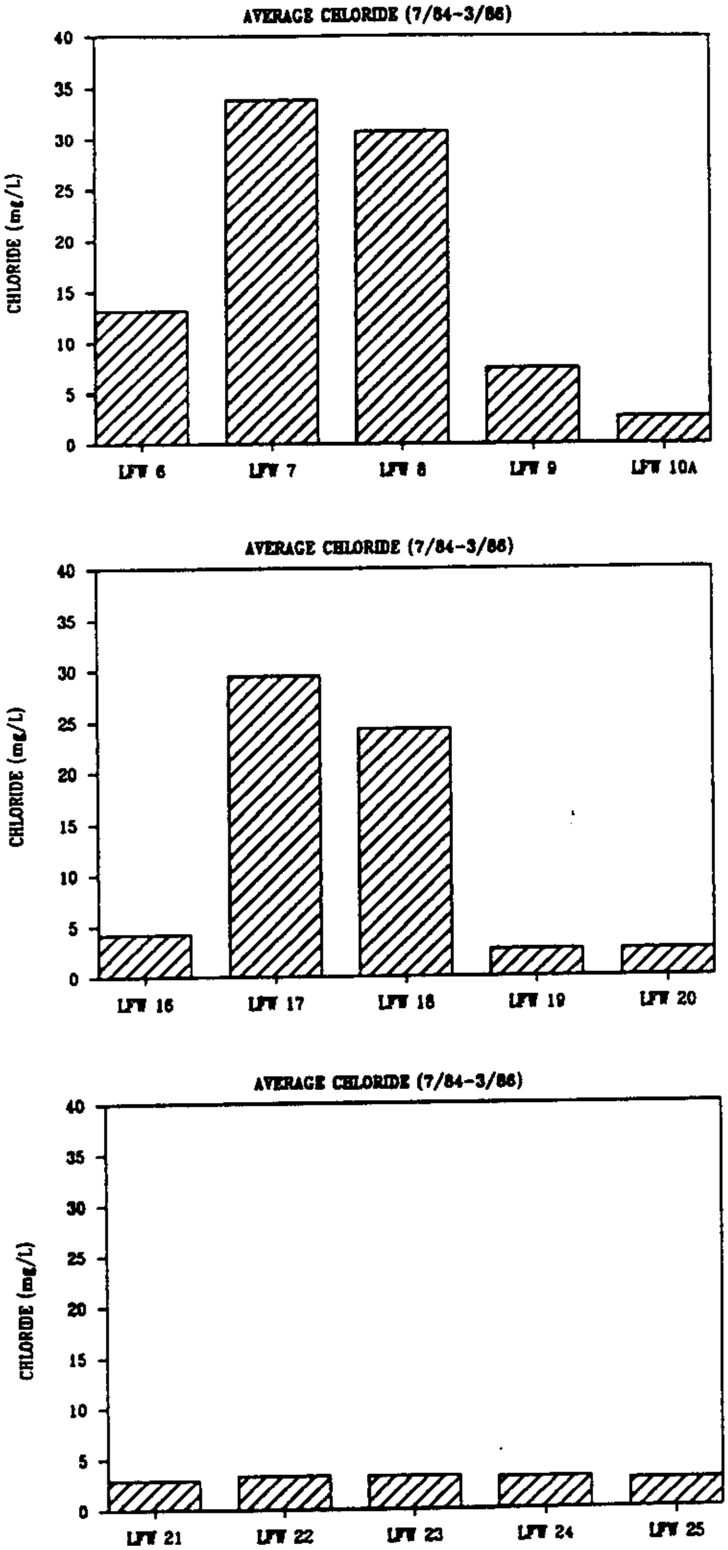


FIGURE 15-48. Average Chloride Concentrations in the Sanitary Landfill Wells

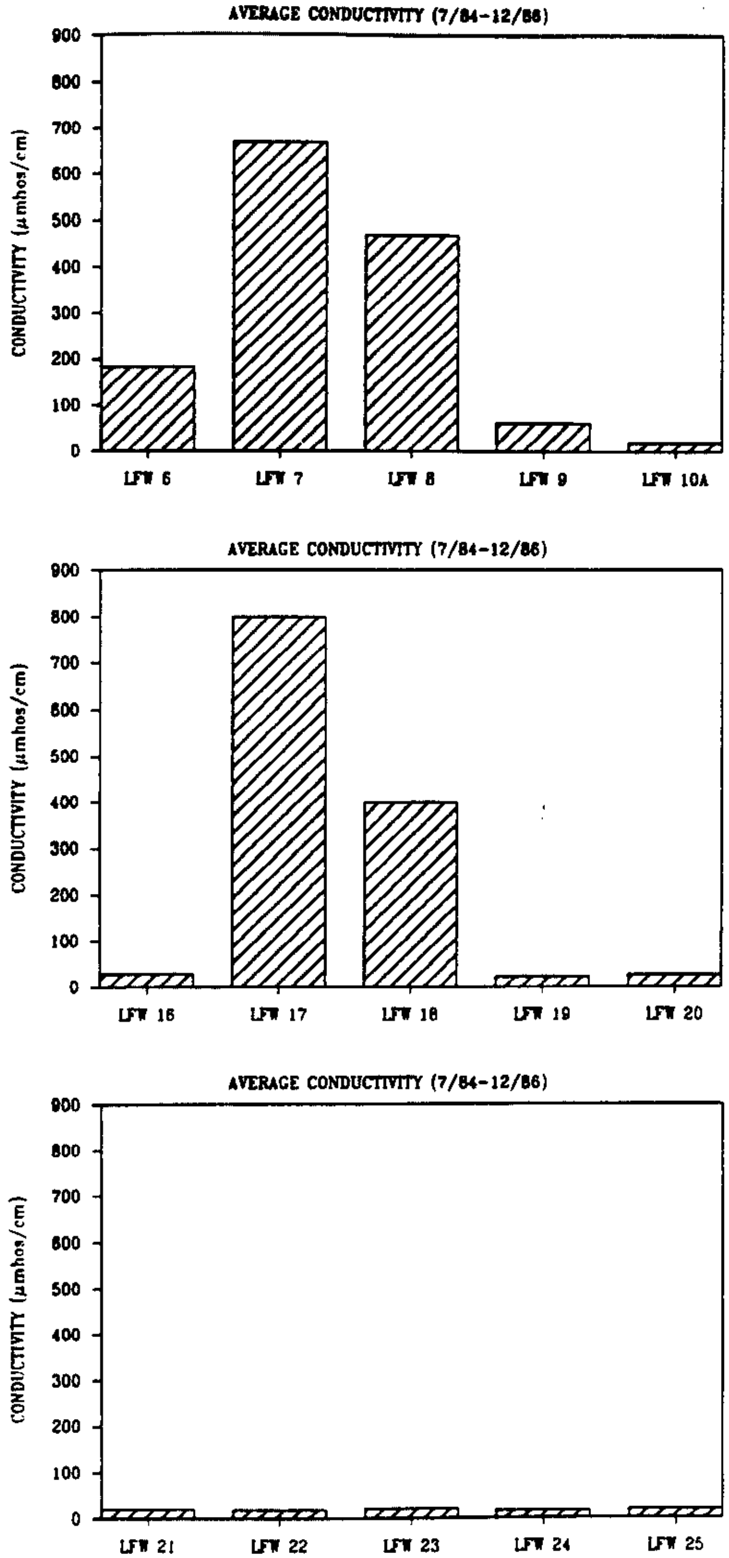


FIGURE 15-49. Average Conductivity in the Sanitary Landfill Wells

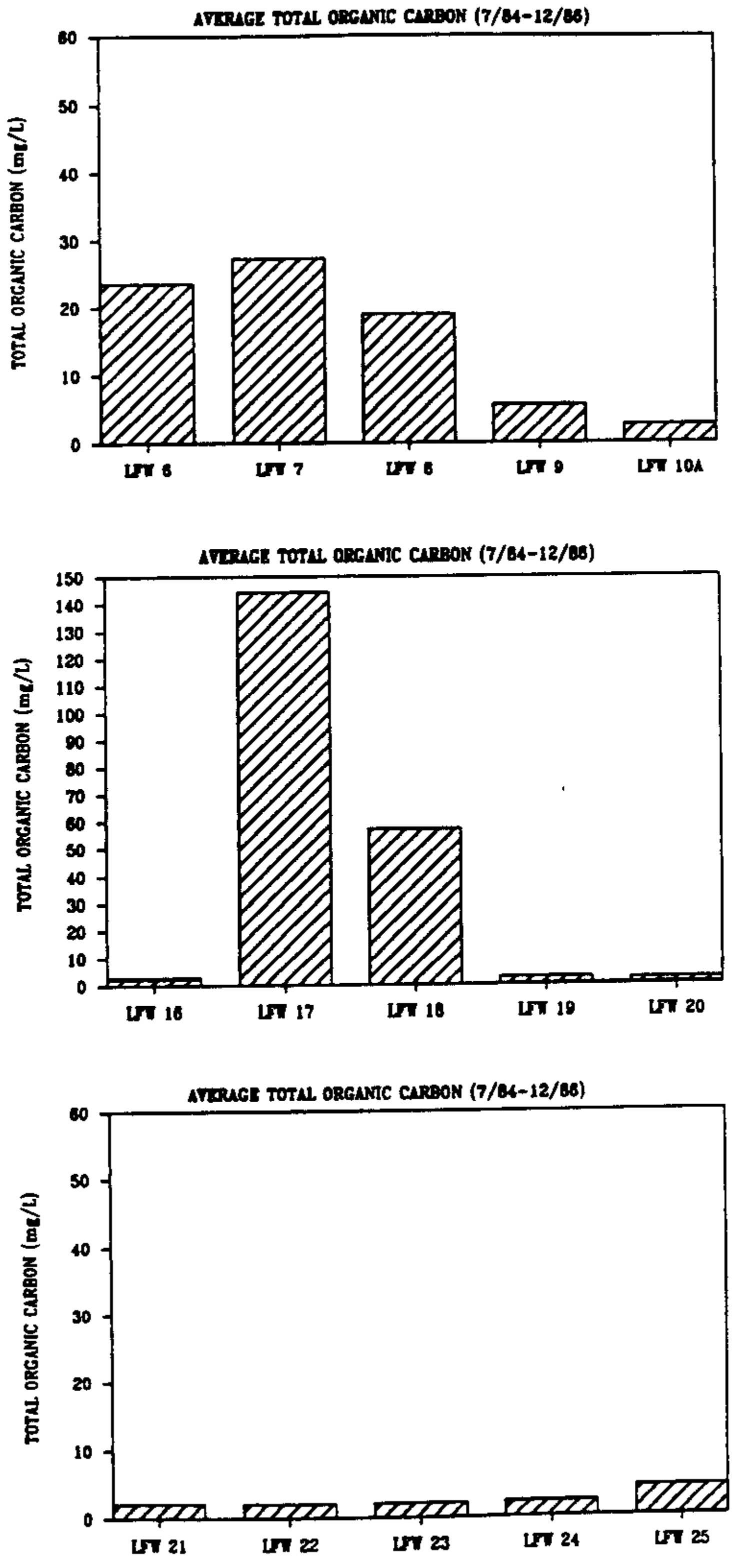


FIGURE 15-50. Average Total Organic Carbon (TOC) Concentrations in the Sanitary Landfill Wells

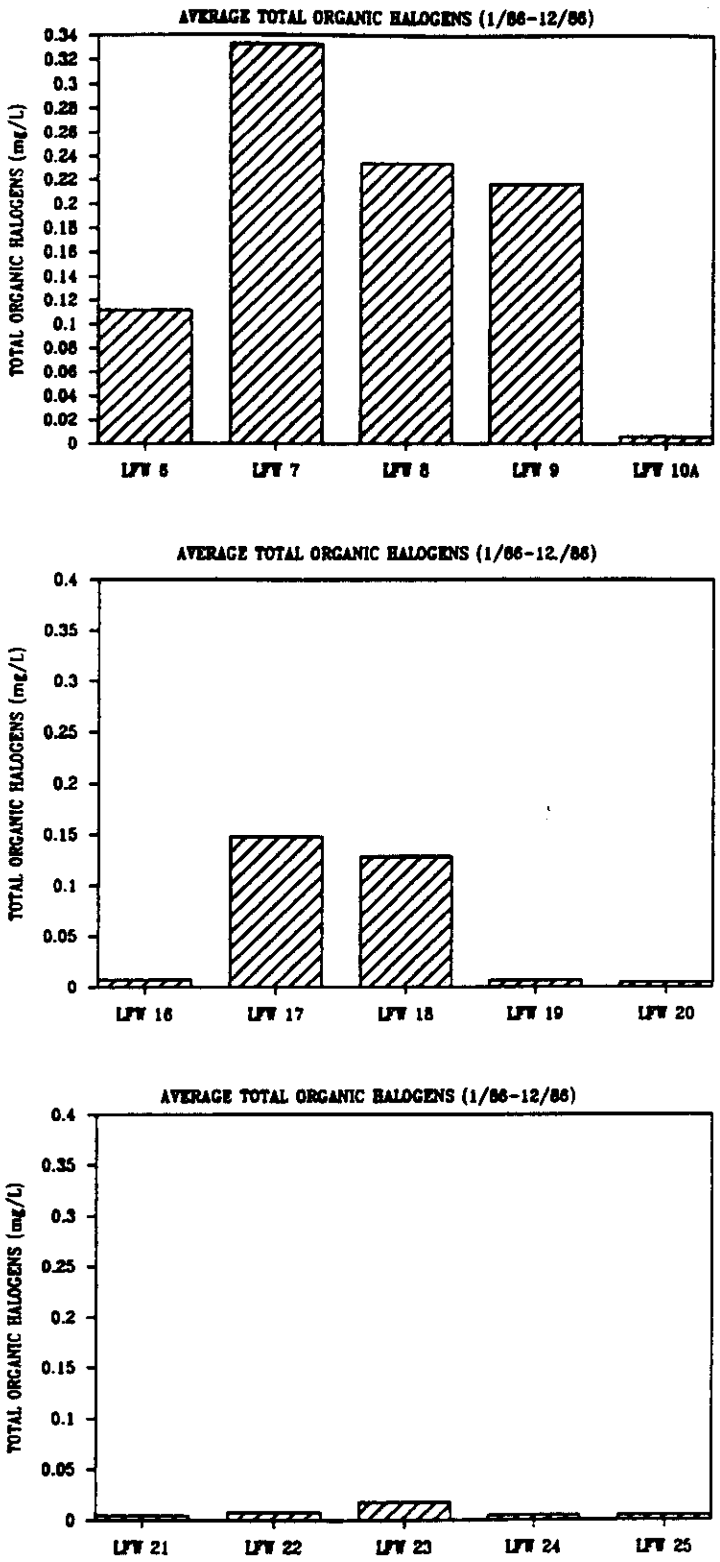


FIGURE 15-51. Average Total Organic Halogens (TOH) Concentrations in the Sanitary Landfill Wells

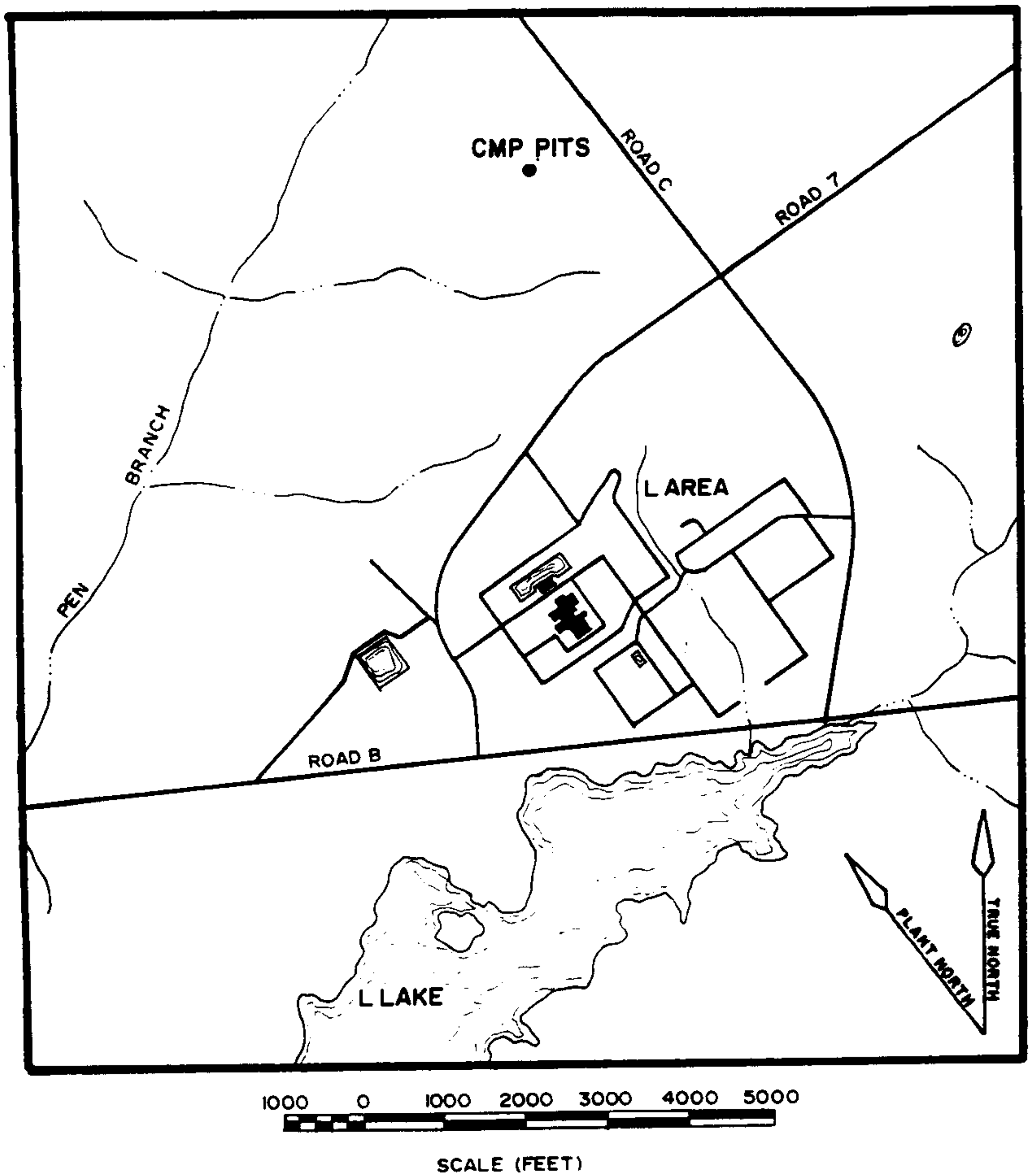


FIGURE 15-52. Location of the Chemicals, Metals, and Pesticides (CMP) Pits

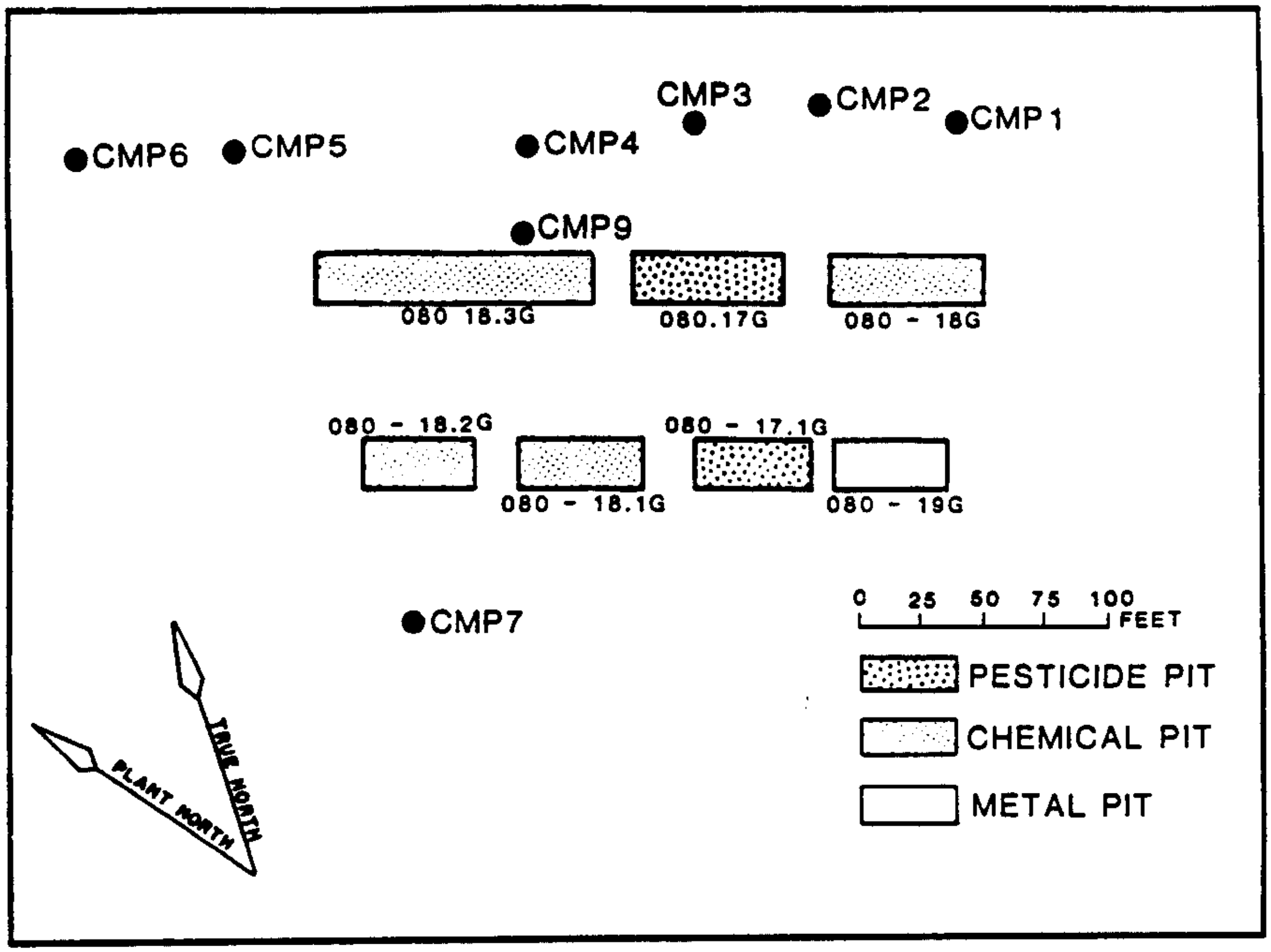


FIGURE 15-53. The Chemicals, Metals, and Pesticides (CMP) Pits

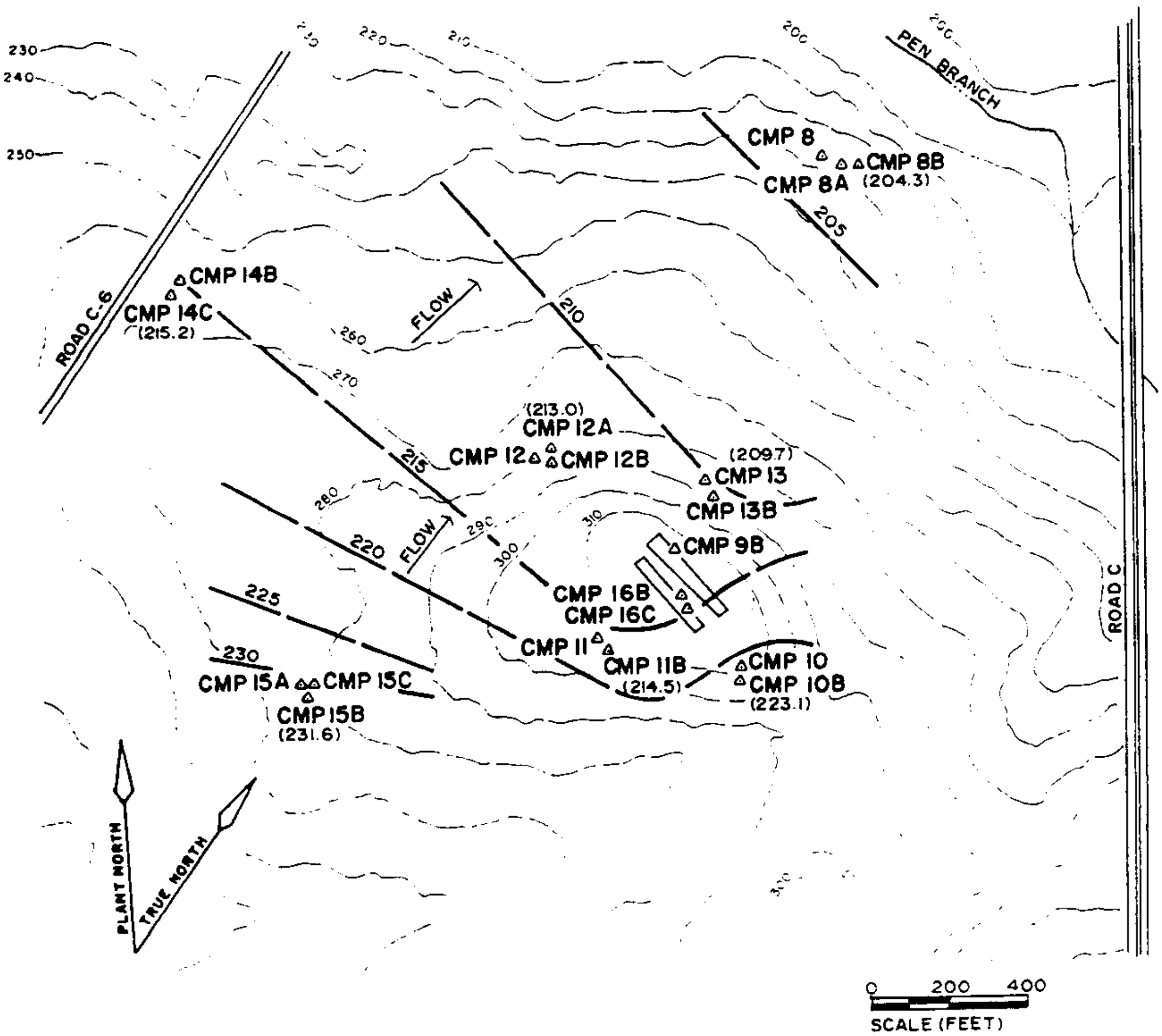


FIGURE 15-54. The Chemicals, Metals, and Pesticides (CMP) Pits Water-Table Elevation Map

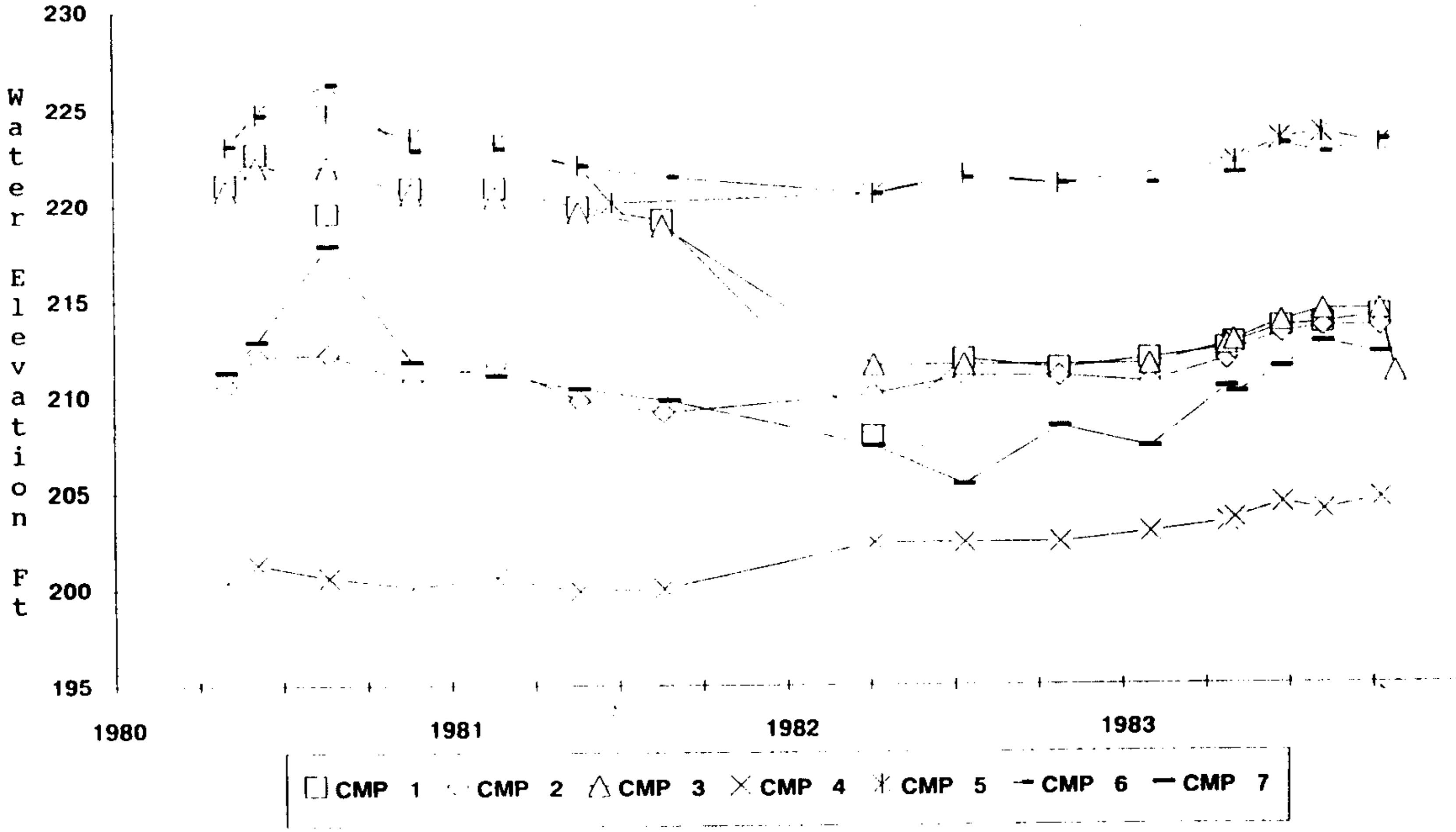


FIGURE 15-55. Hydrograph of Chemicals, Metals, and Pesticides (CMP) Pits Water-Table Wells CMP 1 Through CMP 7

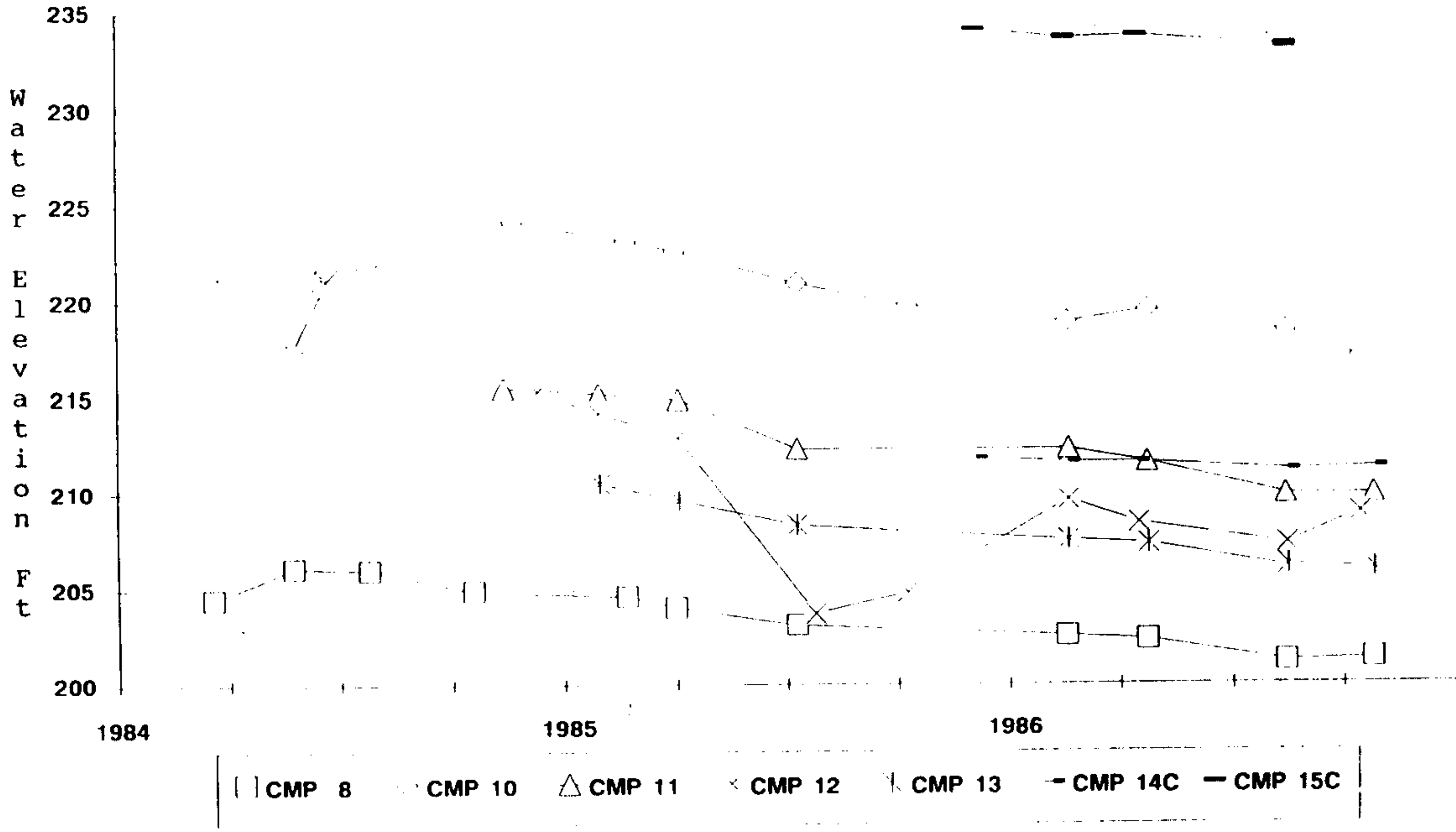


FIGURE 15-56. Hydrograph of Chemicals, Metals, and Pesticides (CMP) Pits Water-Table Wells CMP 8 Through CMP 15C

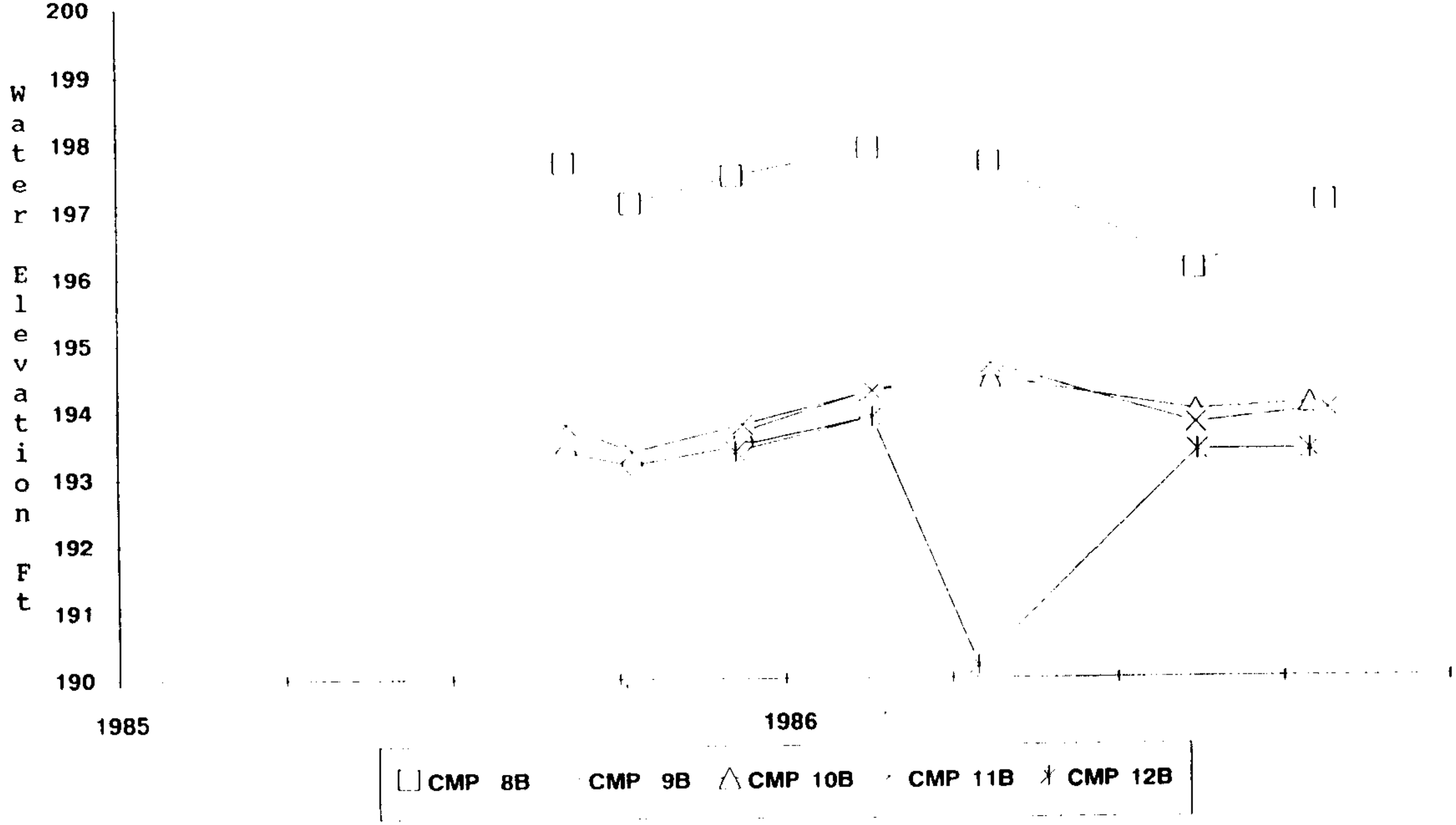


FIGURE 15-57. Hydrograph of Chemicals, Metals, and Pesticides (CMP) Pits McBean Formation Monitoring Wells CMP 8B Through CMP 12B

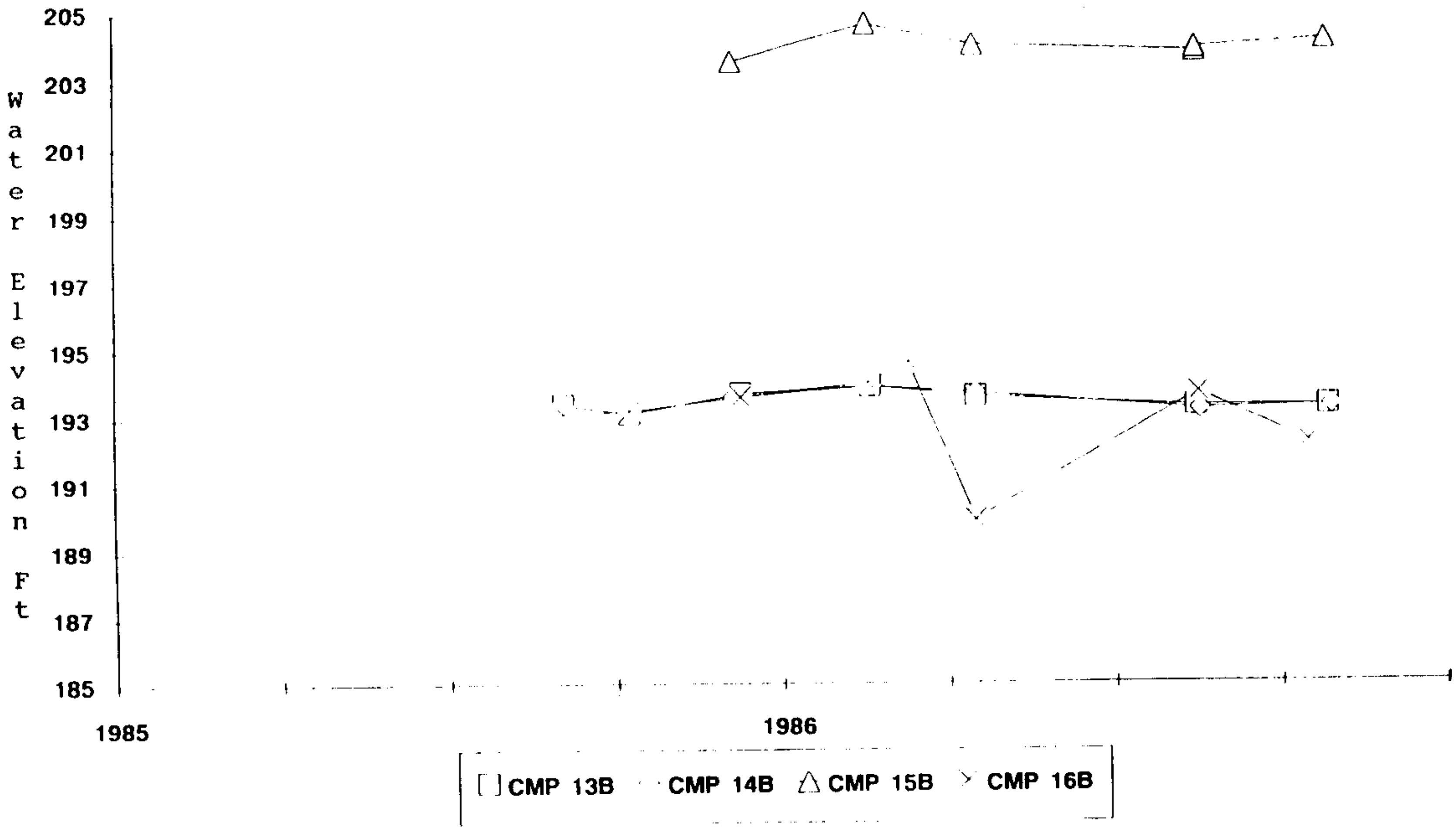


FIGURE 15-58. Hydrograph of Chemicals, Metals, and Pesticides (CMP) Pits McBean Formation Monitoring Wells CMP 13B Through CMP 16B

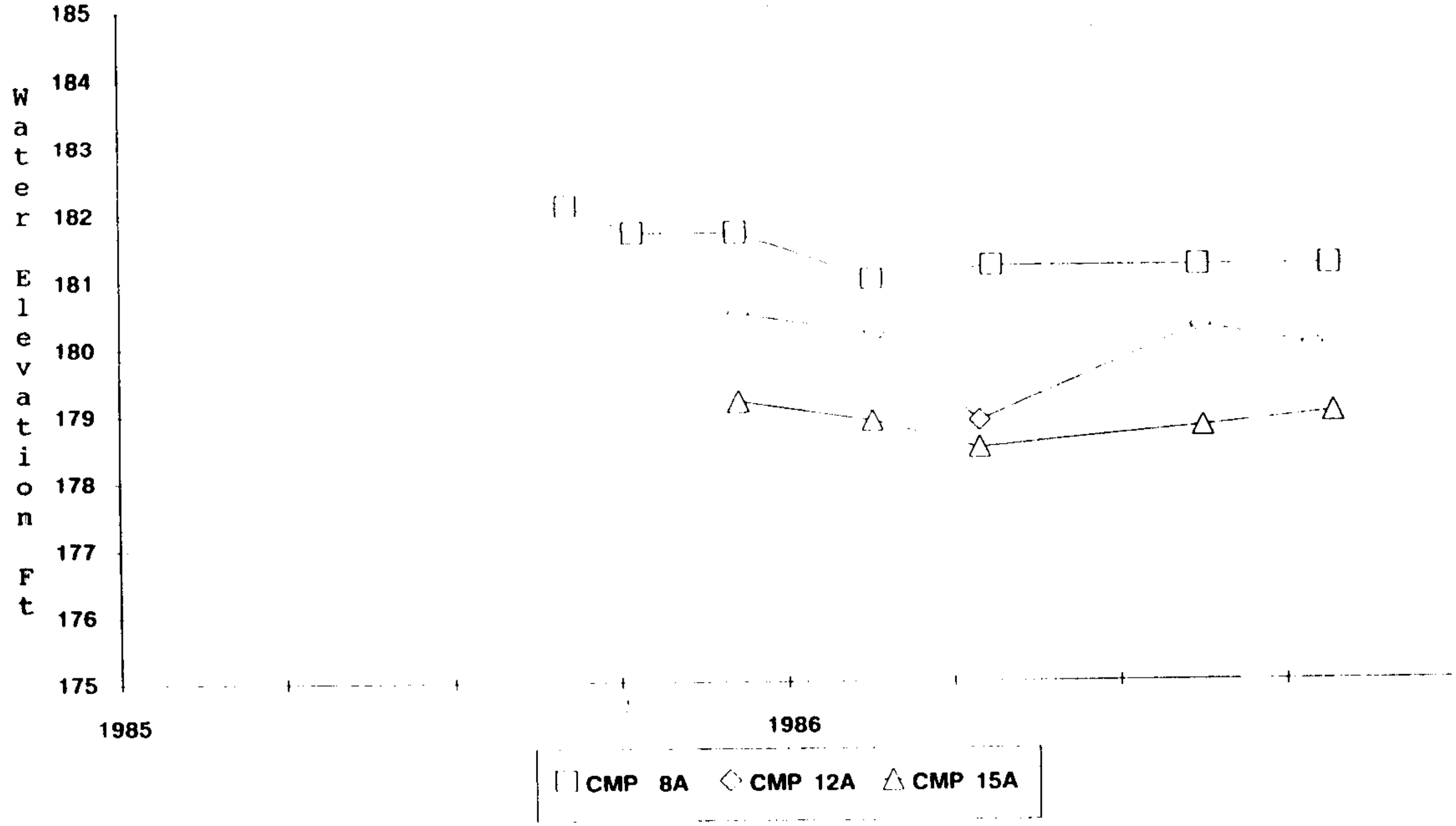


FIGURE 15-59. Hydrograph of Chemicals, Metals, and Pesticides (CMP) Pits Congaree Formation Monitoring Wells CMP 8A Through CMP 15A

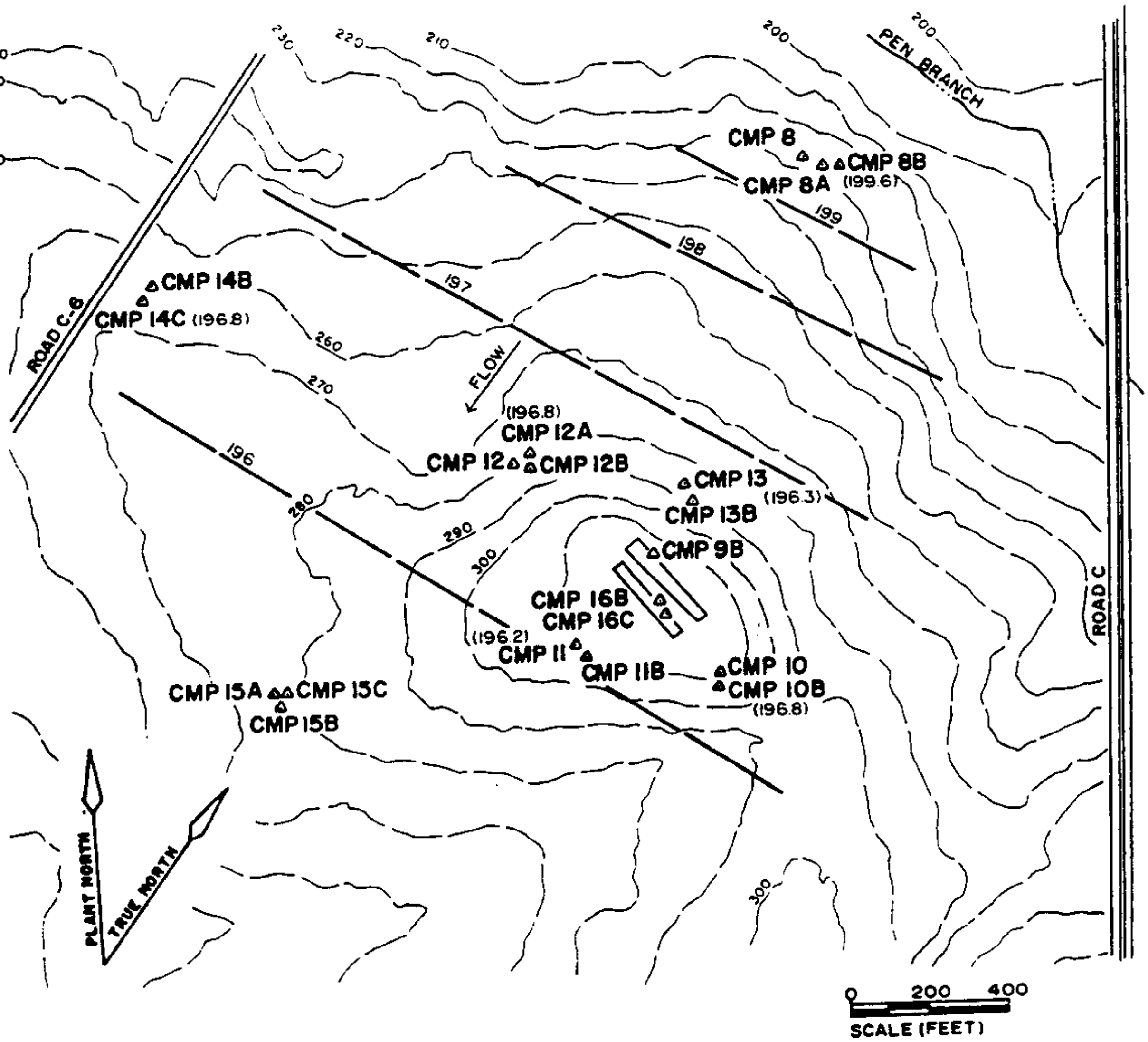


FIGURE 15-60. Piezometric Contour Map of the Zone Directly Above the Green Clay at the Chemicals, Metals, and Pesticides (CMP) Pits

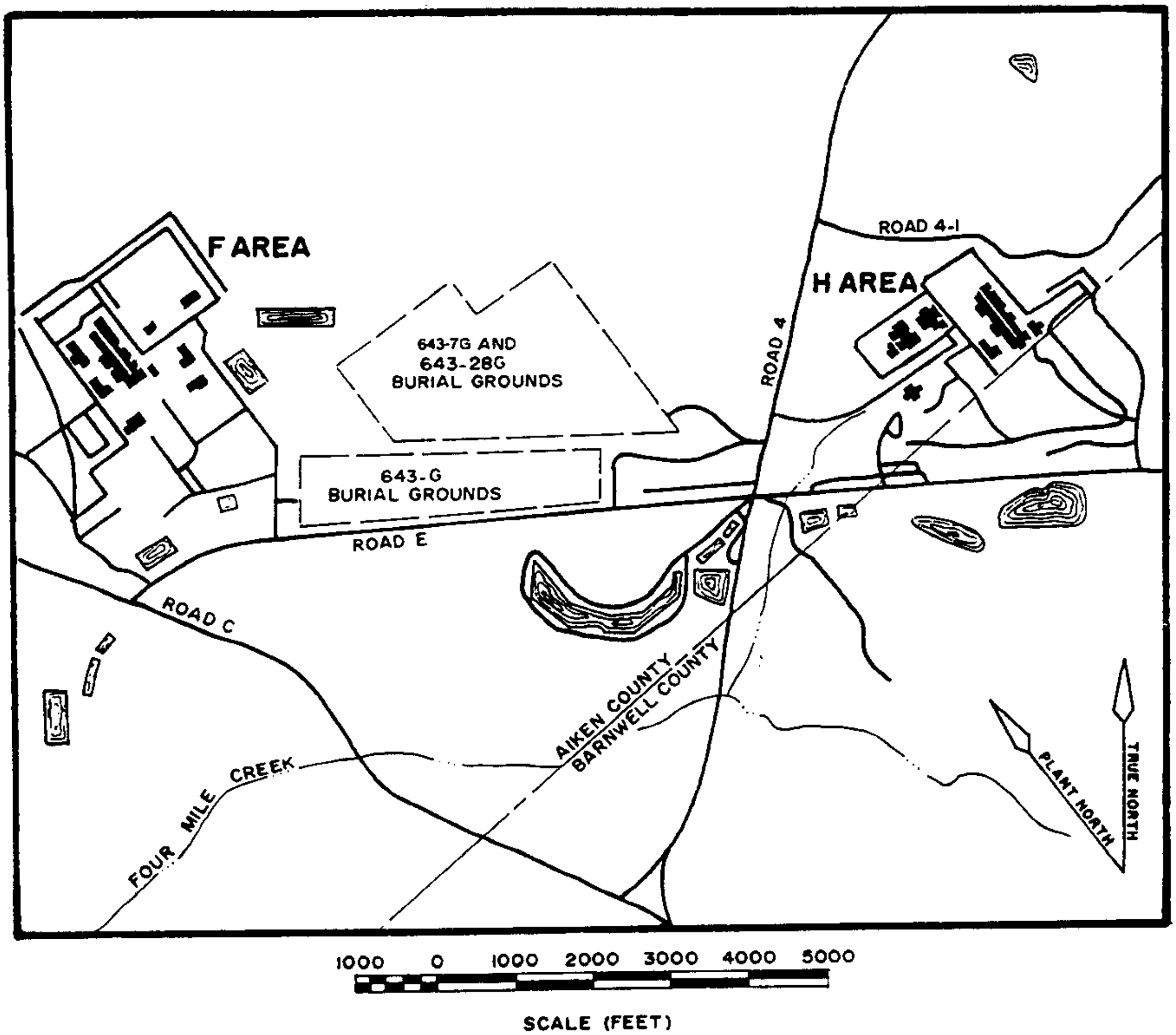


FIGURE 15-61. Location of the Radioactive Waste Burial Grounds

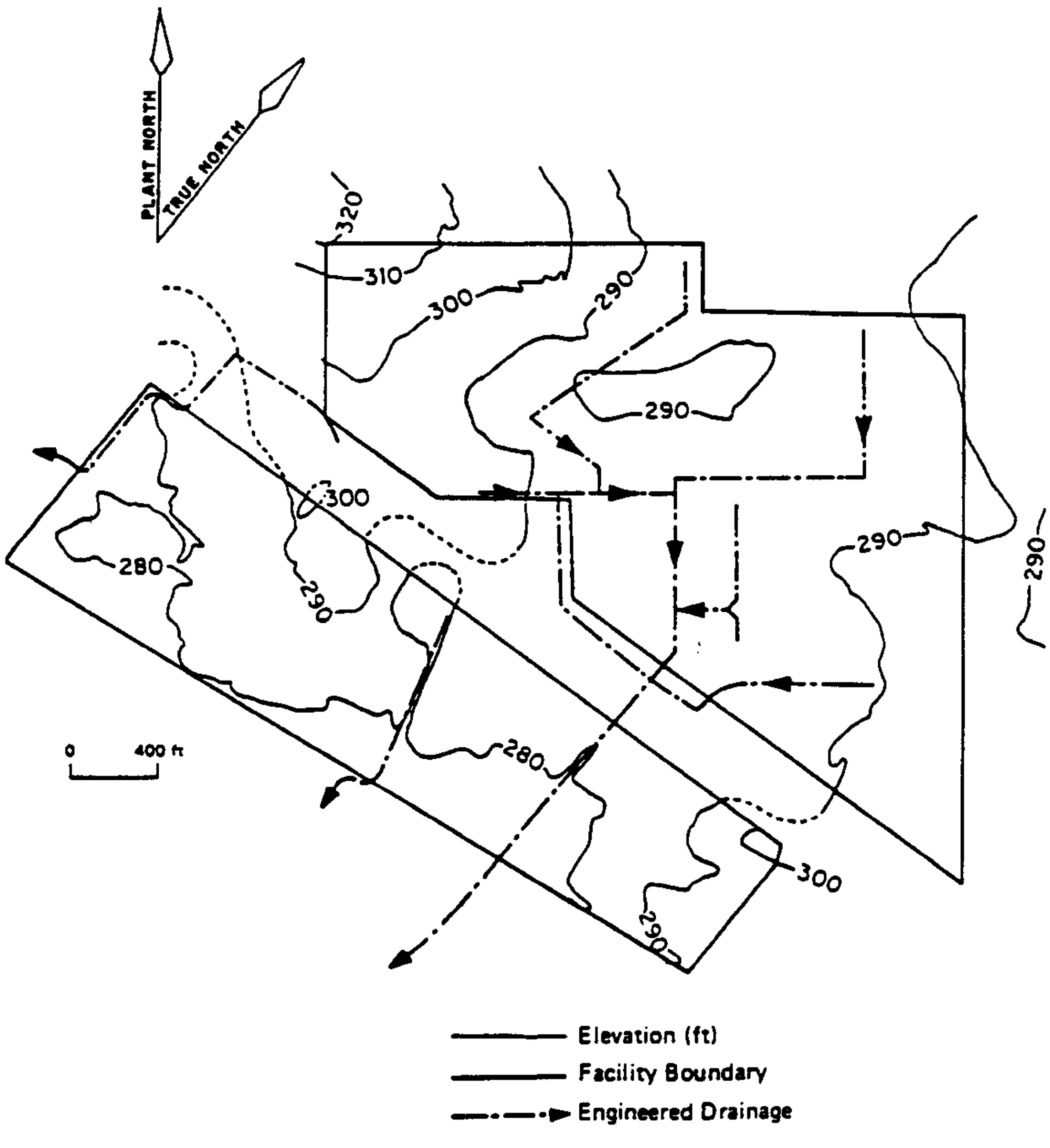


FIGURE 15-62. Topography and Drainage in the Radioactive Waste Burial Grounds

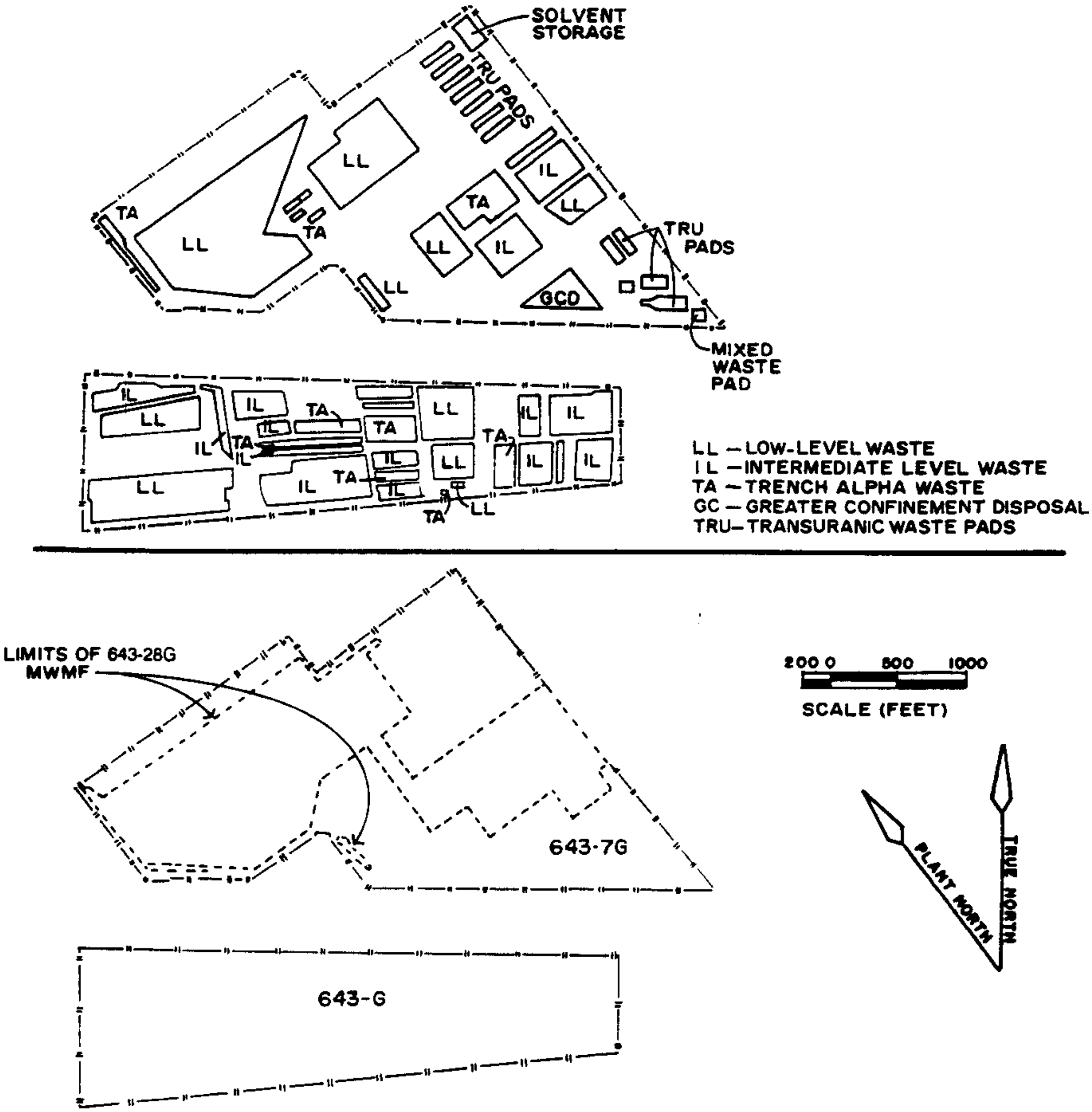


FIGURE 15-63. Waste Storage Areas Within the Radioactive Waste Burial Grounds

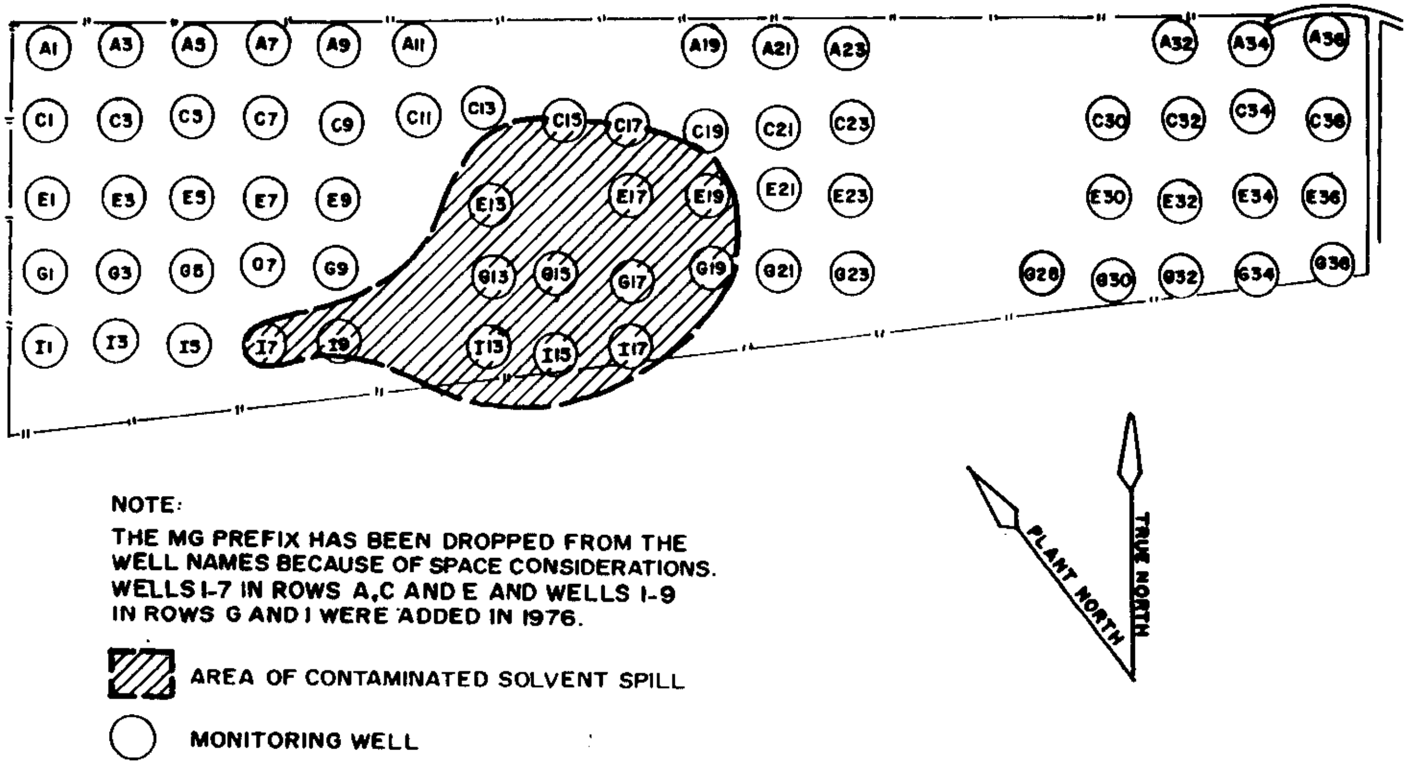


FIGURE 15-64. Old Burial Ground (643-G) Area Affected by Solvent Spill (1971)

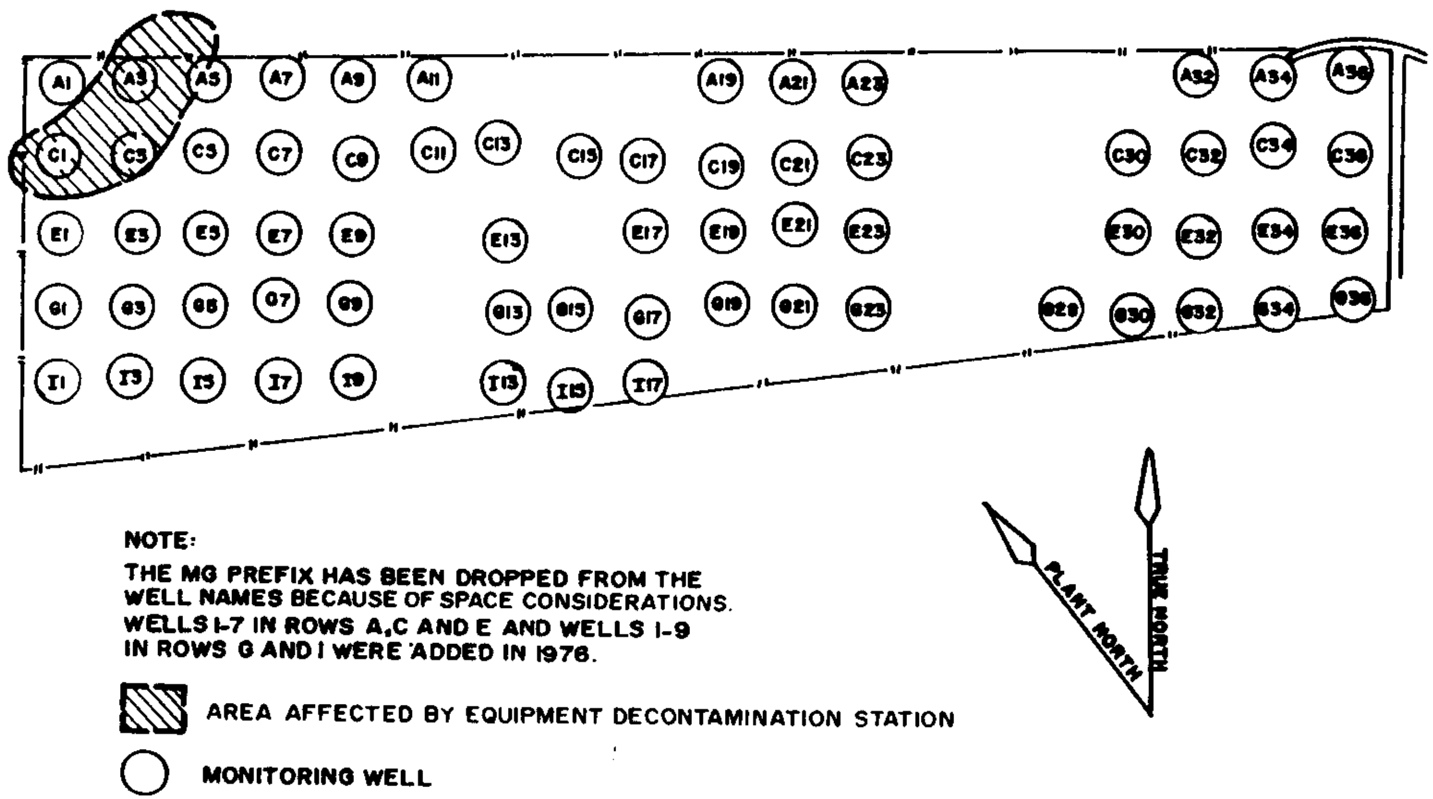


FIGURE 15-65. Old Burial Ground (643-G) Area Affected by Equipment Decontamination Station

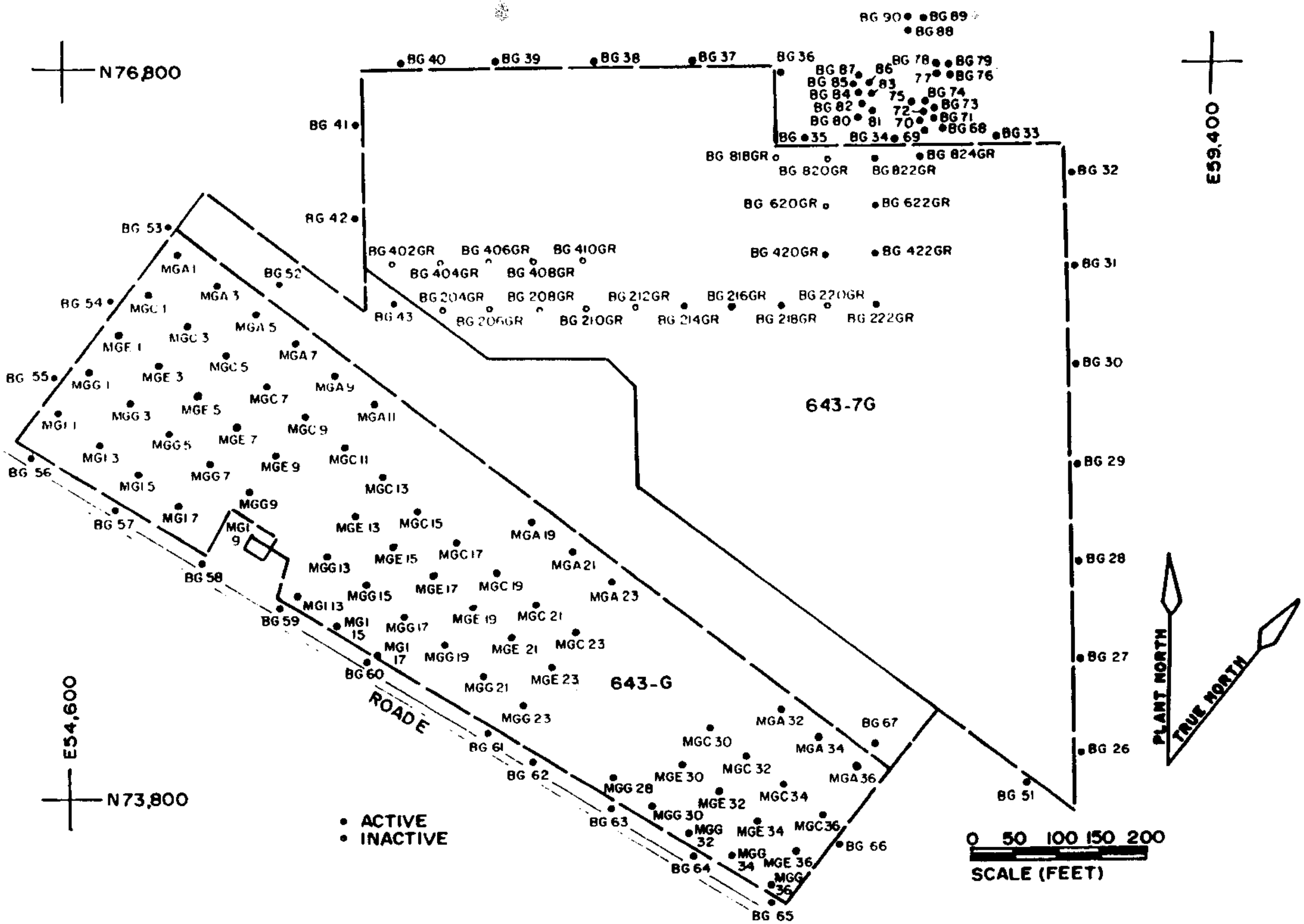


FIGURE 15-66. Radioactive Waste Burial Grounds Wells

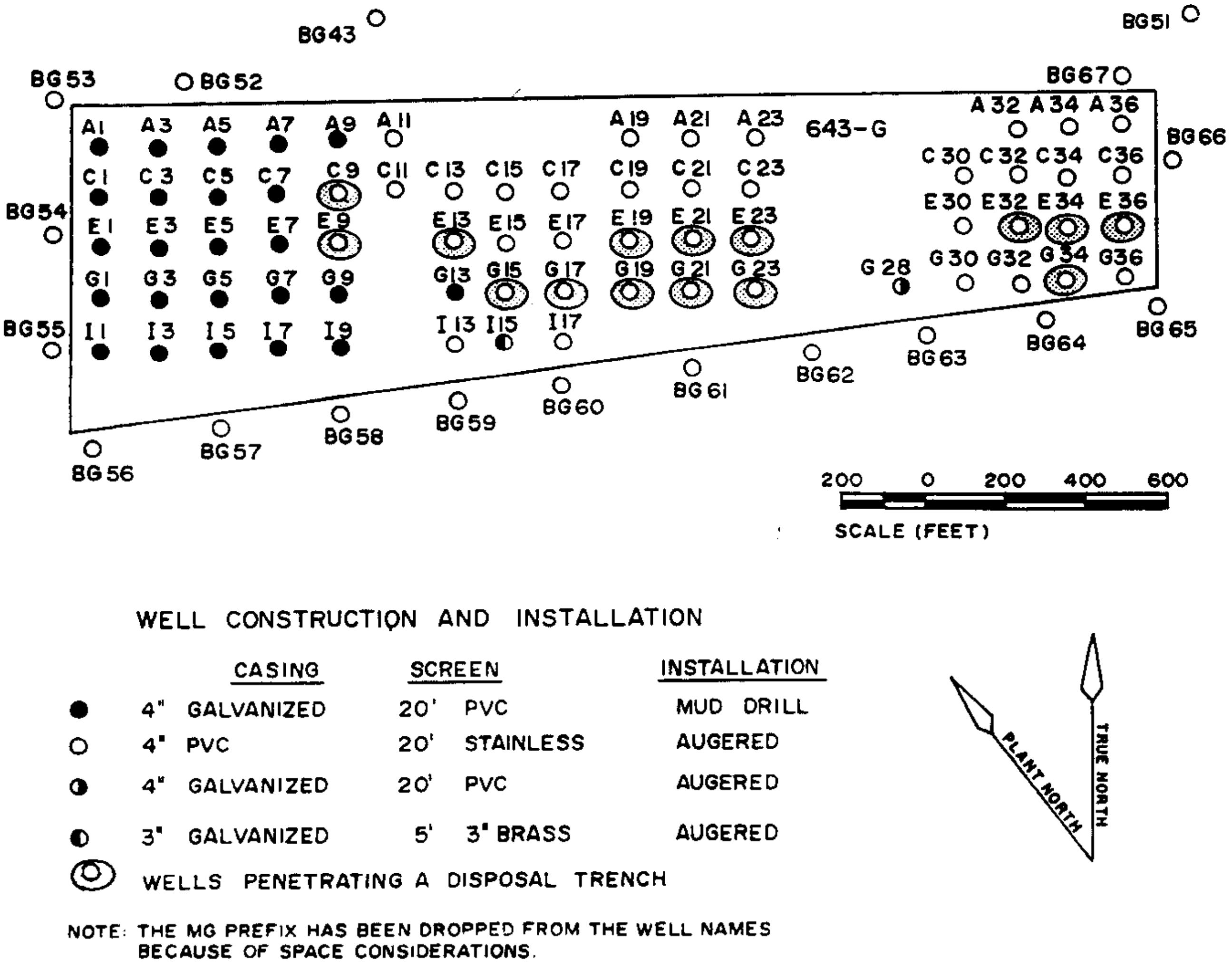


FIGURE 15-67. Construction Details of Old Burial Ground (643-G) Grid Wells

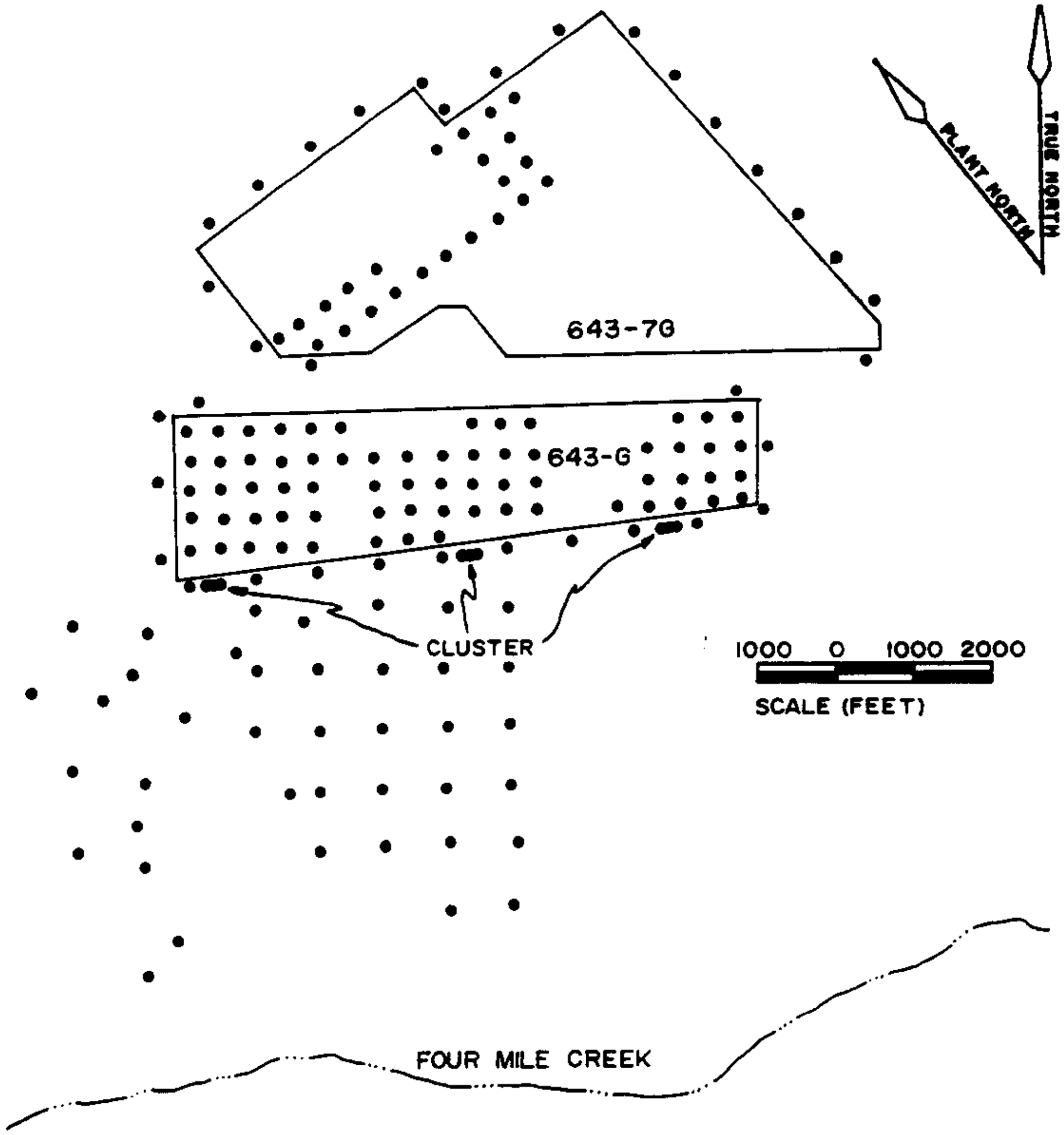


FIGURE 15-68. Plume Monitoring Wells Around the Radioactive Waste Burial Grounds

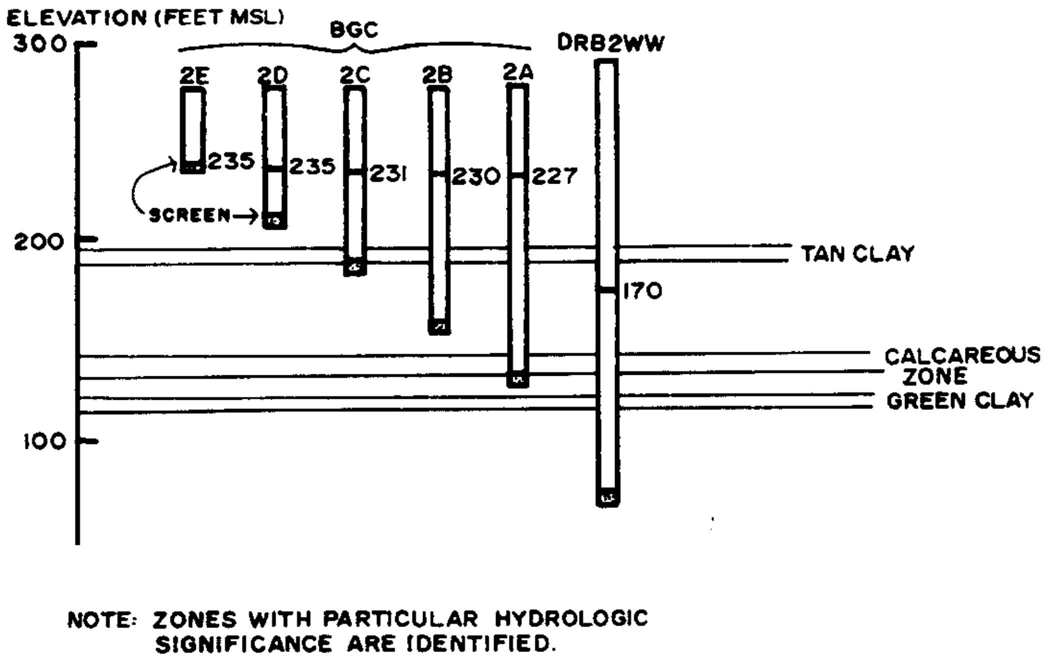


FIGURE 15-69. Vertical Head Relationships in Burial Grounds Cluster Wells

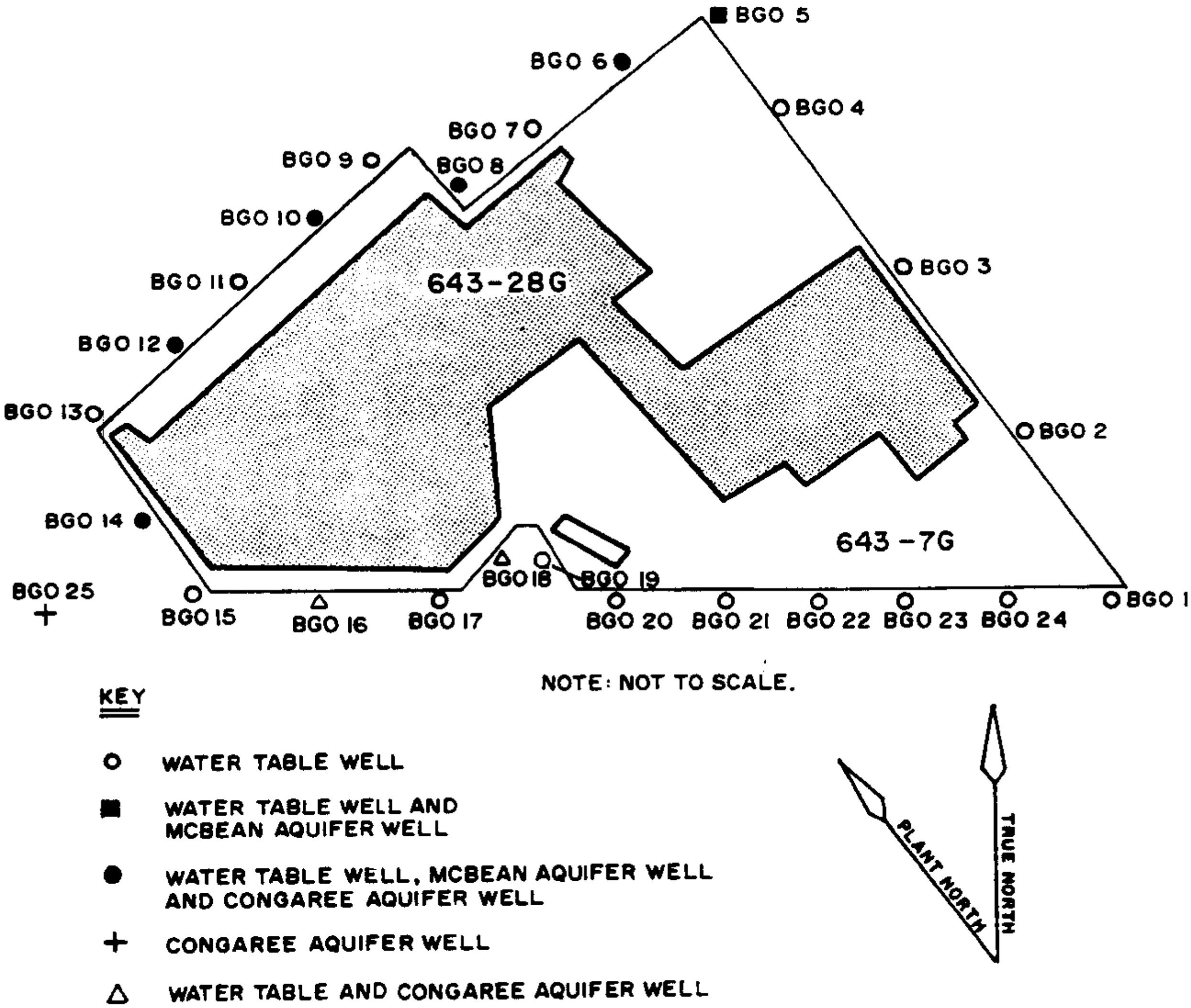


FIGURE 15-70. Proposed RCRA Point-of-Compliance Wells Around the New Burial Ground (643-7G) and Mixed Waste Management Facility (MWMF; 643-28G)

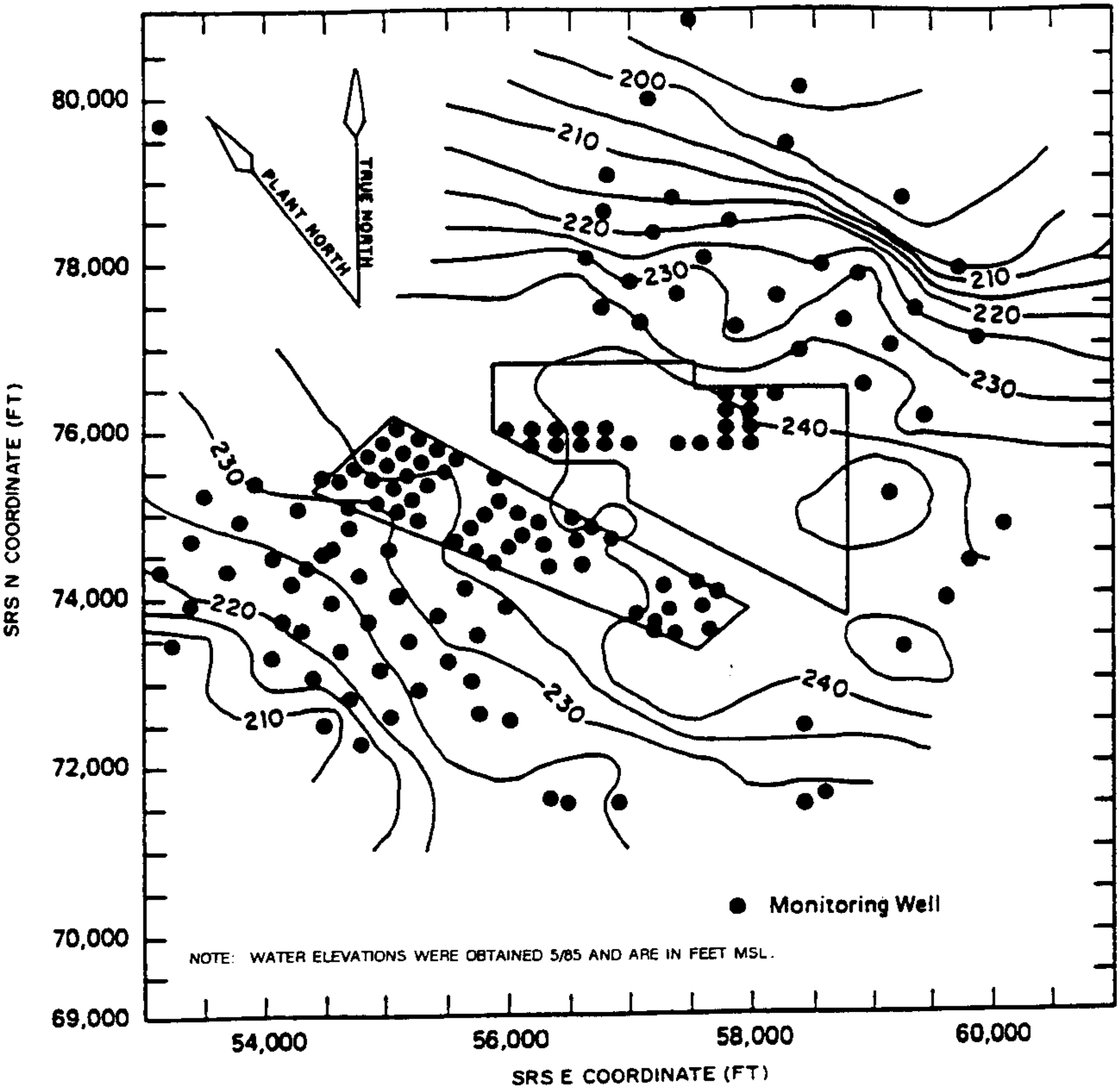


FIGURE 15-71. Radioactive Waste Burial Grounds Water-Table Elevation Map

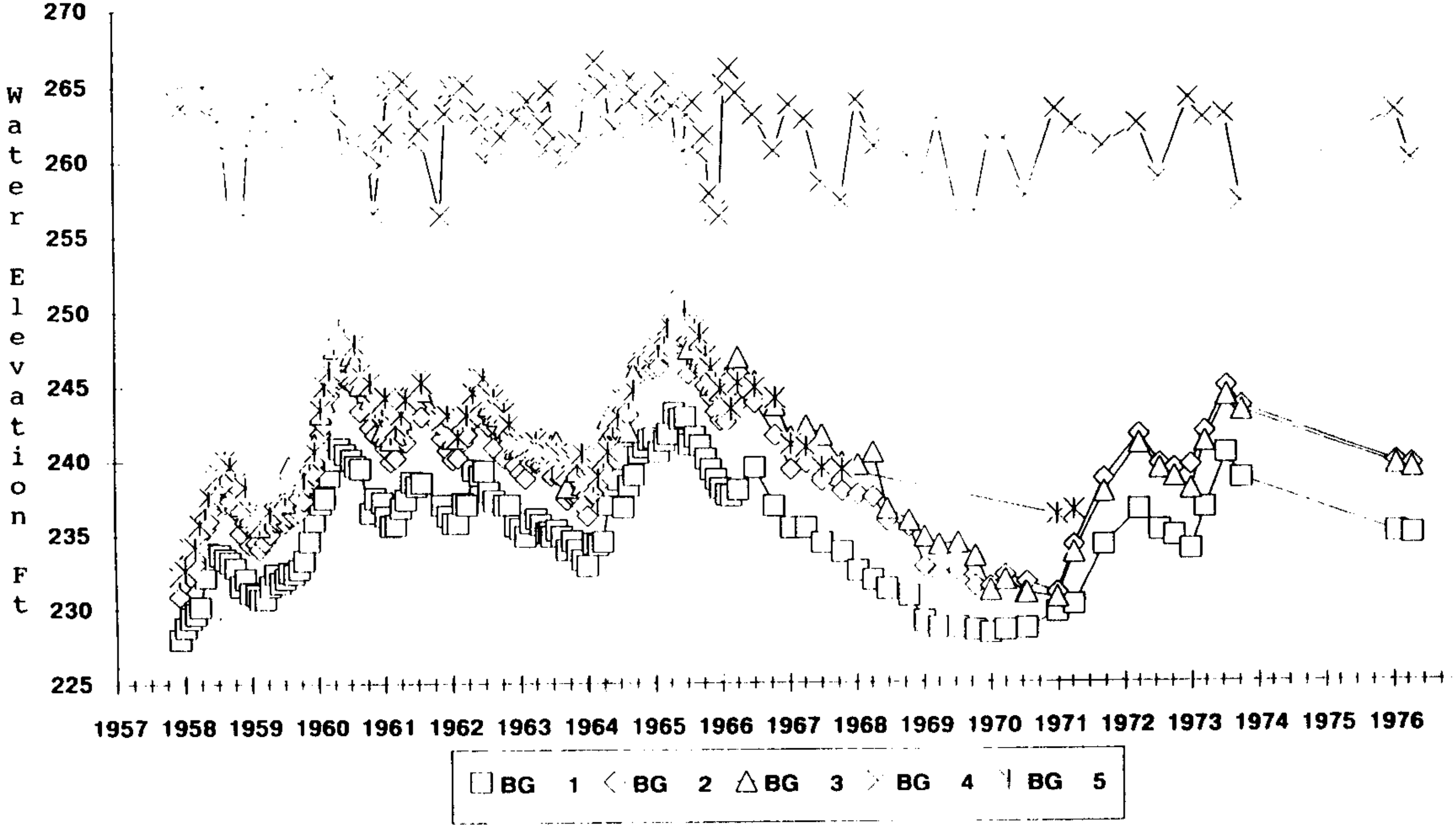


FIGURE 15-72. Hydrograph of Radioactive Waste Burial Grounds Wells BG 1 Through BG 5

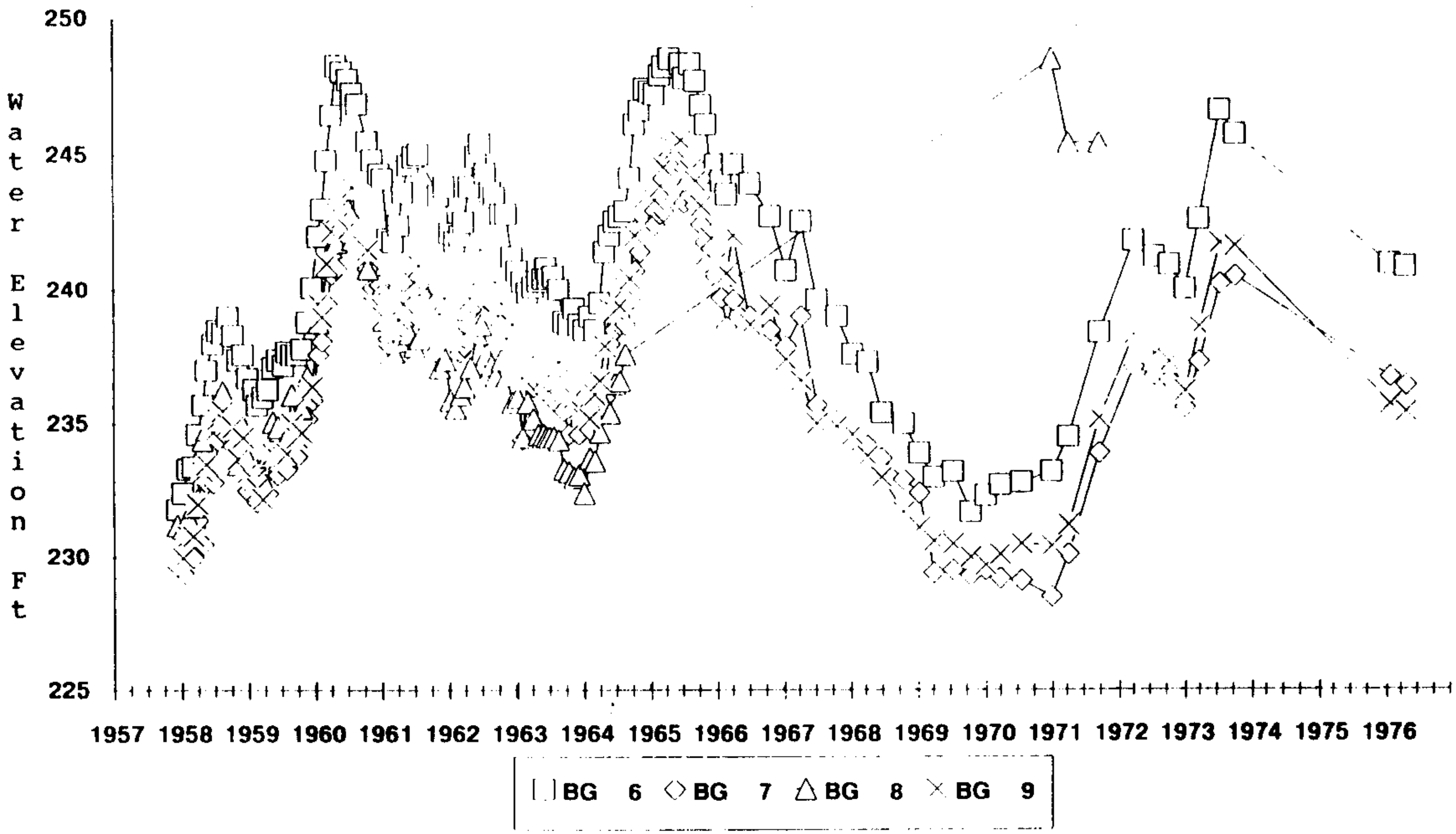


FIGURE 15-73. Hydrograph of Radioactive Waste Burial Grounds Wells BG 6 Through BG 9

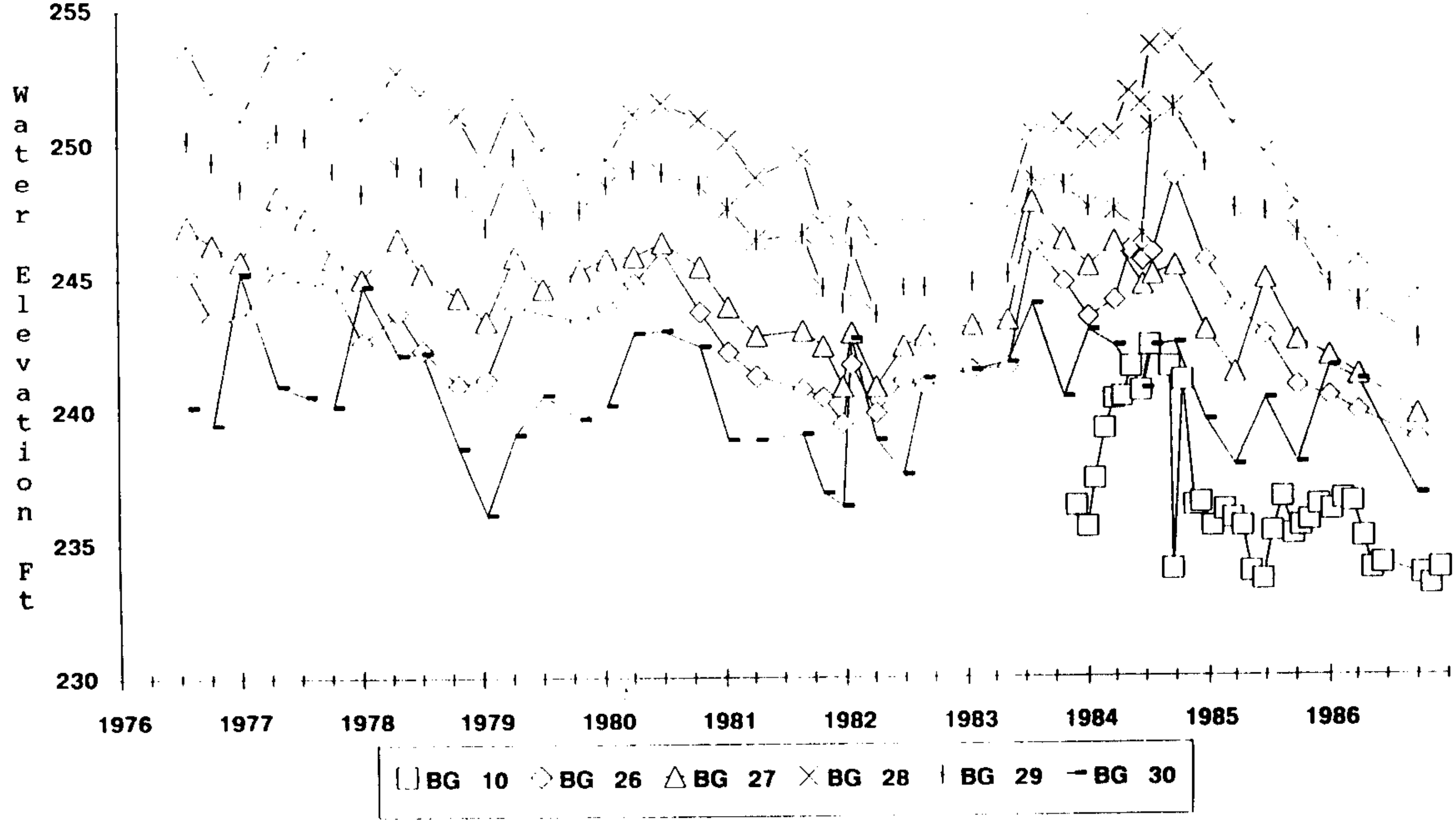


FIGURE 15-74. Hydrograph of Radioactive Waste Burial Grounds Wells BG 10 Through BG 30

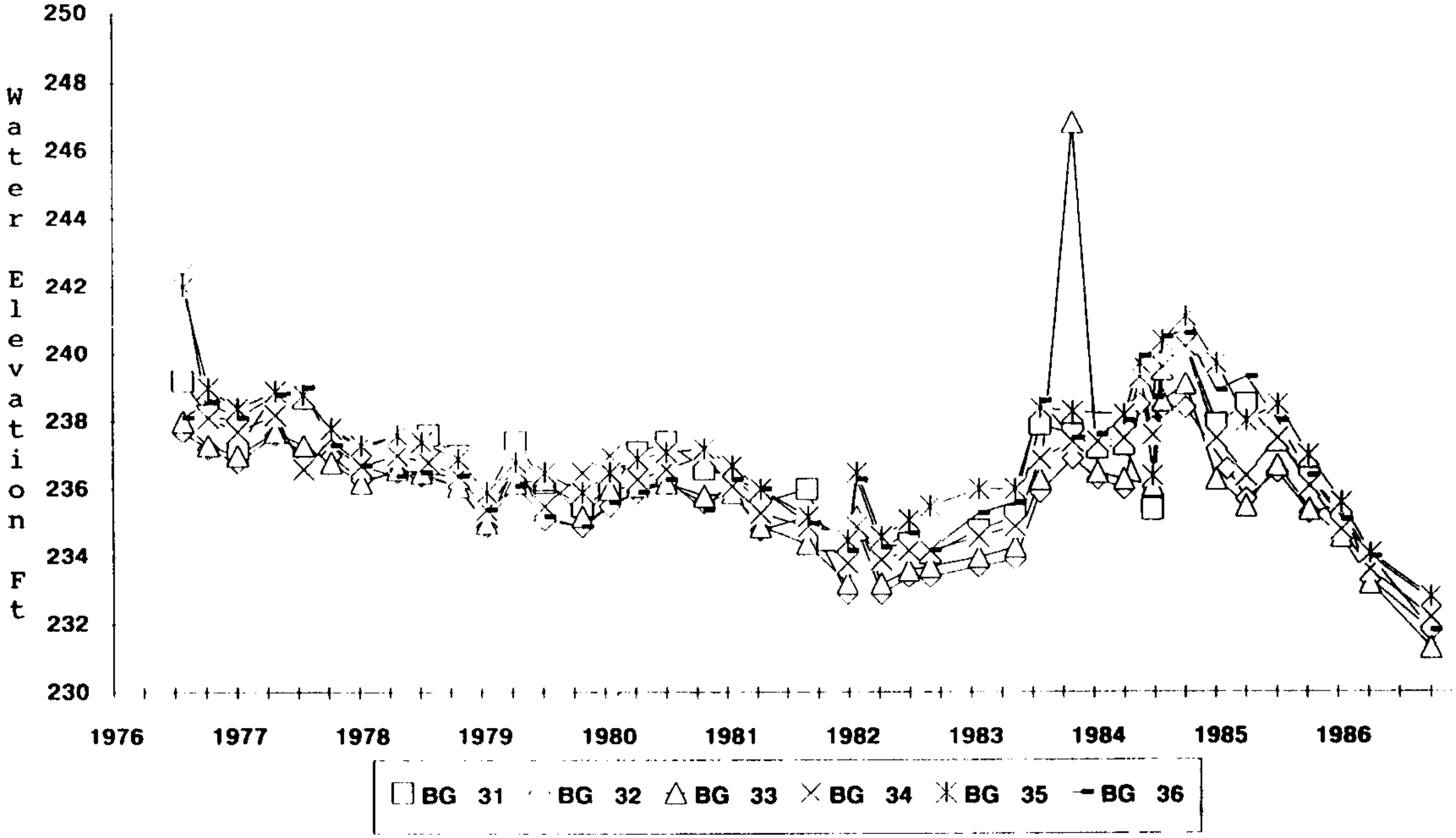


FIGURE 15-75. Hydrograph of Radioactive Waste Burial Grounds Wells BG 31 Through BG 36

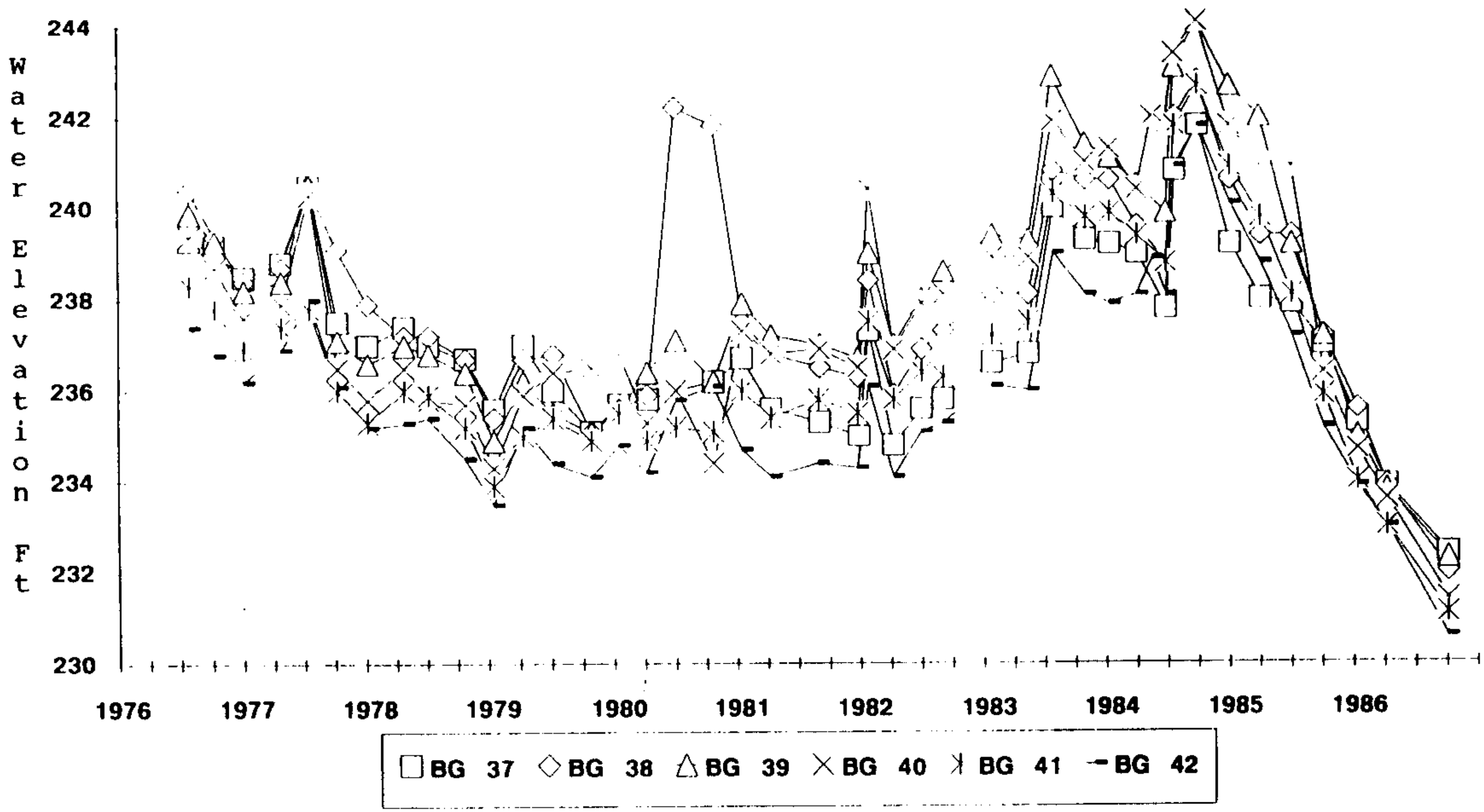


FIGURE 15-76. Hydrograph of Radioactive Waste Burial Grounds Wells BG 37 Through BG 42

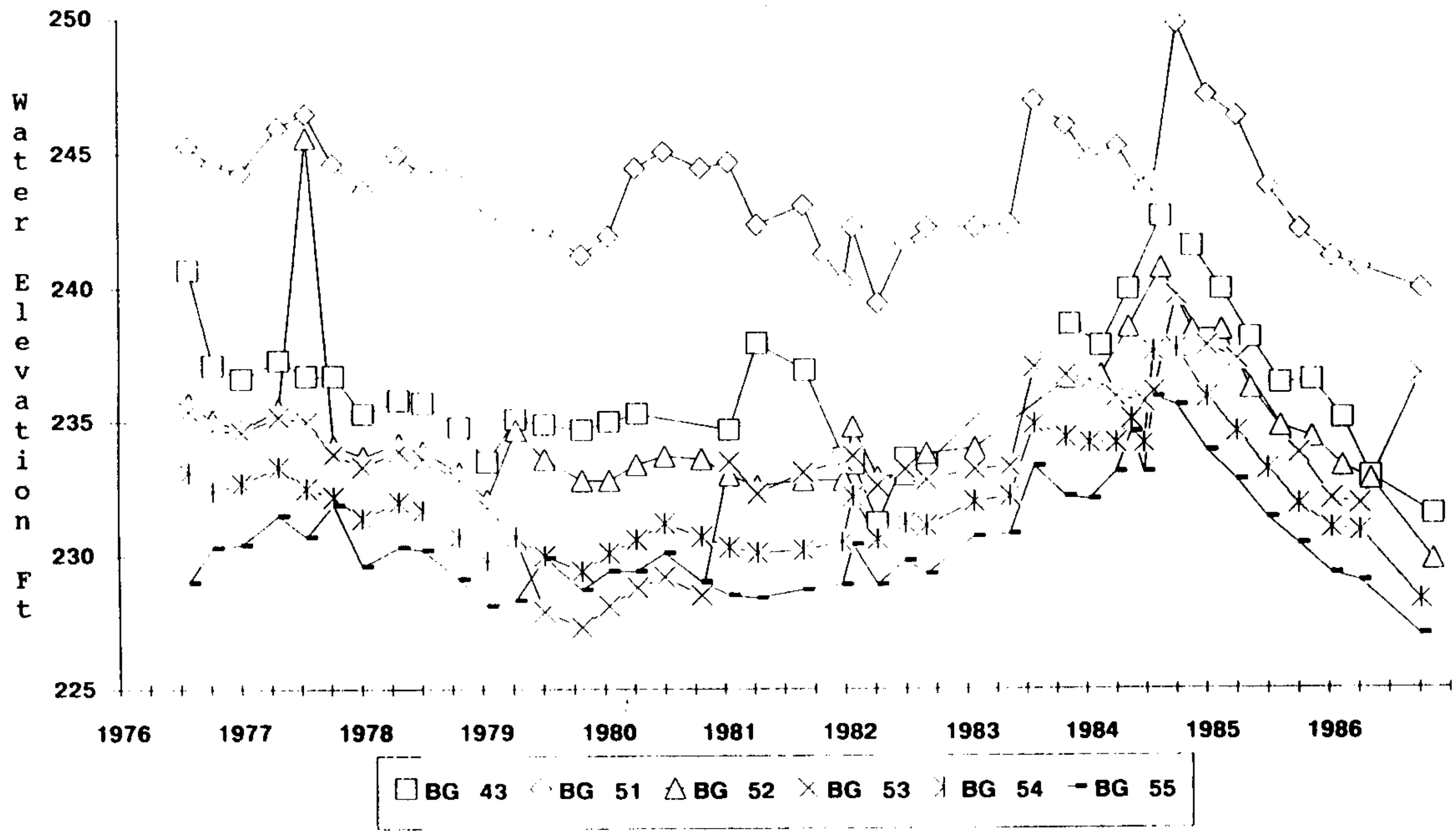


FIGURE 15-77. Hydrograph of Radioactive Waste Burial Grounds Wells BG 43 Through BG 55

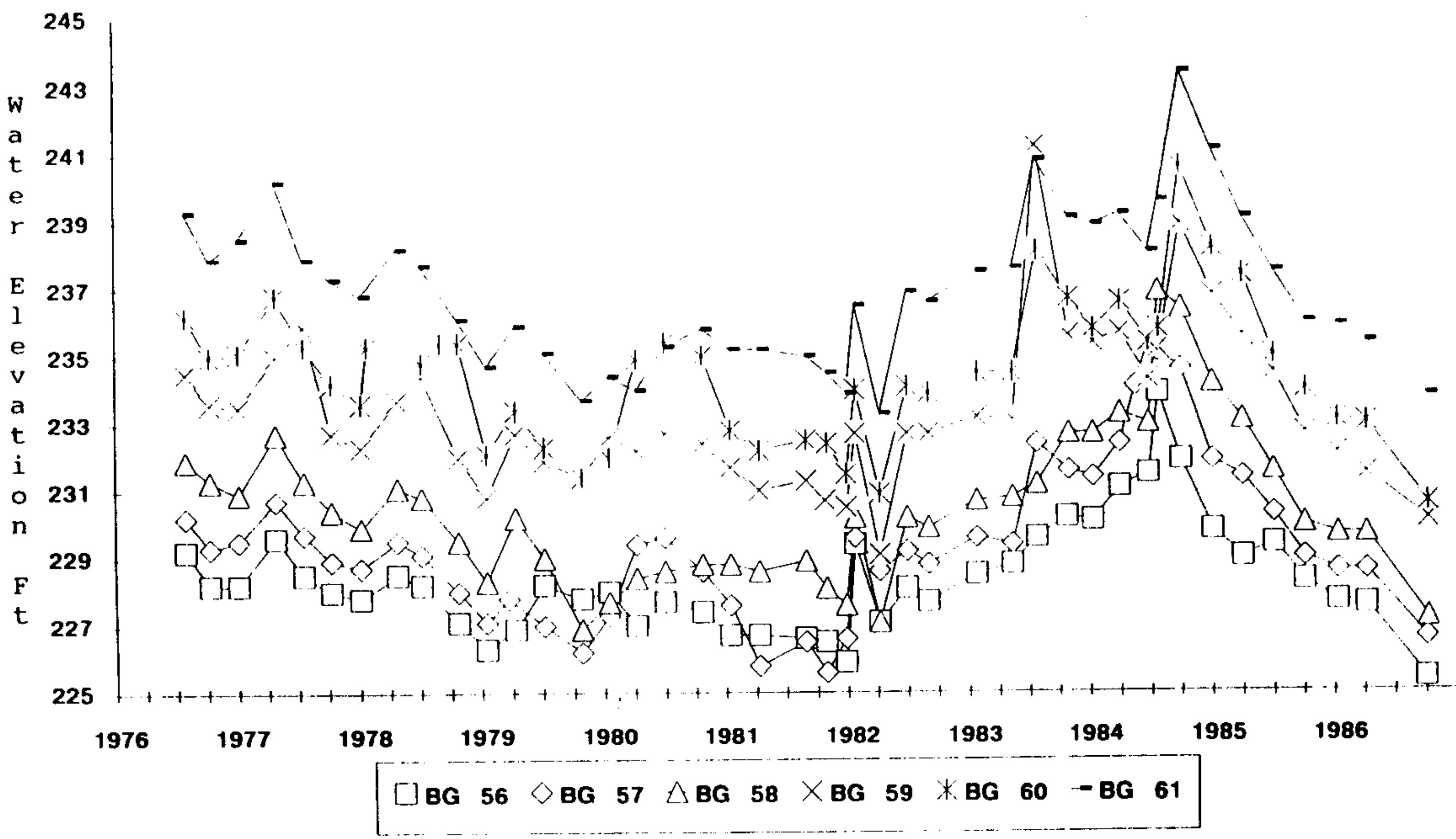
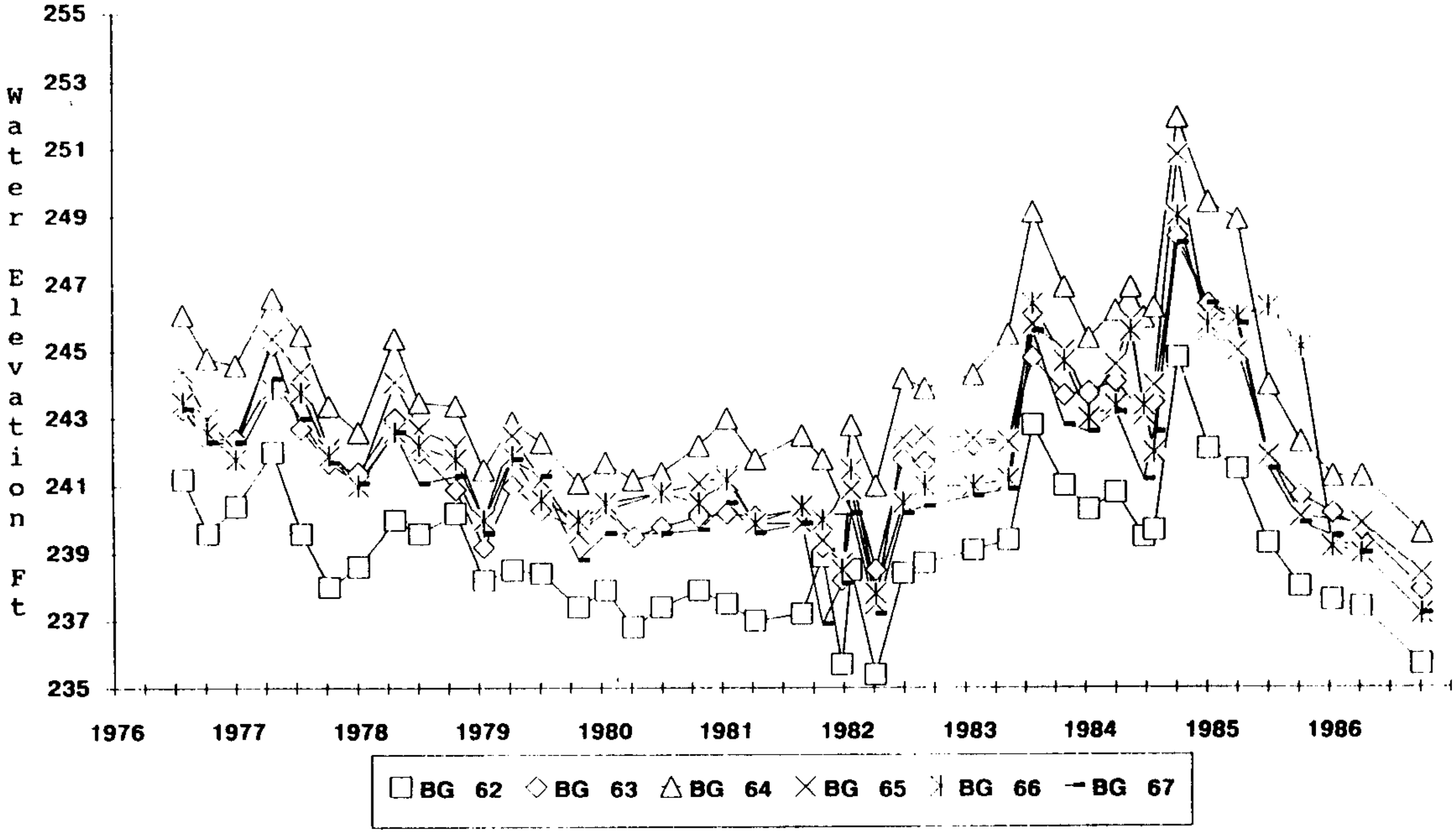


FIGURE 15-78. Hydrograph of Radioactive Waste Burial Grounds Wells BG 56 Through BG 61



NOTE: A WATER LEVEL OF 275.4 FT OBTAINED FOR WELL BG 65 ON 1/11/86 IS NOT PLOTTED.

FIGURE 15-79. Hydrograph of Radioactive Waste Burial Grounds Wells BG 62 Through BG 67

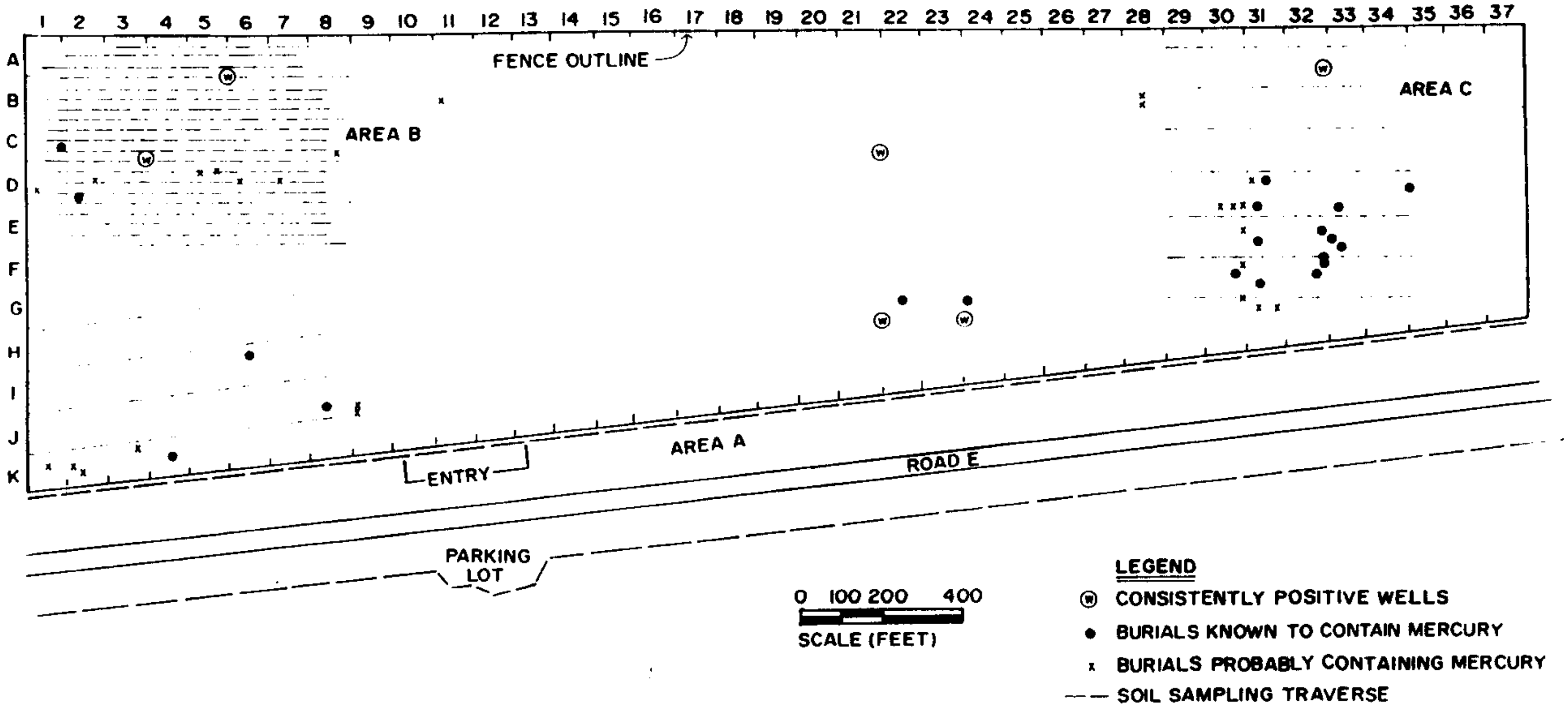


FIGURE 15-80. Soil Sampling Locations for Mercury in the Old Burial Ground (643-G)

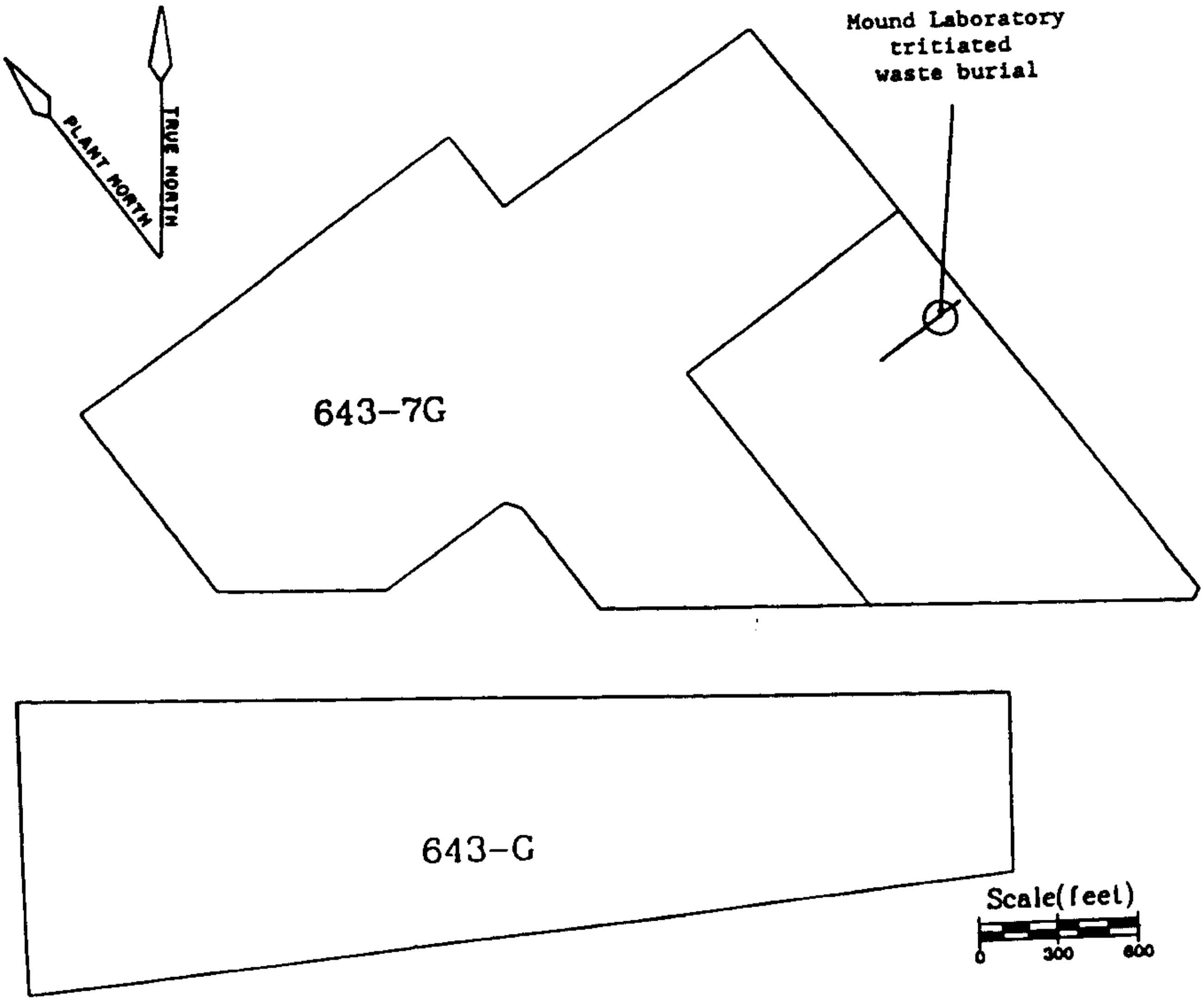


FIGURE 15-81. Location of the Mound Laboratory Tritiated Waste Burial in the New Burial Ground (643-7G)

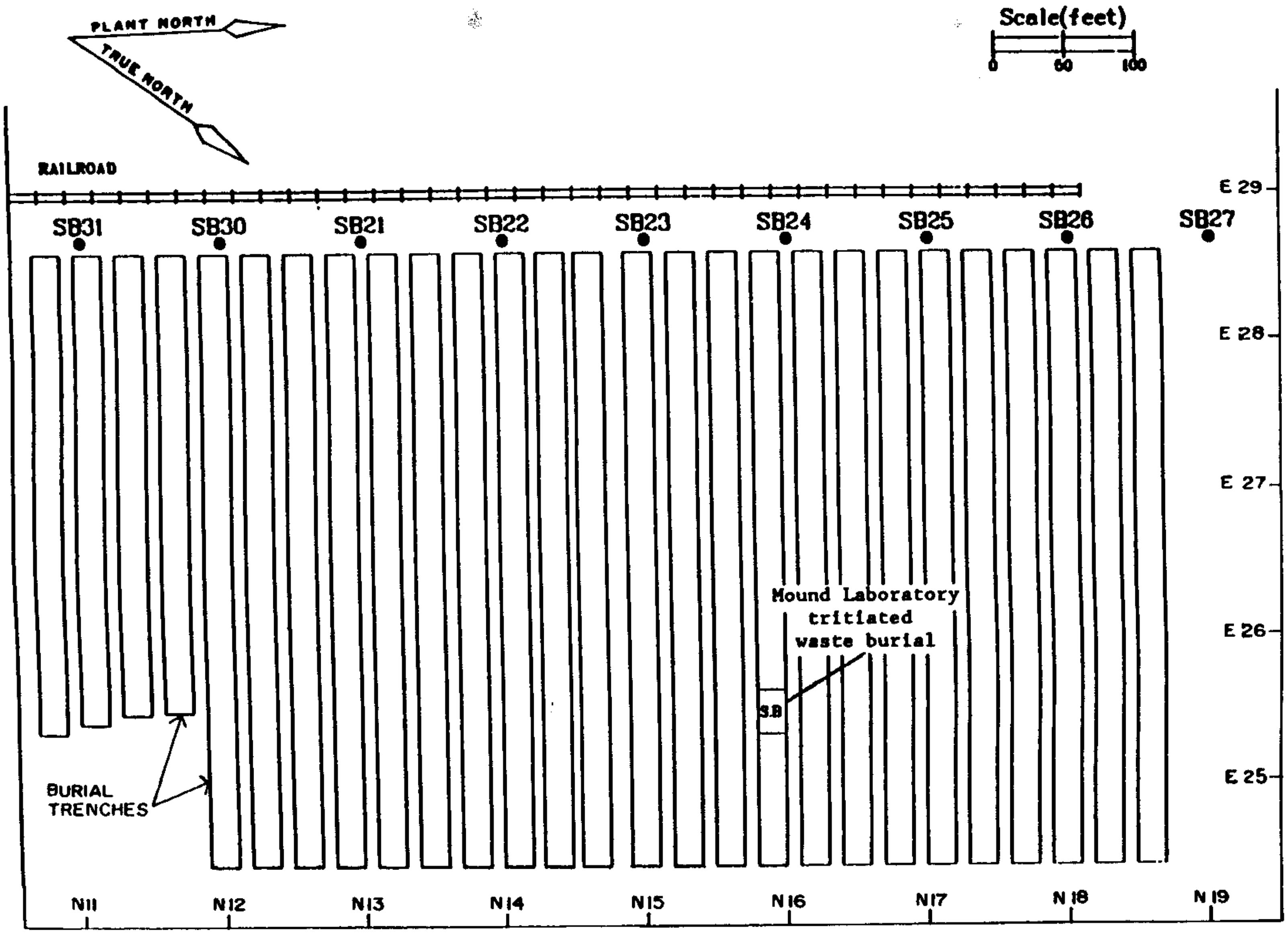


FIGURE 15-82. Soil Sampling Locations for Tritium Near the Mound Laboratory Waste Burial

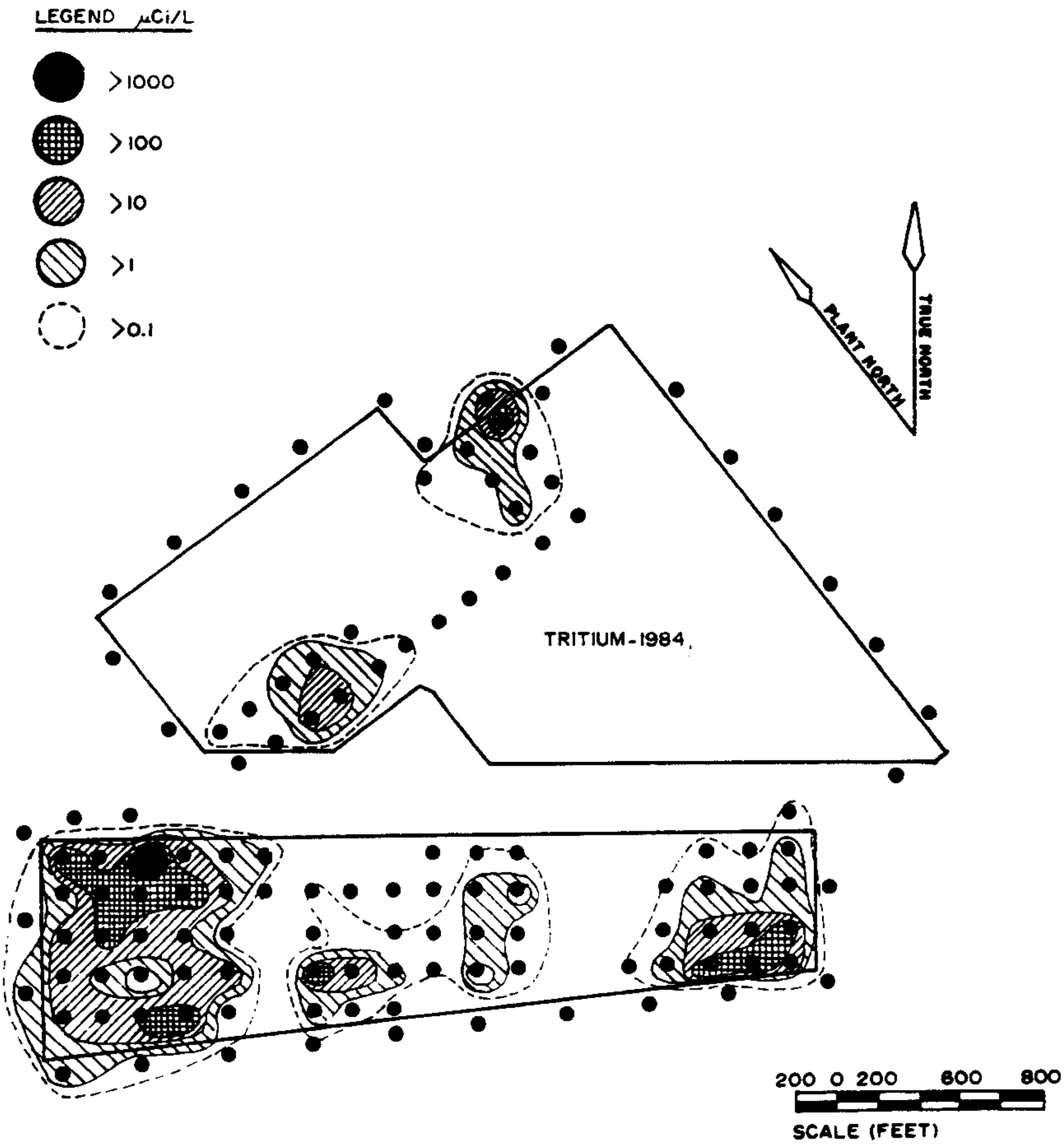


FIGURE 15-83. Radioactive Waste Burial Grounds Groundwater Tritium Plumes

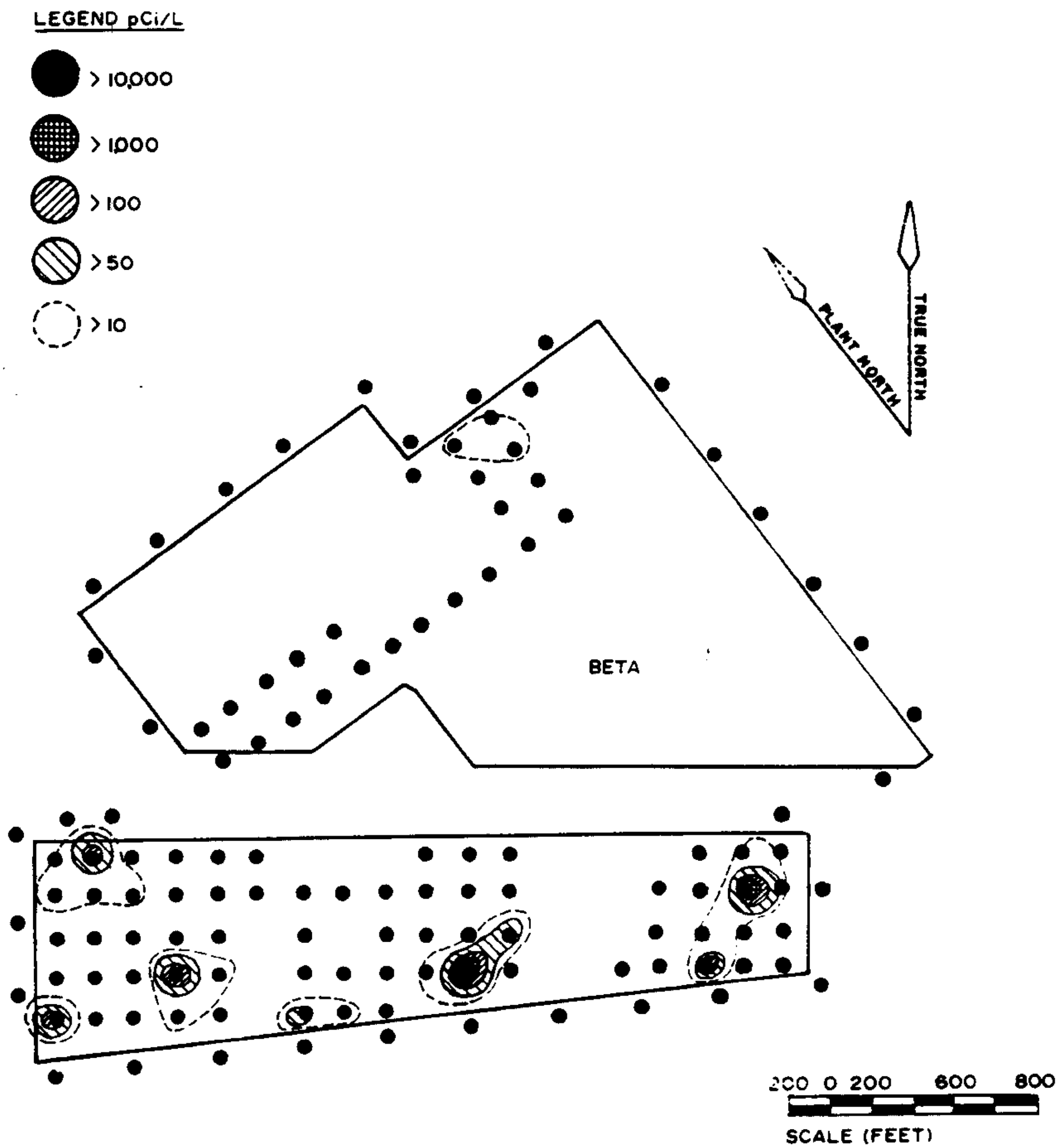


FIGURE 15-84. Radioactive Waste Burial Grounds Groundwater Nonvolatile Beta Plumes

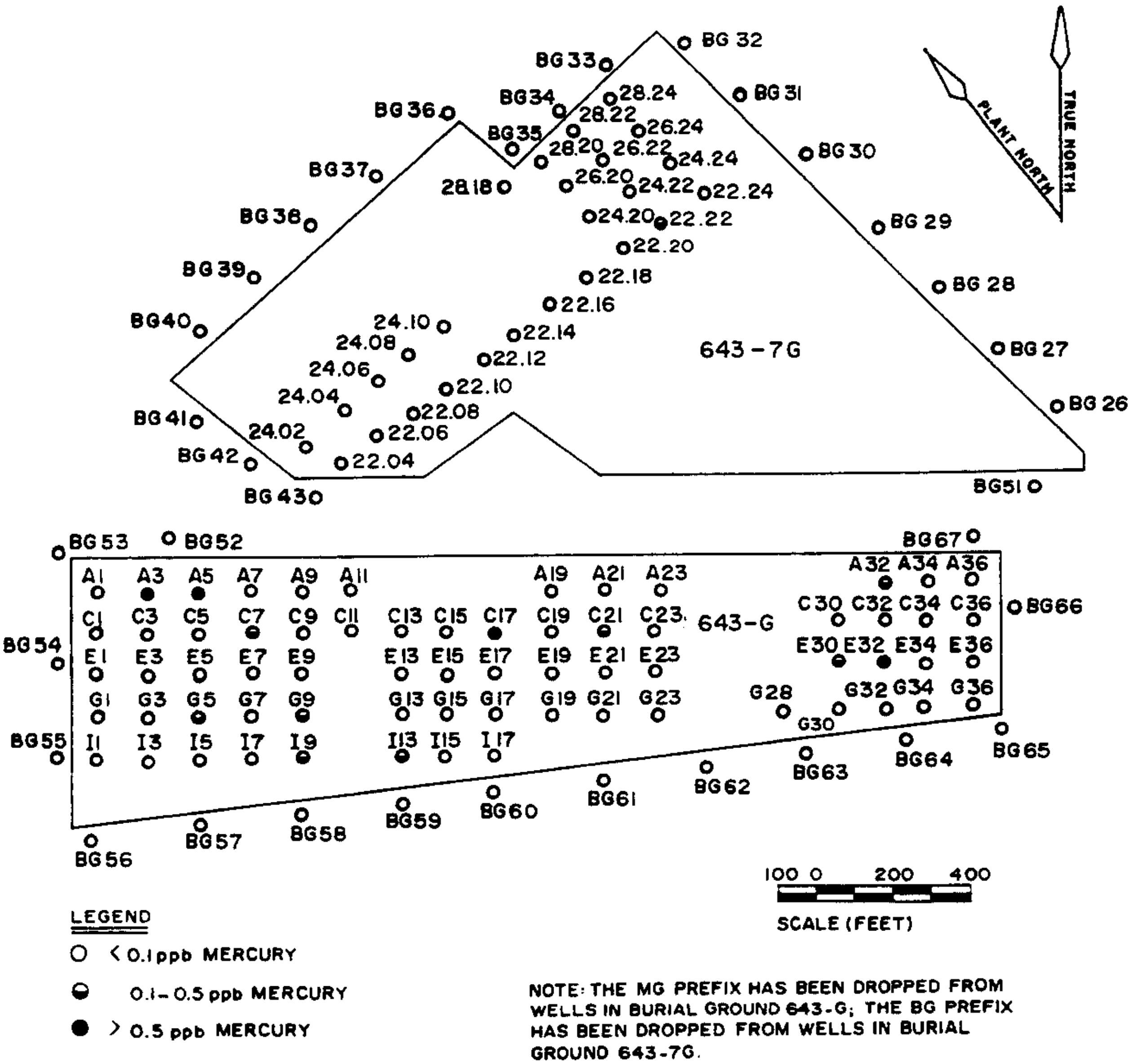


FIGURE 15-85. Mercury Concentrations in Radioactive Waste Burial Grounds Wells

SECTION 16 PLANNED ACTIONS

16.01 SUMMARY

The Savannah River Site (SRS) plans to close its waste sites in a manner that minimizes the need for future maintenance and that controls or eliminates the post-closure escape of wastes to the environment. All waste sites to be closed must follow the sequence of characterization, assessment, and closure plan development and approval before closure can begin. Sites progress through this sequence at different rates. Each site has been assigned to a custodial group charged with developing and implementing a closure plan for the site. Site custodians are responsible for gathering documentation about each site's history and contents, characterizing the site's present condition, and assessing each site's environmental threats.

The National Environmental Policy Act (NEPA) requires that the environmental consequences of each waste-site closure be assessed. NEPA requirements for most SRS waste sites are expected to be satisfied by the issuance of a Record of Decision (ROD) on the Environmental Impact Statement (EIS) for Waste Management and Groundwater Protection at SRS, which was released for public review and comment in April 1987. The EIS describes the closure options for each SRS waste site and the environmental impacts of each option. The ROD will address public comments on the proposed actions and may select preferred options for any of the proposed actions. Some sites may require additional approval from the South Carolina Department of Health and Environmental Control (SCDHEC) or may need to meet additional regulatory conditions before closure can begin.

Section 16.02 describes the status of each planned action listed in the *Technical Summary of Groundwater Quality Protection Program at Savannah River Plant* (Christensen and Gordon, 1983). Section 16.03 outlines the status of and planned actions for each waste site as of the end of 1986.

16.02 STATUS OF PLANS LISTED IN THE *TECHNICAL SUMMARY OF GROUNDWATER QUALITY PROTECTION PROGRAM AT SAVANNAH RIVER PLANT*

In the *Technical Summary of Groundwater Quality Protection Program at Savannah River Plant* (DPST-83-829), Christensen and Gordon (1983) list planned actions for SRS waste sites. This section updates those actions, and the following section lists the current planned actions for each site.

16.02.01 Savannah River Laboratory (SRL) Seepage Basins

The 1983 report lists the following planned actions for the Savannah River Laboratory (SRL) Seepage Basins (Buildings 904-53G1, 904-53G2, 904-54G, and 904-55G): continuation of monitoring, plume definition, and closure.

Monitoring has continued. A comprehensive basin sediment sampling program performed in early 1983 found that the basins pose essentially no risk to groundwater. Several wells near the SRL Seepage Basins have shown chlorinated degreasing solvents. These contaminants are not thought to have originated in the SRL Seepage Basins and are being tracked as part of the M-Area plume definition program. A closure plan for these basins is being developed.

16.02.02 A-Area Motor Shop Oil Basin

The 1983 report lists groundwater monitoring and closure as the planned actions for the A-Area Motor Shop Oil Basin (Building 904-101G). Two monitoring wells were installed around this basin. The basin has been taken out of service and is undergoing a site assessment so that a closure plan may be developed.

16.02.03 A-Area Metals Burning Pit

The 1983 report lists groundwater monitoring as the planned action for the A-Area Metals Burning Pit (Building 731-4A). Six monitoring wells were installed, and four wells currently monitor the site.

16.02.04 Miscellaneous Chemical Basin

The 1983 report lists groundwater monitoring as the planned action for the Miscellaneous Chemical Basin (Building 731-5A), which was thought to have been a part of the area designated as the A-Area Metals Burning Pit. However, in late 1986, it was discovered that the Miscellaneous Chemical Basin was a separate site near the Metals Burning Pit. Monitoring wells were scheduled for installation around the Miscellaneous Chemicals Basin in early 1987.

16.02.05 A-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the A-Area Coal Pile Runoff Containment Basin (Building 788-3A): continuation of monitoring, runoff treatment, and closure.

Groundwater monitoring has continued, with new PVC-cased wells replacing the older, steel-cased wells in 1984. Runoff treatment was proposed, but this idea was not pursued because an assessment of the coal pile runoff control basins suggested that they are not a major source of groundwater contamination. The basin is still in service.

16.02.06 A-Area Burning/Rubble Pits

The 1983 report lists groundwater monitoring as the planned action for the A-Area Burning/Rubble Pits (Building 731-A and 731-1A). Five monitoring wells were installed at the site, and four of the wells are currently active.

16.02.07 A-Area Ash Piles

The 1983 report lists groundwater monitoring as the planned action for A-Area Ash Pile 788-2A; no planned action was given for ash pile 788-A. Five monitoring wells were installed around ash pile 788-2A; four of the wells are currently active.

16.02.08 Metallurgical Laboratory Seepage Basin

The 1983 report lists the following planned actions for the Metallurgical Laboratory Seepage Basin (Building 904-110G): effluent treatment, groundwater monitoring, and closure.

Effluent collection and treatment has begun. Five groundwater monitoring wells were installed; three of the wells are currently active. The basin has been taken out of service. Assessment work is scheduled for 1987 so that a closure plan may be developed.

16.02.09 M-Area Settling Basin

The 1983 report lists the following as planned actions for the M-Area Settling Basin and vicinity (Buildings 904-51G and 904-112G): continue monitoring, plume definition, groundwater removal and treatment, and basin closure.

Monitoring has continued, and many additional plume definition wells have been installed. The plume of chlorocarbon contaminants is now well defined, particularly in areas of high concentration. SRS's quarterly groundwater quality assessment reports document the plume definition monitoring results. Groundwater removal and treatment have begun. Since the 1983 report was released, SRS has demonstrated that air stripping is an effective method for treating the contaminated groundwater under M Area and has designed and installed a 400-gpm air stripper and a network of 11 recovery wells. By the end of 1986 over 100,000 lb of chlorocarbons had been removed from the groundwater.

Basin closure also has progressed. A closure plan was submitted to SCDHEC, was revised in accordance with SCDHEC comments, and was open for public comment. SCDHEC conditionally approved the plan in 1987. SRS will revise the plan in the fall of 1987 to accommodate

SCDHEC's conditions for approval, and closure is expected to begin during the spring of 1988.

16.02.10 Silverton Road Waste Site

The 1983 report lists the following planned actions for the Silverton Road Waste Site (Building 731-3A): continuation of monitoring and plume definition.

Groundwater monitoring has continued. Additional wells were installed to define contaminant plumes. All groundwater monitoring results consistently show low concentrations of contaminants (below 20 mg/L of volatile organics), making further plume definition unnecessary.

16.02.11 C-Area Reactor Seepage Basins

Stone and Christensen (1983) call for continued use of the C-Area Reactor Seepage Basins (Buildings 904-66G, 904-67G, and 904-68G). These basins are used when the C-Area reactor is operating. Six wells currently monitor the groundwater at the site.

16.02.12 C-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the C-Area Coal Pile Runoff Containment Basins (Building 189-C): continuation of monitoring, runoff treatment, and closure.

Groundwater monitoring has continued at this site. Runoff treatment is unnecessary because the C-Area coal pile has been removed. An assessment of this basin shows that the basin is not a major source of groundwater contamination. The basin will be closed following development of a closure plan.

16.02.13 C-Area Ash Piles

No planned action was listed for the C-Area Ash Piles (Buildings 188-C, 188-1C, and 188-2C) in the 1983 report.

16.02.14 C-Area Burning/Rubble Pit

The 1983 report lists groundwater monitoring as the planned action for the C-Area Burning/Rubble Pit (Building 131-C). Four monitoring wells were installed at the site in 1983 and 1984.

16.02.15 C-Area Asbestos Pits

The 1983 report lists erosion control as the planned action for the C-Area Asbestos Pits (Buildings 080-21G and 080-22G). The sites are inspected periodically for erosion or maintenance needed to prevent erosion, and corrective action is taken as needed.

16.02.16 D-Area Oil Disposal Basin

The 1983 report lists groundwater monitoring and closure as the planned actions for the D-Area Oil Disposal Basin (Building 631-G). Four monitoring wells were installed around this basin in late 1983 and 1984. Although the basin has not been closed, it has been backfilled and may not require additional closure actions.

16.02.17 D-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the D-Area Coal Pile Runoff Containment Basin (CPRB; Building 489-D): continuation of monitoring, runoff treatment, and closure.

Monitoring has continued. Runoff treatment was proposed at one time, but has not been pursued because a study showed that the basin is not a major source of groundwater contamination. An assessment of the basin's impact on groundwater quality was done, and additional study of the migration of metals and organic constituents of coal is planned by the University of Georgia's Savannah River Ecology Laboratory (SREL). The additional study is scheduled to begin in 1987 and is expected to quantify the contributions of contaminants from the coal pile, the basin, and the D-Area Ash Basin. The results of this study will be useful in identifying additional actions needed. The basin has not been closed. Additional monitoring wells will be installed to aid in the basin study.

16.02.18 D-Area Burning/Rubble Pits

The 1983 report lists groundwater monitoring as the planned action for the D-Area Burning Rubble Pits (Buildings 431-D and 431-1D). Four monitoring wells were installed in late 1983 and 1984 and are currently in use.

16.02.19 TNX Burying Ground

No planned action is listed for the TNX Burying Ground (Building 643-57) in the 1983 report. Current planned actions for this site are given in Table 16-1.

16.02.20 TNX Storage Area

The 1983 report lists no planned action for the TNX Storage Area. This area is currently closed.

16.02 21 D-Area Ash Basins

The 1983 report lists no planned action for the D-Area Ash Basins (Buildings 488-D, 488-1D, and 488-2D). Monitoring wells will be installed around the basins as necessary as part of the D-Area Coal Pile Runoff Containment Basin assessment program.

16.02.22 New TNX Seepage Basin

The 1983 report lists the following planned actions for the New TNX Seepage Basin (Building 904-102T): continuation of monitoring, wastewater treatment, and closure.

Groundwater monitoring has continued. Plans for a wastewater treatment facility have been developed. SCDHEC has issued a construction permit for the treatment facility, which is expected to begin operating in 1988. The basin will be taken out of service and closed after the treatment facility begins operating.

16.02.23 Old TNX Seepage Basin

The 1983 report identifies the following planned actions for the Old TNX Seepage Basin (Building 904-76T): continuation of monitoring and plume definition.

Monitoring has continued, and three additional wells were installed to help define the lateral concentration gradients of observed contaminants. In addition, sediment and soil cores from the bottom of the basin were analyzed to determine which constituents in the basin could be considered potential groundwater contaminants.

16.02.24 D-Area Asbestos Pit

The 1983 report lists erosion control as the planned action for the D-Area Asbestos Pit (Building 080-20G). The site is inspected periodically for erosion or maintenance needed to prevent erosion, and corrective action is taken as needed.

16.02.25 F-Area Acid/Caustic Basin

The 1983 report lists groundwater monitoring as the only planned action for the F-Area Acid/Caustic Basin (Building 904-74G). Four monitoring wells were installed in 1983 and 1984 and are currently active.

16.02.26 F-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the F-Area Coal Pile Runoff Containment Basin (Building 289-F): continuation of monitoring, runoff treatment, and closure.

Groundwater monitoring has continued. The coal pile in F Area has been removed, and the area where coal had been stored was limed and seeded. Runoff in this area shows no influence from the coal pile. An assessment of this basin is in process and shows that the basin is not a major source of groundwater contamination. After the assessment is completed, a closure plan will be developed.

16.02.27 F-Area Ash Basins

No planned action is given in the 1983 report for the F-Area Ash Basins (Buildings 288-F and 288-1F).

16.02.28 F-Area Burning/Rubble Pits

The 1983 report lists groundwater monitoring as the planned action for the F-Area Burning/Rubble Pits (Buildings 231-F and 231-1F). Seven monitoring wells were installed around the pits; four wells are currently in use.

16.02.29 F-Area Scrap Lumber Pile

The 1983 report lists groundwater monitoring as the planned action for the F-Area Scrap Lumber Pile (Building 231-3F). Groundwater monitoring wells have not been installed at this site, but they have been installed at the nearby F-Area Burning/Rubble Pits.

16.02.30 F-Area Retention Basins

The F-Area Retention Basins (Buildings 281-3F and 281-8F) are not listed in the planned actions section of the 1983 report.

16.02.31 F-Area Tank Farm

The F-Area Tank Farm (Building 241-F) is not covered in the 1983 report because it is outside the scope of the agreement between SRS and the South Carolina Department of Health and Environmental Control (SCDHEC).

16.02.32 F-Area Seepage Basins

The 1983 report lists the following planned actions for the F-Area Seepage Basins (Buildings 904-41G, 904-42G, 904-43G): continuation of monitoring, plume definition, and closure.

Groundwater monitoring has continued, and additional wells have been installed around the F-Area Seepage Basins. More wells have been proposed for installation near the basins. Sampling methods have been refined, and certain metal sampling devices that could have affected groundwater sampling results have been eliminated. Plume definition has begun and will be completed when the currently proposed wells have generated analyses that show the lateral variability of the plumes. Closure of these basins has not yet begun. Closure plans have been developed and submitted to SCDHEC as part of SRS's Part B permit application. Plans have been developed for construction of a wastewater treatment facility that will allow these basins to be taken out of service and to be closed. Closure is expected to begin late in 1988.

16.02.33 Old F-Area Seepage Basin

The 1983 report lists installation of monitoring wells as the only planned action for the Old F-Area Seepage Basin (Building 904-49G). Four wells were installed in late 1983 and 1984 and are being monitored currently.

16.02.34 H-Area Retention Basins

The H-Area Retention Basins (Buildings 231-3H and 231-8H) are not covered in the 1983 report because they are outside the scope of the agreement between SRS and SCDHEC.

16.02.35 H-Area Acid/Caustic Basin

The 1983 report lists groundwater monitoring as the only planned action for the H-Area Acid/Caustic Basin (Building 904-75G). Because the H-Area Acid/Caustic Basin is in an area underlain by much underground piping, well installation has been delayed until all interferences can be mapped and avoided. Present plans call for these wells to be installed late in 1988.

16.02.36 H-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the H-Area Coal Pile Runoff Containment Basin (Building 289-H): continuation of monitoring, runoff treatment, and closure.

Monitoring has continued. Treatment has been planned for the coal pile runoff, but was not pursued because an assessment of the coal pile basins suggested that they were not a major source of groundwater contamination. The basin has not been closed.

16.02.37 H-Area Ash Basin

The 1983 report calls for no action at the H-Area Ash Basin (Building 288-H). The basin is currently active.

16.02.38 H-Area Tank Farm

The H-Area Tank Farm (Building 241-H) is not covered in the 1983 report because it is outside the scope of the agreement between SRS and SCDHEC.

16.02.39 H-Area Seepage Basins

The 1983 report lists the following planned actions for the H-Area Seepage Basins (Buildings 904-44G, 904-45G, 904-46G, 904-56G): continuation of monitoring, plume definition, and closure.

Groundwater monitoring has continued, and additional wells have been installed around the H-Area Seepage Basins. More wells have been proposed for installation near the basins. Sampling methods have been refined, and certain metal sampling devices that could have affected groundwater sampling results have been eliminated. Plume definition has begun and will be completed when the currently proposed wells have generated analyses that show the lateral variability of the plumes. Closure of these basins has not yet begun. Closure plans have been developed and submitted to SCDHEC as part of SRS's Part B permit application. Plans have been developed for construction of a wastewater treatment facility that will allow these basins to be taken out of service and to be closed. Closure is expected to begin late in 1988.

16.02.40 K-Area Reactor Seepage Basin

Stone and Christensen, in Volume II of the 1983 report, do not list any planned action for the K-Area Reactor Seepage Basin (Building 904-65G). Five monitoring wells were installed around the basin in 1984; four wells at the site are currently active.

16.02.41 K-Area Retention Basin

No planned action was listed for the K-Area Retention Basin (Building 904-88G) in Volume II of the 1983 report. Five monitoring wells are active at the site.

16.02.42 K-Area Acid/Caustic Basin

The 1983 report lists groundwater monitoring as the only planned action for the K-Area Acid/Caustic Basin (Building 904-80G). Monitoring wells were installed at the site in late 1983 and 1984.

16.02.43 K-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the K-Area Coal Pile Runoff Containment Basin (Building 189-K): continuation of monitoring, runoff treatment, and closure.

Groundwater monitoring has continued. Treatment for the runoff was proposed at one time, but was not pursued because an assessment of the coal pile runoff containment basins suggested that they are not a major source of groundwater contamination. The basin is still in service.

16.02.44 K-Area Ash Basin

The 1983 report lists groundwater monitoring as the only planned action for the K-Area Ash Basin (Building 188-K). Four monitoring wells were installed in late 1983 at this site and are currently in use.

16.02.45 K-Area Burning/Rubble Pit

Groundwater monitoring is the planned action given for the K-Area Burning/Rubble Pit (Building 131-K) in the 1983 report. Four monitoring wells were installed in late 1983 and 1984; all four wells are currently active.

16.02.46 K-Area Bingham Pump Outage Pit

No planned action was given for the K-Area Bingham Pump Outage Pit (Building 643-1G) in the 1983 report. The site has been inactive since 1958.

16.02.47 L-Area Reactor Seepage Basin

Volume II of the 1983 report lists no planned action for the L-Area Reactor Seepage Basin (Building 904-64G). Four wells currently monitor the site.

16.02.48 L-Area Acid/Caustic Basin

The 1983 report lists groundwater monitoring as the only planned action for the L-Area Acid/Caustic Basin (Building 904-79G). Four monitoring wells were installed at the site in late 1983 and 1984. All four wells are currently active.

16.02.48 L-Area Ash Basin

The 1983 report lists no planned action for the L-Area Ash Basin (Building 188-L). The site has been inactive since 1968.

16.02.49 L-Area Burning/Rubble Pit

Groundwater monitoring is the planned action given for the L-Area Burning/Rubble Pit (Building 131-L) in the 1983 report. Four monitoring wells were installed at the site in late 1983 and 1984 and are currently active.

16.02.50 L-Area Oil and Chemical Basin

The 1983 report lists the following planned actions for the L-Area Oil and Chemical Basin (Building 904-83G): continuation of monitoring, plume definition, and closure.

Groundwater monitoring has continued. Plume definition is underway. Assessment work that must precede closure, such as sediment and soil sampling, has been done. An assessment report for this basin is being prepared. Closure options for the basin are described in the EIS.

16.02.51 L-Area Bingham Pump Outage Pits

The 1983 report lists no planned action for the L-Area Bingham Pump Outage Pits (Buildings 643-2G and 643-3G). These sites have been inactive since 1957 and 1958, respectively.

16.02.52 P-Area Reactor Seepage Basins

Stone and Christensen, in Volume II of the 1983 report, call for no planned action for the P-Area Reactor Seepage Basin (Buildings 904-61G, 904-62G, and 904-63G). Seven new monitoring wells were installed in 1984 and are currently active.

16.02.53 P-Area Acid/Caustic Basin

The 1983 report lists groundwater monitoring as the only planned action for the P-Area Acid/Caustic Basin (Building 904-78G). Four groundwater monitoring wells were installed at this site in late 1983 and 1984 and are currently active.

16.02.54 P-Area Coal Pile Runoff Containment Basin

The 1983 report lists the following planned actions for the P-Area Coal Pile Runoff Containment Basins (Building 189-P): continuation of monitoring, runoff treatment, and closure.

Groundwater monitoring has continued. Treatment for the runoff was proposed at one time, but was not pursued because an assessment of the coal pile runoff containment basins suggested that they are not a major source of groundwater contamination. The basin is still in service.

16.02.55 P-Area Ash Basin (188-P)

The 1983 report lists no action for the P-Area Ash Basin (Building 188-P). The basin is currently active.

16.02.56 P-Area Bingham Pump Outage Pit

No planned action is listed for the P-Area Bingham Pump Outage Pit (Building 643-4G) in the 1983 report. This site has been inactive since 1958.

16.02.57 P-Area Burning/Rubble Pit

Groundwater monitoring is the planned action listed for the P-Area Burning/Rubble Pit (Building 131-P) in the 1983 report. Four groundwater monitoring wells, installed in 1983 and 1984, currently monitor the site.

16.02.58 R-Area Acid/Caustic Basin

The 1983 report lists groundwater monitoring as the only planned action for the R-Area Acid/Caustic Basin (Building 904-77G). Four wells were installed in late 1983 and 1984 and are currently monitoring groundwater at the site.

16.02.59 R-Area Ash Basin

No planned action is listed for the R-Area Ash Basin (Building 188-R) in the 1983 report. This site has been inactive since 1964.

16.02.60 R-Area Burning/Rubble Pits

The 1983 report lists groundwater monitoring as the planned action for the R-Area Burning/Rubble Pits (Buildings 131-R and 131-1R). Four monitoring wells were installed at the site in late 1983 and 1984 and are still active.

16.02.61 R-Area Asbestos Pit

The 1983 report lists erosion control as the planned action for the R-Area Asbestos Pit (Building 080-1R). The site is inspected periodically for erosion or maintenance needed to prevent erosion, and corrective action is taken as needed. The site was covered in 1981.

16.02.62 R-Area Bingham Pump Outage Pits

No planned action is listed for the R-Area Bingham Pump Outage Pits (Buildings 643-8G, 643-9G, and 643-10G) in the 1983 report. These sites have been inactive since 1958.

16.02.63 R-Area Reactor Seepage Basins

In Volume II of the 1983 report, Stone and Christensen call for continued maintenance of the R-Area Reactor Seepage Basins. The asphalt cover is maintained, and a groundwater monitoring network is in place at the basins.

16.02.64 Hydrofluoric Acid Spill Area

The 1983 report lists groundwater monitoring as the planned action for the Hydrofluoric Acid Spill Area (Building 631-4G). Four monitoring wells were installed at the site in 1984 and are still active.

16.02.65 Ford Building Seepage Basin

The 1983 report lists waste investigation and groundwater monitoring as the planned actions for the Ford Building Seepage Basin (Building 904-91G). A waste characterization study was performed as described in the EIS. Three wells were installed at the site in 1983 and 1984 and are currently monitoring the groundwater at the basin.

16.02.66 Fire Department Training Facility

The 1983 report lists the following planned actions for the Fire Department Training Facility (Building 904-113G): waste investigation, groundwater monitoring, and closure.

Waste investigation was undertaken through documentation that shows how the site was used and through soil samples taken in 1986. Two monitoring wells were installed in 1983 and 1984 and are currently active. The site has been backfilled but has not been closed.

16.02.67 Hazardous Waste Storage Facility

The 1983 report lists no planned actions for the Hazardous Waste Storage Facility (Buildings 709-G and 709-4G). After the 1983 report was issued, a Part B permit application for SRS's hazardous waste management facilities, including these two buildings, was submitted to SCDHEC.

16.02.68 CS-Area Burning/Rubble Pits

The 1983 report lists groundwater monitoring as the planned action for the Central Shops Area Burning/Rubble Pits (Buildings 631-1G, 631-5G, and 631-6G). Four wells were installed around pits 631-1G and 631-5G. Monitoring wells have not been installed around pit 631-6G.

16.02.69 Savannah River Laboratory (SRL) Oil Test Site

The 1983 report lists waste reduction verification as the planned action for the Savannah River Laboratory (SRL) Oil Test Site (Building 080-16G). Soil samples taken from the oil test site verify a reduction in oil content at the site.

16.02.70 Ford Building Waste Site

No planned action is listed for the Ford Building Waste Site (Building 643-11G). The site is inactive.

16.02.71 Sanitary Sewage Sludge Lagoon

The 1983 report lists no planned action for the Sanitary Sewage Sludge Lagoon (Building 080-24G). The site is currently active, although closure is planned for the near future.

16.02.72 CS-Area Scrap Lumber Pile

Groundwater monitoring is the planned action listed in the 1983 report for the CS-Area Scrap Lumber Pile. Monitoring wells were installed at the adjacent burning/rubble pits, but wells have not be installed at this site.

16.02.73 Road A (Baxley Road) Chemical Basin

The 1983 report lists groundwater monitoring as the planned action for the Road A (Baxley Road) Chemical Basin (Building 904-111G). Four wells were installed in 1983 and 1984 and currently monitor the site.

16.02.74 40-Acre Hardwood Site

The 1983 report lists continued monitoring as the only planned action for the 40-Acre Hardwood Site (Building 761-G). With agreement from SCDHEC, quarterly monitoring has been discontinued, and monitoring is now performed annually.

16.02.75 K-Area Borrow Pit

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-4G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.76 Sandy (Lucy) Site

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-3G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.77 Orangeburg (Sandy Clay) Site

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-2G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.78 Kato Road Site

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-6G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.79 Lower Kato Road Site

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-1G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.80 Par Pond Borrow Pit

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-5G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.81 Road F Site

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-7G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.82 Second Par Pond Borrow Pit

The 1983 report lists continued monitoring as the only planned action for the K-Area Borrow Pit (Building 761-8G). With agreement from SCDHEC, SRS has discontinued quarterly monitoring, and monitoring is now performed annually.

16.02.83 D-Area Waste Oil Facility

The 1983 report lists no planned action for the D-Area Waste Oil Facility (Building 489-D). The site is currently active.

16.02.84 Gas Cylinder Disposal Facility

No planned action is listed for the Gas Cylinder Disposal Facility (Building 131-2L) in the 1983 report. The site has been inactive since 1982.

16.02.85 Rubble Pits

The 1983 report lists groundwater monitoring as the planned action for F-Area Rubble Pit 231-2F, Central Shops Rubble Pit 631-3G, A-Area Rubble Pit 731-2A, and L-Area Rubble Pit 131-1L. These rubble pits are adjacent to burning/rubble pits, around which wells have been installed.

The 1983 report lists no action for the remaining rubble pits: Central Shops Rubble Pit 631-7G, D-Area Rubble Pit 431-2D, F-Area Rubble Pit 231-4F, Forestry Rubble Pit 761-9G, L-Area Rubble Pits 131-4L and 131-3L, and R-Area Rubble Pit 131-2R. All of the rubble pits are backfilled and inactive.

16.02.86 Rubble Piles

The 1983 report lists no planned action for the following SRS rubble piles: A-Area Rubble Pile (Building 731-6A), Forestry Rubble Pile (Building 631-9G), Gunsite 51 Rubble Pile (Building 080-29G), Gunsite 72 Rubble Pile (Building 080-31G), and Gunsite 102 Rubble Pile (Building 080-30G).

The following SRS rubble piles are not listed in Christensen and Gordon (1983) because they were not recognized as SRS waste sites until after the publication of that report: Miscellaneous (Central Shops) Rubble Pile, Cemetery Road Rubble Pile (Building 631-11G), Brag Bray Road Rubble Pile (Building 631-14G), Rubble Pile at Road 781.1 (Building 631-13G), Rubble Pile between Cemetery and Brag Bray roads

(Building 631-12G), L-Area Rubble Pile, R-Area Rubble Pile, and Gunsite 113 Rubble Pile (Building 631-15G). As listed in Table 16-1, all SRS rubble piles are either closed or inactive and scheduled for closure.

16.02.87 Gunsite 720 Rubble Pit

The Gunsite 720 Rubble Pit (Building 631-16G) was added to the list of SRS waste sites after Christensen and Gordon's 1983 report was published. The site is inactive and is scheduled for a site assessment (Table 16-1).

16.02.88 Erosion Control Sites

The 1983 report lists no action for the following erosion control sites: C-Area Erosion Control Site (Building 131-1C), F-Area Erosion Control Site (Building 080-28G), H-Area Erosion Control Site (Building 080-25G), L-Area Erosion Control Site (Building 080-26G), P-Area Erosion Control Site (Building 131-1P), 3G Pumphouse Erosion Control Site (Building 631-8G), and Substation 51 Erosion Control Site (Building 080-27G). The D-F Steamline Erosion Control Site was not on the list of SRS waste sites in 1983 because this site was permitted but never used. All of the erosion control sites except for the D-F Steamline Site are currently in use. The sites contain inert material only, and no further action is planned.

16.02.89 Central Shops Oil Storage Pad

The 1983 report lists no action for the CS Oil Storage Pad (Building 080-15G). The site is inactive.

16.02.90 Earthen Basins

Christensen and Gordon's 1983 report did not include the SRS earthen basins in the reactor areas: C, K, L, P, and R. The C, K, and L basins were never used and are inactive. The P-Area Earthen Basin is closed. The R-Area Earthen Basin is inactive but a site assessment is planned.

16.02.91 Risher Road Metal Pit

The Risher Road Metal Pit (Building 631-17G) was added to the list of SRS waste sites after the 1983 report was published. The site is inactive.

16.02.92 Scrap Metal Pile

The Scrap Metal Pile (Building 631-18G) was added to the list of SRS waste sites after the 1983 report was published. The site is inactive.

16.02.93 Sanitary Landfill

The 1983 report lists continued monitoring as the only planned action for the Sanitary Landfill (Building 740-G). Monitoring has continued and has been expanded as the landfill has expanded.

16.02.94 Chemicals, Metals, and Pesticides (CMP) Pits

The 1983 report lists the following as planned actions for the Chemicals, Metals, and Pesticides (CMP) Pits (Buildings 080-17G, 080-17.1G, 080-18G, 080-18.1G, 080-18.2G, 080-18.3G, 080-19G): continuation of monitoring, plume definition, waste and soil removal, and closure.

Monitoring is continuing. Additional wells were installed to allow for lateral and vertical definition of plume extent and concentration. The waste and contaminated soil were removed from the site under SCDHEC observation and approval, and a clay cap and membrane liner were installed at the excavated site. Monitoring results obtained after excavation have consistently shown low concentrations of contaminants. Additional closure action is not planned.

16.02.95 Radioactive Waste Burial Grounds

The 1983 report lists the expansion of groundwater monitoring for nonradioactive components as the only planned action for the Radioactive Waste Burial Grounds (Buildings 643-G, 643-7G, and 643-28G). Several studies of nonradioactive constituents have been conducted in the Burial Grounds, and a proposal has been submitted to and approved by SCDHEC to install a network of RCRA-type monitoring wells around the perimeter of Burial Grounds 643-7G and 643-28G in 1987. Assessment and closure information is provided in Table 16-1.

16.03 PLANNED ACTIONS FOR WASTE SITES

Planned actions for waste sites fall into several broad categories. The categories include several that are self-explanatory, such as "install monitoring wells." Other planned actions include waste-site characterization, which involves researching a site's history, identifying the site's location and the types and volumes of waste sent to the site, and estimating the site's inventory. Site assessment includes a review of information generated during characterization, review of groundwater monitoring data, soil or sediment cores data, or other data to assess the site's environmental risks and to guide the development of a closure plan.

Most waste sites are subject to the National Environmental Policy Act (NEPA), which requires certain documentation and public notice before actions are taken that may cause irreversible environmental effects. Most waste sites' pre-closure NEPA requirements will be fulfilled by an Environmental Impact Statement (EIS) currently available for public review and comment. The EIS defines several closure options, assesses the environmental and health risks for each option, and estimates the costs of implementing each option. After the public comment period ends, the Department of Energy will issue a Record of Decision (ROD) that will define which option or combination of options has been selected for closing waste sites at SRS.

SRS's general plan is to begin characterization and assessment of waste sites that have not yet been assessed by the end of 1988. Closure plans are to be developed from assessment data. Closure of some waste sites is complete, and closure of all presently inactive sites is planned to be complete by 1998, assuming adequate funding.

For sites that have monitoring wells, monitoring will continue unless specified otherwise. An additional planned action for all sites that have monitoring wells is a review of the wells' locations, depths, and construction. This review is scheduled to begin in the summer of 1987 and will result in identification of needed changes.

At the end of 1986, no sites were identified as needing groundwater remediation except for the A/M-Area cleanup program already underway. Many waste sites' impacts on groundwater are under study, and closure plans for some of these sites may eventually include remedial actions.

TABLE 16-1

Planned Actions for Savannah River Site Waste Sites as of December 1986

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
A/M Area					
Savannah River Laboratory (SRL) Seepage Basins	904-53G1 904-53G2 904-54G 904-55G	ASB	Inactive	Complete	Closure plan, closure
A-Area Motor Shop Oil Basin	904-101G	AOB	Inactive	Planned	Closure plan, closure
A-Area Metals Burning Pit	731-4A	ABP	Inactive	Ongoing	Complete assessment, closure plan, closure
Miscellaneous Chemical Basin	731-5A	None	Inactive	Planned	Install monitoring, wells, closure plan, closure
A-Area Coal Pile Runoff Containment Basin	788-3A	ACB	Active	Ongoing	Complete assessment, continued use
A-Area Burning/Rubble Pits	731-A 731-1A	ARP	Inactive	Ongoing	Complete assessment, closure plan, closure
A-Area Ash Piles	788-A 788-2A	None ARP	Inactive Active	None None	None Continued use
Metallurgical Laboratory Seepage Basin	904-110G	AMB	Inactive	Ongoing	Complete assessment, closure plan, closure
M-Area Settling Basin and Vicinity	904-51G 904-112G	MSB	Inactive	Complete	Closure, continue remedial action
Silverton Road Waste Site	731-3A	SRW	Inactive	Planned	Closure plan, closure
C Area					
C-Area Reactor Seepage Basins	904-66G 904-67G 904-68G	CSB	Active	None	Continued use
C-Area Coal Pile Runoff Containment Basin	189-C	CCB	Inactive	Complete	Closure plan, closure
C-Area Ash Piles	188-C 188-1C 188-2C	None	Inactive	Planned	None at this time
C-Area Burning/Rubble Pit	131-C	CRP	Inactive	Planned	Closure plan, closure
C-Area Asbestos Pits	080-21G 080-22G	None	Inactive	Planned	None at this time

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
D Area and TNX					
D-Area Oil Disposal Basin	631-G	DOB	Inactive	Planned	Closure plan, closure
D-Area Coal Pile Runoff Containment Basin	489-D	DCB	Active	Ongoing	Continued use, complete assessment, additional monitoring wells
D-Area Burning/Rubble Pits	431-D 431-1D	DBP	Inactive	Ongoing	Complete assessment, closure plan, closure
TNX Burying Ground	643-5T	None	Inactive	Planned	Closure plan, closure
TNX Storage Area	None	None	Closed	None	None at this time
D-Area Ash Basins	488-D 488-1D 488-2D	None	Active	None	Continued use
New TNX Seepage Basin	904-102T	YSB	Active	Ongoing	Complete assessment, construct wastewater treatment facility, closure plan, closure
Old TNX Seepage Basin	904-76T	XSB	Inactive	Ongoing	Complete assessment, Closure plan, closure
D-Area Asbestos Pit	080-20G	None	Inactive	Planned	Closure plan, closure
F Area					
F-Area Acid/Caustic Basin	904-74G	FAC	Inactive	Complete	Closure plan, closure
F-Area Coal Pile Runoff Containment Basin	289-F	FCB	Inactive	Ongoing	Complete assessment, replace well FCB 1
F-Area Ash Basins	288-F 288-1F	None	Inactive	Planned	Closure plan, closure
F-Area Burning/Rubble Pits	231-F 231-1F	FBP	Inactive	Planned	Closure plan, closure
F-Area Scrap Lumber Pile	231-3F	None	Active	None	Continued use
F-Area Retention Basins	281-3F 281-8F	None None	Inactive Active	Planned None	None at this time Continued use
F-Area Tank Farm	241-F	FTF	Active	None	Continued use
F-Area Seepage Basins	904-41G 904-42G 904-43G	F, FSB	Active	Complete	Add point-of-compliance wells, construct wastewater treatment facility, closure plan, closure

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
F Area (cont.)					
Old F-Area Seepage Basin	904-49G	FNB	Inactive	Ongoing	Complete assessment, closure plan, closure
H-Area					
H-Area Retention Basins	231-3H	HR3	Inactive	Planned	Closure plan, closure
	231-8H	HR8	Active	None	None at this time
H-Area Acid/Caustic Basin	904-75G	None	Inactive	Complete	Install monitoring wells, closure plan, closure
H-Area Coal Pile Runoff Containment Basin	289-H	HCB	Active	Ongoing	Complete assessment
H-Area Ash Basin	288-H	None	Active	None	Continued use
H-Area Tank Farm	241-H	HPM, HTF, 241-H	Active	None	Continued use
H-Area Seepage Basins	904-44G 904-45G 904-46G 904-56G	H, HSB	Active	Complete	Add point-of-compliance wells, construct waste-water treatment facility, closure plan, closure
K Area					
K-Area Reactor Seepage Basin	904-65G	KSB	Inactive	Planned	None at this time
K-Area Retention Basin	904-88G	KRB	Active	None	Continued use
K-Area Acid/Caustic Basin	904-80G	KAC	Inactive	Complete	Closure plan, closure
K-Area Coal Pile Runoff Containment Basin	189-K	KCB	Active	Planned	Continued use
K-Area Ash Basin	188-K	KAB	Active	None	Continued use
K-Area Burning/Rubble Pit	131-K	KRP	Inactive	Planned	Closure plan, closure
K-Area Bingham Pump Outage Pit	643-1G	None	Inactive	Planned	Closure plan, closure
L Area					
L-Area Reactor Seepage Basin	904-64G	LSB	Active	None	Continued use
L-Area Acid/Caustic Basin	904-79G	LAC	Inactive	Complete	Closure plan, closure

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
L Area (cont.)					
L-Area Ash Basin	188-L	None	Inactive	Planned	Closure plan, closure
L-Area Burning/Rubble Pit	131-L	LRP	Inactive	Planned	Closure plan, closure
L-Area Oil and Chemical Basin	904-83G	LCO	Inactive	Planned	Closure plan, closure
L-Area Bingham Pump Outage Pits	643-2G 643-3G	None	Inactive	Planned	Closure plan, closure
P Area					
P-Area Reactor Seepage Basins	904-61G 904-62G 904-63G	PSB	Active	None	Continued use
P-Area Acid/Caustic Basin	904-78G	PAC	Inactive	Complete	Closure plan, closure
P-Area Coal Pile Runoff Containment Basin	189-P	PCB	Active	Planned	Continued use
P-Area Ash Basin	188-P	None	Active	None	Continued use
P-Area Bingham Pump Outage Pit	643-4G	None	Inactive	Planned	Closure plan, closure
P-Area Burning/Rubble Pit	131-P	PRP	Inactive	Planned	Closure plan, closure
R Area					
R-Area Acid/Caustic Basin	904-77G	RAC	Inactive	Complete	Closure plan, closure
R-Area Ash Basin	188-R	None	Inactive	Planned	Closure plan, closure
R-Area Burning/Rubble Pits	131-R 131-1R	RRP	Inactive	Planned	Closure plan, closure
R-Area Asbestos Pit	080-1R	None	Inactive	Planned	Closure plan, closure
R-Area Bingham Pump Outage Pits	643-8G 643-9G 643-10G	None	Inactive	Planned	Closure plan, closure
R-Area Reactor Seepage Basins	904-57G 904-58G 904-59G 904-60G 904-103G 904-104G	RSA, RSB, RSC, RSD, RSE	Inactive	Planned	Additional monitoring wells, closure plan, closure

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
Central Shops (CS) Area					
Hydrofluoric Acid Spill Area	631-4G	CSA	Inactive	Planned	Closure plan, closure
Ford Building Seepage Basin	904-91G	HXB	Inactive	Planned	Closure plan, closure
Fire Department Training Facility	904-113G	CSC	Inactive	Planned	Closure plan, closure
Hazardous Waste Storage Facility	709-G 709-4G	HWS	Active	None	Continued use
CS-Area Burning/Rubble Pits	631-1G 631-5G 631-6G	CSR None	Inactive	Planned	Closure plan, closure
Savannah River Laboratory (SRL) Oil Test Site	080-16G	None	Inactive	Planned	Closure plan, closure
Ford Building Waste Site	643-11G	None	Inactive	Planned	Closure plan, closure
Sanitary Sewage Sludge Lagoon	080-24G	None	Active	Ongoing	Closure plan, closure
CS-Area Scrap Lumber Pile	631-2G	None	Active	None	Continued use
Miscellaneous Waste Sites					
Road A (Baxley Road) Chemical Basin	904-111G	BRD	Inactive	Planned	Closure plan, closure
Sewage Sludge Sites:					
40-Acre Hardwood Site	761-G	SSS	Inactive	Ongoing	Complete assessment, closure plan, closure
K-Area Borrow Pit	761-4G	SSS	Inactive	Ongoing	Re-open site, install new monitoring wells
Sandy (Lucy) Site	761-3G	SSS	Closed	Complete	None at this time
Orangeburg (Sandy Clay) Site	761-2G	SSS	Closed	Complete	None at this time
Kato Road Site	761-6G	SSS	Closed	Complete	None at this time
Lower Kato Road Site	761-1G	SSS	Closed	Complete	None at this time
Par Pond Borrow Pit	761-5G	SSS	Inactive	Ongoing	Re-open site, install new monitoring wells
Road F Site	761-7G	SSS	Closed	Ongoing	Complete assessment

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
Miscellaneous Waste Sites (cont.)					
Second Par Pond Borrow Pit	761-8G	SSS	Inactive	Ongoing	Replace well SSS 27
D-Area Waste Oil Facility	484-D	None	Active	None	Continued use
Gas Cylinder Disposal Facility	131-2L	None	Inactive	Planned	Closure plan, closure
A-Area Rubble Pit	731-2A	None	Inactive	Planned	Closure plan, closure
Central Shops Rubble Pits	631-3G 731-7G	None	Inactive	Planned	Closure plan, closure
D-Area Rubble Pit	431-2D	None	Inactive	Planned	Closure plan, closure
F-Area Rubble Pits	231-2F 231-4F	None	Inactive	Planned	Closure plan, closure
Forestry Rubble Pit	761-9G	None	Inactive	Planned	Closure plan, closure
L-Area Rubble Pits	131-1L 131-3L 131-4L	None	Inactive	Planned	Closure plan, closure
R-Area Rubble Pit	131-2R	None	Inactive	Planned	Closure plan, closure
A-Area Rubble Pile	731-6A	None	Inactive	None	None at this time
Miscellaneous (Central Shops) Rubble Pile	None	None	Inactive	Planned	Closure plan, closure
Cemetery Road Rubble Pile	631-11G	None	Closed	Complete	None at this time
Brag Bray Road Rubble Pile	631-14G	None	Closed	Complete	None at this time
Rubble Pile at Road 781.1	631-13G	None	Closed	Complete	None at this time
Rubble Pile between Cemetery and Brag Bray Roads	631-12G	None	Closed	Complete	None at this time
SREL Rubble Pile	631-10G	None	Closed	Complete	None at this time
Forestry Rubble Pile	631-9G	None	Closed	Complete	None at this time
L-Area Rubble Pile	None	None	Inactive	Planned	Closure plan, closure
R-Area Rubble Pile	None	None	Inactive	Planned	Closure plan, closure
Gunsite 51 Rubble Pile	080-29G	None	Closed	Complete	None at this time

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
Miscellaneous Waste Sites (cont.)					
Gunsite 72 Rubble Pile	080-31G	None	Closed	Complete	None at this time
Gunsite 102 Rubble Pile	080-30G	None	Inactive	Complete	Closure plan, closure
Gunsite 113 Rubble Pile	631-15G	None	Inactive	Ongoing	Closure plan, closure
Gunsite 720 Rubble Pit	631-16G	None	Inactive	Planned	Closure plan, closure
C-Area Erosion Control Site	131-1C	None	Active	None	Continued use
P-Area Erosion Control Site	131-1P	None	Active	None	Continued use
Substation 51 Erosion Control Site	080-27G	None	Active	None	Continued use
F-Area Erosion Control Site	080-28G	None	Active	None	Continued use
H-Area Erosion Control Site	080-25G	None	Active	None	Continued use
L-Area Erosion Control Site	080-26G	None	Active	None	Continued use
3G-Pumphouse Erosion Control Site	631-8G	None	Active	None	Continued use
D-F Steamline Erosion Control Site	None	None	Never used	None	None at this time
Central Shops Oil Storage Pad	080-15G	None	Inactive	None	None at this time
C-Area Earthen Basin	None	None	Never used	None	None at this time
K-Area Earthen Basin	None	None	Never used	None	None at this time
L-Area Earthen Basin	None	None	Never used	None	None at this time
P-Area Earthen Basin	None	None	Closed	Complete	None at this time
R-Area Earthen Basin	None	None	Inactive	Planned	Closure plan, closure
Risher Road Metal Pit	631-17G	None	Inactive	Planned	Closure plan, closure
Scrap Metal Pile	631-18G	None	Inactive	Planned	Closure plan, closure
Sanitary Landfill	740-G	LFW	Active	None	Continued use

TABLE 16-1 (cont.)

Waste Site	Bldg. No.	Well Series	Status	Assessment	Planned Action
Miscellaneous Waste Sites (cont.)					
CMP Pits	080-17G 080-17.1G 080-18G 080-18.1G 080-18.2G 080-18.3G 080-19G	CMP	Closed	Complete	None at this time
Radioactive Waste Burial Grounds	643-G	BG, MG grid wells	Inactive	Ongoing	Closure plan, closure
	643-7G	BG	Active	Planned	Continued use, installation of point-of-compliance monitoring wells
	643-28G	BG	Inactive	Complete	Closure plan, closure

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OSR 14-357
(Rev 11-89)

WSRC
SAVANNAH RIVER SITE
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Document Number DPSP-88-1002
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Volume I

TITLE Technical Summary of Groundwater Quality Protection Program at the SRS (1952-1986) (u)

AUTHOR(S) James D. Heffner BUILDING NO. 735-A PHONE NO. 5-1974

TYPE: ☐ INTERNAL DOCUMENT (Within SRS) ☑ EXTERNAL DOCUMENT (To OSTI)

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June 10, 1992

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Savannah River Operations Office
Building 719-5A
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Dear Mr. Dixon:

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Please review for patent considerations:

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5. Title "TECHNICAL SUMMARY OF GROUNDWATER QUALITY PROTECTION PROGRAM AT THE SAVANNAH RIVER SITE (1952-1986) (U)" J. D. Heffner

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Document Revision Number	Ø
Reference Document Number(s), if Appropriate	
Date (YY/MM/DD)	91/11/01
Circle One: Lifetime / Nonpermanent	Lifetime
Retention Period *(If Nonpermanent)*	
Classification *(If Unclassified, so state. Also include UCNI.)*	Unclassified
Authors	J. D. Heffner
Originating Department or Corporate Author	EPD/EMS
Title	TECHNICAL SUMMARY OF GROUNDWATER QUALITY PROTECTION PROGRAM AT THE SRS (1952-1986) (U) Vol. I & II
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