HYDROLOGIC MONITORING FOR SHIRLEY BASIN'S TAILINGS
SEEPAGE CONTROL PLAN

HYDROLOGIC MONITORING
FOR SHIRLEY BASIN'S TAILINGS
SEEPAGE CONTROL PLAN

PREPARED FOR:

PATHFINDER MINES CORPORATION

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1.0 SUMMARY AND INTRODUCTION

1.1 SUMMARY

1. The recharge lines and fresh water injection wells have created hydrologic mounds in the Surficial aquifer that have caused seepage gradient reversal toward the collection wells, as originally intended. The gradient reversals can be measured along the northeastern and southeastern length of the Surficial aquifer where tailings seepage is primarily occurring. Reversal in this area has been enhanced by the use of water from wells WW20 and WW23 (see Section 3). Gradient reversal was restored in late 1997 and was maintained through 2000.

2. Concentrations of seepage constituents in the Surficial aquifer in the Mine Creek area have improved upgradient of the recharge lines north and south of Mine Creek. Gradient reversal was maintained for the immediate Mine Creek area and north of Mine Creek during 2000. There was no substantial change in restoration for these areas during 2000. The seepage front has been pulled back to close proximity to the collection wells and the collection/recharge system is functioning as a seepage containment system.

3. Surface water monitoring in Spring Creek does not indicate measurable environmental impact from tailings seepage in 2000 because of improvement of water quality in the Surficial aquifer. Comparative data are included in Section 5.0.

4. White River aquifer monitoring continues to indicate no impacts that can be attributable to tailings seepage (see Section 6.0). However, current and previous years' monitoring data from well WH-9 has shown elevated TDS, Cl and SO_4 concentrations. This is thought to be a localized phenomenon.

5. The 2000 enhanced evaporation system consisted of about 812 evaporative heads and 30 to 47 acres of solution ponds, resulting in a net loss of about 35 million gallons of ponded solution and moderate progress in tailings dewatering (see Section 8). Two new clay-lined evaporation ponds were constructed in the northwestern part of Tailings Pond No. 5.

6. Additional tailings dewatering wells were installed in the spring of 1997 and during the winter 1998/1999. The dewatering of tailings is proceeding and will facilitate consolidation and reduce seepage. Tailings Pond No. 4 and Pond No. 5 are showing appreciable reductions in water levels due to dewatering.

7. Surficial collection wells near the center of the tailings impoundment are being pumped. Extraction of the seepage-impacted water beneath the tailings reduces the migration of contaminants beyond the tailings area.

8. A significant portion of the Surficial collection water has been separated and discharged to the Area 2/8 reservoir. This has been done with rigorous monitoring of the water quality of the discharge.

1.2 INTRODUCTION

Figure 1.2-1 presents the major tailings area features. These include the Mine Creek area, where the original recharge and collection systems were installed. The recharge system, installed during the summer of 1986, was constructed to supply water to insure continuous seepage gradient reversal in the Mine Creek area (see Figure 1.2-1). This has been accomplished and continues to contain tailings seepage close to the downgradient edge of the No. 5 tailings dam on the southeast end. Subsequent additions and modifications to the seepage containment and aquifer restoration system have continued restoration efforts in the Mine Creek area, and expanded the restoration effort to the entire tailings area. A number of reports have already been prepared and submitted to the NRC which document the purposes and development of the recharge and collection system. This is the latest in this series of reports, which is provided in accordance with SUA-442, Condition 47. The NRC site standards for thirteen constituents are presented in Table 1.2-1.

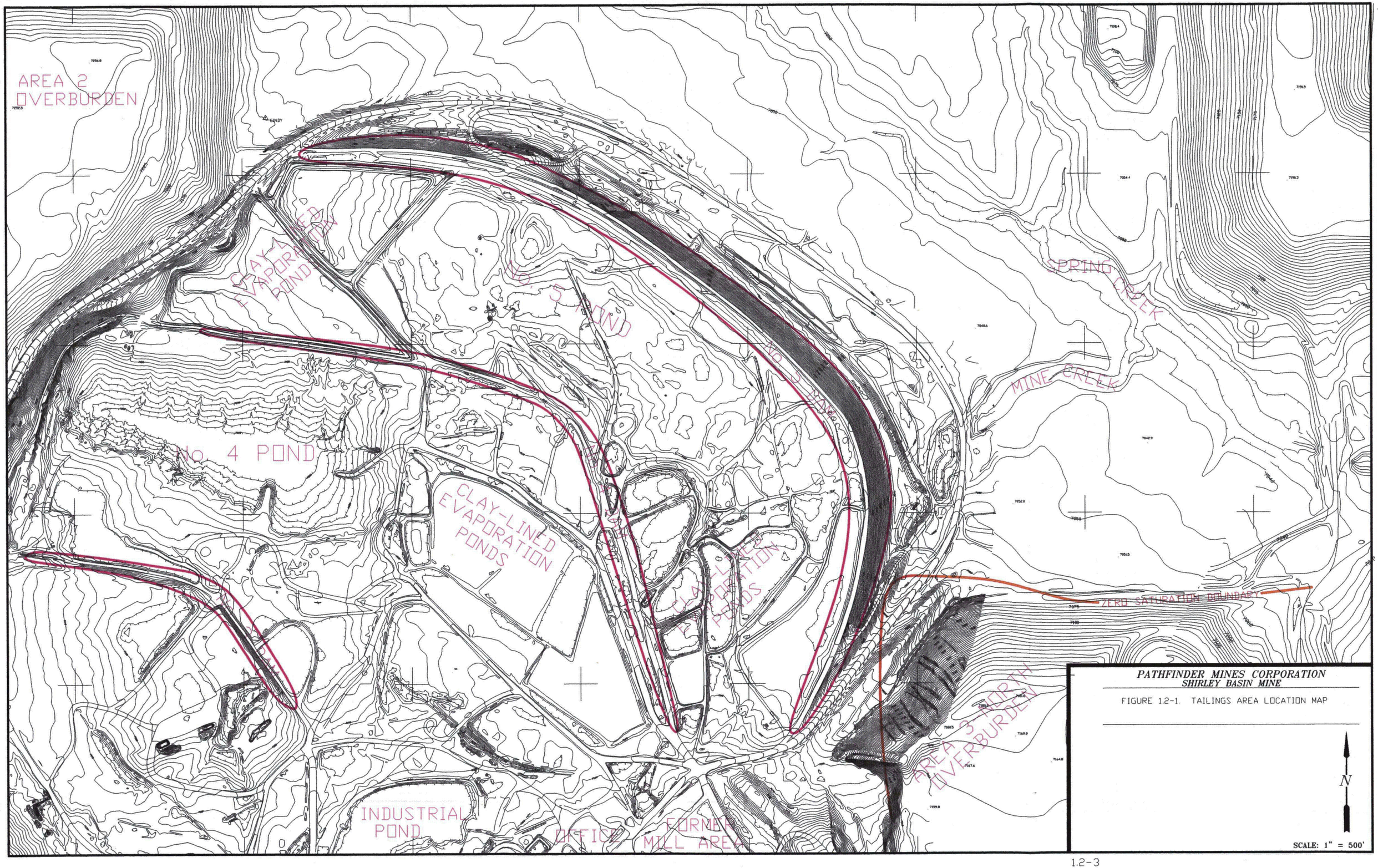
This report is divided into eight main sections. Section 2 discusses the Mine Creek area pumping operations. Sections 3, 4, 5, and 6 discuss various monitoring results. Section 7 addresses recent additions and modifications to the seepage containment and aquifer restoration system. Section 8 addresses tailings dewatering and evaporation of tailings solution. Section 9 addresses recommendations for continued aquifer restoration. Appendix A presents a tabulation of Surficial water quality data. Appendix B presents a tabulation of White River, Wind River, and Tailings water quality data. Appendix C presents a tabulation of Surface water quality data. Appendix D presents graphically the concentrations or activities for major ions and site standard constituents for selected Surficial aquifer wells.

Pathfinder will continue to monitor the efficiency of the recharge system and compile annual reports. These reports will document the previous years' results and describe any modifications to the system necessary to improve the system's performance.

TABLE 1.2-1. SHIRLEY BASIN NRC SITE STANDARDS.

CONSTITUENTS	NRC SITE STANDARD
ARSENIC	0.05
BARIUM	1.0
BERYLLIUM	0.02
CADMIUM	0.01
CHROMIUM	0.05
GROSS ALPHA	15
LEAD	0.05
MOLYBDENUM	0.1
NICKEL	0.05
RADIUM-226 + RADIUM-228	5.0
SELENIUM	0.01
THORIUM-230	0.3
URANIUM	0.07

NOTE: All concentrations are in mg/l except: Radium-226 + Radium-228, Gross Alpha and Thorium-230 are in pCi/l.



PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE

FIGURE 1.2-1. TAILINGS AREA LOCATION MAP

2.0 MINE CREEK AREA PUMPING OPERATIONS

2.1 COLLECTION WELL PUMPING

Nineteen pumpback (collection) wells, 5A-1, P1, P3, P4, P7, P6, P8A, P9, P10, P11, P12, P14, P15, P16, P17, P18, P19A, P20 and P21, were pumped during 2000. Table 2.1-1 shows the recommended water levels, locations of the pump intakes, and average discharge rates for each pumpback well. Figure 2.1-1 presents the locations of the wells and recharge lines.

TABLE 2.1-1. RECOMMENDED COLLECTION WELL PUMPING LEVELS AND OBSERVED RATES.

WELL NO.	RECOMMENDED PUMPING WATER LEVEL (FT-MP)	PUMP INTAKE LEVEL (FT-MP)	AVERAGE YEARLY DISCHARGE (GPM) 2000
5A-1	15.0	19.0	4.63
P1	30.0	36.7	1.42
P3	26.0	26.5	5.53
P4	--	--	2.40
P6	26.0	29.0	2.89
P7	15.5	27.0	2.27
P8A	25.0	28.7	7.42
P9	40.0	47.5	0.45
P10	36.5	37.1	0.67
P11	35.0	35.6	0.38
P12	32.0	--	0.67
P14	34.0	--	1.12
P15	38.0	--	0.27
P16	37.0	--	0.34
P17	33.0	--	0.55
P18	34.0	--	0.62
P19A	--	--	1.70
P20	32.0	--	1.62
P21	29.0	--	4.42
TOTAL GPM			39.2

Note: FT = feet
MP = measuring point
GPM = gallons per minute

The pumpback collection system has averaged about 39 gpm during the year. This is a slight decrease from the 1999 yield. Additional tailings area Surficial aquifer collection averaged approximately 10.8 gpm in 2000.

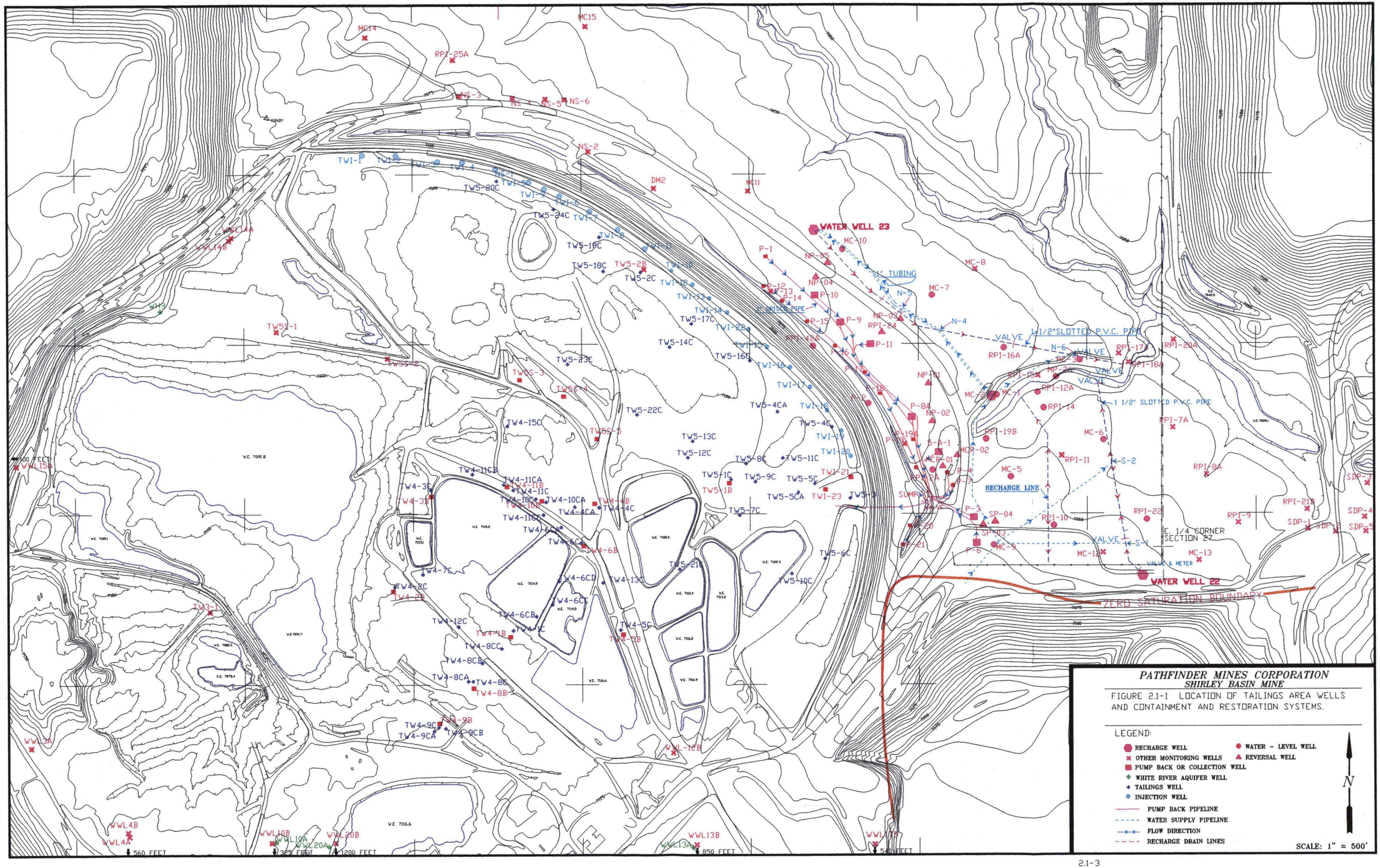


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FIGURE 2.1-1 LOCATION OF TAILINGS AREA WELLS AND CONTAINMENT AND RESTORATION SYSTEMS.

2.2 RECHARGE WELL PUMPING

Pathfinder Mines has injected White River water and Wind River water into the Surficial aquifer to aid the collection system and create a hydraulic barrier. White River wells WW23 and Wind River well WW20 are used to supply this injection water. Table 2.2-1 presents the recommended pumping levels for these recharge wells and some observed pumping rates to the recharge system for 2000. Pumping from recharge well WW22 was discontinued very early in 1999 because water was reaching the surface above the recharge lines.

TABLE 2.2-1. RECOMMENDED RECHARGE SUPPLY WELL PUMPING LEVELS AND OBSERVED RATES.

WELL NO.	RECOMMENDED MAX. WATER LEVEL (FT-MP)	PUMP INTAKE LEVEL (FT-MP)	OBSERVED DISCHARGE (GPM) JANUARY - DECEMBER 2000
WW22	PUMPING DISCONTINUED EARLY IN 1999		
WW23	183	185	16.1
WW20	150	158	101.0
TOTAL GPM			117.1

NOTE: FT = feet
MP = measuring point
GPM = gallons per minute

3.0 TAILINGS AREA AQUIFERS

Table 3.0-1 presents well data for Surficial aquifer wells, Table 3.0-2 presents well data for tailings wells and Table 3.0-3 presents well data for White River aquifer wells in the tailings area. Table 3.0-4 presents well data for Wind River aquifer well WW20.

TABLE 3.0-1. BASIC WELL DATA FOR THE SURFICIAL AQUIFER WELLS.

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
5A-1	108363	88117	21.7	5.0	2.1	7045.81	18-19	3-5
DM-2	109920	86340	46.0	2.0	3.1	7063.00	3-46	0-3
MC01	108702	88470	37.0	6.0	2.2	7043.80	0-37	0-11
MC03	108913	88962	41.5	6.0	3.5	7042.90	0-19	13-15
MC05	108216	88551	47.0	6.0	1.2	7053.10	37-48	25-26
MC06	108437	89107	44.0	6.0	1.7	7046.01	0-38	-
MC07	109296	88091	39.5	6.0	1.1	7049.61	0-40	-
MC08	109444	88336	28.7	6.0	1.1	7045.74	0-25	-
MC09	107818	88447	33.9	6.0	1.9	7056.81	10-37	0-4
MC10	109566	87557	35.5	6.0	1.5	7052.60	0-30	-
MC11	109895	87002	56.5	5.0	1.7	7056.51	0-48	-
MC12	107771	89094	38.0	5.0	1.8	7053.30	0-38	-
MC13	107728	89656	37.6	5.0	2.8	7047.40	0-37	-
MC14	110805	84735	60.1	5.0	2.5	7084.71	0-57	-
MC15	110868	86036	61.6	5.0	1.4	7060.51	0-68	-
MCR01	108275	88145	30.6	2.0	1.5	7042.55	26-29	23-24
MCR02	108349	88239	44.1	2.0	1.6	7046.16	39-42	37-38
MP-26	108783	89129	---	2.0	---	7033.59	-	-
NP01	108770	88056	26.9	2.0	2.1	7051.28	22-24	18-20
NP02	108540	88078	29.7	2.0	1.1	7052.88	21-27	22-23
NP03	109145	87894	23.0	2.0	1.0	7051.07	19-21	16-17
NP04	109392	87392	39.1	2.0	2.3	7055.87	24-27	19-21
NP05	109475	87460	28.9	2.0	2.4	7055.37	21-25	18-21
NS-1	110023	85504	98.1	5.0	1.7	7107.60	76-96	30-58
NS-2	110128	86051	48.8	5.0	1.4	7067.00	8-47	0-5
NS-3	110459	85290	81.0	4.0	1.7	7080.90	39-79	0-53
NS-4	110445	85606	41.9	2.0	1.7	7070.30	20-40	0-10
NS-5	110440	85801	52.5	4.0	1.4	7066.60	11-51	0-10
NS-6	110436	85912	41.9	2.0	2.0	7065.20	20-40	0-25
P-1	109319	87107	37.1	5.0	1.6	7058.12	25-27	21-22
P-2	108657	87704	40.9	5.0	1.3	7054.10	38-39	34-35
P-3	107975	88315	29.6	5.0	1.7	7056.30	25-27	14-15
P-4	108239	88172	---	---	---	---	-	-
P-6	107846	88346	29.9	5.0	1.8	7058.20	28-30	19-21
P-7	108169	88203	32.2	5.0	1.2	7047.10	28-30	24-26
P-8A	108571	87957	30.3	5.0	1.0	7051.40	27-29	22-24
P-9	109127	87537	48.7	5.0	0.9	7053.90	46-48	41-42

TABLE 3.0-1. BASIC WELL DATA FOR THE SURFICIAL AQUIFER WELLS. (cont'd.)

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
P-10	109289	87383	39.5	5.0	1.3	7055.30	36-37	28-29
P-11	108997	87715	38.5	5.0	0.8	7052.40	33-36	22-23
P-12	109340	87084	36.4	5.0	1.5	7060.69	16-36	0-11
P-13	109311	87125	41.1	2.0	1.2	7059.41	20-40	0-10
P-14	109254	87192	37.6	5.0	1.3	7059.07	16-36	0-11
P-15	109134	87340	41.0	5.0	1.4	7056.96	21-41	0-10
P-16	108991	87503	39.9	5.0	1.7	7055.87	18-38	0-9
P-17	108830	87679	36.3	5.0	1.2	7057.25	25-35	0-10
P-18	108707	87772	37.2	4.0	1.4	7056.77	16-36	0-10
P-19	108408	87919	25.3	4.0	1.1	7055.66	14-34	0-5
P-19A	---	---	---	---	---	---	-	-
P-20	107927	87947	34.5	5.0	1.8	7053.14	12-32	0-10
P-21	107817	87904	32.3	5.0	2.2	7056.14	10-30	0-8
RPI-5A	108105	87882	15.0	1.3	---	7051.10	11-14	6-8
RPI-7A	108509	89500	21.8	1.3	1.5	7042.90	19-21	13-15
RPI-8	108230	89709	21.0	1.3	---	7039.40	17-20	12-18
RPI-8A	108225	89700	14.4	1.3	1.2	7039.40	11-13	9-10
RPI-9	107947	89891	21.3	1.3	1.1	7041.10	18-21	15-17
RPI-10	107396	88813	25.4	1.3	0.7	7049.41	23-26	14-15
RPI-11	108339	88850	32.4	1.3	1.2	7049.70	29-31	22-24
RPI-14	108625	88752	11.8	1.3	0.4	7041.90	9-11	6-7
RPI-15	108812	88708	20.0	1.3	1.3	7039.60	18-20	15-17
RPI-15A	108000	88700	8.0	1.3	1.1	7040.10	6-8	3-4
RPI-16A	109000	88514	20.9	1.3	1.1	7047.60	31-33	28-29
RPI-17A	108960	89190	13.4	1.3	1.4	7037.00	10-12	9-10
RPI-18A	108895	89253	10.7	1.3	1.2	7031.85	8-10	5-6
RPI-19B	108455	88402	15.3	1.3	1.7	7046.81	11-14	8-10
RPI-20A	109030	89512	7.8	1.3	1.0	7030.85	5-7	2-3
RPI-21B	108018	90329	16.1	1.3	1.3	7036.64	11-14	9-10
RPI-22	107962	89356	20.4	1.3	1.1	7047.48	19-21	14-15
RPI-24	109073	87790	30.4	1.3	1.9	7052.15	28-30	25-26
RPI-24A	109070	87790	20.0	1.3	1.9	7052.30	18-20	15-16
RPI-32	109125	89635	20.0	1.3	---	7036.35	18-20	16-17
RPI-42A	108997	87390	14.3	1.3	1.5	7061.17	14-16	15-16
RPI-44A	109530	87095	18.0	1.3	---	7059.15	16-18	13-14
SDP-1	107911	90307	---	1.3	---	7038.40	-	-
SDP-2	107891	90470	---	1.3	---	7044.15	-	-

TABLE 3.0-1. BASIC WELL DATA FOR THE SURFICIAL AQUIFER WELLS. (cont'd.)

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
SDP-3	108175	90661	24.1	1.3	2.8	7038.80	-	-
SDP-4	107976	90644	24.1	1.3	3.1	7046.04	-	-
SDP-5	107890	90652	22.8	1.3	3.2	7046.75	-	-
SP03	107932	88383	33.7	2.0	1.3	7056.09	30-31	27-28
SP04	107953	88452	34.4	2.0	1.7	7054.72	31-32	27-28
TW3-1	107430	82380	76.8	5.0	1.8	7096.00	35-75	6-24
TW4-1B	107287	85575	62.3	5.0	1.0	7114.58	40-60	39-45
TW4-2B	107547	84878	94.1	5.0	0.8	7110.03	72-92	42-62
TW4-3B	108104	85108	91.6	5.0	1.6	7112.47	69-89	49-65
TW4-4B	108062	86075	67.2	5.0	1.8	7112.44	46-66	27-39
TW4-5B	107293	86238	60.8	5.0	1.1	7115.66	39-59	31-42
TW4-6B	107813	86009	75.9	5.0	1.8	7114.32	54-74	34-60
TW4-8B	106979	85355	61.5	5.0	1.5	7117.89	50-60	14-47
TW4-9B	106776	85152	78.4	5.0	1.2	7115.06	57-77	30-50
TW4-10B	108077	85760	74.9	5.0	1.7	7112.41	53-73	38-58
TW4-11B	108162	85557	78.7	5.0	1.4	7112.26	57-77	30-49
TW5-1B	108180	86876	90.8	5.0	1.4	7105.56	70-90	54.5-65
TW5-2B	109441	86369	73.5	5.0	0.6	7103.61	52-72	38-53
TW5S-1	109064	84203	94.5	5.0	1.7	7111.70	53-93	11-42
TW5S-2	108917	84849	100.0	5.0	1.0	7112.20	59-99	12-49
TW5S-3	109108	83745	94.0	5.0	1.2	7112.76	53-93	18-37
TW5S-4	109065	84203	100.9	5.0	1.7	7111.69	59-99	20-49
TW5S-5	108916	84849	84.7	5.0	1.0	7107.79	44-84	15-43
TWI-1	110109	84716	96.5	5.0	1.2	7106.50	55-95	23-53
TWI-2	110106	84916	87.0	5.0	1.7	7106.70	55-85	0-44
TWI-3	110059	85162	104.8	5.0	1.7	7106.60	63-103	8-54
TWI-4	110063	85309	97.5	5.0	1.7	7107.10	56-96	0-55
TWI-5	109947	85701	93.7	5.0	2.0	7107.40	52-92	8.5-47
TWI-6	109866	85882	91.8	5.0	1.7	7106.60	50-90	7-53
TWI-7	109774	86060	91.5	5.0	2.1	7107.50	49-89	8-53
TWI-8	109668	86227	93.1	5.0	1.2	7106.60	62-92	8-55
TWI-9	109908	85792	104.8	5.0	2.3	7107.10	62-102	24-57
TWI-10	109429	86546	70.4	5.0	1.7	7106.60	39-69	13-49
TWI-11	109554	86386	99.8	5.0	2.0	7106.60	58-98	19-57
TWI-12	109349	86662	83.6	5.0	1.0	7106.26	53-83	0-10
TWI-13	109267	86763	88.7	5.0	0.8	7107.62	68-88	0-22
TWI-14	109186	86867	86.2	5.0	1.8	7108.08	55-85	0-51

TABLE 3.0-1. BASIC WELL DATA FOR THE SURFICIAL AQUIFER WELLS. (cont'd.)

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
TWI-15	108982	87103	75.1	5.0	1.2	7107.51	54-74	0-52
TWI-16	108862	87237	89.3	5.0	1.4	7107.58	58-88	0-18
TWI-17	108746	87355	80.5	5.0	1.0	7107.12	60-80	28-57
TWI-18	108608	87457	87.0	5.0	1.3	7107.79	66-86	0-56
TWI-19	108488	87540	81.7	5.0	1.0	7107.47	61-81	24-55
TWI-20	108338	87597	86.5	5.0	1.2	7107.85	55-85	0-16
TWI-21	108219	87597	80.7	5.0	1.1	7107.51	49-79	0-50
TWI-22	109086	86993	88.1	5.0	1.3	7107.75	57-87	0-18
TWI-23	108142	87445	82.2	5.0	1.2	7107.64	61-81	0-57
WWL-3A	106626	50744	99.3	4.0	1.7	7114.20	81-101	60-70
WWL-4A	105555	83331	95.8	4.0	1.8	7129.90	76-96	62-71
WWL-4B	105575	83322	47.7	4.0	0.7	7127.20	30-50	20-27
WWL-10B	105744	84168	68.6	5.0	1.4	7125.10	54-74	22-28
WWL-12B	106598	86537	71.1	5.0	1.1	7118.57	54-74	6-13
WWL-13B	105205	86689	57.2	5.0	1.1	7141.20	40-60	7-17
WWL-14A	109620	83937	95.8	4.0	0.8	7113.00	79-99	44-51
WWL-14B	109609	83923	38.0	5.0	1.9	7113.70	18-38	0-12
WWL-15A	108284	82559	120.0	4.0	1.1	7144.40	110-120	99-107
WWL-19B	104375	87698	56.0	4.0	2.5	7138.50	34-54	27-29
WWL-20B	104861	84544	60.2	4.0	1.4	7139.00	39-59	33-35

TABLE 3.0-2. BASIC WELL DATA FOR THE TAILINGS WELLS.

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
TW4-1C	107317	85592	49.8	5.0	0.3	7112.44	8-48	4.5-6
TW4-1C1	107287	85575	26.2	2.0	1.7	7118.02	15-25	11-15
TW4-1C2	107288	85576	41.7	2.0	1.1	7121.33	29-39	25-30
TW4-2C	107573	84890	46.0	5.0	1.0	7109.30	4-44	1.5-4
TW4-2C1	107547	84878	19.5	2.0	1.3	7109.55	8-18	0-7
TW4-3C	108142	85105	33.0	5.0	2.0	7112.26	9-49	1.5-5
TW4-3C1	108104	85108	34.7	2.0	1.7	7112.03	22-32	20-22
TW4-3C2	108105	85109	22.3	2.0	1.6	7111.81	10-20	7-9
TW4-4C	108038	86101	33.0	5.0	1.6	7111.82	12-32	4-6
TW4-4CA	108041	85956	57.5	4.0	1.5	7112.25	-	0-9
TW4-5C	107319	86227	42.0	5.0	1.3	7115.37	21-41	0-5
TW4-6C	107828	85993	47.7	5.0	1.4	7113.93	6-46	4-11
TW4-6CA	107921	85875	35.3	4.0	1.1	7113.37	14-34	0-6
TW4-6CB	107398	85728	26.4	4.0	1.6	7110.73	5-25	1-4
TW4-6CC	107469	85824	40.1	4.0	1.0	7108.15	19-39	0-2
TW4-6CD	107604	85863	40.5	4.0	1.4	7107.91	19-39	17-18
TW4-7C	107645	85057	52.0	5.0	1.1	7113.42	11-51	5-9
TW4-8C	107020	85352	50.5	5.0	1.3	7116.62	9-49	1-13
TW4-8CA	107021	85324	45.4	4.0	1.7	7117.84	24-44	0-24
TW4-8CB	107126	85407	48.1	4.0	1.5	7118.12	27-47	0-31
TW4-8CC	107211	85522	40.3	4.0	1.6	7115.64	19-39	0-2
TW4-9C	106750	85147	40.6	5.0	1.6	7115.35	19-39	0-12
TW4-9CA	106728	85121	39.7	4.0	1.1	7115.61	18-38	0-12
TW4-9CB	106744	85190	20.0	2.0	1.3	7117.10	0-20	0-0
TW4-9CC	106776	85152	---	1.3	---	---	-	-
TW4-10C	108089	85727	56.8	5.0	1.7	7112.64	15-55	5-11
TW4-10CA	108070	85787	56.4	4.0	1.1	7112.54	15-55	0-9
TW4-11C	108140	85593	57.3	5.0	1.7	7112.71	15-55	7-12
TW4-11CA	108173	85537	60.0	4.0	1.8	7112.53	18-58	2-10
TW4-11CB	108233	85351	20.4	4.0	1.4	7112.10	0-20	0-0
TW4-11CC	107995	85771	34.5	4.0	1.5	7112.64	13-33	0-5
TW4-15C	108516	85559	37.1	5.0	1.9	7110.38	15-35	7-11
TW4-17C	---	---	33.6	5.0	0.9	---	13-33	-
TW4-18C	---	---	44.3	5.0	0.6	---	4-44	-
TW4-19C	---	---	25.8	5.0	0.8	---	6-25	-
TW4-21C	---	---	80.0	5.0	---	---	20-80	-
TW5-1C	108203	86887	58.8	5.0	2.0	7107.58	17-57	1.5-6

TABLE 3.0-2. BASIC WELL DATA FOR THE TAILINGS WELLS. (cont'd.)

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
TW5-1C1	108180	86876	32.3	2.0	2.8	---	9-29	0-5
TW5-1C2	108200	86940	54.9	2.0	2.6	---	36-52	29-31
TW5-2C	109423	86350	38.9	5.0	1.6	7104.04	0-38.4	0-2
TW5-2C1	109441	86369	9.2	2.0	2.3	---	0-9.2	-
TW5-3	108091	87593	43.6	5.0	2.0	7108.50	22-42	2-4
TW5-4C	108510	87485	50.4	5.0	1.6	7108.30	9-49	0-8
TW5-4CA	108600	87163	36.0	4.0	1.7	7108.68	13-33	0-0
TW5-5C	108177	87383	52.3	5.0	1.7	7108.20	21-51	0-8
TW5-5CA	108125	87285	35.5	4.0	1.7	7108.20	14-34	0-2
TW5-6C	107736	87442	47.3	5.0	1.8	7108.40	16-46	0-10
TW5-7C	107991	86938	56.5	5.0	2.8	7108.15	14-54	6-12
TW5-8C	108294	86976	44.2	5.0	1.6	7106.17	3-43	4-5
TW5-9C	108189	87031	34.0	4.0	1.3	7106.57	13-33	0-5
TW5-12C	108330	86630	22.0	2.0	1.8	7101.28	-	-
TW5-13C	108426	86659	23.4	2.0	1.0	7101.54	-	-
TW5-14C	108984	86518	25.3	2.0	4.1	7097.96	-	-
TW5-16C	108901	87001	41.3	5.0	1.5	7104.21	20-40	11-14
TW5-17C	109118	86653	41.6	5.0	1.9	7103.69	20-40	11-15
TW5-18C	109429	86130	42.1	5.0	2.5	7100.55	20-40	9-13
TW5-19C	109629	86106	41.6	5.0	2.0	7105.72	20-40	6-12
TW5-20C	109959	85500	36.0	5.0	1.6	7106.62	14-34	9-13
TW5-21C	107674	86580	54.8	5.0	1.9	7114.04	33-53	16-20
TW5-22C	108583	86326	37.0	5.0	1.8	7104.30	15-35	7-10
TW5-23C	108881	85916	41.4	5.0	1.5	7104.53	20-40	7-11
TW5-24C	109793	85836	40.0	4.0	1.8	7105.53	18-38	16-18

TABLE 3.0-3. BASIC WELL DATA FOR THE WHITE RIVER AQUIFER WELLS.

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
MC02	108693	88431	165.0	6.0	0.0	7045.21	70-160	28-30
WH-9	109197	83514	190.0	5.0	2.7	7119.80	130-190	113-121
WW-22	107600	89330	184.6	6.0	1.0	7051.00	64-184	21-28
WW-23	109674	87393	193.5	5.0	2.1	7054.40	113-194	70-75
WWL-10A	105745	84187	133.6	4.0	0.7	7125.00	114-134	108-112
WWL-16A	102228	85174	187.2	4.0	2.8	7172.08	165-185	139-145
WWL-18A	103861	83301	171.5	4.0	1.3	7163.10	151-171	124-132
WWL-20A	104821	84547	140.3	4.0	0.8	7139.34	122-142	119-128

TABLE 3.0-4. BASIC WELL DATA FOR THE WIND RIVER AQUIFER WELLS

WELL NAME	NORTH. COORD.	EAST. COORD.	TOTAL DEPTH (ft-mp)	CASING DIAMETER (in)	STICKUP (ft)	MP ELEV. (ft-msl)	CASING PERFORATIONS (ft-lsd)	BENTONITE SEAL (ft-lsd)
WW-20	107450	82240	430.0	7.0	0.3	7114.99	410-425	350-360

3.1 RATE AND DIRECTION OF GROUND-WATER MOVEMENT

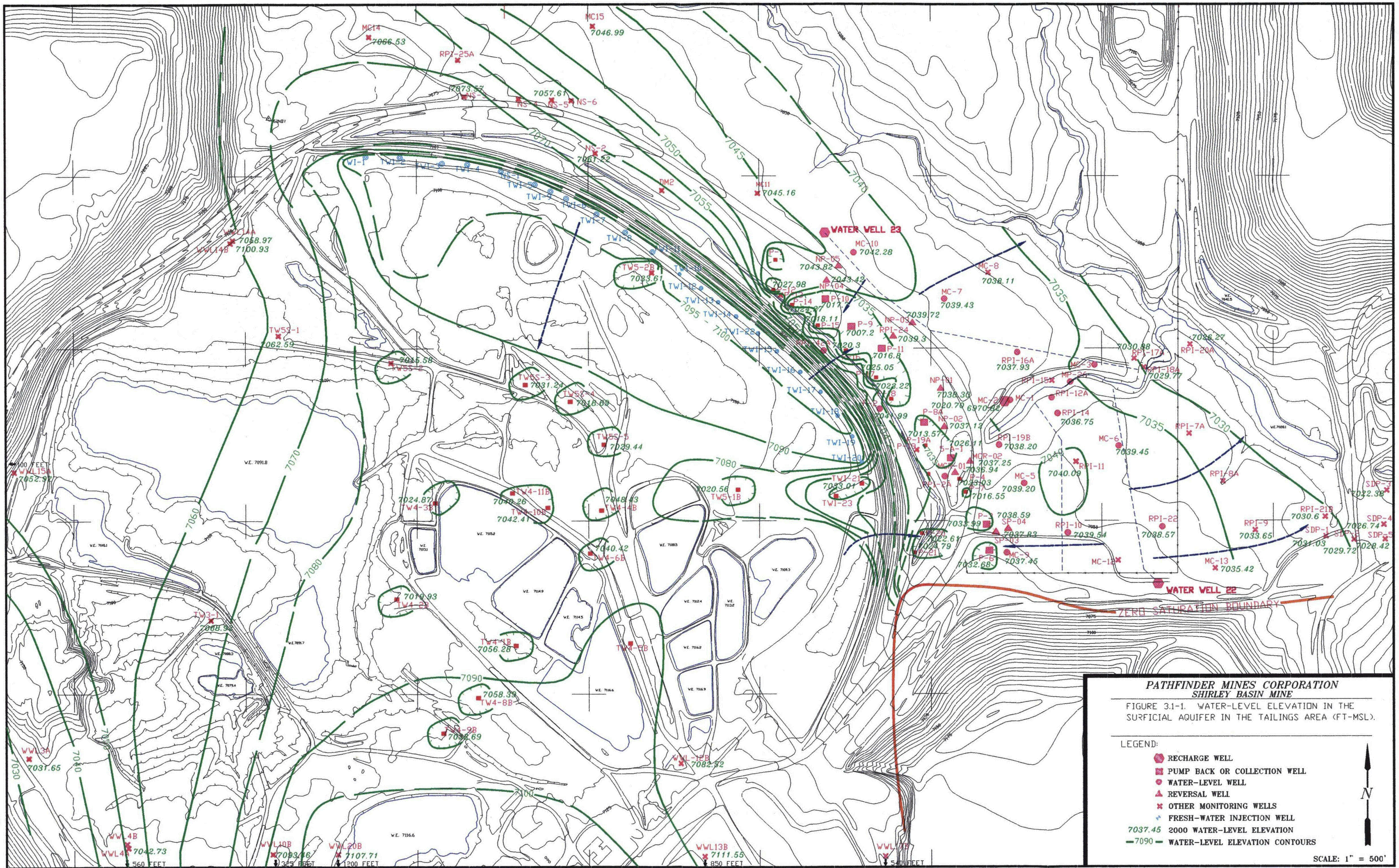
Water-level elevations define the gradient and direction of ground-water flow in the Surficial aquifer. Figure 3.1-1 presents the water-level elevation of the Surficial aquifer in the tailings area. Because the majority of Surficial wells within the actual tailings area have been converted to injection or collection wells, the contours in the immediate vicinity of these wells represent expected water-level elevations outside of the immediate cone of depression or water level mound around each active well.

The general shape of the piezometric surface indicates the complexity of the containment and restoration systems, as well as past artificial and natural recharge. The operation of the collection and recharge system downgradient of the No. 5 Dam will be discussed in more detail in subsequent sections. In the immediate tailings area, the recharge comes from surface runoff, seepage from the industrial pond, recharge to overburden piles south of the tailings area, and seepage from the tailings. To the east, the known outlet is the Mine Creek channel where the primary restoration effort has been directed.

Surficial collection and injection operations within the perimeter of the No. 5 Dam have created a depression in the potentiometric surface in the middle of the tailings, with a hydraulic ridge along the line of injection wells. Continued operation of the collection and injection system should increase the gradient toward the middle of the tailings.

Hydraulic gradient times the horizontal permeability divided by the effective porosity yields the ground-water velocity. The ground water in the south Mine Creek recharge line is presently moving downgradient toward Spring Creek at a rate of 3.75 ft/day based on the present hydraulic gradient and aquifer properties. An average permeability of 25 ft/day, gradient of 0.015 ft/ft and effective porosity of 0.1 were used in this estimate. The gradient on the west side of the south recharge line ranges from approximately 0.003 to 0.013 ft/ft, giving an apparent seepage velocity ranging from 0.75 ft/day to 3.25 ft/day.

The gradient in the north Mine Creek recharge area between wells MC-7 and MC-8 (northeast of the north recharge line) is 0.0044 ft/ft. The piezometric surface between the wells is very flat and appears to steepen dramatically near Spring Creek. Based on water quality measurements, this area has been restored and remains so. The gradient reversal between reversal wells NP04 and NP05 was maintained and there was a substantial restoration of water quality in these wells following operational downtime in 1996 and 1997.


PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 3.1-1. WATER-LEVEL ELEVATION IN THE SURFICIAL AQUIFER IN THE TAILINGS AREA (FT-MSL).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
7037.45 2000 WATER-LEVEL ELEVATION
7090 WATER-LEVEL ELEVATION CONTOURS
SCALE: 1" = 500'
N
WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
MC14 7066.53
MC15 7046.99
RPI-25A
7073.57 NS-3
NS-4
7057.61 NS-5
NS-6
NS-2 7061.22
DM2
MC11 7045.16
MC-10 7042.28
NP-05 7043.82
7043.42 NP-04
P-10
P-14
P-15
P-9 7007.2
NP-03 7039.72
RPI-24 7039.3
P-11 7016.8
MC-8 7038.11
MC-7 7039.43
RPI-16A 7037.93
7030.88 RPI-17A
7026.27 RPI-20A
RPI-18A 7029.77
MC-3
MP-26
RPI-15
RPI-12A
MC-2
MC-1
RPI-14 7036.75
NP-01 7038.30
7020.70 6970.82
P-8A
NP-02 7037.12
7013.57
P-19A
RPI-19B 7038.20
7026.11
S-A-1
MCR-02 7037.25
MCR-01 7036.94
P-4 7023.03
RPI-2A
P-7 7016.55
MC-5 7039.20
7040.09
RPI-11
MC-6 7039.45
RPI-7A
RPI-8A
SDP-3 7022.38
7038.59 SP-04
7033.99
7037.83
SP-03
P-6 7032.68
MC-9 7037.45
RPI-10 7039.54
RPI-22 7038.57
MC-12
MC-13 7035.42
RPI-9 7033.65
RPI-21B 7030.6
SDP-1
7031.03
7029.72
SDP-4 7026.74
SDP-5 7028.42
P-20
7022.61
7024.79
P-21
TWI-1
TWI-2
TWI-3
TWI-4
NS-1
TWI-5
TWI-9
TWI-6
TWI-7
TWI-8
TWI-11
TWI-10
TWI-12
TWI-13
TWI-14
TWI-22
TWI-15
TWI-16
TWI-17
TWI-18
TWI-19
TWI-20
TWI-21 7033.01
TWI-23
TW5-2B 7033.61
7027.98
7018.11
7020.3
7025.05
P-17
7023.22
7041.99
7024.27
WWL14A 7058.97
WWL14B 7100.93
TW5S-1 7062.59
7015.58 TW5S-2
TW5S-3 7031.24
TW5S-4 7018.69
TW5S-5 7029.44
7020.56 TW5-1B
TW4-11B 7040.26
TW4-10B 7042.41
7048.43 TW4-4B
7024.87 TW4-3B
7040.42 TW4-6B
7019.93 TW4-2B
TW4-1B 7056.28
TW4-5B
7058.39 TW4-8B
TW4-9B 7038.69
WWL-12B 7082.52
100 FEET
WWL15A 7052.97
TW3-1 7068.93
WWL3A 7031.65
WWL4B
WWL4A 7042.73
560 FEET
WWL10B 7093.46
325 FEET
WWL20B 7107.71
1200 FEET
WWL13B 7111.55
850 FEET
WWL17B
540 FEET
SINDY
W.E. 7091.8
W.E. 7091.7
W.E. 7080.3
W.E. 7079.4
W.E. 7115.2
W.E. 7114.9
W.E. 7114.5
W.E. 7116.6
W.E. 7108.5
W.E. 7112.4
W.E. 7113.2
W.E. 7116.2
W.E. 7116.9
W.E. 7109.3
7030
7035
7040
7045
7050
7055
7060
7070
7080
7090
7095
7100

3.2 GRADIENT REVERSAL

Pumping of the collection wells is used to establish and maintain gradient reversal in the Surficial aquifer in the Mine Creek area. A gradient reversal exists when the water elevation of monitor wells closest to the recharge line is higher than water elevations of monitor wells closest to the collection wells. This is an important measurement because the lack of reversal for a long period of time lessens the chance of containing tailings seepage. Ten reversal wells are used to evaluate gradient reversal. The following listing is from the north end of the seepage area to the south end. The reversal monitoring wells closest to the recharge lines are: NP05, NP03, NP01, MCR02, and SP04 (see Figure 2.1-1). Paired with these wells are NP04, RPI-24, NP02, MCR01, and SP03, respectively.

Table 3.2-1 presents the monitoring dates and elevations during 2000. Comparison of water-level elevations for these wells indicates continuous reversal in reversal well pairs MCR02-MCR01, SP04-SP03, NP01-NP02, NP03-RPI24 and NP05-NP04, (see Figures 3.2-1, 3.2-2, 3.2-3, 3.2-4 and 3.2-5 respectively).

TABLE 3.2-1. REVERSAL WELL MONITORING
2000

DATE	01/05/00	02/02/00	03/02/00	04/04/00	05/01/00	06/06/00	07/05/00	08/02/00	09/01/00	10/02/00	11/01/00	12/04/00
WELL												
NPO2	7036.9	7036.88	FROZEN	7037.47	7039.43	7039.56	7038.71	7037.59	7037.22	7037.12	7036.97	7036.99
7052.88	-2.07	-2.02	———	-1.87	-0.56	-0.7	-1.21	-1.86	-1.87	-2.01	-1.85	-1.81
NPO1	7038.97	7038.9	7038.86	7039.34	7039.99	7040.26	7039.92	7039.45	7039.09	7039.13	7038.82	7038.8
7051.81												
RPI24	7039.44	7039.34	7039.28	7039.86	7040.51	7040.57	7040.26	7039.92	7039.49	7039.3	7039.2	7039.17
7052.15	-0.48	-0.44	-0.48	-0.41	-0.23	-0.25	-0.32	-0.32	-0.37	-0.42	-1.16	-0.49
NPO3	7039.92	7039.78	7039.76	7040.27	7040.74	7040.82	7040.58	7040.24	7039.86	7039.72	7040.36	7039.66
7051.07												
NPO4	7043.21	7042.89	7042.85	7043.55	7044.43	7044.95	7044.97	7044.34	7043.52	7043.42	7043.11	7042.7
7055.87	-0.65	-0.93	-0.96	-1.24	-0.91	-0.45	-0.09	-0.08	-0.51	-0.4	-0.73	-0.82
NPO5	7043.86	7043.82	7043.81	7044.79	7045.34	7045.4	7045.06	7044.42	7044.03	7043.82	7043.84	7043.52
7055.37												
MCRO1	7036.4	7036.51	7036.48	7037.08	7037.84	7037.84	7037.26	7036.79	7036.94	7036.94	7037	7036.99
7042.55	-0.51	-0.49	-0.52	-0.48	-0.28	-0.3	-0.45	-0.46	-0.36	-0.31	-0.35	-0.28
MCRO2	7036.91	7037	7037	7037.56	7038.12	7038.14	7037.71	7037.25	7037.3	7037.25	7037.35	7037.27
7046.16												
SPO3	7037.35	7037.4	7037.46	7037.75	7038.35	7038.56	7038.21	7038.25	7038.11	7037.83	7037.5	7037.43
7056.09	-0.88	-0.89	-0.91	-0.93	-0.79	-0.7	-0.78	-0.68	-0.58	-0.76	-0.88	-0.76
SPO4	7038.23	7038.29	7038.37	7038.68	7039.14	7039.26	7038.99	7038.93	7038.69	7038.59	7038.38	7038.19
7054.72												

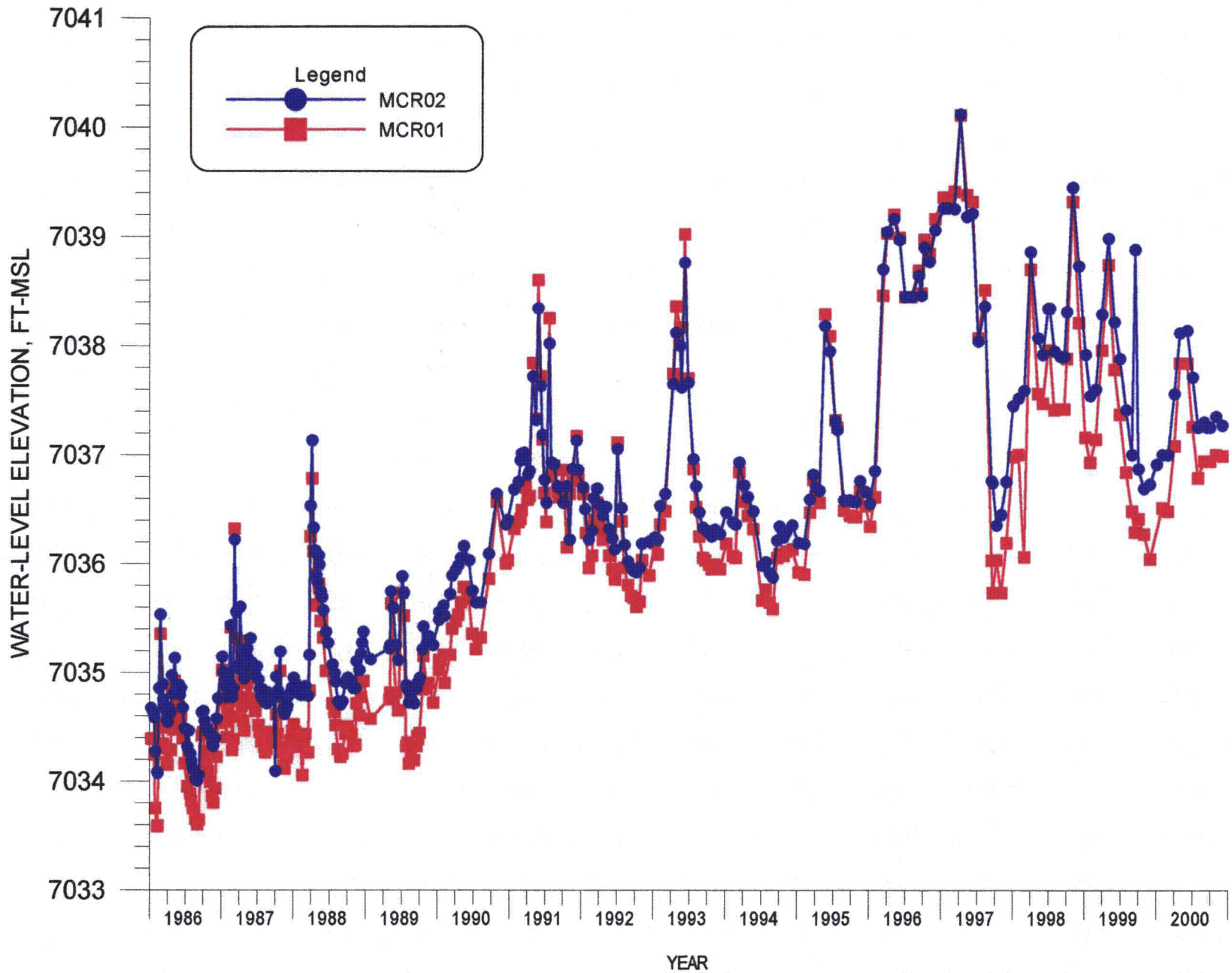


FIGURE 3.2-1. WATER-LEVEL ELEVATION FOR REVERSAL WELLS MCR02 AND MCR01.

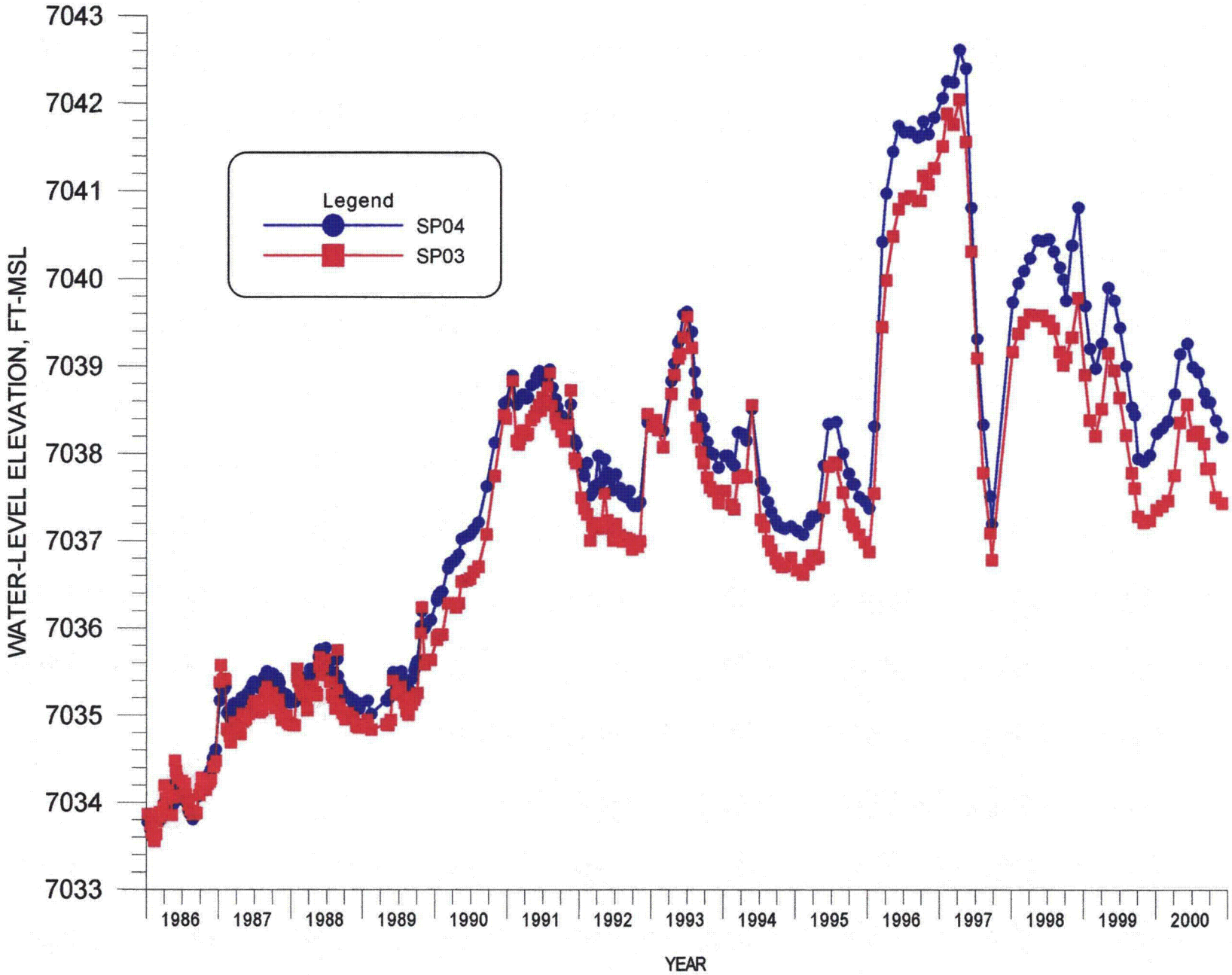


FIGURE 3.2-2. WATER-LEVEL ELEVATION FOR REVERSAL WELLS SP04 AND SP03.

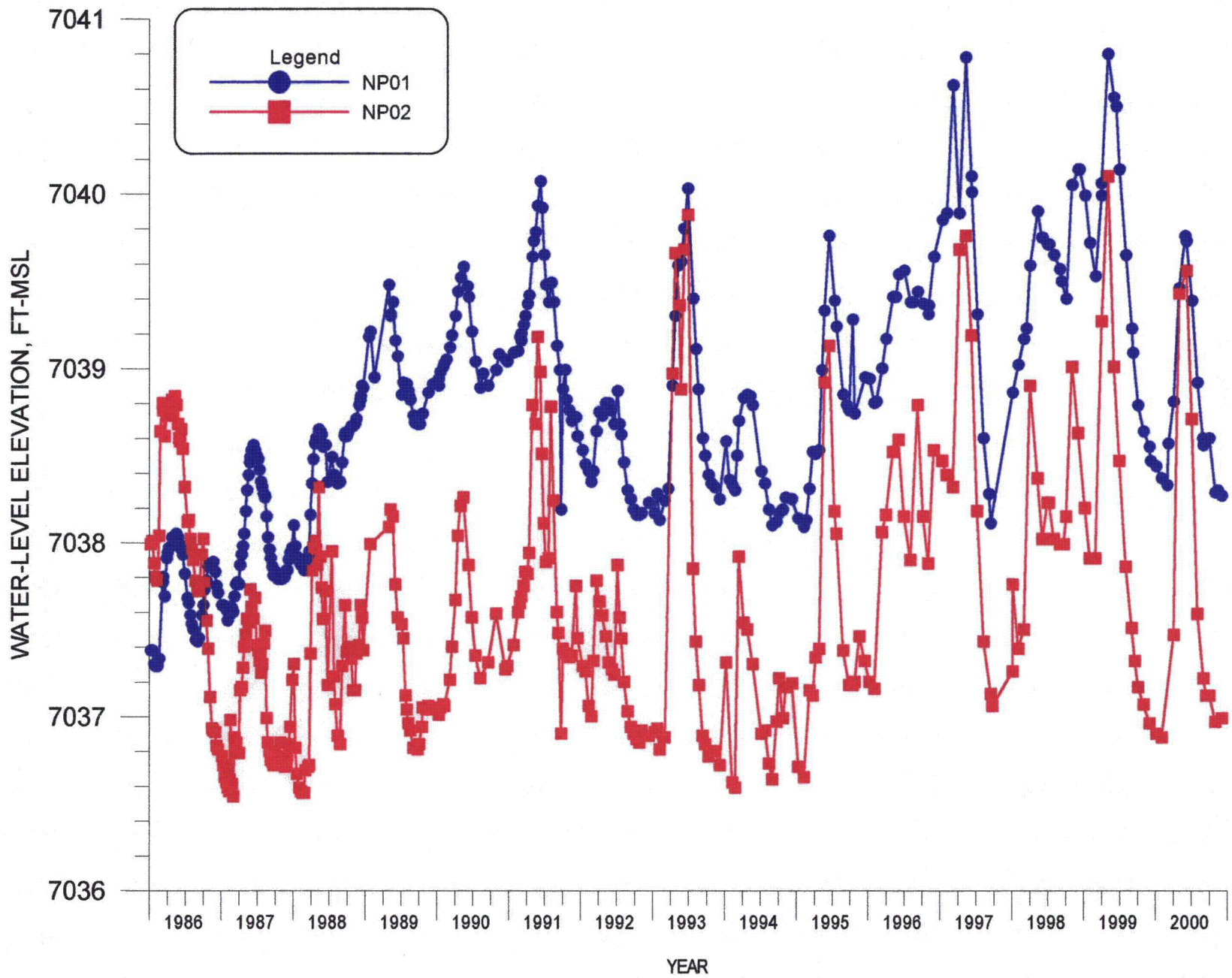


FIGURE 3.2-3. WATER-LEVEL ELEVATION FOR REVERSAL WELLS NP01 AND NP02.

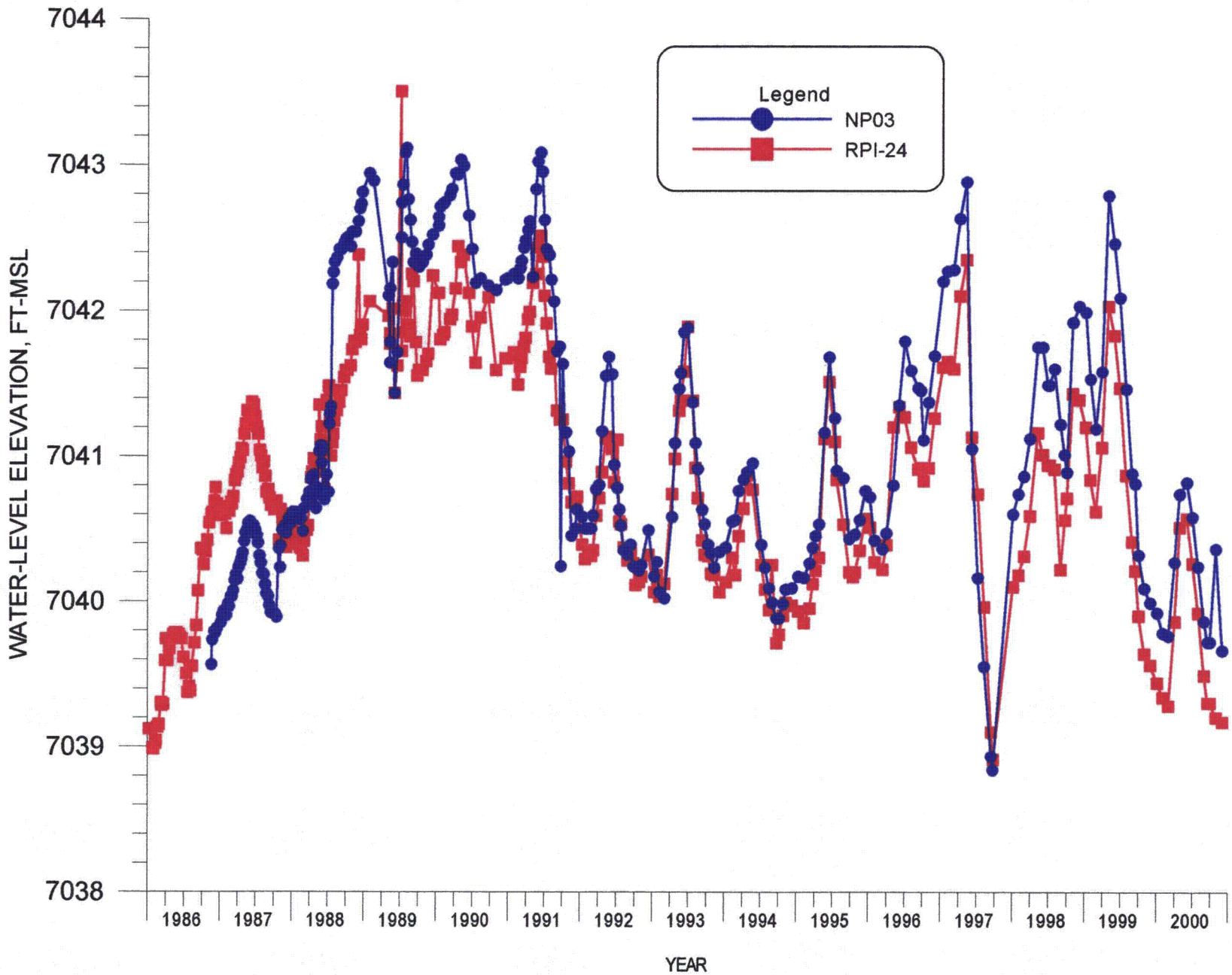


FIGURE 3.2-4. WATER-LEVEL ELEVATION FOR REVERSAL WELLS NP03 AND RPI-24.

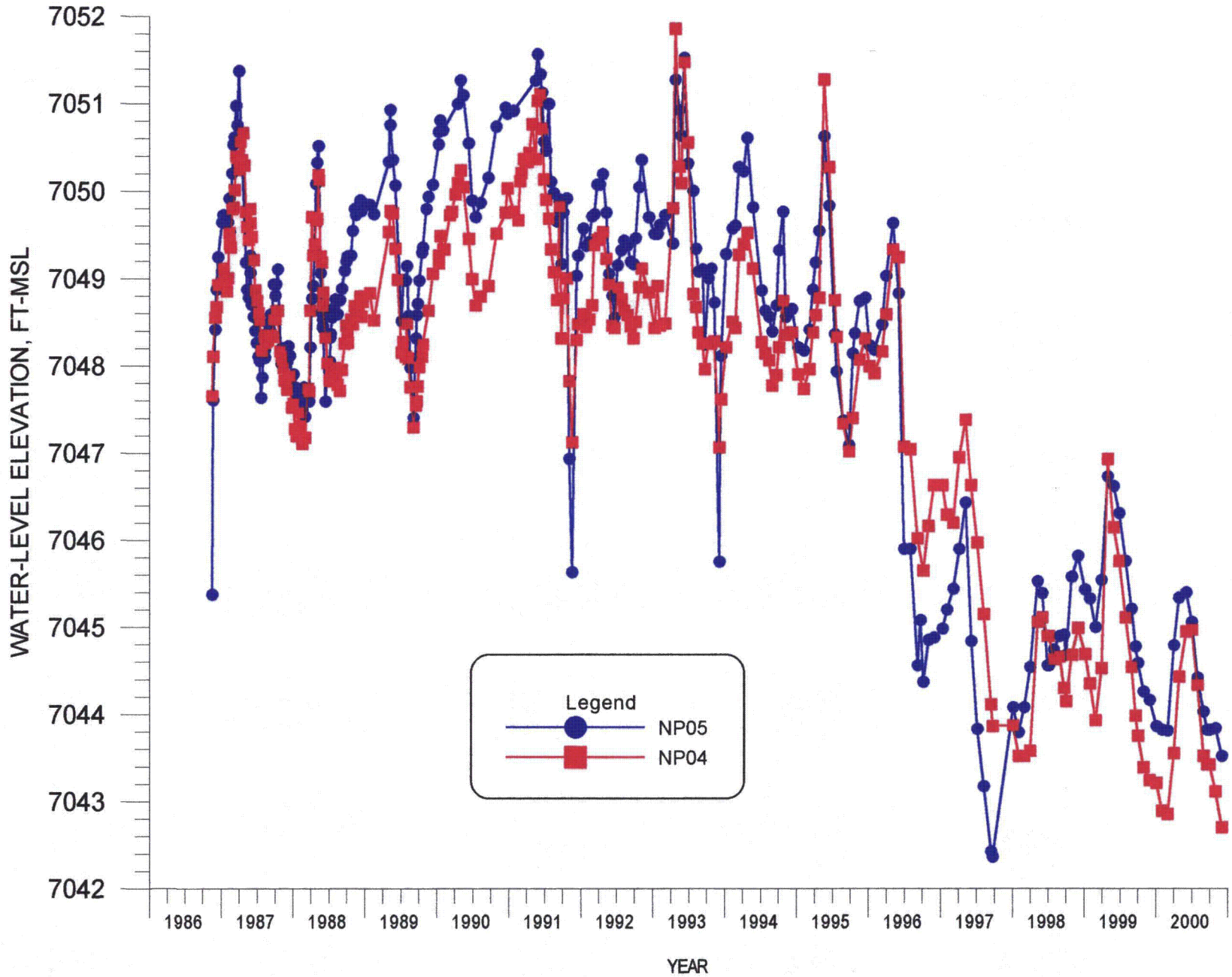


FIGURE 3.2-5. WATER-LEVEL ELEVATION FOR REVERSAL WELLS NP05 AND NP04.

3.3 WATER-LEVEL CHANGES

Water levels are monitored in numerous wells in the Surficial aquifer to define the water level changes from the collection pumping and the injection into the recharge lines and injection wells. Section 3.2 presents the changes in water level in the reversal wells. Water-level changes in several Surficial aquifer wells will be discussed and presented in this section.

Figure 3.3-1 presents the water-level plots for south area Surficial wells RPI-10, RPI-9, and RPI-8A (see Figure 3.1-1 for the locations of these wells with respect to the south drain). Figure 3.3-2 presents the water-level changes in wells MC-6 and RPI-18A, and illustrates that the water-level elevations close to the recharge line have recovered to pseudo-equilibrium with the recharge system operation while wells that are some distance away are unaffected.

The water-level responses between the south recharge line and the Mine Creek collection wells is shown in Figure 3.3-3 for wells RPI-19B, RPI-14, and RPI-20A. Water levels in RPI-20A increased in 1998 but have since dropped and remained relatively steady through 2000. Water levels in wells RPI-19B and RPI-14 have shown a modest decline over the same period. Water levels in some of the Mine Creek wells near Spring Creek have also been influenced by variations in stage in Spring Creek. Water levels have responded significantly to recharge into the north Mine Creek recharge line. Magnitude of water-level rises has been a function of the distance from the recharge line in the north area with much greater rises close to the line when it was functioning. Figure 3.3-4 presents the water levels in wells RPI-16A, MC-7, and MC-11. Water-level changes in well MC-7 have been a function of changes in recharge rates into the north line with some seasonal cycling. Well MC-11 has shown a modest decline in water level over the last several years.

Careful evaluation of Figure 3.1-1 shows a ground-water mound having developed over the recharge lines. This mound is forcing seepage to the collection system (P wells) on the upgradient side of the recharge lines. This mound has not changed appreciably south of Mine Creek during 2000.

Water-level changes in the area north of the No. 5 Dam have resulted from the operation of the injection well system. The north injection system consists of 22 injection wells. Figures 3.3-5 and 3.3-6 present the water level elevations for the NS series monitoring wells and well MC-15, which is located farther from the injection wells. The initial rapid water-level change in some wells as a result of injection is evident in Figures 3.3-5 and 3.3-6. All of the downgradient wells have shown a water-level rise as a result of the injection, followed by some decay with the gradual loss of injectivity. Pre-existing trends and seasonal fluctuations also appear to be having some effect on the water-level elevation of more distant wells.

Surficial and tailings collection wells within the tailings impoundment area were made operational during 1994. Surficial wells TW4-1B, TW4-2B, TW4-3B, TW4-4B, TW4-5B, TW4-6B, TW4-8B, TW4-9B, TW4-10B, TW4-11B, TW5-1B, TW5-2B, TWI-21, TWI-23, TW5S-3, TW5S-4 and TW5S-5 have been pumped. Many of the wells have been pumped nearly continuously for up to six years, while others were installed as late as 1995 and have been pumped intermittently. Well TW4-5B was destroyed in 2000. The water level declines for the Surficial Aquifer in the interior of the tailings area range up to 40 feet at the pumping wells, but a practical maximum water level decline outside of the cone of depression for a pumping well is expected to be 20 feet. There is a mild depression in the piezometric surface in the center of the tailings that is formed by the collection in this area and injection along the crest of the No. 5 Dam. The tailings dewatering is discussed in Section 8.0.

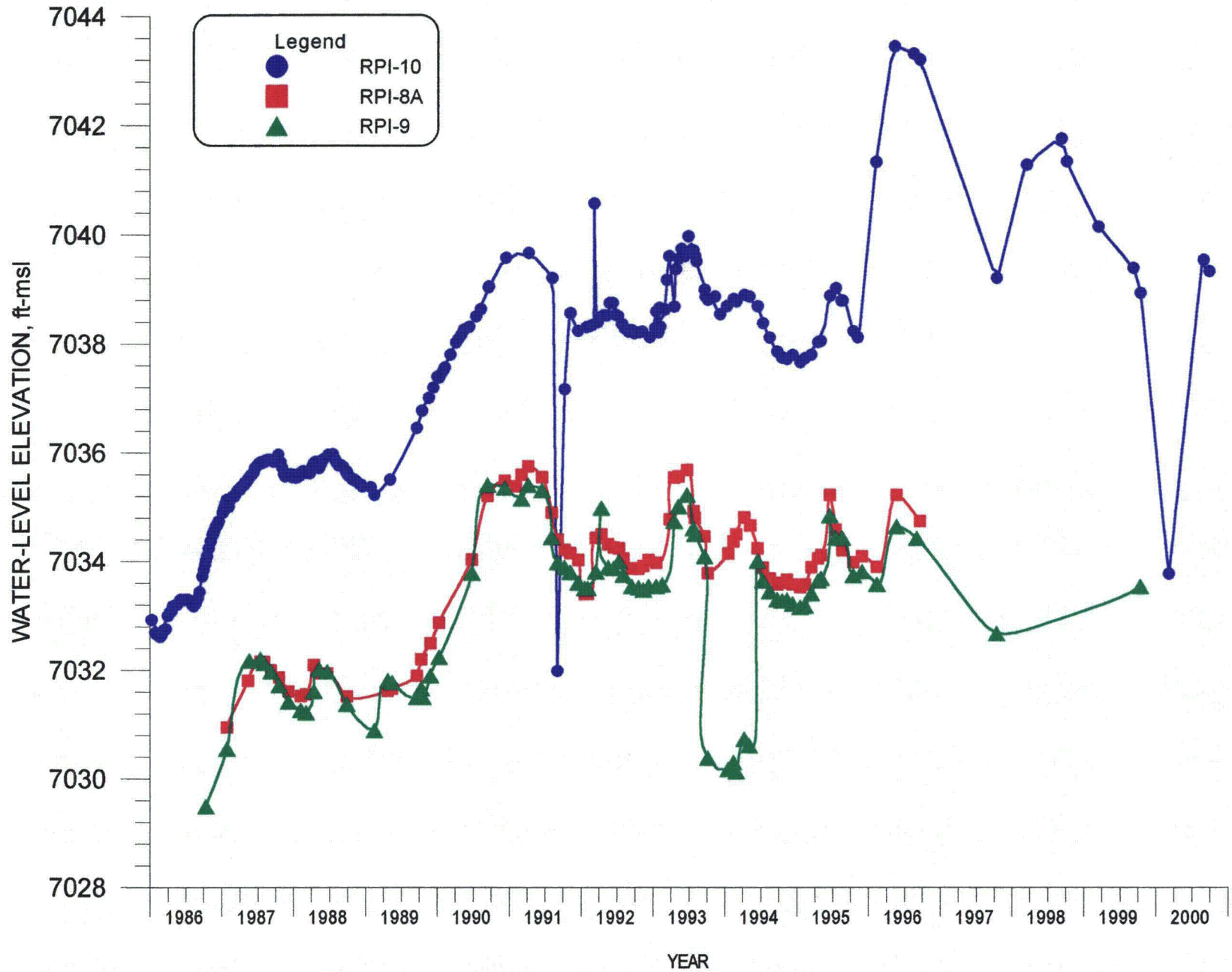


FIGURE 3.3-1. WATER-LEVEL ELEVATION FOR WELLS RPI-10, RPI-8A AND RPI-9.

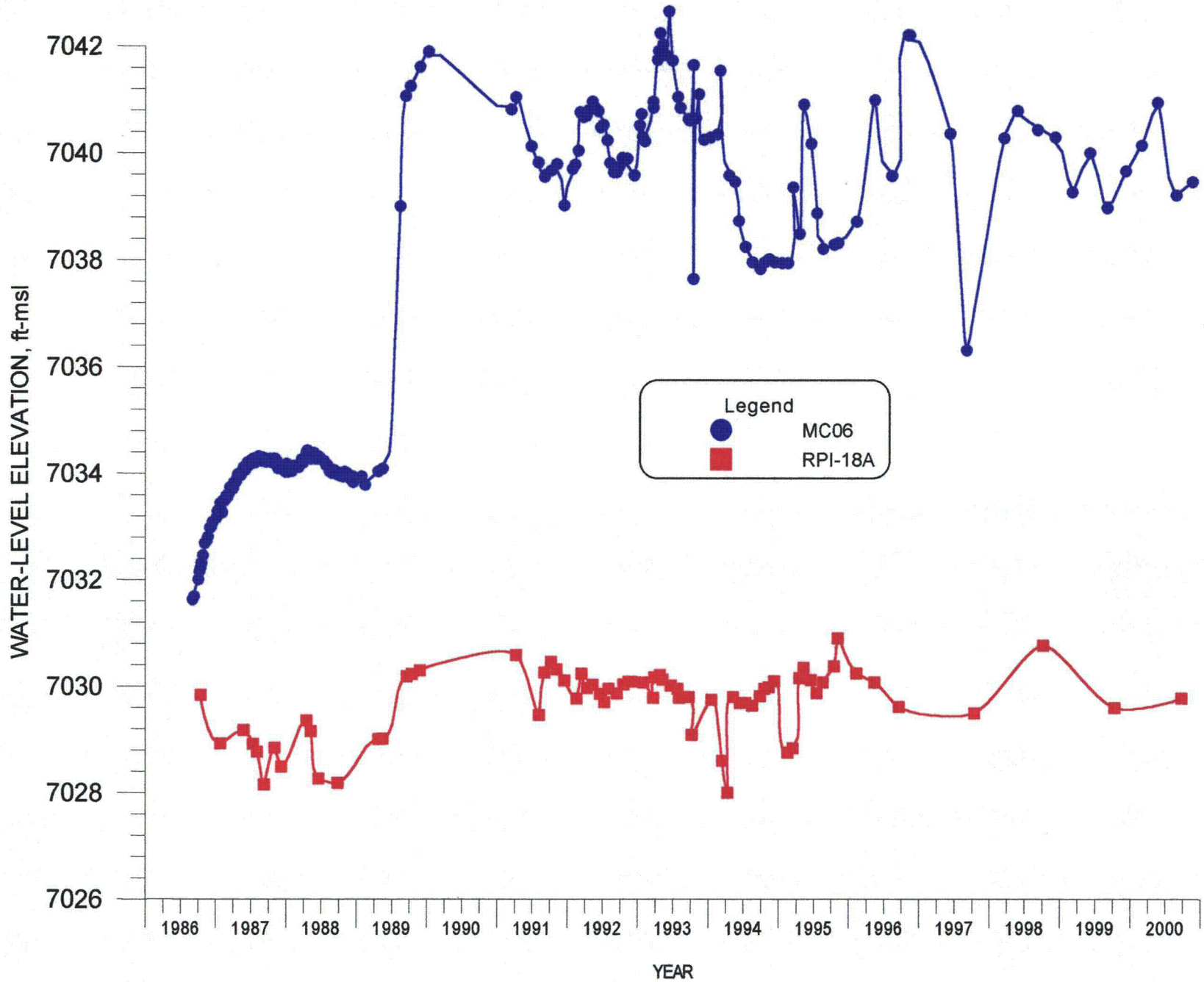


FIGURE 3.3-2. WATER-LEVEL ELEVATION FOR WELLS MC06 AND RPI-18A.

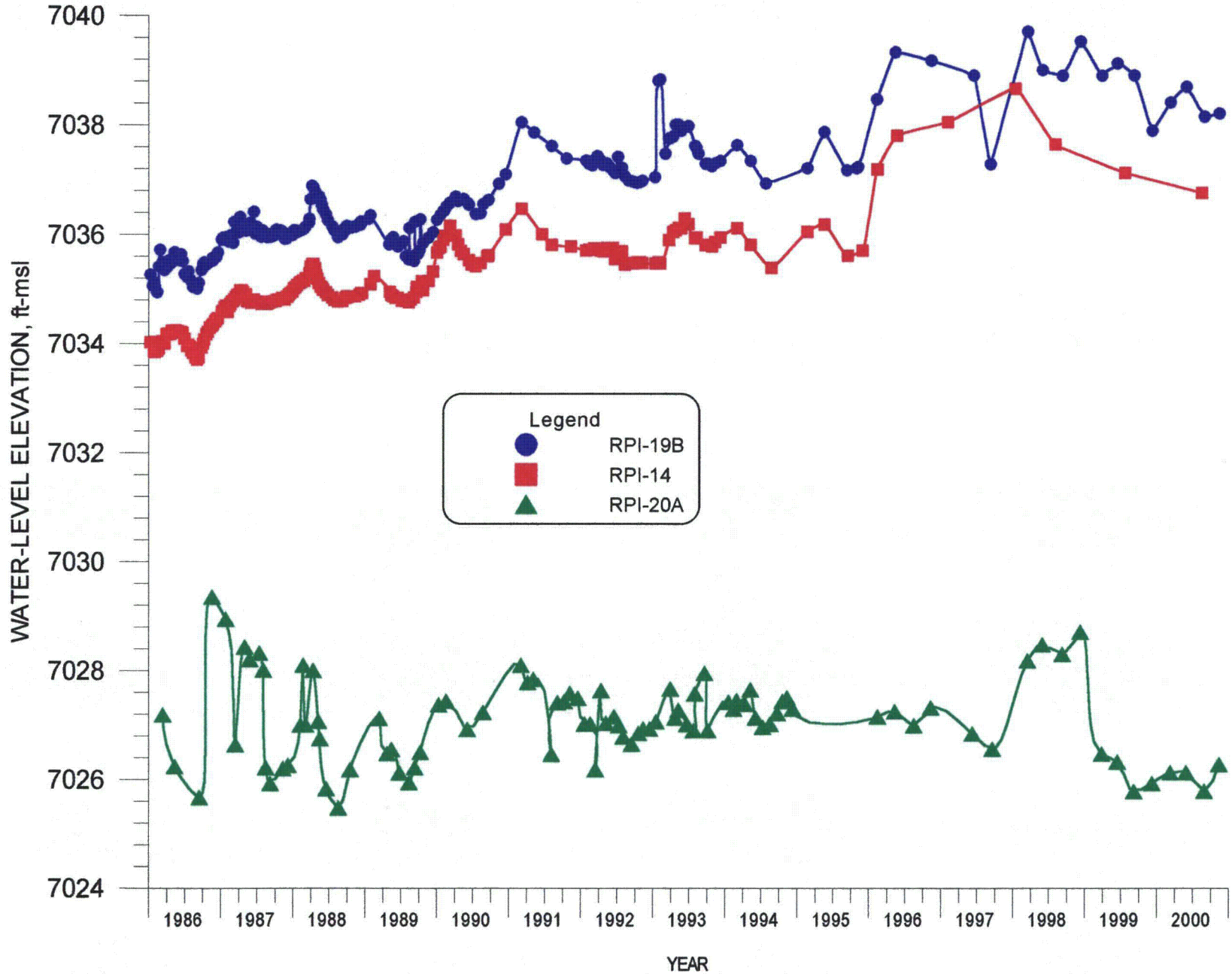


FIGURE 3.3-3. WATER-LEVEL ELEVATION FOR WELLS RPI-19B, RPI-14 AND RPI-20A.

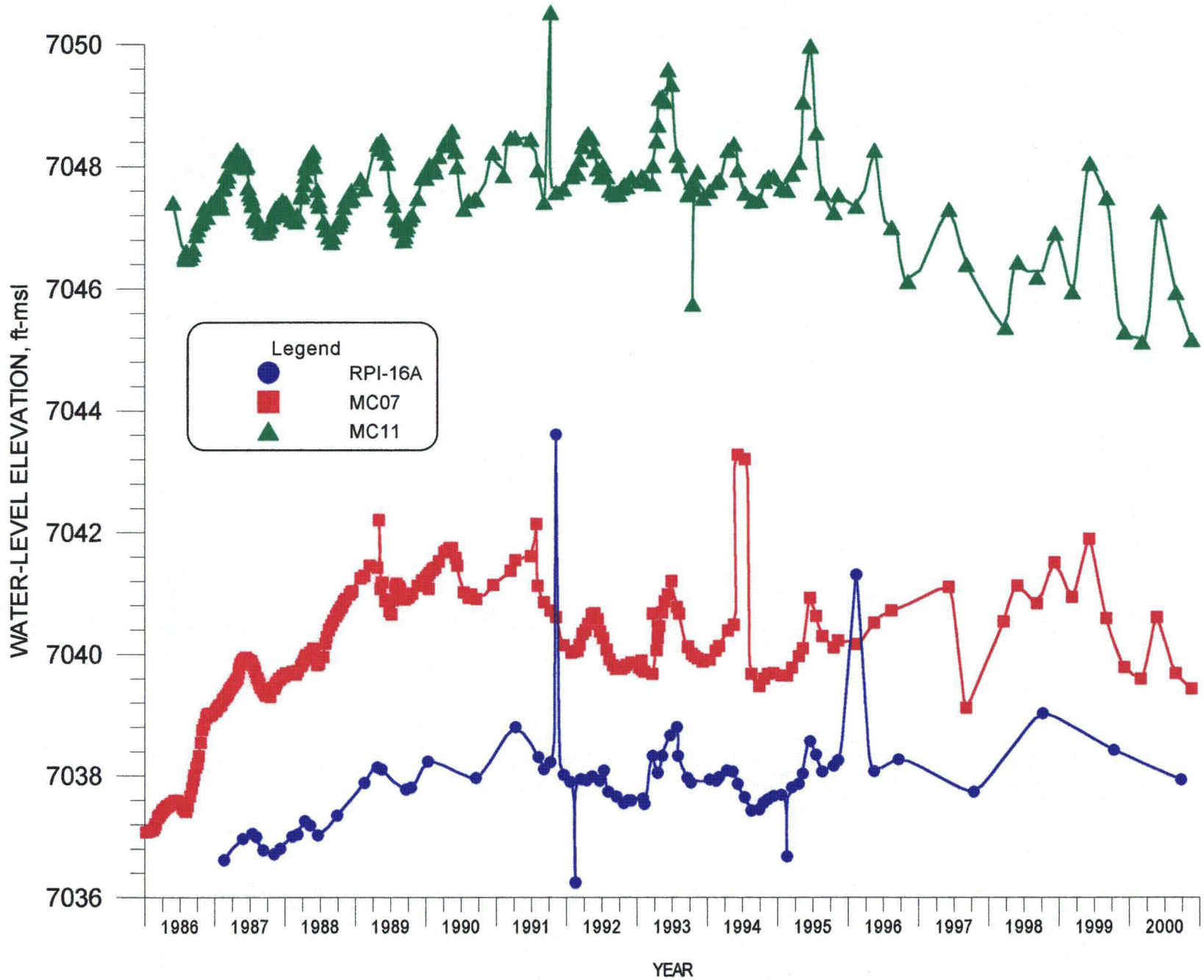


FIGURE 3.3-4. WATER-LEVEL ELEVATION FOR WELLS RPI-16A, MC07 AND MC11.

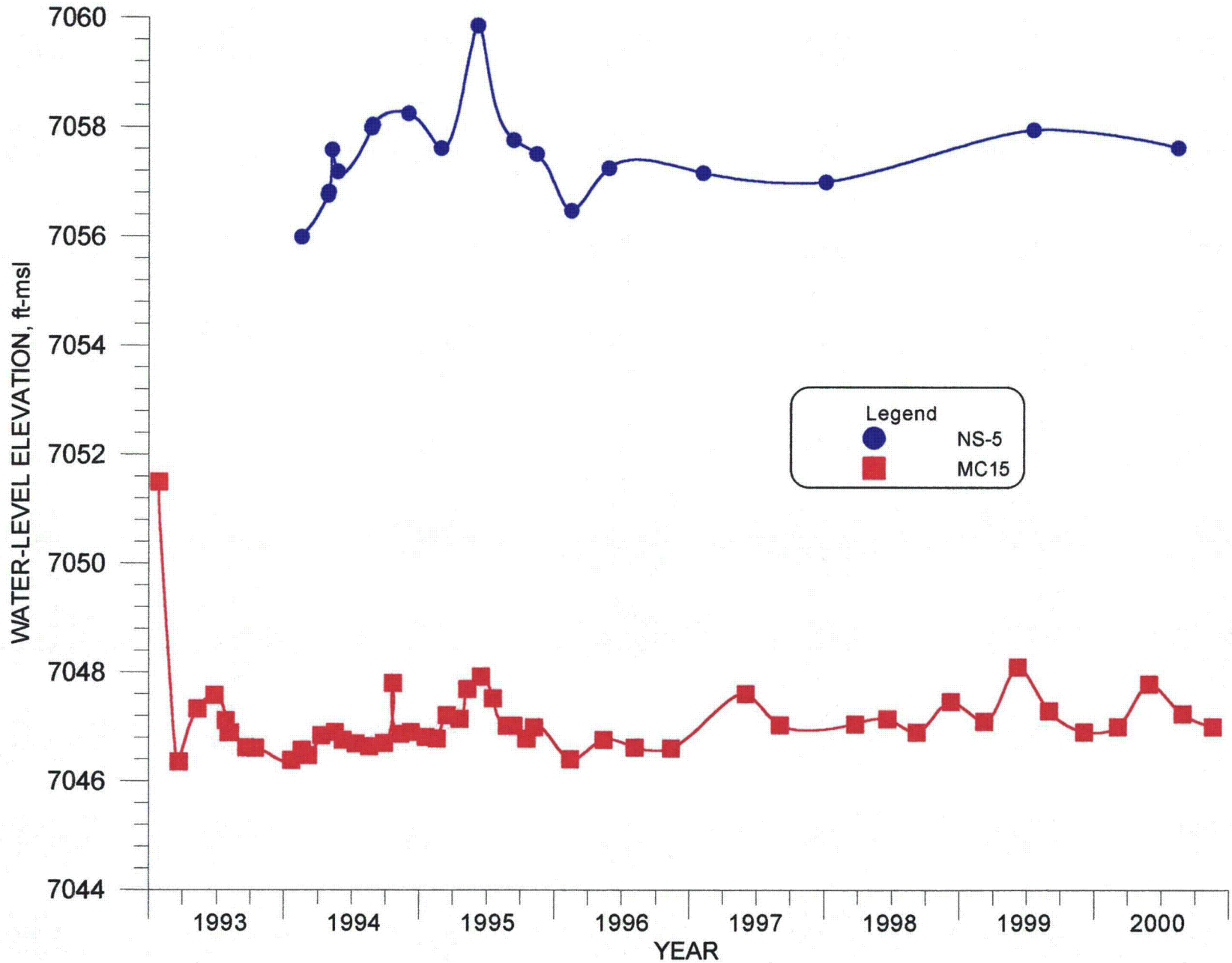


FIGURE 3.3-5. WATER-LEVEL ELEVATION FOR WELLS NS-5 AND MC15.

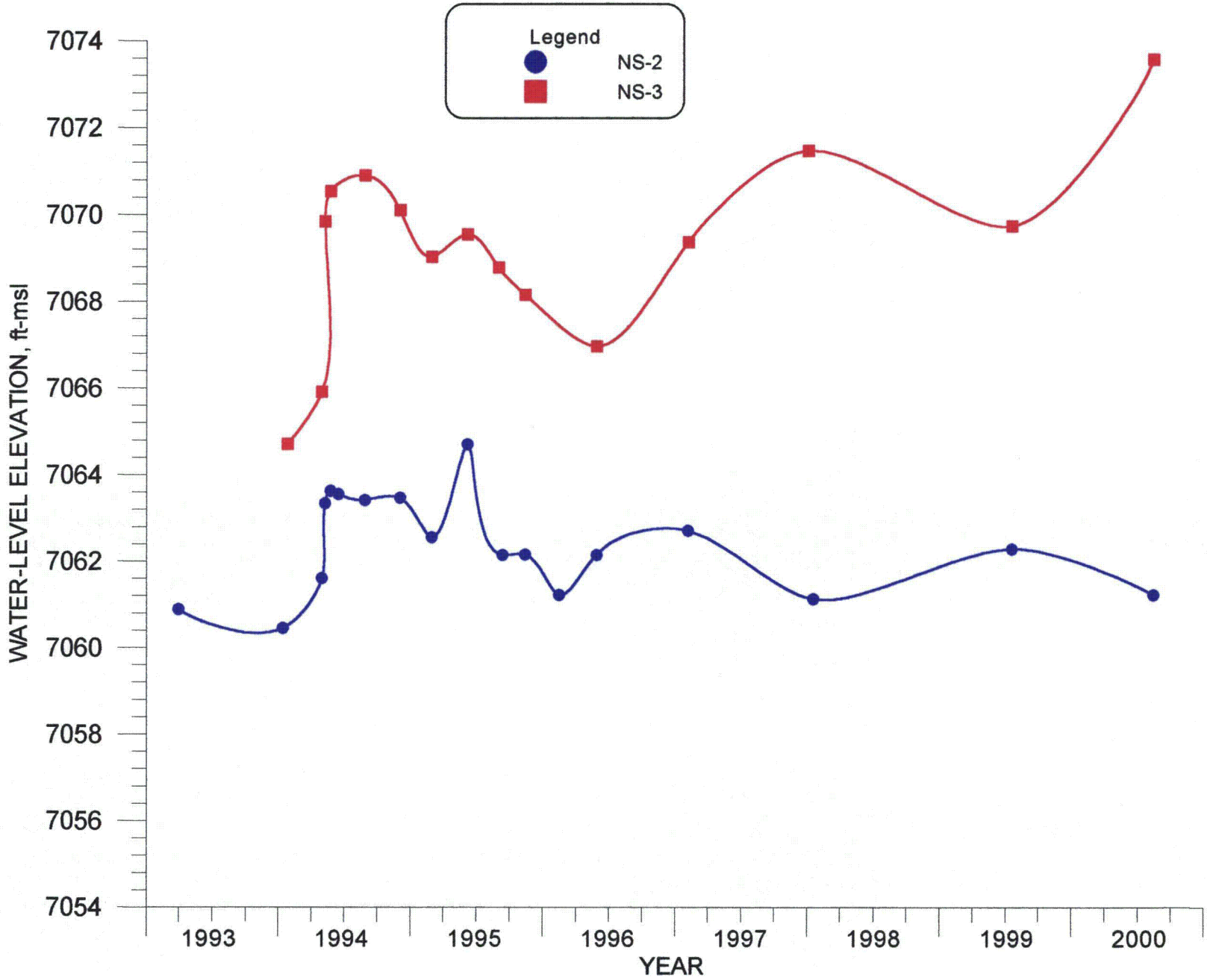


FIGURE 3.3-6. WATER-LEVEL ELEVATION FOR WELLS NS-2 AND NS-3.

4.0 SURFICIAL AQUIFER WATER QUALITY

Tables 4.0-1 and 4.0-2 present year 2000 water quality data for Surficial wells in the tailings area. The year 2000 data is broken into two groups of constituents for the two tables. Values that exceed site standards in Table 1.2-1 are highlighted in Tables 4.0-1 and 4.0-2. Historic water quality data are presented in Appendices A, B and C. Appendix A presents the tabulated water quality data for the Surficial wells. Appendix B presents water quality data for White River wells, Wind River wells and tailings wells in the tailings area. Appendix C presents the surface water quality data. The ordering of the wells in the appendices and in Table 4.0-1 and Table 4.0-2 is done in alphabetical order by well name.

Water quality analyses are used to indicate the direct effect of recharge water on water quality of the Surficial aquifer. The historic indicator parameters are TDS, chloride, and conductivity. A fourth water quality parameter, uranium concentration, is incorporated as the hazardous constituent of interest. For the year 2000, maps displaying measured concentrations or activity of sulfate, radium-226 + radium-228, selenium, arsenic, barium, beryllium, cadmium, chromium, gross alpha, lead, molybdenum, nickel and thorium-230 are included in this report. Of these additional constituents, only sulfate is displayed with iso-concentration contours because it is the only additional constituent that exhibits a discernable site-derived seepage plume. Chloride and TDS concentration will be used in this report to identify and convey the water-quality changes. The field conductivity has been used in the past as an important indicator of water quality. However, conductivity changes for some wells are not supported by the more reliable water quality measures of chloride and TDS concentrations. The chloride and TDS concentrations are considered the primary indicators of water quality. Field conductivity is still considered a gross indication of changes in water quality but is only used when supported by other parameters or when other information is not available.

Figure 4.0-1 presents the chloride contours for the Surficial aquifer in the tailings area for 2000. Chloride ions are usually considered conservative (not affected by chemical reactions or adsorption) in this

aquifer and, therefore, a good indicator of ground-water movement rates as well as water quality changes. Chloride concentrations exceed 1000 mg/l at most of the containment system collection wells. Chloride concentrations are about 50 mg/l or less in the area where the White River and Wind River waters have been recharged into the horizontal drains. The water quality in the Surficial aquifer near the containment system has greatly improved, as well as water quality in areas near Spring Creek. All concentrations downgradient of the recharge line are less than 50 mg/l except wells RPI-11 and RPI-14, where restoration has lagged due to lower permeabilities in this area. TDS and chloride concentrations in wells RPI-7A, RPI-8A, RPI-9 and RPI-20A are nearly restored, and have shown little change in recent years. This will be discussed in more detail in subsequent sections.

Figures 4.0-2, 4.0-3, 4.0-4, and 4.0-5 present the TDS, field conductivity, uranium and sulfate contours, respectively, for the Surficial aquifer in the tailings area for 2000. In general, these constituents exhibit similar patterns to chloride. These parameters are more likely to be affected by geochemical or other attenuating processes and typically exhibit more variability in background concentrations than chloride. Hence, there is probably less sensitivity to seepage impacts or corrective action efforts for these constituents when compared to chloride, but the indications of seepage impacts are similar.

Figures 4.0-6 through 4.0-17 present the Ra226 +Ra228, selenium, thorium-230, arsenic, barium, beryllium, cadmium, chromium, gross alpha, lead, molybdenum, and nickel activities or concentrations, respectively, for the Surficial aquifer in the tailings area for 2000. Occurrences of elevated concentrations or activities of these constituents do not exhibit discernable seepage patterns.

TABLE 4.0-1. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY.

Cl THROUGH Ra226+228

Sample Point Name	Date	Cl (mg/l)	SO4 (mg/l)	pH(f) (std. units)	TDS (mg/l)	Cond(f) (µmhos)	As (mg/l)	Se (mg/l)	Unat (mg/l)	Ra226 (pCi/l)	Ra228 (pCi/l)	Ra226+228 (pCi/l)
5A-1	3/8/2000	16.6	415	6.55	1160	1659	—	—	—	—	—	—
	5/23/2000	—	—	6.25	—	2560	—	—	—	—	—	—
	8/29/2000	275	620	6.80	1670	2200	—	—	—	—	—	—
	11/14/2000	203	469	6.40	1370	1925	0.0020	0.0100	***0.608***	0.500	< 1.000	< 1.50
MC05	8/15/2000	19.1	289	5.80	691	945	—	—	0.0195	—	—	—
MC06	2/29/2000	22.9	546	6.90	1250	1692	—	—	—	—	—	—
	5/22/2000	—	—	6.75	—	1880	—	—	—	—	—	—
	8/29/2000	26.7	347	5.85	896	1264	—	—	—	—	—	—
	11/20/2000	11.3	336	6.70	886	1235	0.0451	< 0.0010	***0.191***	0.600	< 1.000	< 1.60
MC07	2/29/2000	12.8	83.8	7.00	363	536	—	—	—	—	—	—
	5/22/2000	—	—	7.25	—	515	—	—	—	—	—	—
	8/29/2000	13.9	85.8	6.50	371	560	—	—	—	—	—	—
	11/20/2000	13.5	69.6	6.85	330	489	0.0056	***0.0320***	0.0185	0.500	< 1.000	< 1.50
MC08	3/7/2000	27.1	192	6.90	586	874	—	—	—	—	—	—
	11/3/2000	23.2	149	7.05	515	765	0.0111	***0.0226***	0.0516	1.30	< 1.000	< 2.30
MC09	2/29/2000	208	382	6.30	1280	1742	—	—	—	—	—	—
	5/30/2000	230	371	6.25	1300	1754	0.0018	***0.0466***	***0.629***	1.30	< 1.000	< 2.30
	8/29/2000	235	349	6.30	1320	1783	—	—	—	—	—	—
	11/20/2000	207	345	6.65	1230	1595	0.0068	***0.0697***	***0.606***	0.700	4.40	***5.10***
MC10	8/15/2000	14.6	49.1	6.80	340	502	—	—	0.0296	—	—	—
MC11	3/7/2000	166	48.6	6.80	586	1017	—	—	—	—	—	—
	5/30/2000	284	86.1	6.90	792	539	0.0017	< 0.0010	***0.117***	2.50	< 1.000	< 3.50
	8/29/2000	202	66.0	6.75	696	1192	—	—	—	—	—	—
	11/20/2000	144	28.7	6.90	512	912	0.0028	0.0011	0.0584	1.80	< 1.000	< 2.80
MC13	11/3/2000	9.60	262	6.80	604	873	0.0010	0.0020	0.0509	1.30	< 1.000	< 2.30
MC14	3/7/2000	6.30	24.9	7.00	331	529	—	—	—	—	—	—
	5/30/2000	3.50	27.6	7.20	269	1332	0.0037	< 0.0010	***0.0914***	< 0.200	< 1.000	< 1.20
	8/29/2000	7.10	25.9	7.25	339	529	—	—	—	—	—	—
	11/20/2000	7.50	23.5	7.00	333	545	0.0041	< 0.0010	***0.0923***	0.400	< 1.000	< 1.40

TABLE 4.0-1. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd)

Cl THROUGH Ra226+228

Sample Point Name	Date	Cl (mg/l)	SO4 (mg/l)	pH(f) (std. units)	TDS (mg/l)	Cond(f) (µmhos)	As (mg/l)	Se (mg/l)	Unat (mg/l)	Ra226 (pCi/l)	Ra228 (pCi/l)	Ra226+228 (pCi/l)
MC15	3/7/2000	1590	686	6.15	4100	6000	—	—	—	—	—	—
	5/30/2000	1610	681	6.15	4180	6090	—	< 0.0010	0.531	—	—	—
	8/29/2000	1460	616	6.35	3910	5550	—	—	—	—	—	—
	11/20/2000	1120	476	6.30	2960	4590	—	0.0061	0.380	1.60	< 1.000	< 2.60
MCR01	9/15/2000	18.0	270	6.95	710	961	—	0.0010	0.0720	0.400	< 1.000	< 1.40
MCR02	9/15/2000	17.8	270	7.05	684	913	—	< 0.0010	0.156	< 0.200	< 1.000	< 1.20
NP01	3/9/2000	23.1	130	7.10	371	301	—	—	—	—	—	—
	5/31/2000	18.9	135	6.20	457	539	0.0048	0.0090	0.149	0.800	2.40	3.20
	8/30/2000	20.9	142	5.60	473	683	—	—	—	—	—	—
	11/14/2000	12.1	119	6.85	449	673	0.0060	0.0130	0.141	0.400	< 1.000	< 1.40
NP02	9/15/2000	48.6	209	7.15	693	—	—	0.0220	0.377	0.800	< 1.000	< 1.80
NP03	9/19/2000	13.2	80.7	7.30	352	540	—	0.0300	0.0205	< 0.200	< 1.000	< 1.20
NP04	9/19/2000	1560	1460	6.35	5850	7690	—	0.0090	2.76	0.700	5.30	6.00
NP05	9/19/2000	25.4	56.6	7.40	405	554	—	0.0270	0.0577	1.40	< 1.000	< 2.40
NS-2	8/15/2000	151	110	6.80	647	1061	—	—	0.0546	—	—	—
NS-3	8/15/2000	24.7	131	7.40	494	759	—	—	0.0178	—	—	—
NS-5	8/15/2000	136	26.3	7.30	548	923	—	—	0.0355	—	—	—
P-2	8/15/2000	841	1080	6.70	3450	4620	—	—	0.608	—	—	—
P-3	9/20/2000	276	499	6.80	1570	2270	0.0020	0.0100	0.652	< 0.200	< 1.000	< 1.20
P-4	4/7/2000	—	—	6.75	—	1415	—	—	—	—	—	—
P-6	9/20/2000	356	445	6.60	1680	2400	0.0070	0.0970	0.627	< 0.200	< 1.000	< 1.20
P-7	4/7/2000	—	—	6.70	—	1413	—	—	—	—	—	—
P-8A	4/10/2000	256	585	6.70	1710	2270	—	—	1.16	1.20	< 1.000	< 2.20
	9/20/2000	303	629	6.60	1910	2660	0.0060	0.0180	1.48	< 0.200	< 1.000	< 1.20
P-9	9/20/2000	1300	1230	6.30	4670	6560	0.0060	0.0120	2.97	0.900	< 1.000	< 1.90
P-10	9/20/2000	1290	1070	6.40	4540	6540	0.0060	0.0090	1.51	0.600	2.10	2.70
P-11	9/20/2000	1430	1590	6.30	5630	7620	0.0080	0.0170	3.64	1.30	1.50	2.80
P-12	7/26/2000	1440	1130	6.20	4720	6590	—	—	1.68	—	—	—

TABLE 4.0-1. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd.)

Cl THROUGH Ra226+228

Sample Point Name	Date	Cl (mg/l)	SO4 (mg/l)	pH(f) (std. units)	TDS (mg/l)	Cond(f) (µmhos)	As (mg/l)	Se (mg/l)	Unat (mg/l)	Ra226 (pCi/l)	Ra228 (pCi/l)	Ra226+228 (pCi/l)
P-14	7/26/2000	1250	1140	6.40	4370	6070	—	—	*1.29*	—	—	—
P-15	7/26/2000	1480	1490	6.40	5260	7000	—	—	*1.56*	—	—	—
P-16	7/26/2000	1670	1860	6.30	6350	8100	—	—	*2.23*	—	—	—
P-17	7/26/2000	1380	1720	6.30	5700	7190	—	—	*1.64*	—	—	—
P-18	7/26/2000	858	1470	6.55	4220	5260	—	—	*1.51*	—	—	—
P-19A	8/2/2000	571	1140	6.30	3080	3940	—	—	*2.05*	—	—	—
P-20	4/10/2000	2680	1580	6.15	6950	9310	—	—	*2.72*	1.30	< 1.000	< 2.30
	8/2/2000	1850	1450	6.25	5750	7910	—	—	*2.67*	—	—	—
P-21	4/10/2000	2340	1730	6.20	7950	10570	—	—	*2.00*	2.40	1.90	4.30
	8/2/2000	2710	1790	6.05	7920	10600	—	—	*2.00*	—	—	—
RPI-10	3/9/2000	10.6	321	7.00	690	911	—	—	—	—	—	—
	8/30/2000	10.8	330	6.85	703	938	—	—	—	—	—	—
	9/27/2000	11.3	267	7.00	710	1009	0.0010	0.0020	*0.411*	< 0.200	< 1.000	< 1.20
RPI-11	8/16/2000	322	88.4	7.30	879	1454	—	—	*0.272*	—	—	—
RPI-14	8/16/2000	202	493	7.30	1320	1827	—	—	*0.202*	—	—	—
RPI-16A	9/26/2000	18.9	76.9	6.25	374	625	0.0127	*0.0274*	0.0243	< 0.200	< 1.000	< 1.20
RPI-17A	9/26/2000	11.3	233	5.40	638	993	0.0027	< 0.0010	0.0264	< 0.200	< 1.000	< 1.20
RPI-18A	9/26/2000	11.6	218	5.90	592	929	0.0036	< 0.0010	0.0485	< 0.200	< 1.000	< 1.20
RPI-19B	3/10/2000	9.70	270	6.90	615	903	—	—	—	—	—	—
	5/31/2000	11.8	276	6.50	615	873	0.0013	< 0.0010	*0.107*	< 0.200	3.00	< 3.20
	8/30/2000	10.8	283	6.20	632	907	—	—	—	—	—	—
	11/14/2000	4.20	259	6.80	632	916	0.0020	< 0.0010	0.0622	0.600	< 1.000	< 1.60
RPI-20A	3/10/2000	32.0	293	6.80	747	1082	—	—	—	—	—	—
	5/31/2000	30.8	272	6.70	713	1024	0.0177	< 0.0010	0.0170	0.400	1.50	1.90
	8/30/2000	24.7	275	6.30	712	1024	—	—	—	—	—	—
	11/14/2000	26.8	273	6.75	731	1027	0.0260	< 0.0010	0.0122	0.700	< 1.000	< 1.70
RPI-21B	3/10/2000	11.5	277	6.90	625	904	—	—	—	—	—	—
	5/31/2000	11.6	276	7.10	634	897	0.0020	< 0.0010	*0.113*	< 0.200	9.80	*< 10.00*
	8/30/2000	10.4	282	7.20	621	869	—	—	—	—	—	—

TABLE 4.0-1. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd.)

Cl THROUGH Ra226+228

Sample Point Name	Date	Cl (mg/l)	SO4 (mg/l)	pH(f) (std. units)	TDS (mg/l)	Cond(f) (µmhos)	As (mg/l)	Se (mg/l)	Unat (mg/l)	Ra226 (pCi/l)	Ra228 (pCi/l)	Ra226+228 (pCi/l)
RPI-21B	11/14/2000	< 1.000	263	6.75	630	899	0.0030	0.0010	0.0860	0.700	< 1.000	< 1.70
RPI-22	9/27/2000	10.0	219	7.20	620	982	0.0010	< 0.0010	0.0158	< 0.200	< 1.000	< 1.20
RPI-24	9/19/2000	1080	820	6.70	3630	5040	—	0.0120	1.47	< 0.200	2.40	< 2.60
SP03	9/14/2000	152	289	7.00	987	1392	—	0.0060	0.338	0.400	< 1.000	< 1.40
SP04	9/14/2000	25.5	291	7.15	740	995	—	0.0030	0.232	0.400	< 1.000	< 1.40
TW3-1	8/15/2000	2810	1750	6.35	8110	10730	—	—	1.97	—	—	—
TW4-1B	8/2/2000	2400	3590	5.50	9420	11670	—	—	1.26	—	—	—
TW4-2B	8/2/2000	2510	1370	5.90	7030	9720	—	—	1.69	—	—	—
TW4-3B	8/2/2000	3840	1360	5.80	9390	13330	—	—	4.46	—	—	—
TW4-4B	8/4/2000	4320	8090	4.00	19000	19480	—	—	5.78	—	—	—
TW4-6B	8/4/2000	4050	4620	5.40	13600	16910	—	—	0.221	—	—	—
TW4-8B	8/4/2000	511	2750	6.05	5050	5580	—	—	0.138	—	—	—
TW4-9B	8/4/2000	707	986	6.35	3130	4080	—	—	0.530	—	—	—
TW4-10B	8/9/2000	2140	2410	5.75	7870	10010	—	—	1.75	—	—	—
TW4-11B	8/9/2000	2400	2250	5.95	8160	10420	—	—	1.01	—	—	—
TW5-1B	8/9/2000	3510	1300	5.80	8480	11900	—	—	0.975	—	—	—
TW5-2B	8/9/2000	2170	4550	4.20	9880	11100	—	—	1.02	—	—	—
TW5S-1	8/16/2000	1600	797	6.65	4250	6060	—	—	0.272	—	—	—
TW5S-2	8/9/2000	575	199	5.75	1500	2290	—	—	0.238	—	—	—
TW5S-3	8/9/2000	635	359	6.00	1880	2870	—	—	0.249	—	—	—
TW5S-4	8/9/2000	841	523	6.75	2580	3820	—	—	0.537	—	—	—
TW5S-5	8/9/2000	2540	1700	6.15	7510	9870	—	—	0.891	—	—	—
TWI-21	8/10/2000	3570	1900	6.10	9290	12620	—	—	0.424	—	—	—
WWL-3A	11/8/2000	601	587	6.90	2090	3020	0.0027	0.0906	0.258	10.7	< 1.000	< 11.7
WWL-4A	11/8/2000	29.5	79.0	6.50	389	634	< 0.0010	0.133	0.0748	1.80	< 1.000	< 2.80
WWL-10B	11/8/2000	75.5	310	6.50	787	1106	< 0.0010	0.0816	0.0714	1.90	< 1.000	< 2.90
WWL-12B	11/8/2000	1690	646	6.25	4010	6080	0.0061	0.0335	0.804	3.90	< 1.000	< 4.90

TABLE 4.0-1. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd.)

Cl THROUGH Ra226+228

Sample Point Name	Date	Cl (mg/l)	SO4 (mg/l)	pH(f) (std. units)	TDS (mg/l)	Cond(f) (µmhos)	As (mg/l)	Se (mg/l)	Unat (mg/l)	Ra226 (pCi/l)	Ra228 (pCi/l)	Ra226+228 (pCi/l)
WWL-13B	11/8/2000	110	1060	6.50	2500	2980	0.0242	*0.367*	*17.1*	1.80	< 1.000	< 2.80
WWL-14A	11/3/2000	191	115	6.50	733	1160	0.0053	*0.0264*	*0.107*	1.70	< 1.000	< 2.70
WWL-14B	11/3/2000	89.2	2050	6.40	3460	3790	0.0166	*0.548*	*0.776*	4.60	3.40	*8.00*
WWL-15A	11/8/2000	599	400	6.60	1730	2510	0.0052	*0.133*	*0.137*	2.30	< 1.000	< 3.30
WWL-20B	11/8/2000	51.4	296	6.65	947	1242	0.0077	*0.0278*	*0.360*	1.30	< 1.000	< 2.30

NOTES: indicates that value exceeds the NRC site standard.
"<" sign before a value indicates that the value is less than the detection limit.
An "f" subscript on a parameter indicates that values were field measured.
All values are in MG/L unless otherwise noted and the following:
COND = conductivity in micromhos/cm @ 25 DEC. C
pH = pH, in standard units
"#" symbol before a value indicates that the value was a re-check sample.

TABLE 4.0-2. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd.)

Th-230 THROUGH Ni

Sample Point Name	Date	Th230 (pCi/l)	Alpha (pCi/l)	Ba (mg/l)	Be (mg/l)	Cd (mg/l)	Cr (mg/l)	NO3 (mg/l)	Fe (mg/l)	Pb (mg/l)	Mo (mg/l)	Ni (mg/l)
5A-1	3/8/2000	—	—	—	—	—	—	0.600	—	—	—	—
	8/29/2000	—	—	—	—	—	—	0.950	—	—	—	—
	11/14/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.620	—	< 0.0500	< 0.100	< 0.0500
MC06	2/29/2000	—	—	—	—	—	—	0.600	—	—	—	—
	8/29/2000	—	—	—	—	—	—	< 0.100	—	—	—	—
	11/20/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	< 0.0500	< 0.100	< 0.0500
MC07	2/29/2000	—	—	—	—	—	—	1.35	—	—	—	—
	8/29/2000	—	—	—	—	—	—	1.24	—	—	—	—
	11/20/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	1.05	—	< 0.0500	< 0.100	< 0.0500
MC08	3/7/2000	—	—	—	—	—	—	2.02	—	—	—	—
	11/3/2000	—	—	—	< 0.0100	< 0.0050	< 0.0500	1.40	—	—	—	< 0.0500
MC09	2/29/2000	—	—	—	—	—	—	3.15	—	—	—	—
	5/30/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	3.77	—	< 0.0500	< 0.100	< 0.0500
	8/29/2000	—	—	—	—	—	—	4.74	—	—	—	—
	11/20/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	4.29	—	< 0.0500	< 0.100	< 0.0500
MC11	3/7/2000	—	—	—	—	—	—	0.410	—	—	—	—
	5/30/2000	< 0.200	1.80	0.100	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	< 0.0500	< 0.100	< 0.0500
	8/29/2000	—	—	—	—	—	—	< 0.100	—	—	—	—
	11/20/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	< 0.0500	< 0.100	< 0.0500
MC13	11/3/2000	—	—	—	< 0.0100	< 0.0050	< 0.0500	0.350	—	—	—	< 0.0500
MC14	3/7/2000	—	—	—	—	—	—	0.590	—	—	—	—
	5/30/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.100	—	< 0.0500	< 0.100	< 0.0500
	8/29/2000	—	—	—	—	—	—	0.110	—	—	—	—
	11/20/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.150	—	< 0.0500	< 0.100	< 0.0500
MC15	3/7/2000	—	—	—	—	—	—	0.930	—	—	—	—
	5/30/2000	—	1.30	—	—	—	—	0.540	—	—	—	—
	8/29/2000	—	—	—	—	—	—	0.540	—	—	—	—
	11/20/2000	—	< 1.000	—	—	—	—	0.440	—	—	—	—
MCR01	9/15/2000	—	< 1.000	—	—	—	—	0.570	—	—	—	—

TABLE 4.0-2. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd.)

Th-230 THROUGH Ni

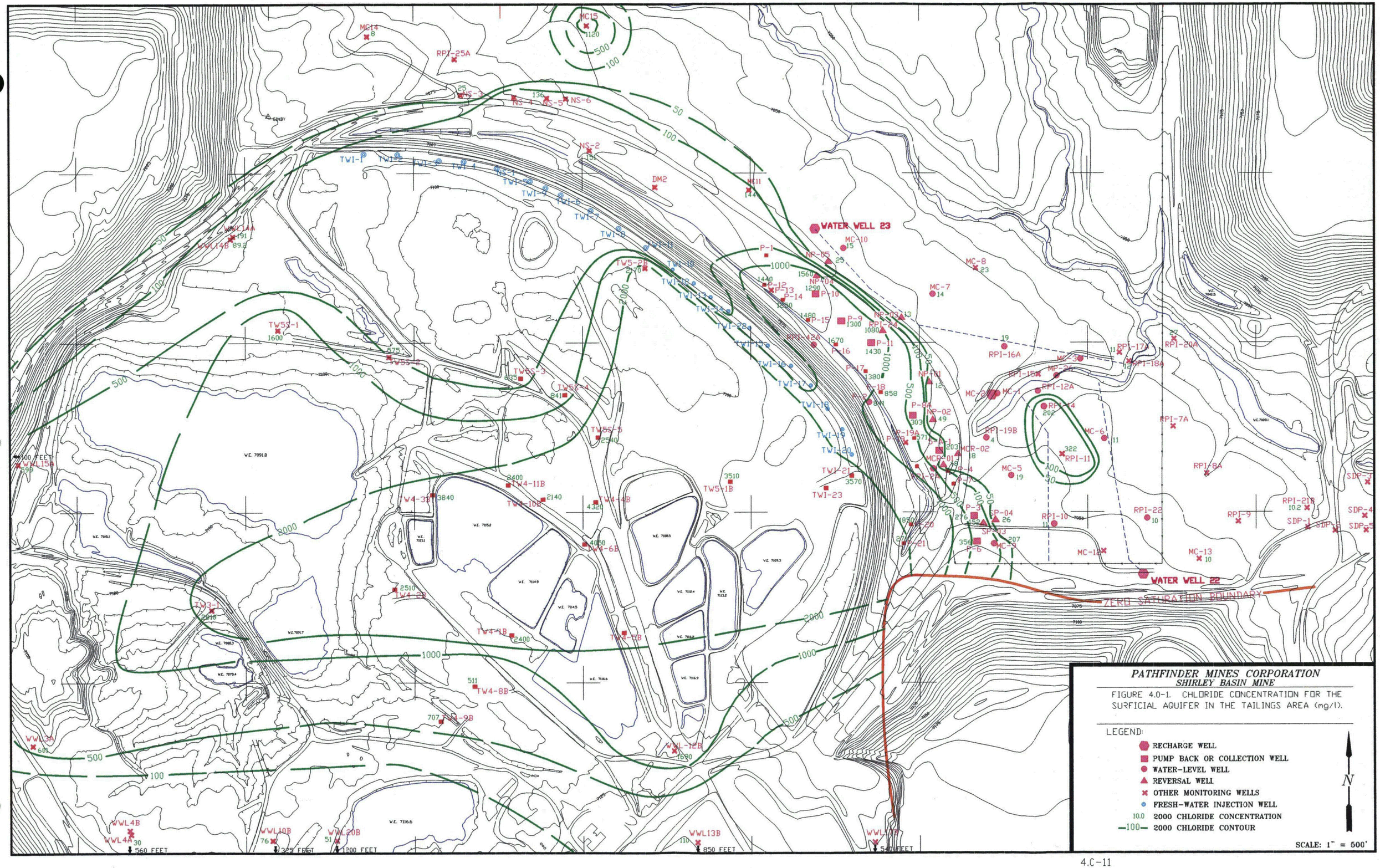
Sample Point Name	Date	Th230 (pCi/l)	Alpha (pCi/l)	Ba (mg/l)	Be (mg/l)	Cd (mg/l)	Cr (mg/l)	NO3 (mg/l)	Fe (mg/l)	Pb (mg/l)	Mo (mg/l)	Ni (mg/l)
MCR02	9/15/2000	—	< 1.000	—	—	—	—	0.240	—	—	—	—
NP01	3/9/2000	—	—	—	—	—	—	1.16	—	—	—	—
	5/31/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.810	—	< 0.0500	< 0.100	< 0.0500
	8/30/2000	—	—	—	—	—	—	0.810	—	—	—	—
	11/14/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.770	—	< 0.0500	< 0.100	< 0.0500
NP02	9/15/2000	—	< 1.000	—	—	—	—	1.07	—	—	—	—
NP03	9/19/2000	—	< 1.000	—	—	—	—	0.960	—	—	—	—
NP04	9/19/2000	—	1.30	—	—	—	—	0.110	—	—	—	—
NP05	9/19/2000	—	2.50	—	—	—	—	0.820	—	—	—	—
P-3	9/20/2000	< 0.200	—	—	< 0.0100	< 0.0100	< 0.0500	1.52	—	—	—	< 0.0500
P-6	9/20/2000	< 0.200	—	—	< 0.0100	< 0.0100	< 0.0500	5.71	—	—	—	< 0.0500
P-8A	9/20/2000	< 0.200	—	—	< 0.0100	< 0.0100	< 0.0500	2.33	—	—	—	< 0.0500
P-9	9/20/2000	< 0.200	—	—	< 0.0100	< 0.0100	< 0.0500	1.11	—	—	—	0.0500
P-10	9/20/2000	< 0.200	—	—	< 0.0100	< 0.0100	< 0.0500	0.410	—	—	—	0.0500
P-11	9/20/2000	< 0.200	—	—	< 0.0100	< 0.0100	< 0.0500	1.95	—	—	—	0.0500
RPI-10	3/9/2000	—	—	—	—	—	—	< 0.100	—	—	—	—
	8/30/2000	—	—	—	—	—	—	0.100	—	—	—	—
	9/27/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.140	—	—	< 0.100	< 0.0500
RPI-16A	9/26/2000	< 0.200	—	—	< 0.0100	< 0.0050	< 0.0500	1.11	—	—	—	< 0.0500
RPI-17A	9/26/2000	< 0.200	—	—	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	—	—	< 0.0500
RPI-18A	9/26/2000	< 0.200	—	—	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	—	—	< 0.0500
RPI-19B	3/10/2000	—	—	—	—	—	—	0.550	—	—	—	—
	5/31/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.360	—	< 0.0500	< 0.100	< 0.0500
	8/30/2000	—	—	—	—	—	—	0.390	—	—	—	—
	11/14/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.520	—	< 0.0500	< 0.100	< 0.0500
RPI-20A	3/10/2000	—	—	—	—	—	—	< 0.100	—	—	—	—
	5/31/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.110	—	< 0.0500	< 0.100	< 0.0500
	8/30/2000	—	—	—	—	—	—	< 0.100	—	—	—	—

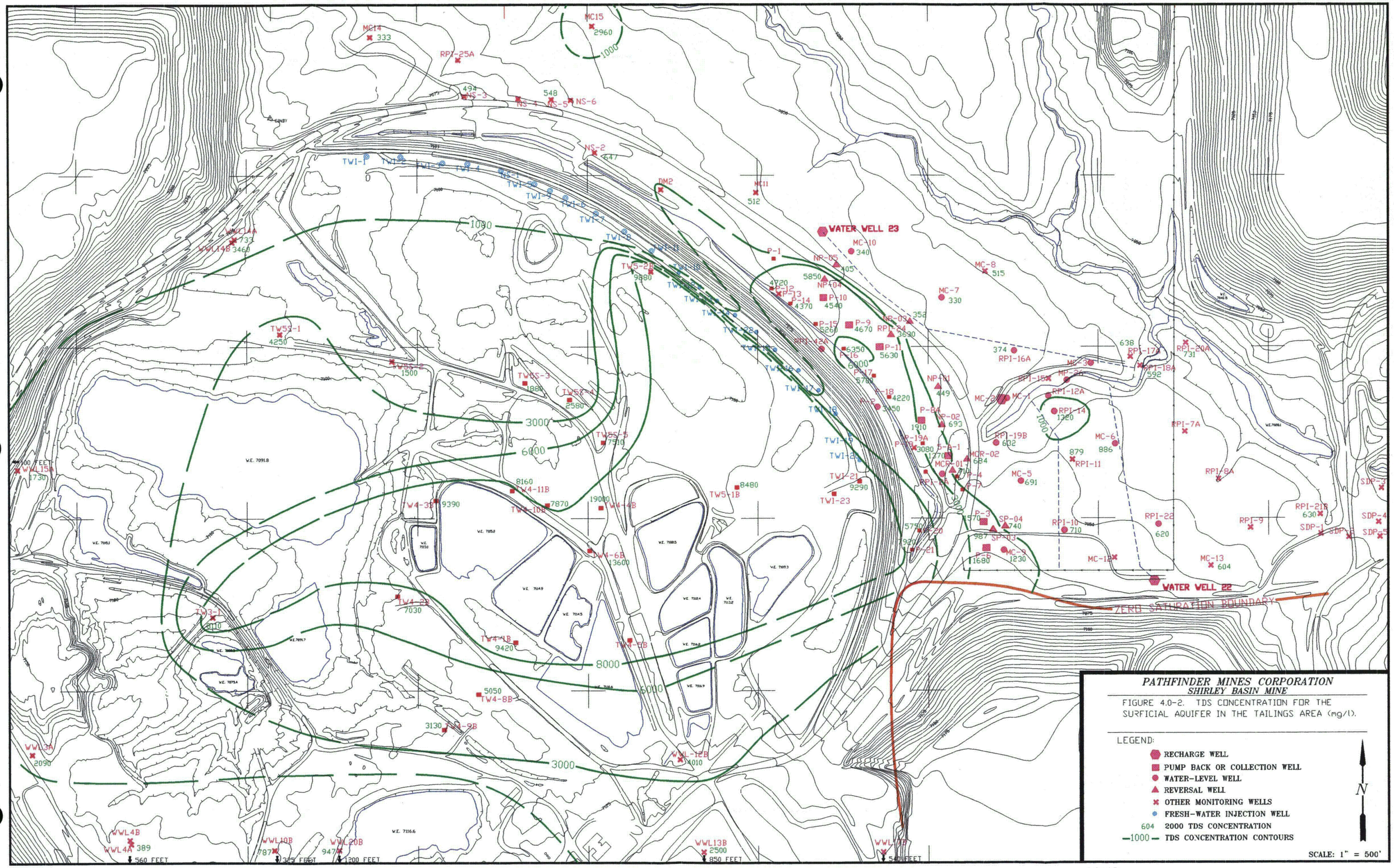
TABLE 4.0-2. YEAR 2000 SHIRLEY BASIN MINE SURFICIAL AQUIFER WATER QUALITY. (cont'd.)

Th-230 THROUGH Ni

Sample Point Name	Date	Th230 (pCi/l)	Alpha (pCi/l)	Ba (mg/l)	Be (mg/l)	Cd (mg/l)	Cr (mg/l)	NO3 (mg/l)	Fe (mg/l)	Pb (mg/l)	Mo (mg/l)	Ni (mg/l)
RPI-20A	11/14/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	< 0.0500	< 0.100	< 0.0500
RPI-21B	3/10/2000	—	—	—	—	—	—	0.400	—	—	—	—
	5/31/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.450	—	< 0.0500	< 0.100	< 0.0500
	8/30/2000	—	—	—	—	—	—	0.390	—	—	—	—
	11/14/2000	< 0.200	< 1.000	< 0.100	< 0.0100	< 0.0050	< 0.0500	0.460	—	< 0.0500	< 0.100	< 0.0500
RPI-22	9/27/2000	< 0.200	—	—	< 0.0100	< 0.0050	< 0.0500	0.600	—	—	—	< 0.0500
RPI-24	9/19/2000	—	1.000	—	—	—	—	1.34	—	—	—	—
SP03	9/14/2000	—	< 1.000	—	—	—	—	1.16	—	—	—	—
SP04	9/14/2000	—	< 1.000	—	—	—	—	0.810	—	—	—	—
WWL-3A	11/8/2000	< 0.200	11.6	< 0.100	< 0.0100	< 0.0050	< 0.0500	12.9	—	< 0.0500	< 0.100	< 0.0500
WWL-4A	11/8/2000	< 0.200	1.40	< 0.100	< 0.0100	< 0.0050	< 0.0500	1.84	—	< 0.0500	< 0.100	< 0.0500
WWL-10B	11/8/2000	< 0.200	1.70	< 0.100	< 0.0100	< 0.0050	< 0.0500	6.35	—	< 0.0500	< 0.100	< 0.0500
WWL-12B	11/8/2000	< 0.200	4.30	0.172	< 0.0100	< 0.0050	< 0.0500	5.35	—	***0.0559***	< 0.100	< 0.0500
WWL-13B	11/8/2000	< 0.200	2.50	< 0.100	< 0.0100	< 0.0050	< 0.0500	6.05	—	< 0.0500	< 0.100	< 0.0500
WWL-14A	11/3/2000	—	—	—	< 0.0100	< 0.0050	< 0.0500	1.63	—	—	—	< 0.0500
WWL-14B	11/3/2000	—	—	—	< 0.0100	< 0.0050	< 0.0500	< 0.100	—	—	—	< 0.0500
WWL-15A	11/8/2000	< 0.200	2.50	< 0.100	< 0.0100	< 0.0050	< 0.0500	2.95	—	< 0.0500	< 0.100	< 0.0500
WWL-20B	11/8/2000	< 0.200	< 1.000	0.211	< 0.0100	< 0.0050	< 0.0500	6.78	—	< 0.0500	< 0.100	< 0.0500

NOTES: indicates that value exceeds the NRC site standard.
"<" sign before a value indicates that the value is less than the detection limit.
An "f" subscript on a parameter indicates that values were field measured.
All values are in MG/L unless otherwise noted and the following:
COND = conductivity in micromhos/cm @ 25 DEC. C
pH = pH, in standard units
"#" symbol before a value indicates that the value was a re-check sample.


WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
100 FEET
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-1. CHLORIDE CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
10.0 2000 CHLORIDE CONCENTRATION
100 2000 CHLORIDE CONTOUR
N
SCALE: 1" = 500'



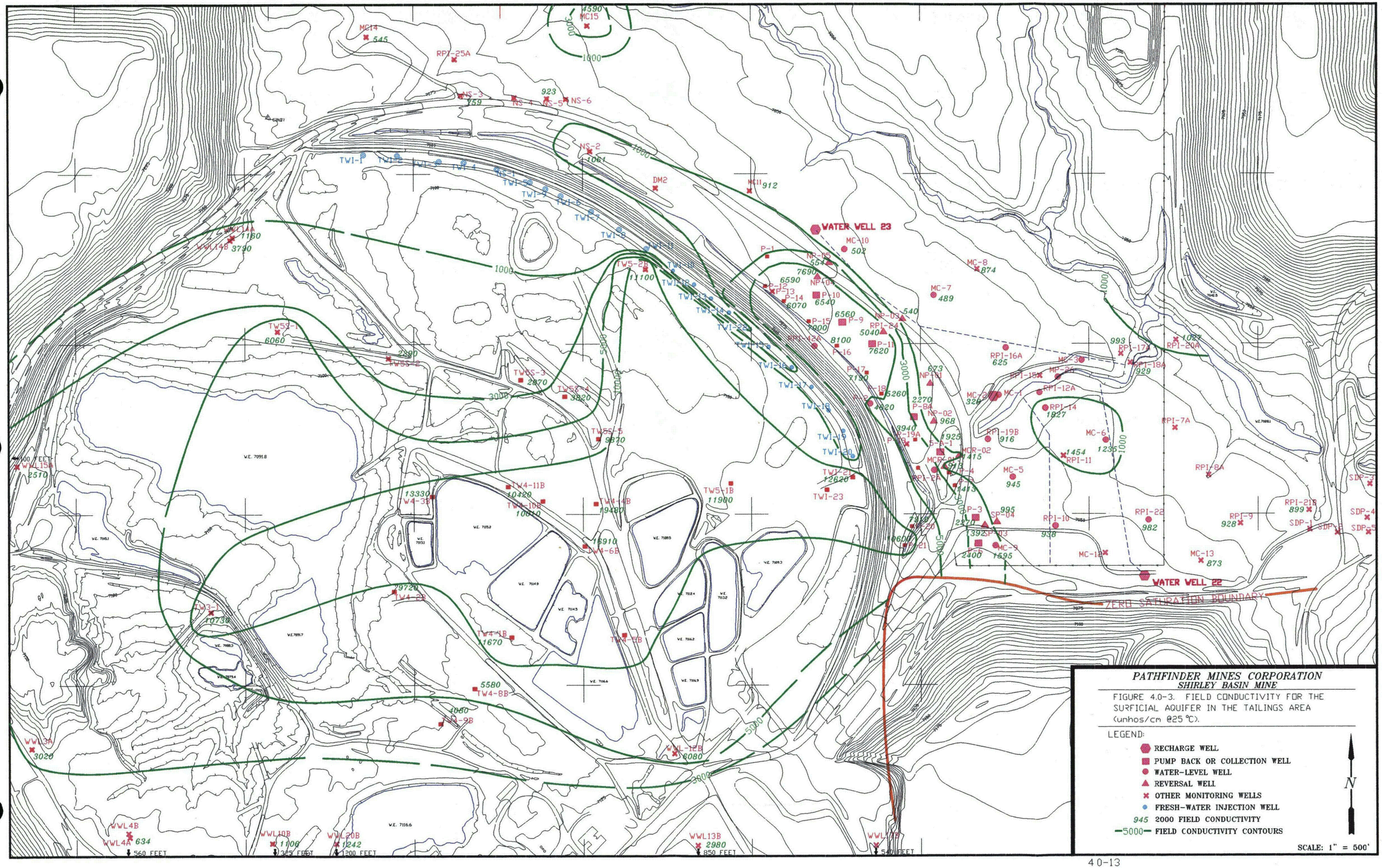
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE

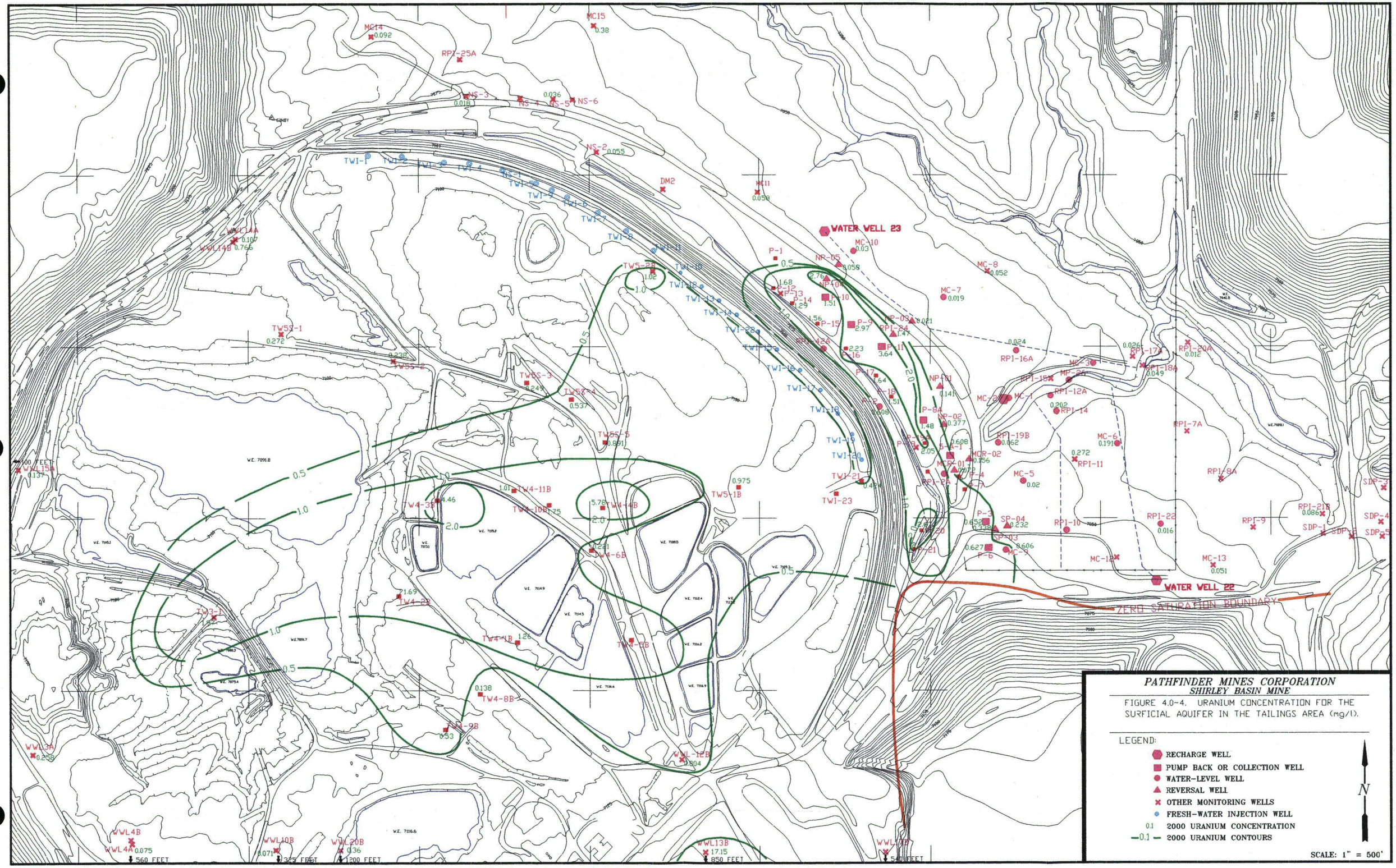
FIGURE 4.0-2. TDS CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).

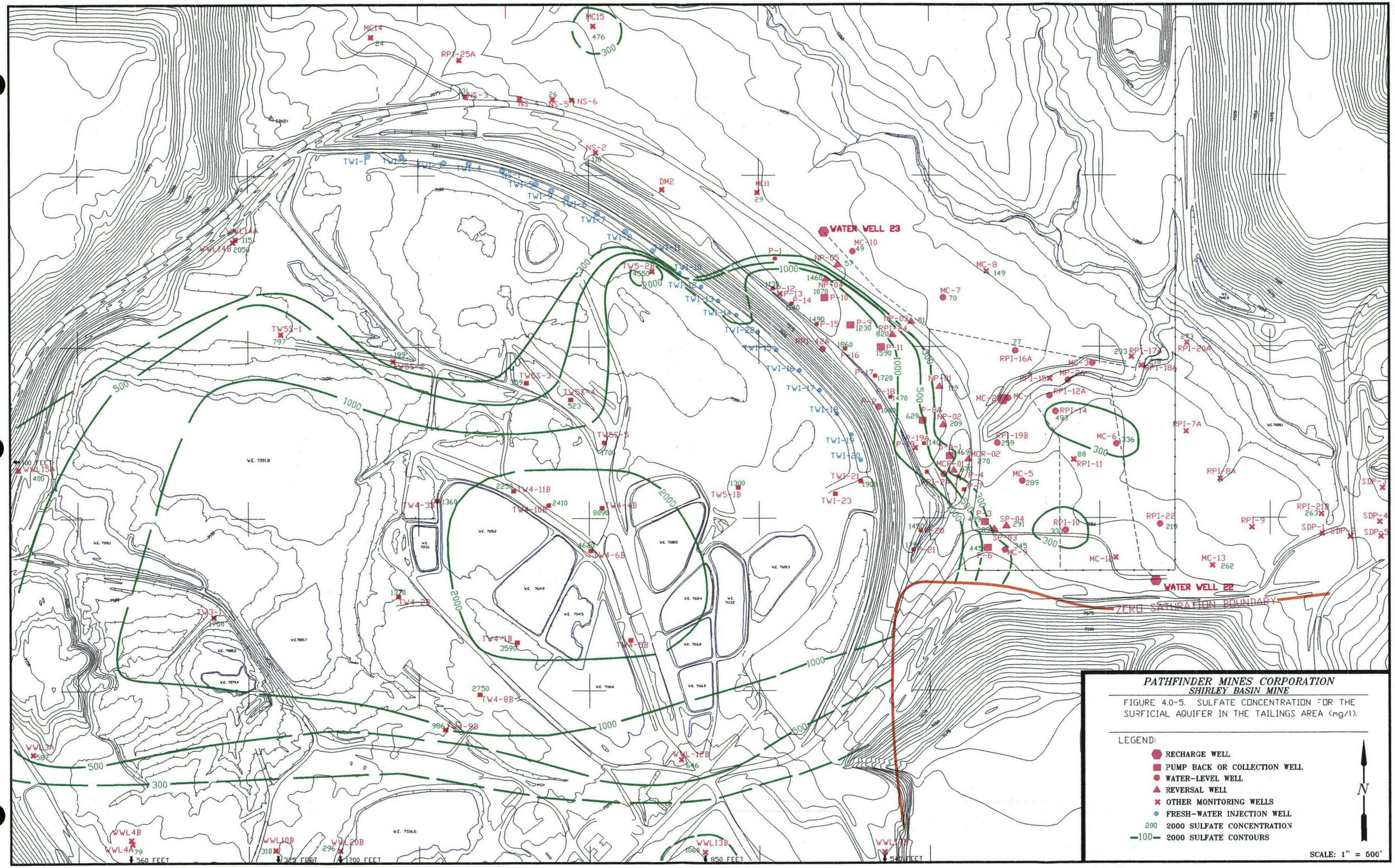
LEGEND:

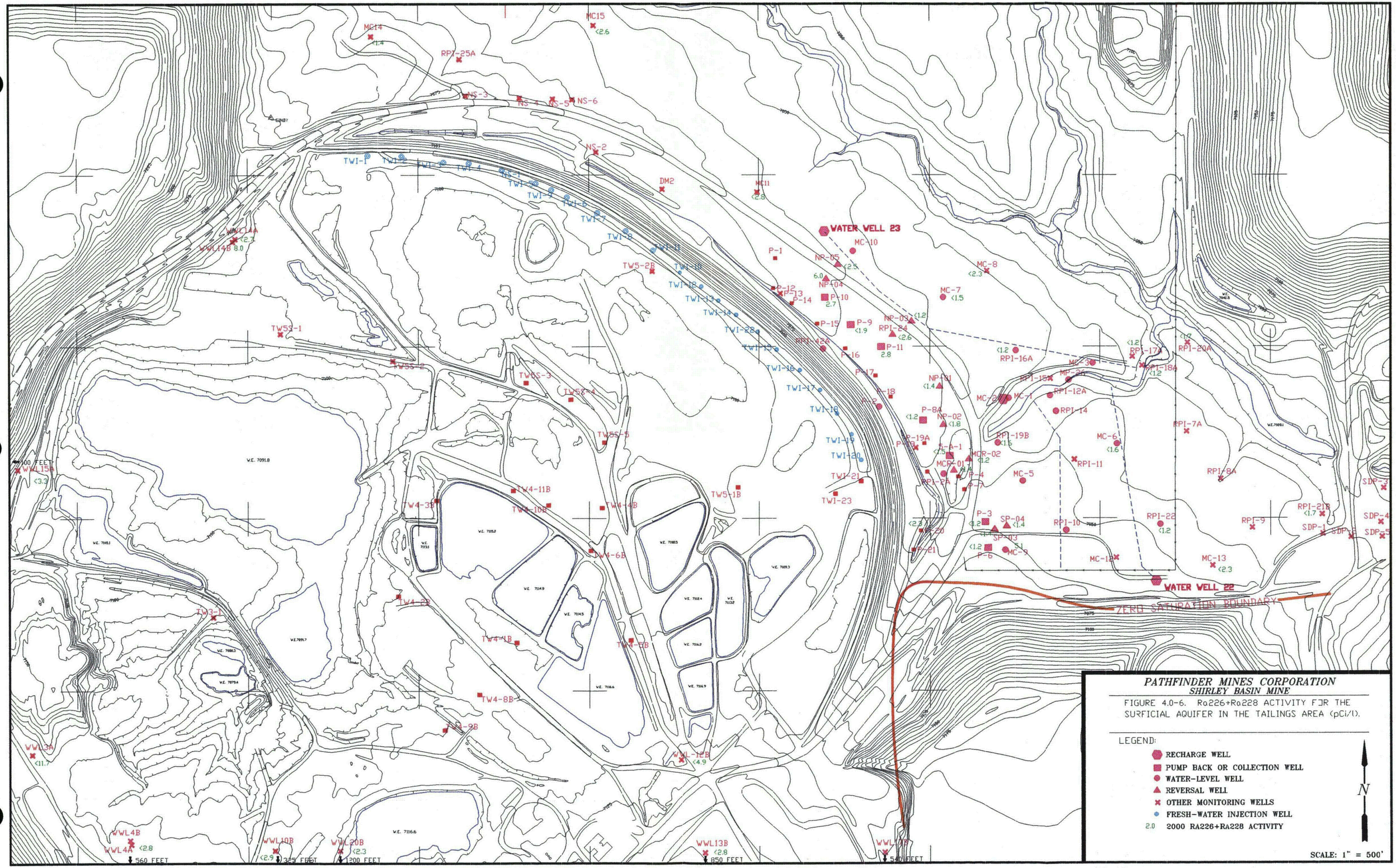
- RECHARGE WELL
- PUMP BACK OR COLLECTION WELL
- WATER-LEVEL WELL
- REVERSAL WELL
- OTHER MONITORING WELLS
- FRESH-WATER INJECTION WELL
- 604 2000 TDS CONCENTRATION
- —1000— TDS CONCENTRATION CONTOURS

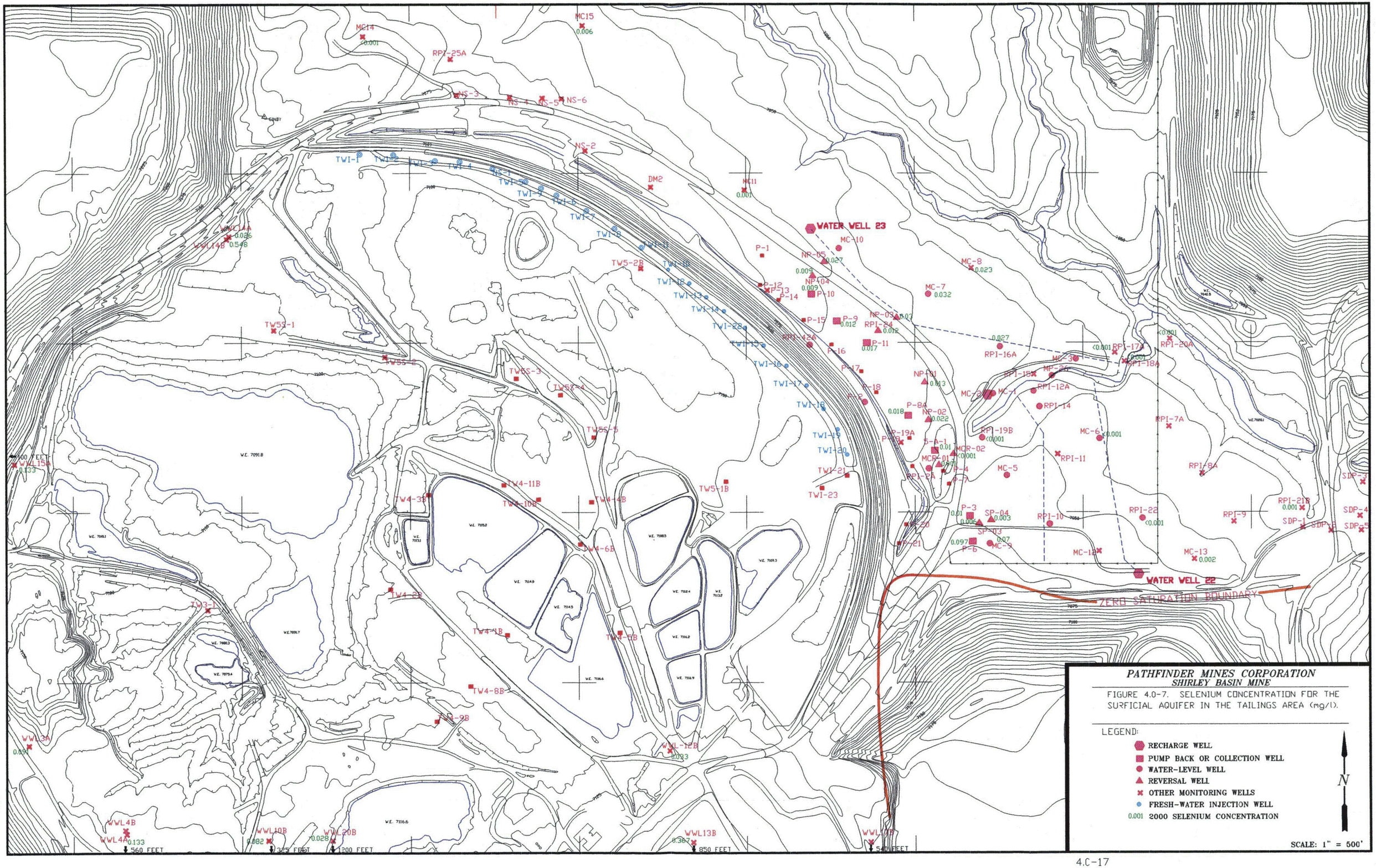
SCALE: 1" = 500'


PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-3. FIELD CONDUCTIVITY FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (umhos/cm @25 °C).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
945 2000 FIELD CONDUCTIVITY
5000 FIELD CONDUCTIVITY CONTOURS
N
SCALE: 1" = 500'
WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY


WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-4. URANIUM CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
0.1 2000 URANIUM CONCENTRATION
0.1 2000 URANIUM CONTOURS
N
SCALE: 1" = 500'


WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-5. SULFATE CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
200 2000 SULFATE CONCENTRATION
100 2000 SULFATE CONTOURS
N
SCALE: 1" = 500'


PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-6. Ra226+Ra228 ACTIVITY FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (pCi/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
2.0 2000 RA226+RA228 ACTIVITY
N
SCALE: 1" = 500'
WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
100 FEET
560 FEET
325 FEET
1200 FEET
850 FEET
540 FEET



PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE

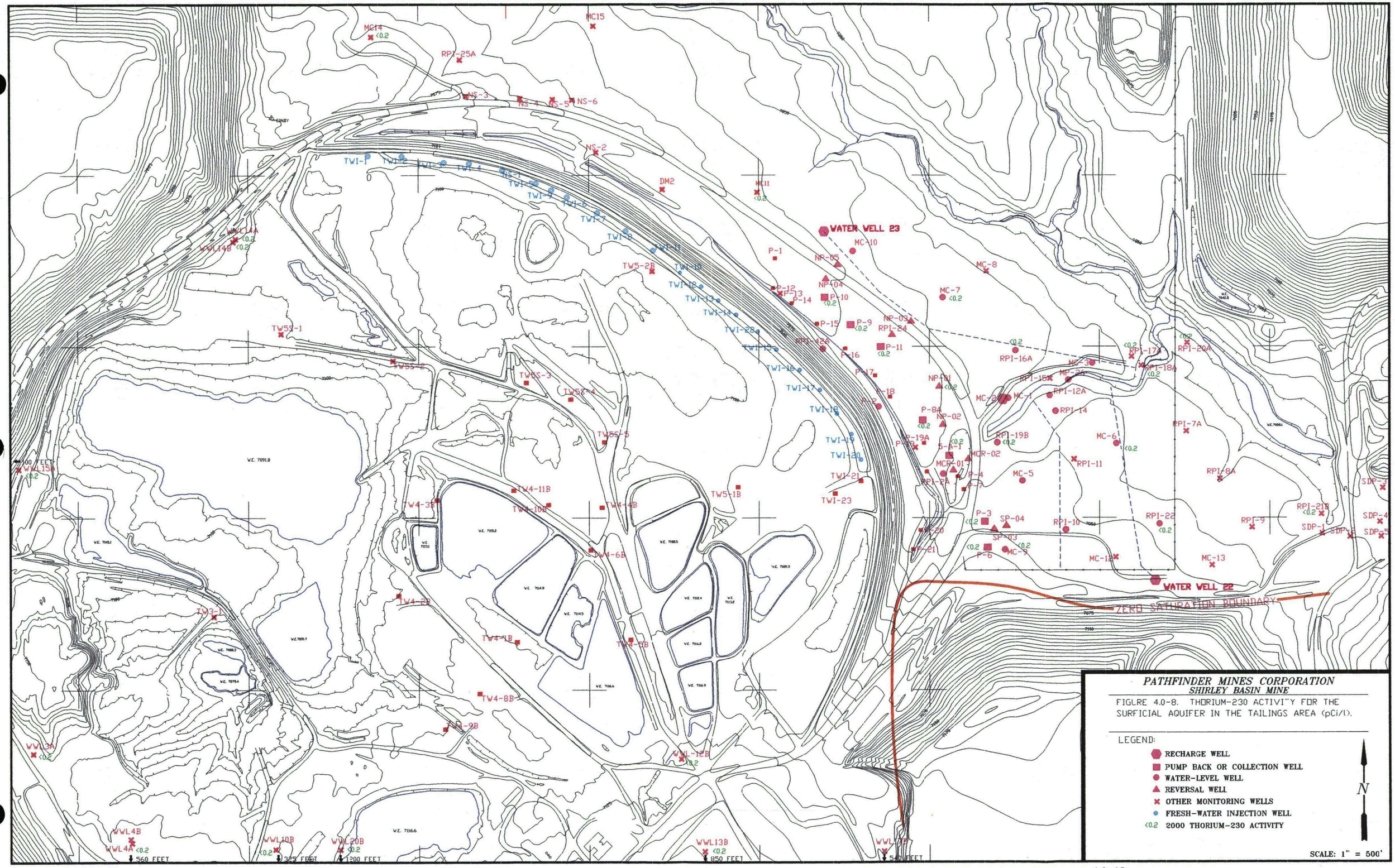
FIGURE 4.0-7. SELENIUM CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).

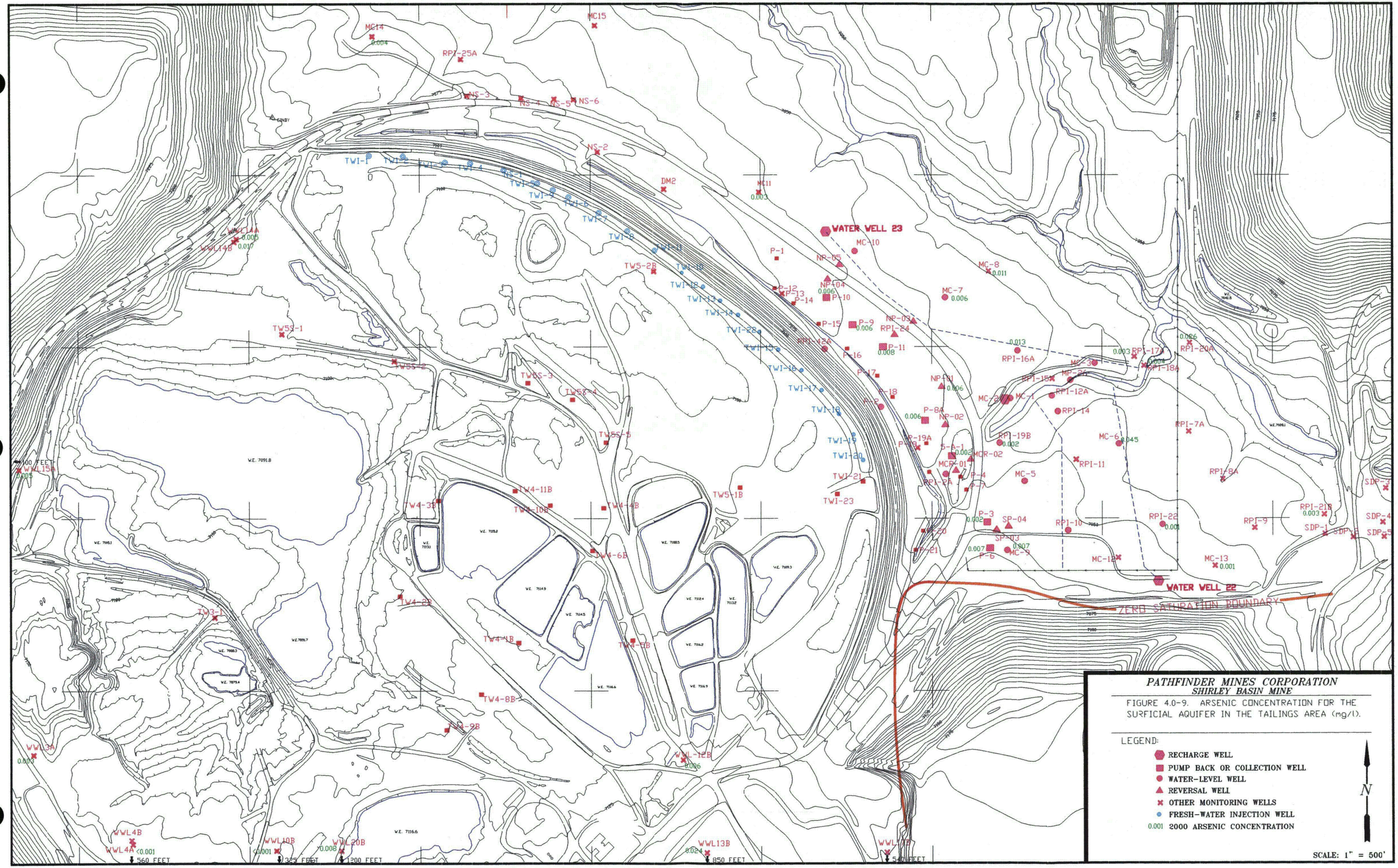
LEGEND:

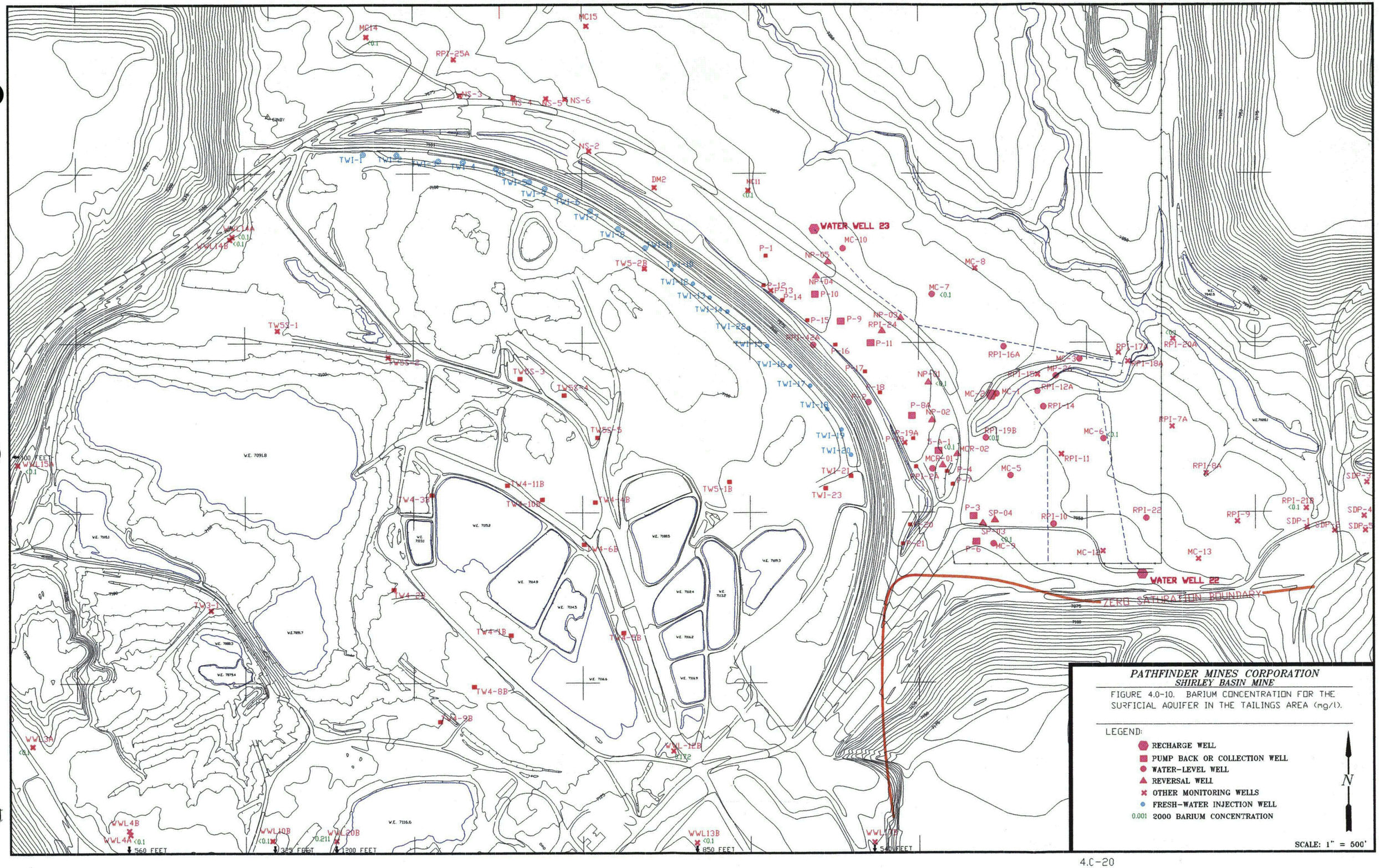
- RECHARGE WELL
- PUMP BACK OR COLLECTION WELL
- WATER-LEVEL WELL
- REVERSAL WELL
- OTHER MONITORING WELLS
- FRESH-WATER INJECTION WELL
- 0.001 2000 SELENIUM CONCENTRATION

N

SCALE: 1" = 500'


WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-8. THORIUM-230 ACTIVITY FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (pCi/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
<0.2 2000 THORIUM-230 ACTIVITY
N
SCALE: 1" = 500'


WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-9. ARSENIC CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
0.001 2000 ARSENIC CONCENTRATION
N
SCALE: 1" = 500'


WATER WELL 23
WATER WELL 22
ZERO SATURATION BOUNDARY
PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE
FIGURE 4.0-10. BARIUM CONCENTRATION FOR THE SURFICIAL AQUIFER IN THE TAILINGS AREA (mg/l).
LEGEND:
RECHARGE WELL
PUMP BACK OR COLLECTION WELL
WATER-LEVEL WELL
REVERSAL WELL
OTHER MONITORING WELLS
FRESH-WATER INJECTION WELL
0.001 2000 BARIUM CONCENTRATION
N
SCALE: 1" = 500'
100 FEET
560 FEET
325 FEET
1200 FEET
850 FEET
540 FEET