PETROTOMICS COMPANY
770 W. Collins, Suite 100, Casper, Wyoming 82601 Telephone: (307) 234-9341

April 25, 2002

Mr. Melvyn Leach, Chief
Fuel Cycle Licensing Branch, FCSS
C/o Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

40-6659

Re: Petrotomics Company, Shirley Basin, Wyoming
Second Response to DEQ, August 2, 2001 Letter to Mr. Phillip Ting, NRC

Dear Mr. Leach:

Pursuant to Mr. Gary Beach's, Wyoming Department of Environmental Quality, Water Quality Division Administrator, August 2, 2001 letter to Mr. Ting, as well as, numerous discussions with the NRC staff, Petrotomics has the following comments regarding sulfate concentrations beyond its northern Long Term Care Area Boundary (LCAB).

In the August 2, 2001 letter Mr. Beach noted that the DEQ's primary concern is the likelihood of sulfate contaminated groundwater migrating off the facility property, basically beyond the northeastern LCAB by approximately 200 feet by the year 2200. Petrotomics original conservative ACL groundwater model projected sulfate concentrations on the order of 6000 mg/l to migrate beyond the northeastern LCAB. Mr. Beach further notes, that since WDEQ Chapter 8, Class III groundwater use standards for sulfate are 3000 mg/l (livestock use) Petrotomics would be out of compliance with the State standard in the year 2200. The DEQ requested that some control measure be implemented that would restrict this slight exceedence or asked if the NRC or Department of Energy would be liable in the future. Prior to the DEQ inquiry Petrotomics had performed a cost benefit analysis and determined that engineered solutions would not be cost effective for the benefits derived. The engineered fix would also involve groundwater pumping directly effecting the commingled 11(e) 2 materials NRC had in the ACL.

Petrotomics reviewed DEQ's concerns and provided numerous items for DEQ consideration, which it believed, would rectify the exceedence. These options were outlined in our December 2, 1998 correspondence to the DEQ and NRC. The DEQ ignored those options until they recognized that Petrotomics closure was near.

In view of Petrotomics pending license termination and site transfer to the DOE, we moved forward with a technical analysis of the sulfate issue. In recent consultation with the NRC staff, Petrotomics contracted with Lewis Water Consultants to review our original ACL model as well as, the current groundwater conditions, and remodel sulfate.

Petrotomics has observed increasing water levels in its northern wells. These increases are directly associated with the rapid filling and recharge of our neighbor's (Pathfinder Mines, Inc.) 200 acre lake in Section 33. This lake is adjacent to the area projected to have the sulfate exceedence in 2200. The filling and recharge has accelerated our projected model result by at

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least 50 year. It is demonstrating a reversal of groundwater flow from the north to the southeast; this southeast flow of lake groundwater is overtaking the projected movement of sulfate flow from our property to the north.

In addition, Lewis Water Consultants have clearly demonstrated that by running the original ACL groundwater model (The fate and transport model presented in Section 2.2.4 of the ACL application.) with current groundwater conditions forward, Petrotomics projected sulfate plume actually is shrinking. Further the current data and modeling shows that the 6000 mg/l plume remains well within the LCAB, never causing an exceedeance of the State use standard of 3000 mg/l beyond the property line.

The results of the most recent modeling (April 2002) run have been discussed with the NRC staff and are attached hereto.

Consequently, Petrotomics assures the NRC that it is and will continue to be in compliance with NRC and State of Wyoming use standards. Further, the effects of naturally occurring gypsum precipitate (a sulfate retardant), dispersion and mixing will continue to reduce and attenuate sulfate concentrations within the LCAB.

Petrotomics does not now, nor will we have a problem with exceeding the State use standard beyond our LCAB. The NRC and DOE will not have an exceedence beyond the LCAB to mitigate with the State of Wyoming.

Petrotomics request the NRC present these conclusions to Mr. Beach and the Wyoming DEQ. Should you wish to discuss this further, please feel free to contact me at (307) 234-9341 or Mr. Mike Franko at the Denver Office (303) 793-4379.

Sincerely,

Stephen J. Pfaff
Site Supervisor

PC: U.S. Nuclear Regulatory Commission
Mr. Rick Weller – ADDRESSEE ONLY
Fuel Cycle Licensing Branch
Mail Stop T-8A33
Washington, DC 20555

Update of Sulfate Transport Modeling at the Petrotomics Site

Prepared for:

Petrotomics Company
770 W. Collins Avenue
Casper, WY 82601

Prepared by:

Lewis Water Consultants, Inc.
11808 Decatur Drive
Westminster, Colorado 80234

April 16, 2002

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Attachment B Pathfinder Area 2/8 Reservoir Elevation Data
Attachment C Sulfate Concentration in Groundwater, June 1998

1. INTRODUCTION

This report provides an update to previously completed sulfate transport simulations at the former Petrotomics uranium mine and mill tailings site in Shirley Basin, Wyoming (Figure 1). Previous simulations completed as part of the application for Alternate Concentration Limits (ACLs) suggested that sulfate concentrations along Petrotomics Long Term Care Area Boundary (LCAB) may exceed the State of Wyoming Class III groundwater livestock use standard of 3,000 mg/l as early as the year 2000 (Figure 2-36, Petrotomics, 1996). Based on recent groundwater monitoring data, the accelerated filling of the Pathfinder Area 2/8 reservoir, and the conservative nature of model predictions, concentrations of sulfate should never exceed 3,000 mg/l along the LCAB. Therefore, Petrotomics believes that U.S. NRC and Wyoming DEQ concern regarding potential sulfate excursions beyond the LCAB at concentrations greater than 3,000 mg/l are unwarranted. The purpose of this work is to update the sulfate transport model with more current field data, and to predict the resulting sulfate concentrations in groundwater over a 1000-year period to quantitatively address this issue.

1.1 Background

As discussed in detail in the ACL application, the original transport model was never designed to predict observed chemical concentrations in groundwater, but to *overpredict* concentrations and provide a margin of safety, in accordance with NRC ACL application guidance. This conservatism was demonstrated to the NRC by verifying the flow and transport model over the period 1993-1997 (Petrotomics, 1998). Results of this modeling indicated sulfate concentrations were overpredicted by more than 50 percent in 11 of 12 wells located downgradient of the covered tailings.

Given that the original transport model was designed to overpredict chemical concentrations in groundwater, it is not surprising that results of recent groundwater monitoring at the site show groundwater concentrations at the site are currently much lower than originally predicted by the transport model. Concentrations of sulfate in existing monitoring wells have declined on average

by more than 20 percent since 1998, and more than 30 percent since 1992. These observations are in sharp contrast to transport modeling results that predicted increasing concentrations downgradient of the facility over the same period (Petrotomics, 1996; Petrotomics, 1998).

In addition to the observed decrease in chemical concentrations at the site, the groundwater flow direction and velocity has changed significantly in recent years due to the accelerated filling of the Pathfinder Area 2/8 reservoir (formerly Pathfinder Pit 33, Figure 1). As a result, the groundwater flow direction in the Main Sand aquifer has shifted from northward (toward the reservoir), to eastward (away from the reservoir) in a much more rapid fashion than originally predicted. Hydraulic gradients in both the Upper and Main Sands are essentially flat, with associated low groundwater velocities. Current groundwater flow direction and velocity at the site therefore precludes significant migration of chemical constituents toward the LCAB. The location of the Petrotomics LCAB is shown on Figure 1. These observations provide factual support for Petrotomics contention that sulfate concentrations will not exceed 3,000 mg/l at the LCAB in the future.

2. SULFATE MODELING APPROACH

The purpose of this work is to update the original sulfate transport model using recent water level and water quality data, and simulate sulfate transport over the next 1000 years (starting in January of 2002) in a manner identical to that employed in the original ACL application (Petrotomics, 1996). In other words, only the initial conditions for the flow and transport models were changed; all other flow and transport model parameters and assumptions remain identical to that of the original transport model. In this manner, the conservatism of model predictions remains intact.

2.1 Flow Model Simulation

The previously calibrated and verified MODFLOW model was utilized to simulate groundwater flow at the site (Petrotomics, 1996; Petrotomics, 1998). The flow model was initialized to average annual conditions observed in 1997 that resulted from the model verification effort

(Petrotomics, 1998). Model boundary cells representing the Area 2/8 reservoir were updated using average annual water level data obtained from the Pathfinder Area 2/8 reservoir (Attachment B). The model was run forward from 1997 to January of 2002 using the updated Area 2/8 reservoir elevation data. MODFLOW results for January of 2002 were used as the starting point for sulfate transport simulations. The predicted water level elevation of the Upper and Main Sands in January of 2002 is provided in Figures 2 and 3, respectively.

The groundwater flow model was moved forward in transient mode from January of 2002 until an approximate steady state condition was achieved in approximately 2040 (slightly sooner than originally predicted due to the accelerated filling of the Pathfinder Area 2/8 reservoir). The projected steady state water level elevations of the Upper and Main Sands are provided in Figures 2-29 and 2-30 of Petrotomics (1996). Groundwater velocity files for sulfate modeling simulations were created from MODFLOW output files as described in Petrotomics (1996).

2.2 Sulfate Transport Model Simulation

The original RAND3D transport model was utilized to simulate sulfate transport at the site (Petrotomics, 1996). The original sulfate transport model was initialized to sulfate concentrations observed in 1995 (Figures 2-32 and 2-33, Petrotomics, 1996). In order to more accurately represent current conditions, the sulfate model was initialized to current conditions (e.g. January 2002) using the following procedure:

- Sulfate concentrations observed in the Upper and Main Sands in June of 1998 were digitized (Attachment C). The June 1998 period represents the most recent monitoring data available prior to the abandonment of the majority of site monitoring wells. Thus, the June 1998 data set provides a reasonable (and conservative) estimate for the lateral extent of sulfate in groundwater at the site for purposes of the sulfate modeling. More recent monitoring data from seven existing monitor wells indicate sulfate concentrations have decreased since June of 1998 and that the plume is likely "shrinking".

- Concentrations of the digitized June 1998 were conservatively reduced by an additional 10 % to account for the decrease in chemical concentration observed between June of 1998 and January of 2002. Concentrations in downgradient monitoring wells have decreased between 10 and 28 % (average of 20 %) since June of 1998. The resulting digitized sulfate plume was imported into the transport model as an initial condition by the procedure described in Petrotomics (1996).

Once initial sulfate concentrations were established, the model was used to simulate sulfate transport over a 1000 year period in a manner identical to that described in the original ACL application (Petrotomics, 1996).

3. RESULTS

Results of the sulfate transport modeling are illustrated in Figures 4 through 17. Sulfate concentrations in the Upper and Main Sands do not exceed 3,000 mg/l along the northern or eastern LCAB at any time during the 1000-year simulation period. It should be noted that actual sulfate concentrations are likely to be significantly lower than model results indicate due to the conservative nature of model predictions.

4. SUMMARY

Petrotomics has updated the original sulfate transport model using recent Pathfinder Area 2/8 reservoir elevations and water quality data. The updated model was used to simulate sulfate transport over a 1000 year period in a manner identical to that employed in the original ACL application (Petrotomics, 1996). Results of this modeling indicate sulfate concentrations should not exceed 3,000 mg/l along the LCAB at any time in the future.

5. REFERENCES

Petrotomics. 1996. *Petrotomics Tailings Facility Application for Alternate Concentration Limits to Amend USNRC Source Material License SUA 551.* September 1996.

Petrotomics. 1998. *Petrotomics Tailings Facility Application for Alternate Concentration Limits, Source Material License SUA 551, Addendum to Response to NRC Open Issue 5 (Model Verification). March 1998.*

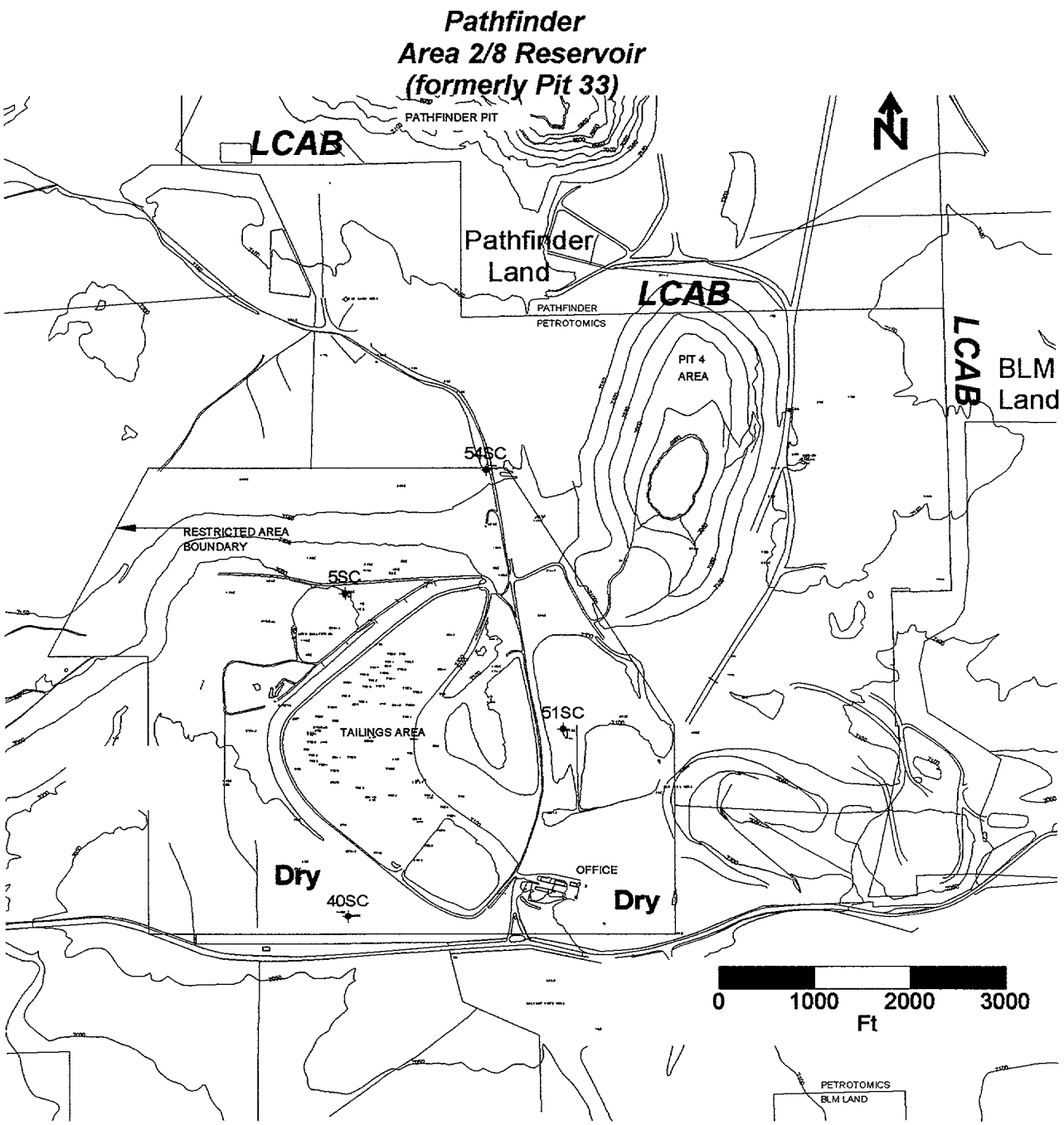

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Figure 1. Petrotomics site map

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

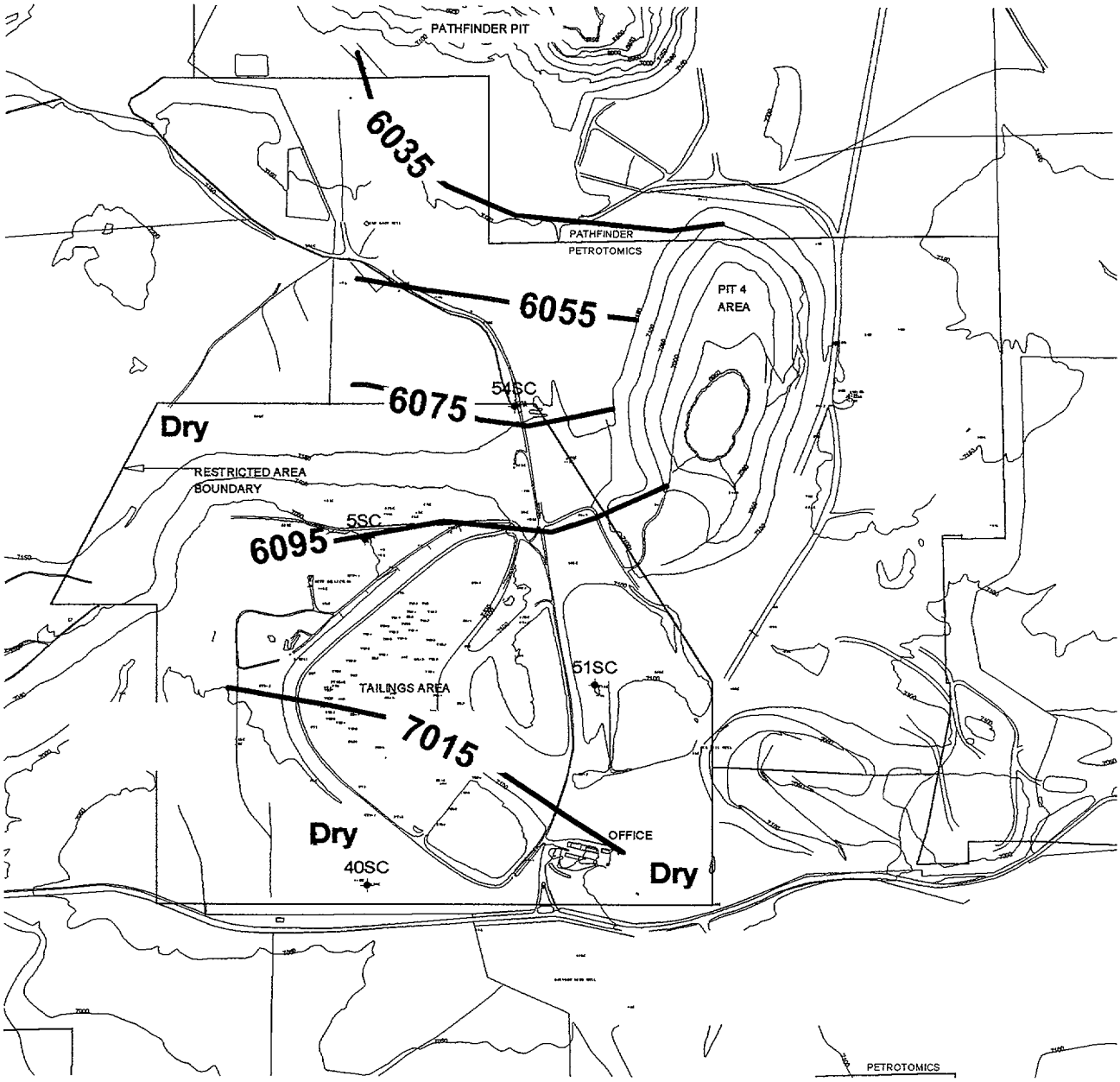

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Figure 2. Simulated Upper Sand water level elevation
January 2002

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

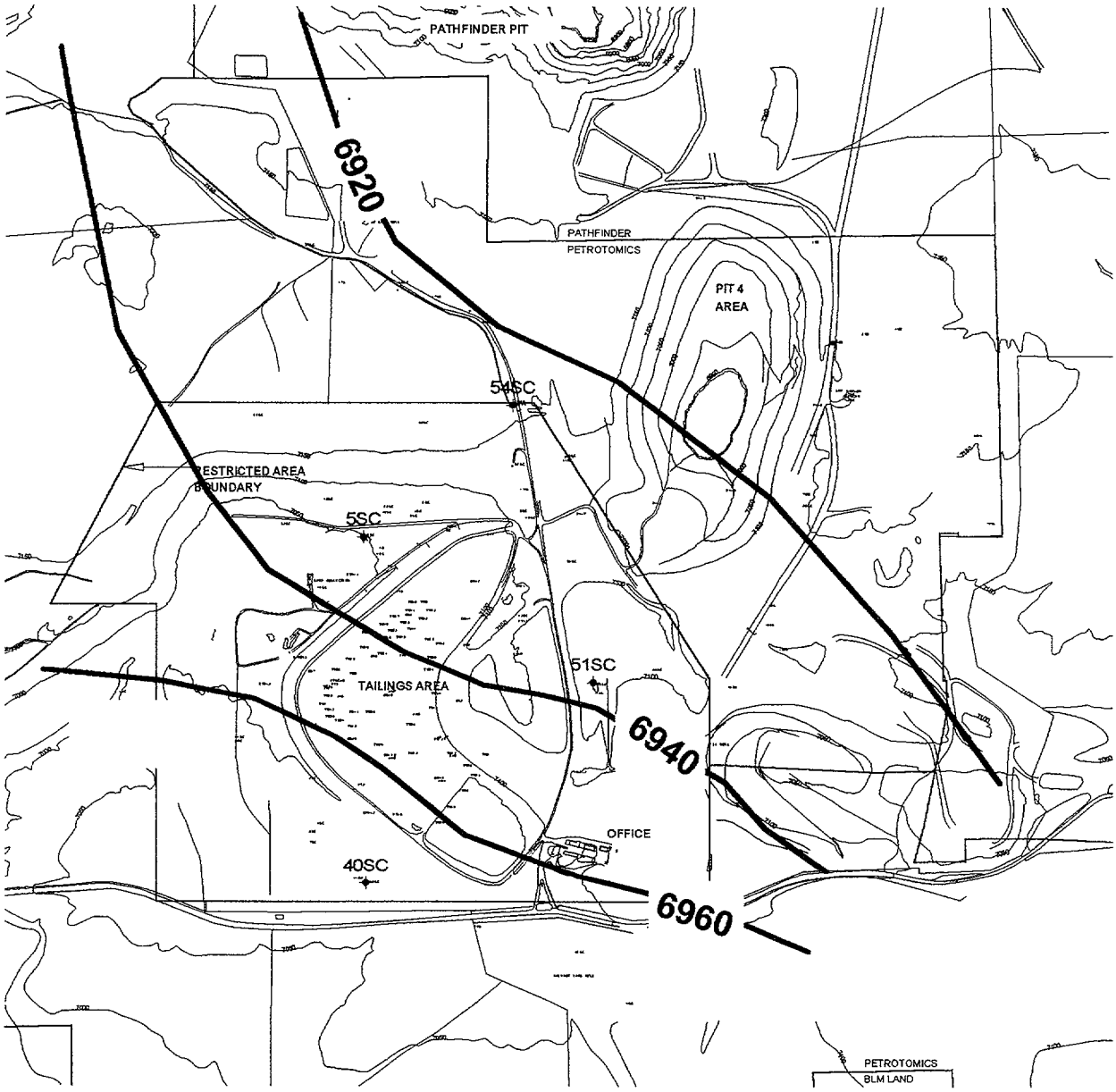

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Figure 3. Simulated Main Sand water level elevation
January 2002

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

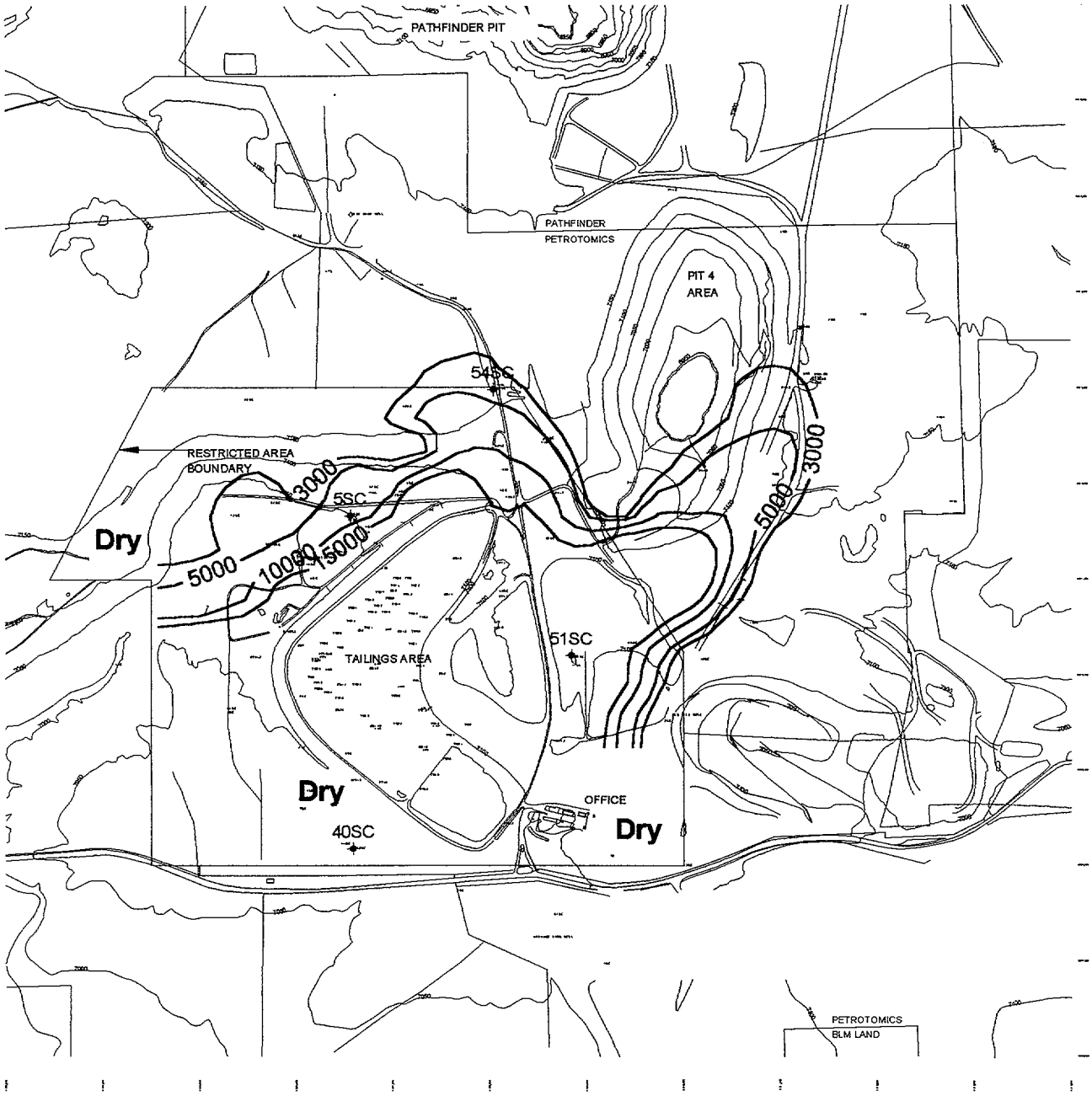

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Figure 4. Modeled sulfate concentration (mg/L)
Upper Sand, 5 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

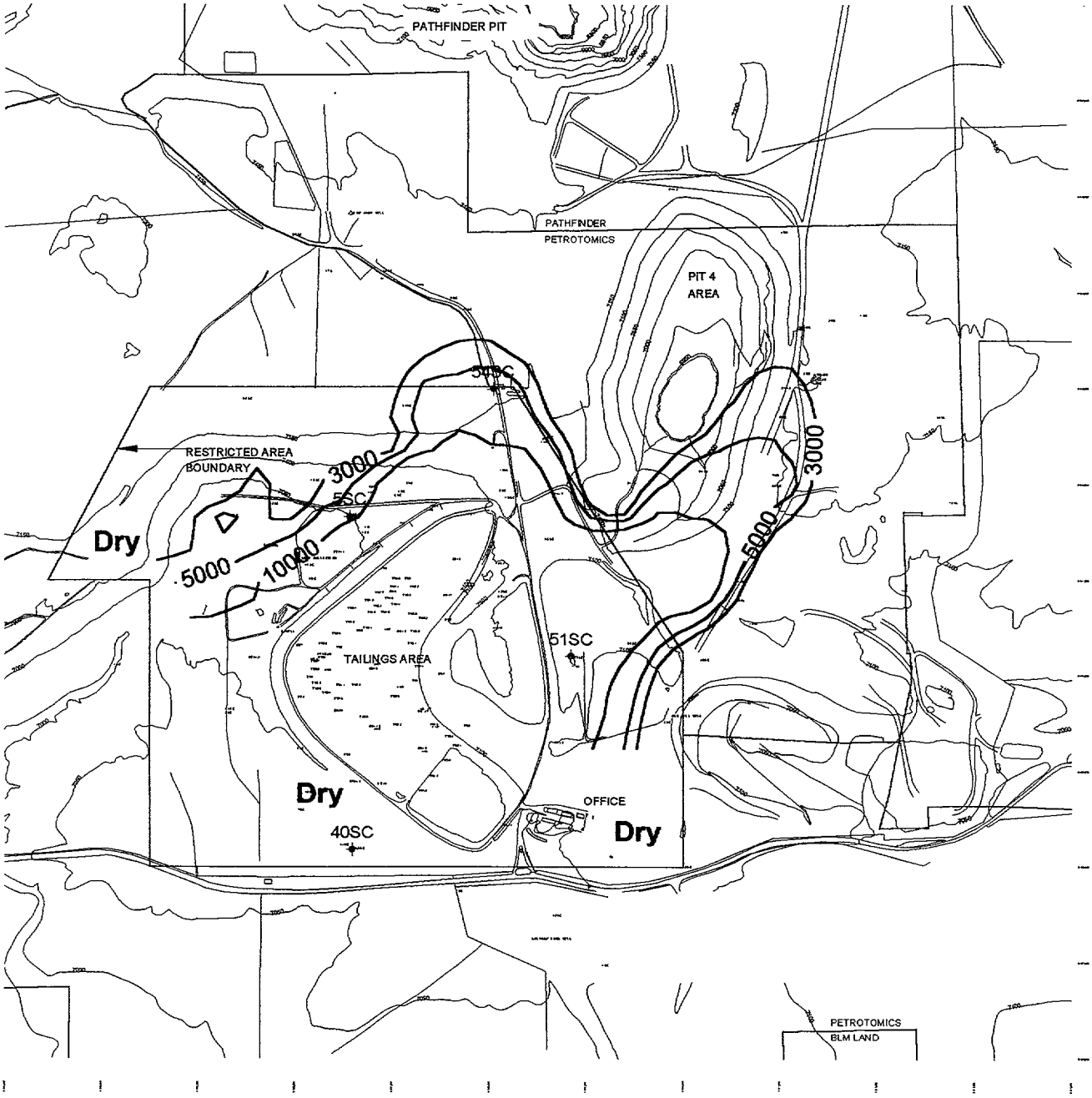

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Figure 5. Modeled sulfate concentration (mg/L)
Upper Sand, 20 year projection

Date:	April 2002
Project:	SE/SO4 Model
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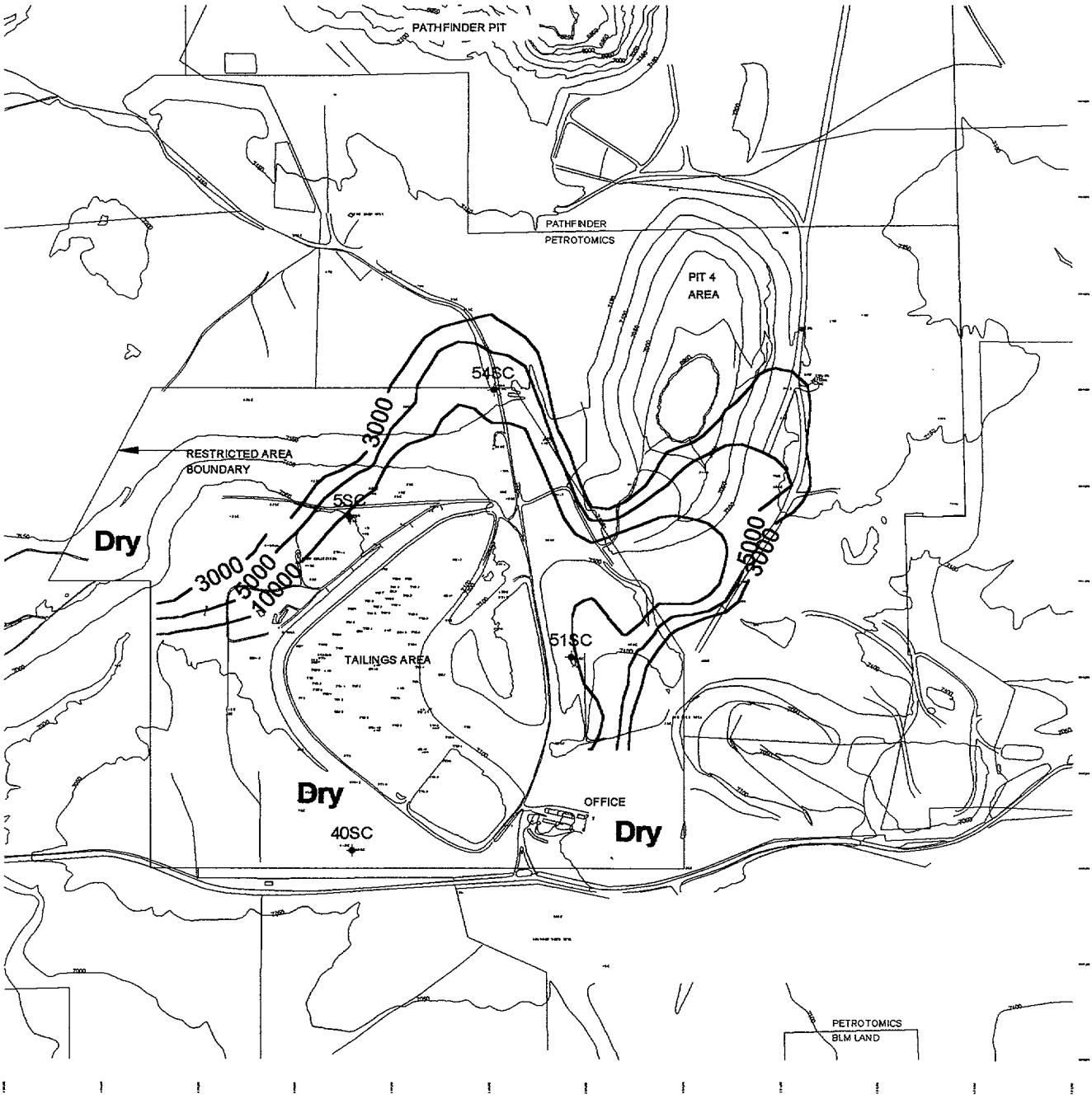

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Figure 6. Modeled sulfate concentration (mg/L)
Upper Sand, 50 year projection

Date:	April 2002
Project:	SE/SO4 Model
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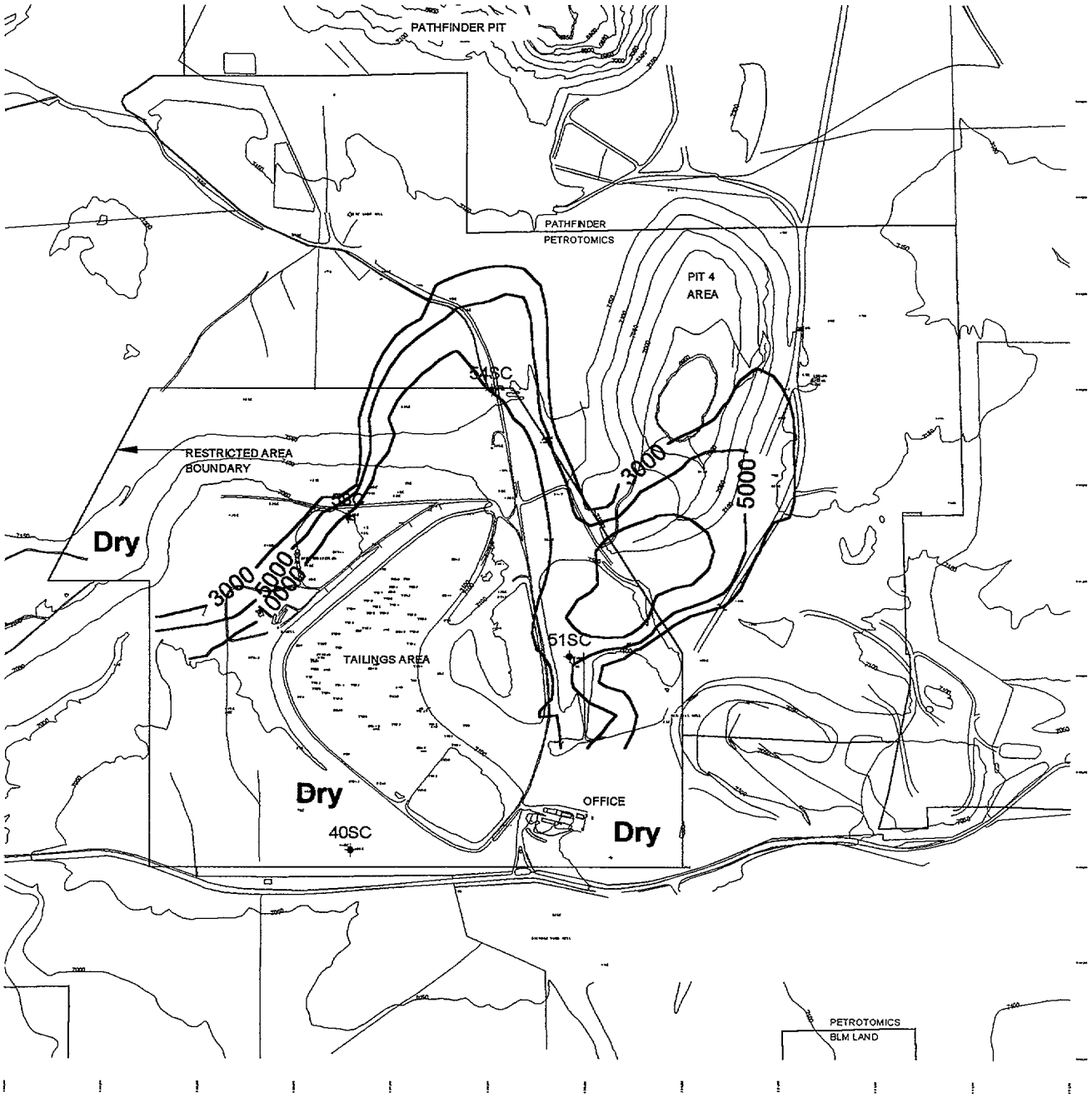

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Figure 7. Modeled sulfate concentration (mg/L)
Upper Sand, 100 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

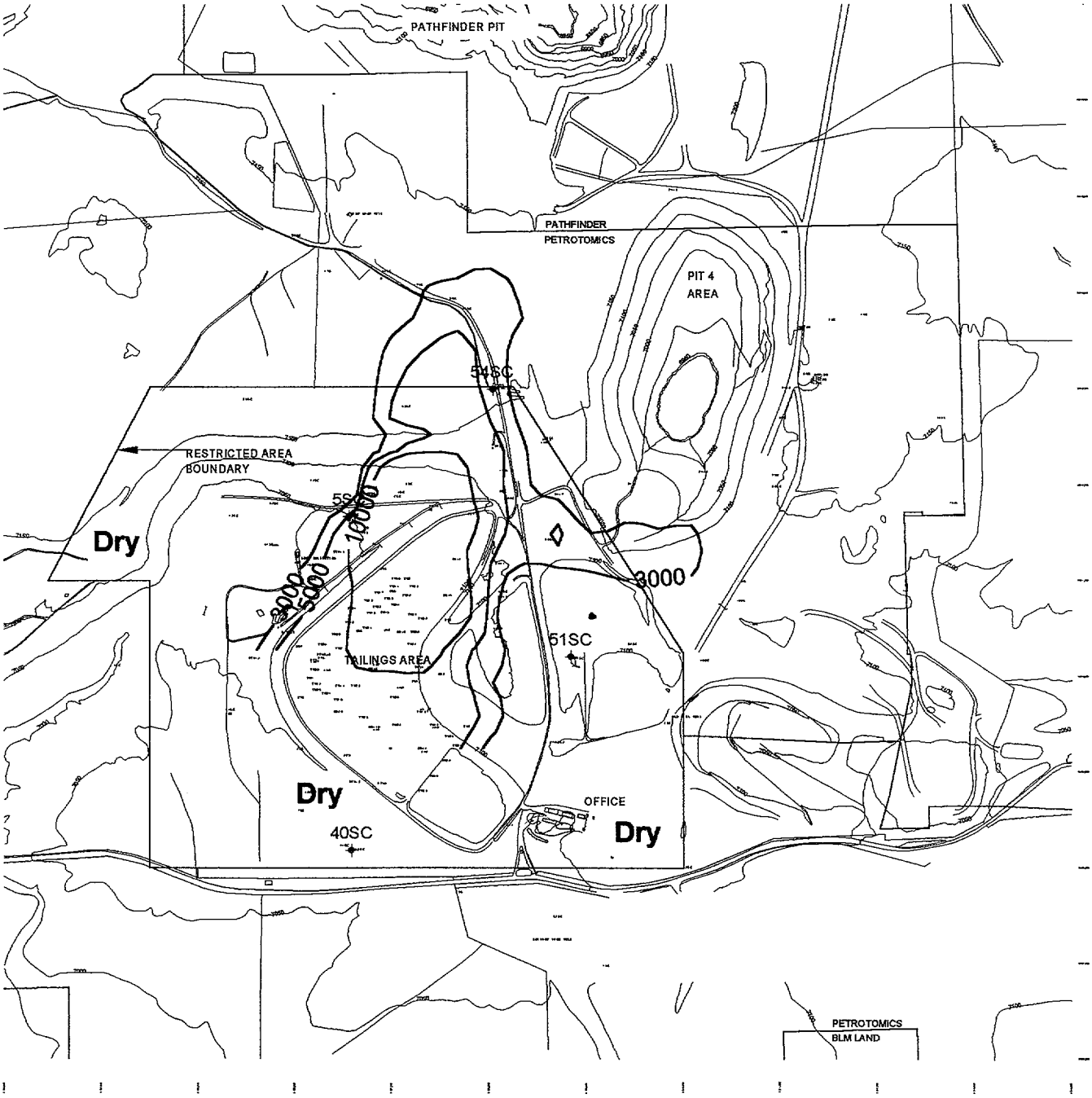

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Figure 8. Modeled sulfate concentration (mg/L)
Upper Sand, 200 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

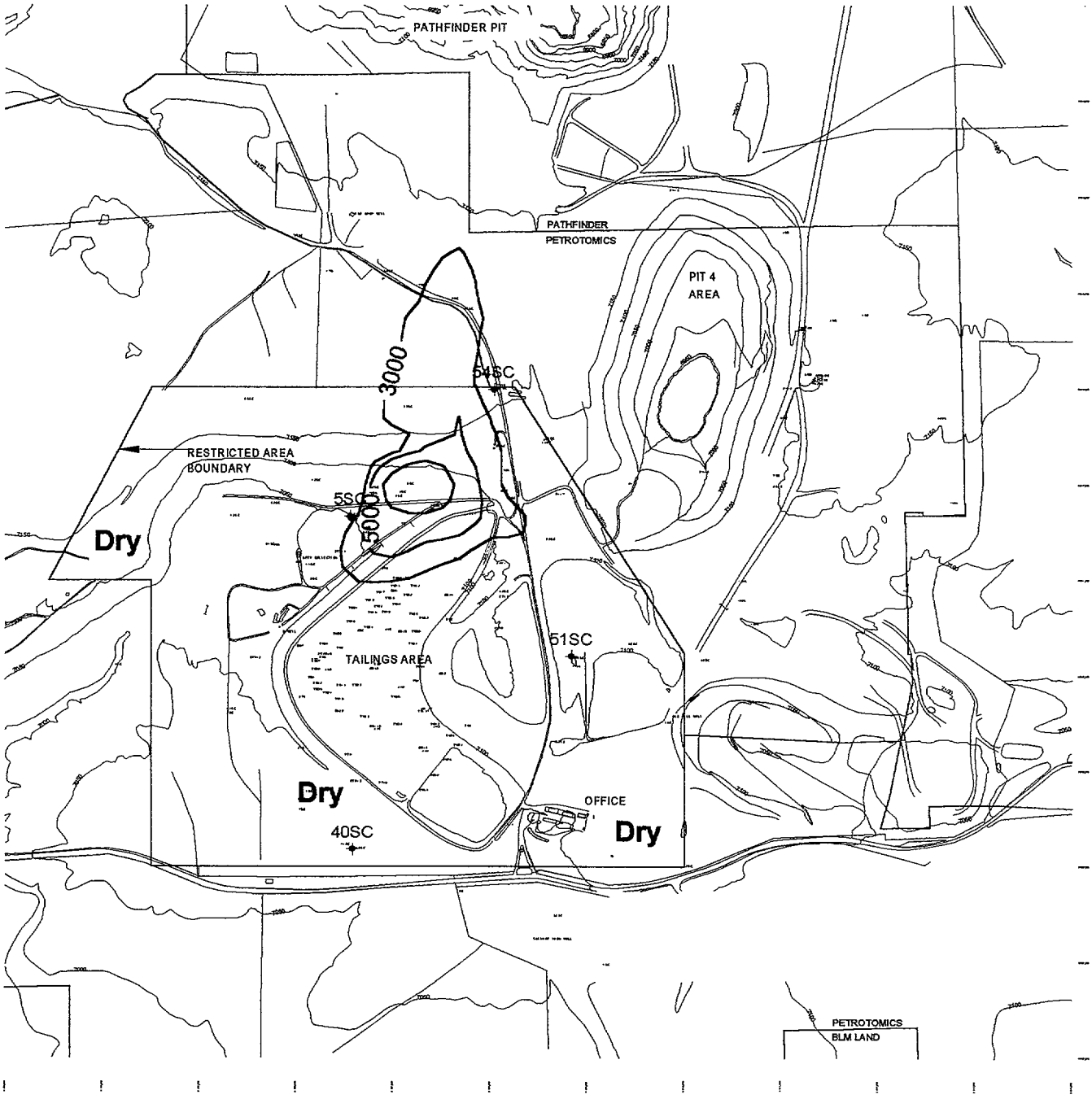

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Figure 9. Modeled sulfate concentration (mg/L)
Upper Sand, 500 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

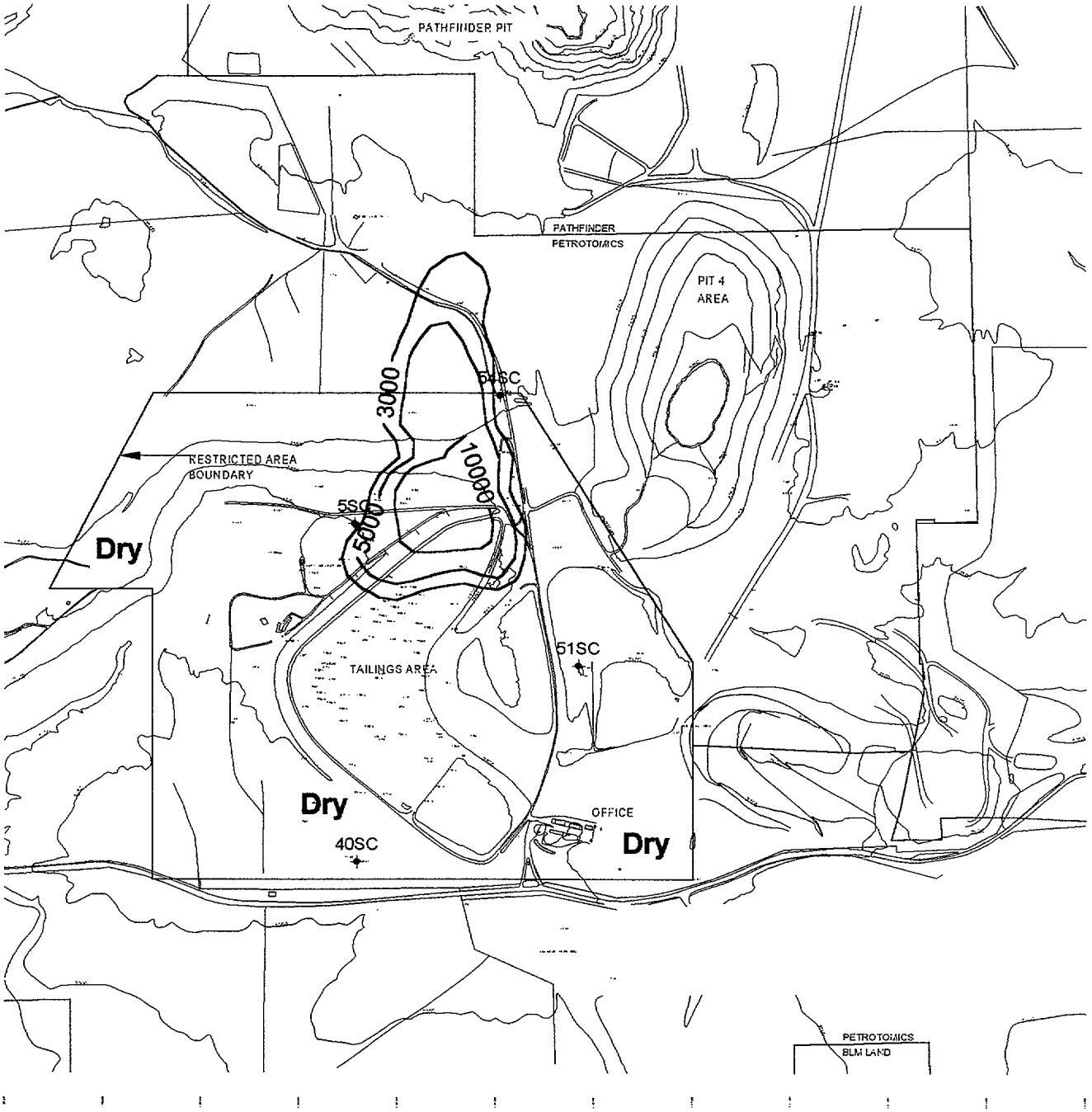

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Figure 10. Modeled sulfate concentration (mg/L)
Upper Sand, 1000 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

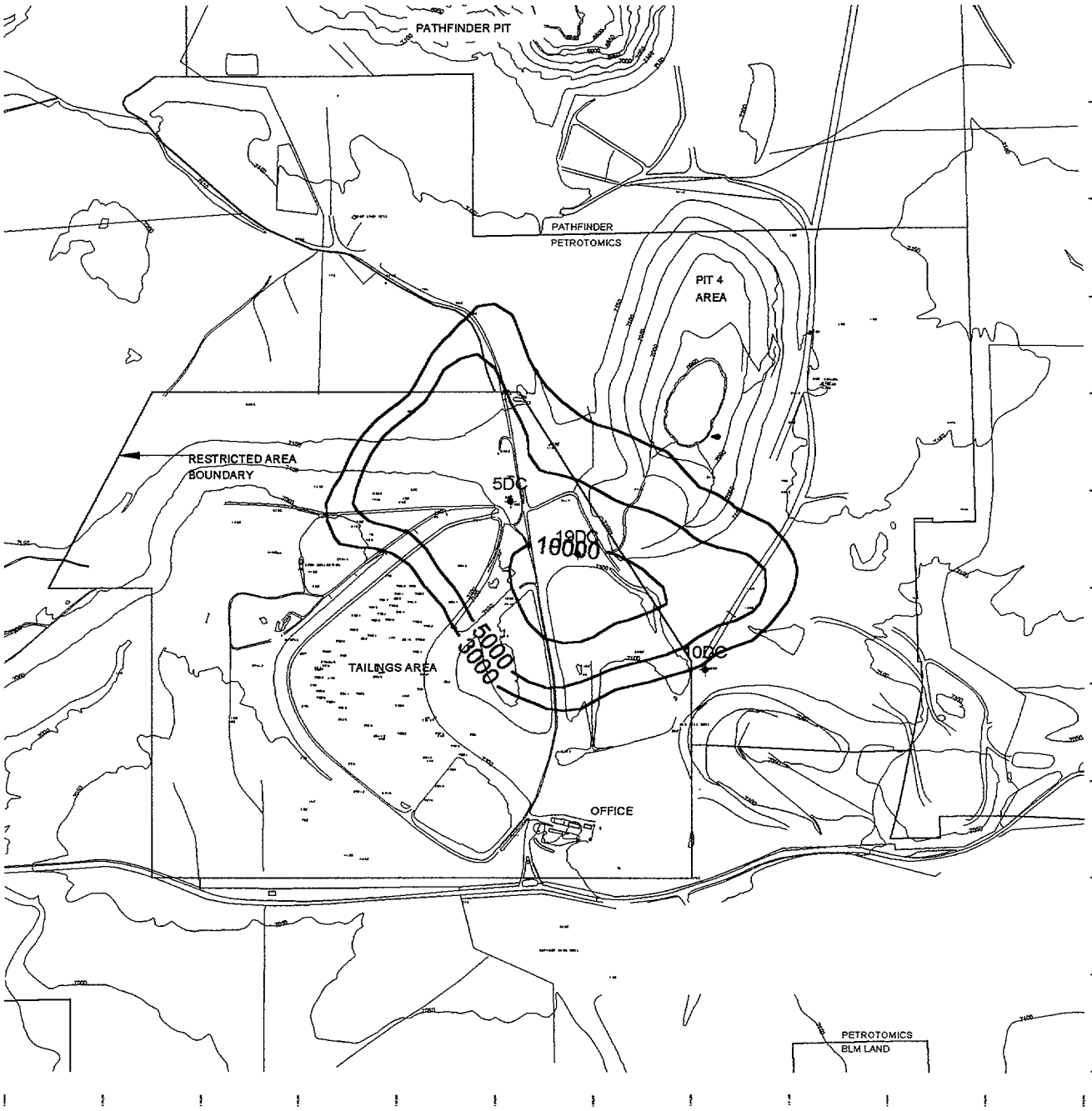

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Figure 11. Modeled sulfate concentration (mg/L)
Main Sand, 5 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

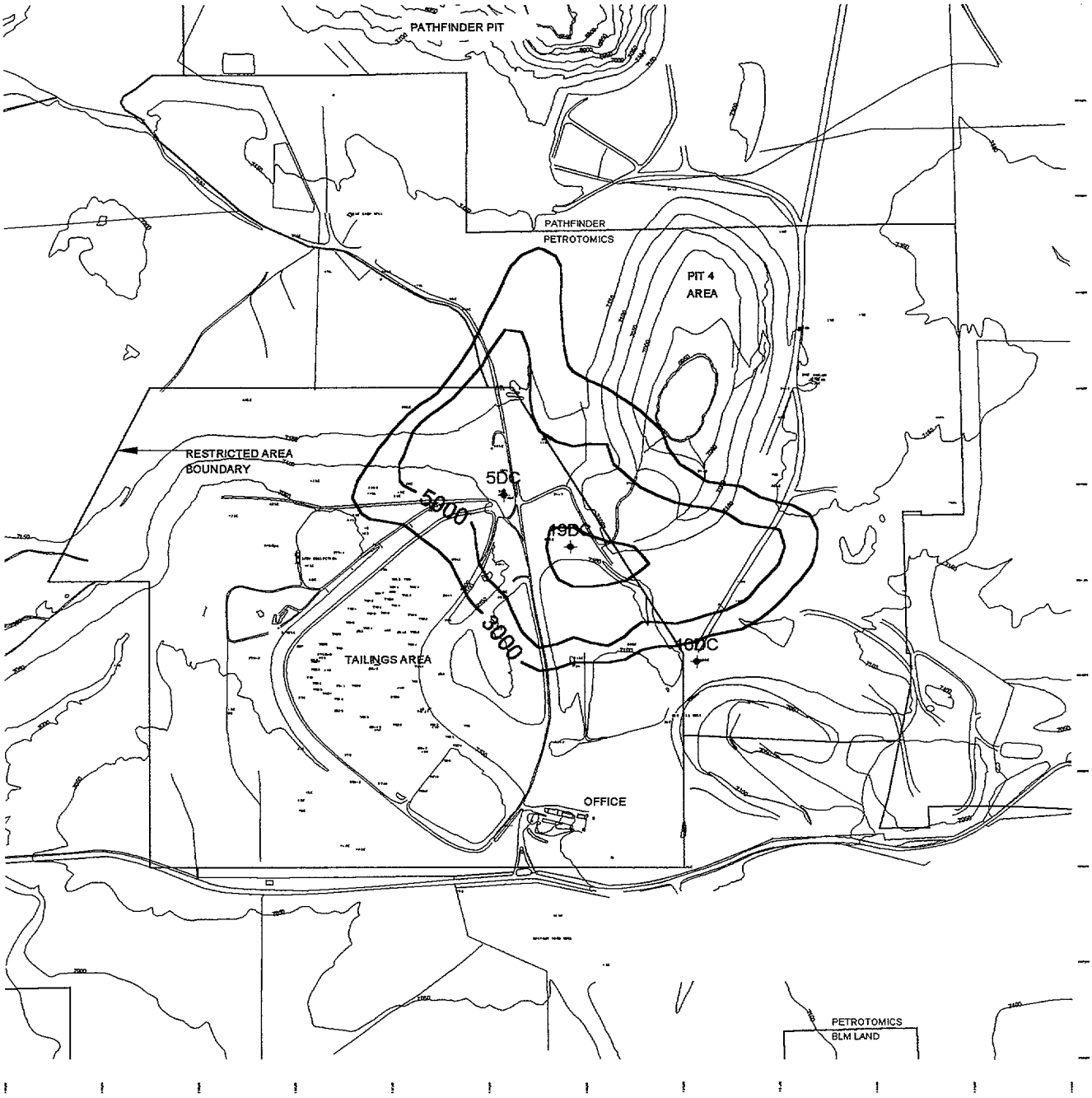

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Figure 12. Modeled sulfate concentration (mg/L)
Main Sand, 20 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

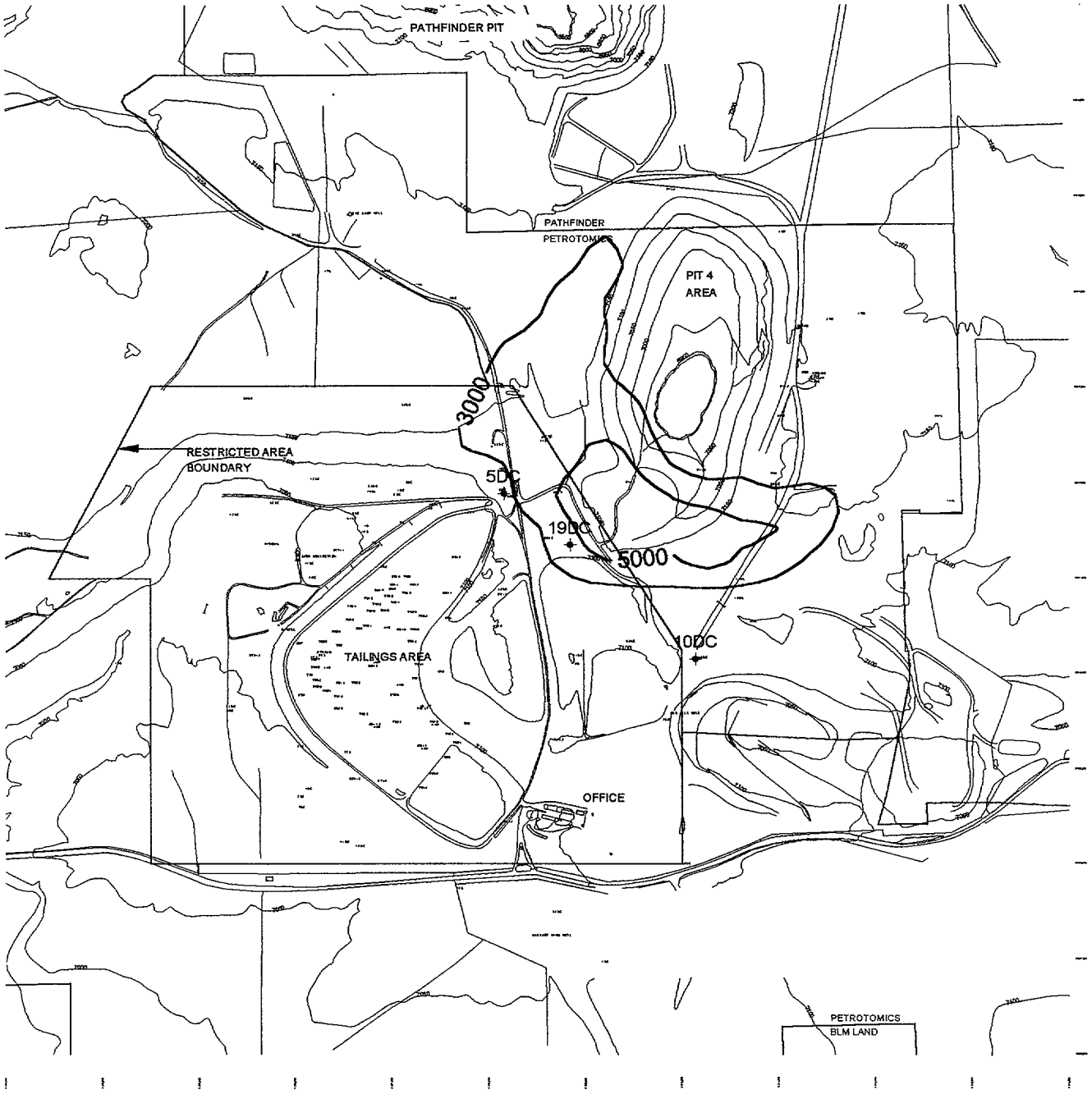

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Figure 13. Modeled sulfate concentration (mg/L)
Main Sand, 50 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

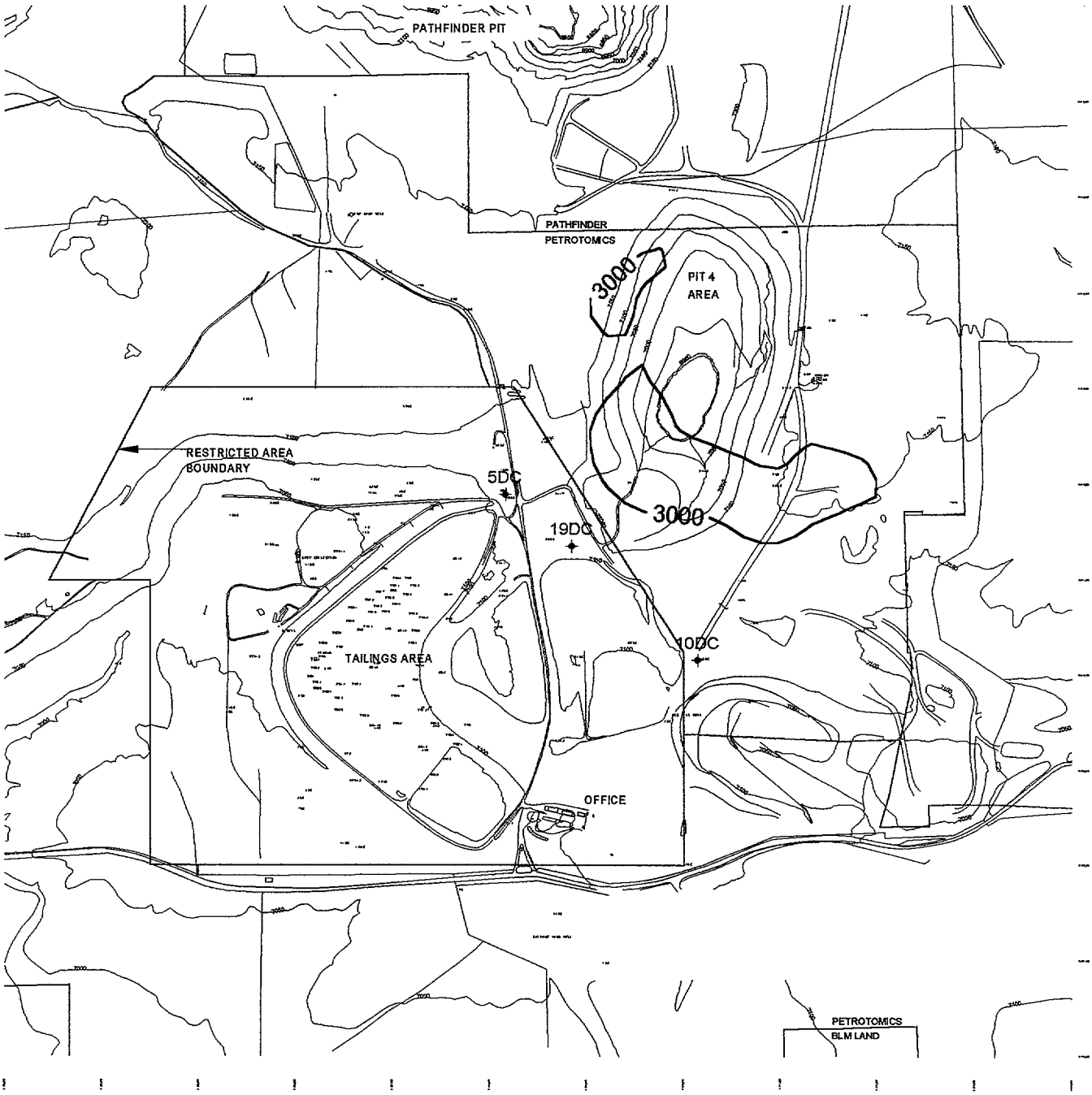

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Figure 14. Modeled sulfate concentration (mg/L)
Main Sand, 100 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

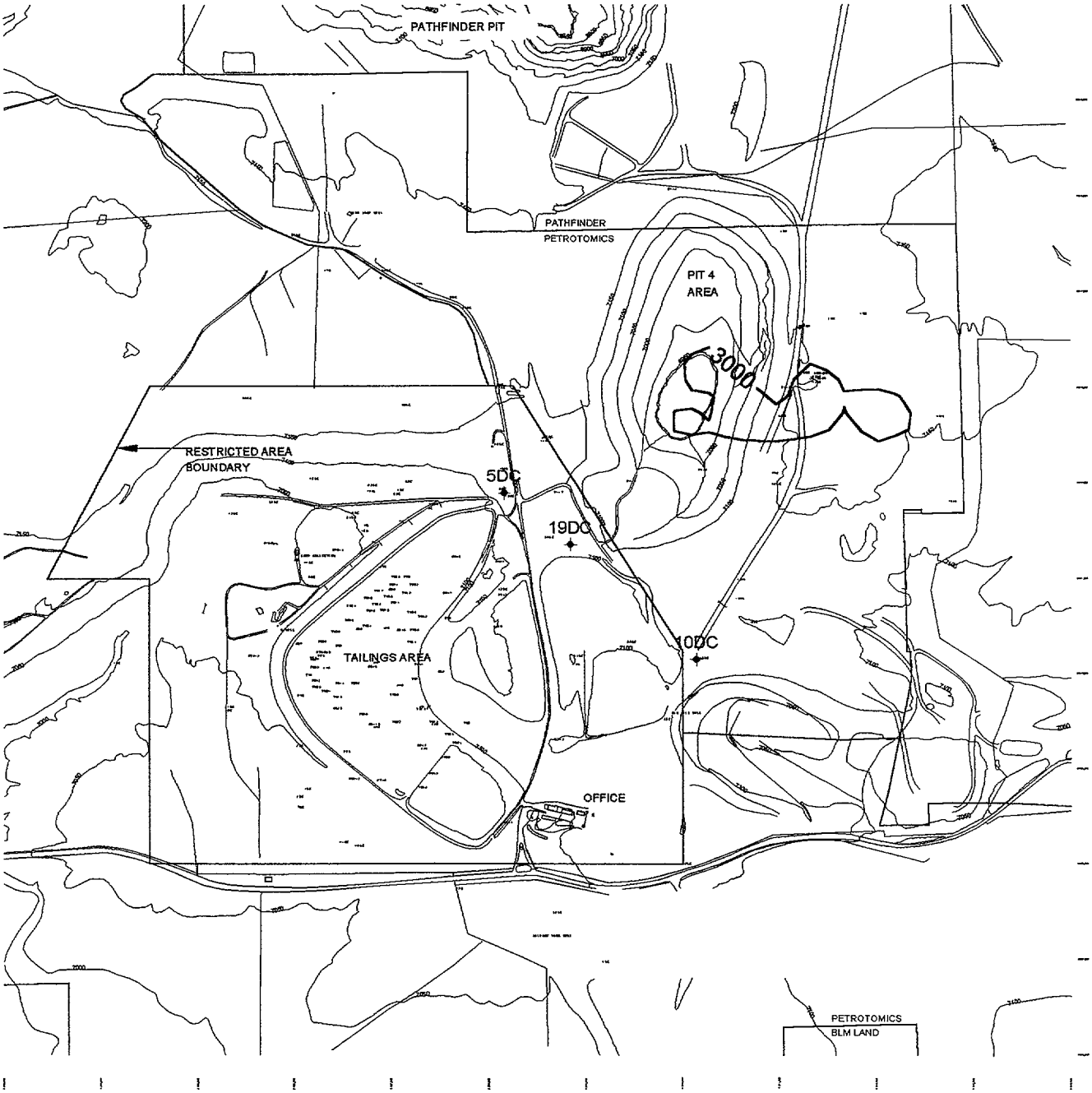

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Figure 15. Modeled sulfate concentration (mg/L)
Main Sand, 200 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

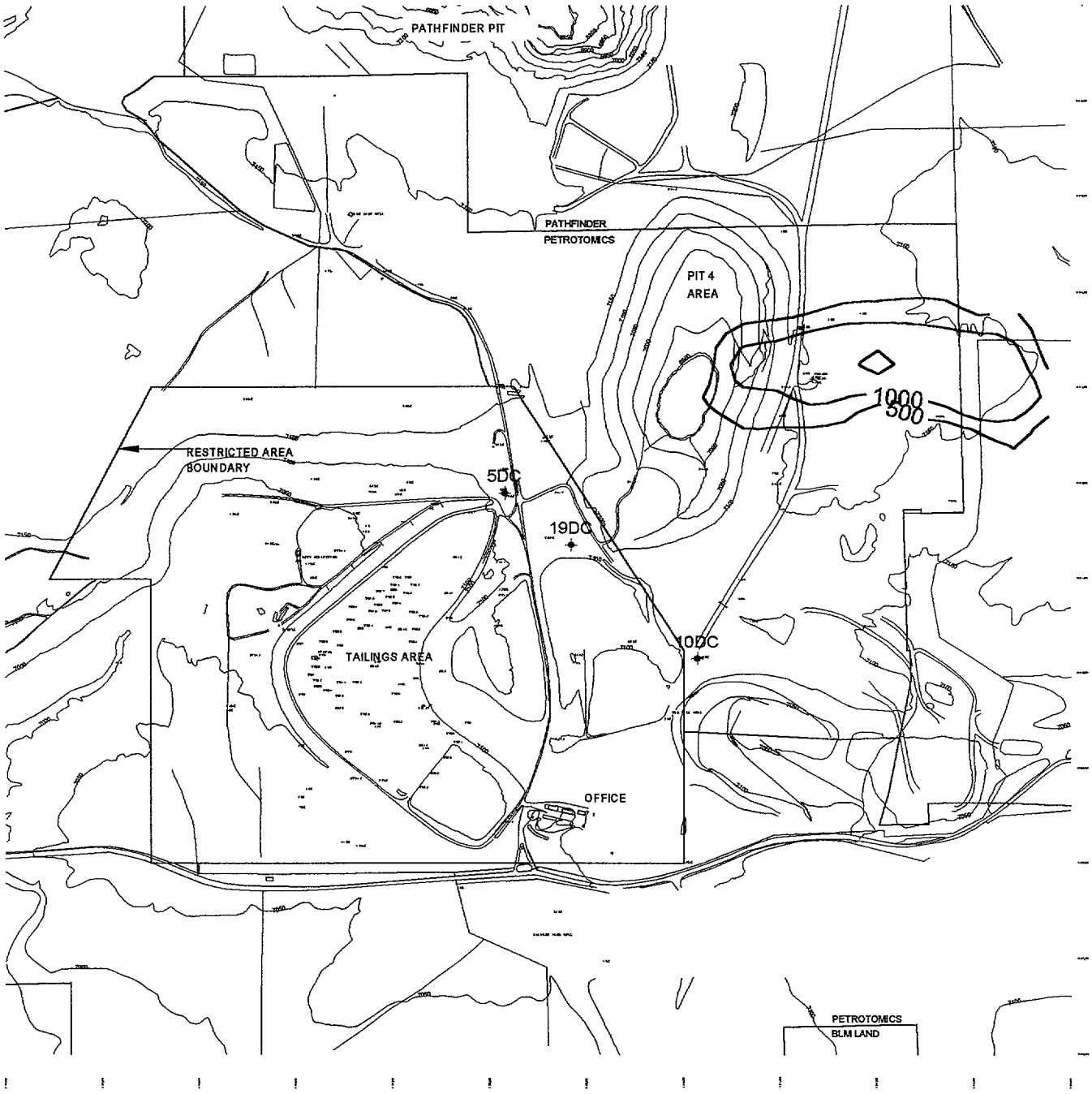

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Figure 16. Modeled sulfate concentration (mg/L)
Main Sand, 500 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

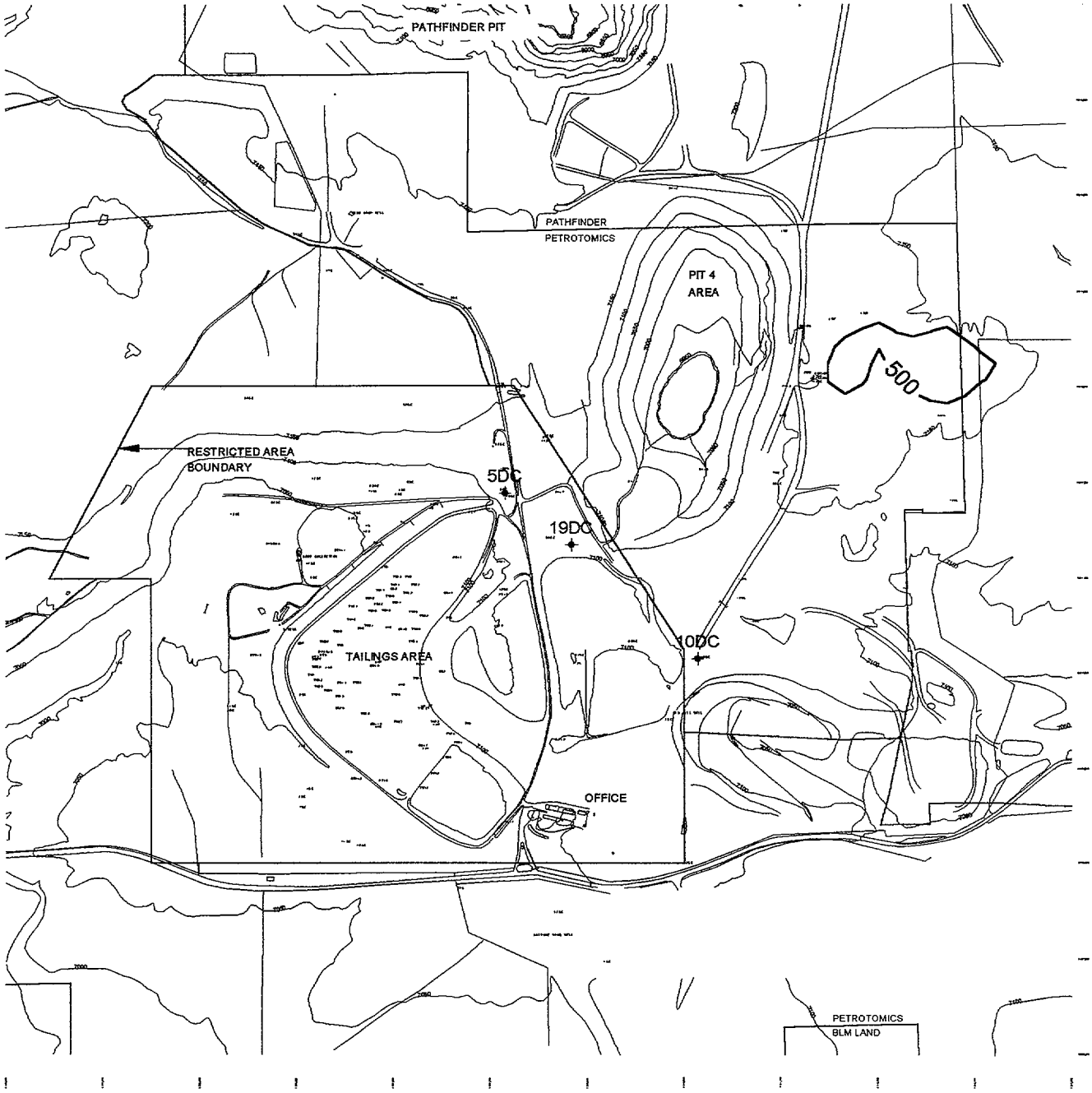

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Figure 17. Modeled sulfate concentration (mg/L)
Main Sand, 1000 year projection

Date:	April 2002
Project:	SE/SO4 Model
File:	fig_port.ppt

ATTACHMENT A

HISTORICAL SULFATE CONCENTRATION DATA

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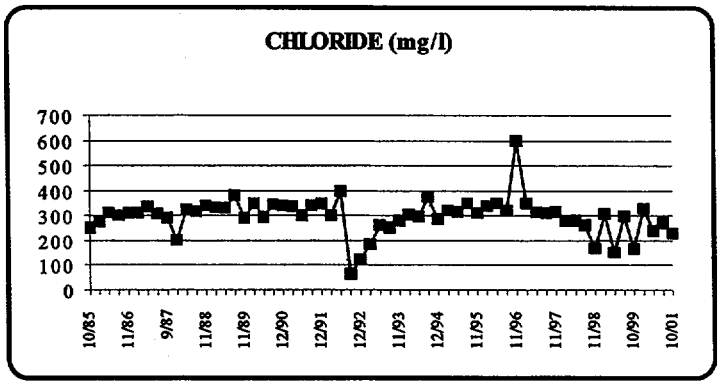
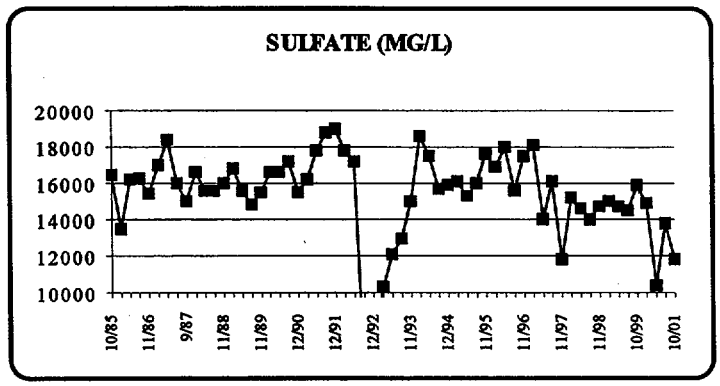
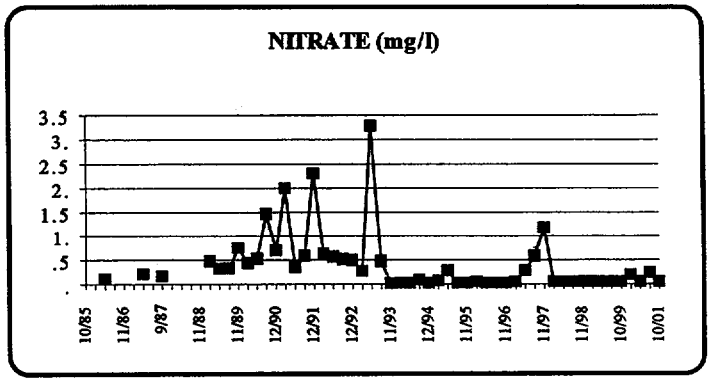
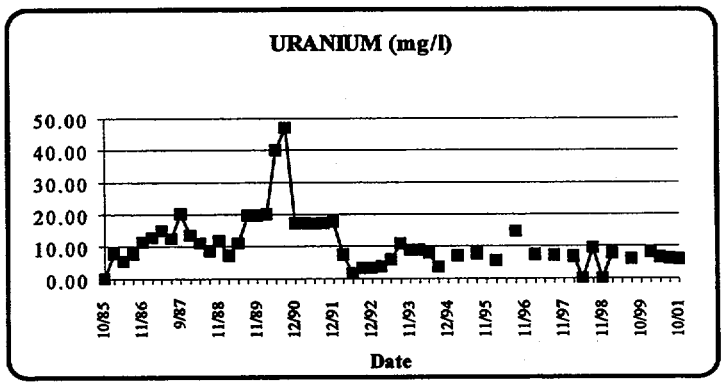
DATE	CHLORIDE	SO4	NO3	URANIUM
01-Oct-85	250	16450		0.08
01-Mar-86	275	13480		7.90
01-May-86	310	16200	.11	5.50
01-Sep-86	300	16250		7.77
01-Nov-86	309	15420		11.40
01-Mar-87	311	17000		12.80
01-May-87	336	18400	.21	15.00
01-Jun-87	307	16000		12.40
01-Sep-87	291	15000	.17	20.20
01-Jan-88	201	16600		13.50
01-Jun-88	324	15600		11.00
01-Sep-88	316	15600		8.70
01-Nov-88	340	16000		11.80
01-Mar-89	331	16800	.47	7.30
01-May-89	330	15600	.32	11.00
01-Sep-89	381	14800	.33	19.70
01-Nov-89	290	15500	.74	19.70
01-Mar-90	348	16600	.43	20.10
01-Jun-90	293	16600	.52	39.90
01-Aug-90	344	17200	1.47	47.00
01-Dec-90	339	15500	.69	17.30
01-Feb-91	337	16200	2.	17.30
01-Jun-91	299	17800	.35	17.20
01-Sep-91	341	18800	.58	17.30
01-Dec-91	348	19000	2.31	17.80
01-Feb-92	300	17800	.62	7.52
01-Jul-92	399	17200	.56	1.59
01-Aug-92	64	4480	.51	3.22
01-Dec-92	121	7400	.49	3.31
01-Mar-93	184	10320	.27	3.73
01-May-93	261	12080	3.29	5.87
01-Aug-93	252	12960	.47	10.70
01-Nov-93	278	15000	.02	8.82
01-Mar-94	303	18600	.025	8.85
06-Jun-94	295	17500	.025	7.96
16-Sep-94	375	15700	.09	3.61
09-Dec-94	285	15900	.025	
28-Feb-95	320	16100	.07	7.00
17-May-95	315.	15300	.28	
29-Aug-95	350.	16000	.025	7.56
29-Nov-95	310.	17600	.025	
28-Feb-96	338.	16900	.05	5.55
05-Jun-96	350	18000	.025	
06-Aug-96	320	15600	.025	14.70
25-Nov-96	600	17500	.025	
19-Feb-97	350	18100	.05	7.35
22-May-97	313	14000	.28	
20-Aug-97	310	16100	.57	7.13
11-Nov-97	315	11800	1.18	
04-Feb-98	279	15200	0.050	6.79
20-May-98	280	14600	0.050	
26-Aug-98	262	14000	0.050	9.42
11-Nov-98	168	14700	0.050	
16-Feb-99	307	15000	0.050	7.75
19-May-99	151	14700	0.050	
24-Aug-99	298	14500	0.050	6.13
27-Oct-99	166	15900	0.050	
16-May-00	328	14900	0.190	7.98
21-Oct-00	240	10400	0.050	6.49
22-May-01	271	13800	0.240	6.03
01-Oct-01	229	11800	0.050	5.86









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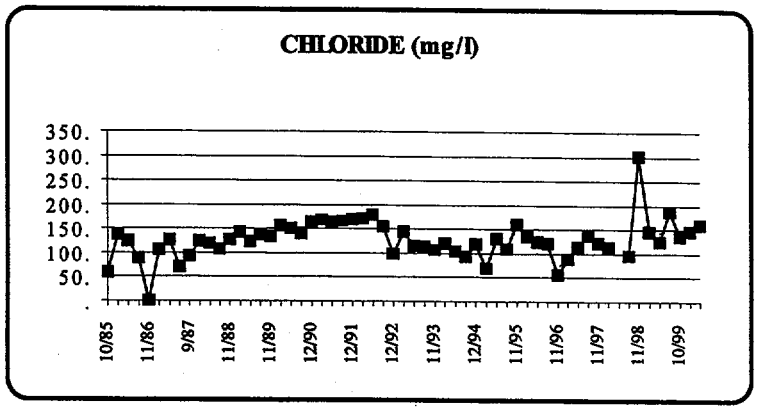
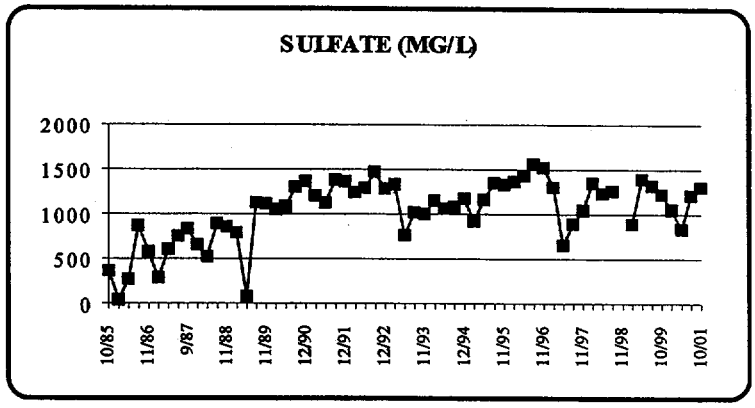
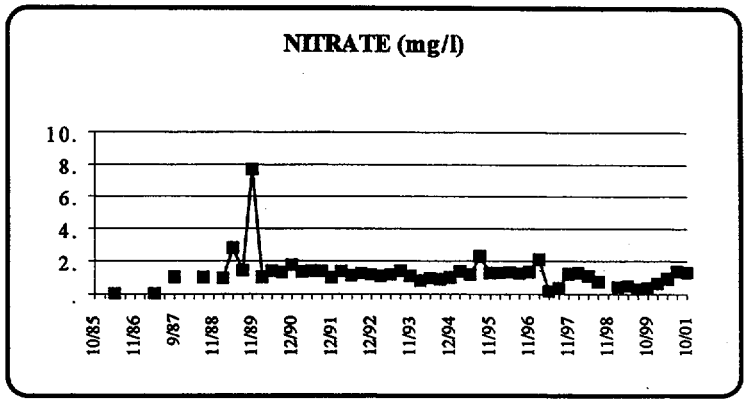
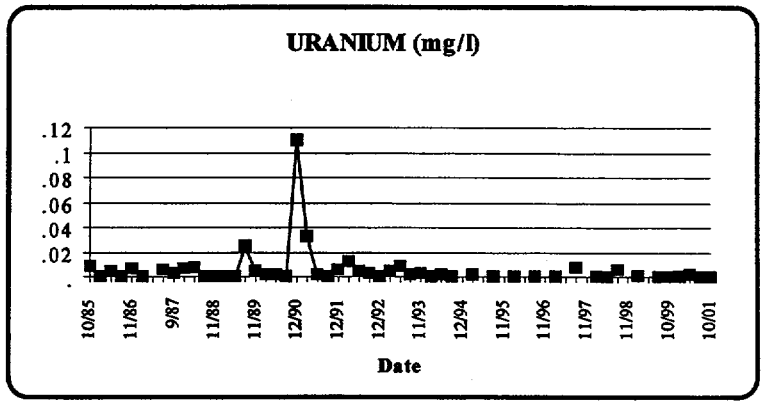
DATE	CHLORIDE	SO4	NO3	URANIUM
01-Oct-85	76.	361		.009
01-Mar-86	6.	39		.0005
01-May-86	58.	266	.02	.005
01-Sep-86	137.	867		.0005
01-Nov-86	124.	573		.007
01-Mar-87	88.	284		.0005
01-May-87		600		
01-Jun-87	106.	750		.006
01-Sep-87	126.	833	1.02	0.003
01-Jan-88	69.7	650		0.007
01-Jun-88	93.	520		.008
01-Sep-88	124.	893	1.	.0005
01-Nov-88	119.	853		.0005
01-Mar-89	107.	787	.96	.0005
01-May-89	127.	75	2.8	.0005
01-Sep-89	142.	1120	1.43	.025
01-Nov-89	123.	1110	7.7	.005
01-Mar-90	137.	1050	1.02	.002
01-Jun-90	134.	1080	1.4	.002
01-Aug-90	156.	1300	1.3	.0005
01-Dec-90	150.	1360	1.74	.11
01-Feb-91	140.	1200	1.34	.033
01-Jun-91	164.	1120	1.4	.002
01-Sep-91	168.	1380	1.36	.0005
01-Dec-91	164.	1360	1.	.006
01-Feb-92	166.	1240	1.36	.013
01-Jul-92	169.	1290	1.13	.005
01-Aug-92	171.	1470	1.24	.003
01-Dec-92	179.	1280	1.17	.0005
01-Mar-93	155.	1330	1.07	.005
01-May-93	98.3	760	1.17	.009
01-Aug-93	144.	1020	1.4	.002
01-Nov-93	115.	1000	1.1	.003
01-Mar-94	113.	1150	.8	.0005
06-Jun-94	107.	1060	.96	.002
16-Sep-94	120.	1080	.88	.0005
09-Dec-94	104.	1170	1.	
28-Feb-95	93.	920	1.37	.002
17-May-95	119.	1160	1.19	
29-Aug-95	68.	1350	2.29	.0005
29-Nov-95	130.	1330	1.28	
28-Feb-96	109.	1360	1.29	.0005
05-Jun-96	160.	1430	1.32	
06-Aug-96	135.	1560	1.25	.0005
25-Nov-96	124.	1520	1.34	
19-Feb-97	121.	1300	2.1	.0005
22-May-97	55.2	650	.17	
20-Aug-97	88.	893	.37	.008
11-Nov-97	113.	1040	1.22	
04-Feb-98	138	1350	1.280	0.0007
20-May-98	122	1230	1.090	
26-Aug-98	113	1260	0.740	0.0060
11-Nov-98				
16-Feb-99	95.9	890	0.420	0.0013
19-May-99	302	1390	0.480	
24-Aug-99	145	1320	0.300	0.0002
27-Oct-99	125	1220	0.360	0.0000
16-May-00	187	1050	0.640	0.0005
21-Oct-00	136	833	0.920	0.0022
23-May-01	146	1210	1.380	0.0002
01-Oct-01	160	1300	1.300	0.0002



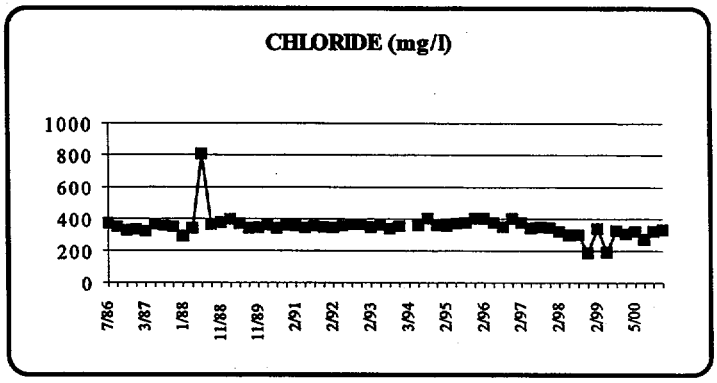


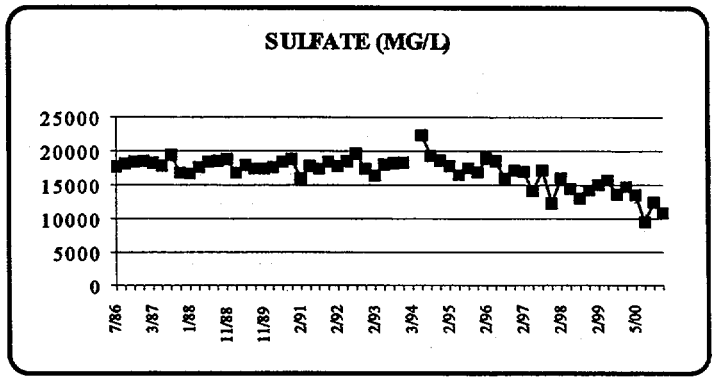


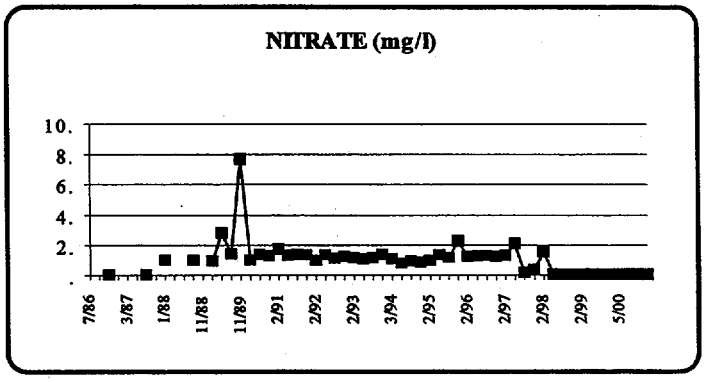


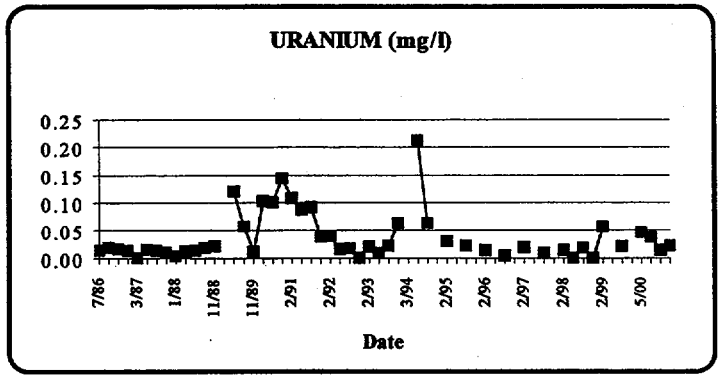
51 SC

DATE	CHLORIDE	SO4	NO3	URANIUM
01-Jul-86	368	17700		0.01
01-Aug-86	348	18100		0.02
01-Oct-86	324	18430	.02	0.02
01-Dec-86	330	18529		0.01
01-Mar-87	320	18200		0.00
01-Jun-87	363	17800		0.02
01-Aug-87	353	19400		0.01
01-Oct-87	349	16800		0.01
01-Jan-88	289	16660	1.02	0.00
01-May-88	339	17600		0.01
01-Jun-88	806	18400		0.01
01-Sep-88	363	18500	1.	0.02
01-Nov-88	375	18800		0.02
01-Mar-89	396	16800	.96	
01-May-89	368	17900	2.8	0.12
01-Sep-89	339	17400	1.43	0.06
01-Nov-89	343	17400	7.7	0.01
01-Mar-90	358	17600	1.02	0.10
01-Jun-90	339	18400	1.4	0.10
01-Aug-90	359	18800	1.3	0.14
01-Feb-91	355	16000	1.74	0.11
01-Jun-91	342	17800	1.34	0.09
01-Sep-91	354	17400	1.4	0.09
01-Dec-91	345	18400	1.36	0.04
01-Feb-92	342	17800	1.	0.04
01-Jul-92	354	18500	1.36	0.02
01-Aug-92	364	19600	1.13	0.02
01-Dec-92	363	17400	1.24	0.00
01-Feb-93	345	16400	1.17	0.02
01-May-93	359	18000	1.07	0.01
01-Aug-93	338	18200	1.17	0.02
01-Nov-93	352	18300	1.4	0.06
01-Mar-94			1.1	
07-Jun-94	360	22300	.8	0.21
15-Sep-94	400	19300	.96	0.06
06-Dec-94	360	18600	.88	
14-Feb-95	355	17800	1.	0.03
18-May-95	370.	16500	1.37	
28-Aug-95	375.	17500	1.19	.022
28-Nov-95	400.	16900	2.29	
28-Feb-96	400.	18900	1.28	.014
05-Jun-96	375	18500	1.29	
06-Aug-96	350	16000	1.32	0.004
26-Nov-96	400	17200	1.25	
18-Feb-97	375	17000	1.34	0.019
22-May-97	341	14100	2.1	
21-Aug-97	347	17200	.17	0.01
12-Nov-97	342	12300	.37	
05-Feb-98	319	16000	1.580	0.0137
20-May-98	297	14400	**0.050**	
20-Aug-98	299	13000	**0.050**	0.0180
11-Nov-98	188	14200	**0.050**	
17-Feb-99	337	15000	**0.050**	0.0564
20-May-99	190	15700	**0.050**	
25-Aug-99	325	13600	**0.050**	0.0207
28-Oct-99	306	14700	**0.050**	
16-May-00	320	13500	**0.050**	0.0458
21-Oct-00	270	9490	**0.050**	0.0370
22-May-01	322	12400	**0.050**	0.0140
01-Oct-01	330	10800	**0.050**	0.0219



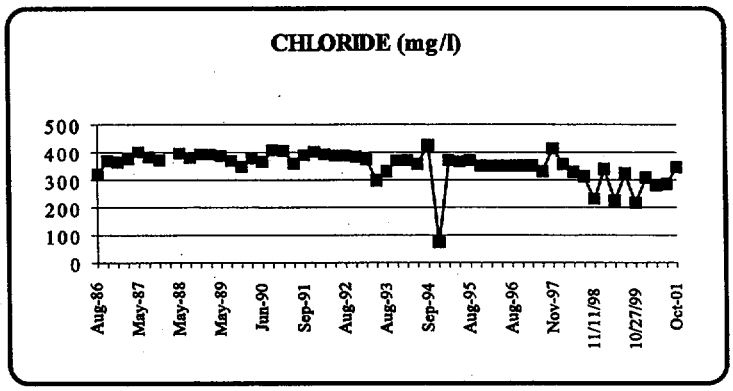


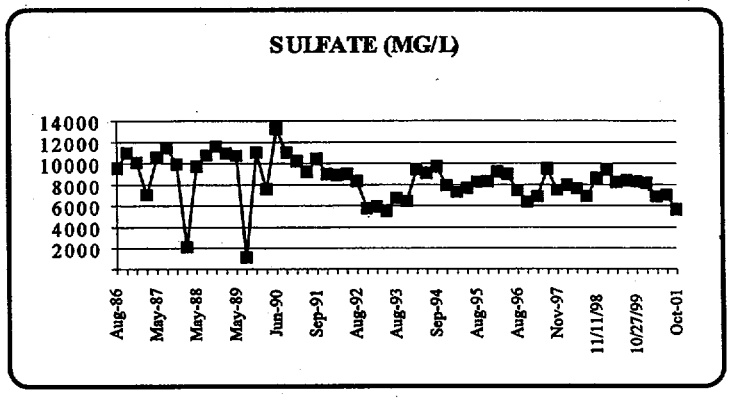


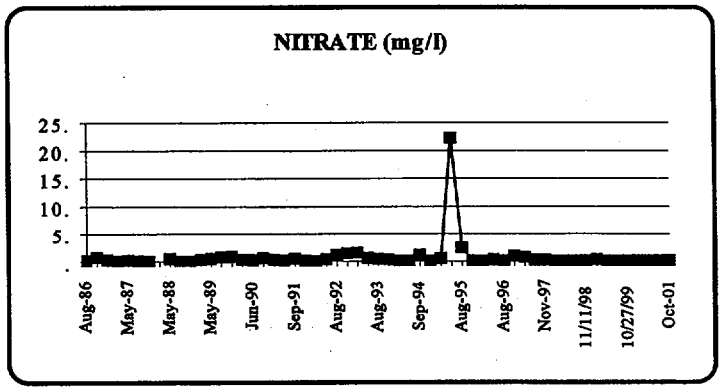


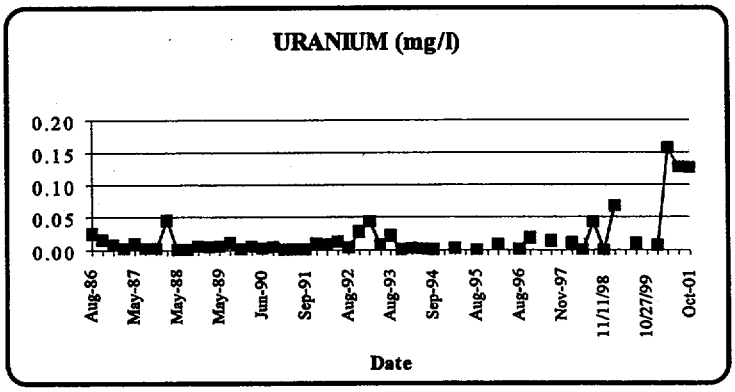
54 SC

DATE	CHLORIDE	SOLIDS	NITRATE	URANIUM
Aug-86	319	9550	.13	0.03
Oct-86	367	10980	.7	0.02
Dec-86	363	10068	.25	0.01
Mar-87	375	7040		0.00
May-87	400	10560	.18	0.01
Aug-87	382	11480	.05	0.00
Oct-87	371	9900		0.00
Jan-88		2080		0.05
May-88	396	9700	.42	0.00
Sep-88	379	10722		0.00
Nov-88	392	11600		0.01
Mar-89	391	10933	.28	0.01
May-89	386	10700	.41	0.01
Sep-89	368	1110	.74	0.01
Nov-89	347	11000	.77	0.00
Mar-90	378	7600	.29	0.01
Jun-90	365	13280	.22	0.00
Aug-90	407	11000	.54	0.01
Feb-91	404	10200	.31	0.00
Jun-91	358	9200	.17	0.00
Sep-91	389	10400	.46	0.00
Dec-91	402	9000	.14	0.01
Feb-92	392	8900	.005	0.01
Jul-92	387	9000	.36	0.01
Aug-92	388	8330	1.08	0.00
Dec-92	384	5760	1.37	0.03
Feb-93	373	5920	1.51	0.04
May-93	298	5520	.55	0.01
Aug-93	329	6720	.36	0.02
Nov-93	369	6440	.3	0.00
Mar-94	370	9440	0.025	0.00
Jun-94	356	9100	0.025	0.00
Sep-94	425	9680	1.090	0.00
Dec-94	72	7960	0.060	
Feb-95	370	7300	0.470	0.00
May-95	365.	7680	22.160	
Aug-95	370.	8280	2.400	0.00
Nov-95	350.	8320	0.025	
Feb-96	350.	9200	0.005	0.01
Jun-96	350	9000	0.250	
Aug-96	350	7450	0.025	0.00
Feb-97	350	6360	0.900	0.02
May-97	350	6880	0.670	
Aug-97	330	9500	0.200	0.01
Nov-97	414	7500	0.210	
Feb-98	355	7980	**0.050**	0.01
05/19/98	328	7660	**0.050**	
08/18/98	312	6900	**0.050**	0.0427
11/11/98	231	8610	**0.050**	
02/16/99	339	9400	0.290	0.0680
05/18/99	225	8250	**0.050**	
08/24/99	323	8400	**0.050**	0.0101
10/27/99	216	8300	**0.050**	
05/16/00	308	8160	**0.050**	0.0074
10/25/00	281	6870	**0.050**	0.1570
May-01	285	7050	**0.050**	0.1270
Oct-01	345	5640	**0.050**	0.1260



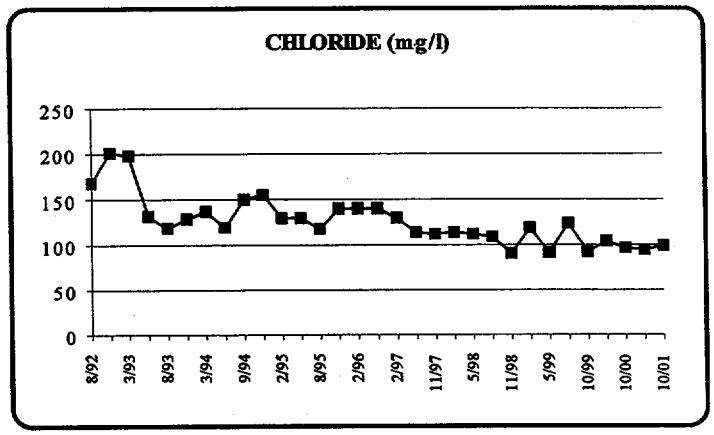


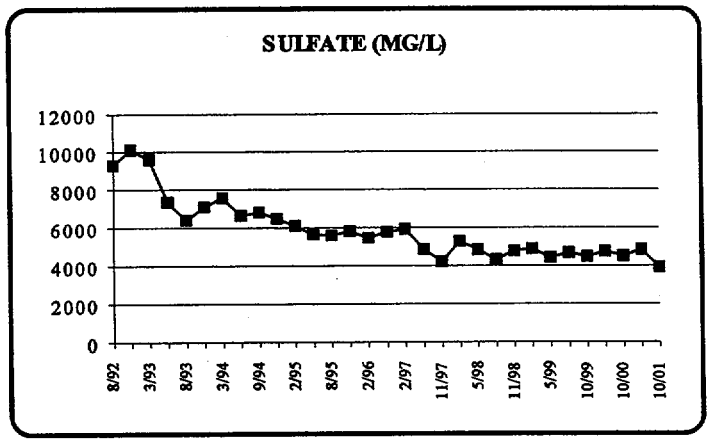


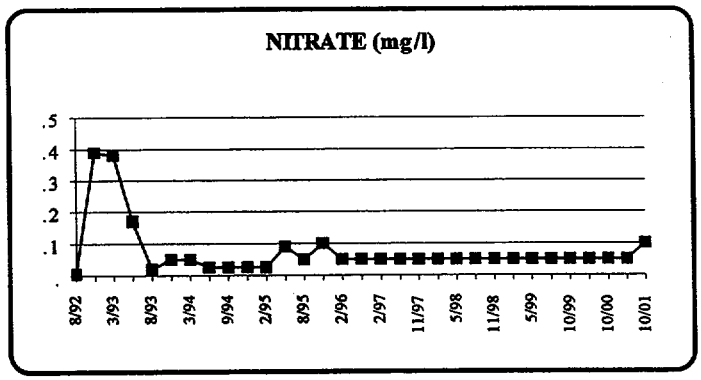


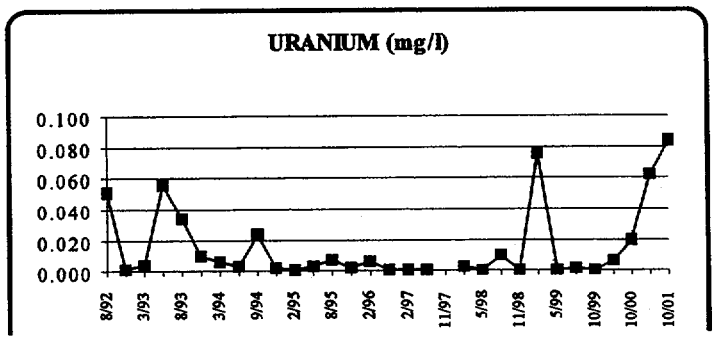
5 DC

DATE	CHLORIDE	Sulfate	NITRATE	URANIUM
01-Aug-92	168	9300	.005	0.051
01-Dec-92	201	10100	.39	0.001
01-Mar-93	198	9600	.38	0.004
01-May-93	132	7360	.17	0.056
01-Aug-93	119	6400	.02	0.034
01-Nov-93	129	7100	0.050	0.010
01-Mar-94	137	7560	0.050	0.006
01-Jun-94	120	6640	.025	0.003
16-Sep-94	150	6800	.025	0.024
08-Dec-94	155	6480	.025	0.002
16-Feb-95	130	6080	.025	0.001
19-May-95	130	5620	.09	0.003
30-Aug-95	118	5580	0.050	0.007
28-Nov-95	140	5790	.1	0.002
29-Feb-96	140	5440	0.050	0.006
05-Jun-96	140	5760	0.050	**0.0005**
19-Feb-97	130	5900	0.050	**0.0005**
20-Aug-97	114	4840	0.050	**0.0005**
11-Nov-97	112	4200	0.050	
04-Feb-98	114	5260	0.050	0.003
19-May-98	112	4810	0.050	
18-Aug-98	109	4300	0.050	0.0101
12-Nov-98	90.5	4750	0.050	
17-Feb-99	119	4850	0.050	0.0758
18-May-99	91.3	4400	0.050	
24-Aug-99	124	4650	0.050	0.0014
27-Oct-99	92.0	4450	0.050	0.0000
16-May-00	104	4720	0.050	0.0063
25-Oct-00	96.4	4490	0.050	0.0199
22-May-01	94.4	4810	**0.050**	0.0620
01-Oct-01	99.	3900	0.100	0.0840



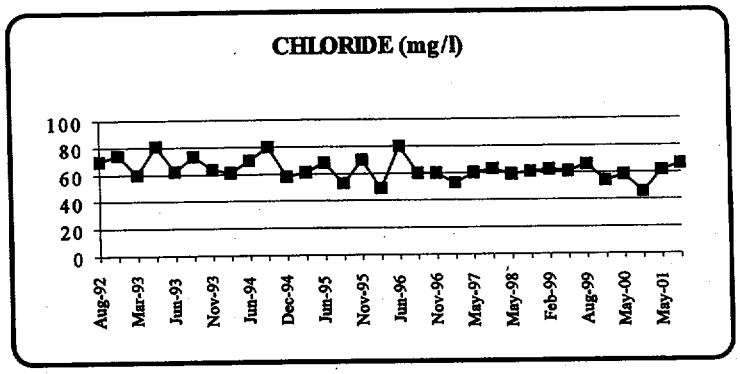


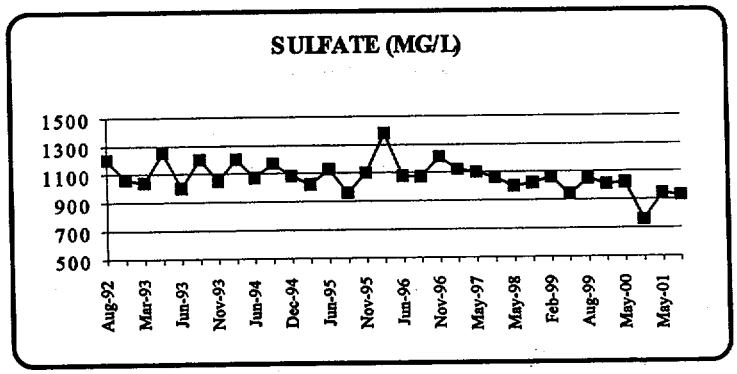


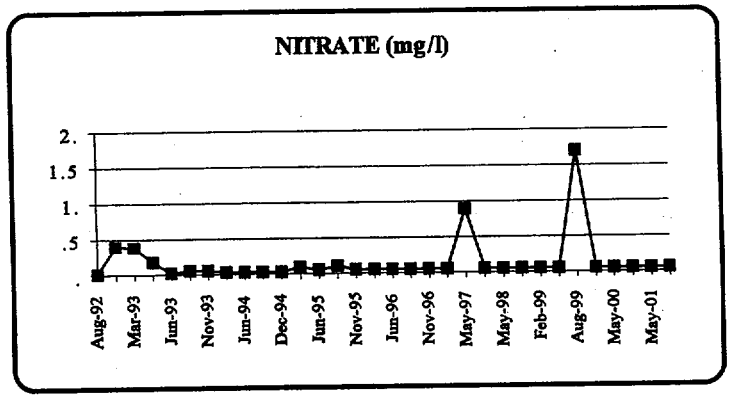


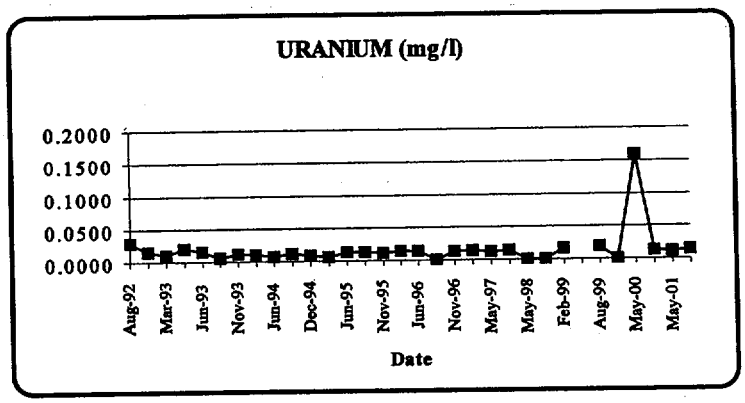
10 DC

DATE	CHLORIDE	SO4	NO3	URANIUM
Aug-92	70	1200	.005	0.0290
Dec-92	74	1060	.39	0.0150
Mar-93	60	1040	.38	0.0100
May-93	81	1250	.17	0.0200
Jun-93	62	1000	.02	0.0150
Aug-93	73	1200	.05	0.0050
Nov-93	63	1050	.05	0.0110
Mar-94	61	1200	.025	0.0100
Jun-94	70	1070	.025	0.0070
Sep-94	80	1170	.025	0.0110
Dec-94	58	1080	.025	0.0080
Feb-95	61.	1020	.09	0.0060
Jun-95	68.	1125	.05	0.0130
Aug-95	53.	960	.1	0.0130
Nov-95	70.	1100	.05	0.0110
Feb-96	49.	1380	.05	0.0140
Jun-96	80	1075	.05	0.0140
Aug-96	60	1070	.05	0.0001
Nov-96	60	1210	.05	0.0130
Feb-97	53	1120	.05	0.0140
May-97	60	1100	.89	0.0120
Feb-98	62.8	1060	.05	0.0140
May-98	59.0	1000	.05	
Nov-98	60.7	1020	.05	
Feb-99	62.3	1060	.05	0.0166
May-99	60.8	944	.05	
Aug-99	65.8	1050	1.7	0.0190
Oct-99	53.9	1010	.05	0.0000
May-00	58.3	1020	.05	0.1590
Oct-00	45.7	759	.05	0.0130
May-01	61.5	946	.05	0.0110
Oct-01	66.	930	.05	0.0140



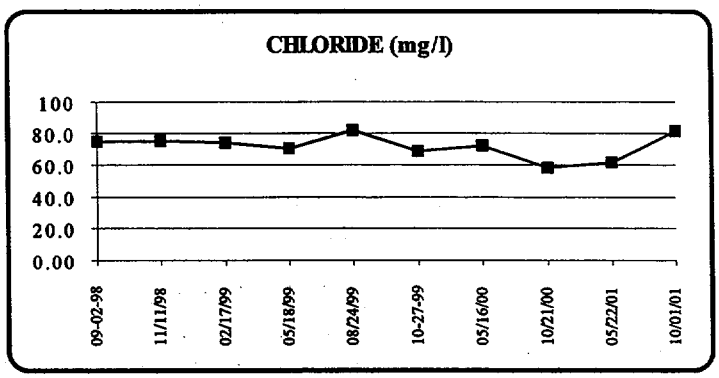


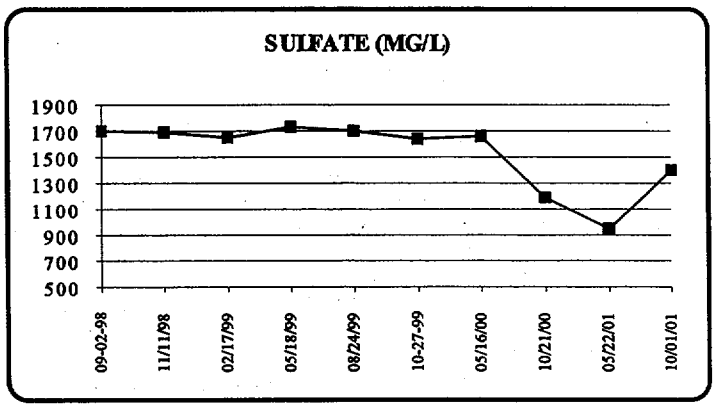


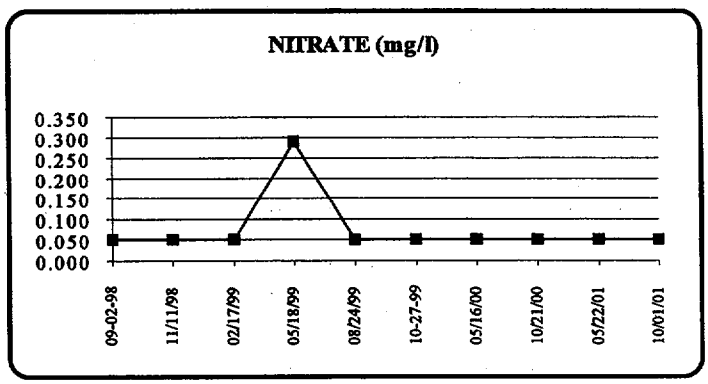


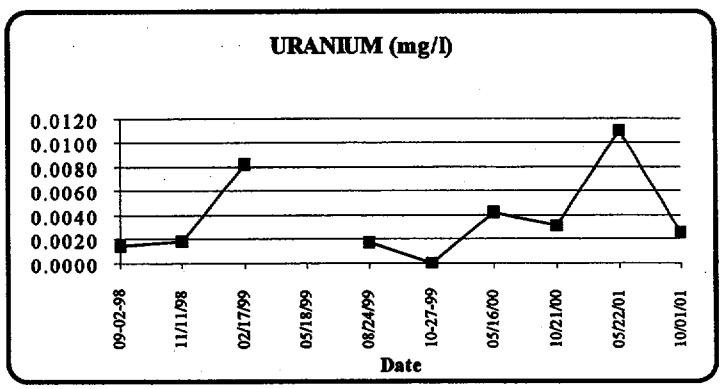
19 DC

DATE	CHLORIDE	SO4	NO3	URANIUM
09-02-98	74.8	1700	0.050	0.0014
11/11/98	75.3	1690	0.050	0.0018
02/17/99	74.1	1650	0.050	0.0082
05/18/99	70.4	1730	0.290	
08/24/99	81.8	1700	0.050	0.0017
10-27-99	68.6	1640	0.050	0.0000
05/16/00	72.2	1660	0.050	0.0042
10/21/00	58.2	1190	0.050	0.0031
05/22/01	61.5	946	0.050	0.0110
10/01/01	81.4	1400	0.050	0.0025









ATTACHMENT B

PATHFINDER AREA 2/8 RESERVOIR ELEVATION DATA

PATHFINDER MINES CORPORATION
SHIRLEY BASIN MINE

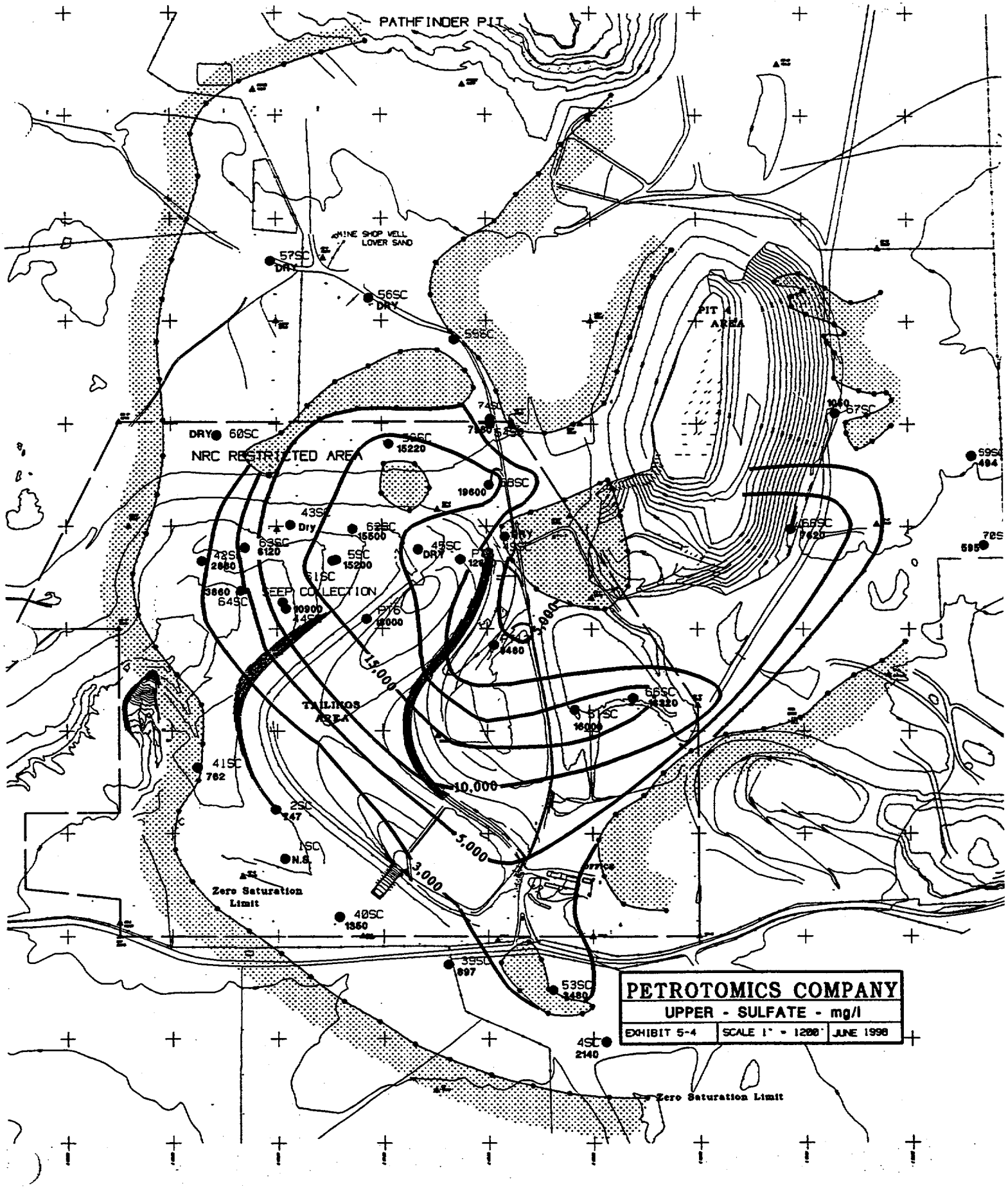
WATER ELEVATIONS OF AREA 2 POND, AREA 3 POND AND AREA 8 POND

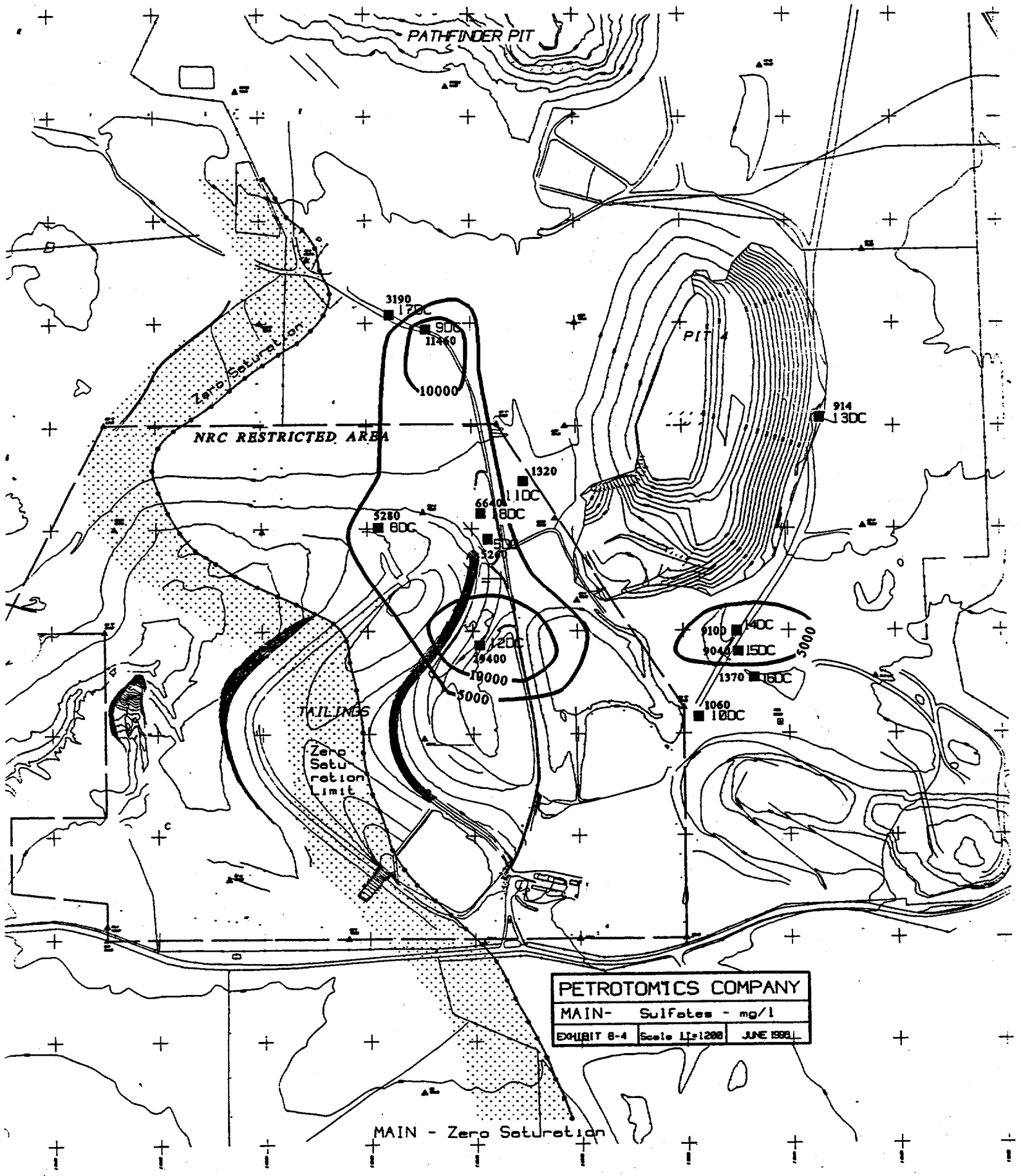
1997	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
AREA 2 POND								6912.87		6914.79	6915.26	6916.3
AREA 3 POND								6891.74		6891.27	6891.26	6891.26
AREA 8 POND								6902.67		6903.17	6903.03	6902.94
1998												
AREA 2 POND	6917.61	6921.13	6921.13	6920.47	6920.08	6919.13	6919.45	6920.24			6920.31	6919.64
AREA 3 POND	6891.29	6893.38	6893.38	6894.33	6894.3	6893.78	6893.64	6893.83			6894.88	6894.93
AREA 8 POND	6903.26	6903.63	6903.63	6904.66	6905.18	6905.72	6906.18	6906.05			6907.82	6908.09
1999												
AREA 2 POND	6919.65		6921.61		6925.29	6926.37	6925.53	6924.76	6923.97	6923.43	6923.13	
AREA 3 POND	6895.1		6897.7		6898.44	6898.63	6898.13	6897.87	6897.68	6897.52	6897.63	
AREA 8 POND	6909.23		6911.13		6911.3	6911.51	6911.85	6912.18	6912.39	6912.88	6913.26	
2000												
AREA 2 POND	6922.94	6922.88	6922.85	6924.06	6926.23	6926.63	6925.98	6925.35	6924.57		6924.48	
AREA 3 POND	6897.9	6897.95		6899.35	6899.64	6899.35	6899.02	6898.73	6898.3		6898.4	
AREA 8 POND	6914.19	6914.57	6915.6	6915.98	6916.01	6915.74	6915.87	6915.97	6915.91		6916.44	
2001												
AREA 2 POND				6925.05	6926.29		6927.45	6926.9	6926.76		6926.1	6925.88
AREA 3 POND				6899.75	6901.19		6900.65	6901.08	6900.65		6900.59	6900.75
AREA 8 POND				6918.73	6919.19		6918.82	6918.95	6918.86		6917.12	6919.45
2002												
AREA 2 POND	6926.06	6926.38										
AREA 3 POND	6900.76	6901.04										
AREA 8 POND	6919.98											

PREDICTED LEVEL OF AREA 2/8 POND IS 6960 IN YEAR 2030. AREA 2 POND AND AREA 8 POND WILL BE ONE.
PREDICTED FINAL LEVEL OF POND 3 IS 6966 TO 6967 IN YEAR 2030

ATTACHMENT C

SULFATE CONCENTRATION IN GROUNDWATER
JUNE 1998


PATHFINDER PIT
MINE SHOP WELL LOWER SAND
57SC DRY
56SC DRY
59SC
PIT 4 AREA
DRY 60SC
NRC RESTRICTED AREA
15220
19600
43SC Dry
62SC 15500
63SC 6120
42SC 2880
5SC 15200
45SC DRY
61SC
SEEP COLLECTION
3860 64SC
10900
PT6 18000
15,000
10,000
5,000
3,000
TAILINGS AREA
41SC 762
2SC 747
1SC N.S.
Zero Saturation Limit
40SC 1350
39SC 897
53SC 3480
4SC 2140
Zero Saturation Limit
67SC
59SC 494
66SC 7620
70S 595
66SC 16320
51SC 16000
PETROTOMICS COMPANY
UPPER - SULFATE - mg/l
EXHIBIT 5-4
SCALE 1" = 1200'
JUNE 1998


PATHFINDER PIT
PIT 4
Zero Saturation
NRC RESTRICTED AREA
TAILINGS
Zero Saturation Limit
3190
12DC
9DC
11460
10000
914
13DC
1320
11DC
6640
18DC
5280
8DC
5DC
3200
12DC
15400
10000
5000
9100
14DC
9040
15DC
5000
1370
16DC
1060
10DC
PETROTOMICS COMPANY
MAIN- Sulfates - mg/l
EXHIBIT 8-4
Scale 1:1200
JUNE 1998
MAIN - Zero Saturation