Rio Algom Mining LLC

August 1, 2006

ADDRESSEE ONLY
Mr. William Von Till, Chief
Uranium Processing Section
Fuel Cycle Facilities Branch, NMSS
Mail Stop T-8A33
U.S. Nuclear Regulatory Commission
Washington, DC 20850

Subject: **Ambrosia Lake Facility**
License SUA-1473, Docket No. 40-8905
License Condition #34, Semiannual Groundwater Report

Dear Mr. Von Till:

Pursuant to license condition #34 of the above referenced license, please find attached the semi-annual groundwater monitoring report for the above referenced facility. The review describes the groundwater stability monitoring plan as approved by Amendment #56.

If you have any questions concerning this submittal, please contact me at (505) 287-8851, extension 15.

Regards,

Peter Luthiger
Manager, Radiation Safety
And Environmental Affairs

Enclosure
CC: R. Jones (Tronox)
Lukes (NRC-MD)
K. Myers (NMED-NM)
file

RIO ALGOM MINING LLC
AMBROSIA LAKE FACILITY

License SUA-1473 Docket 40-8905

Groundwater Stability Monitoring Plan

Semi-Annual Report
August 1, 2006

RIO ALGOM MINING LLC
AMBROSIA LAKE FACILITY
GROUNDWATER MONITORING REPORT – 1ST HALF 2006

NRC source material license SUA-1473, condition #34(D) requires Rio Algom Mining LLC (RAM) submit semi-annual groundwater monitoring reports associated with the facility's groundwater stability monitoring plan established by Amendment 56. Condition 34.D states:

> *Submit, by February 1 and August 1 of each year ground water monitoring reports to include a minimum of the following: potentiometric surface maps for each aquifer; time vs. concentration plots for all parameters for which ACLs have been issued, hydrographs for the downgradient most trend well or POE well in each aquifer, hydraulic gradient calculations, and tabulated analytical data for each ACL parameter for each well.*

This report presents the groundwater monitoring data for monitoring wells completed in the Alluvium, Tres Hermanos A, Tres Hermanos B, and Dakota Sandstone for the period covering January – June 2006.

Background

RAM's Ambrosia Lake facility is located in McKinley County approximately 24 miles due north of Grants, New Mexico, in the Ambrosia Lake valley. Uranium milling activities started at the site in 1957. The waste management structures were Tailings Impoundments 1 and 2, Decantation Pond 3, and Evaporation Ponds 4 through 10. Tailings Impoundments 1 and 2 were built in late 1958, along with Pond 3 at the eastern toe of Tailings Impoundment 1, to accept decanted tailings liquids. Tailings were first produced at the site in November 1958. In 1976, RAM diverted the natural course of the Arroyo del Puerto east of Ponds 4, 5, and 6 and lined Ponds 9 and 10. The solids fraction was disposed through a slurry transfer system to the tailings impoundments, while the liquids fraction was transferred to the evaporation ponds. Evaporation pond residues from Ponds 3, 4, 5, 6, 7, and 8 were placed in Tailings Impoundments 1 and 2 prior to final

reclamation. All the aforementioned tailings impoundments and ponds were unlined. Seepage from the tailings impoundments and Evaporation Ponds 3 through 6, along with seepage from unrelated mining and milling operations, has saturated and impacted the Alluvium of the Arroyo del Puerto (Alluvium). Seepage from the tailings impoundments and evaporation Ponds 7 and 8 has recharged and impacted the Tres Hermanos B (TRB) sandstones within the Mancos Formation shale and the Dakota Sandstone, which underlies the Mancos Formation.

Consequently, in 1983, Rio Algom entered into an Assurance of Discontinuance (AOD) with the State of New Mexico to minimize the future impact of mill tailings solutions seepage on ground water. The approved AOD remedial action required the construction and maintenance of an interceptor trench (IT-1) and the cessation of discharges to unlined Ponds 4 through 8. These ponds were taken out of service in 1983. In the late 1990s, RAM added interceptor trenches IT-2, IT-3, and IT-4 south of Pond 10 to collect seepage potentially missed by IT-1.

In 1986, after the State of New Mexico relinquished its licensing authority over uranium mill activities, NRC reasserted jurisdiction at the site and required that the site begin a ground water detection monitoring program. Data from this program were the basis for the ground water protection standards (GPSs) established for the site by NRC and a corrective action program (CAP) for the ground water was developed based on this information. The CAP required pumping and treating ground water to remove certain constituents. Rio Algom implemented the CAP since the mid-1980s.

Mining and milling operations in the area have had two notable hydrologic effects: creation and maintenance of a saturated zone at the base of the Alluvium and creation of a cone of ground water depression in bedrock aquifers due to dewatering of underground mines. Water quality in the alluvium and the units into which the alluvium drains has also been affected by area mining operations not directly related to the licensee.

2006 Activities

Activities associated with groundwater monitoring program at the mill facility during the first half of 2006 consisted of two aspects. First, Rio Algom's petition for Alternate Concentration Limits (ACLs) was approved by the Nuclear Regulatory Commission in February 2006. With this approval, Rio Algom discontinued the mine dewatering that was mandated by the Corrective Action Plan (CAP) that was implemented in 1989. The CAP consisted of pumping of the Section 30 and 30 West mines to capture bedrock seepage and operation of a groundwater sweep consisting of the Arroyo del Puerto and an interceptor trench at the toe of tailings impoundment #1. The ACL petition demonstrated that the CAP had achieved its maximum potential to reduce concentrations of milling related constituents in groundwater and that current concentrations are As Low As Reasonably Achievable (ALARA). Rio Algom has initiated closure of the intercept trench in order to facilitate completion of remaining surface reclamation efforts. The approved ACLs for the site are presented in Table 1 below.

Table 1

Rio Algom Mining – Ambrosia Lake Operation

Approved Alternate Concentration Limits

Parameter	Dakota	Tres Hermanos A	Tres Hermanos B	Alluvium
U-nat (mg/L)	1.6	No ACL	1.6	23
Th-230 (pCi/L)	945	945	945	13,627
Ra-226 and – 228 (pCi/L)	218	218	218	3,167
Pb-210 (pCi/L)	88	88	88	1,274
Gross Alpha (pCi/L)	No ACL	No ACL	No ACL	8,402
Molybdenum (mg/L)	No ACL	No ACL	No ACL	176
Nickel (mg/L)	6.8	No ACL	6.8	98
Selenium (mg/L)	No ACL	No ACL	No ACL	49
Chloride (mg/L)	3,200	1,070	2,810	7,110
Nitrate (mg/L)	22.8	9.2	7.7	351
Sulfate (mg/L)	6,480	2,584	4,760	12,000
Total Dissolved Solids (mg/L)	14,100	6,400	11,700	26,100

The second activity that occurred during the 1st half of 2006 was initiation of the groundwater stability monitoring plan. The well network was designed to track and assess ground-water contamination between the tailings impoundment and the long-term care boundary and point of exposure (POE). NRC required more frequent monitoring during the beginning of the compliance monitoring program because of uncertainties in the hydrogeologic and transport models. Contaminated ground water will not express itself as surface water; therefore any exposure must occur through actual ground water use.

As a result of receiving the ACL approval in late February 2006, the first quarterly sampling event under the stability monitoring plan was conducted in the second quarter of 2006. Appendix 1 contains the analytical data for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units, respectively. Appendix 2 contains the time versus concentration plots for the ACL parameters for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units.

Appendix 3 contains the hydrographs for the stability monitoring plan wells for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units. The most notable observation in the data is the potentiometric surface drop in the Alluvium. Rio Algom has observed a maximum drop of 6.1 feet and an average drop of 1.3 feet within this unit. This drop is attributable to the discontinuance of the alluvial CAP, which was maintaining the artificial water mound in the vicinity of the site. Rio Algom's groundwater flow model projected a 65-100 year period for the Alluvium to dewater following cessation of the CAP. This water table drop acts to slow the lateral migration rate of milling related seepage. The area with the greatest drop in potentiometric surface was the southeast region (Section 5), which is the area located near the POE for the alluvium.

Rio Algom determined the hydraulic gradients by calculating the difference in groundwater elevation between the most upgradient Point of Compliance well in each unit and the farthest downgradient trend or Point of Exposure well in the same unit. That value was then divided by the distance along a flow path between the two wells. Results of these calculations are summarized below.

- Alluvium – 0.006 feet per foot
- Dakota Sandstone – 0.033 feet per foot
- Tres Hermanos A Sandstone – 0.026 feet per foot
- Tres Hermanos B Sandstone – 0.007 feet per foot

Appendix 4 contains the potentiometric surface maps for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units, respectively.

Data Evaluation

As a component of the ACL approval process, NRC not only established ACLs for specific parameters, but NRC also maintained the groundwater protection standards (GPS) for those constituents for which ACLs were not proposed. During the time from initial ACL submission for the bedrock units (February 2000) to ACL approval (2006), the site maintained the Corrective Action Plan. As a result of incorporating the GPS from the CAP into the ACL approval, a water quality review was undertaken to ascertain the effect of maintaining these constituents in addition to the ACLs within the groundwater stability monitoring program. The observations are discussed below.

Gross Alpha

Review of the gross alpha concentrations observed in groundwater indicate that gross alpha concentrations have historically been above the GPS in three Tres Hermanos B wells, including the background monitor well 19-77; as well as the background well within the Tres Hermanos A unit. This condition was discussed in the bedrock ACL petition within Section 1.0, *General Information* and Section 2.0, *Hazard Assessment*. At that time, Rio Algom did not propose an ACL for gross alpha; but rather requested that gross alpha be eliminated as a GPS as described below.

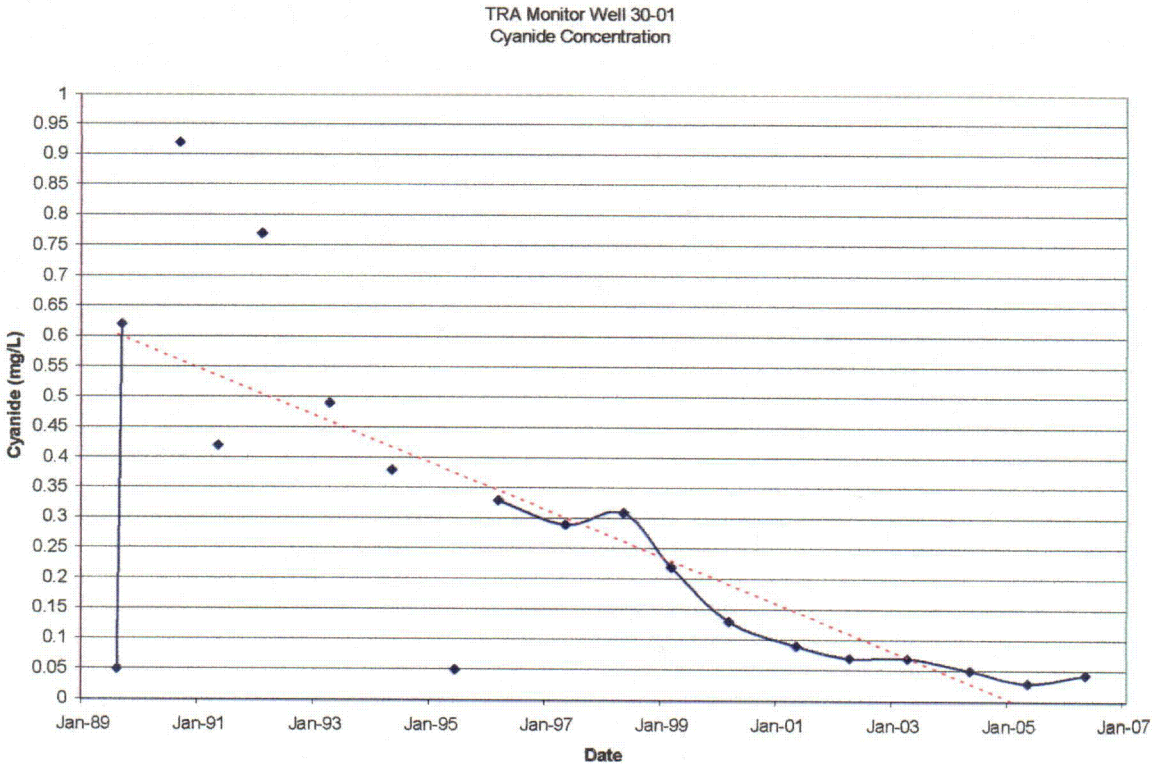
> *"Gross alpha measurement has also been above the corresponding GPS at several of the POC wells in the Tres Hermanos B. However, the regulatory limit in 10 CFR 40,*

Appendix A, Table 5C for gross alpha activity in groundwater excludes uranium and radon alpha activities. The laboratory, who performed the groundwater analyses, has stated that the gross alpha concentration results reported by the laboratory includes alpha activity from U-nat and all other alpha emitters. Normally, alpha activity from uranium will contribute most of the gross alpha activity in neutralized groundwater impacted with uranium mill tailings liquids from sulfuric acid leach process. Furthermore, all the potential alpha emitters in neutralized groundwater impacted with uranium mill tailings liquids (U-nat, Th-230, Ra-226, and Po-210, which is a decay product of Pb-210) are being addressed in the Hazard Assessment and in the proposed ACLs. Therefore, the health hazard and ACL evaluation for gross alpha activity would be duplicative and unnecessary. QMC requests that the GPS for gross alpha be deleted from the licence as a hazardous constituent because the alpha activity hazard is addressed by the proposed ACLs for U-nat, Ra-226 and -228, Pb-210, and Th-230."

As a result of the extended review time for the ACL petitions, this proposal apparently was overlooked by all parties as the ACL review was finalized. As described above, RAM believes that gross alpha is adequately addressed through other ACLs.

Cyanide

The cyanide concentration within Tres Hermanos A (TRA) well 30-01 has averaged 0.33 mg/L since 1989. The current concentration observed in the well is 0.044 mg/L. The GPS for cyanide in the TRA is 0.01 mg/L. The graph below presents the cyanide concentration over time since the CAP was initiated.



Although the cyanide concentrations are just above the GPS, they have consistently been trending downward. Nevertheless, RAM does not believe that the elevated cyanide is attributable to the mill operations as data collected by NRC in April 1987 of the tailings solution indicated a cyanide concentration of 0.025 mg/L. Concentrations in groundwater above this 'worst case' scenario are unexplainable considering the dispersion, dilution, and geochemical processes that associated with groundwater movement.

Beryllium

The current beryllium concentration within well 36-06KD is 0.03 mg/L. The GPS for beryllium in the Dakota is 0.01 mg/L. Attached in appendix 5 is a technical memorandum produced by Dan Erskine, Ph.D. of Intera, Inc. which provides a technical assessment on the beryllium concentrations in well 36-06KD supporting RAMs contention that the beryllium concentrations will not pose any hazard to human health or the environment.

Appendix 1

Stability Monitoring Plan
Analytical Results

RIO ALGOM MINING LLC
1st HALF 2006
DAKOTA WELL RESULTS - ACL PARAMETERS

Well	Date	Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH	Chloride (mg/L)	Sulfate (mg/L)	T.D.S. (mg/L)	Nitrate (mg/L)
17-01KD	23-May-06	683.85	810.30	1624	21.5	10.87	115	680	1240	0.09
30-02KD	22-May-06	308.40	314.00	7730	17.1	7.63	2050	1070	4680	0.13
30-48KD	1-May-06		338.23							
32-45KD	22-May-06	253.40	278.40	1787	15.5	8.3	202	800	1580	0.09
36-06KD	1-May-06	177.25	198.25	9830	15.8	4.51	1330	4230	9830	0.04
5-02KD	12-Jun-06	190.19	191.39							
ACL							3200	6480	14100	22.8

Well	Ni (mg/L)	U-nat (mg/L)	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)
17-01KD	0.0126	0.0005	-0.3	0.0	1.3
30-02KD	0.0247	0.0023	-0.2	0.0	2.9
30-48KD					0.0
32-45KD	0.0007	0.0067	-0.2	1.2	2.7
36-06KD	0.325	1.33	150.0	0.8	72.6
5-02KD					
ACL	6.8	1.6	945	88	218

Well 30-48KD and 5-02KD contained insufficient water for sample collection.
A negative sign corresponds to "less than"

RIO ALGOM MINING LLC
1st HALF 2006
TRA WELL RESULTS - ACL PARAMETERS

Well	Date	Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH	Chloride (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)	T.D.S. (mg/L)
30-01	23-May-06	200.20	207.33	1442	16.5	10.14	330	260	0.12	1050
31-01	26-Jun-06	202.81	250.85	1767	14.6	8.26	54	1060	0.13	1810
33-01TRA	25-Apr-06	118.29	181.00	3780	14.4	8.06	43	1830	0.13	2900
ACL							1070	2584	9.2	6400

Well	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)
30-01	-0.5	0.0	1.5
31-01	0.0	0.0	1.5
33-01TRA	0.0	2.8	2.3
ACL	945	88	218

A negative sign corresponds to "less than"

RIO ALGOM MINING LLC
1st HALF 2006
TRB WELL RESULTS - ACL PARAMETERS

Well	Date	Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH	Chloride (mg/L)	Sulfate (mg/L)	T.D.S. (mg/L)	Nitrate (mg/L)
19-77	26-Jun-06	283.7	287.9	4450	17.2	7.6	16	1930	3310	0.5
31-02	1-May-06	37.83	126.72	6230	13.7	7.54	860	2120	4770	0.7
31-67	24-Apr-06	22.98	96.20	7800	12.7	7.14	960	3040	6790	2.3
36-01	1-May-06	57.51	58.45							
36-02	25-Apr-06	47.84	57.61	10220	13.1	7.6	2040	2720	7430	0.1
ACL							2810	4760	11700	7.7

Well	Ni (mg/L)	U-nat (mg/L)	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)
19-77	0.004	0.0105	-1.4	0	5.2
31-02	0.007	1.0	-0.1	1.2	6.8
31-67	0.017	0.0087	-0.2	0.0	8.9
36-01					
36-02	0.005	0.0036	-0.1	1.8	1.6
ACL	6.8	1.6	945	88	218

A negative sign corresponds to "less than"
Monitor Well 36-01TRB contained insufficient water for sample collection.

RIO ALGOM MINING LLC
1st HALF 2006
ALLUVIAL WELL RESULTS - ACL PARAMETERS

Well	Date	Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH	Chloride (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)	T.D.S. (mg/L)
5-73	24-Apr-06	12.95	31.40	5160	9.8	7.75	600	1740	0.1	3970
5-03	24-Apr-06	20.62	41.58	4990	12.1	8.03	390	2080	0.1	3800
5-04	24-Apr-06	17.42	64.50	499	12.3	8.76	37	140	-0.2	350
5-08	24-Apr-06	31.62	87.57	5240	13.2	9.12	690	1960	0.1	4080
31-61	25-Apr-06	17.41	26.82	7440	12.3	7.23	640	3320	1.2	6510
31-65	24-Apr-06	18.14	46.00	9060	12.1	7.8	630	4060	2.6	8680
32-59	24-Apr-06	14.39	28.75	5160	11.9	7.57	560	1970	0.0	4260
MW-24	25-Apr-06		50.08							
ACL							**7110**	**12000**	**351**	**26100**

Well	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	U-nat (mg/L)	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)	Gross Alpha (pCi/L)
5-73	0.002	0.012	-0.001	0.0213	-0.3	0.0	1.5	165.6
5-03	0.002	0.004	-0.001	0.0062	-0.3	2.8	3.5	0.0
5-04	0.001	0.001	-0.001	0.0053	-0.3	2.2	1.9	0.0
5-08	0.008	0.007	-0.001	0.0120	-0.3	2.1	10.2	37.9
31-61	-0.003	0.015	-0.001	0.1380	-0.2	2.6	3.4	0.0
31-65	0.008	0.009	-0.001	0.1940	0.2	0.2	3.3	8.7
32-59	0.005	0.011	-0.001	0.1720	-0.4	0.7	3.1	0.0
MW-24								
ACL	**176**	**98**	**49**	**23**	**13627**	**1274**	**3167**	**8402**

A negative sign corresponds to "less than"
Monitor Well MW-24 contained insufficient water for sample collection.

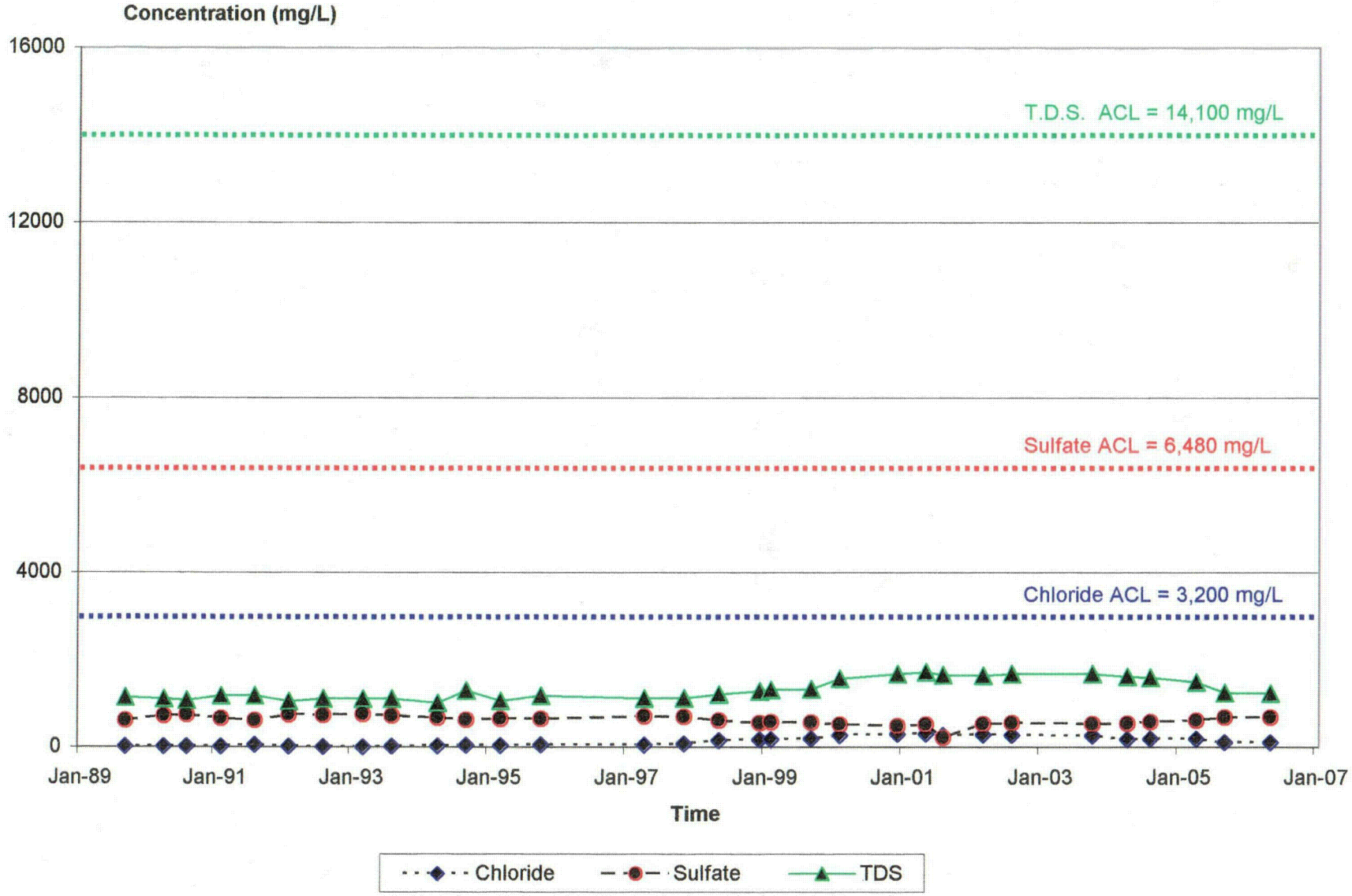
Appendix 2

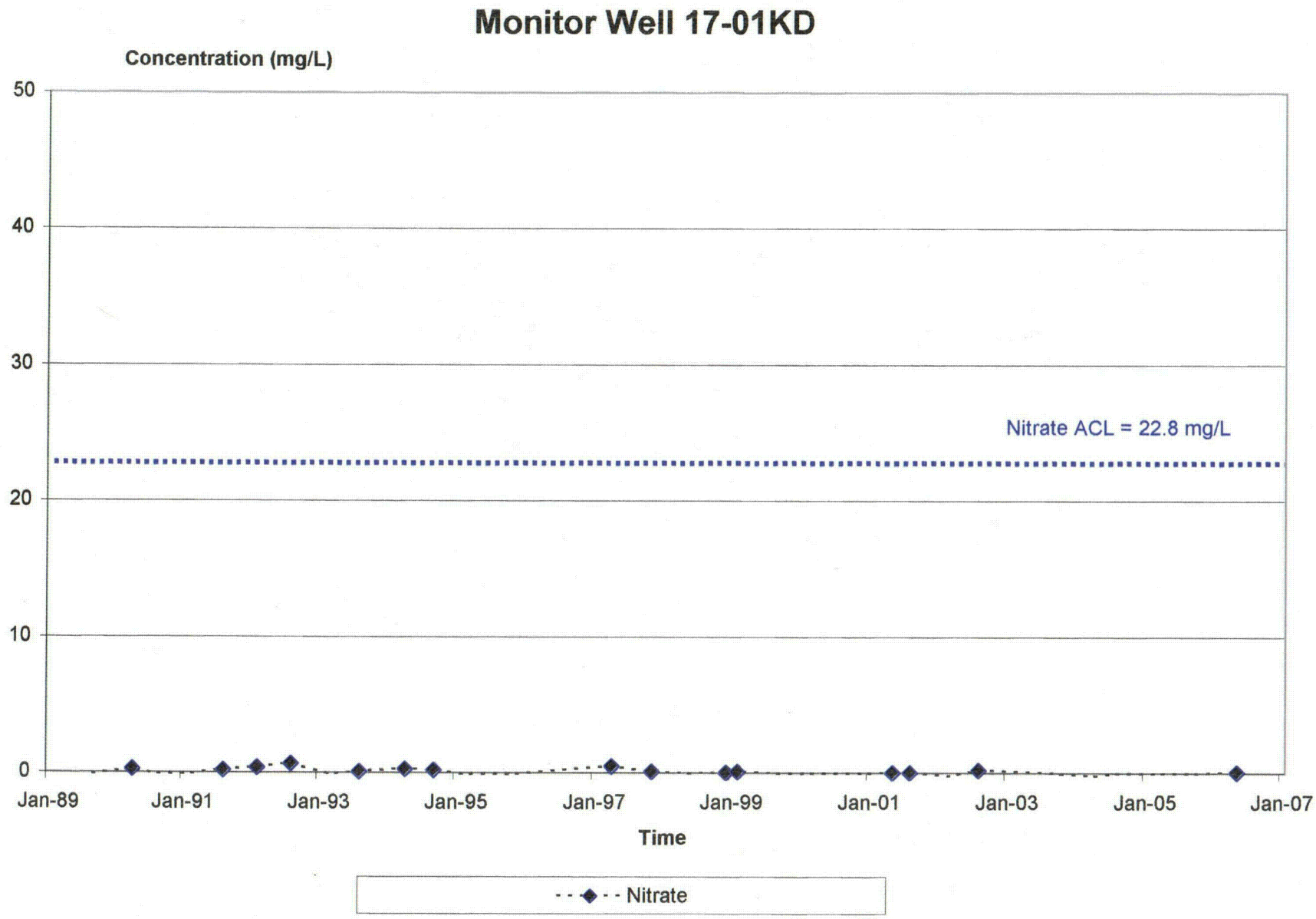
Stability Monitoring Plan
Time vs. Concentration Plots

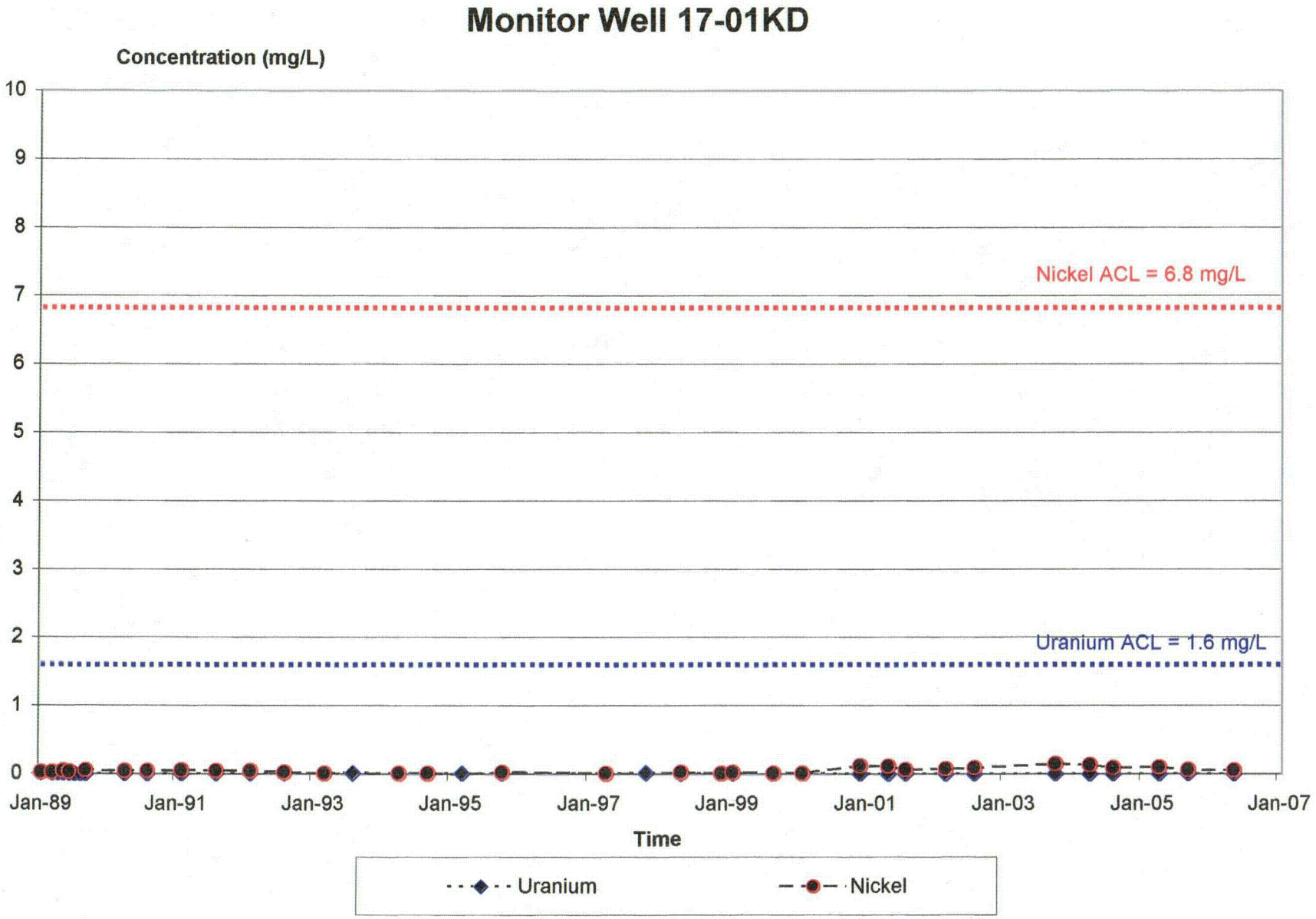
Stability Monitoring Plan
Time vs. Concentration Plots

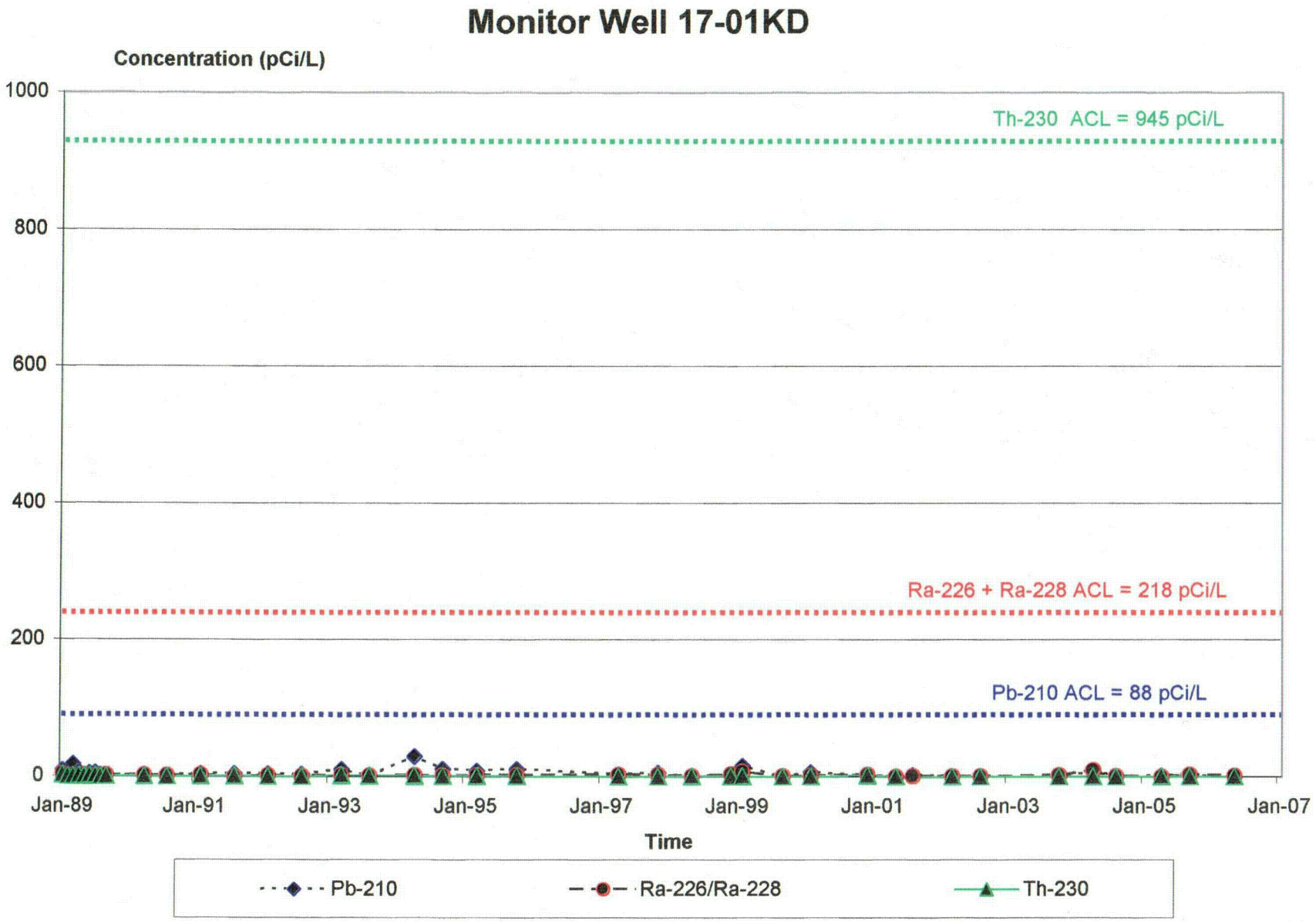
Dakota

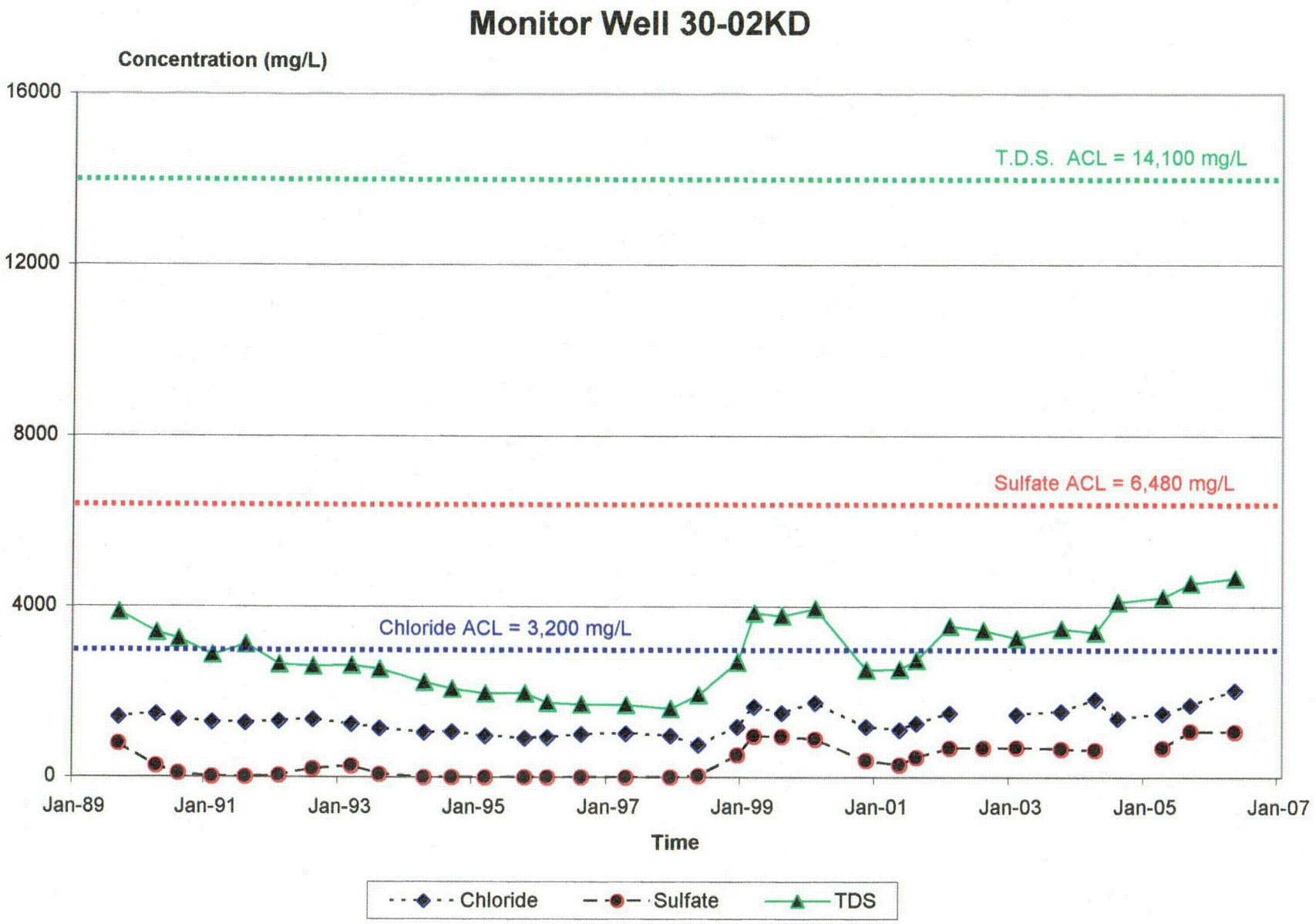
Monitor Well 17-01KD

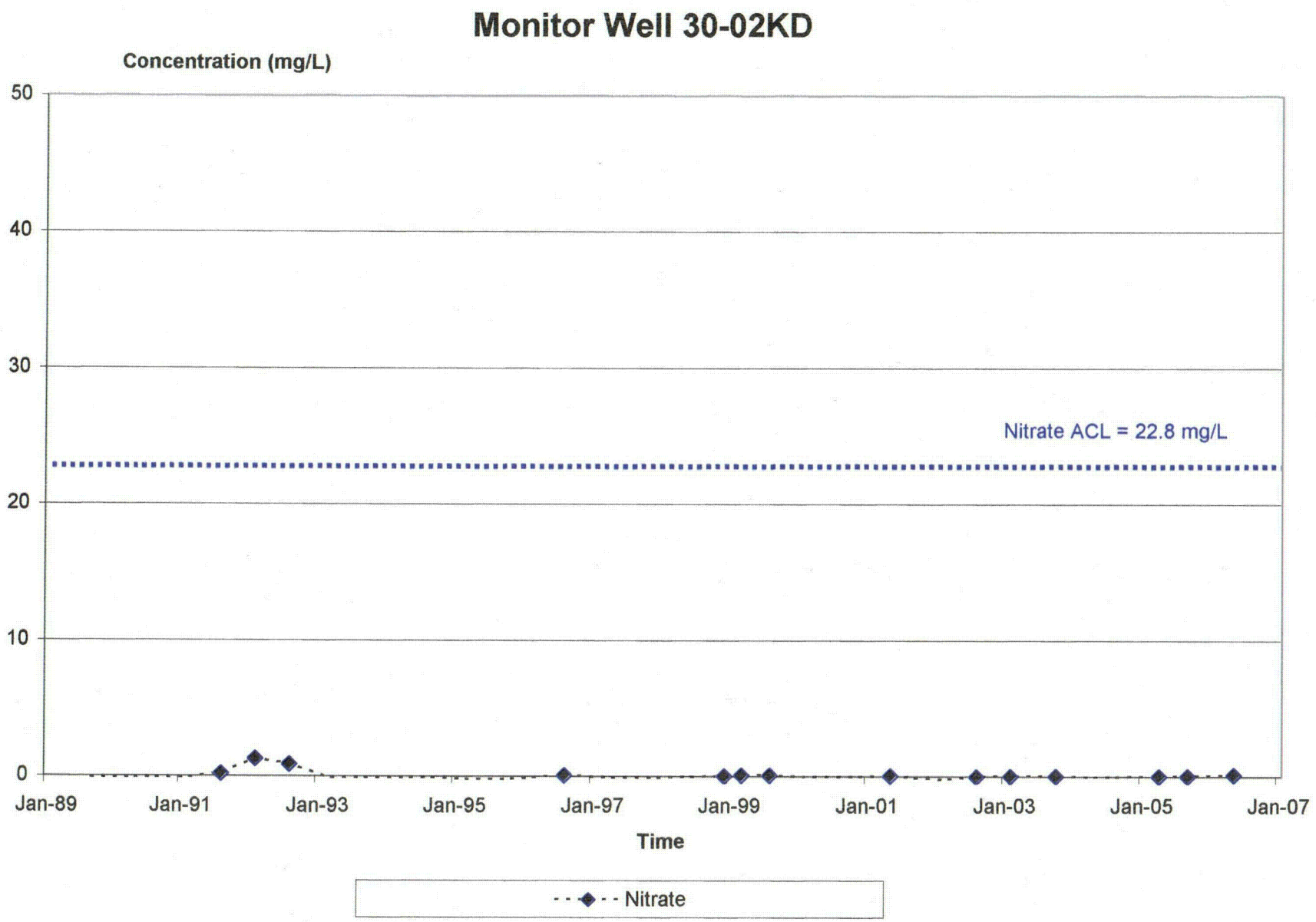


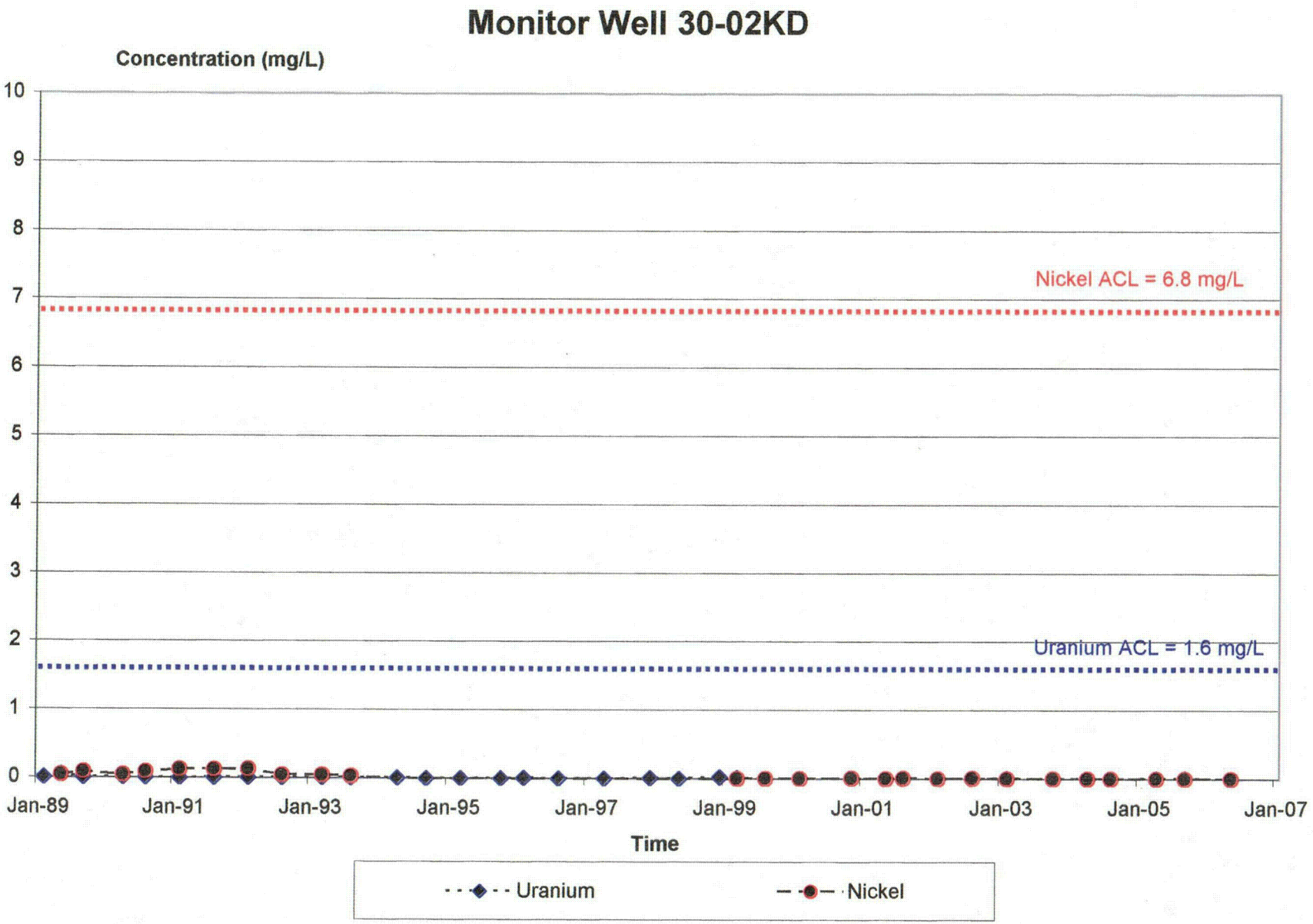

Monitor Well 17-01KD
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 22.8 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

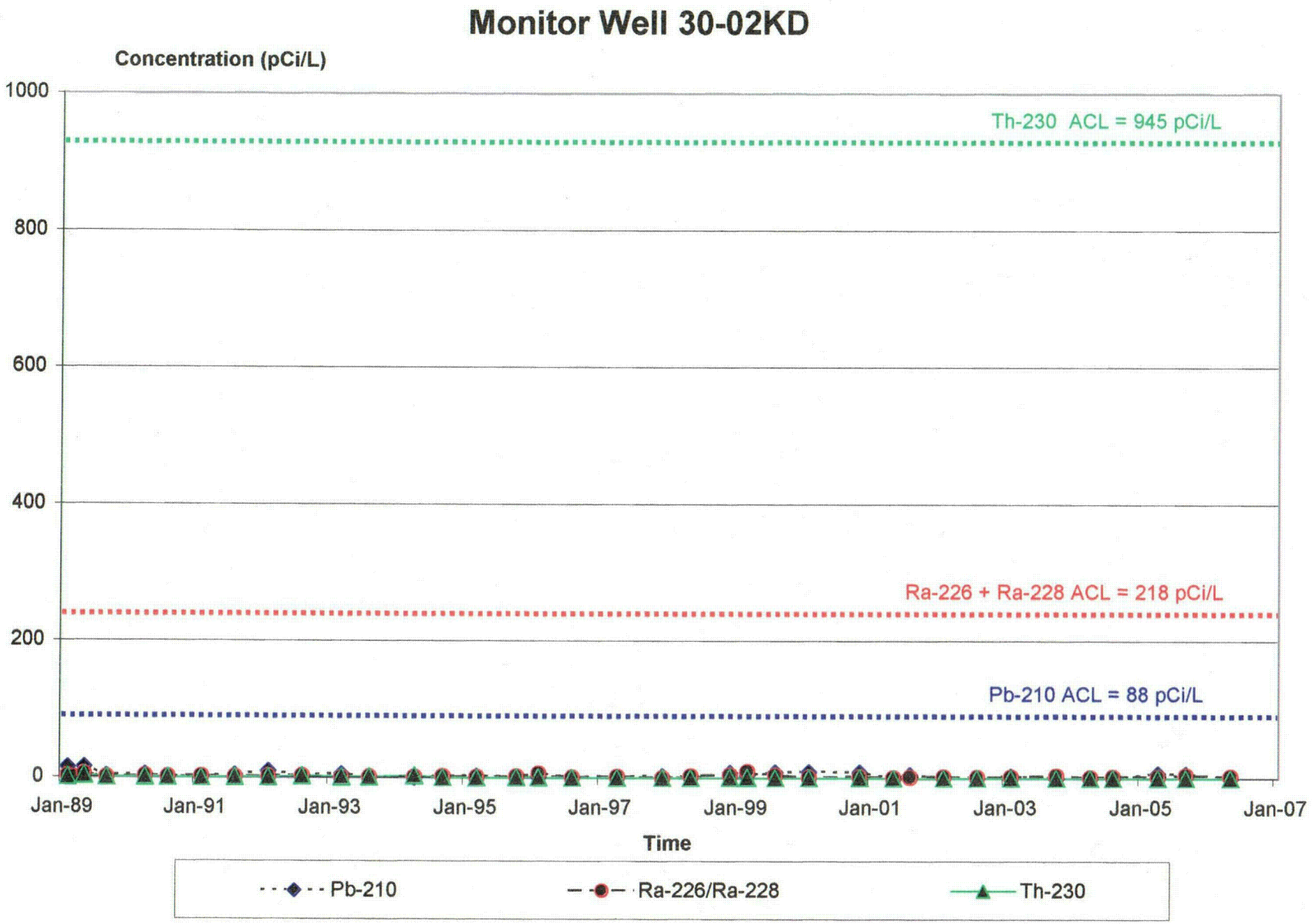

Monitor Well 17-01KD
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel


Monitor Well 17-01KD
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

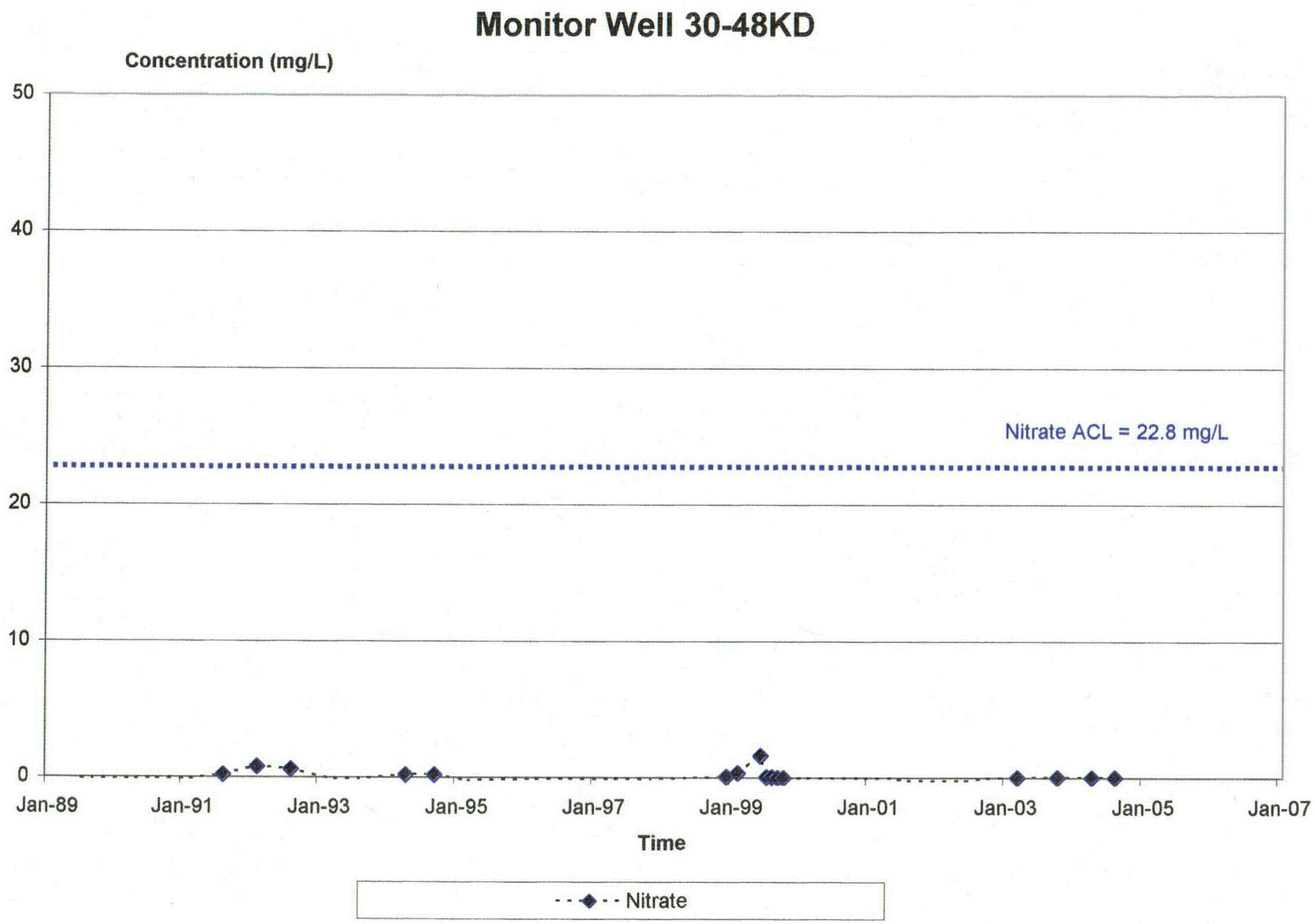

Monitor Well 30-02KD
Concentration (mg/L)
16000
12000
8000
4000
0
T.D.S. ACL = 14,100 mg/L
Sulfate ACL = 6,480 mg/L
Chloride ACL = 3,200 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

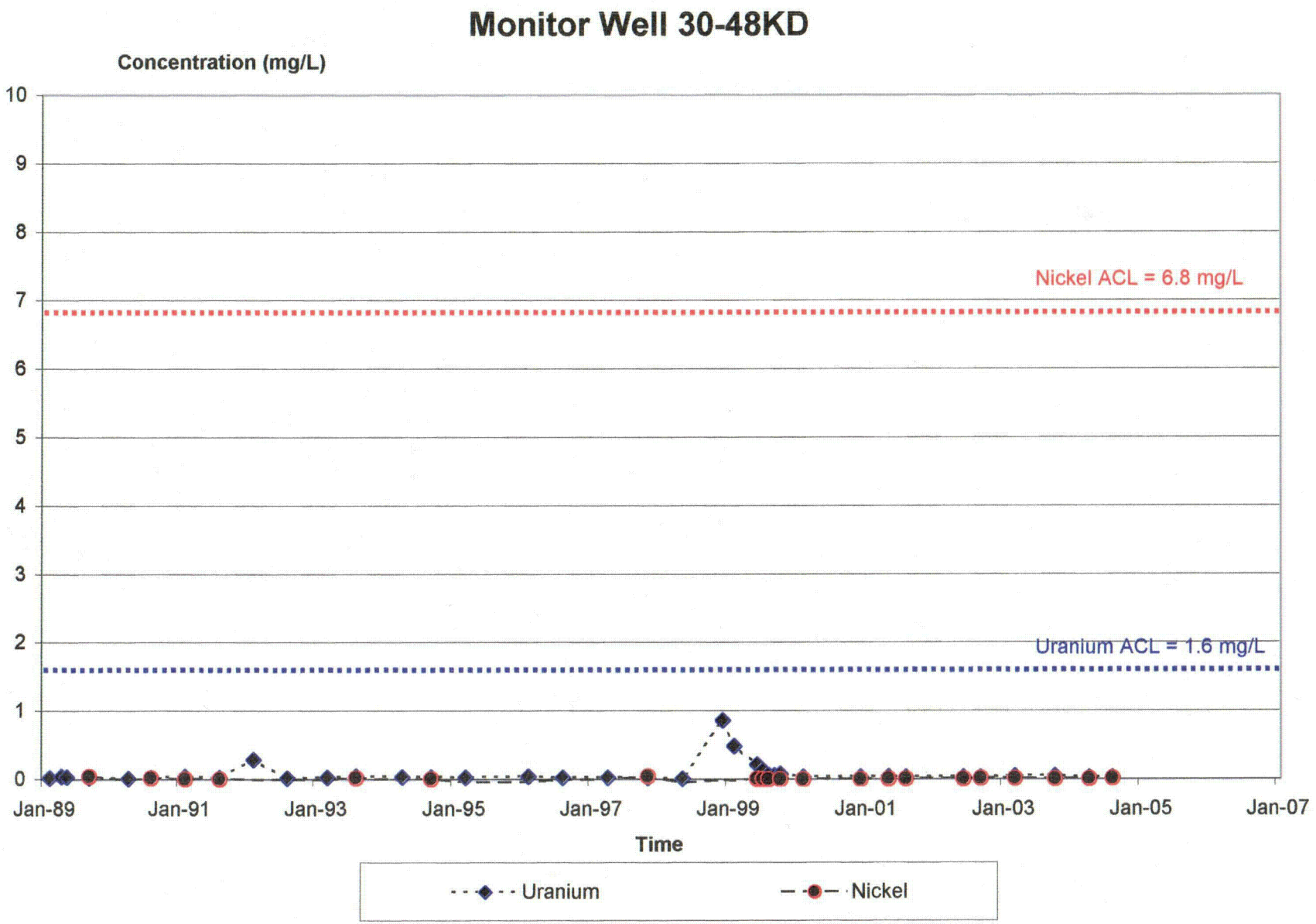

Monitor Well 30-02KD
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 22.8 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate


Monitor Well 30-02KD
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel

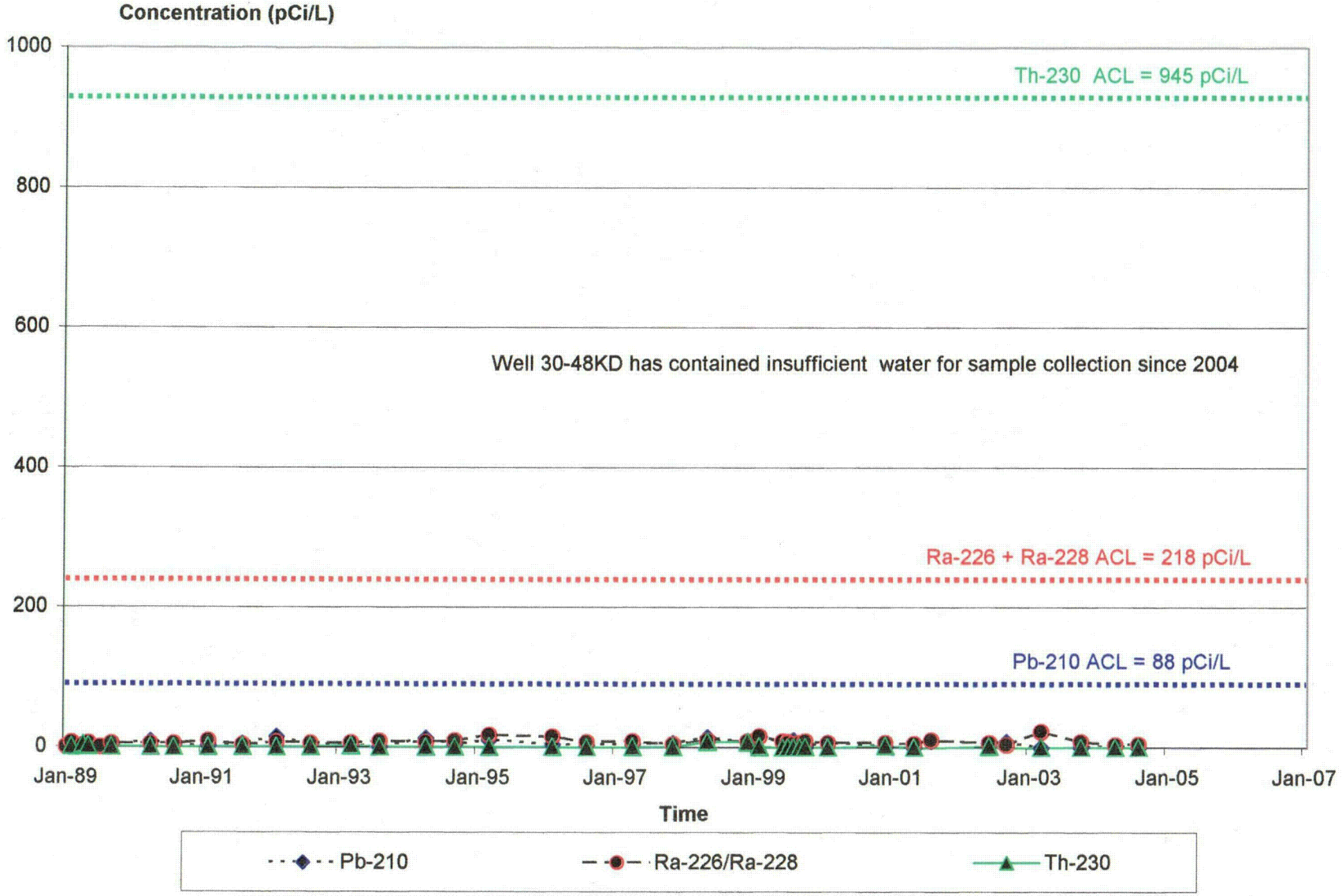

Monitor Well 30-02KD
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

Monitor Well 30-48KD

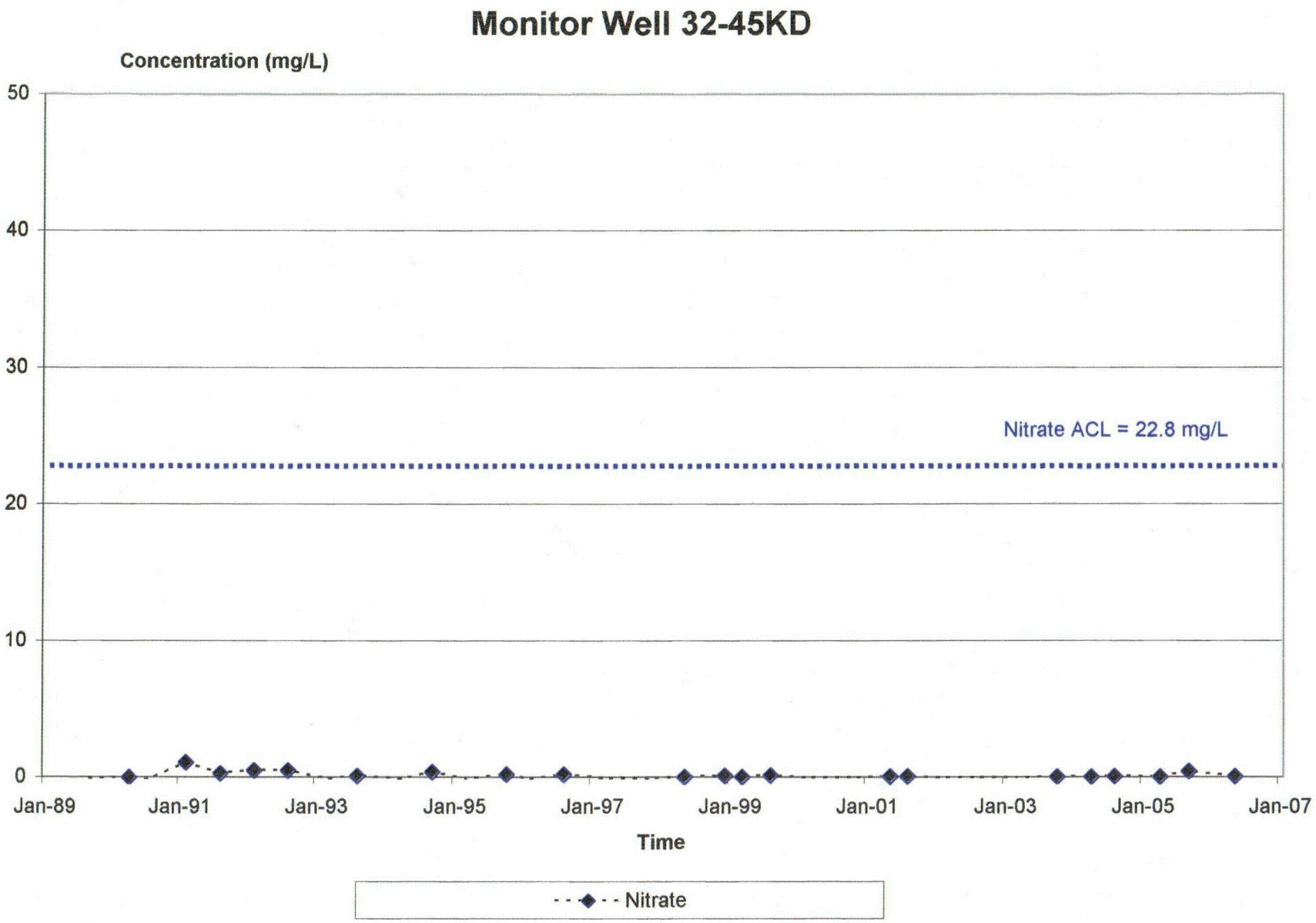

Monitor Well 30-48KD
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 22.8 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate


Monitor Well 30-48KD
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel

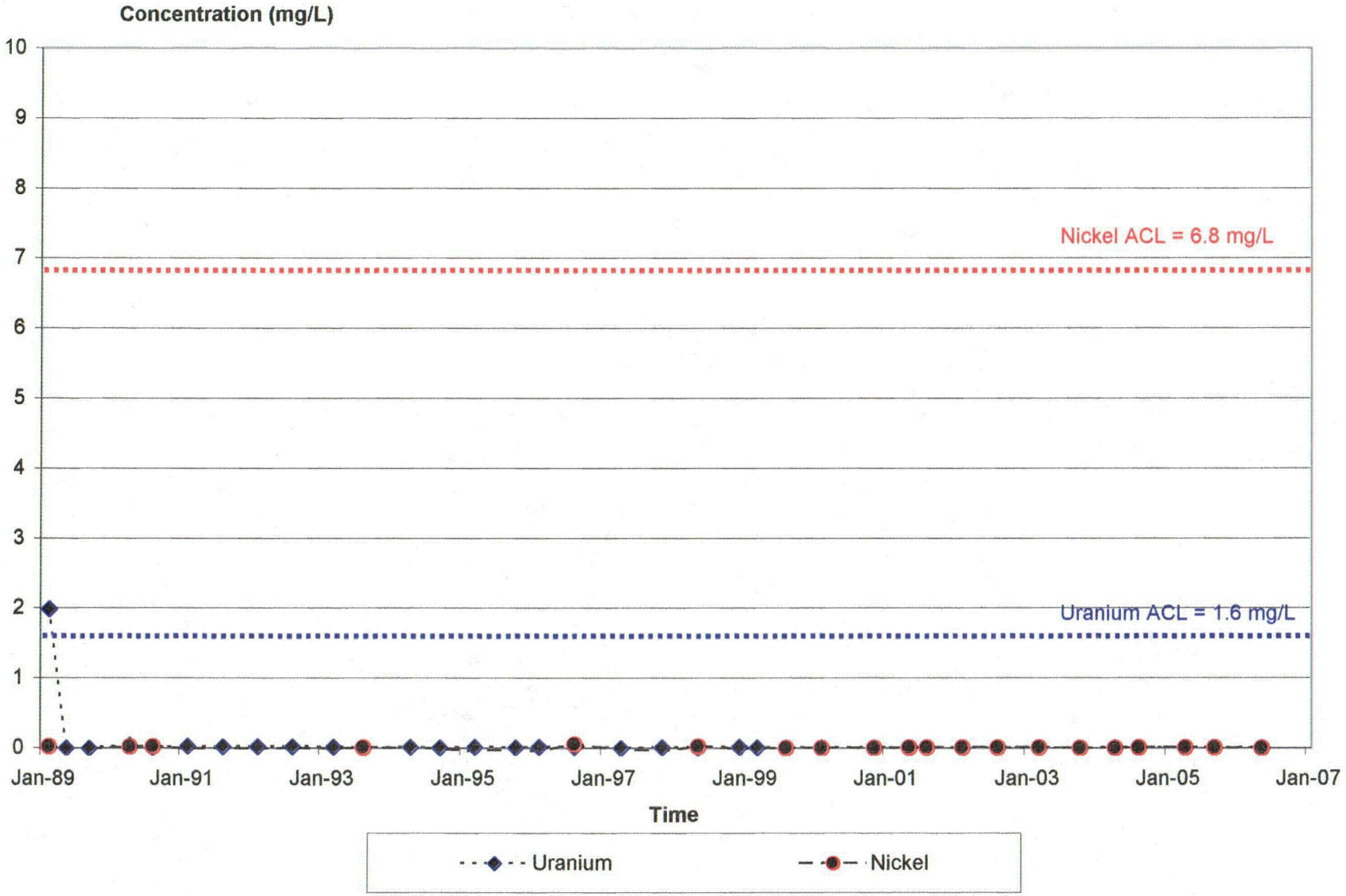
Monitor Well 30-48KD

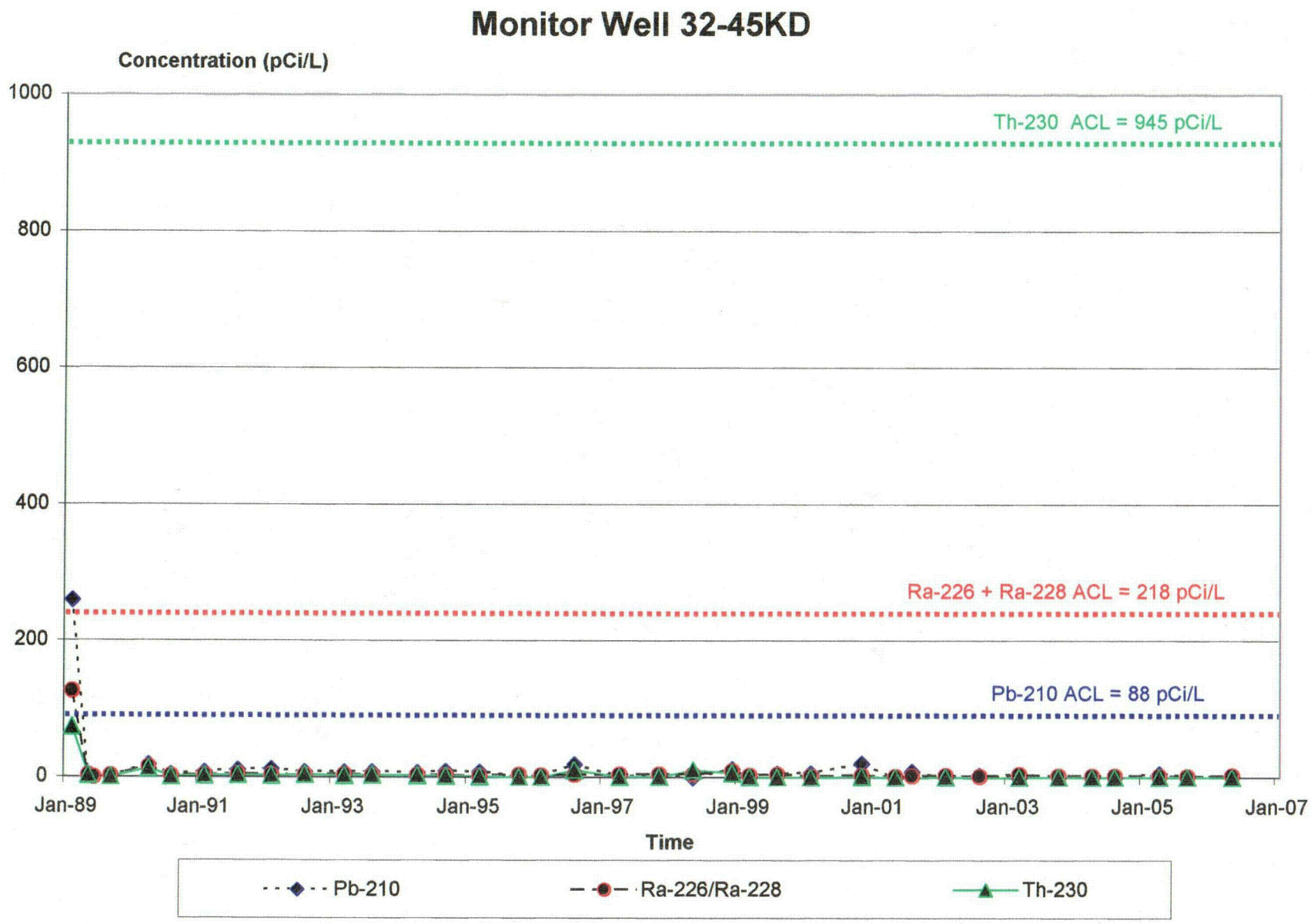


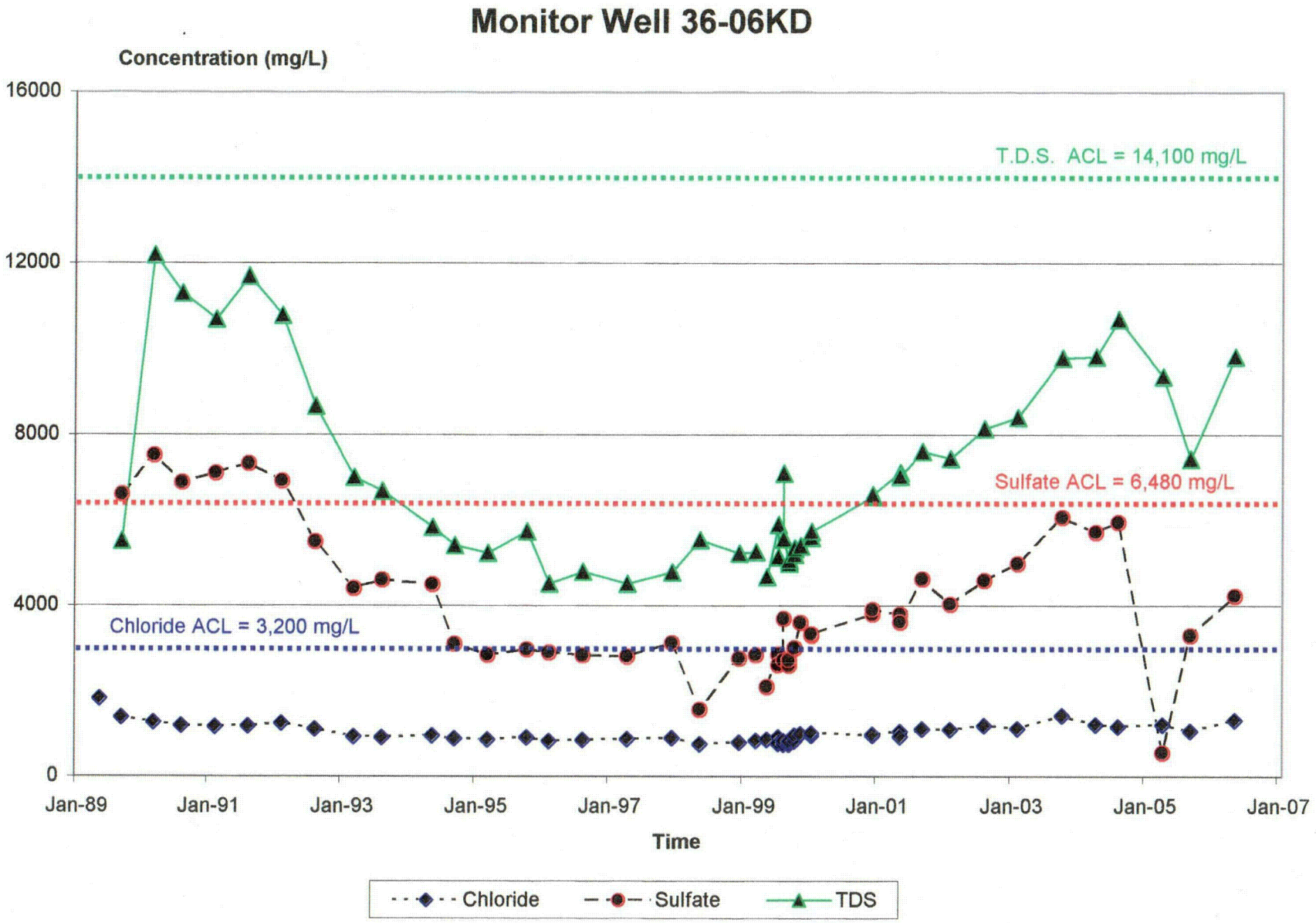
Monitor Well 32-45KD

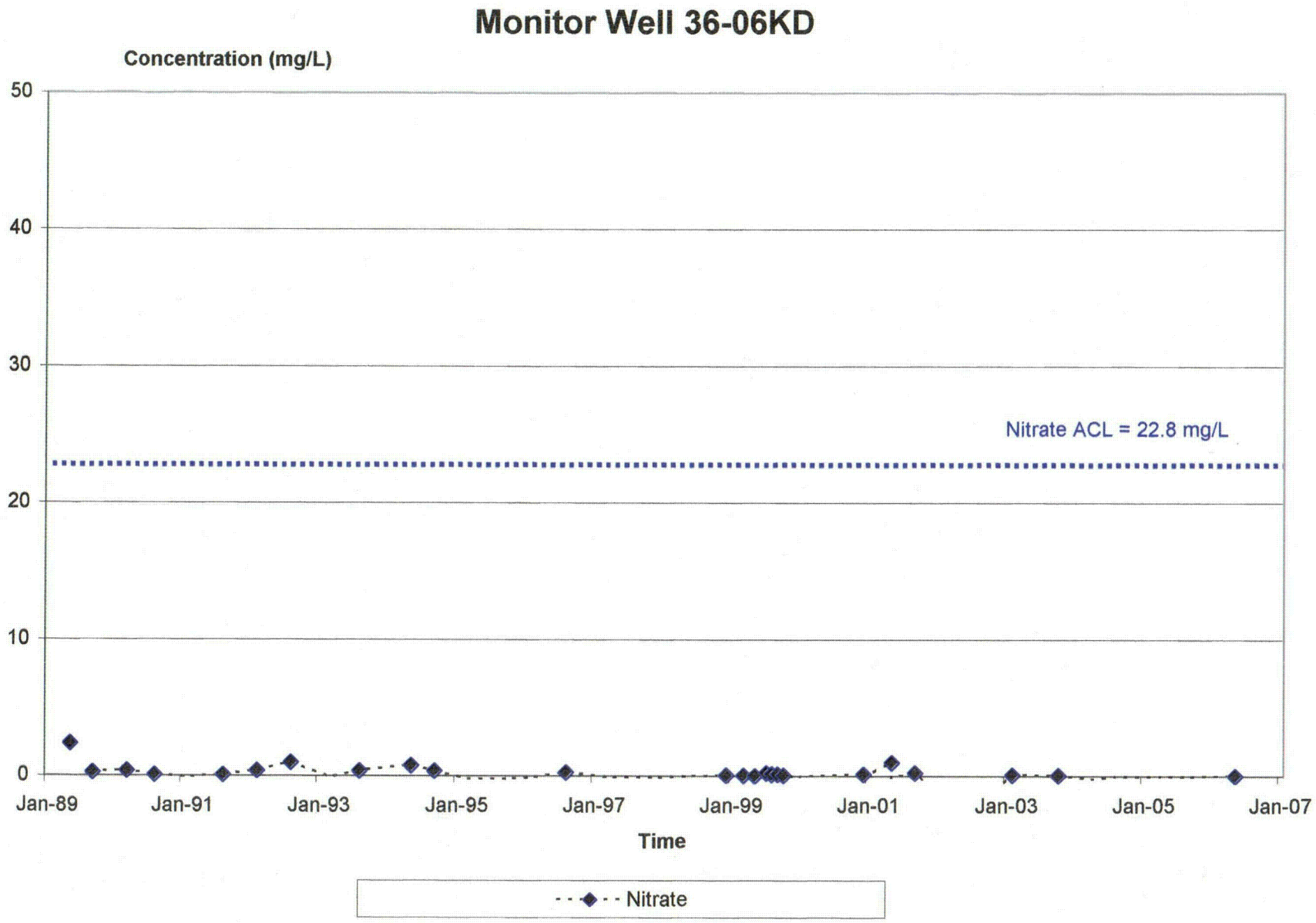

Monitor Well 32-45KD
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 22.8 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

Monitor Well 32-45KD

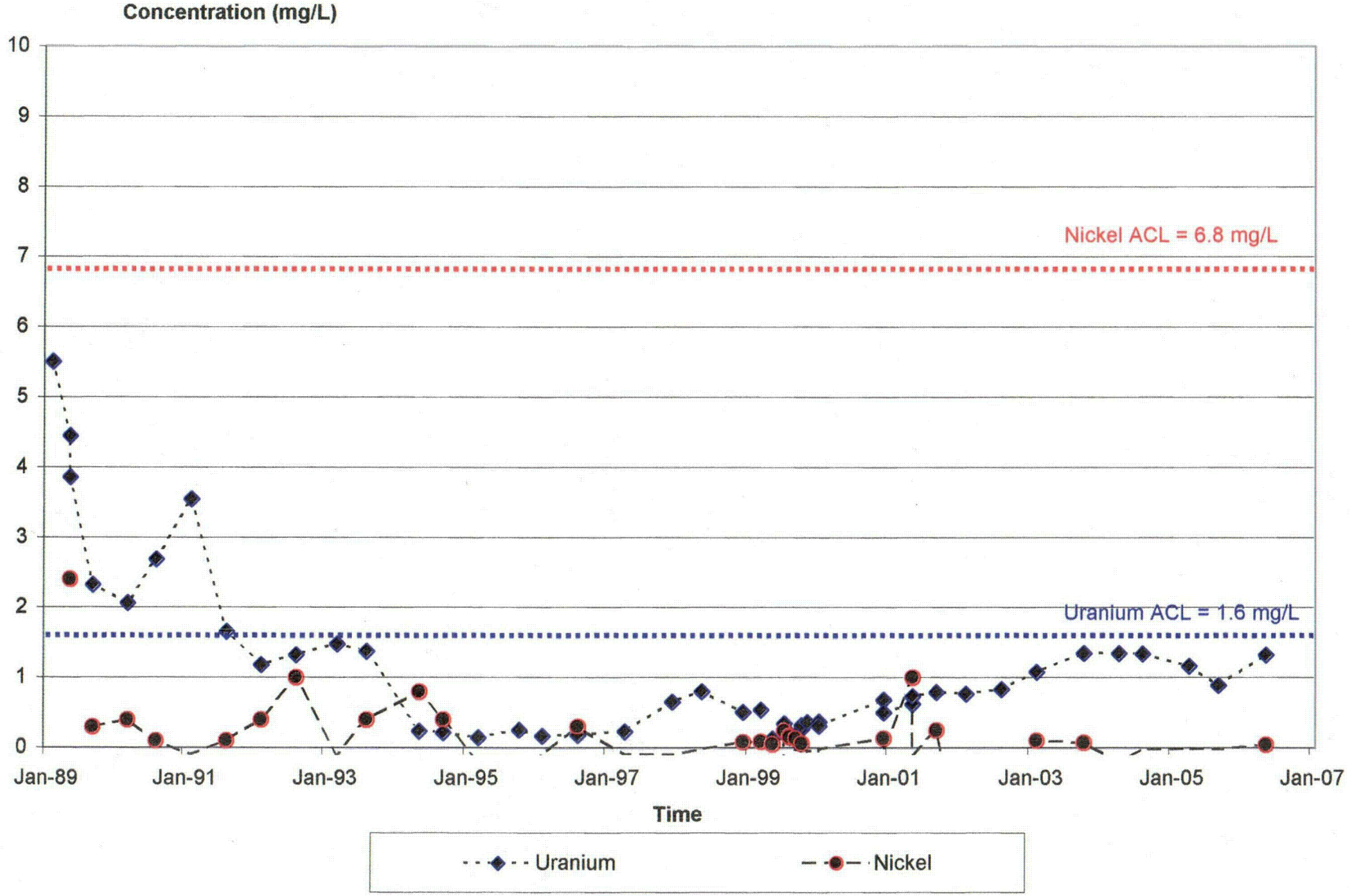


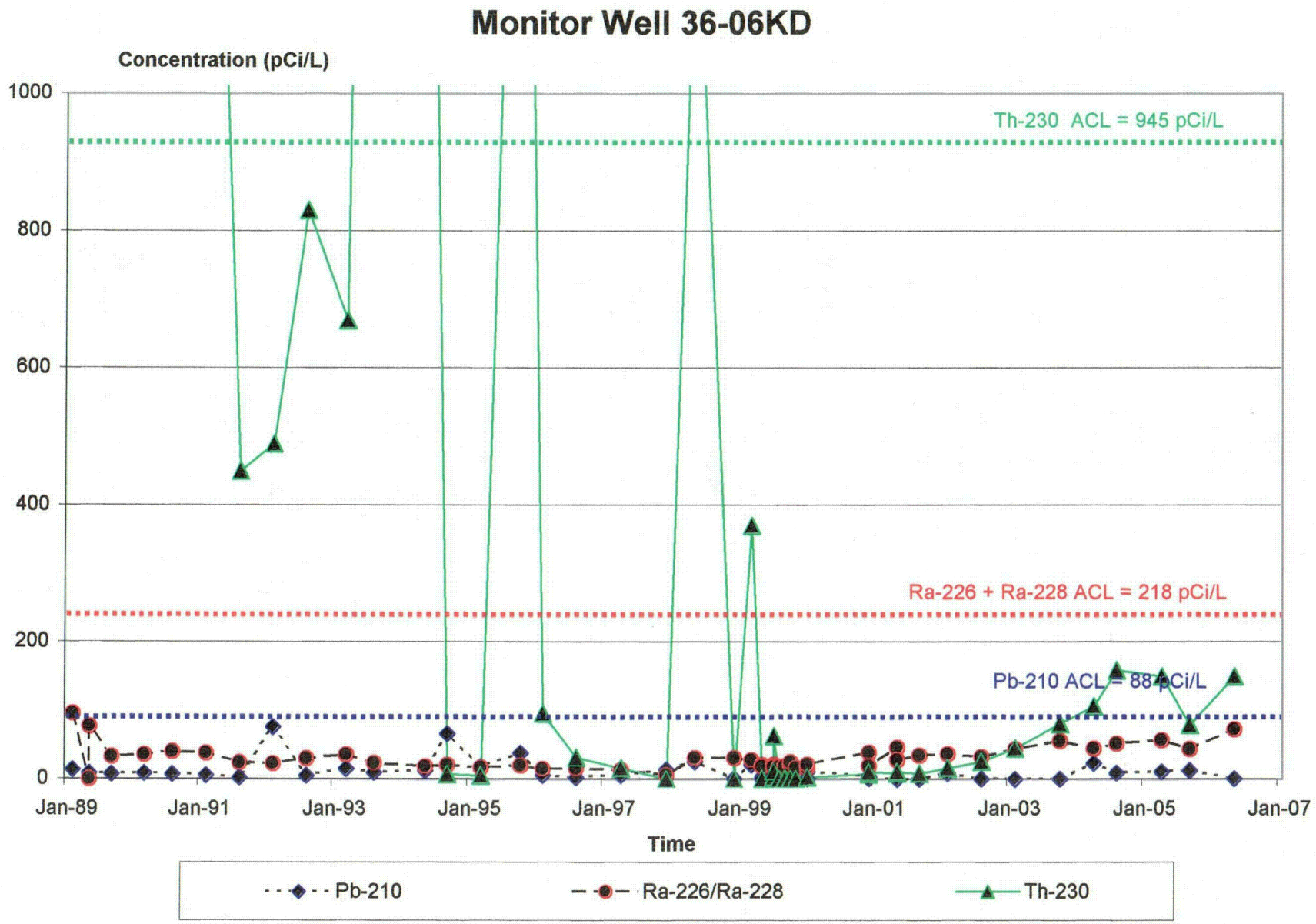

Monitor Well 32-45KD
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230


Monitor Well 36-06KD
Concentration (mg/L)
16000
12000
8000
4000
0
T.D.S. ACL = 14,100 mg/L
Sulfate ACL = 6,480 mg/L
Chloride ACL = 3,200 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

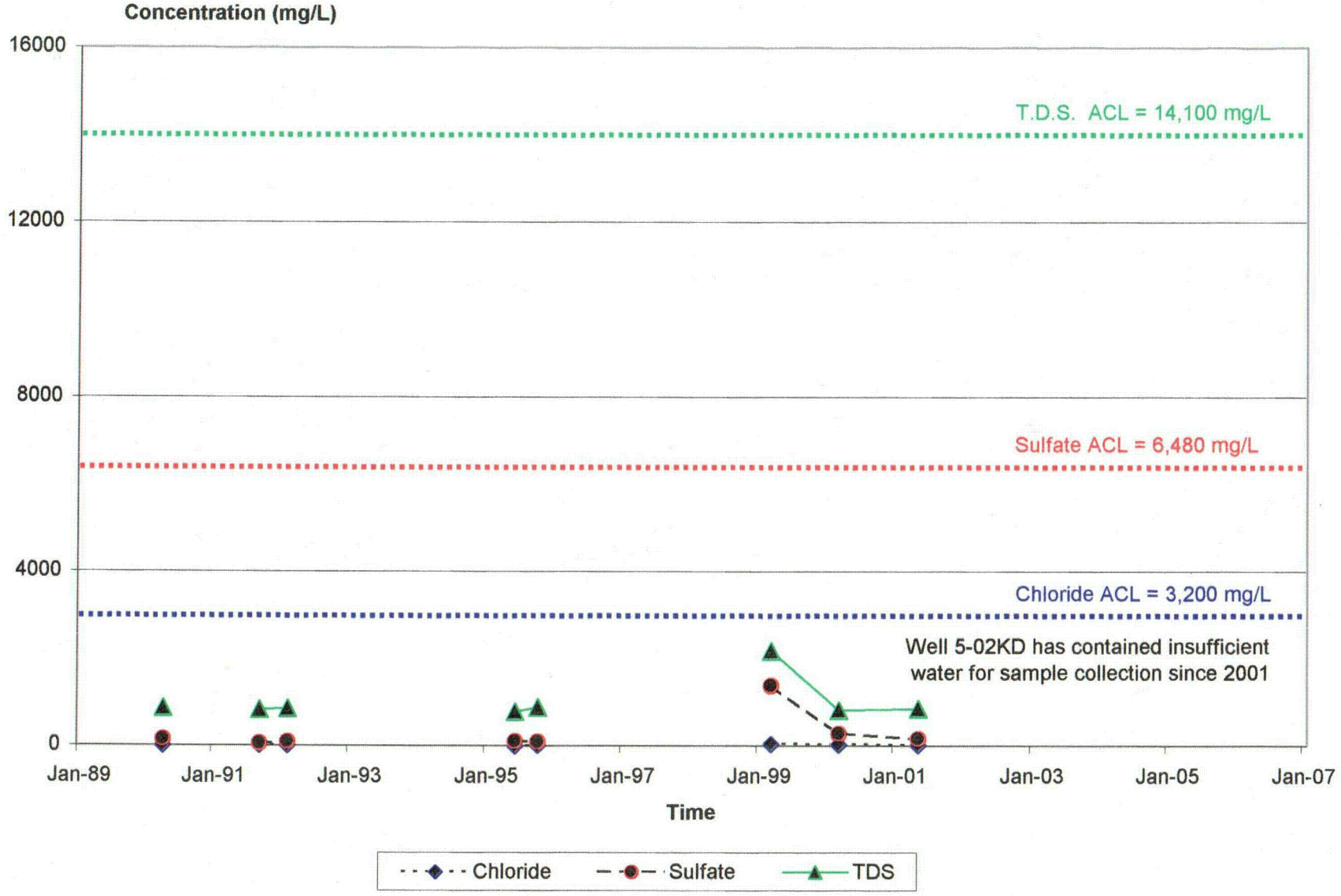

Monitor Well 36-06KD
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 22.8 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

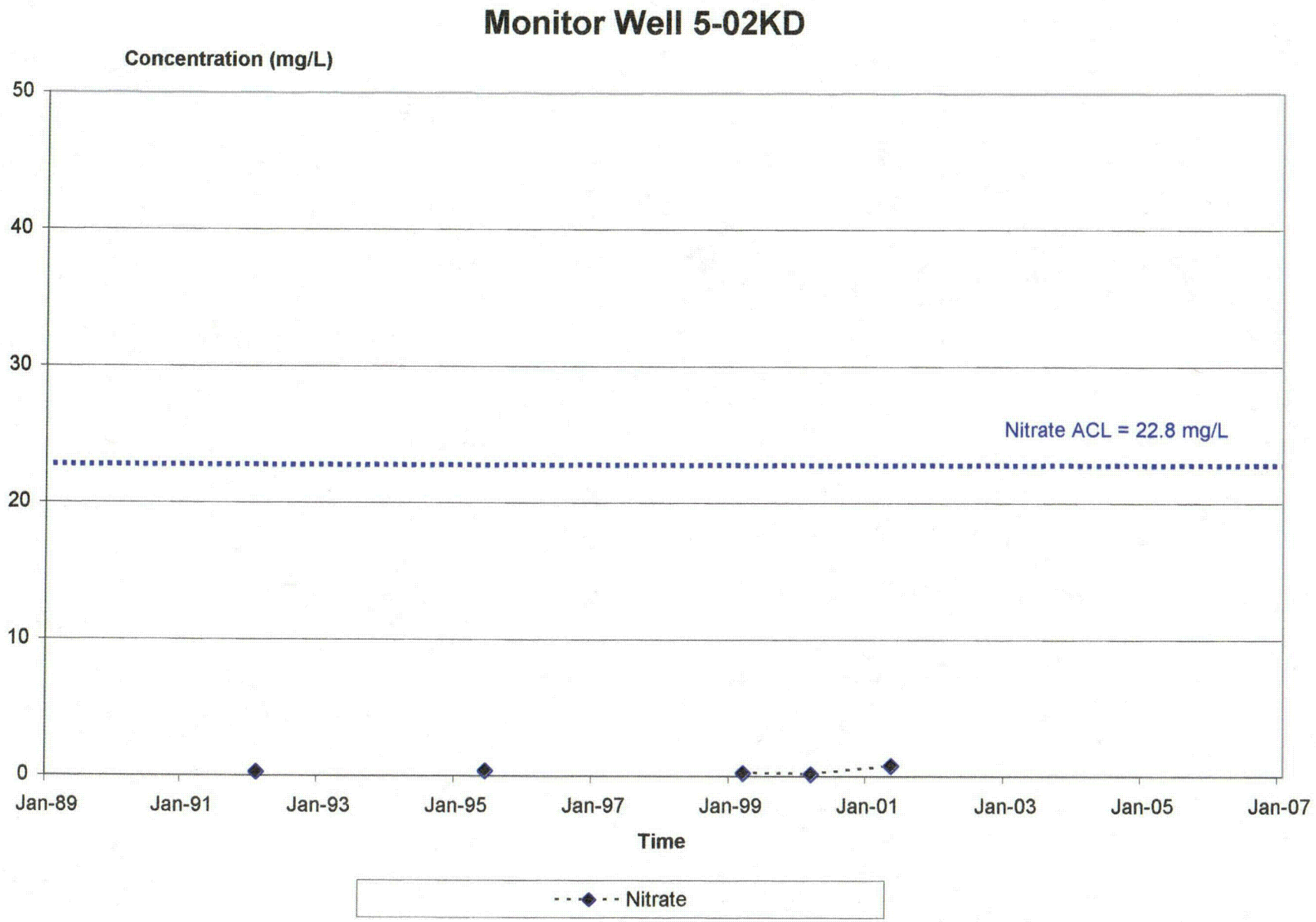
Monitor Well 36-06KD

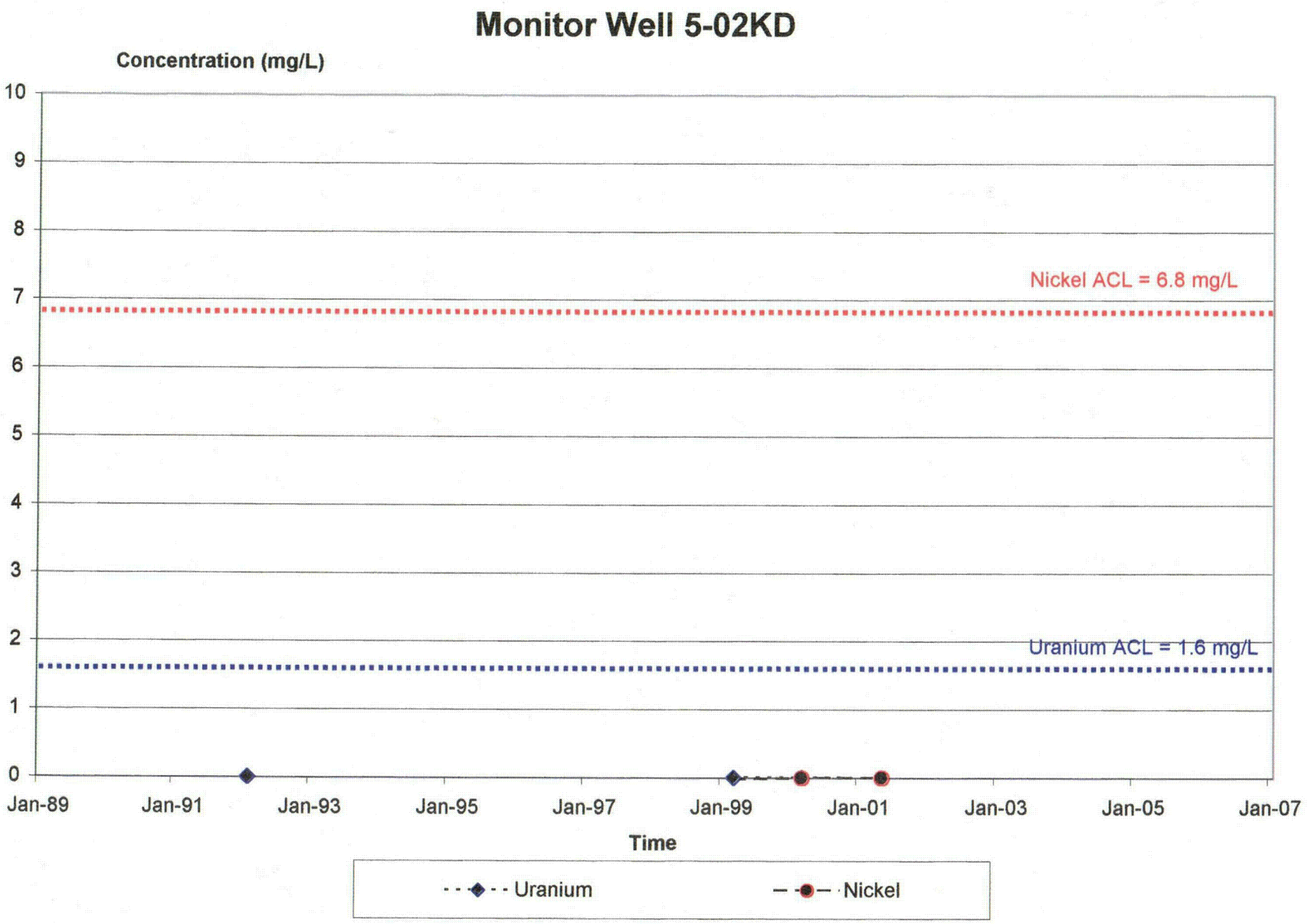



Monitor Well 36-06KD
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

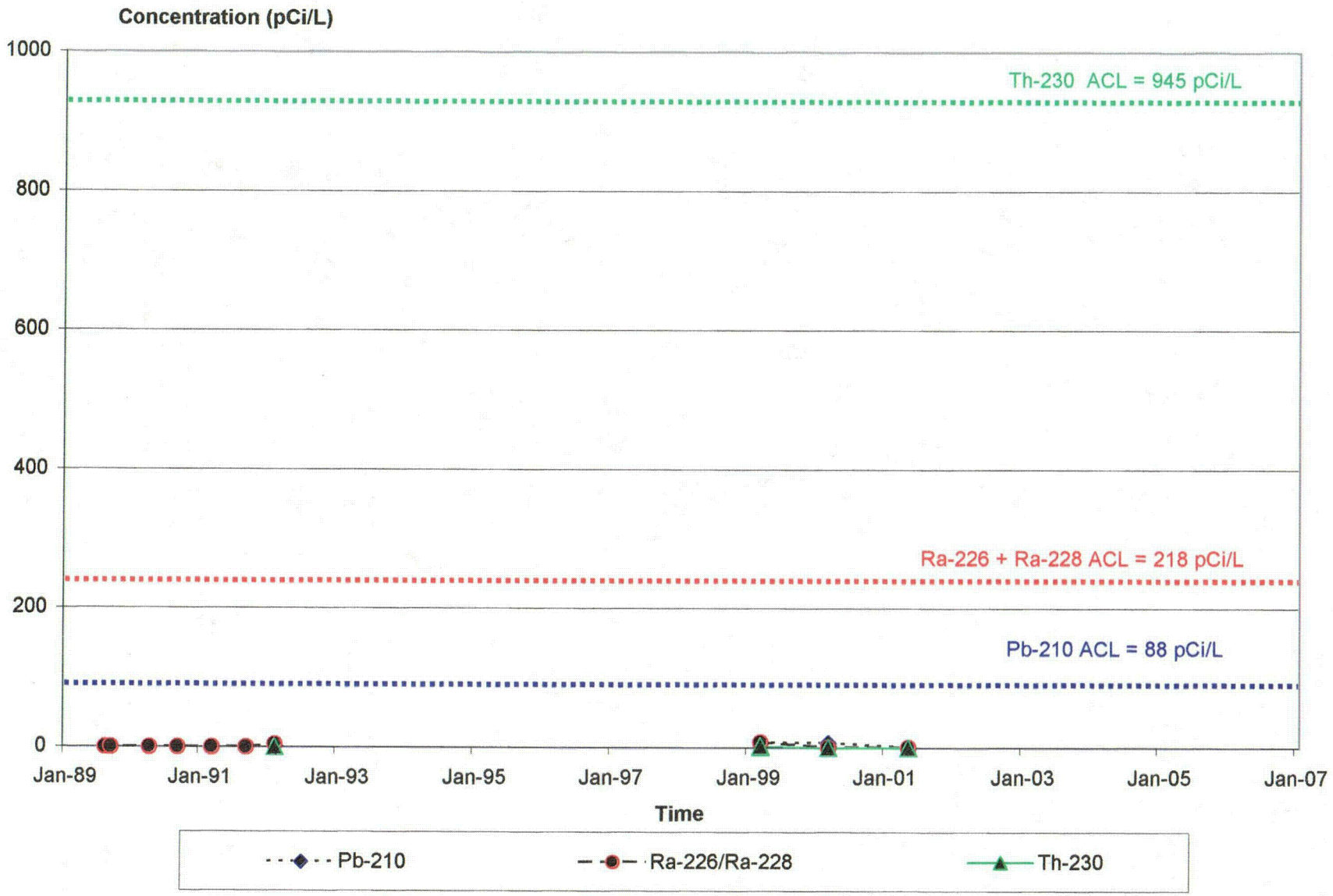
Monitor Well 5-02KD




Monitor Well 5-02KD
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 22.8 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate


Monitor Well 5-02KD
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel

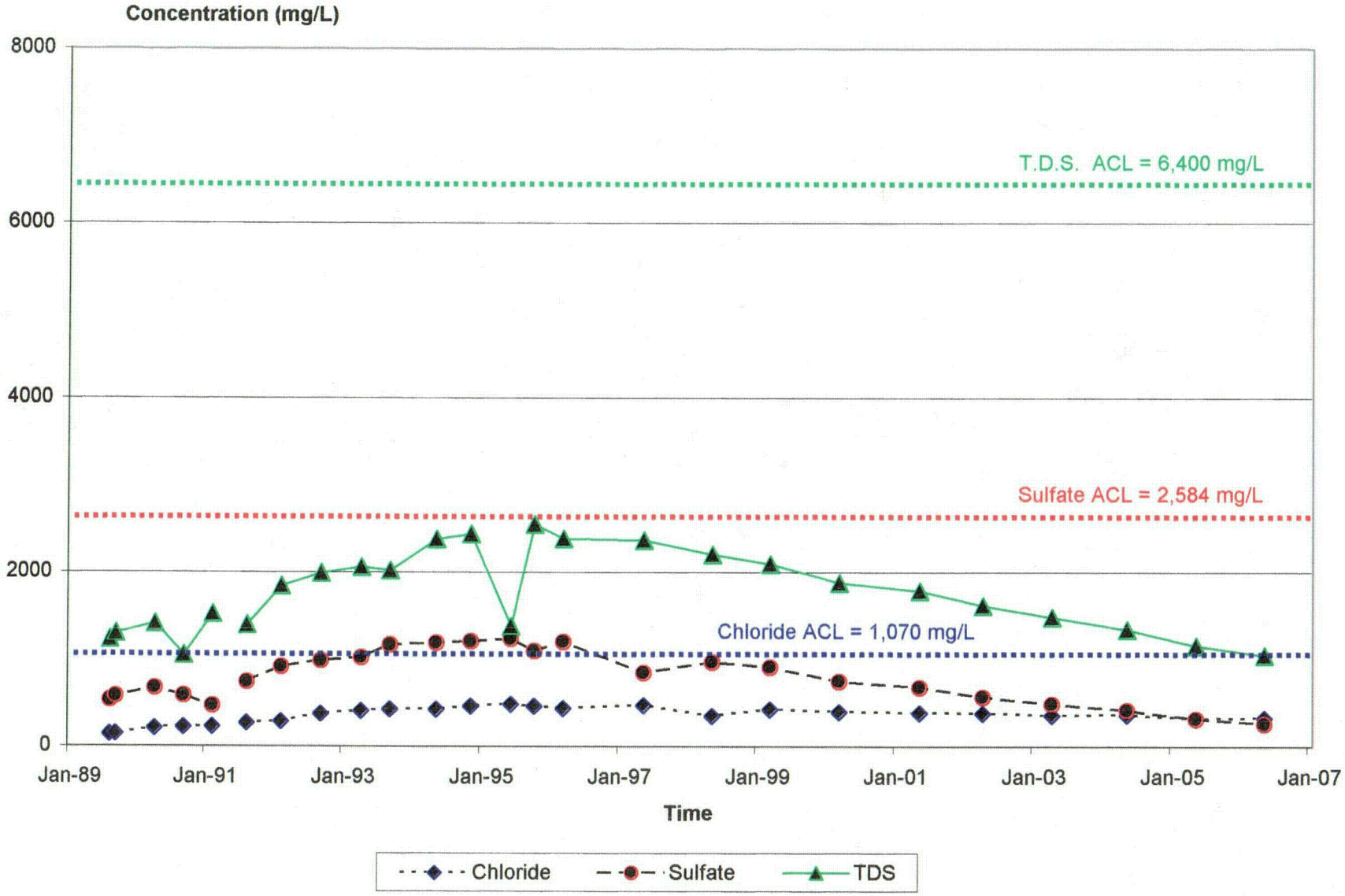
Monitor Well 5-02KD

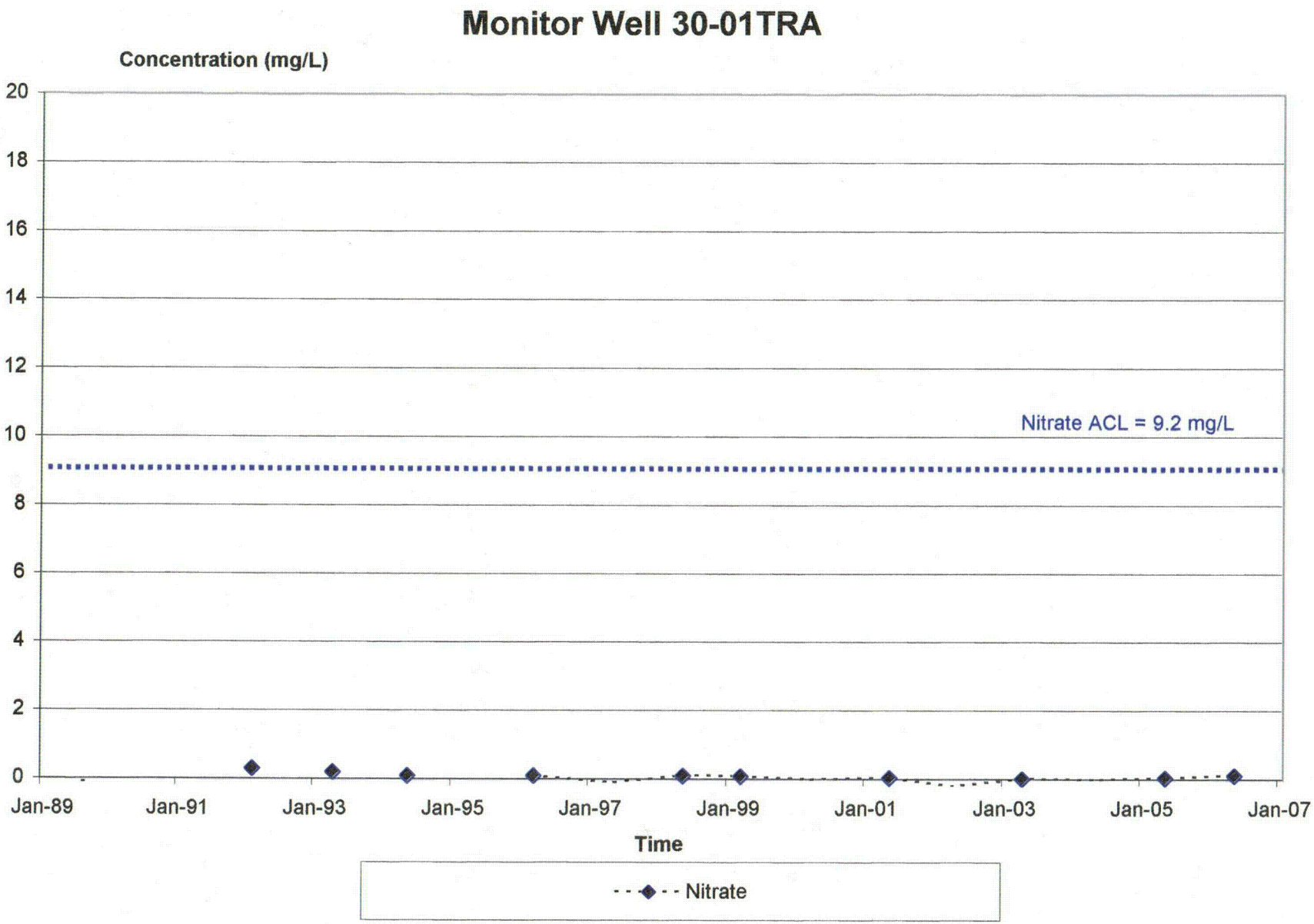


Stability Monitoring Plan
Time vs. Concentration Plots

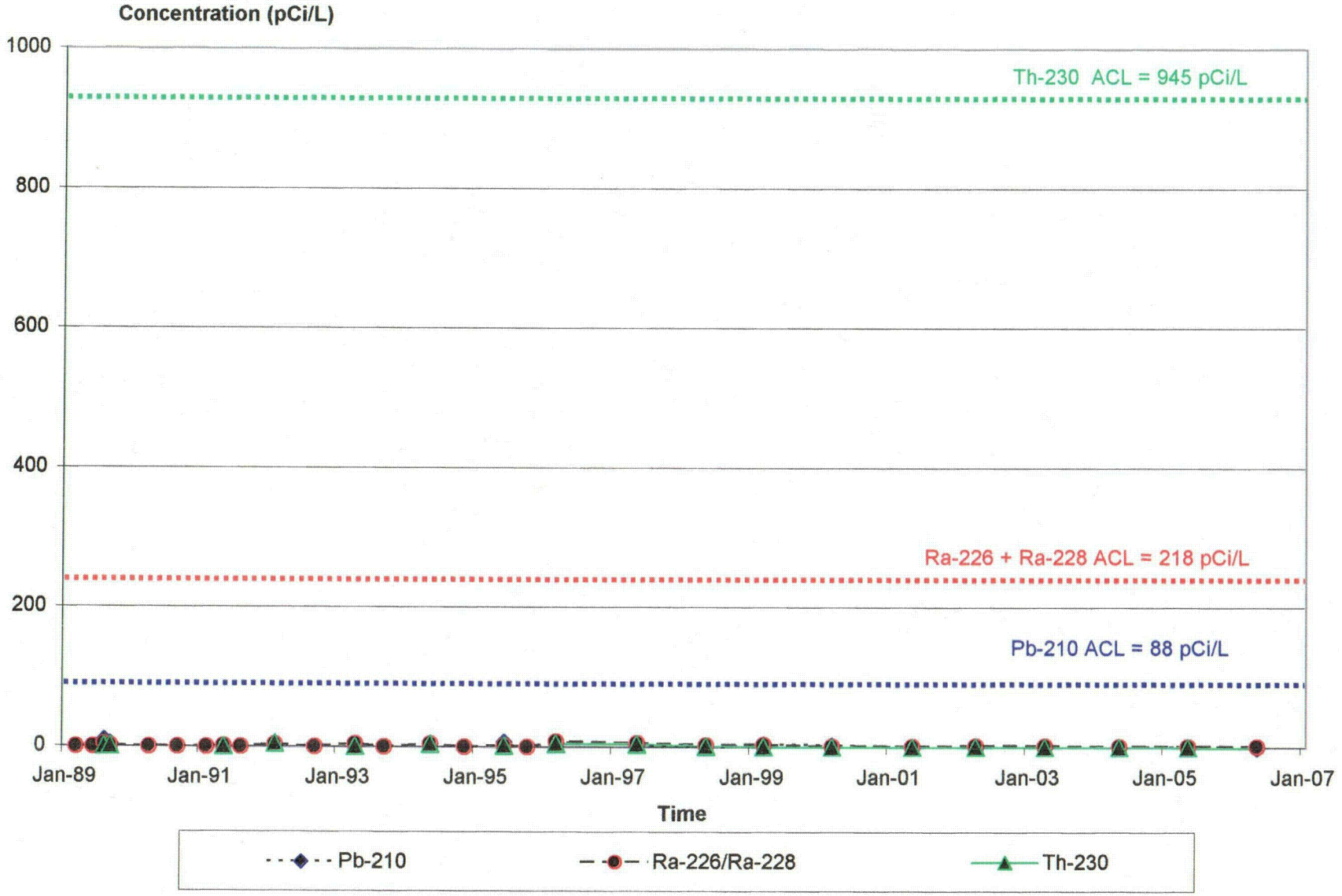
Tres Hermanos A

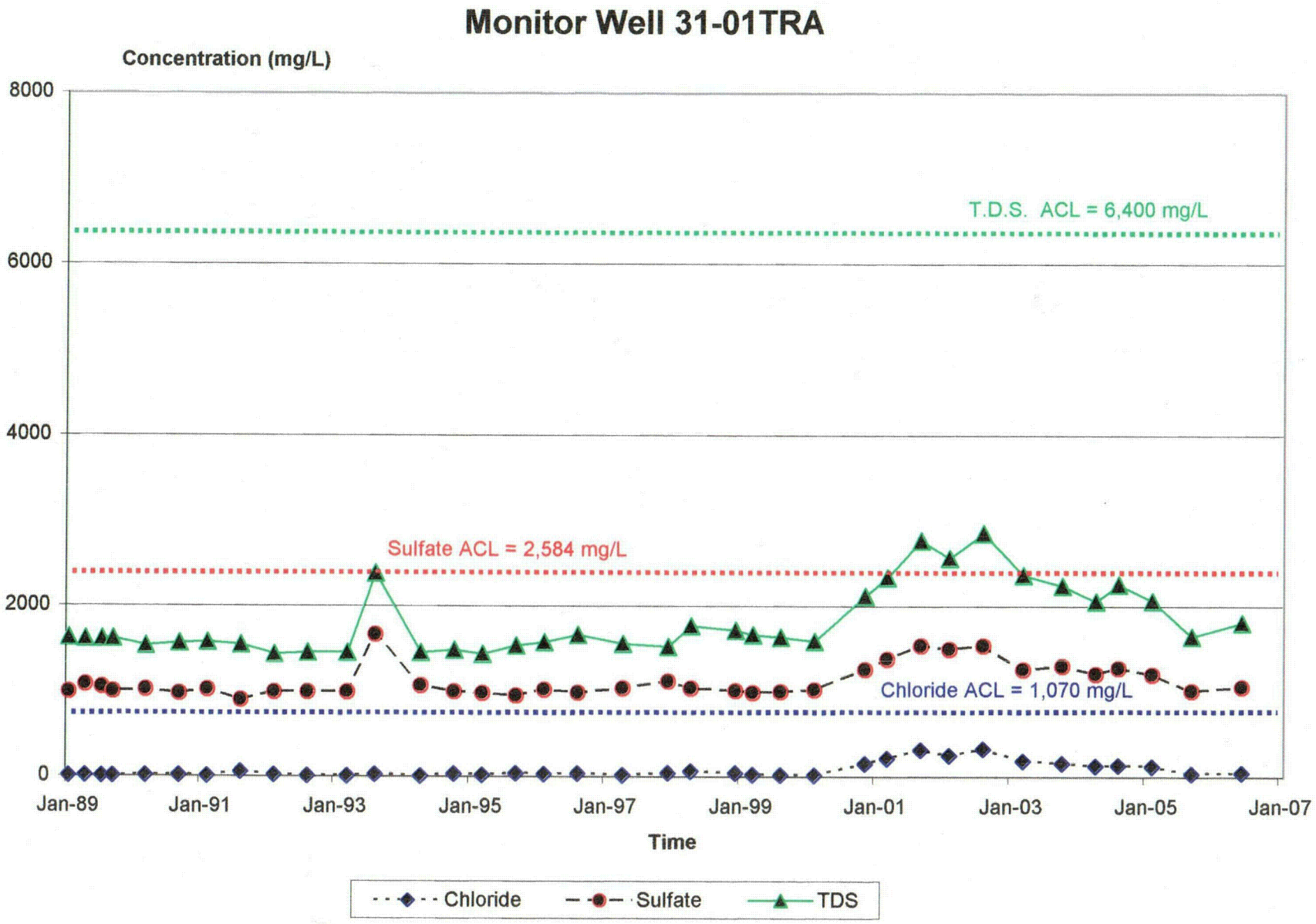
Monitor Well 30-01TRA

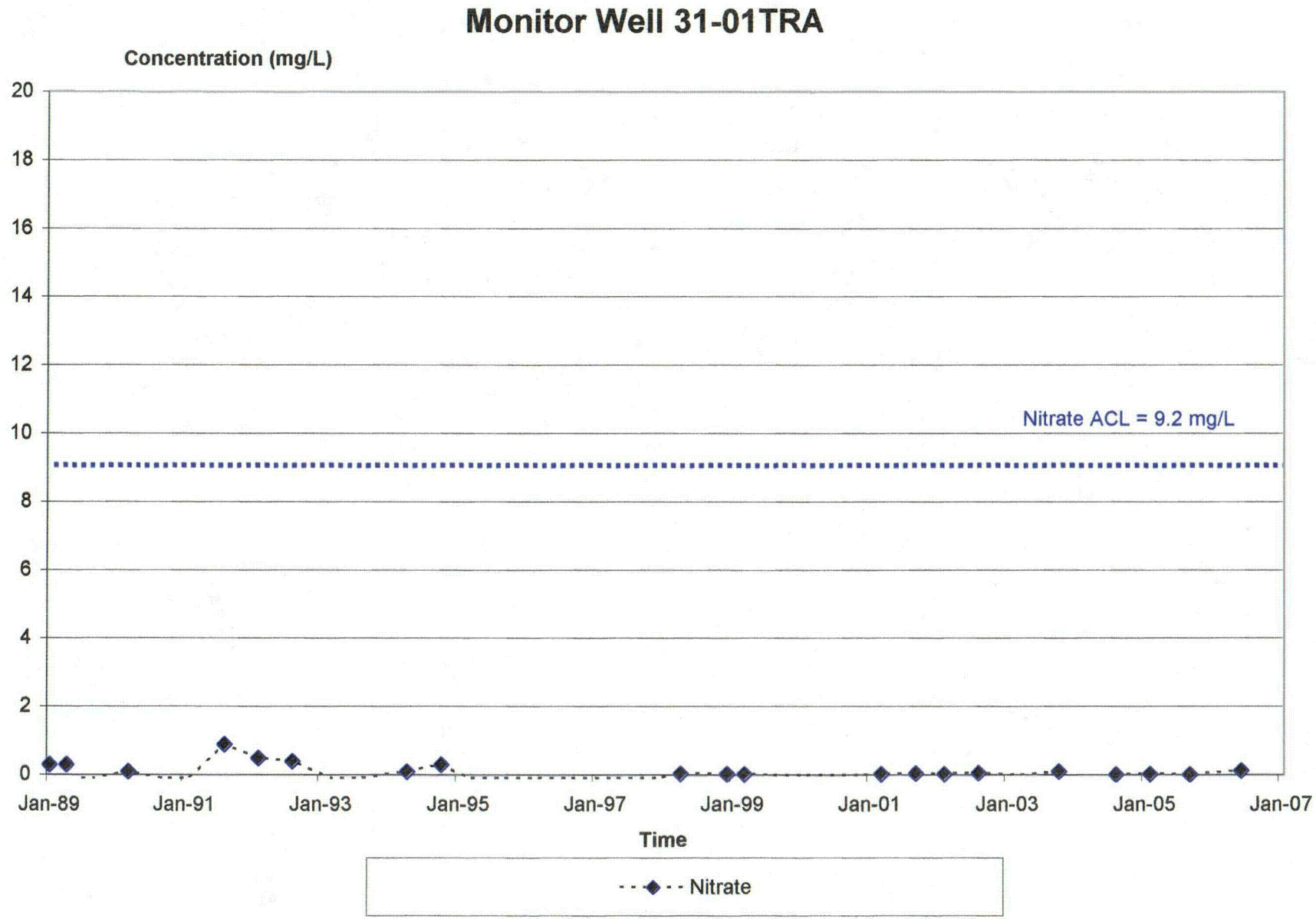


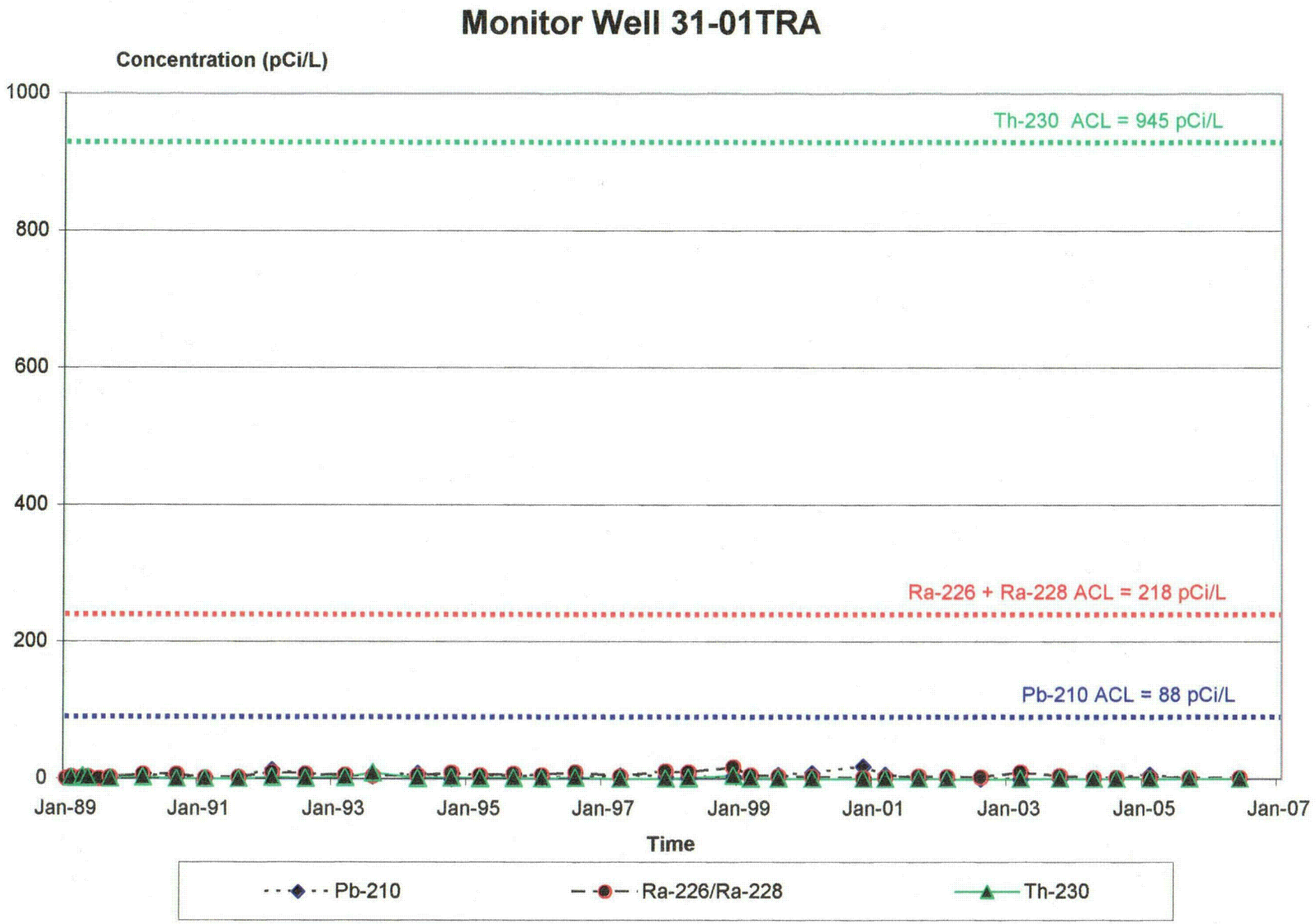

Monitor Well 30-01TRA
Concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0
Nitrate ACL = 9.2 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

Monitor Well 30-01TRA

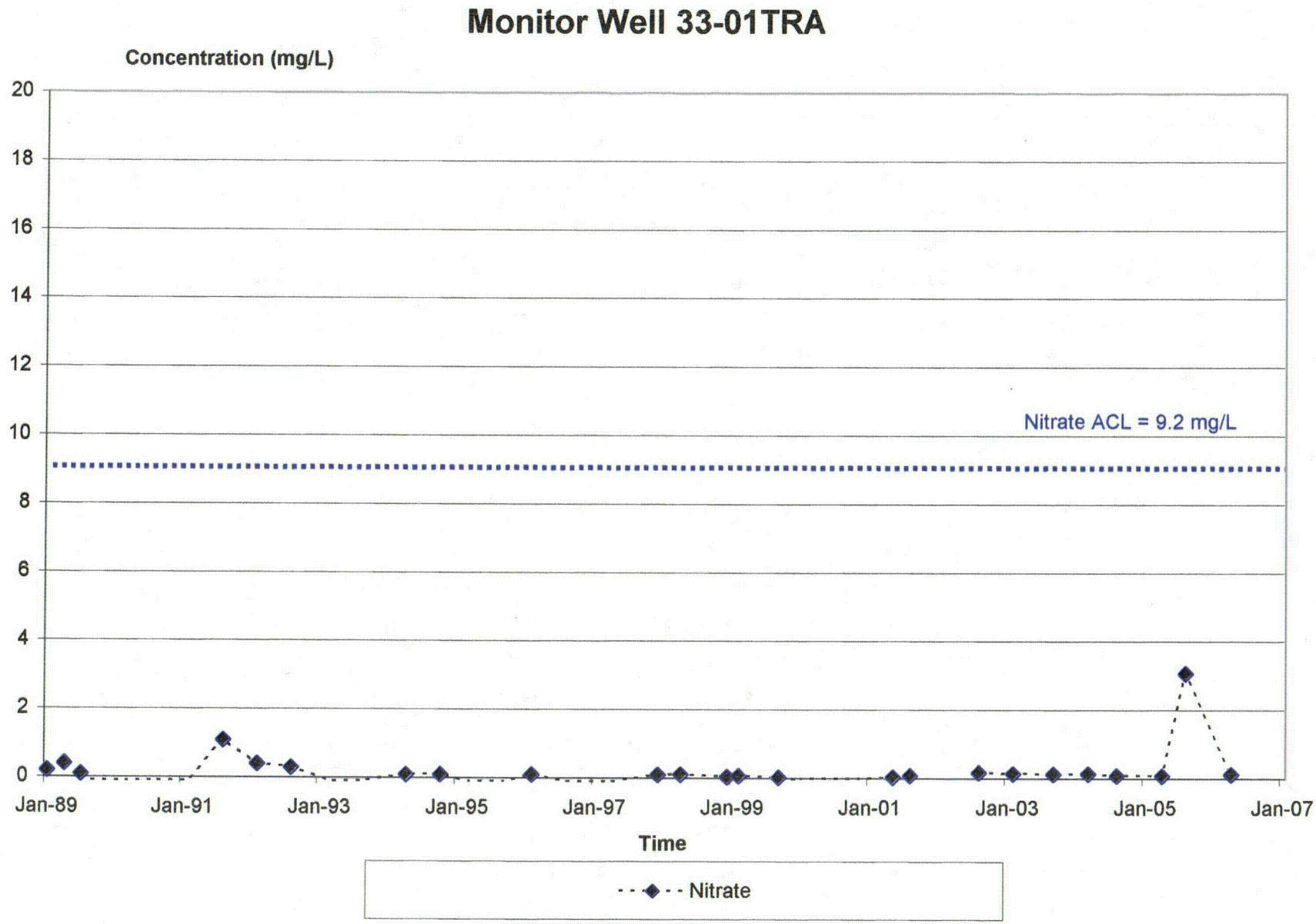


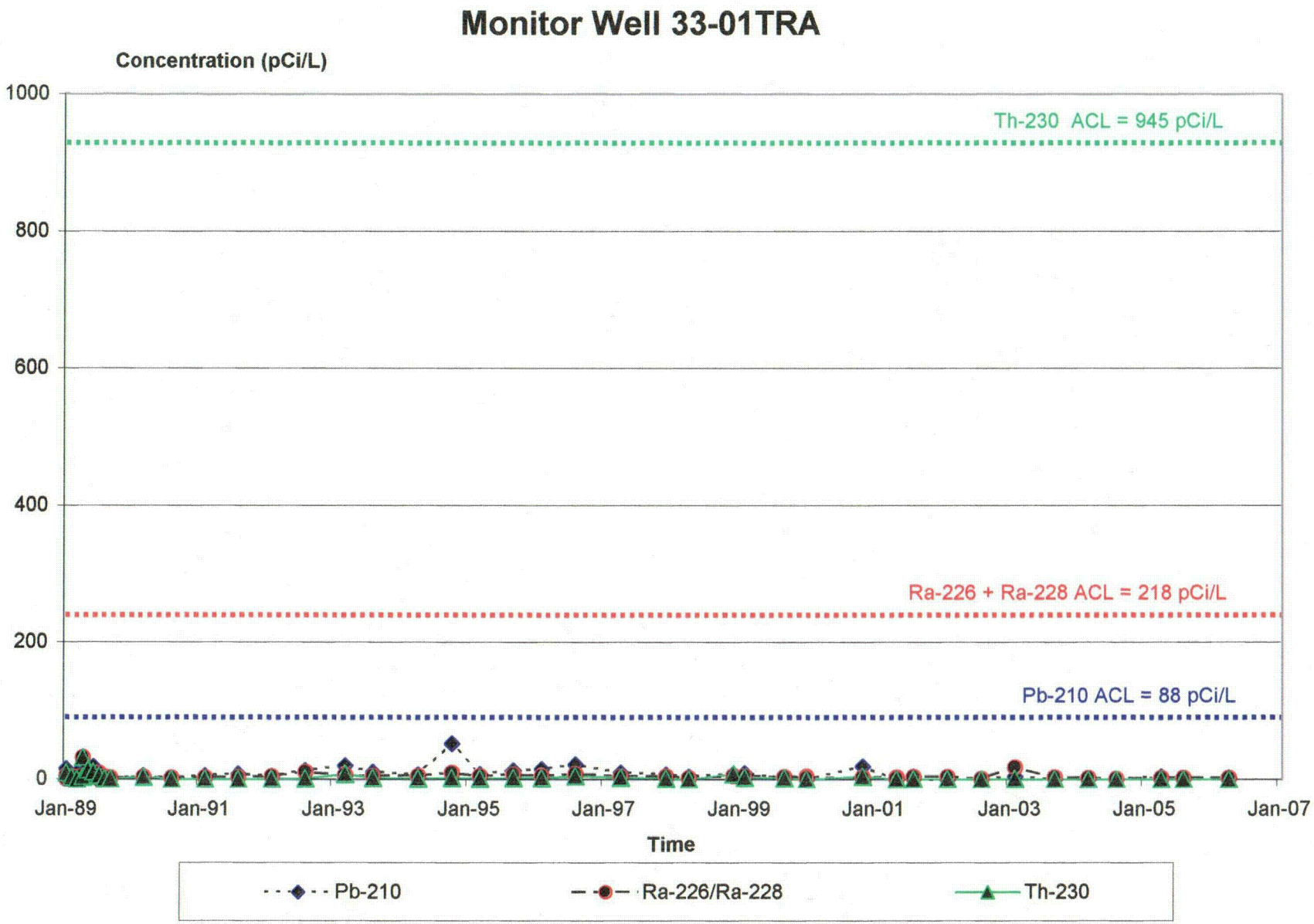

Monitor Well 31-01TRA
Concentration (mg/L)
8000
6000
4000
2000
0
T.D.S. ACL = 6,400 mg/L
Sulfate ACL = 2,584 mg/L
Chloride ACL = 1,070 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS


Monitor Well 31-01TRA
Concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0
Nitrate ACL = 9.2 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate


Monitor Well 31-01TRA
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

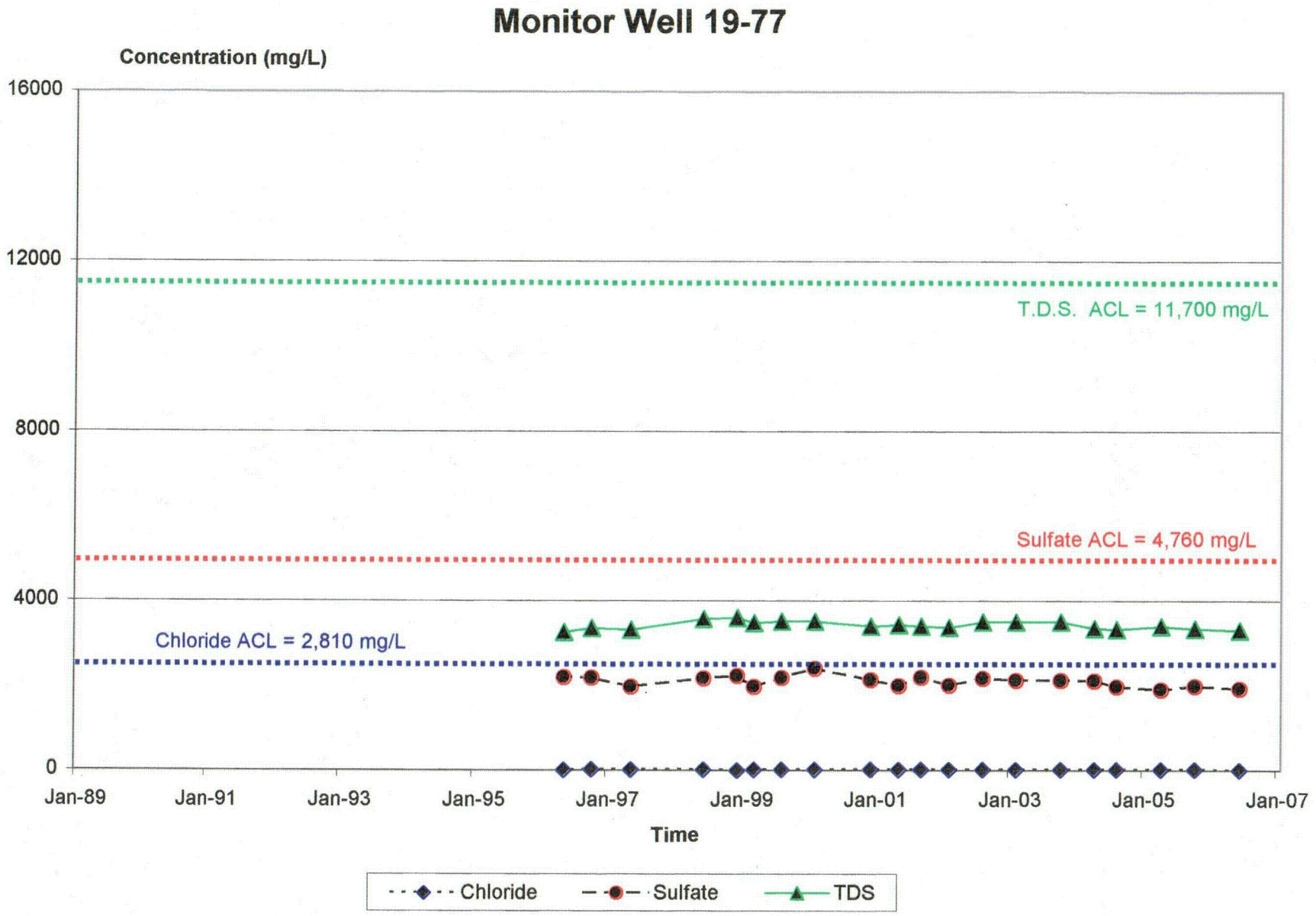
Monitor Well 33-01TRA

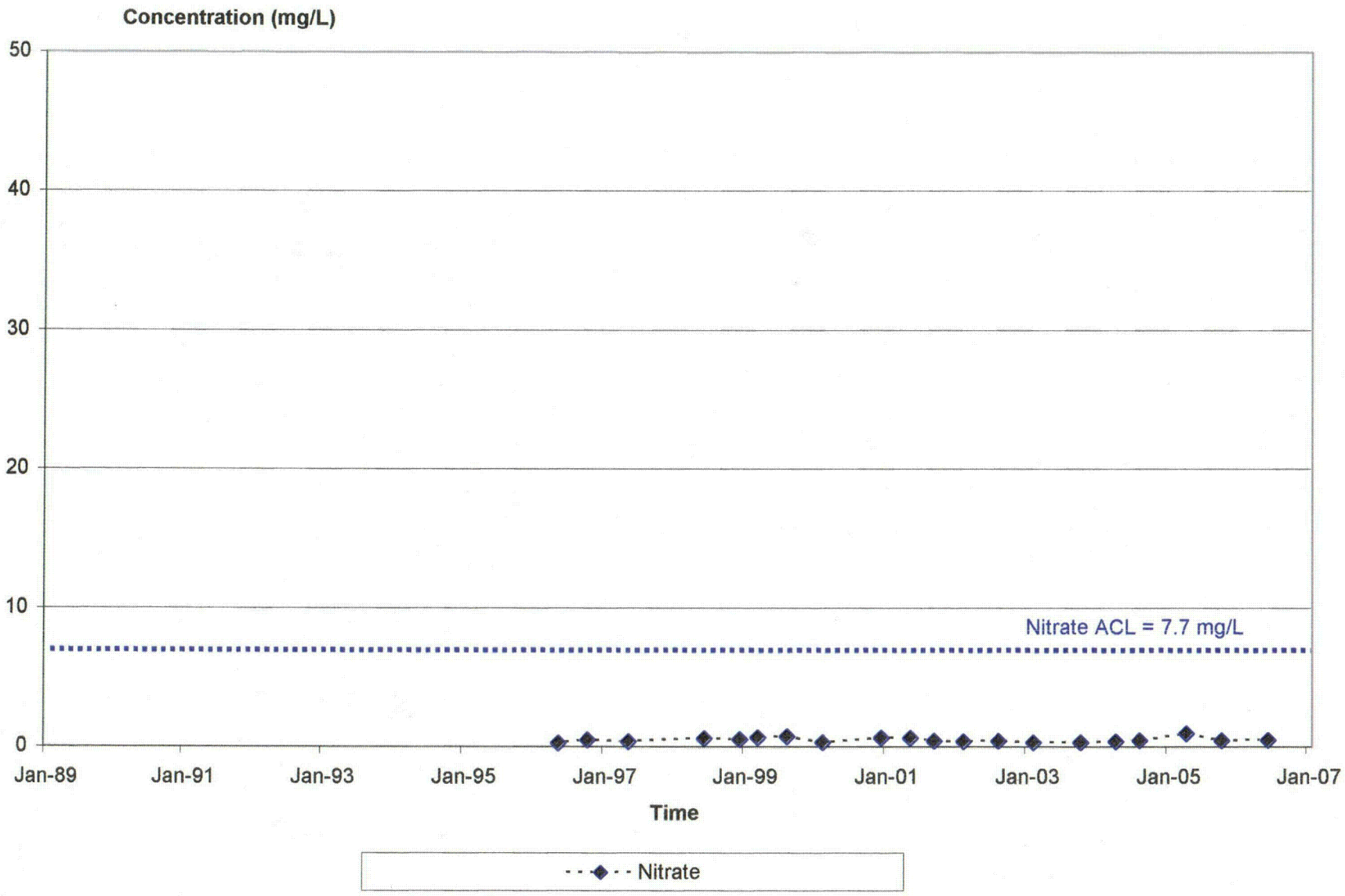

Monitor Well 33-01TRA
Concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0
Nitrate ACL = 9.2 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

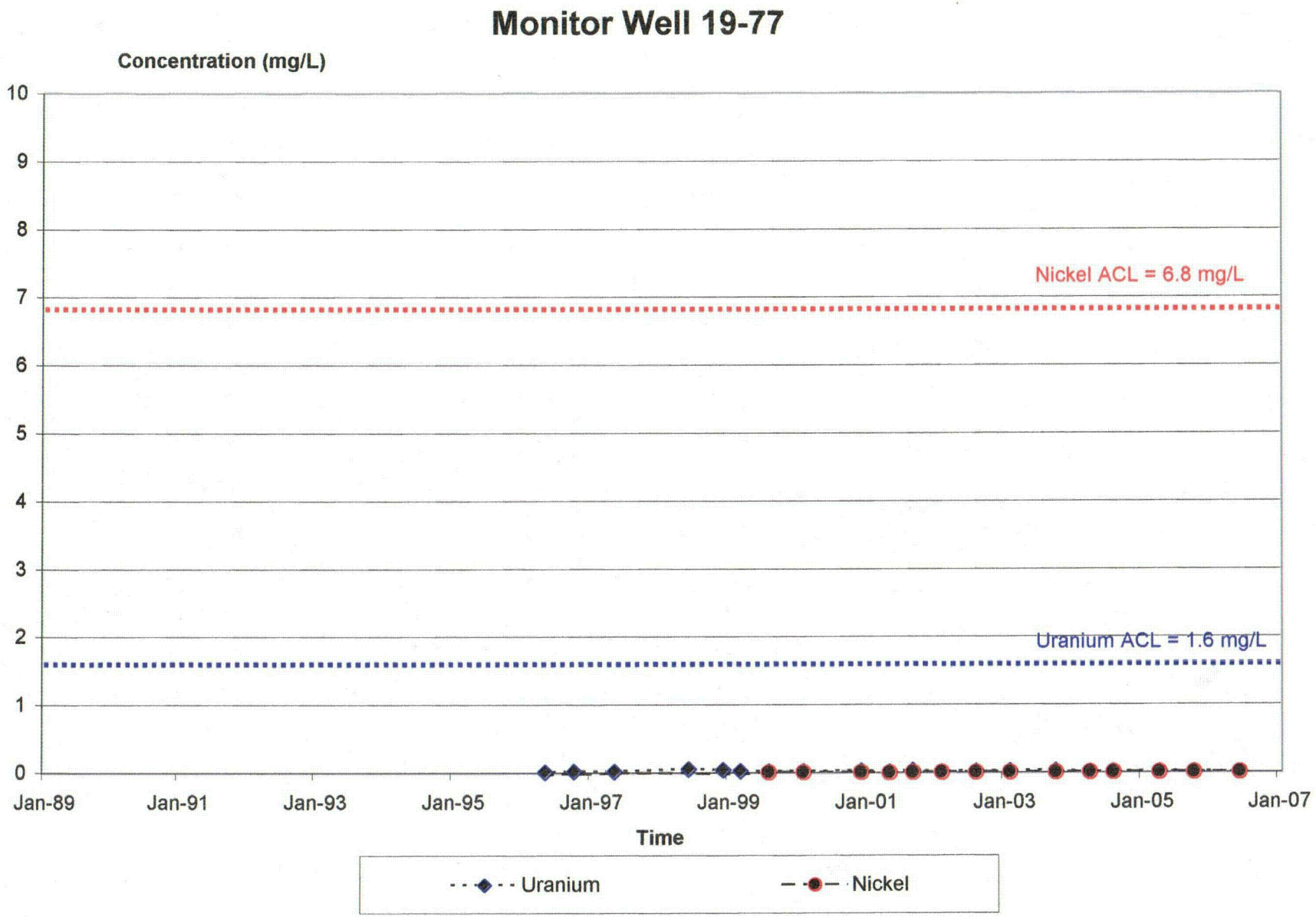

Monitor Well 33-01TRA
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

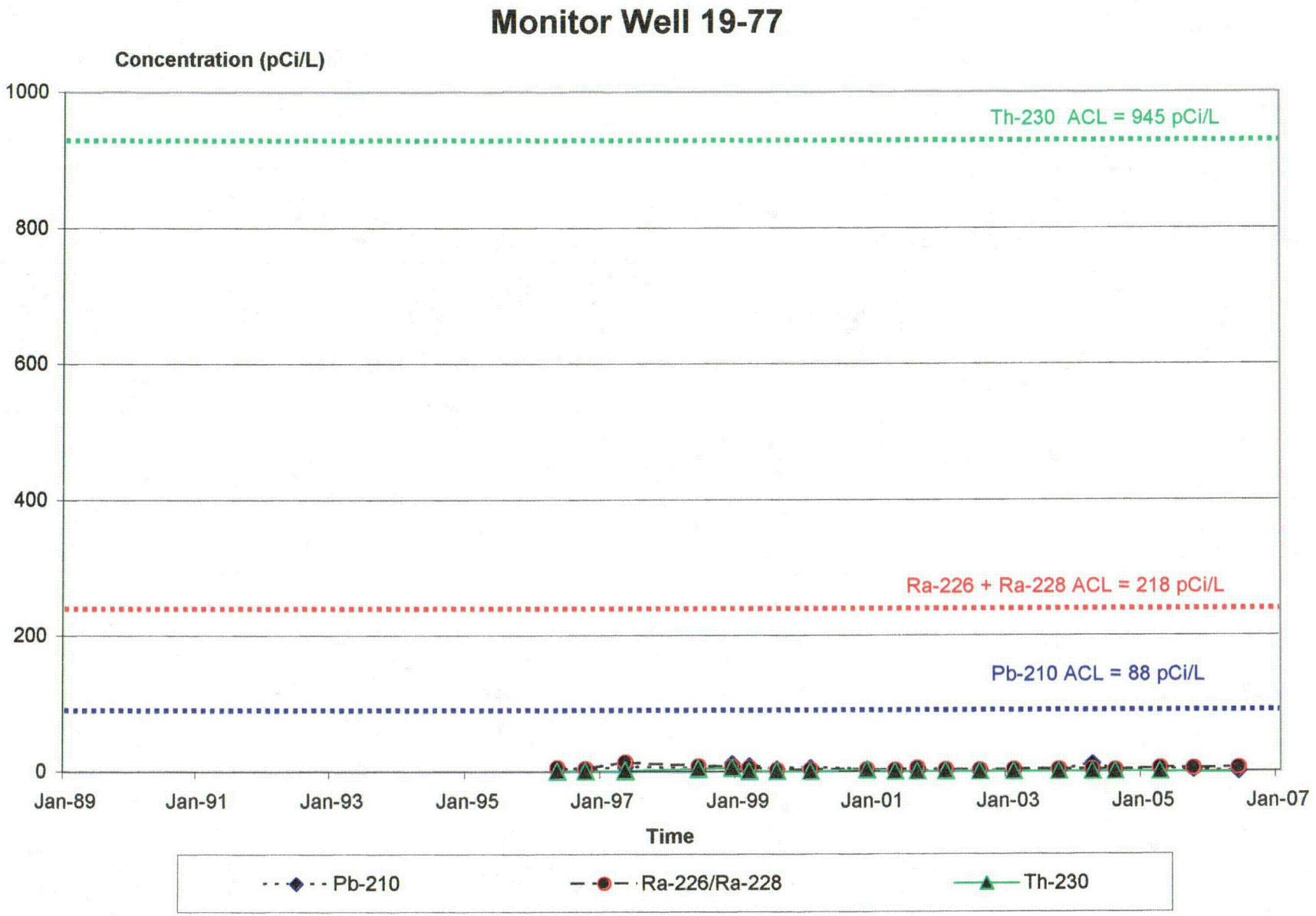
Stability Monitoring Plan
Time vs. Concentration Plots

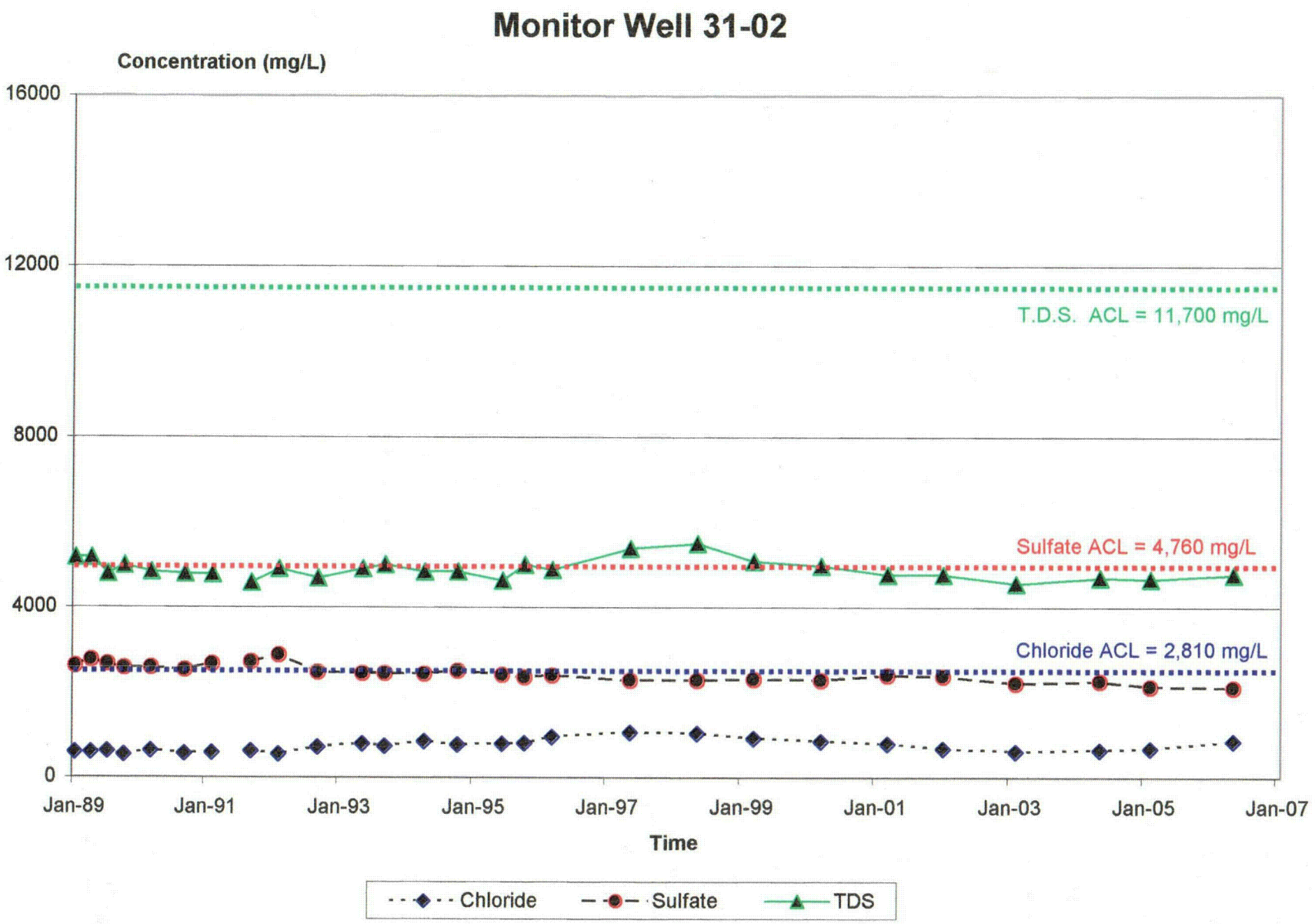
Tres Hermanos B


Monitor Well 19-77
Concentration (mg/L)
16000
12000
8000
4000
0
T.D.S. ACL = 11,700 mg/L
Sulfate ACL = 4,760 mg/L
Chloride ACL = 2,810 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

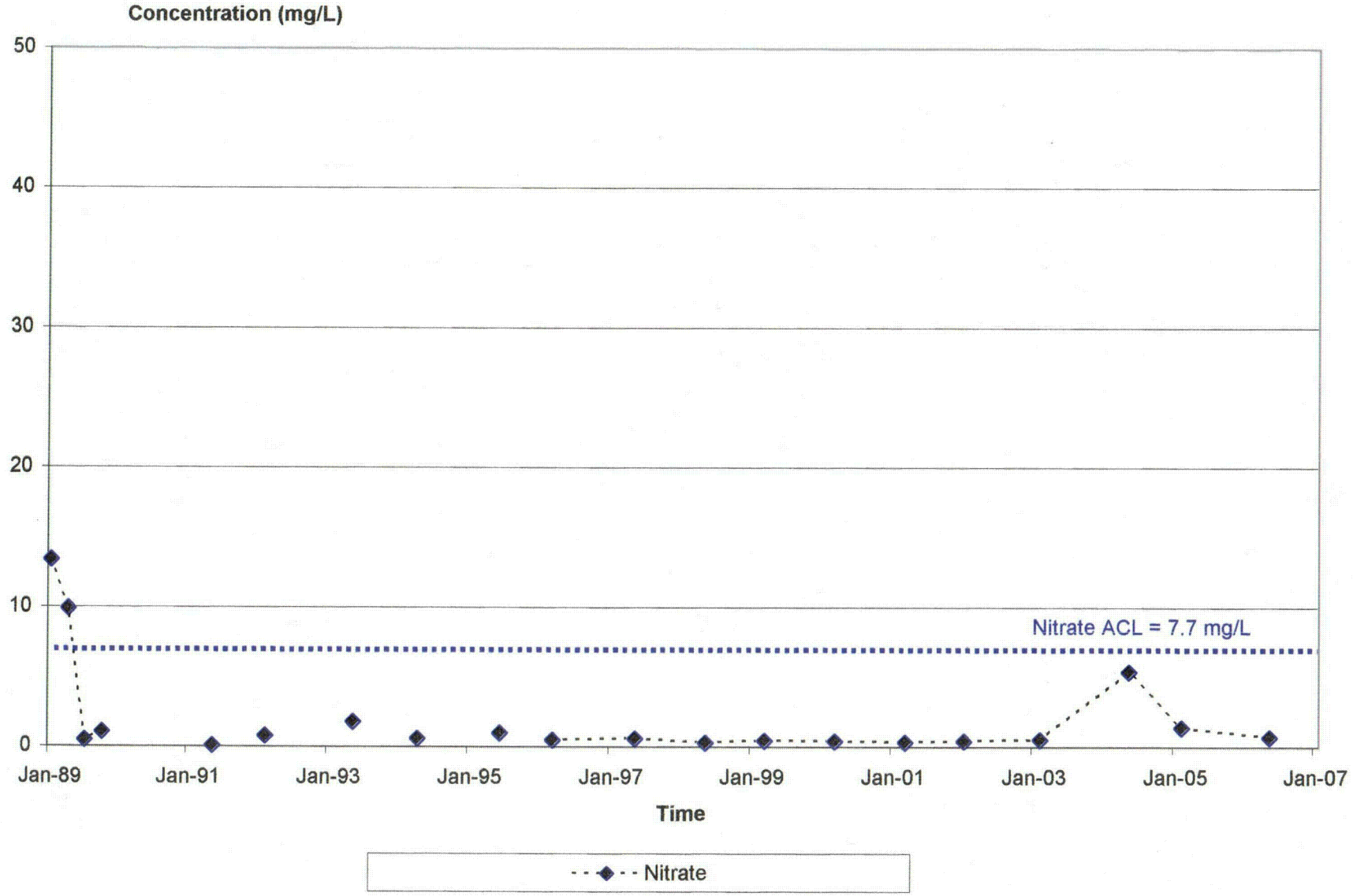

Monitor Well 19-77
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 7.7 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

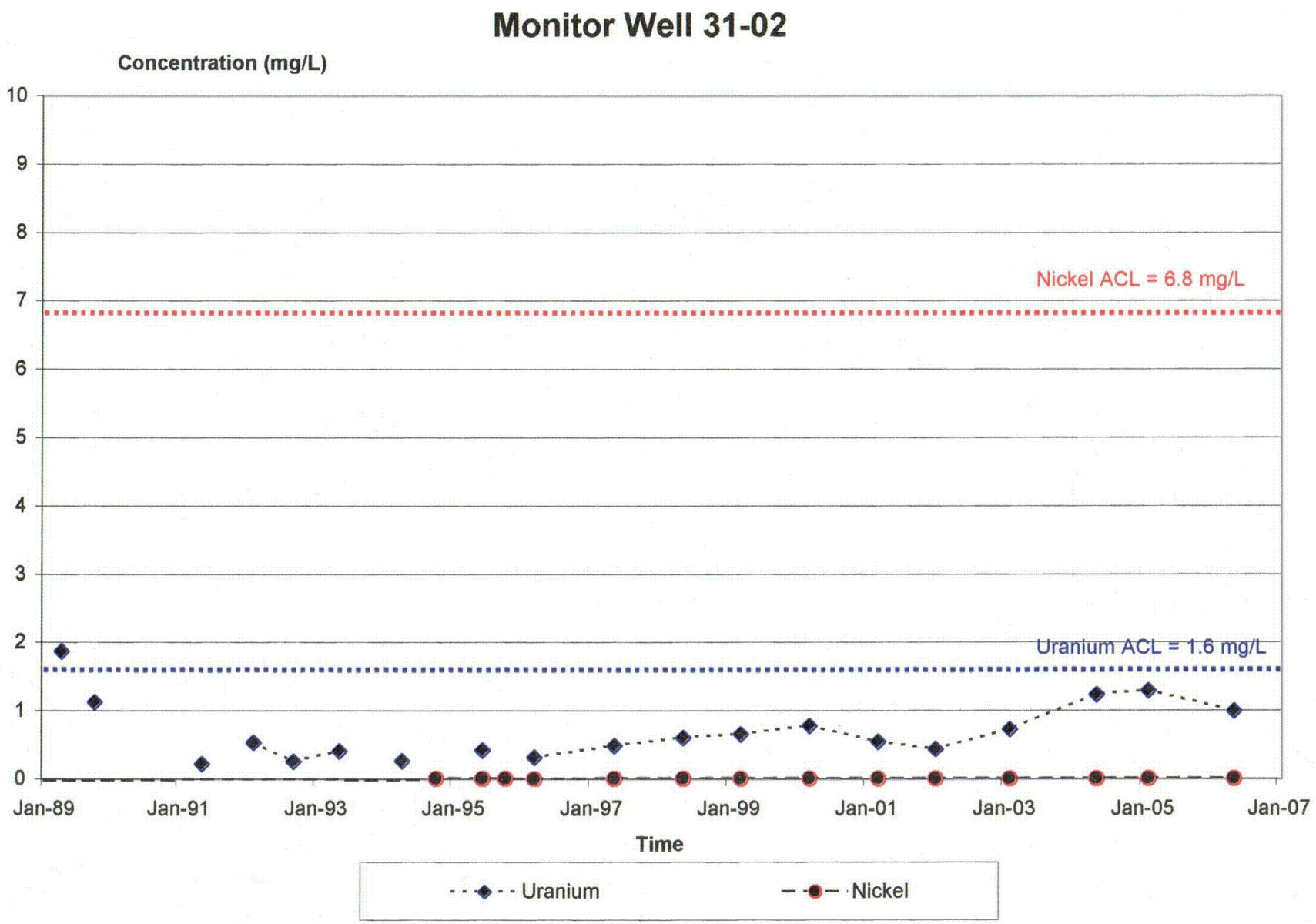

Monitor Well 19-77
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel

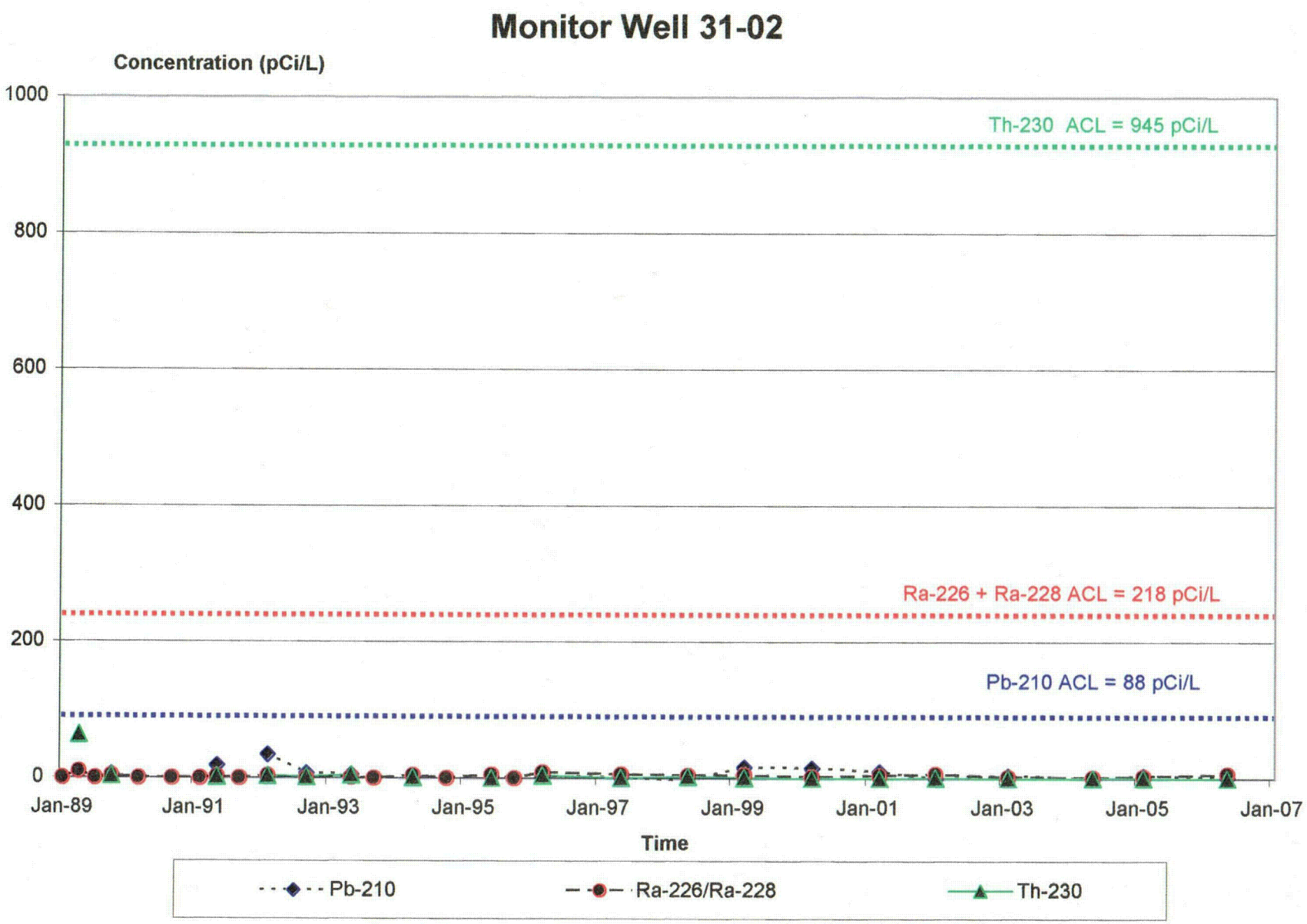

Monitor Well 19-77
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230


Monitor Well 31-02
Concentration (mg/L)
16000
12000
8000
4000
0
T.D.S. ACL = 11,700 mg/L
Sulfate ACL = 4,760 mg/L
Chloride ACL = 2,810 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

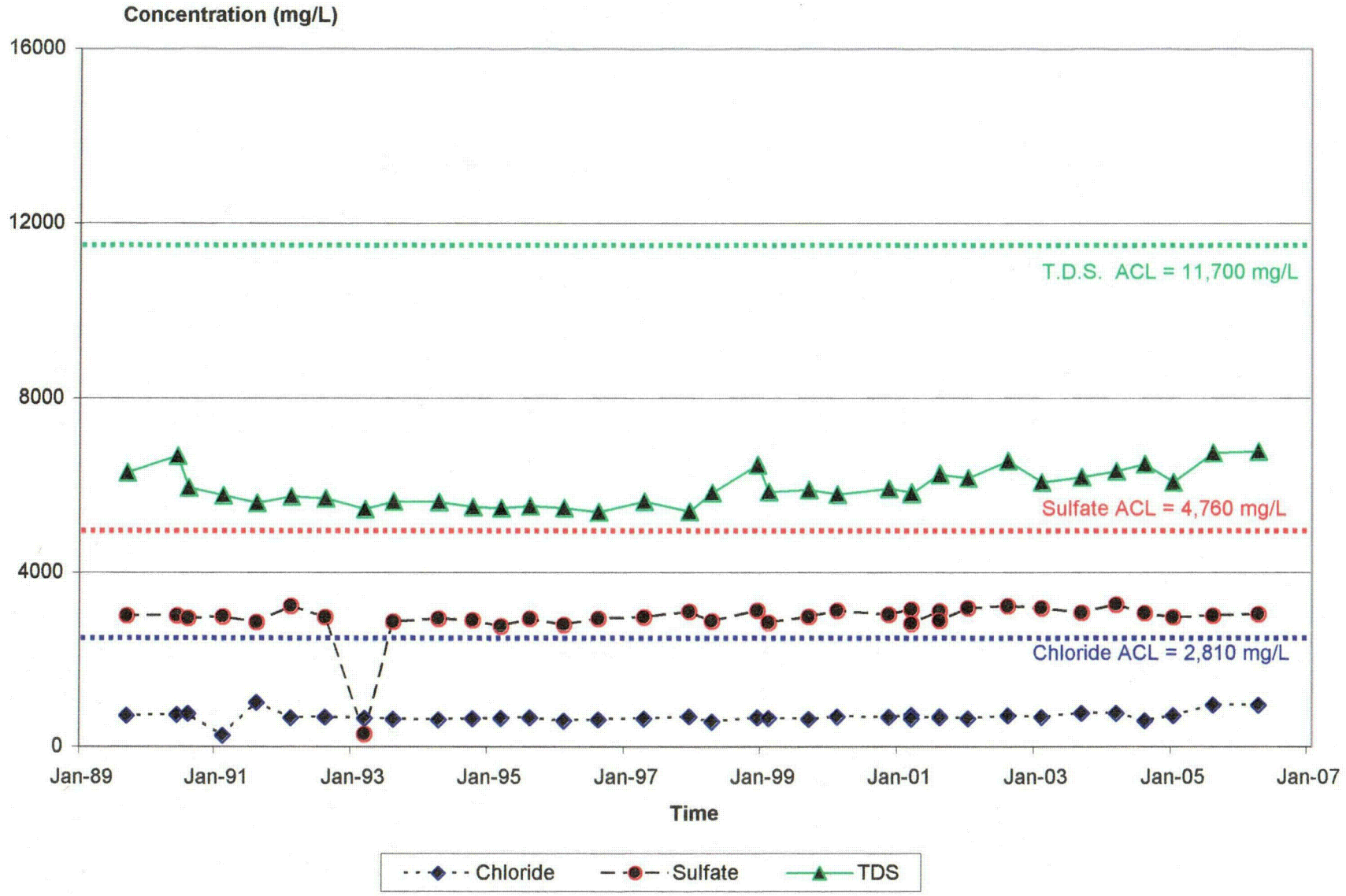
Monitor Well 31-02



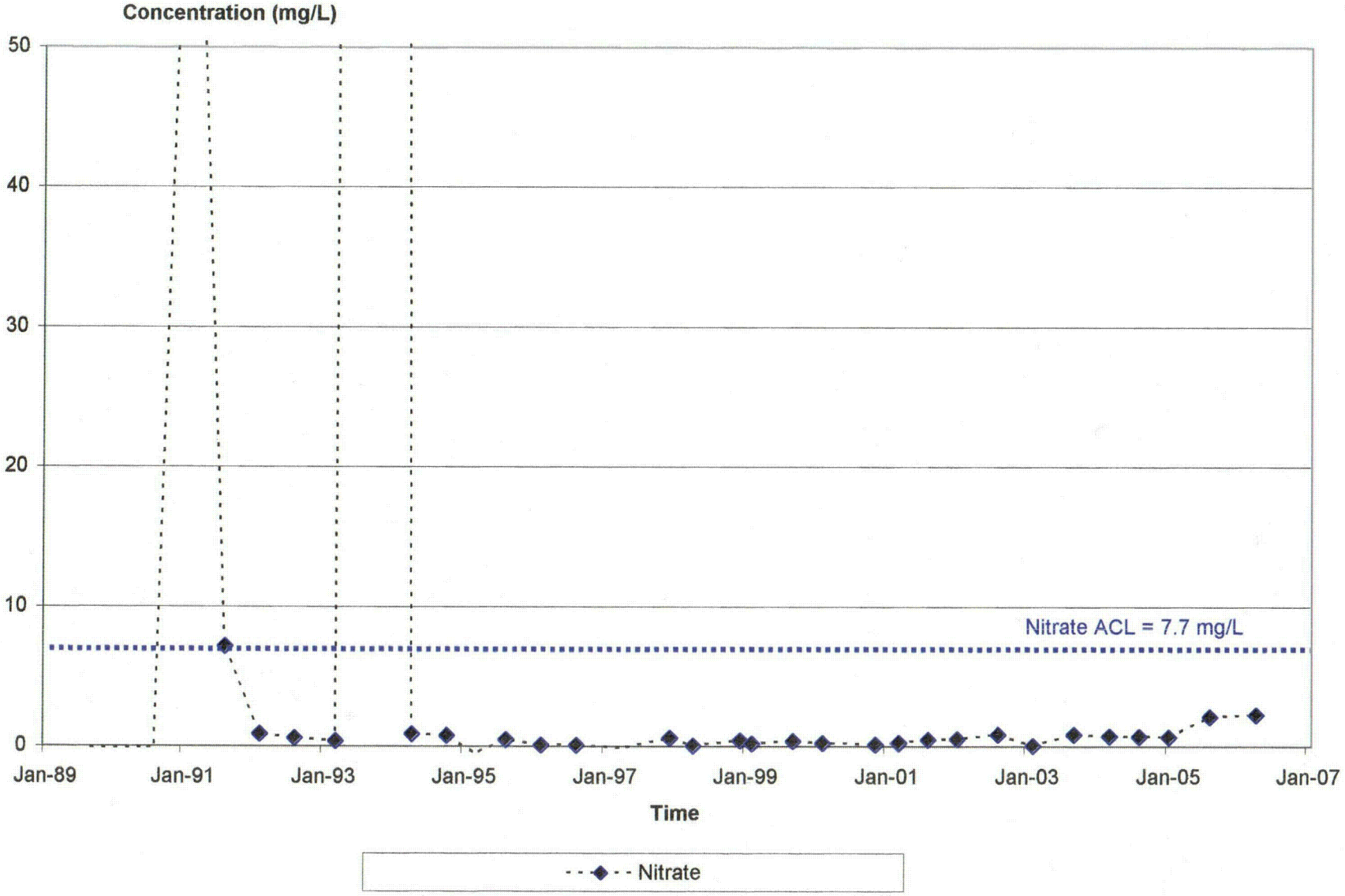

Monitor Well 31-02
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel


Monitor Well 31-02
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

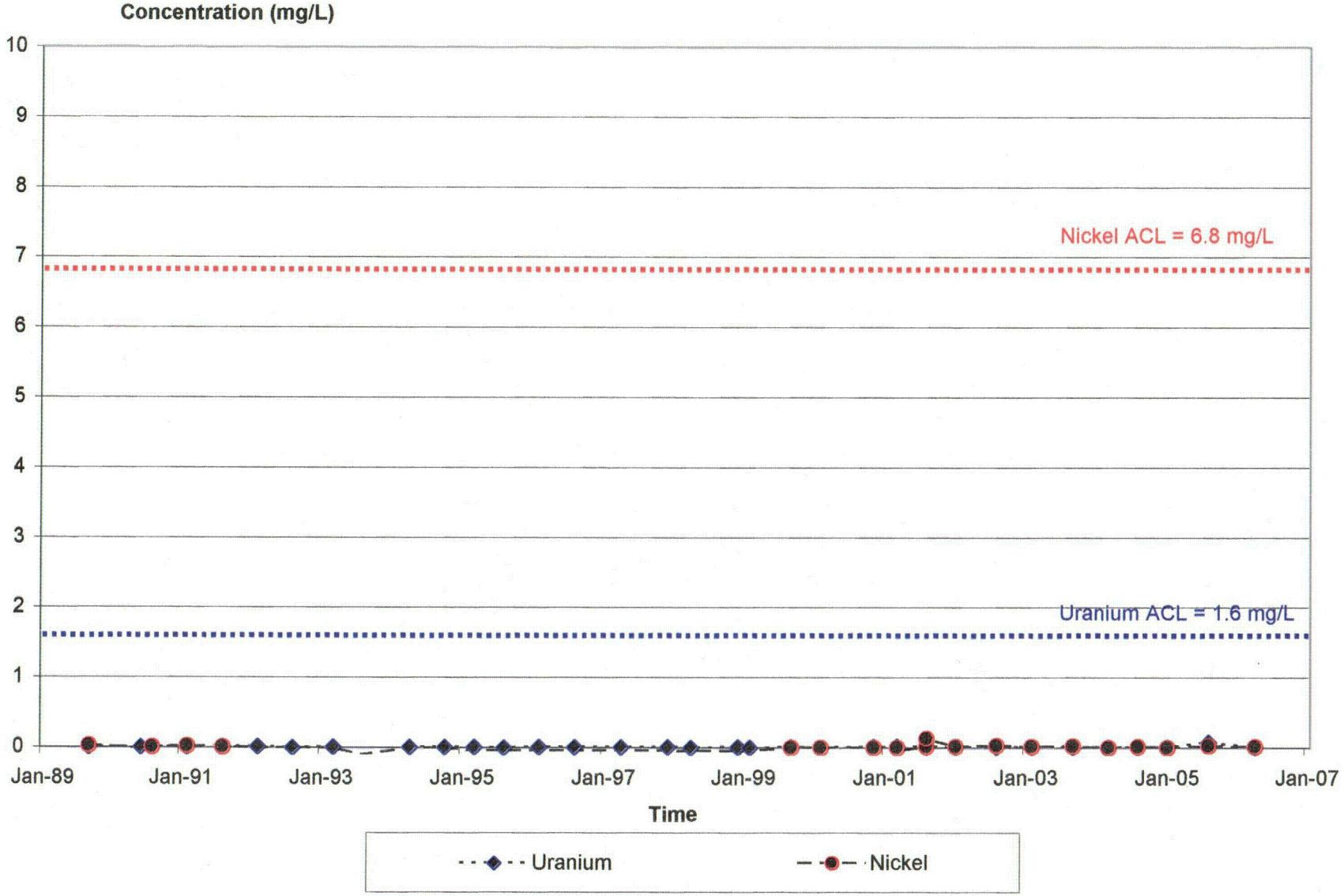
Monitor Well 31-67

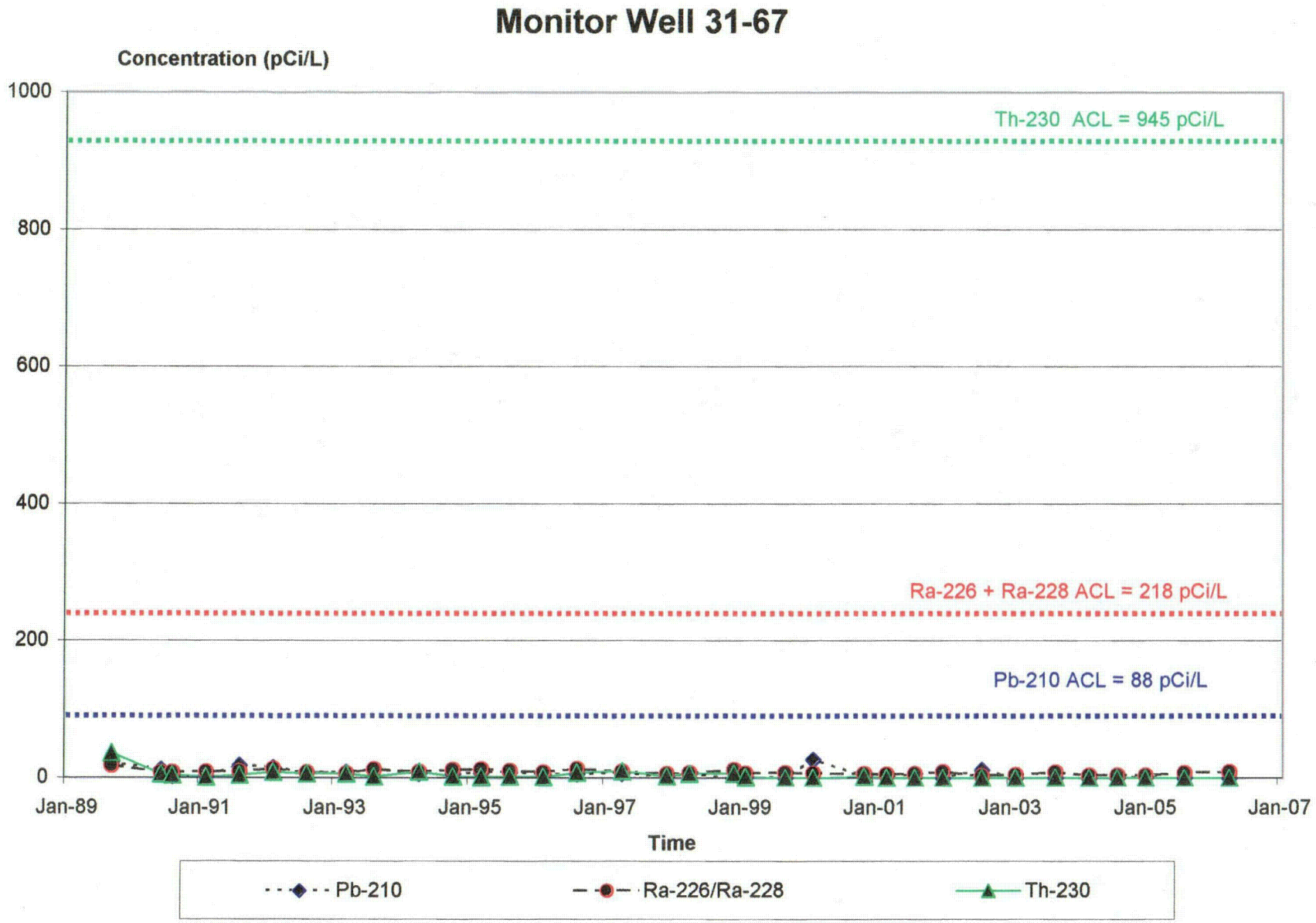


Monitor Well 31-67

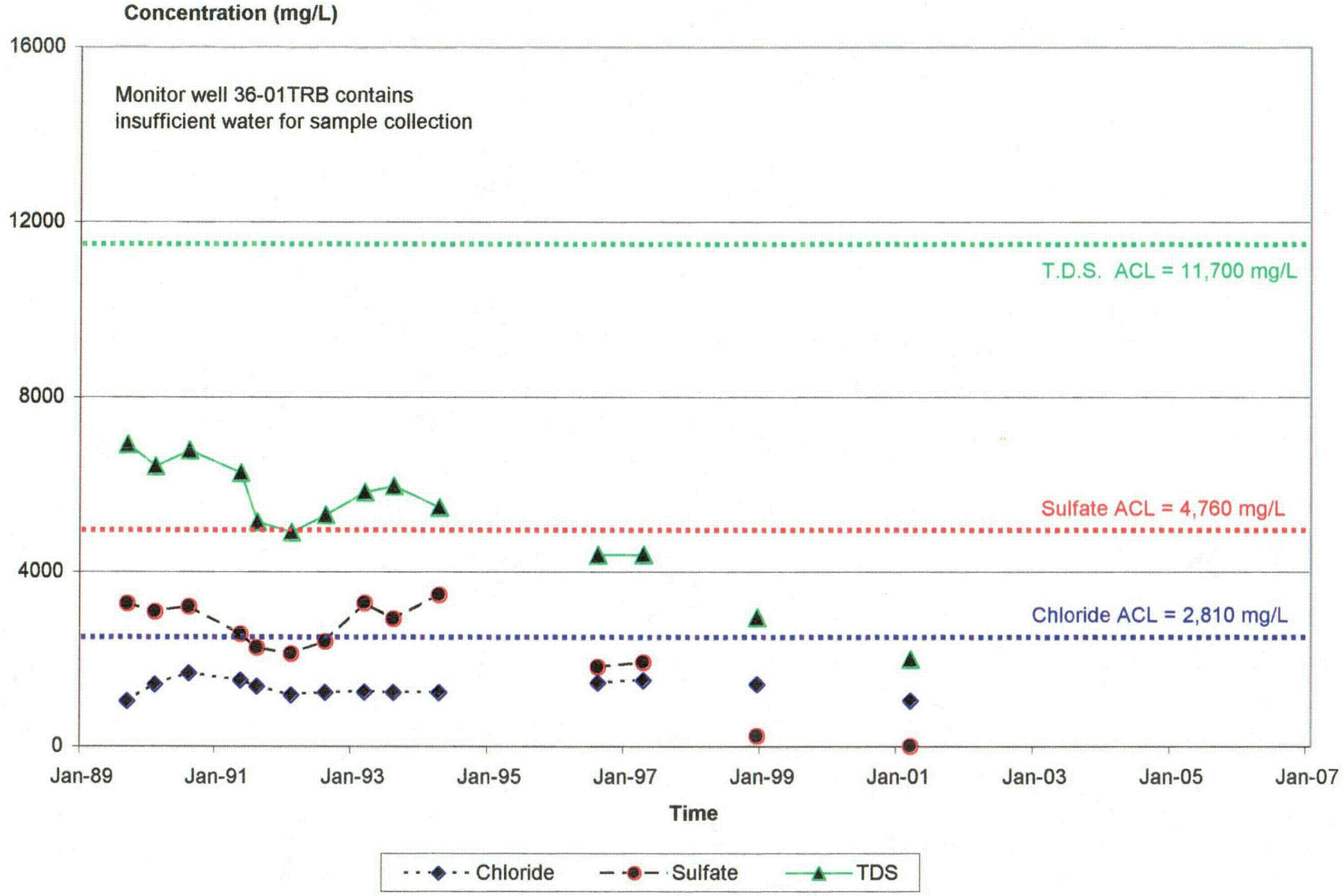


Monitor Well 31-67

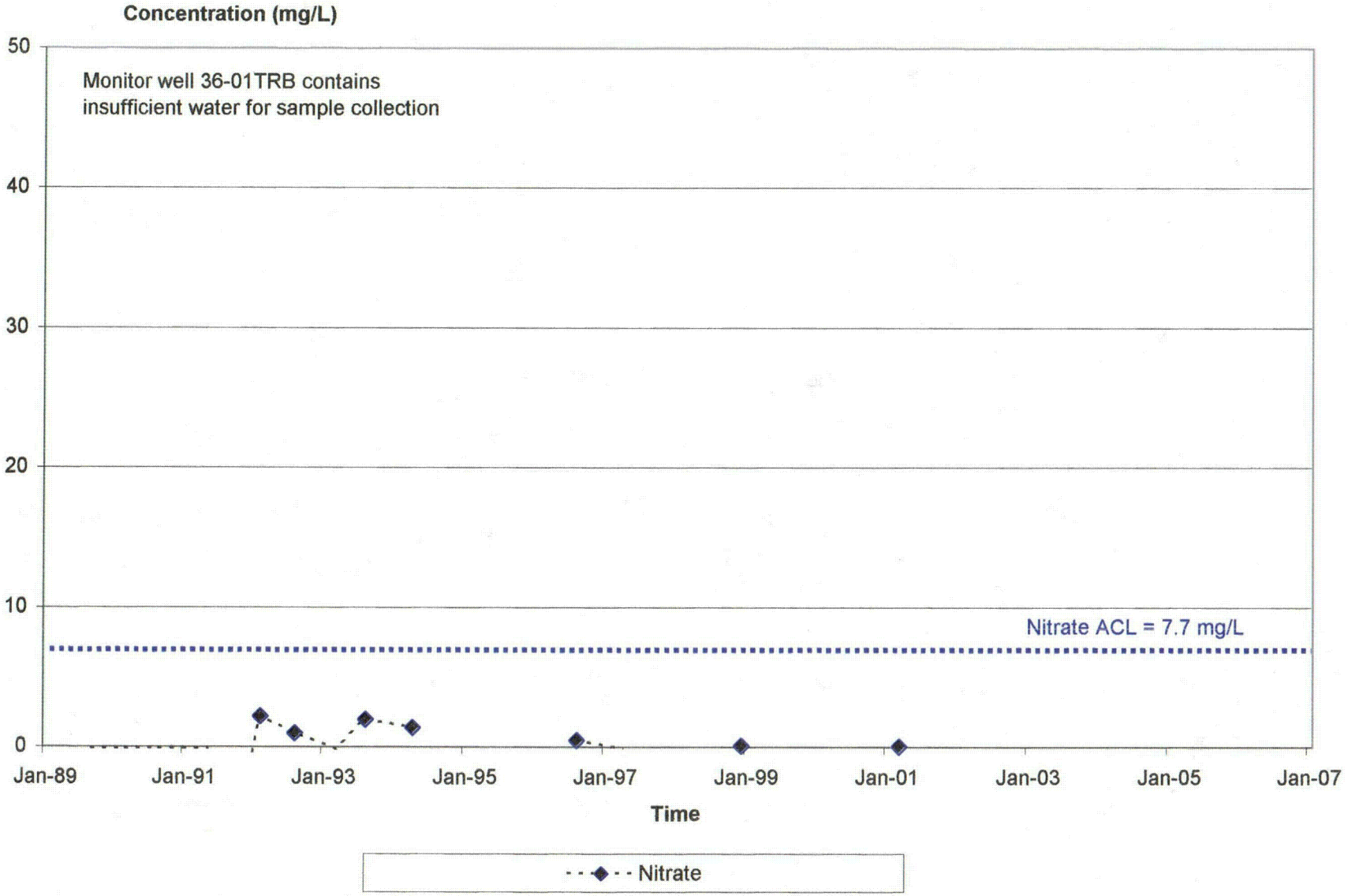



Monitor Well 31-67
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

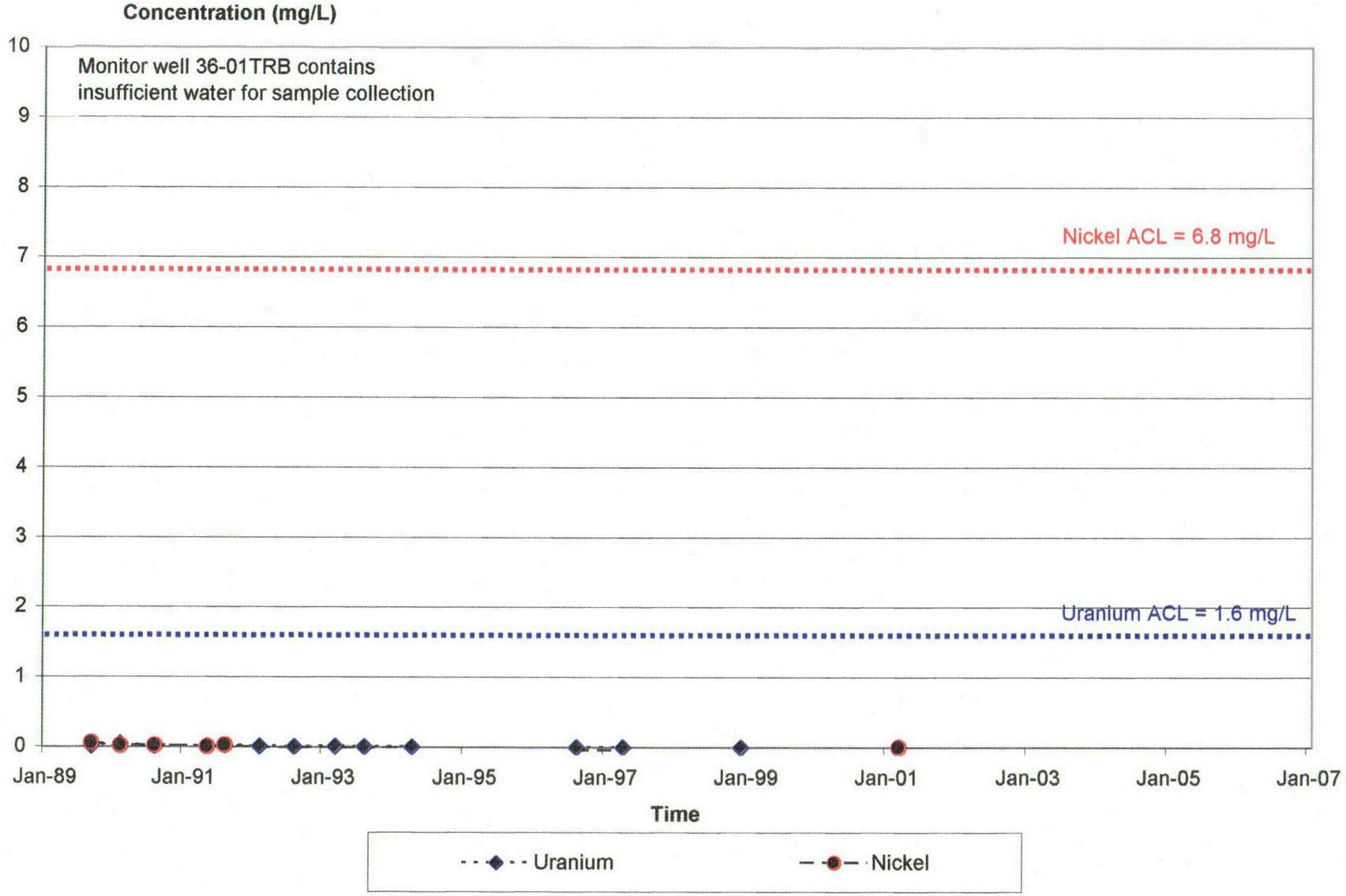
Monitor Well 36-01TRB



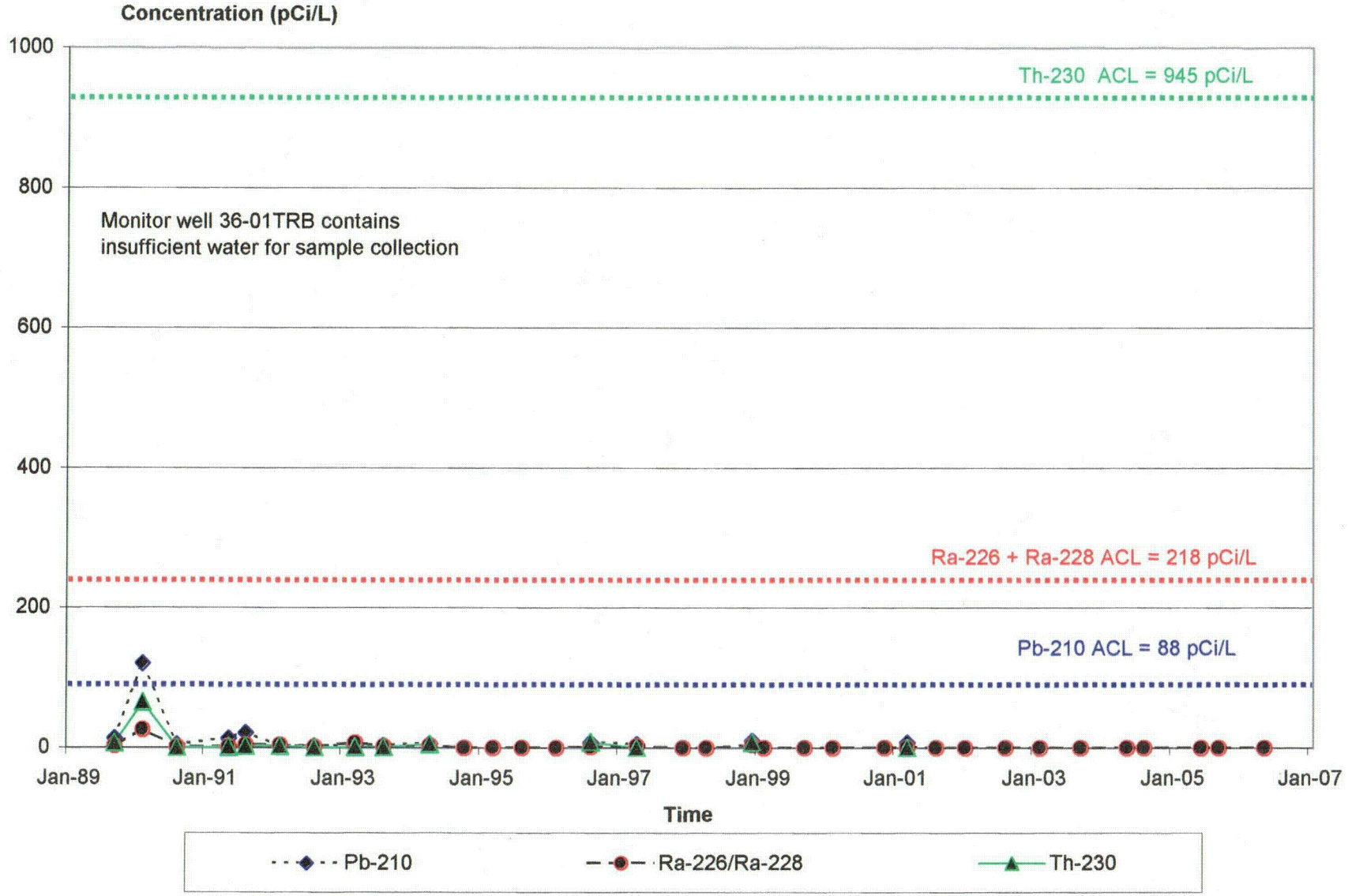
Monitor Well 36-01TRB

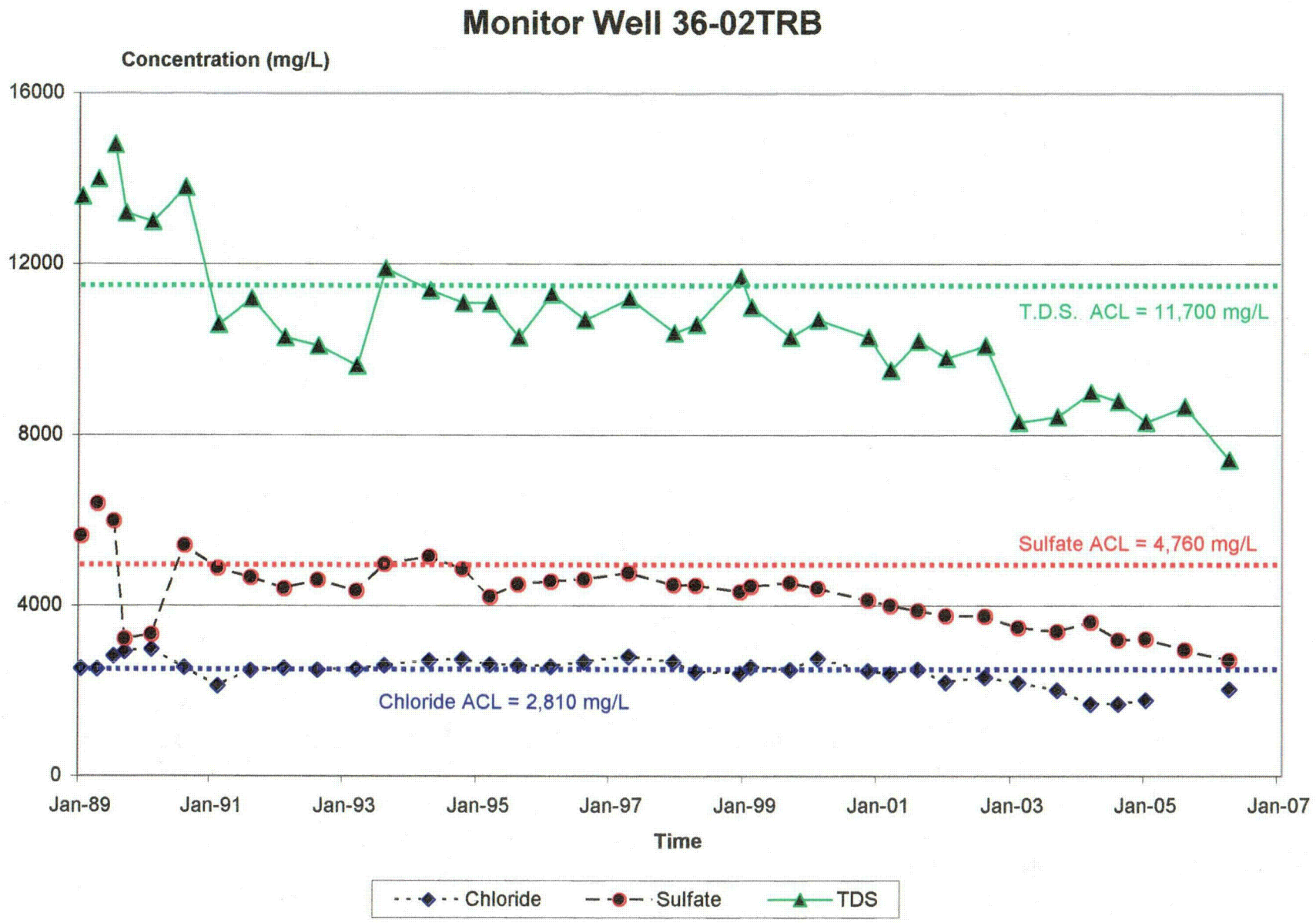


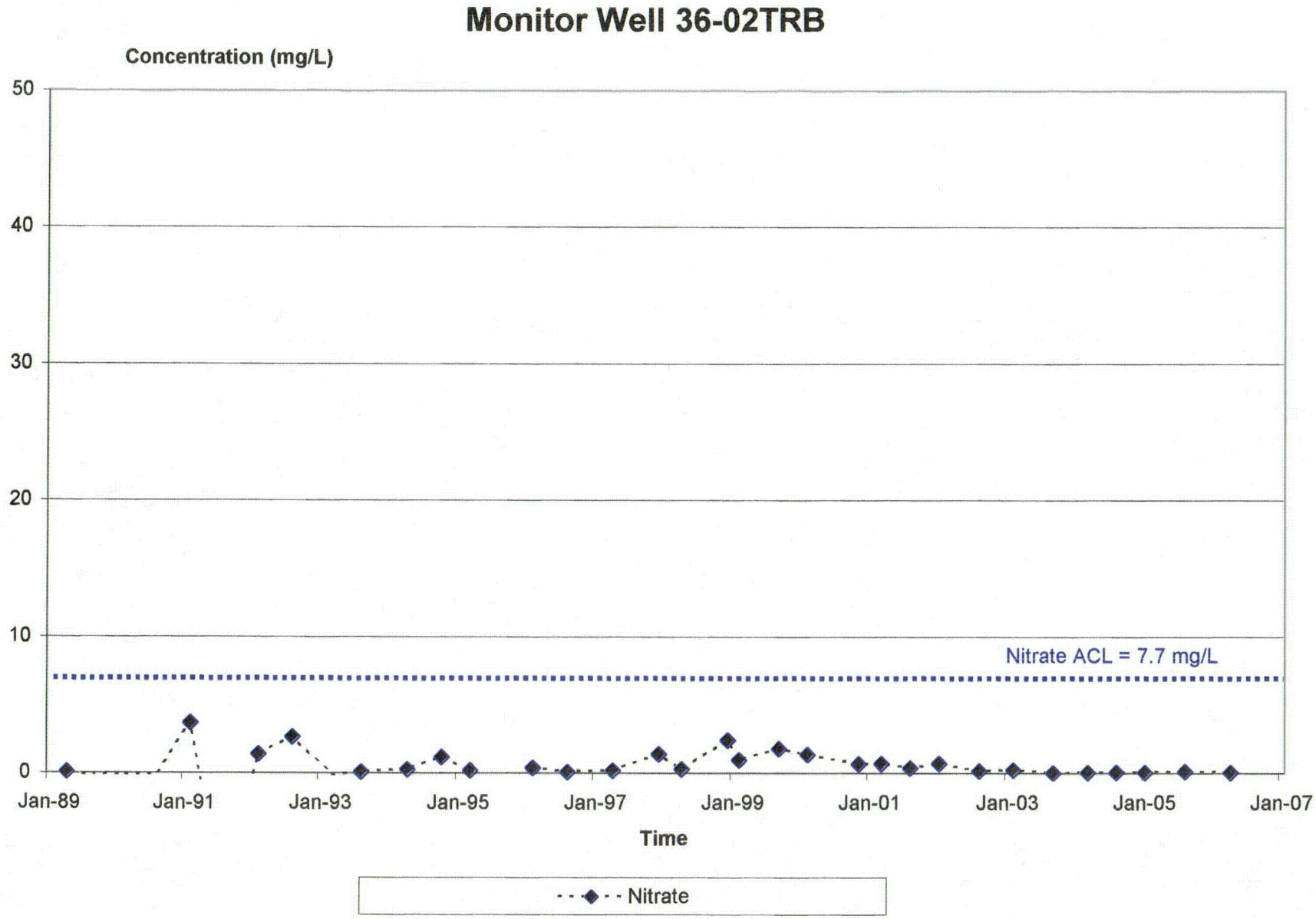
Monitor Well 36-01TRB

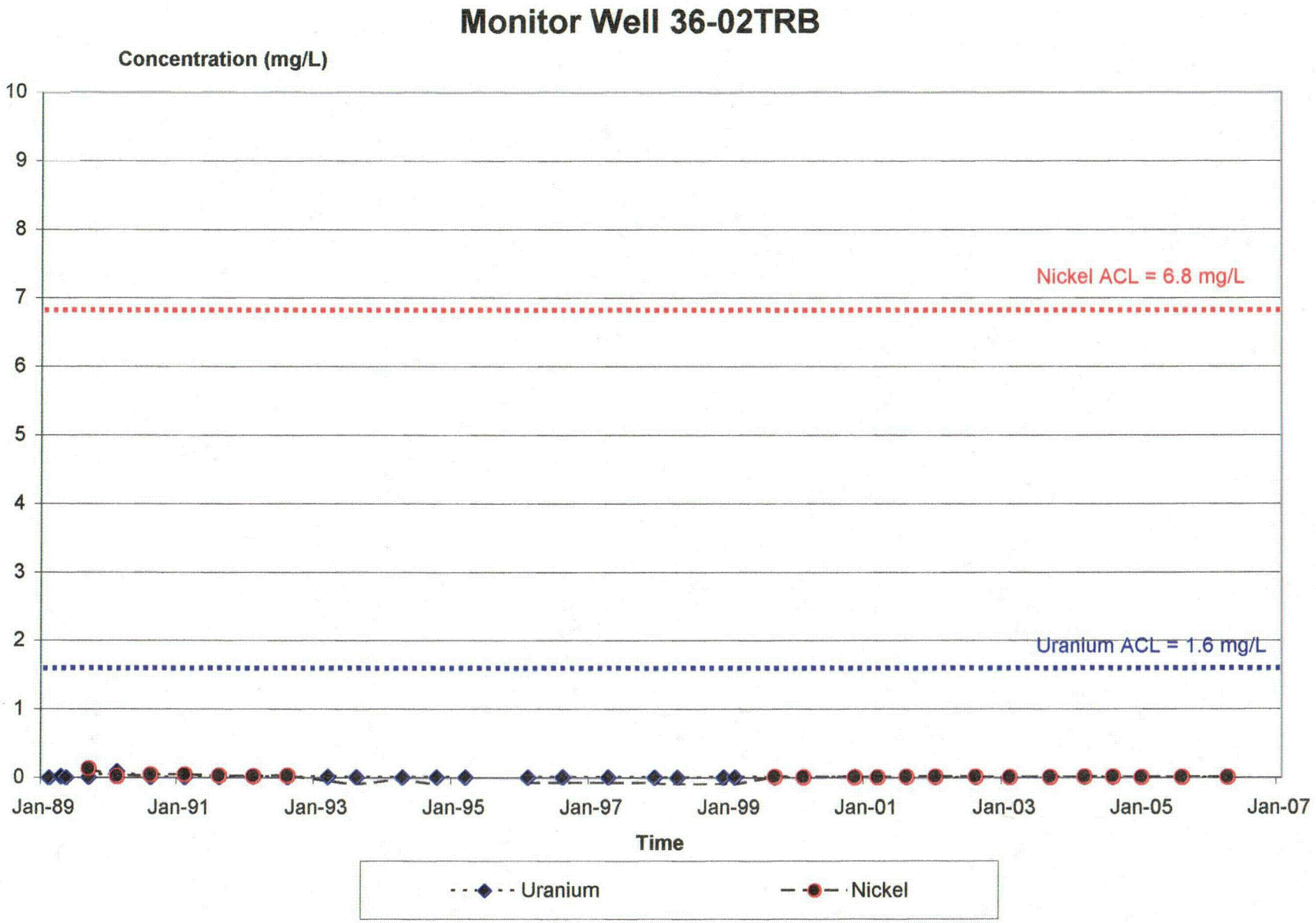


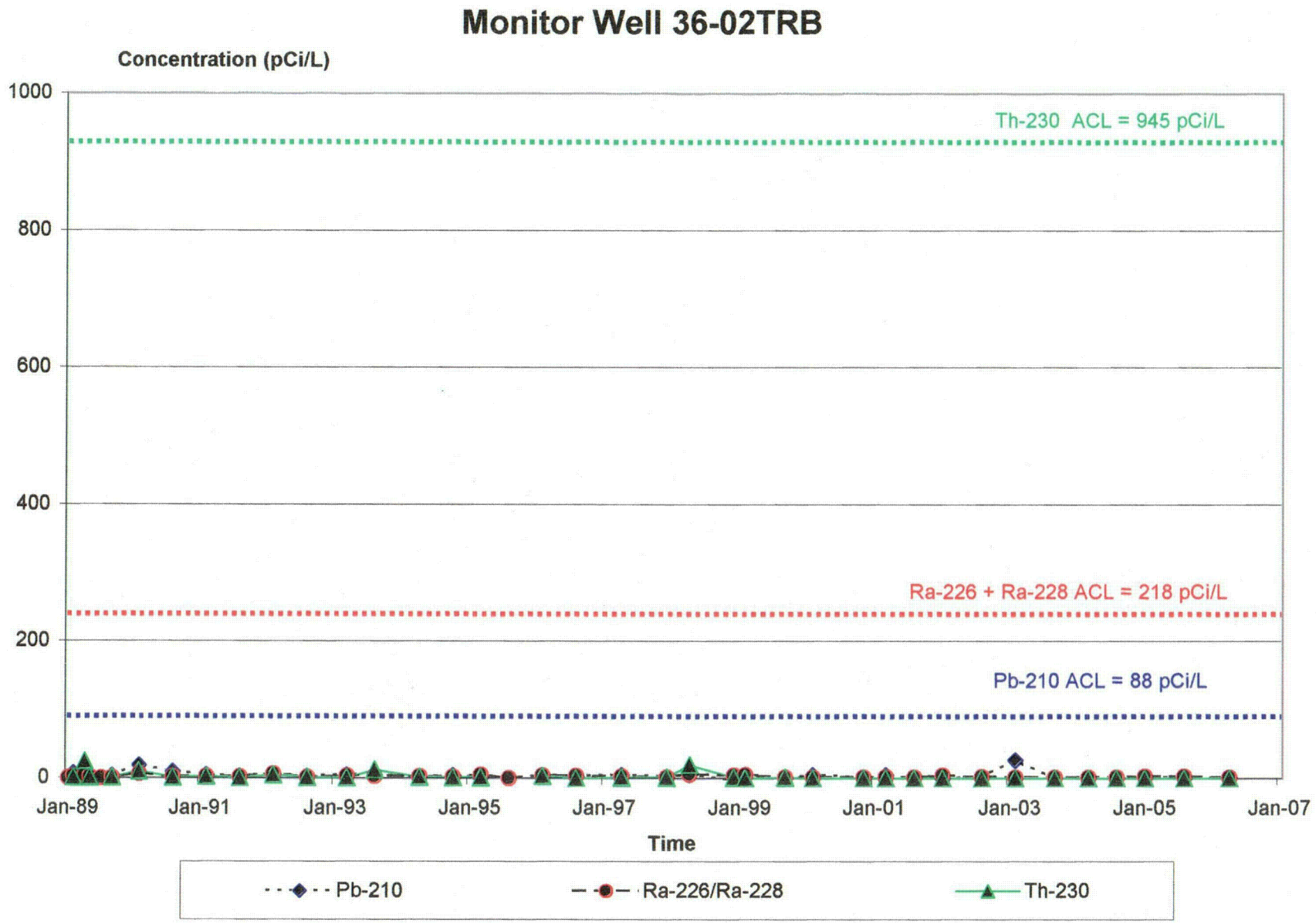
Monitor Well 36-01TRB




Monitor Well 36-02TRB
Concentration (mg/L)
16000
12000
8000
4000
0
T.D.S. ACL = 11,700 mg/L
Sulfate ACL = 4,760 mg/L
Chloride ACL = 2,810 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS


Monitor Well 36-02TRB
Concentration (mg/L)
50
40
30
20
10
0
Nitrate ACL = 7.7 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

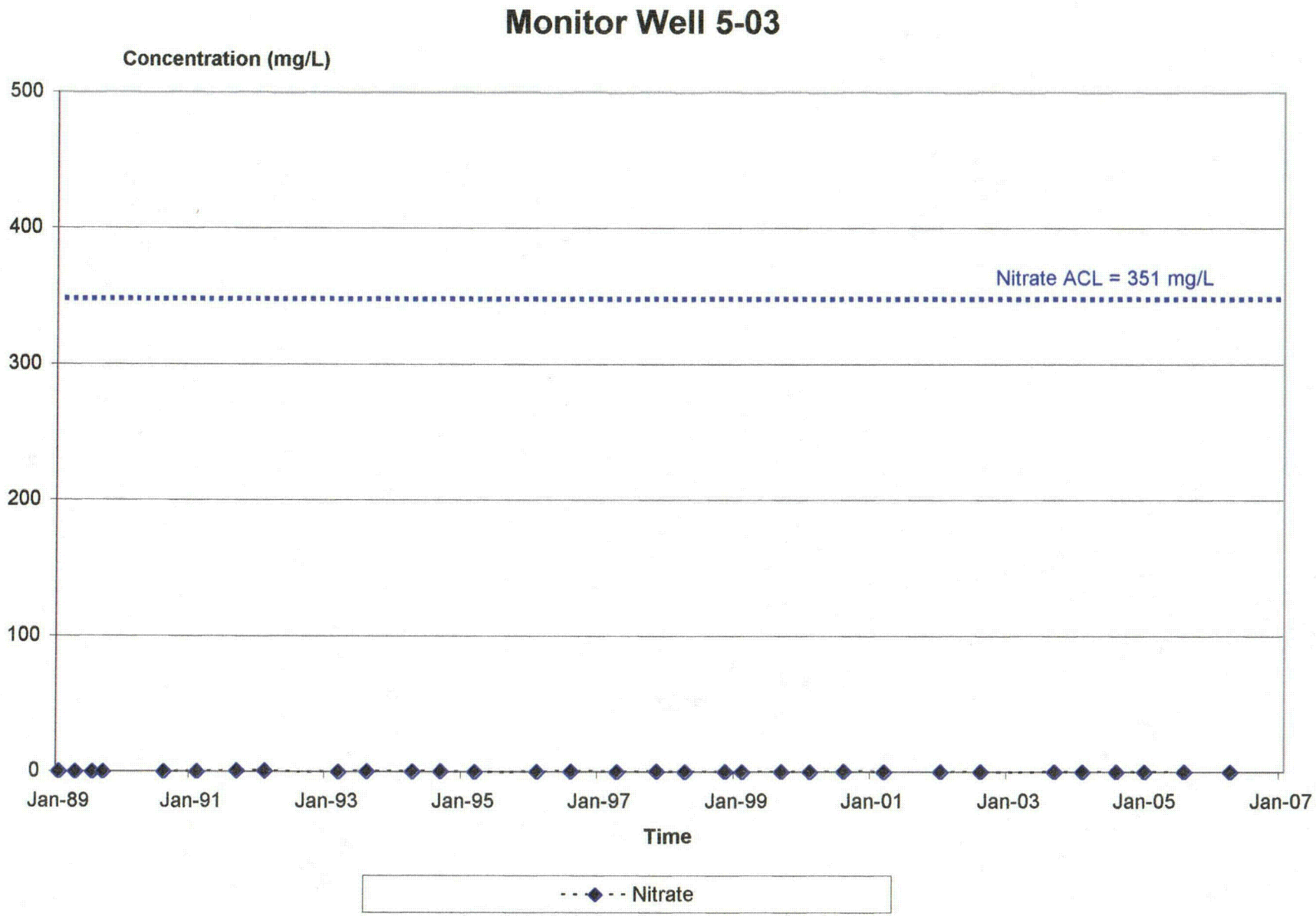

Monitor Well 36-02TRB
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Nickel ACL = 6.8 mg/L
Uranium ACL = 1.6 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Nickel

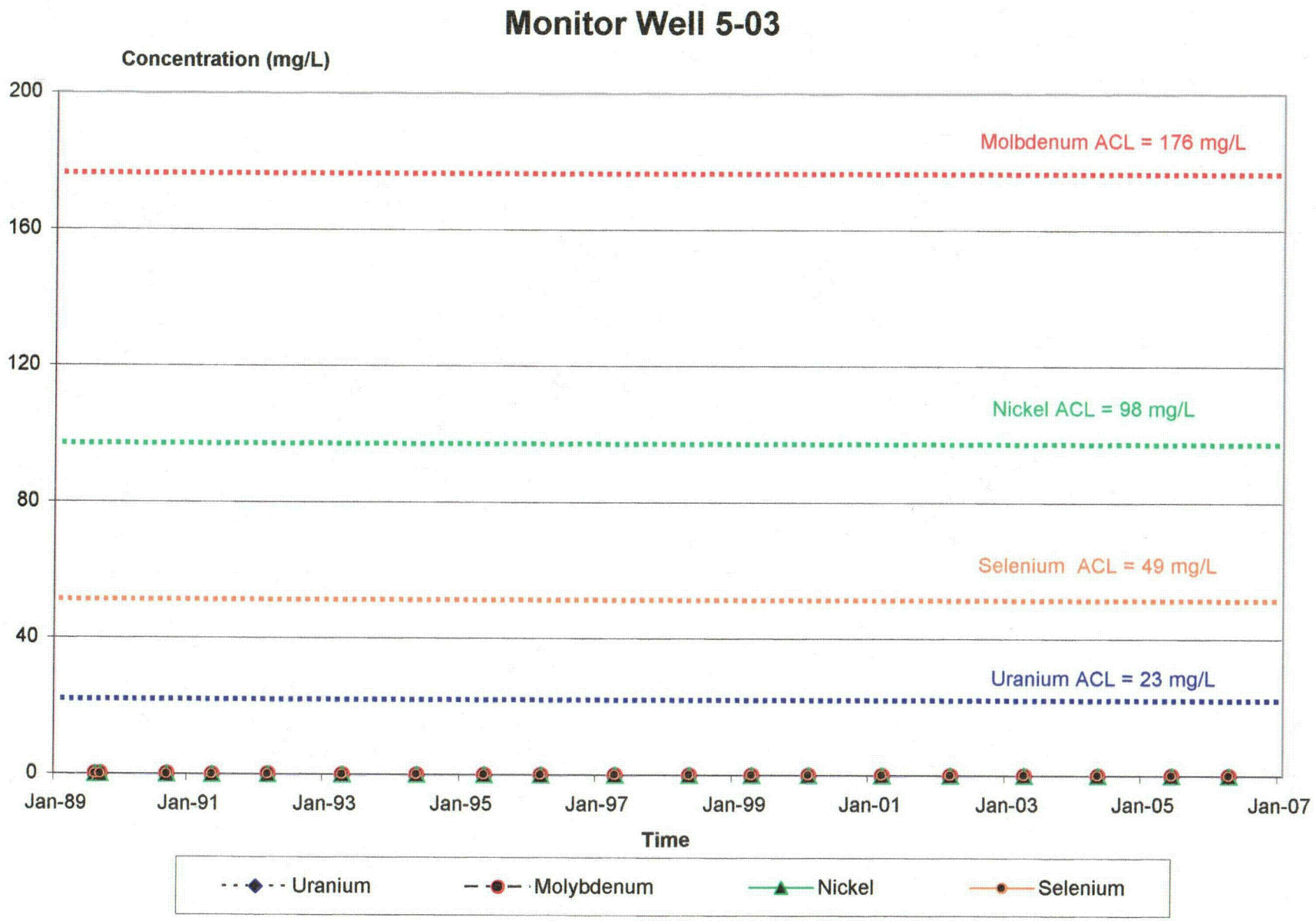

Monitor Well 36-02TRB
Concentration (pCi/L)
1000
800
600
400
200
0
Th-230 ACL = 945 pCi/L
Ra-226 + Ra-228 ACL = 218 pCi/L
Pb-210 ACL = 88 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230

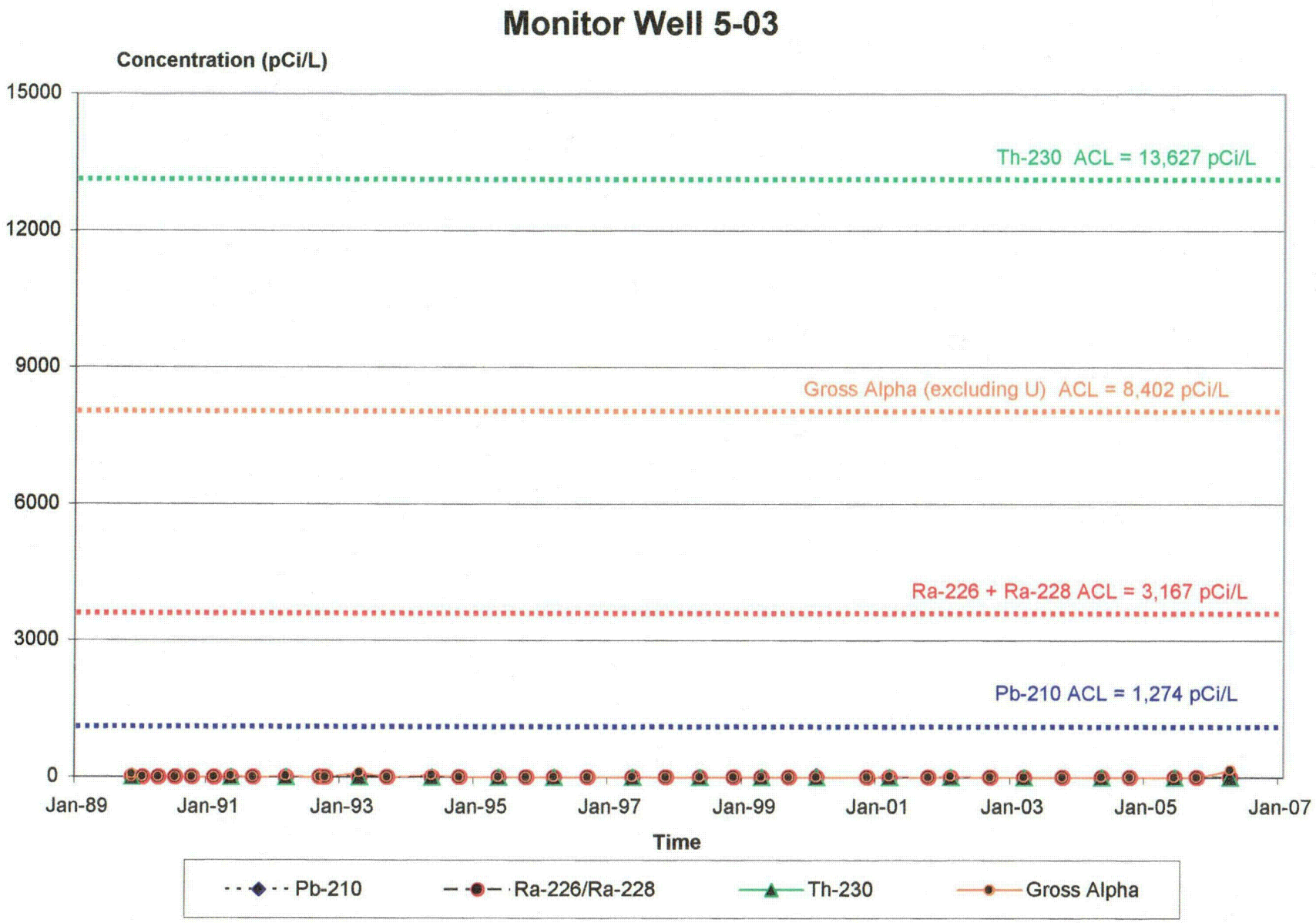
Stability Monitoring Plan
Time vs. Concentration Plots

Alluvuim

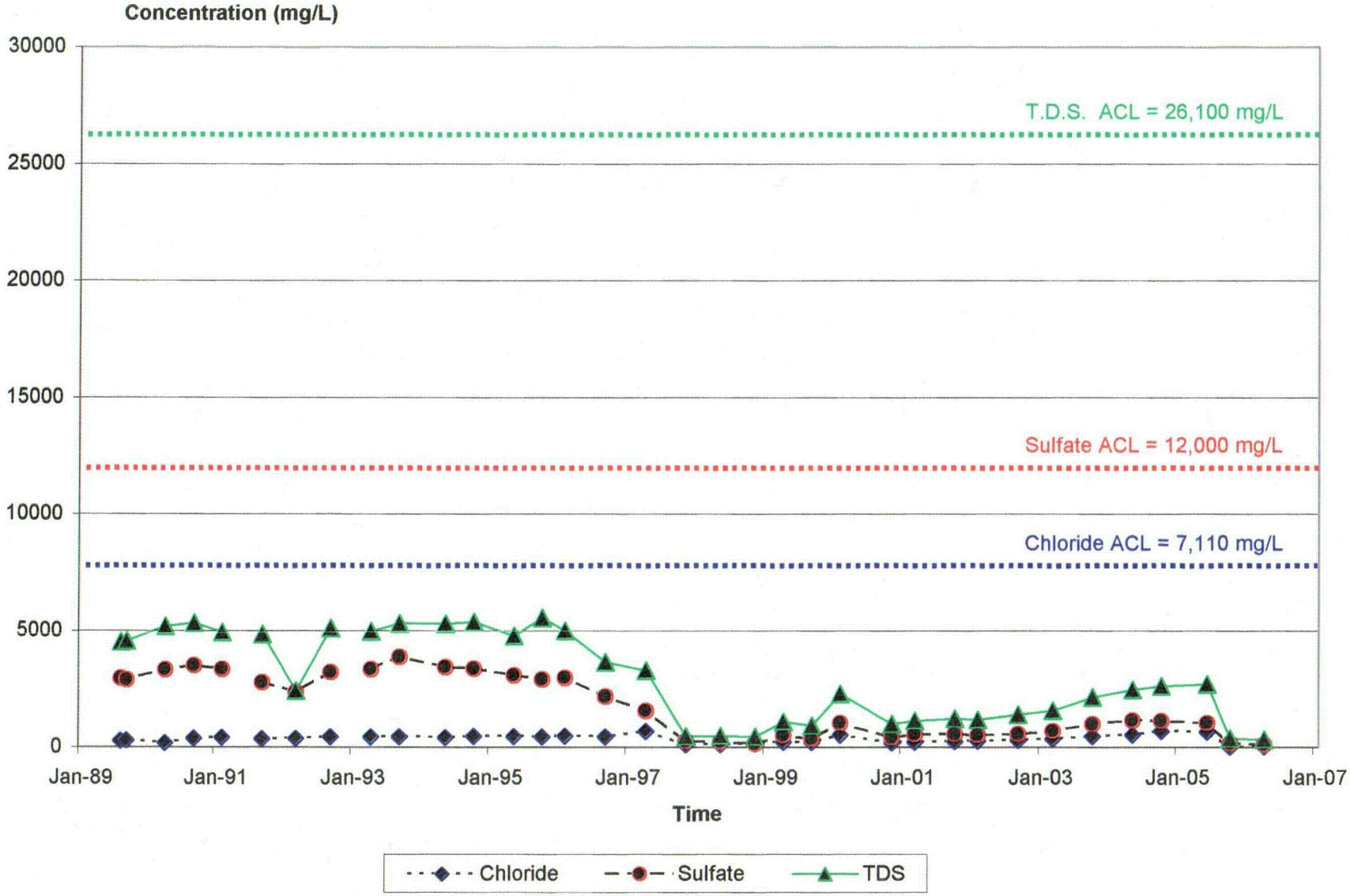
Monitor Well 5-03

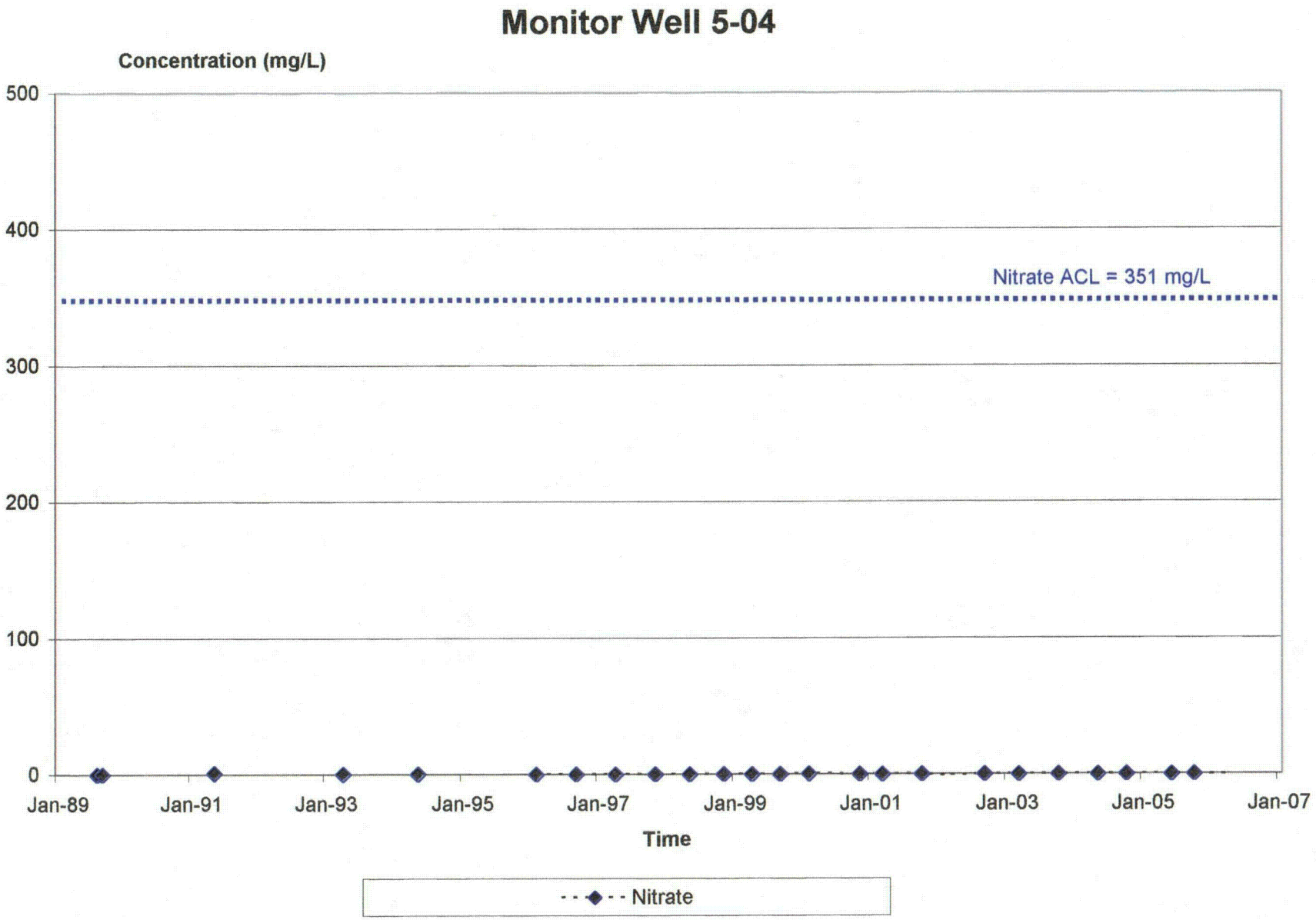

Monitor Well 5-03
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

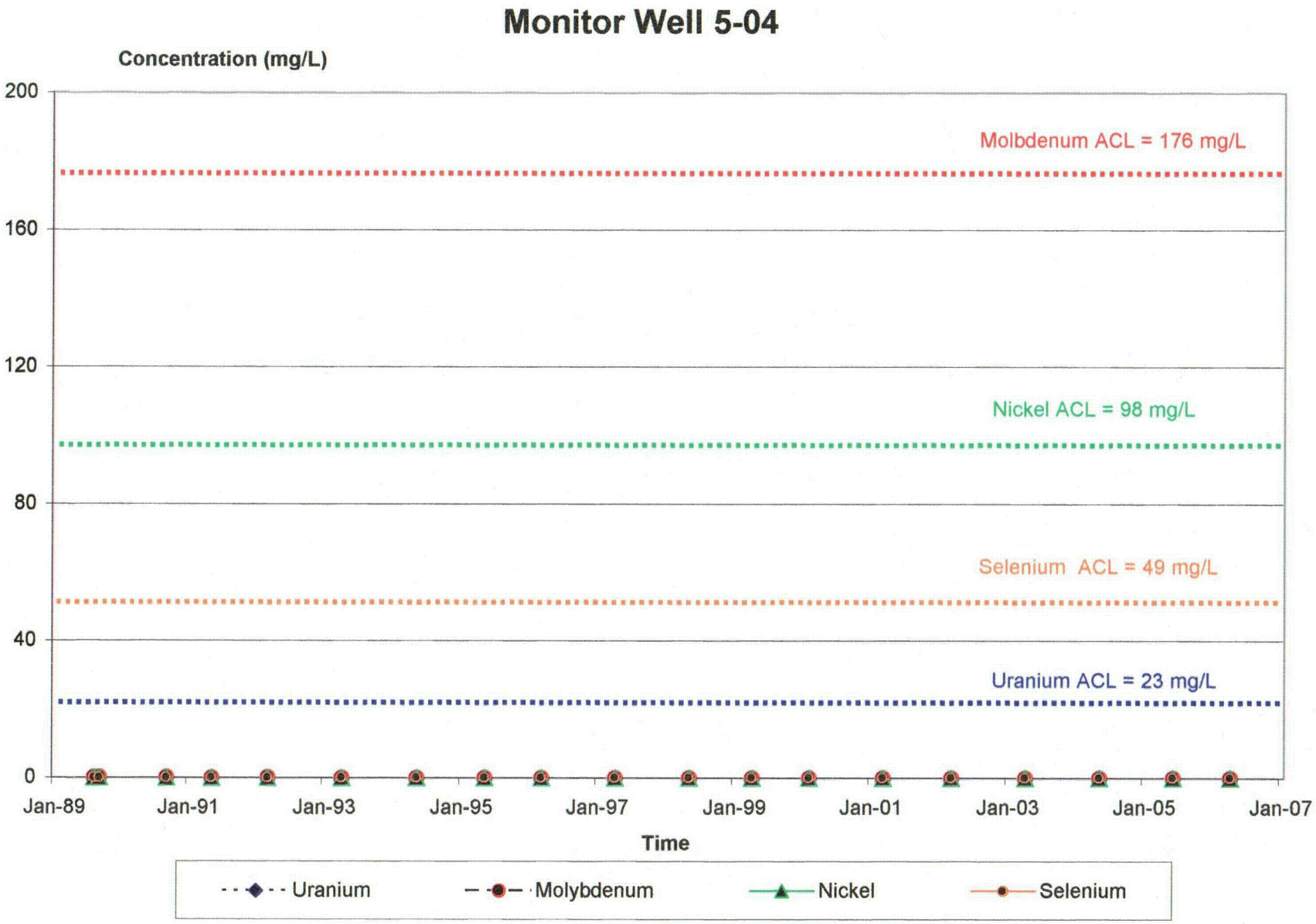

Monitor Well 5-03
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

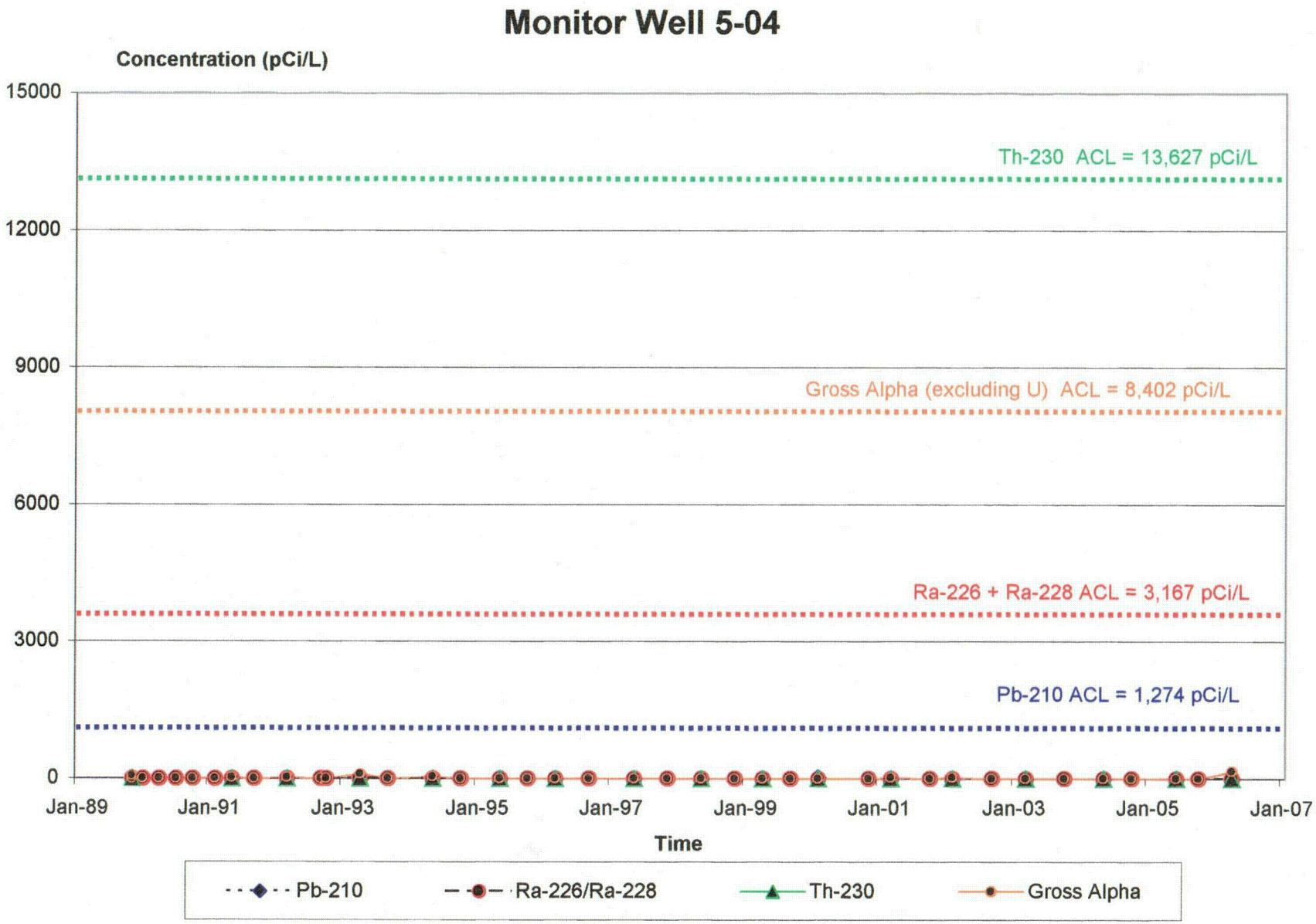

Monitor Well 5-03
Concentration (pCi/L)
15000
12000
9000
6000
3000
0
Th-230 ACL = 13,627 pCi/L
Gross Alpha (excluding U) ACL = 8,402 pCi/L
Ra-226 + Ra-228 ACL = 3,167 pCi/L
Pb-210 ACL = 1,274 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230
Gross Alpha

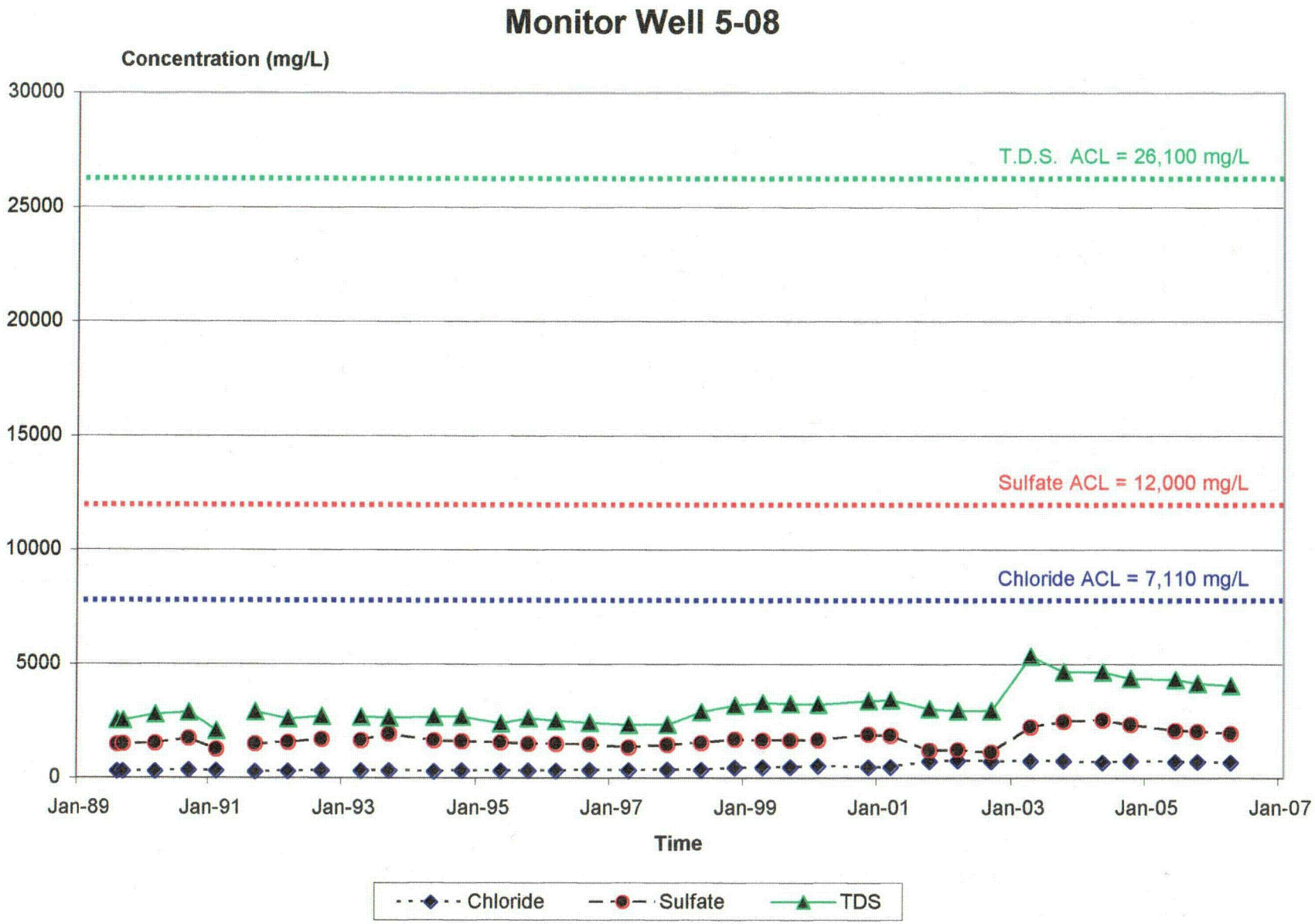
Monitor Well 5-04

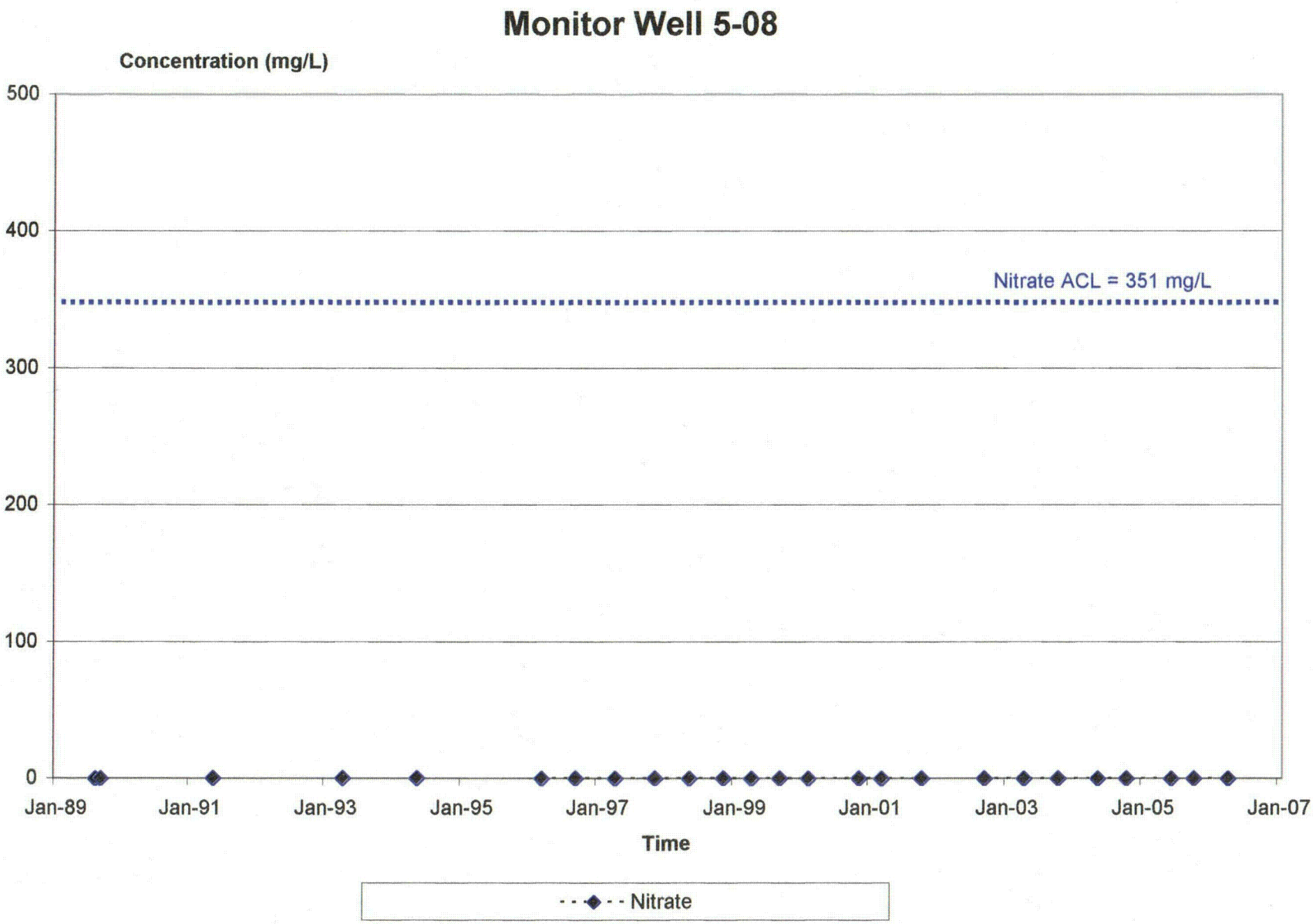


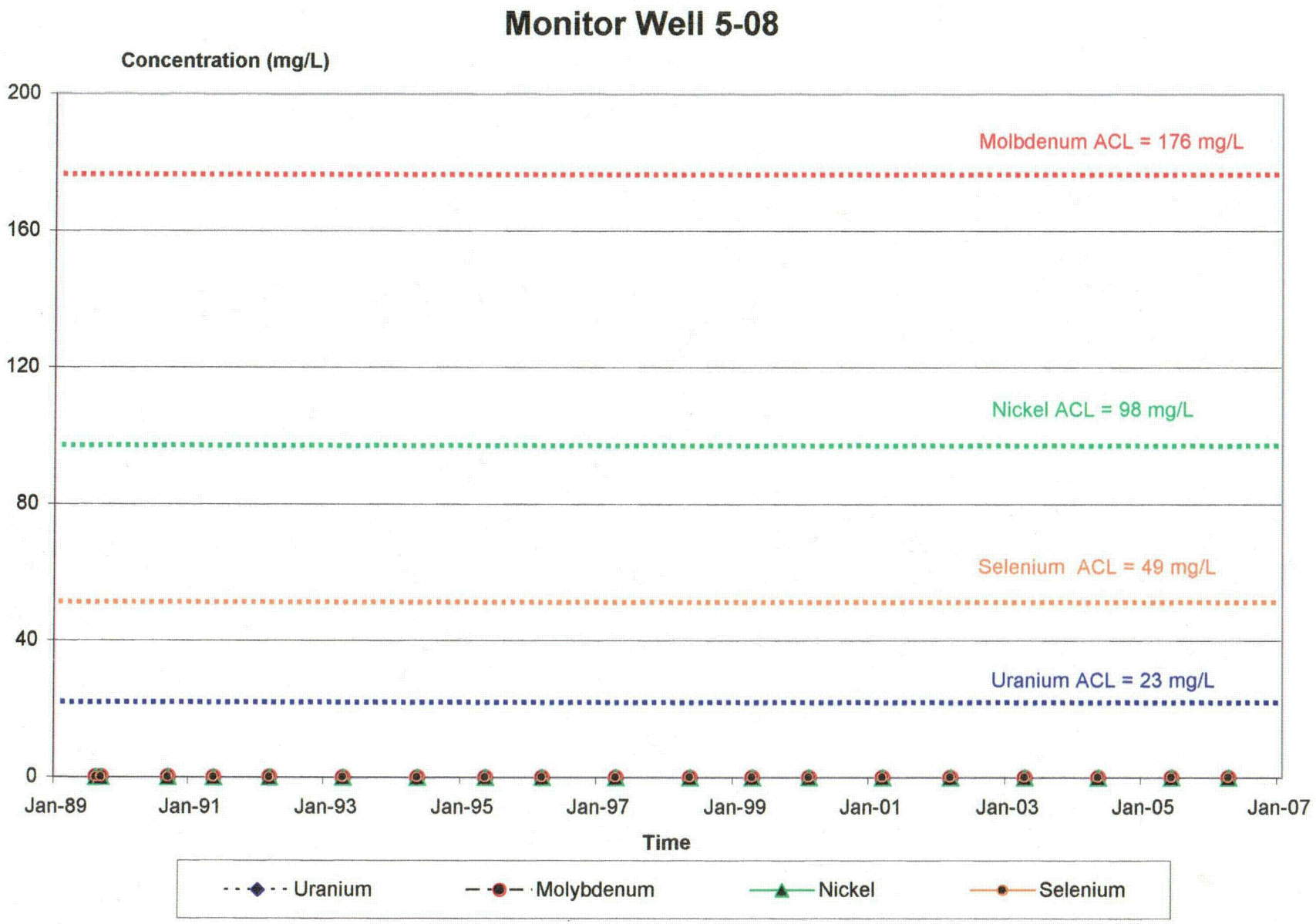

Monitor Well 5-04
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate


Monitor Well 5-04
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

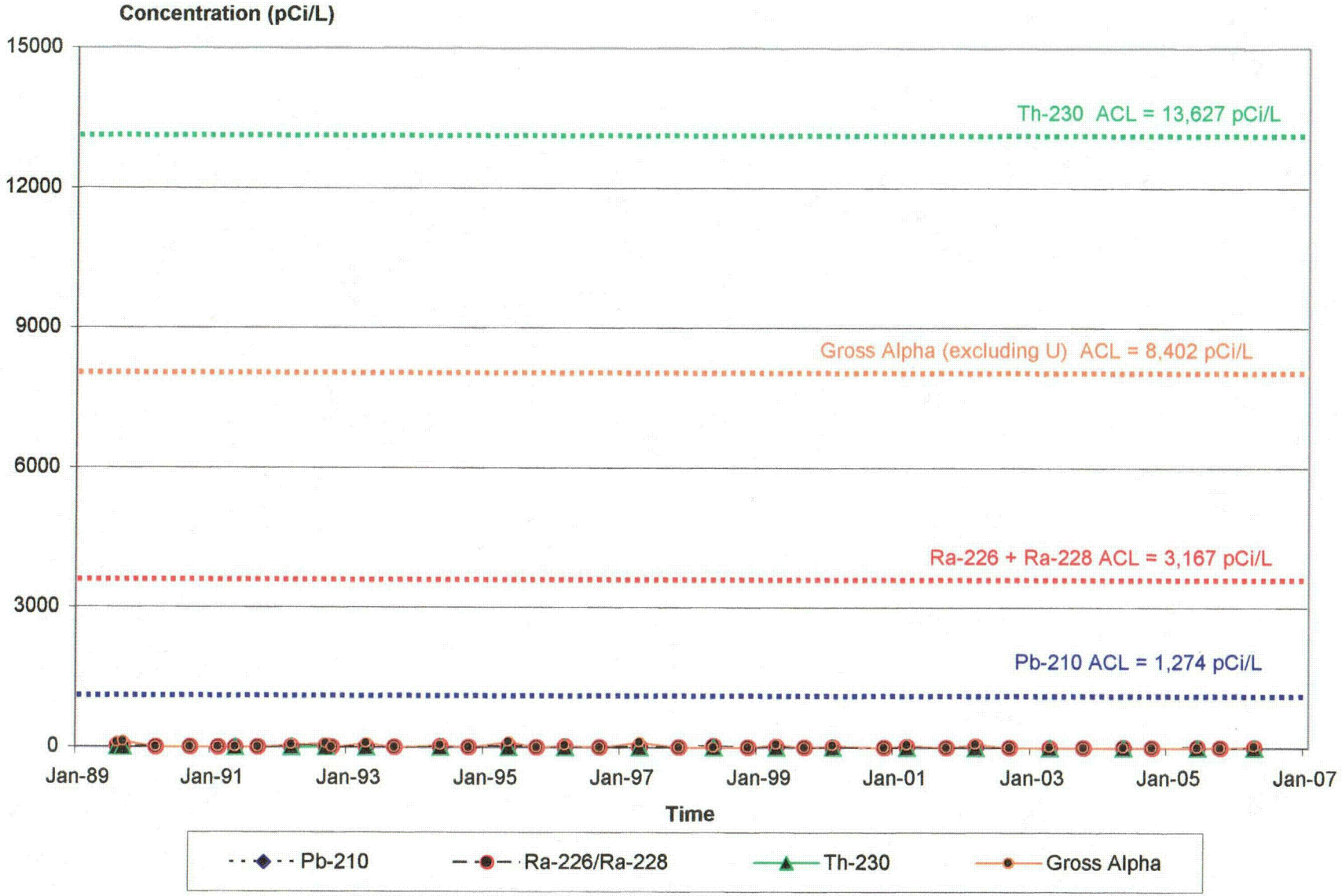

Monitor Well 5-04
Concentration (pCi/L)
15000
12000
9000
6000
3000
0
Th-230 ACL = 13,627 pCi/L
Gross Alpha (excluding U) ACL = 8,402 pCi/L
Ra-226 + Ra-228 ACL = 3,167 pCi/L
Pb-210 ACL = 1,274 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230
Gross Alpha

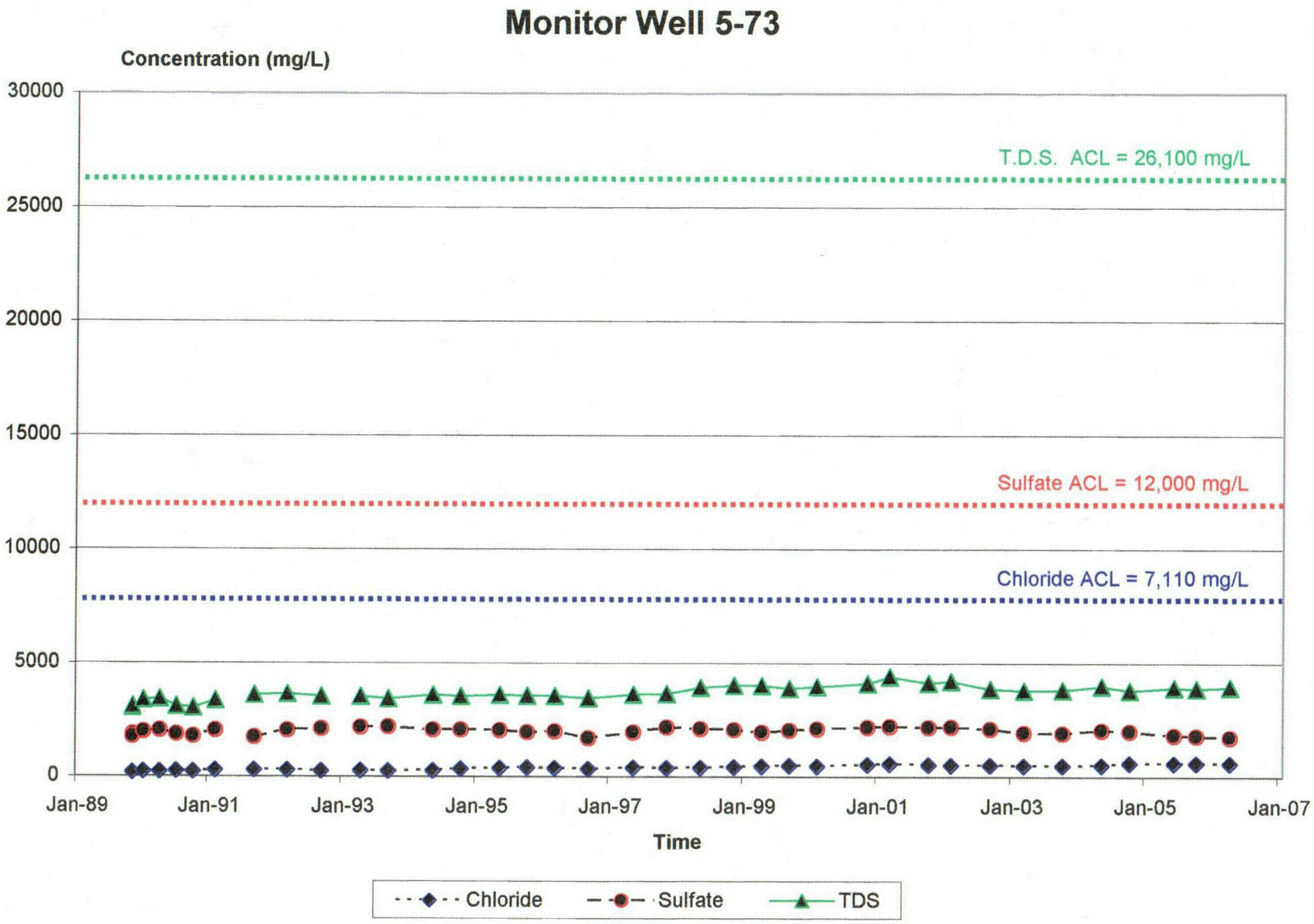

Monitor Well 5-08
Concentration (mg/L)
30000
25000
20000
15000
10000
5000
0
T.D.S. ACL = 26,100 mg/L
Sulfate ACL = 12,000 mg/L
Chloride ACL = 7,110 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

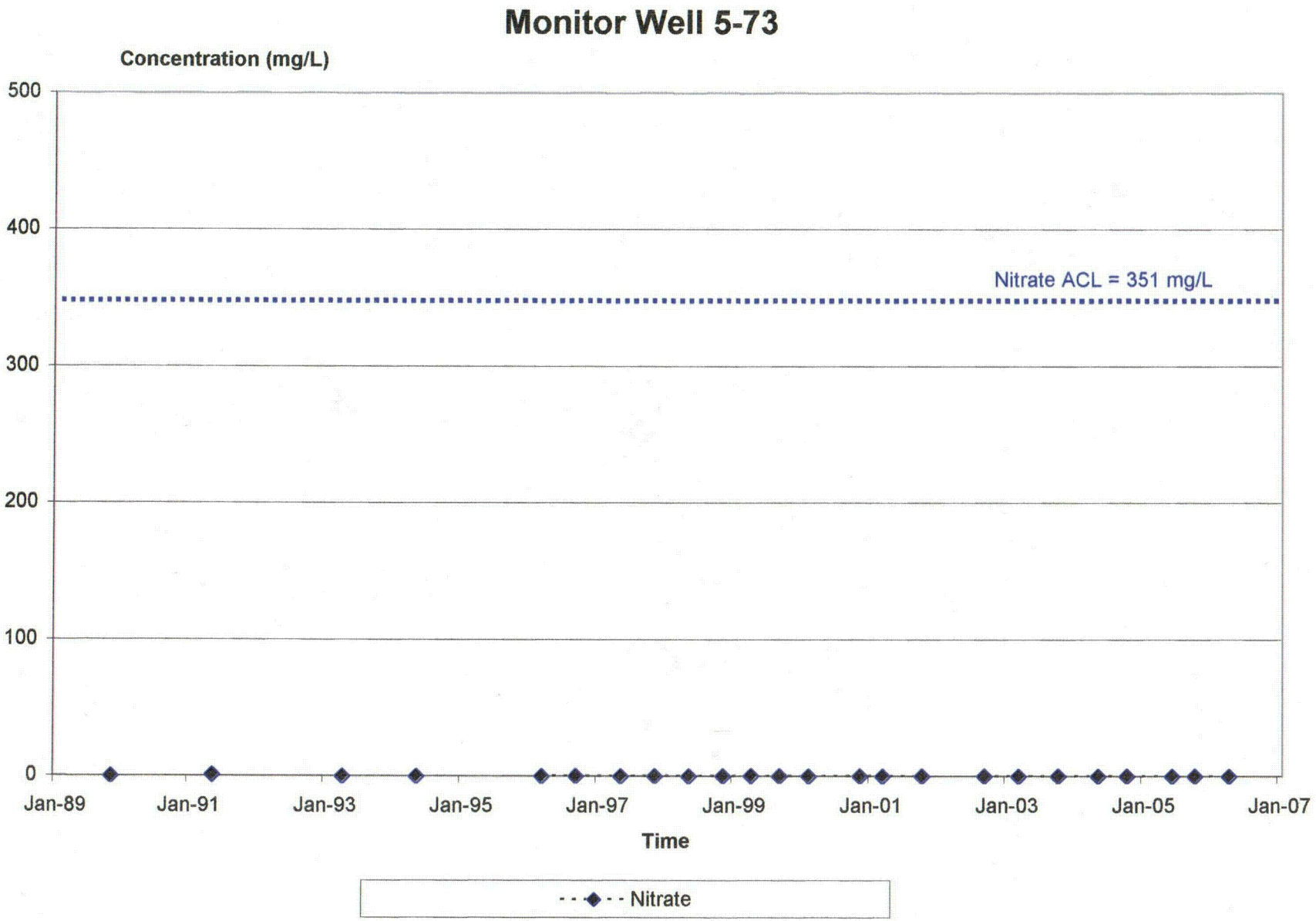

Monitor Well 5-08
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

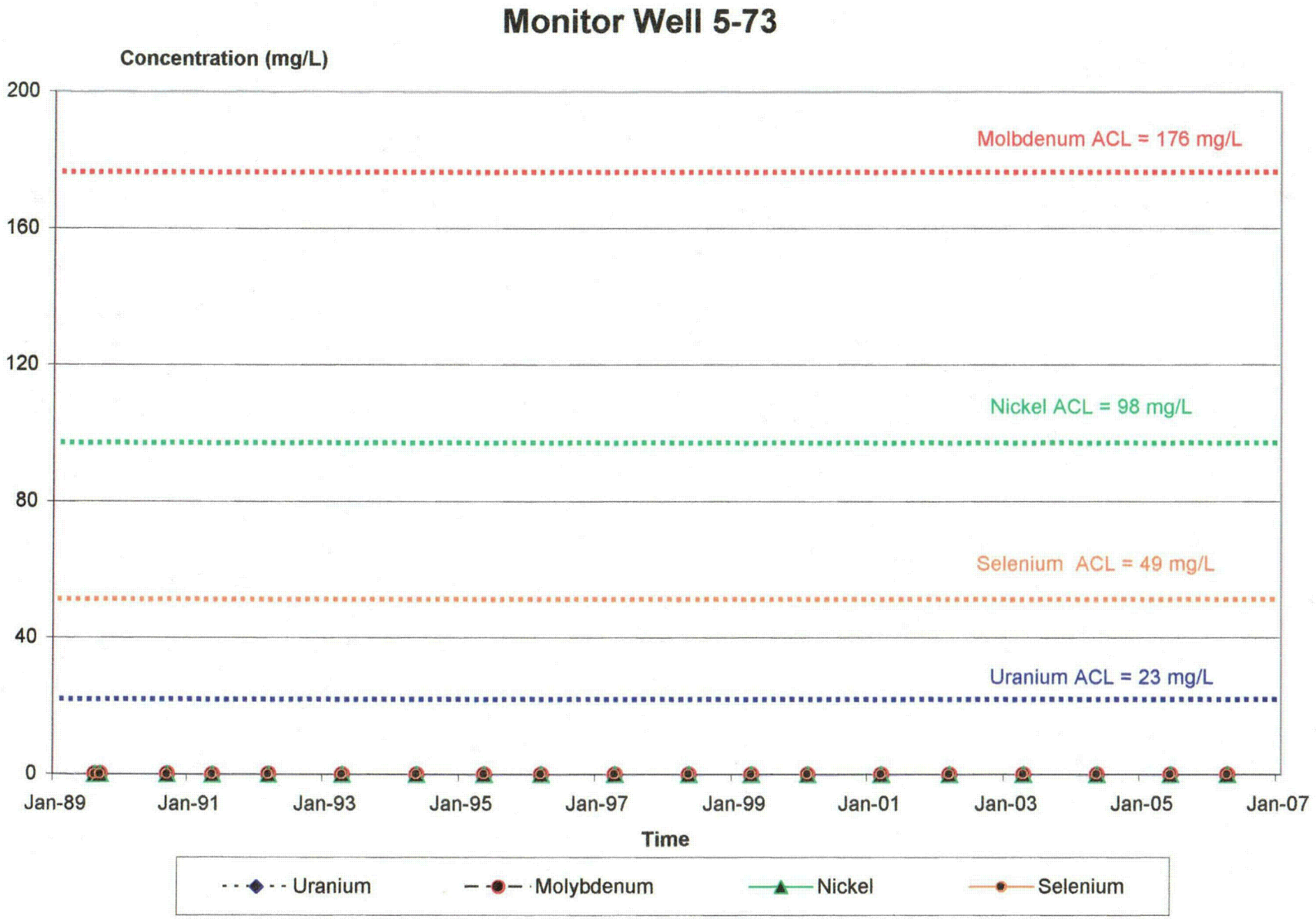

Monitor Well 5-08
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

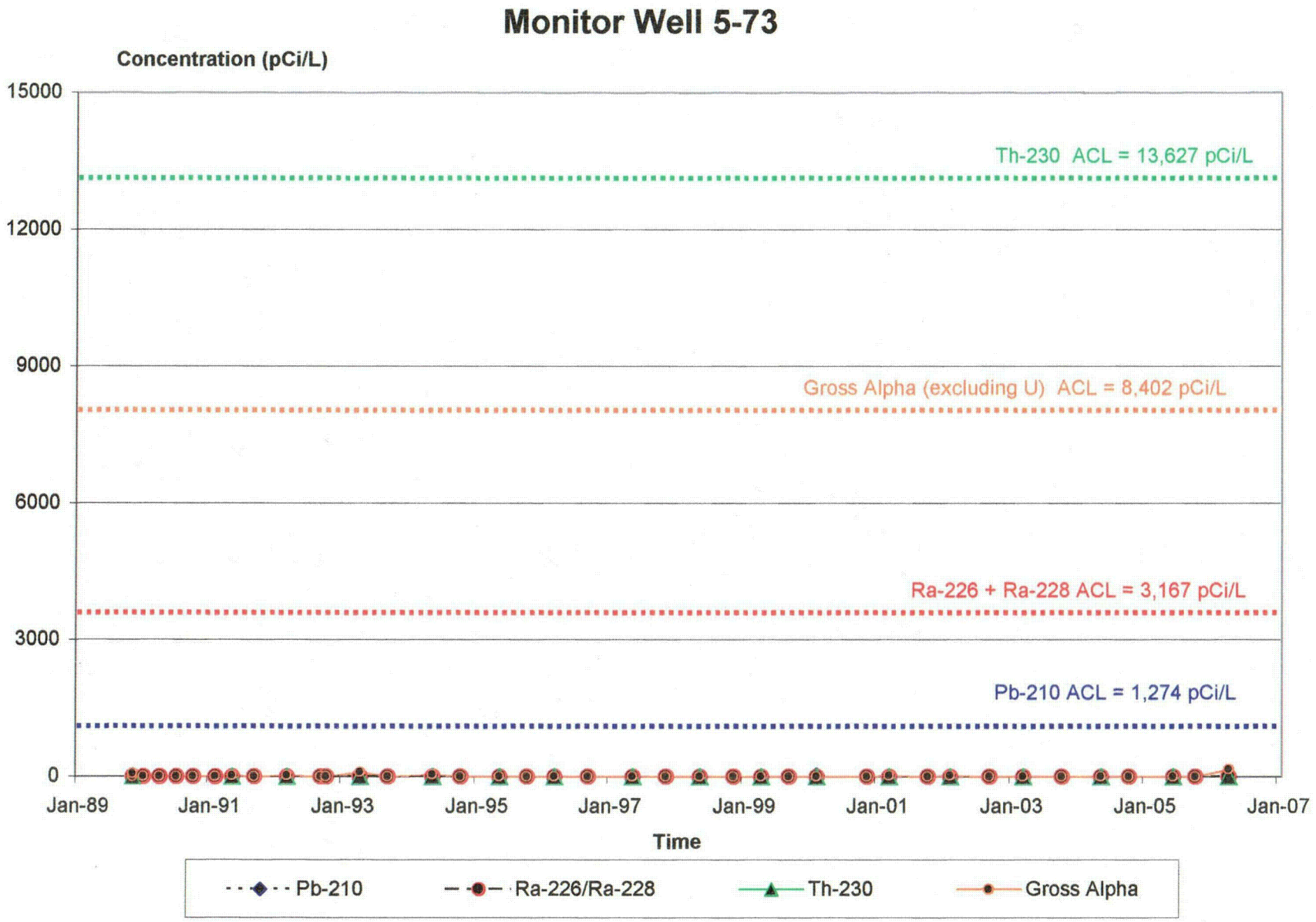
Monitor Well 5-08

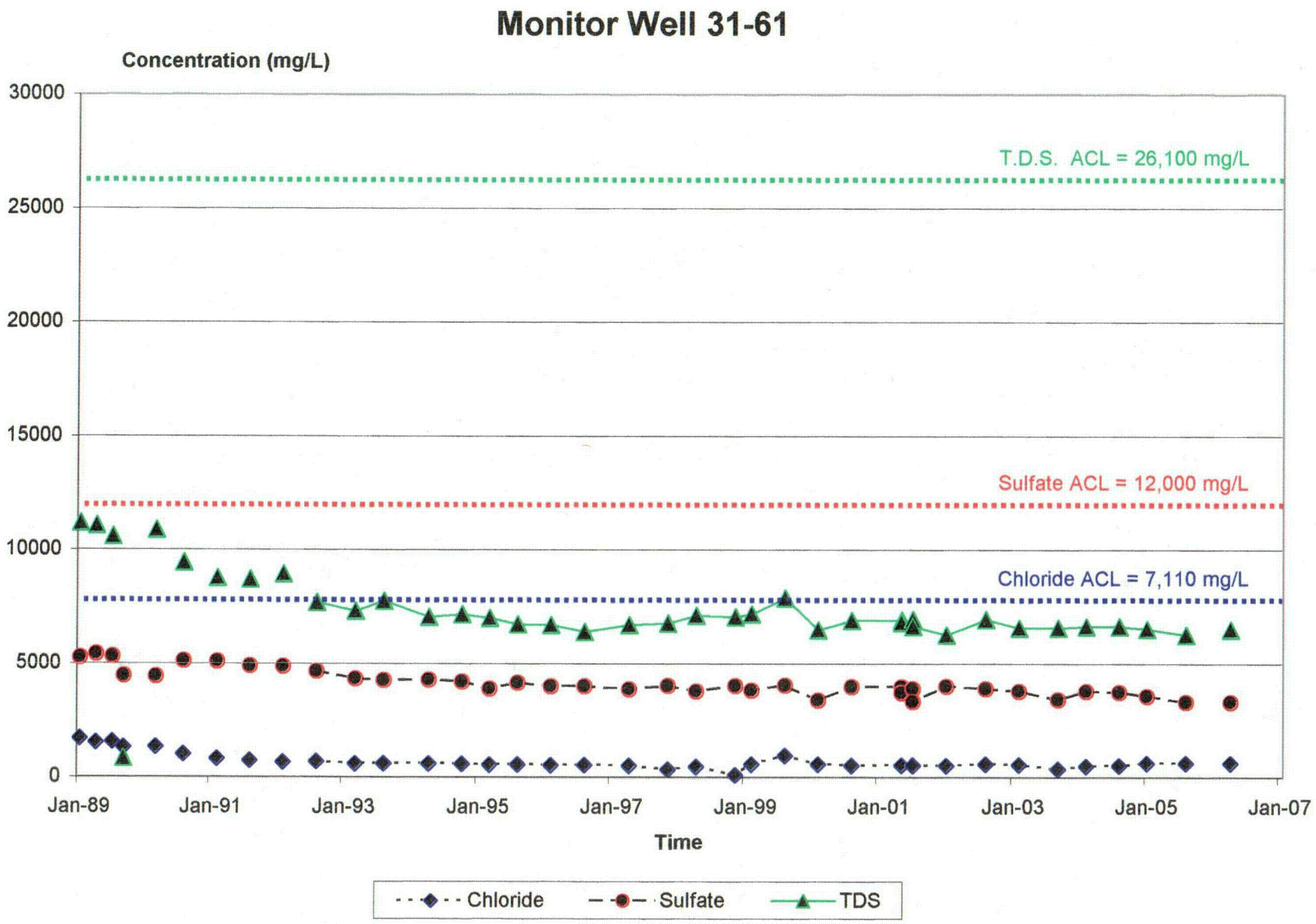


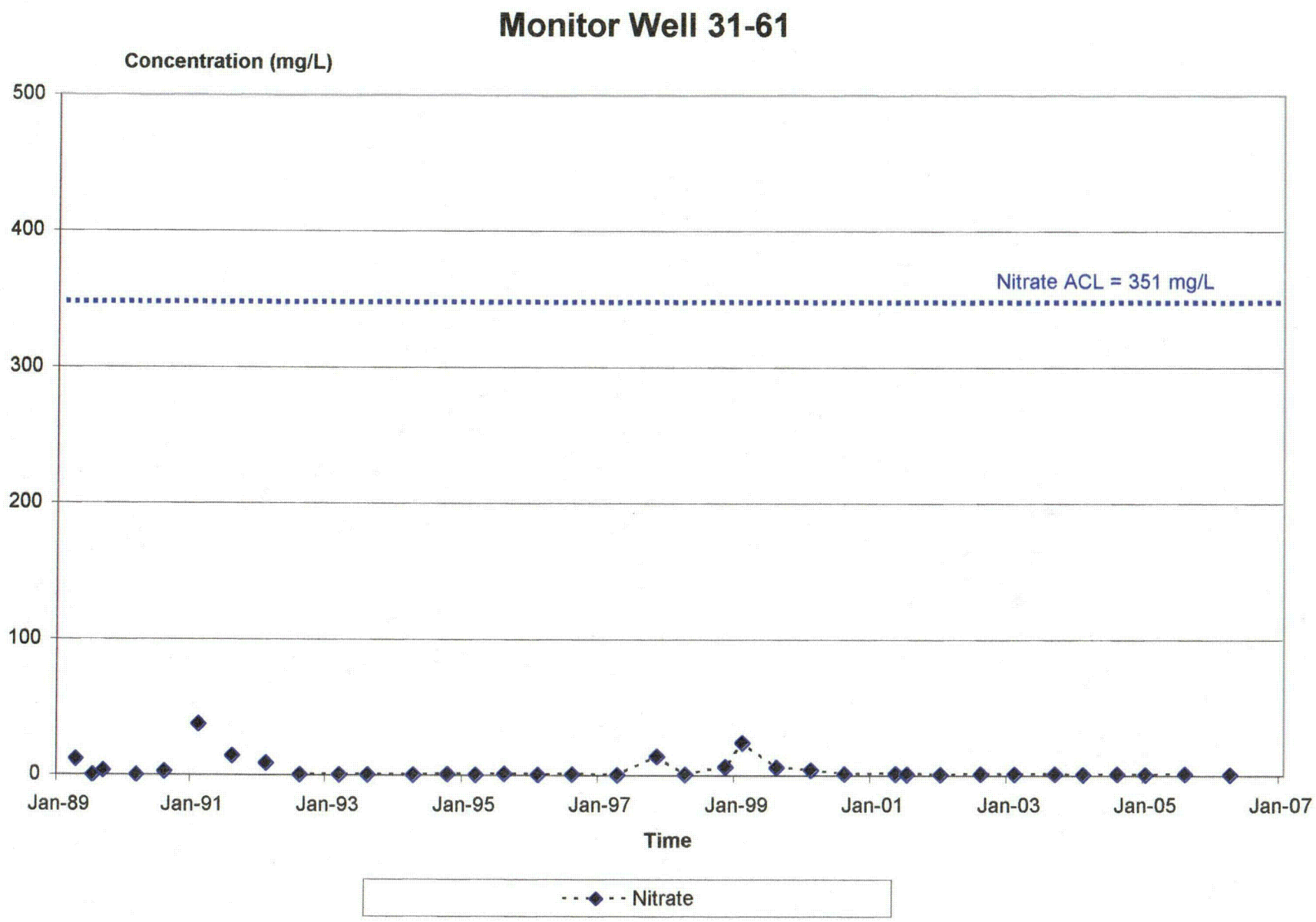

Monitor Well 5-73
Concentration (mg/L)
30000
25000
20000
15000
10000
5000
0
T.D.S. ACL = 26,100 mg/L
Sulfate ACL = 12,000 mg/L
Chloride ACL = 7,110 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

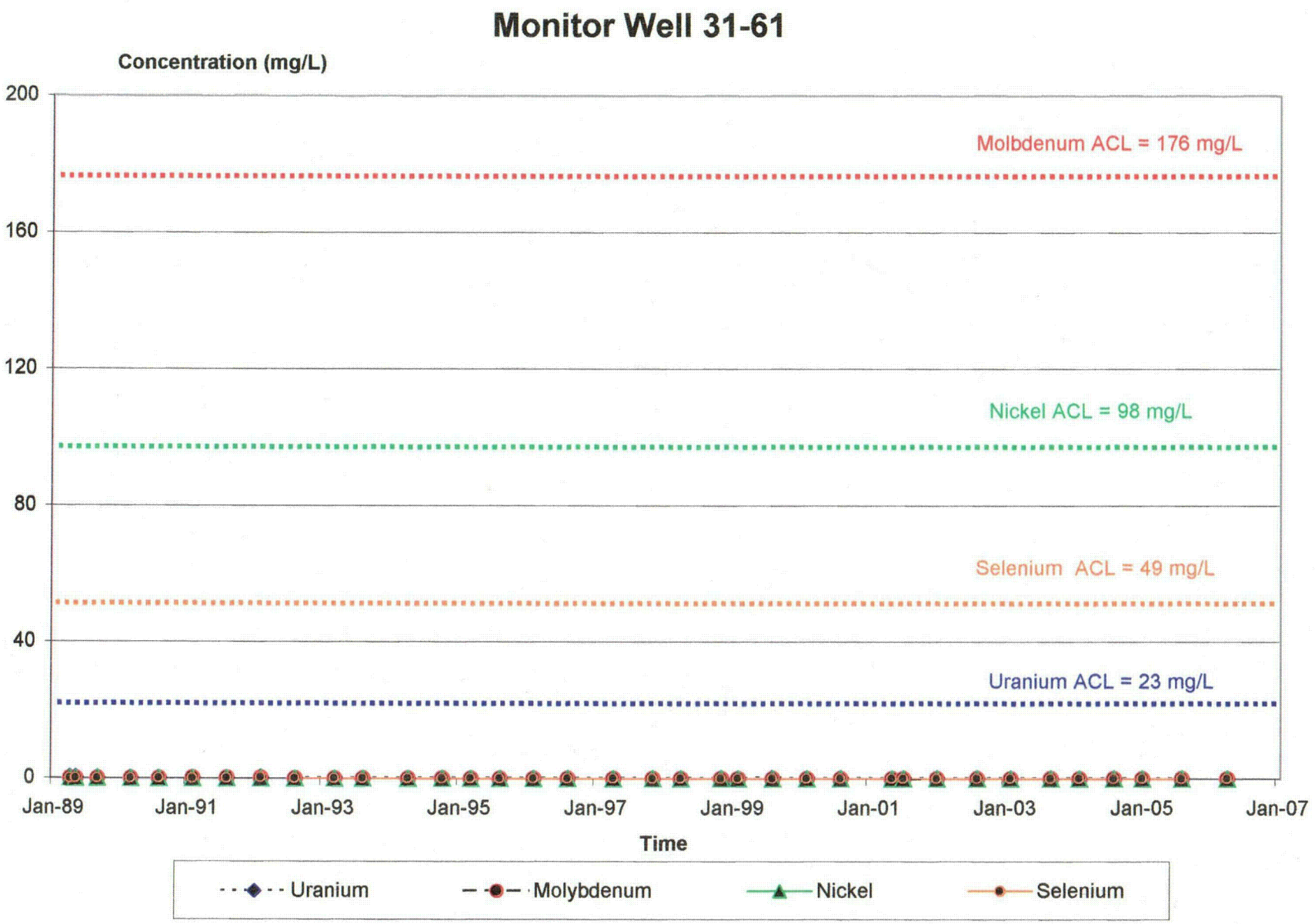

Monitor Well 5-73
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

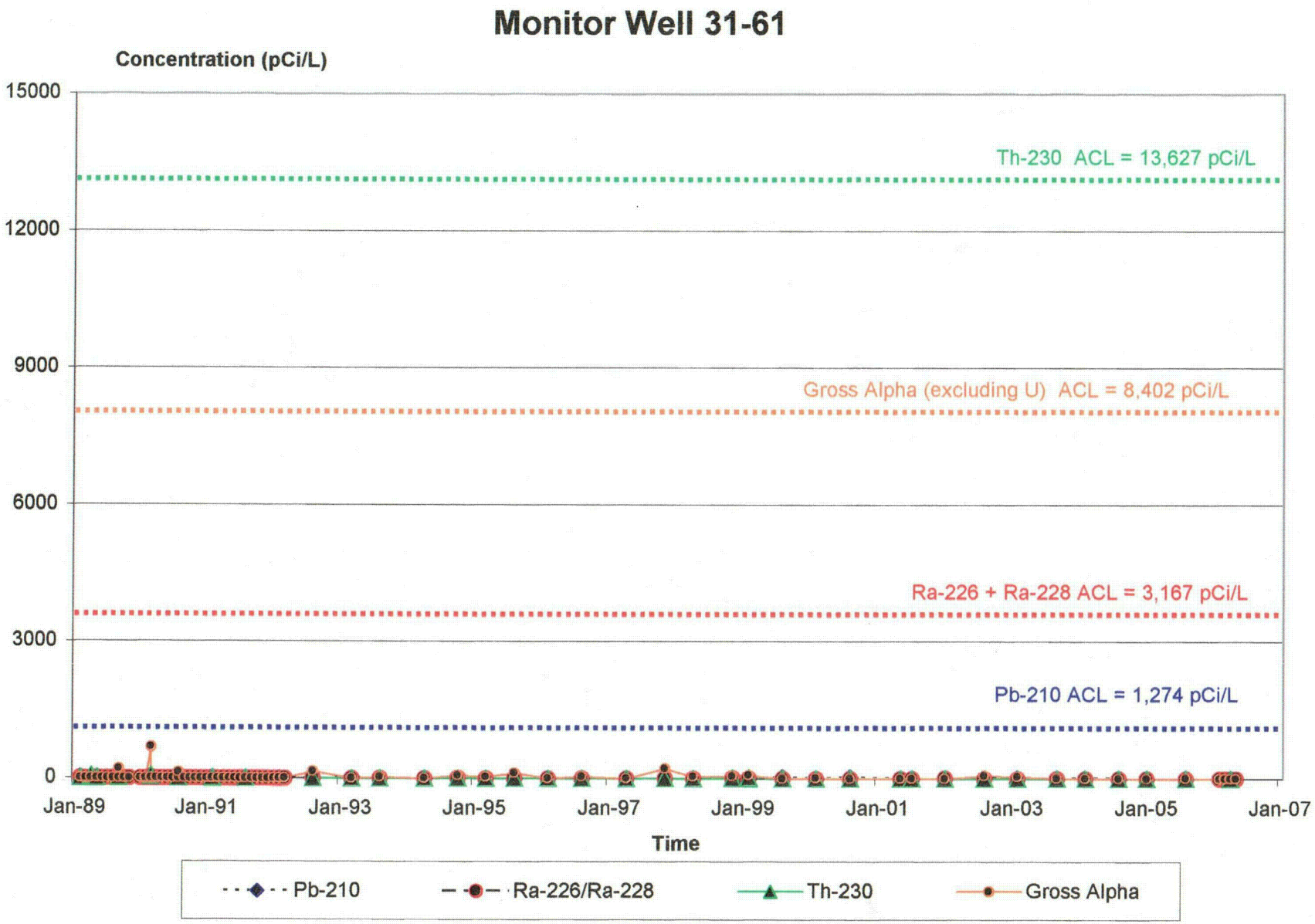

Monitor Well 5-73
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium


Monitor Well 5-73
Concentration (pCi/L)
15000
12000
9000
6000
3000
0
Th-230 ACL = 13,627 pCi/L
Gross Alpha (excluding U) ACL = 8,402 pCi/L
Ra-226 + Ra-228 ACL = 3,167 pCi/L
Pb-210 ACL = 1,274 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230
Gross Alpha

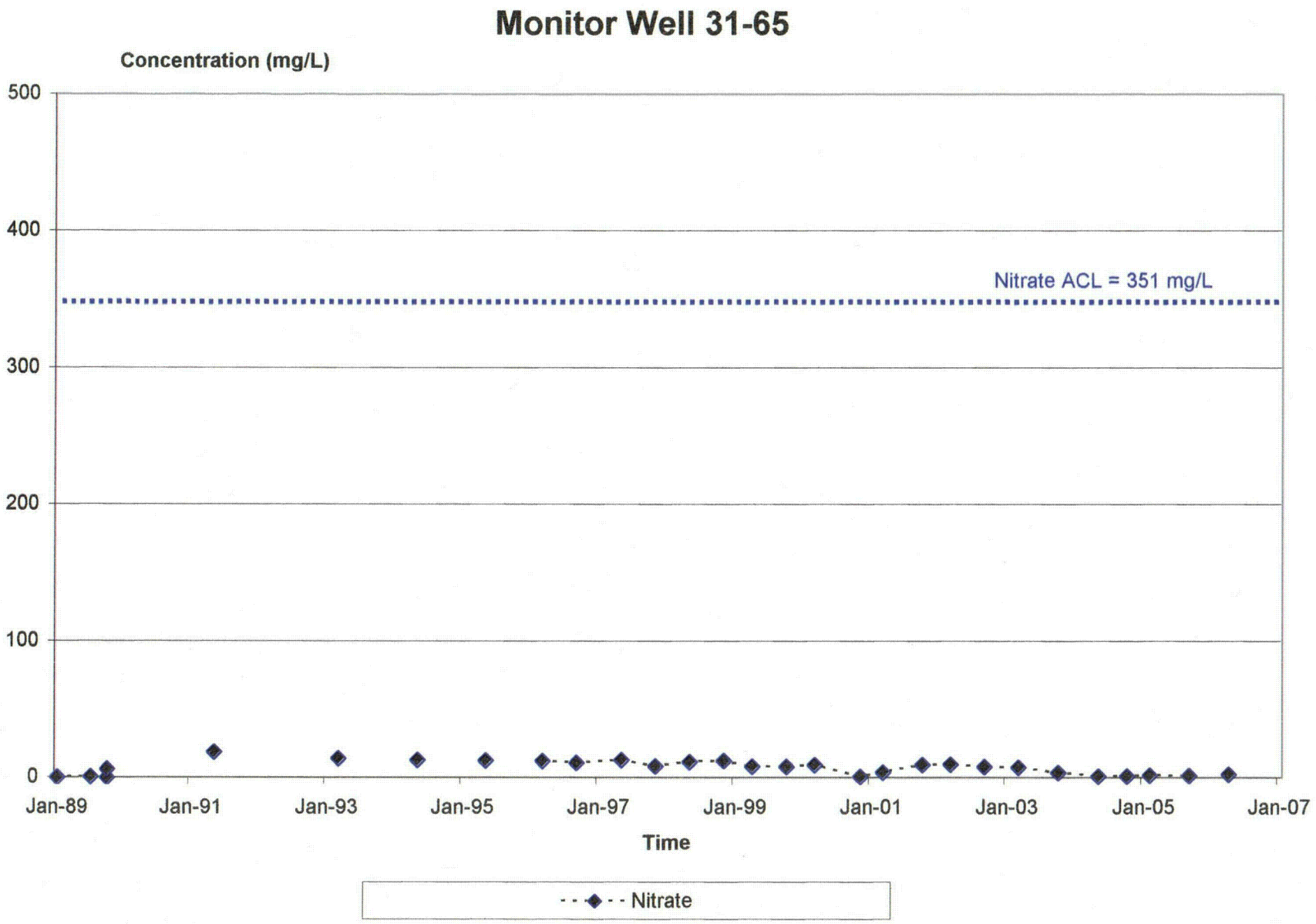

Monitor Well 31-61
Concentration (mg/L)
30000
25000
20000
15000
10000
5000
0
T.D.S. ACL = 26,100 mg/L
Sulfate ACL = 12,000 mg/L
Chloride ACL = 7,110 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

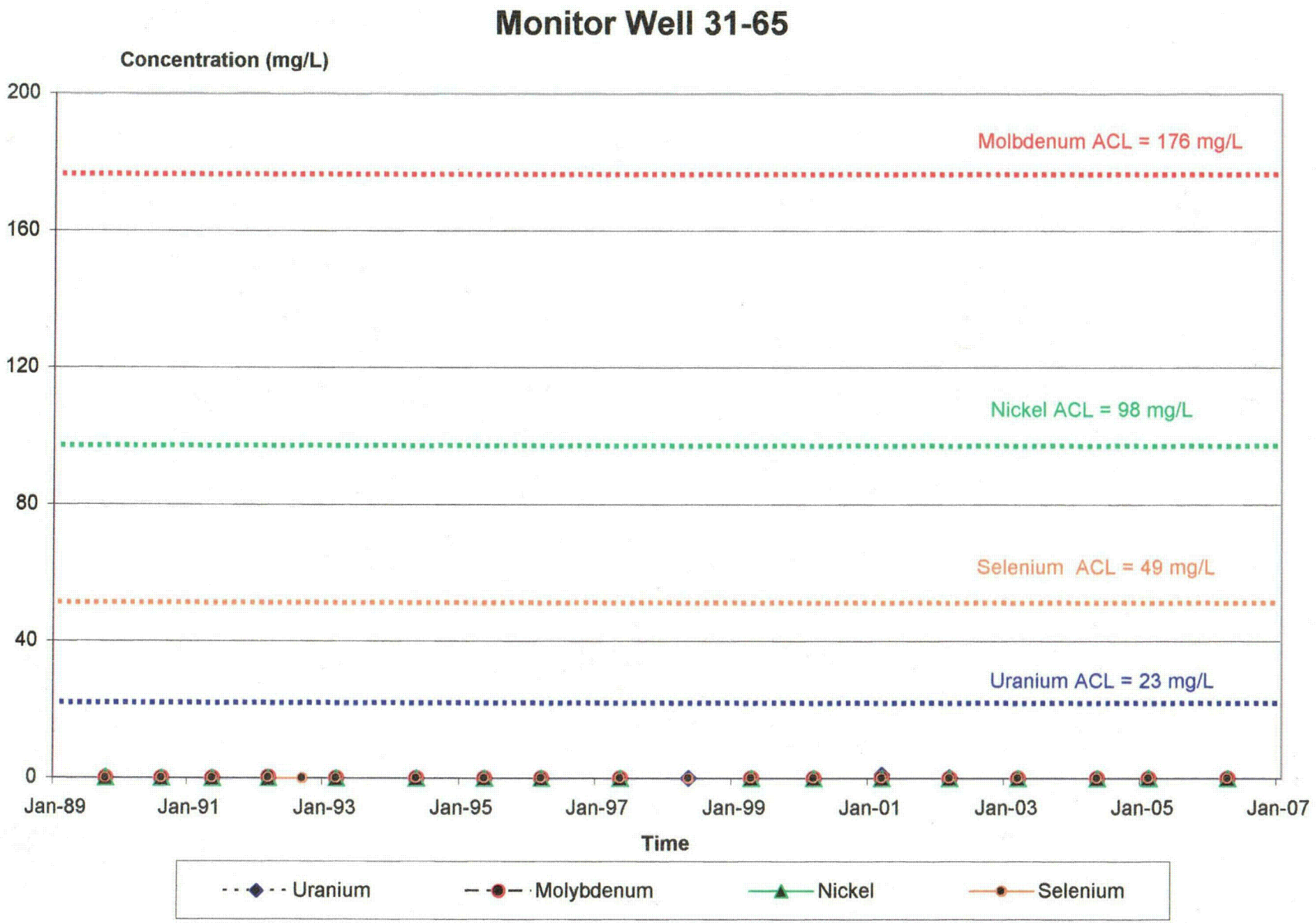

Monitor Well 31-61
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

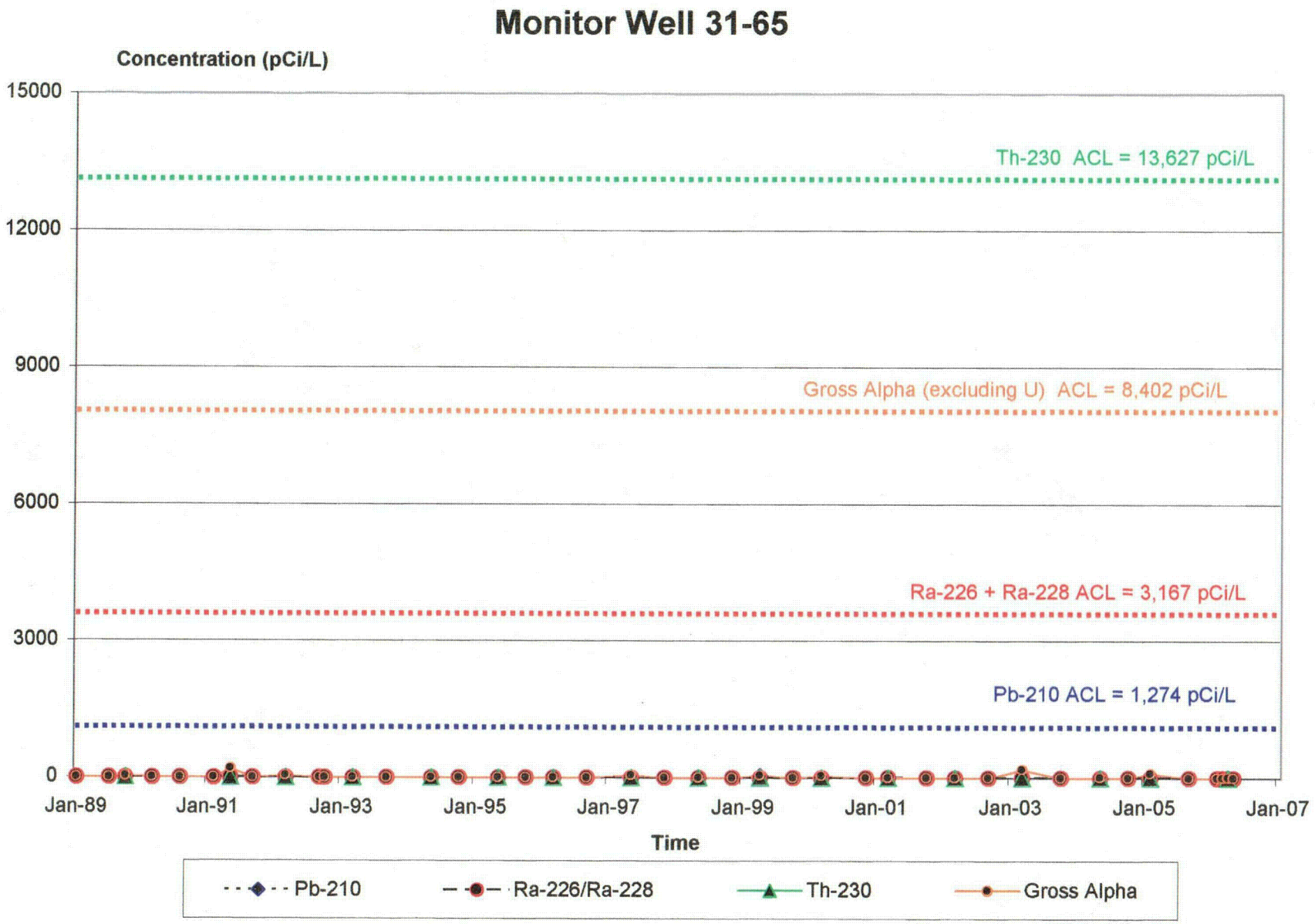

Monitor Well 31-61
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

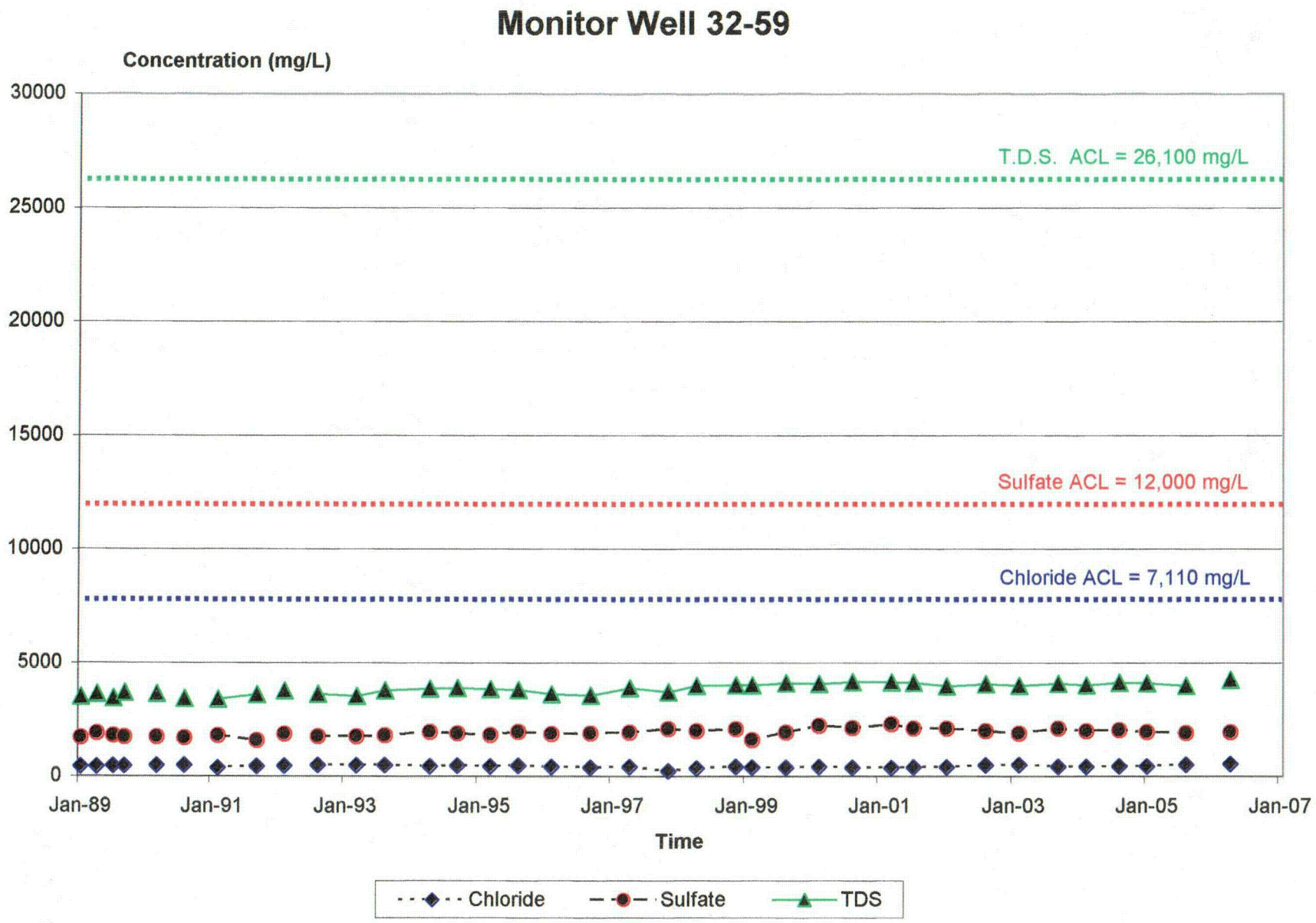

Monitor Well 31-61
Concentration (pCi/L)
15000
12000
9000
6000
3000
0
Th-230 ACL = 13,627 pCi/L
Gross Alpha (excluding U) ACL = 8,402 pCi/L
Ra-226 + Ra-228 ACL = 3,167 pCi/L
Pb-210 ACL = 1,274 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230
Gross Alpha

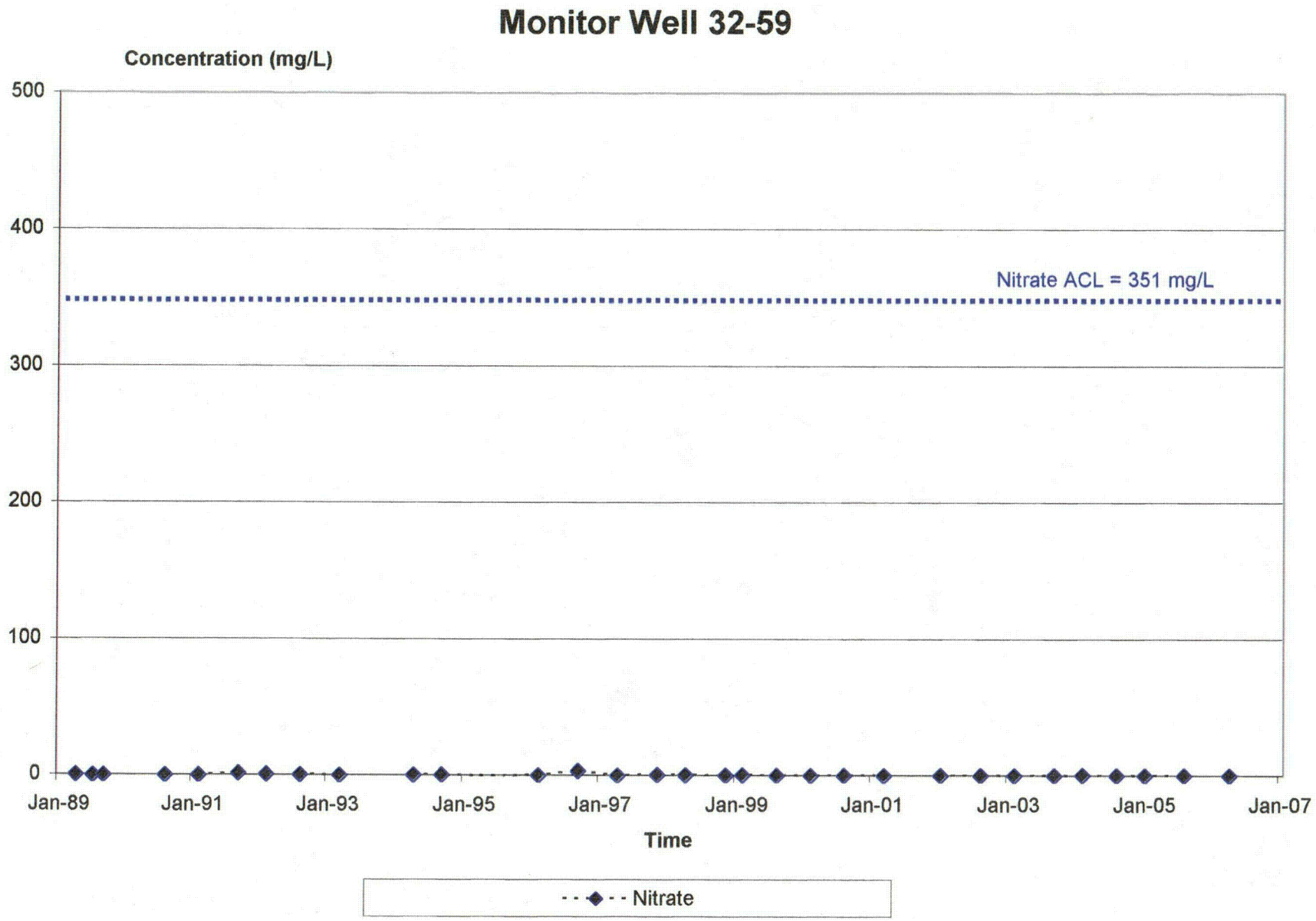
Monitor Well 31-65

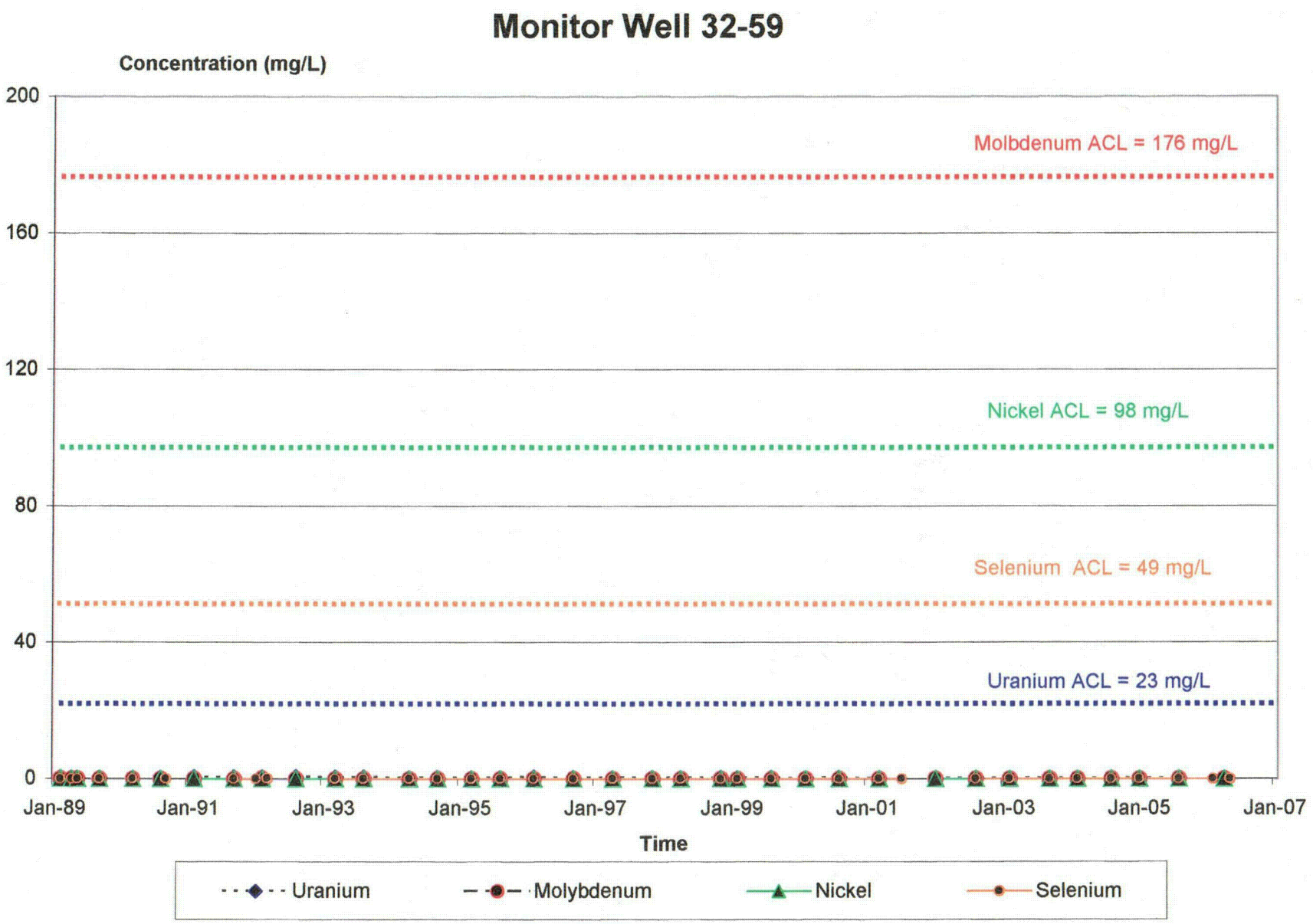

Monitor Well 31-65
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate


Monitor Well 31-65
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

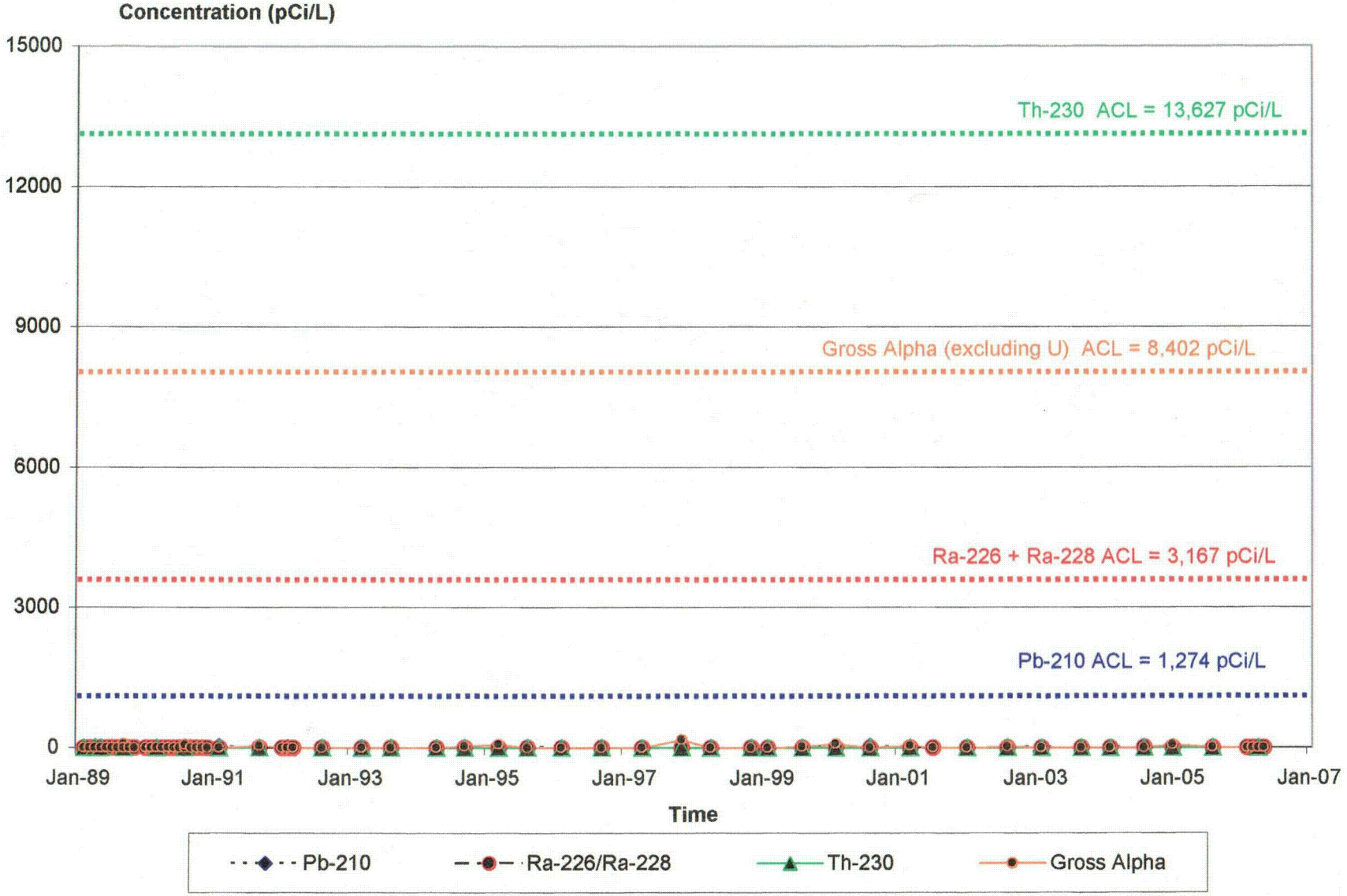

Monitor Well 31-65
Concentration (pCi/L)
15000
12000
9000
6000
3000
0
Th-230 ACL = 13,627 pCi/L
Gross Alpha (excluding U) ACL = 8,402 pCi/L
Ra-226 + Ra-228 ACL = 3,167 pCi/L
Pb-210 ACL = 1,274 pCi/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230
Gross Alpha

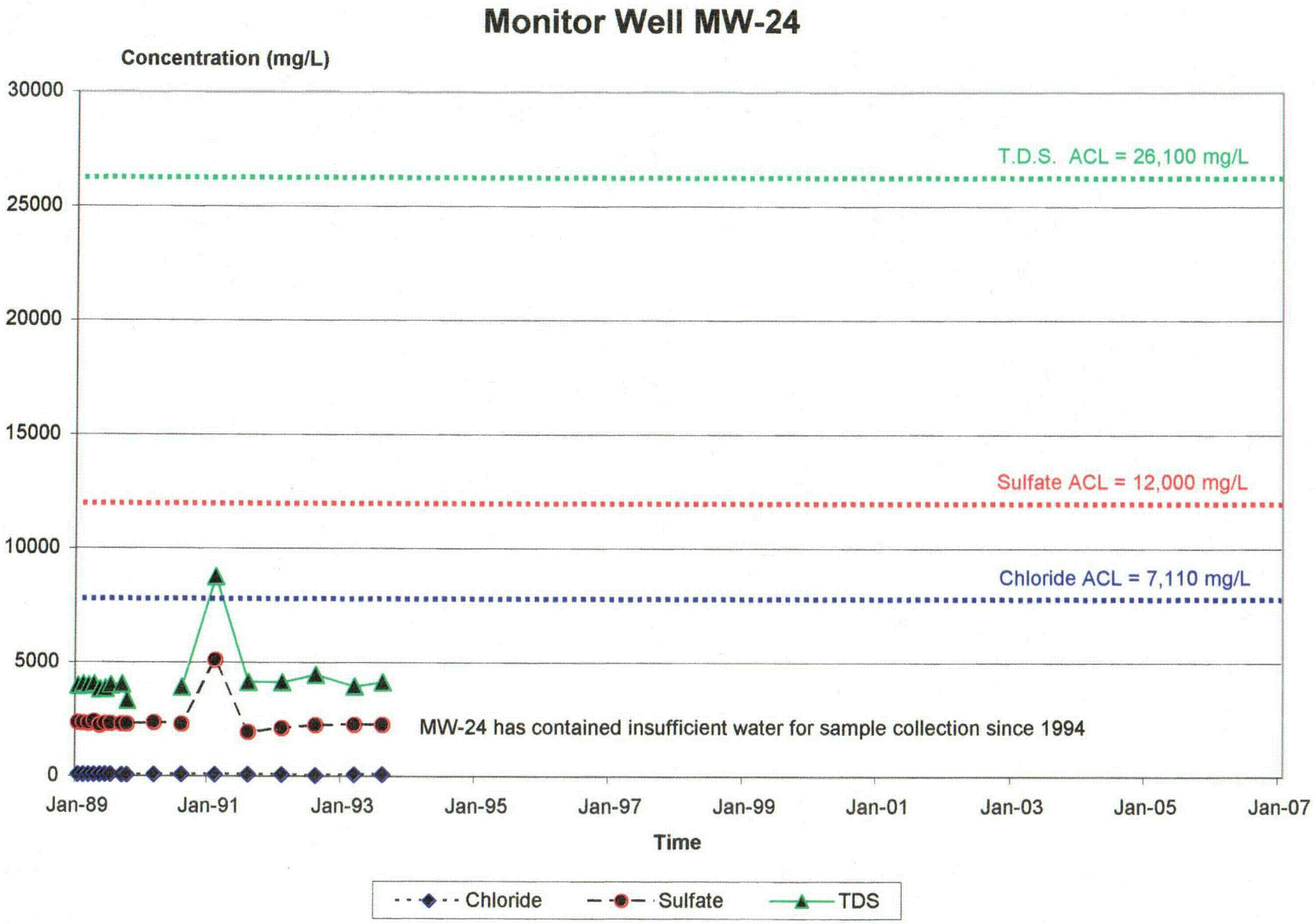

Monitor Well 32-59
Concentration (mg/L)
30000
25000
20000
15000
10000
5000
0
T.D.S. ACL = 26,100 mg/L
Sulfate ACL = 12,000 mg/L
Chloride ACL = 7,110 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS


Monitor Well 32-59
Concentration (mg/L)
500
400
300
200
100
0
Nitrate ACL = 351 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Nitrate

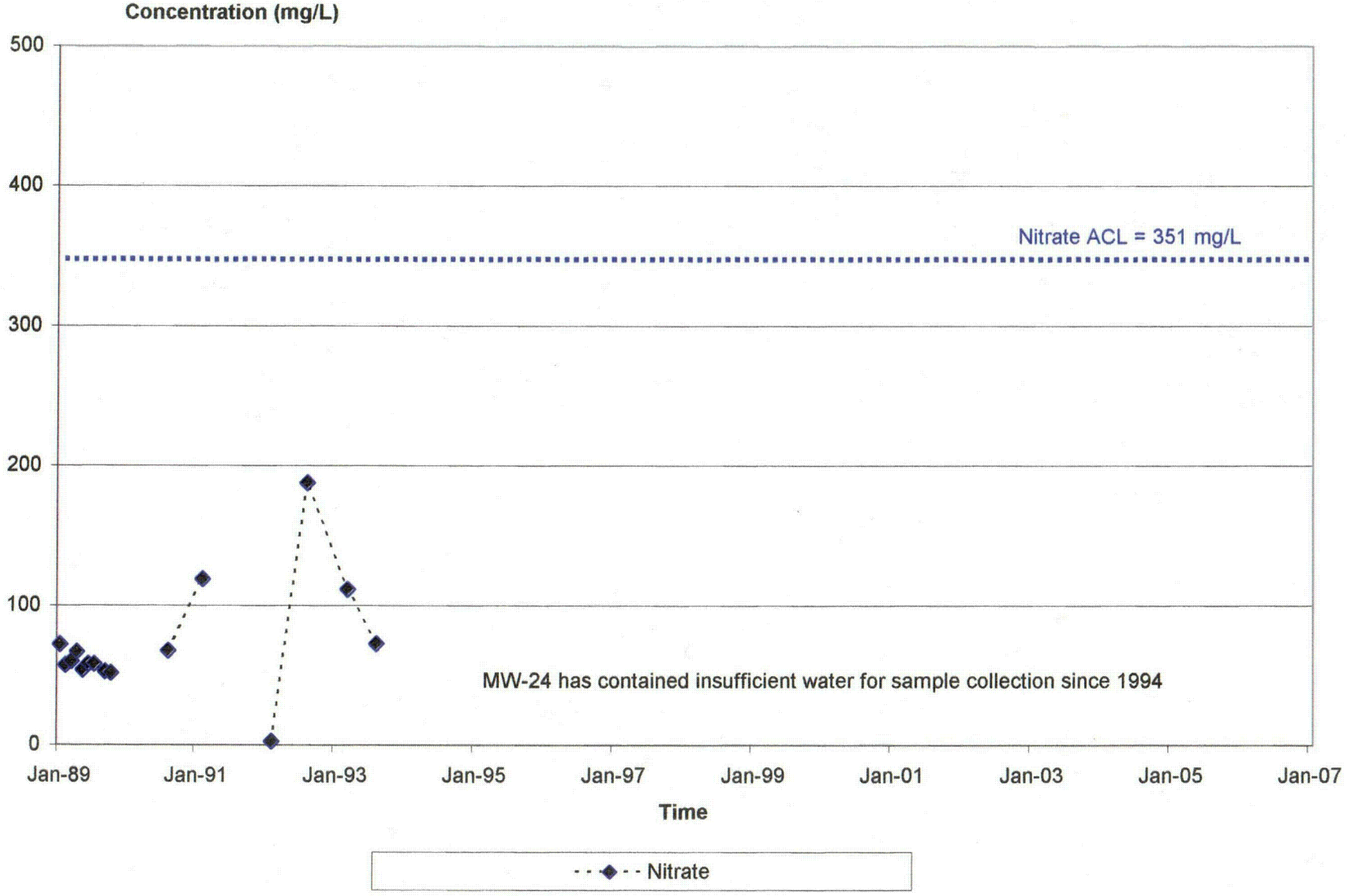

Monitor Well 32-59
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

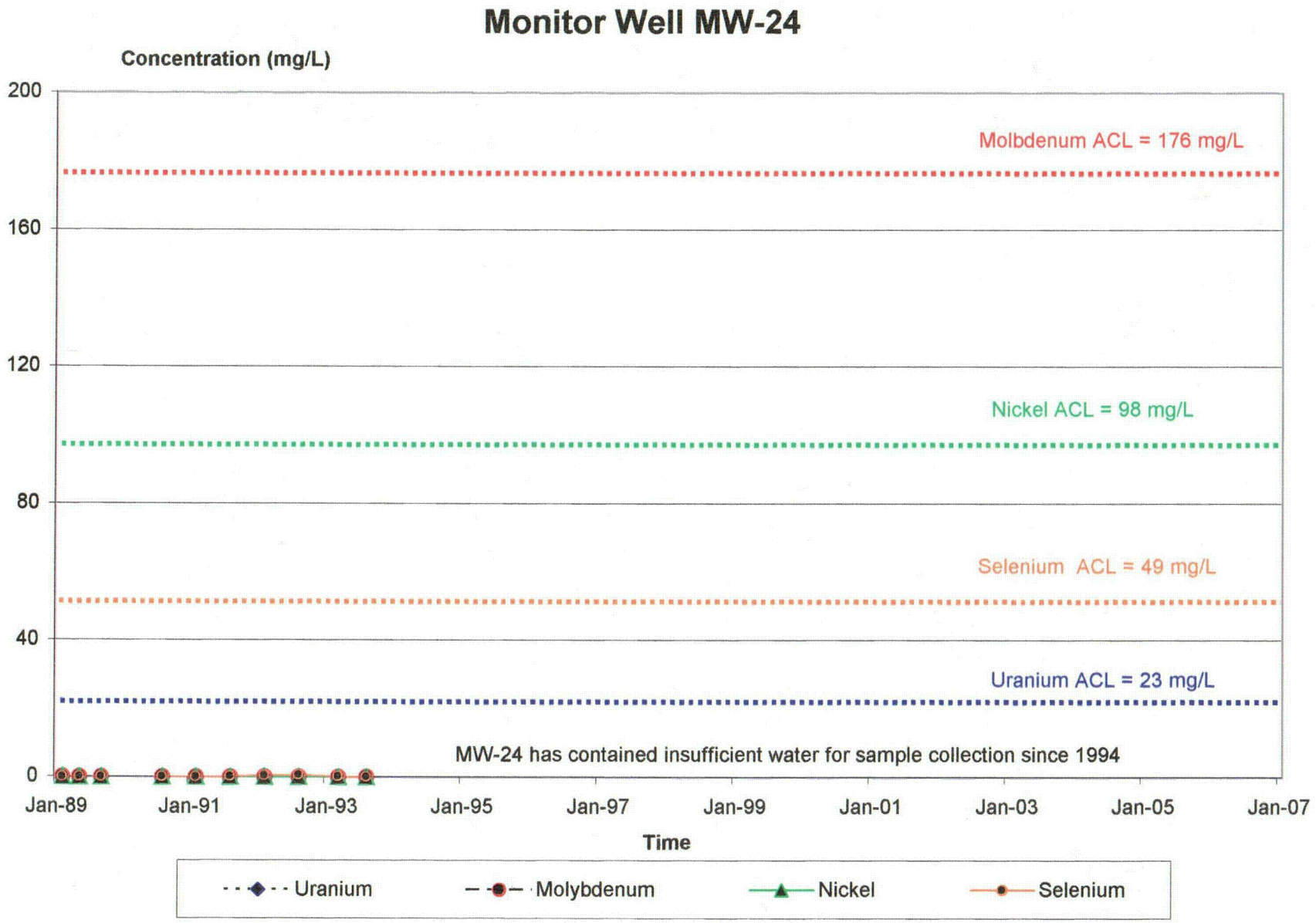
Monitor Well 32-59

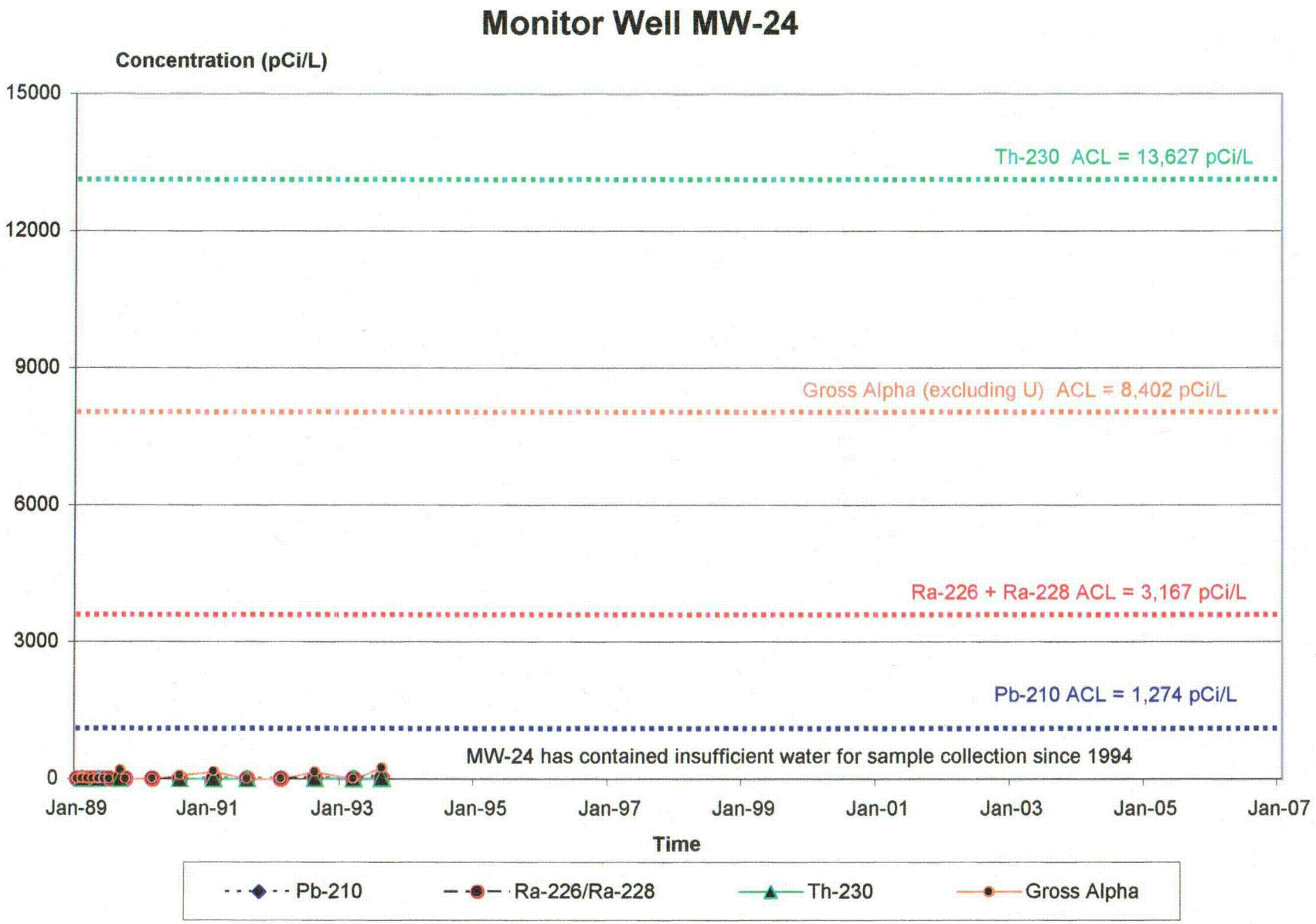



Monitor Well MW-24
Concentration (mg/L)
30000
25000
20000
15000
10000
5000
0
T.D.S. ACL = 26,100 mg/L
Sulfate ACL = 12,000 mg/L
Chloride ACL = 7,110 mg/L
MW-24 has contained insufficient water for sample collection since 1994
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Chloride
Sulfate
TDS

Monitor Well MW-24

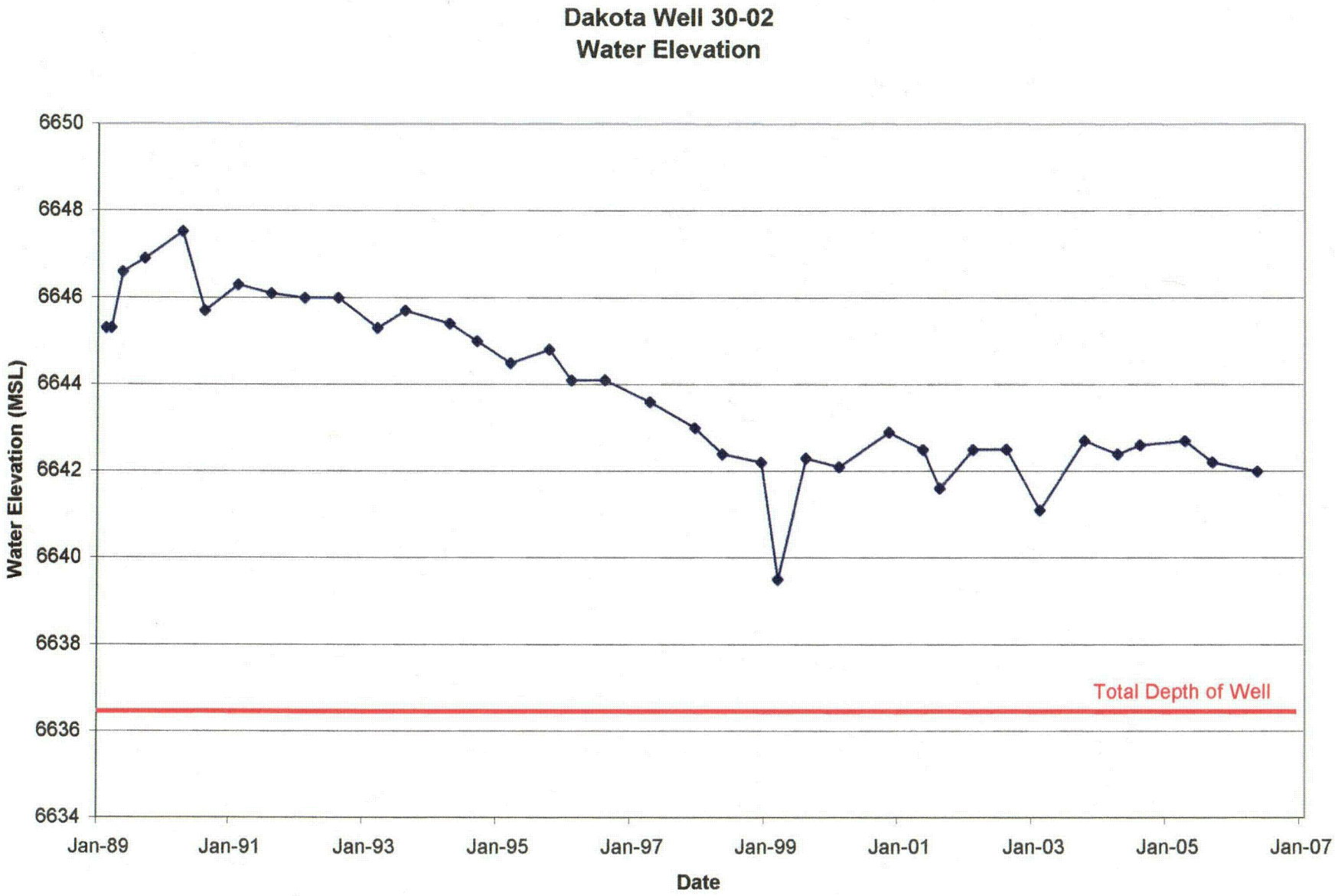


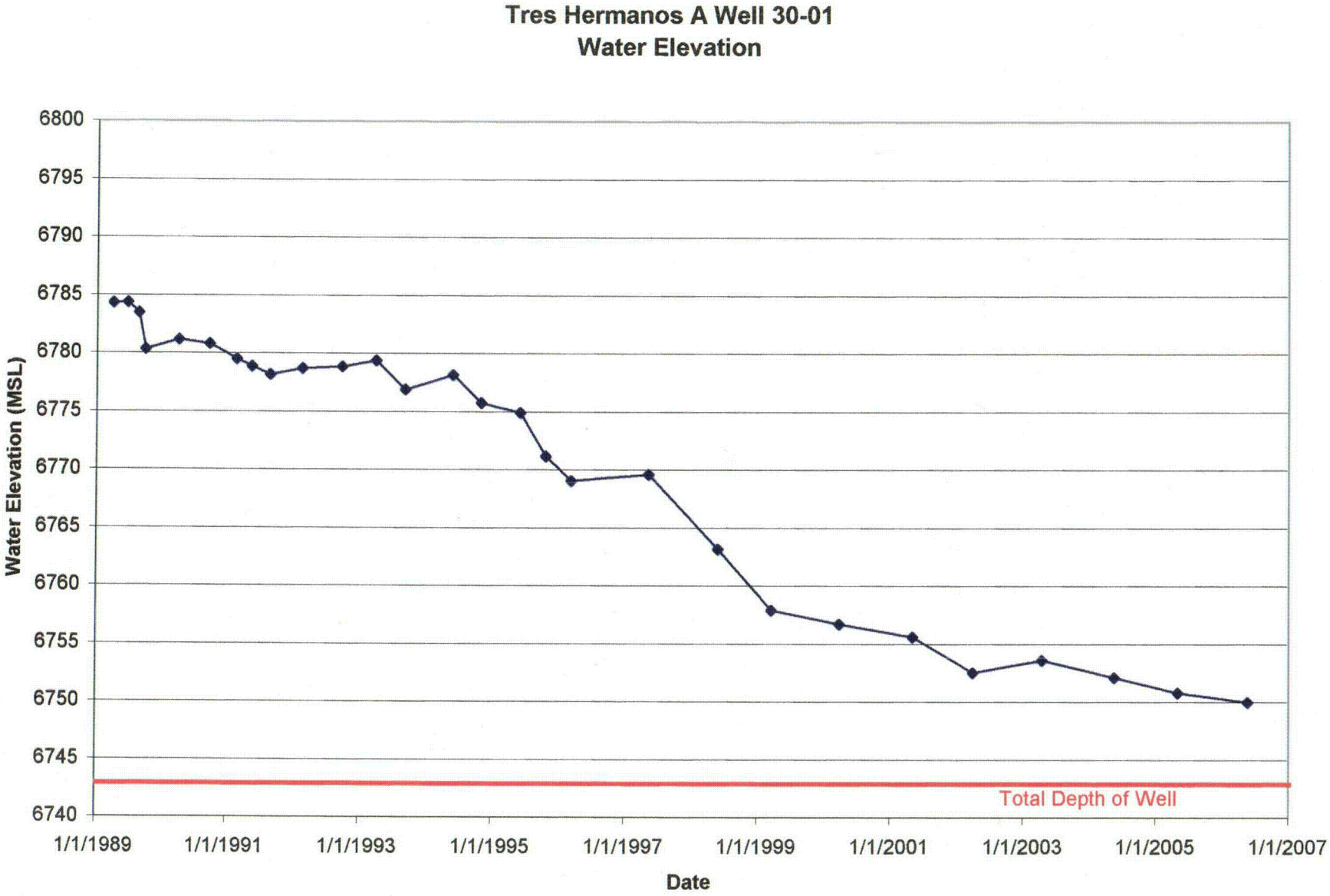

Monitor Well MW-24
Concentration (mg/L)
200
160
120
80
40
0
Molbdenum ACL = 176 mg/L
Nickel ACL = 98 mg/L
Selenium ACL = 49 mg/L
Uranium ACL = 23 mg/L
MW-24 has contained insufficient water for sample collection since 1994
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Uranium
Molybdenum
Nickel
Selenium

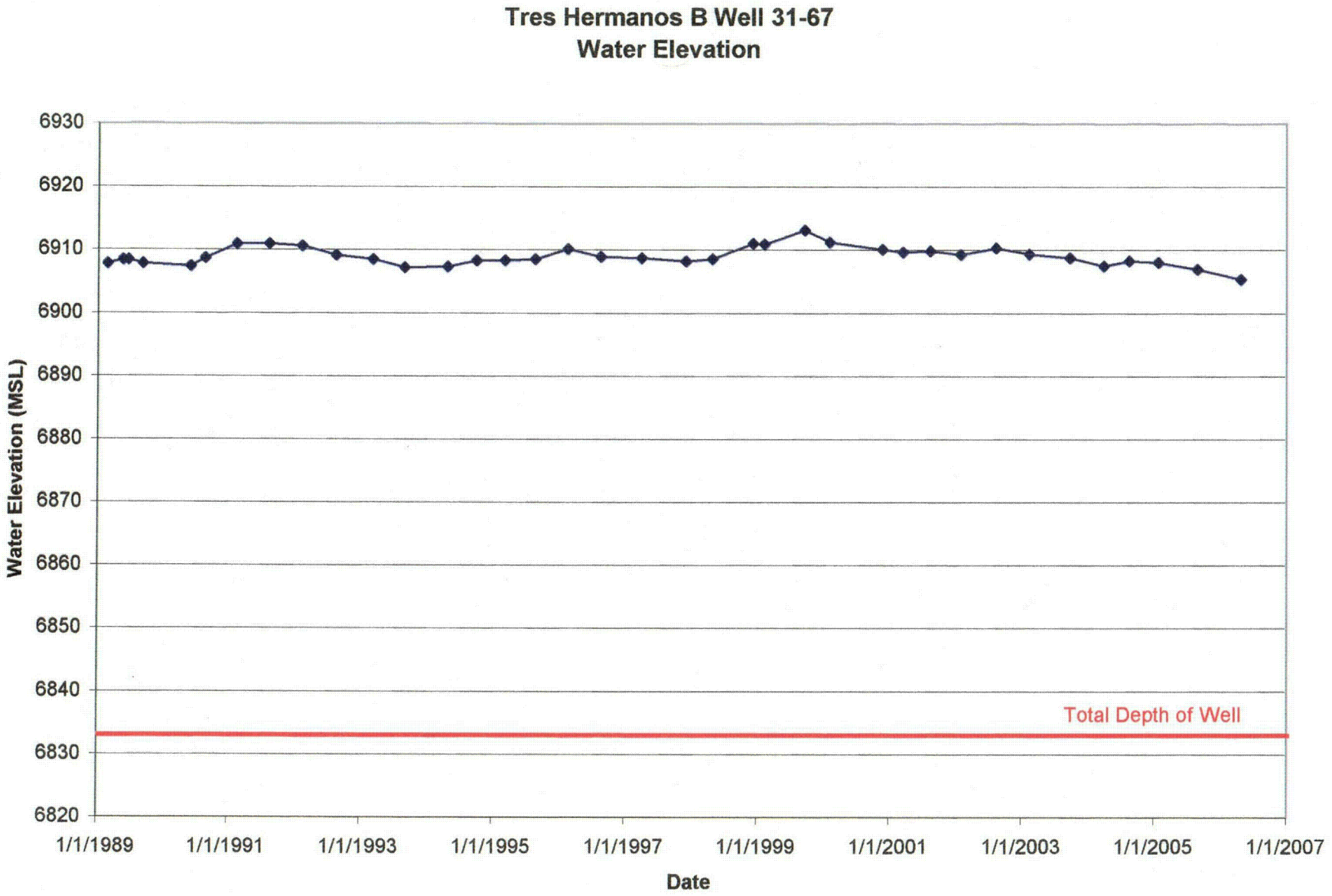

Monitor Well MW-24
Concentration (pCi/L)
15000
12000
9000
6000
3000
0
Th-230 ACL = 13,627 pCi/L
Gross Alpha (excluding U) ACL = 8,402 pCi/L
Ra-226 + Ra-228 ACL = 3,167 pCi/L
Pb-210 ACL = 1,274 pCi/L
MW-24 has contained insufficient water for sample collection since 1994
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Time
Pb-210
Ra-226/Ra-228
Th-230
Gross Alpha

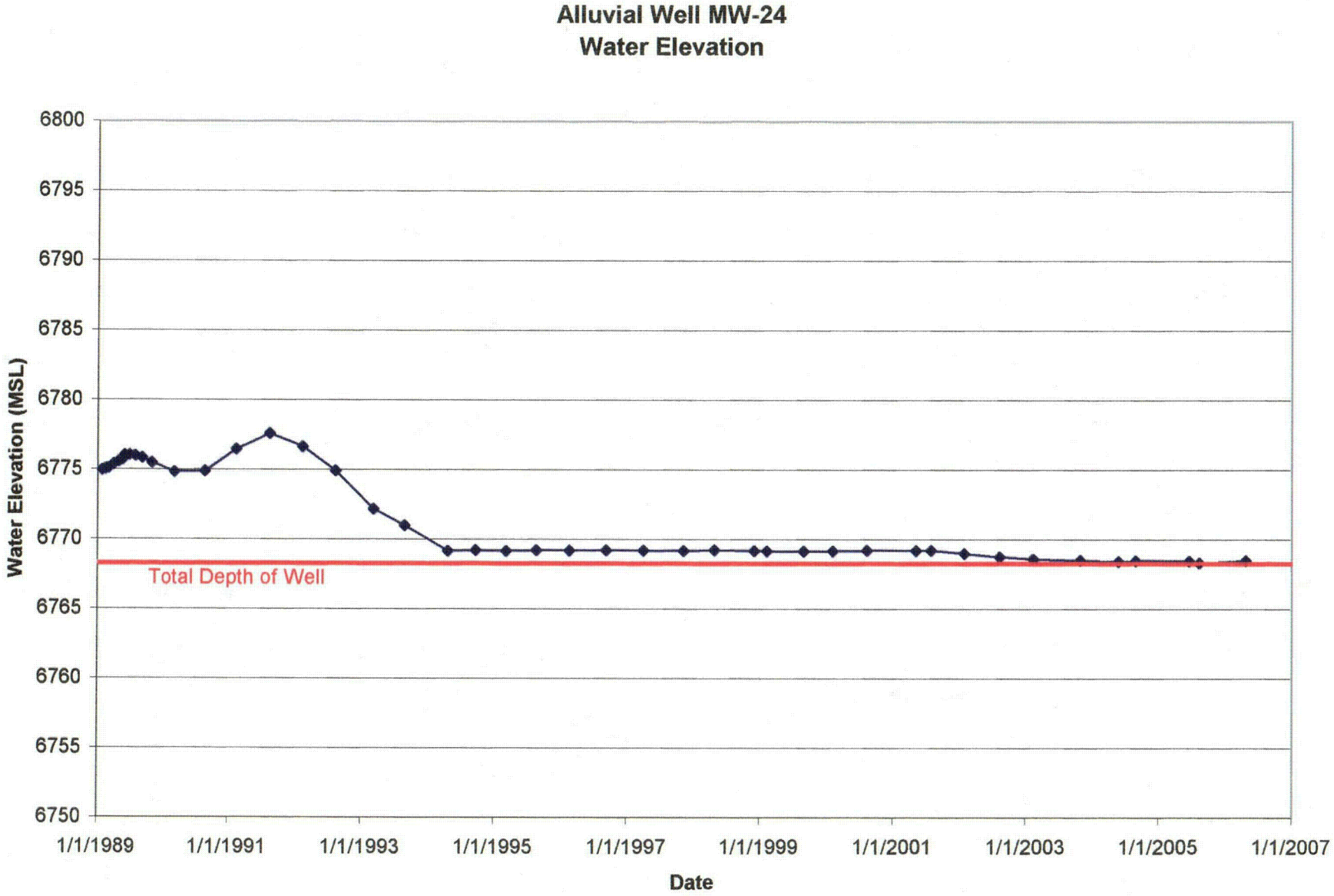
Appendix 3

Stability Monitoring Plan
Hydrographs


Dakota Well 30-02
Water Elevation
6650
6648
6646
6644
6642
6640
6638
6636
6634
Water Elevation (MSL)
Total Depth of Well
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Date

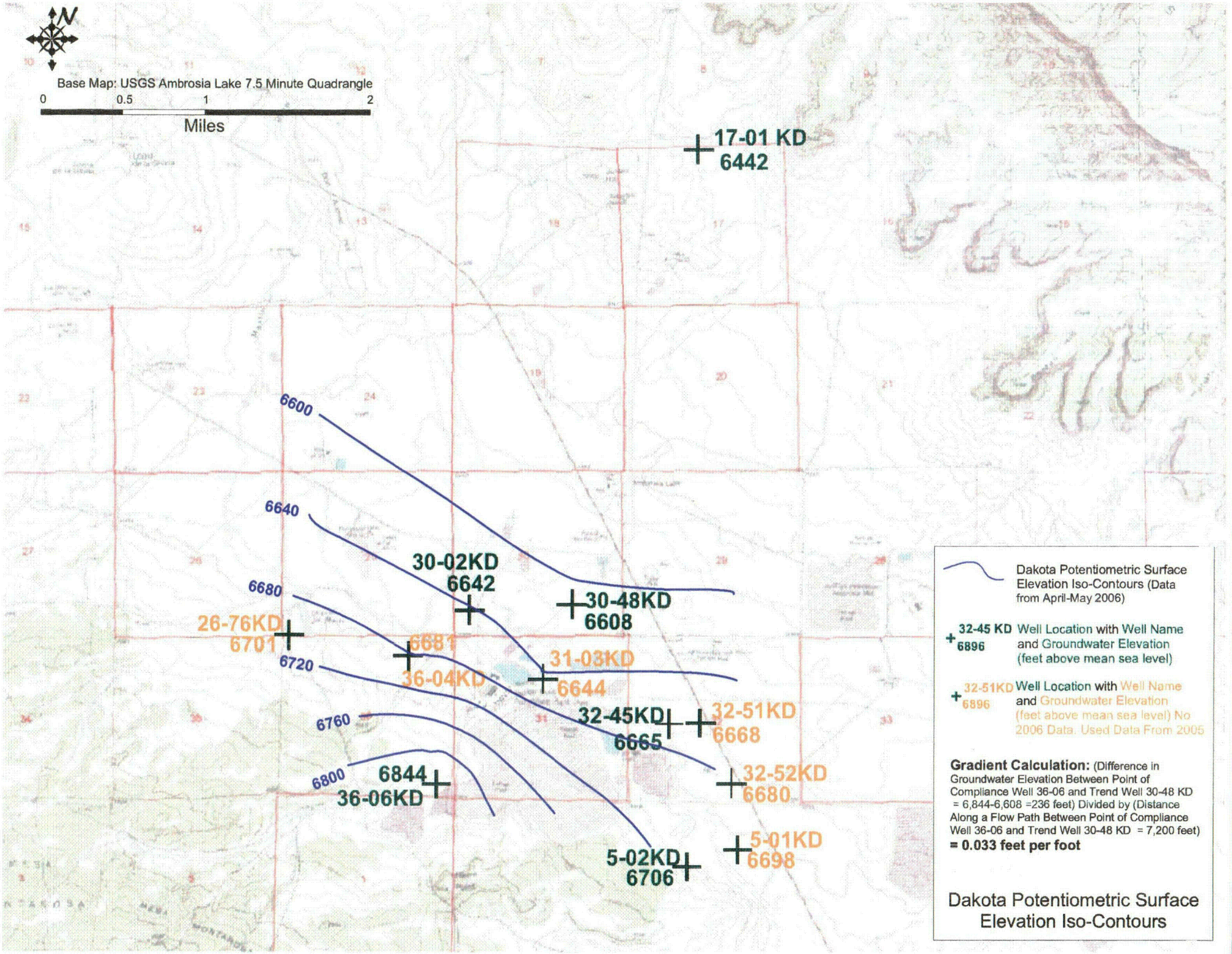

Tres Hermanos A Well 30-01
Water Elevation
6800
6795
6790
6785
6780
6775
6770
6765
6760
6755
6750
6745
6740
Water Elevation (MSL)
Total Depth of Well
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
Date

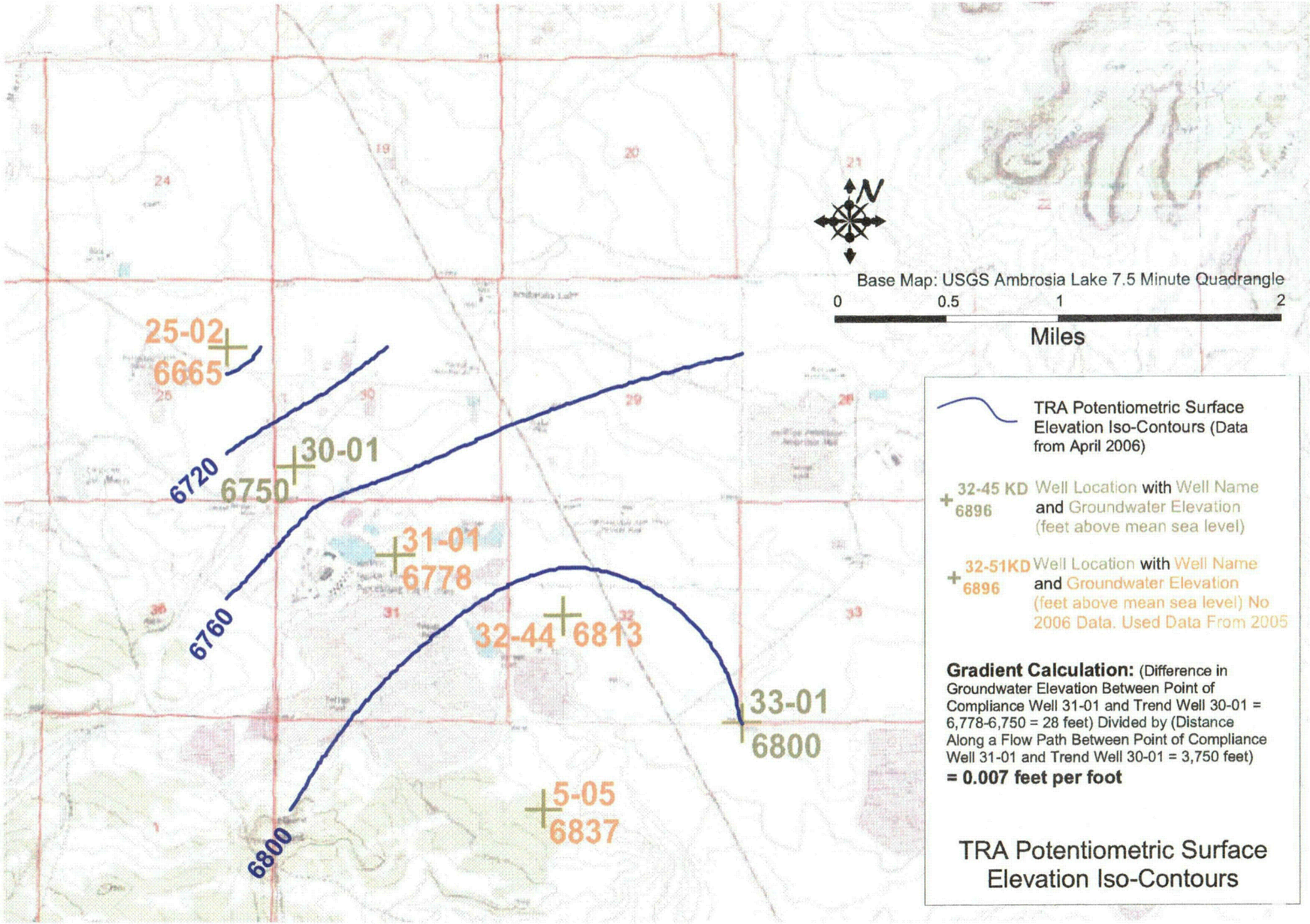

Tres Hermanos B Well 31-67
Water Elevation
Water Elevation (MSL)
6930
6920
6910
6900
6890
6880
6870
6860
6850
6840
6830
6820
Total Depth of Well
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
Date

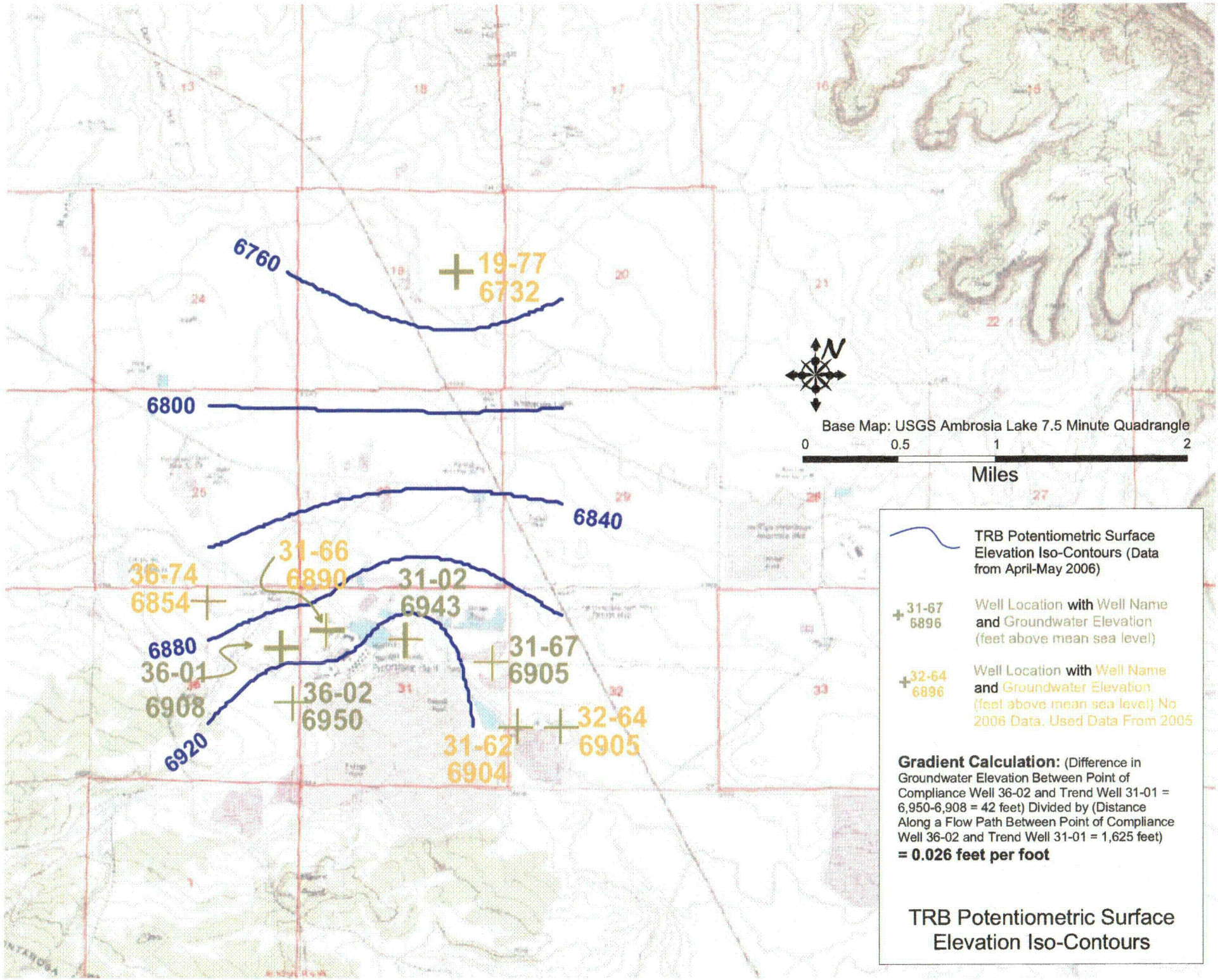

Alluvial Well MW-24
Water Elevation
6800
6795
6790
6785
6780
6775
6770
6765
6760
6755
6750
Water Elevation (MSL)
Total Depth of Well
1/1/1989
1/1/1991
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
Date

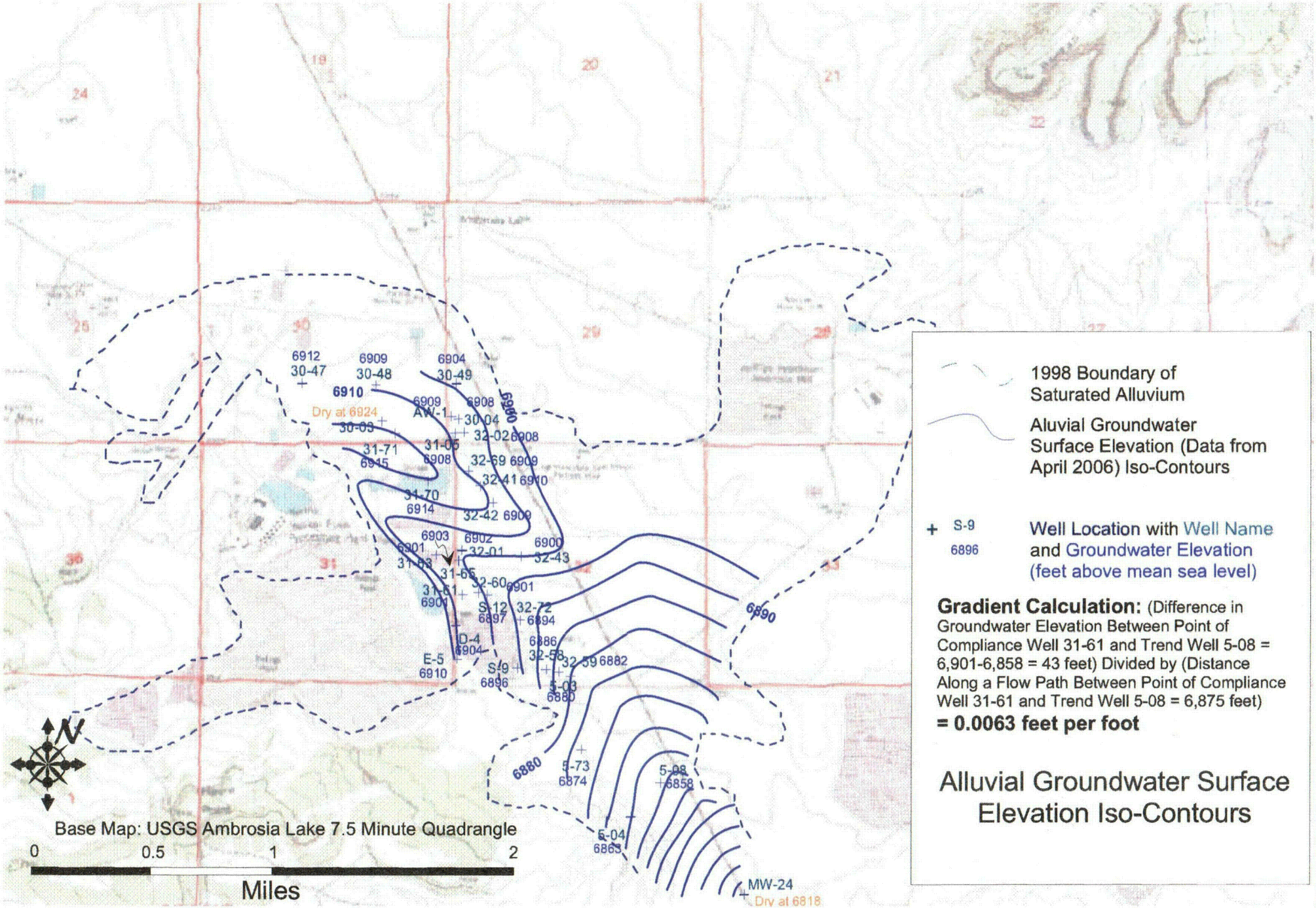
Appendix 4

Stability Monitoring Plan
Potentiometric Surface Maps


N
Base Map: USGS Ambrosia Lake 7.5 Minute Quadrangle
0
0.5
1
2
Miles
17-01 KD
6442
6600
6640
30-02KD
6642
30-48KD
6608
6680
26-76KD
6701
6681
36-04KD
31-03KD
6644
6720
6760
32-45KD
6665
32-51KD
6668
6800
6844
36-06KD
32-52KD
6680
5-01KD
6698
5-02KD
6706
Dakota Potentiometric Surface Elevation Iso-Contours (Data from April-May 2006)
32-45 KD
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level)
32-51KD
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level) No 2006 Data. Used Data From 2005
Gradient Calculation: (Difference in Groundwater Elevation Between Point of Compliance Well 36-06 and Trend Well 30-48 KD = 6,844-6,608 =236 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well 36-06 and Trend Well 30-48 KD = 7,200 feet)
= 0.033 feet per foot
Dakota Potentiometric Surface Elevation Iso-Contours


N
Base Map: USGS Ambrosia Lake 7.5 Minute Quadrangle
0
0.5
1
2
Miles
25-02
6665
30-01
6750
6720
31-01
6778
6760
32-44
6813
33-01
6800
5-05
6837
6800
TRA Potentiometric Surface Elevation Iso-Contours (Data from April 2006)
32-45 KD
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level)
32-51KD
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level) No 2006 Data. Used Data From 2005
Gradient Calculation: (Difference in Groundwater Elevation Between Point of Compliance Well 31-01 and Trend Well 30-01 = 6,778-6,750 = 28 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well 31-01 and Trend Well 30-01 = 3,750 feet)
= 0.007 feet per foot
TRA Potentiometric Surface Elevation Iso-Contours


6760
19-77
6732
6800
6840
31-66
6890
36-74
6854
31-02
6943
6880
36-01
6908
31-67
6905
36-02
6950
32-64
6905
31-62
6904
6920
N
Base Map: USGS Ambrosia Lake 7.5 Minute Quadrangle
0
0.5
1
2
Miles
TRB Potentiometric Surface Elevation Iso-Contours (Data from April-May 2006)
31-67
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level)
32-64
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level) No 2006 Data. Used Data From 2005
Gradient Calculation: (Difference in Groundwater Elevation Between Point of Compliance Well 36-02 and Trend Well 31-01 = 6,950-6,908 = 42 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well 36-02 and Trend Well 31-01 = 1,625 feet)
= 0.026 feet per foot
TRB Potentiometric Surface Elevation Iso-Contours


6912
30-47
6909
30-48
6904
30-49
6910
Dry at 6924
6909
AW-1
6908
30-04
30-03
32-02 6908
31-71
6915
31-05
6908
32-69 6909
32-41 6910
31-70
6914
32-42 6909
6903
6902
6901
32-01
6900
32-43
31-63
31-65
32-60
6901
31-61
6901
S-12
6897
32-72
6894
D-4
6904
6886
32-58
E-5
6910
S-9
6896
32-59 6882
5-03
6880
6890
6880
5-73
6874
5-08
6858
5-04
6863
MW-24
Dry at 6818
N
Base Map: USGS Ambrosia Lake 7.5 Minute Quadrangle
0
0.5
1
2
Miles
1998 Boundary of Saturated Alluvium
Aluvial Groundwater Surface Elevation (Data from April 2006) Iso-Contours
S-9
6896
Well Location with Well Name and Groundwater Elevation (feet above mean sea level)
Gradient Calculation: (Difference in Groundwater Elevation Between Point of Compliance Well 31-61 and Trend Well 5-08 = 6,901-6,858 = 43 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well 31-61 and Trend Well 5-08 = 6,875 feet)
= 0.0063 feet per foot
Alluvial Groundwater Surface Elevation Iso-Contours

Appendix 5

Stability Monitoring Plan
Technical Memorandum - Beryllium

6000 Uptown Blvd. NE
Suite.100
Albuquerque, NM, 87110

MEMORANDUM

DATE: Tuesday, July 11, 2006

TO: Peter Luthiger

FROM: Dan Erskine

SUBJECT: Technical Assessment of Beryllium Concentrations in Monitor Well 36-06 that Exceed License Requirements

---

When the initial Bedrock Alternate Concentration Limits (ACL) Petition was submitted in February 2000, beryllium (Be) concentrations had been below detection for several years, virtually eliminating this element as a constituent of concern (COC). However, recently Be concentrations in groundwater samples from monitor well 36-06 have risen above the license specified groundwater protection limit. This memo is in response to your request to try and identify causes of the increase in Be concentrations and to predict any future trends in those concentrations.

In May of 2001, during the extended review of the initial ACL document, an ACL Petition for the more extensive and problematic alluvial system was submitted. Over the next several years, NRC focused attention on the alluvial system with a number of requests for additional information (RAI) that included a request for justification of the choice of natural uranium (Unat) as the most mobile constituent of concern in the bedrock units. Choice of the most mobile constituent to model attenuation of constituents of concern ensures that model results are conservative and therefore protective of human health and the environment.

Rio Algom was able to successfully defend the choice of Unat as the most mobile COC by citing published studies of fate and transport differences between uranium and other metal COCs, and then demonstrating that those differences in behavior could explain the distribution of COCs in groundwater at the Rio Algom site. In terms of fate and transport behavior, most metal COCs, including Unat and Be are most mobile in acidic (low pH) solutions.

As solutions become more neutral most metal COCs attenuate. This behavior can be explained by the predominance of positively charged species in low pH groundwater. Acidity leading to low pH is simply and abundance of hydronium ions (H_3O^+, or more commonly, H^+) in solution. Most metals, including Be, are present in solution as cations, which are positively charged. At low pH, competition for negatively charged adsorption surfaces allows metals to move freely. As pH increases, positively charged cations are increasingly adsorbed. Generally, metal COCs are essentially completely adsorbed by the time that groundwater has risen to a pH of between 4 and 5 (Brookins, 1988).

Uranium behavior differs from that of most metal COCs in that it is sensitive to oxidation-reduction (redox) conditions. Under reducing conditions it is almost completely immobile in groundwater as a uranium oxide (UO_2). When it encounters oxidizing conditions it is oxidized to uranyl ion

(UO_2^{+2}), a cation whose mobility is enhanced at low pH like most other metal COCs. However, as pH rises, uranyl ion tends to form complexes with carbonate and sulfate ions among others, giving the overall complex an anionic (negatively charged) character. Anions tend to be more mobile than cations as groundwater pH increases. Be does not display the redox behavior exhibited by uranium and is present in groundwater as a cation (Brookins, 1988). Therefore, Be is less mobile than uranium.

In spite of redox behavior that enhances its mobility over that of other metal COCs, uranium is strongly attenuated in groundwater at the Rio Algom site. The NRC has concurred with Rio Algom's demonstration of uranium and metal COCs at the site. A good summary of the discussion between NRC and Rio Algom can be found in the following excerpt from Rio Algoms final response to NRC's last RAI.

Finding 3 – *An incorrect modeling method, resulting in overestimation of the attenuating capacity (i.e. underestimation of attenuation factor), was used for establishing an attenuation factor for the bedrock aquifers. The licensee should revise the modeling method and propose a new set of ACL's. The retardation factor employed in bedrock modeling is acceptable.*

Response – In the technical meeting, Rio Algom agreed to address the modeling issues raised by the Center if there was merit to performing the additional work. The approach discussed in that meeting included the following:

a. It was agreed amongst the attendees at the meeting that a significant geochemical change that is described as a pH change occurs between the actual source (Pond #7 and #8) and the Dakota POC (well 36-06 Kd). The difference of opinion centers on whether the geochemical change between the source and POC, thus, potential impacts at the POC, can/should be limited to a discrete period of 22 years due to the 22 years of unlined pond use, or whether, additional dispersion resulting from the travel distance of 800 feet should extend the timeframe for the active source in modelruns. Rio Algom agrees that the potential for additional dispersion over a longer time frame, theoretically, may exist, but does not believe that, given the site-specific conditions and the proposed institutional controls (i.e., distance to the LTSM boundary (i.e., POEs)), that the groundwater concentrations at the POEs will be exceeded using Rio Algom's proposed ACLs.

b. One approach discussed which the Center was to perform the SOLUTE model between the source and the POC. Using the data generated at the POC, Rio Algom would run the SOLUTE model using the accepted retardation factors between the POC and the proposed POE well (36-04 Kd for the Dakota). Rio Algom suggested that, if such modeling were to be performed, rather than using that proposed POE, the POE should be modeled at what will be the actual institutional control boundary (i.e., the true POE).

c. However, Rio Algom is reluctant to undertake this additional modeling, because any potential benefits to the protection of human health or the environment appear to be minimal. The attendees at the meeting agreed to defer this issue to the meeting with NRC management.

d. In discussions with NRC management Rio Algom noted that 36-06 Kd and the other POC wells have been monitored since the ACL application was submitted in early 2000. During that time, significant closure activities occurred at or near the source areas (Ponds 7 and 8) resulting in a minor spike in COCs at the POC well

> 36-06 Kd, located 800 feet from the source. However, these levels are well below the proposed ACLs (see Figure 1 attached). The spike trended upward for a period of time as expected and, recently, that trend has leveled and is expected to decline. Discussions are summarized by NRC staff in the following paragraph. "Based on information from Rio Algom regarding the modeling of the bedrock aquifer, Rio Algom, NRC management and NRC staff concluded that the uncertainties noted by the NRC staff can be addressed if Rio Algom can demonstrate that the concentrations at the current Point of Compliance (POC) groundwater well are leveling off. Rio Algom stated that the actual POC concentration for constituents are well below the assumed [modeled] concentration and that the trend in the data showed the concentrations to be leveling off. The NRC agreed that if the data could definitively show that the constituent concentration trend was not upward but flat, then it would consider this result as a conservative parameter when addressing uncertainties with the current model. Figure 1 shows uranium concentrations in POC well 36-06 leveling off after rising over several sampling rounds following source disturbance during remedial activities. Note that while uranium concentrations are leveling off, pH values continue to rise, increasing uranium retardation. Thus, the model using the accepted retardation factor adequately predicts impacts of the geochemical environment on the transport of COCs to the POE proposed in the ACLs application, much less the amended POE, which will be 2,700 feet farther away from the POC.

Data collected since this discussion took place confirms the conclusions and indicates that, like other metal COCs, Be will not pose a hazard to human health or the environment. Figure 2 displays groundwater concentration data for monitor well 36-06, including data that has been collected since Figure 1 was developed. Figure 2 also includes a plot of Be concentrations that indicates a strong sensitivity to pH. In fact, the time concentration variability displayed in the Be plot is almost identical that displayed by the Unat plot.

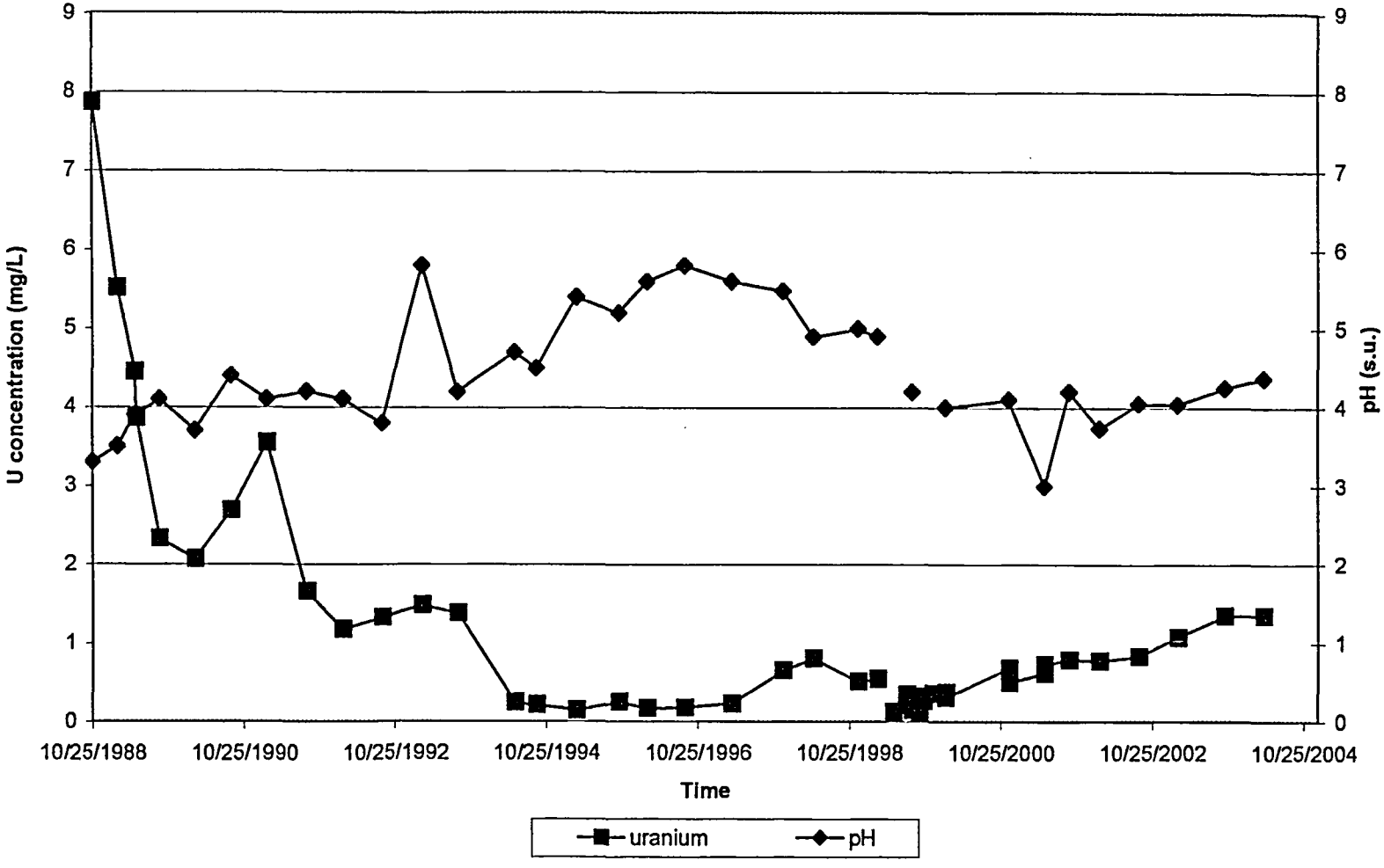
Because all groundwater concentration data is noisy (i.e. contains random variability due to measurement inconsistencies, instrument limitations, etc.), the covariance of Be with pH may be somewhat obscured. One way to screen out the noise is to use moving average trend analysis. A moving average series can be calculated for any time series, and are used to smooth out short-term fluctuations, thus highlighting longer-term trends or cycles. The threshold between short-term and long-term depends on the application, and the parameters of the moving average will be set accordingly. In the case of Be and pH concentrations in monitor well 36-06, a three period moving average can screen out most seasonal fluctuations and sampling noise effects (Figure 3) allowing a more robust comparison of trend variation.

Note that as the pH trend rises steadily from the late 1980's to the late 1990's, the Be trend falls at a steady rate during the same period, reflecting the period that ponds 7 and 8 were no longer being used. The trend pH peak of near 5.5 in 1997 is followed by a decline to a trend low of near 3.5 in 2001, reflecting the expulsion of water from pond sediments during reclamation of the surface. The Be trend remained relatively flat after the pH rose to between 4 and 5, but rose sharply again once the pH trend fell below about 4.5. Finally, once the slug of low pH water expelled during reclamation dissipated in 2002 – 2003, and the pH trend rose above 4, the Be trend began falling sharply.

This analysis supports the initial conclusion that increasing trends in monitor well 36-06 were related to the loading of ponds 7 and 8 water expelled from sediments during the reclamation process. Data collected in the two years since the last investigation has been consistent with our argument at the time,

and running average trend analysis using the enlarged data set demonstrates the strong relationship between rising pH and attenuation of COC metals. This new data clearly indicates that Be concentrations in groundwater present in samples from monitor well 36-06 will not pose a hazard to human health or the environment.

Figure 1. Monitor Well 36-06KD
NRC POC Well for Dakota Formation



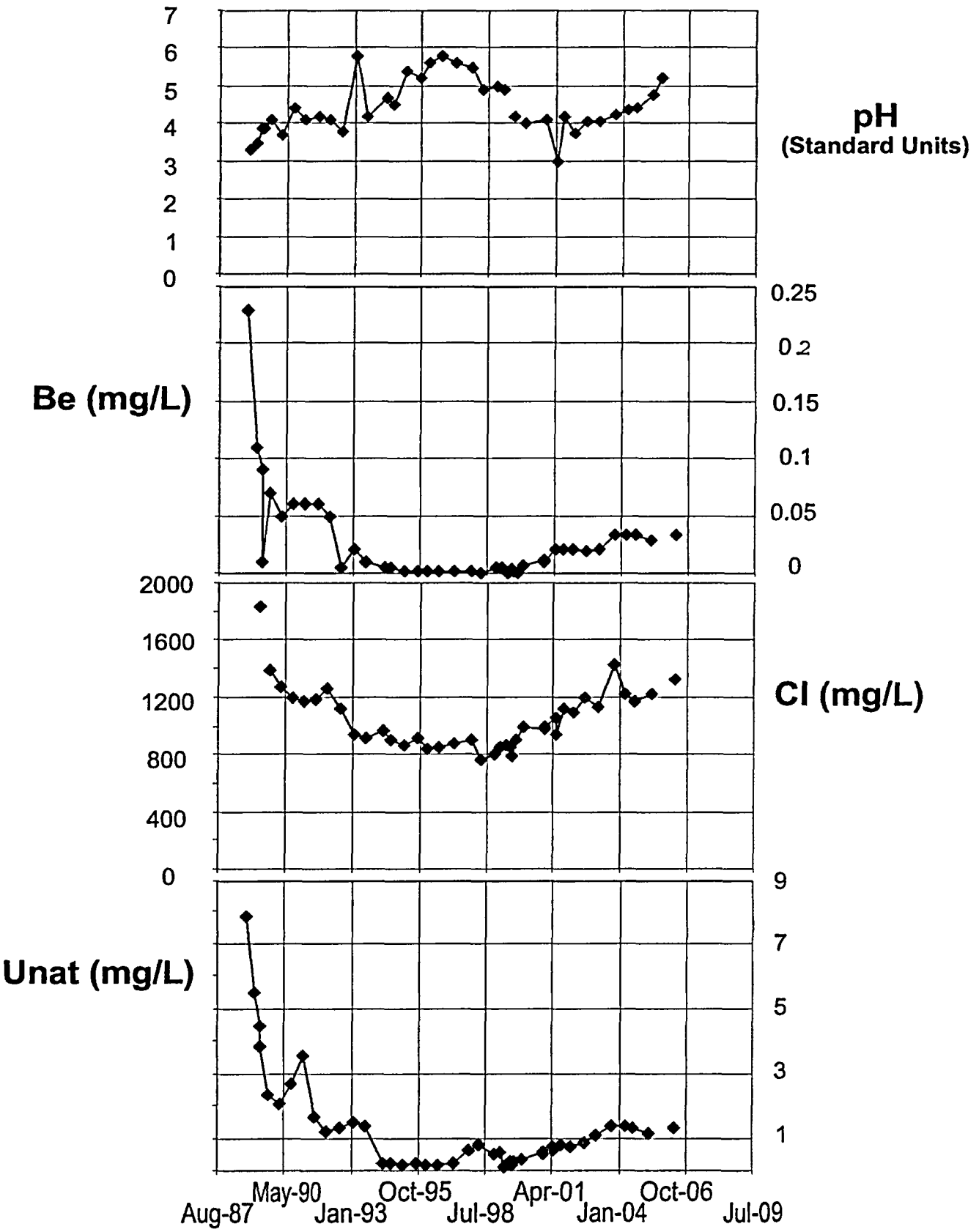


Figure 2. Concentrations of constituents in samples of groundwater from monitor well 36-06KD comparing the trends in concentration over time. Note that beryllium and Unat exhibit a remarkably similar variability with time.

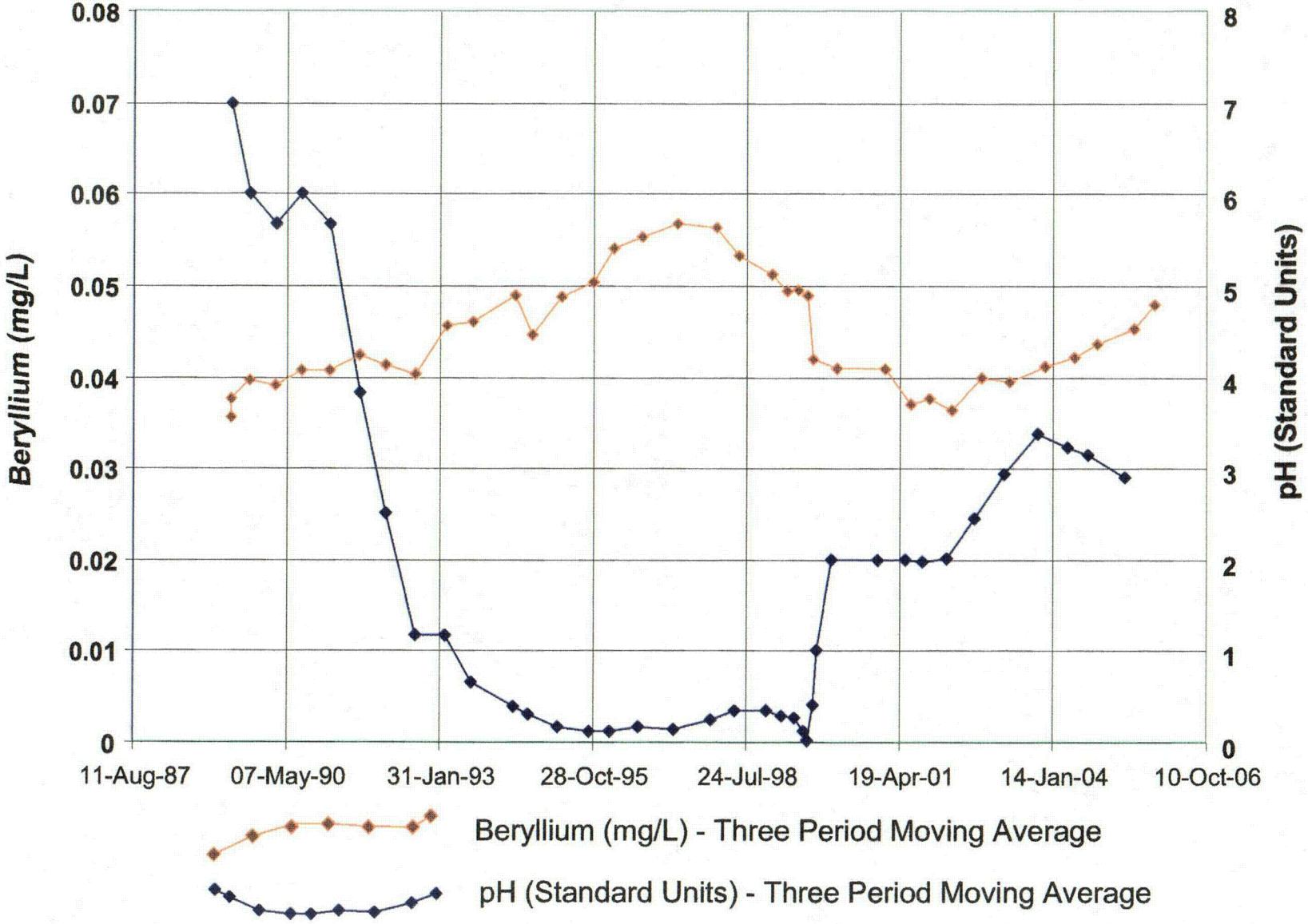


Figure 3. Three period moving average analysis displaying the covariance of beryllium and pH concentrations over time.