SECTION 8

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GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT

FIGURES

TABLES

8.0 SAN ANDRES AQUIFER MONITORING

The San Andres aquifer is the most important regional aquifer in the Grants Project area. The Chinle Formation, which exists between the alluvium and the San Andres, is approximately 800 feet thick at the Homestake tailings site and is primarily a shale with a few sandstone lenses. Therefore, the alluvial aquifer and the San Andres aquifer are separated by a very thick aquitard. The difference in piezometric head between the alluvial and San Andres aquifers is in the range of 80 to 100 feet, which confirms that the flow between the two systems is restricted by the limited permeability of the Chinle Formation. The San Andres and alluvial aquifers are only in direct contact in the western portion of the area presented on Figure 8.0-1 (see magenta pattern area). With no areas of direct communication within the area where the alluvial aquifer is impacted by tailings seepage, and only very limited hydraulic communication through the Chinle shale, the San Andres aquifer is not affected by tailings seepage. The San Andres aquifer has been used as the source for fresh-water injection into the alluvium and Chinle aquifers at the Grants Project, and as a result, a monitoring program was established for the San Andres aquifer.

Table 8.0-1 presents well completion information for the San Andres wells in this area. Homestake's two deep wells within the project area are San Andres wells, #1 Deep and #2 Deep. These wells are used to supply the fresh-water injection systems within the collection area. San Andres well 951 is used as the fresh-water injection supply for the injection system in Sections 28 and 29 while San Andres well 943 is used as the fresh water injection supply for the injection system in Section 3 and Felice Acres. Figure 8.0-1 shows the locations of the San Andres wells relevant to this area. Recharge to the San Andres aquifer occurs mainly west of the area shown in the figure and in the far western portion of the figure. The structure of the San Andres aquifer dips to the east, and thus the ground water system becomes progressively deeper in the easterly direction. The water-level elevations measured during 2004 (Figure 8.0-1) show a very flat piezometric surface with the gradient being from the west-northwest to the east-southeast. The continuity of the gradient in this area indicates that the East and West faults do not significantly affect the ground water flow in the San Andres aquifer. The displacement at the faults is not large enough to completely displace the entire thickness of this aquifer system. The increase in gradient in the project area also indicates a decrease in transmissivity in the area of

the steeper gradient. The faults may cause a decrease in the transmitting ability of the San Andres aquifer in this area.

Figure 8.0-2 presents the most recent water-quality data for the San Andres aquifer. Tables B.6-1 and B.6-2 in Appendix B present the tabulation of the water-quality data for the San Andres aquifer. Figure 8.0-2 shows the 2004 data for sulfate, TDS, uranium and selenium concentrations in the San Andres aquifer. Sulfate concentrations vary from 334 mg/l to 892 mg/l in the San Andres aquifer. Sulfate concentrations are typically near 700 mg/l for Homestake #1 Deep and #2 Deep wells. TDS concentrations have varied from 919 to 2130 mg/l and generally increase in a down-gradient direction. The higher concentrations of sulfate and TDS to the east are natural and typical of a limestone aquifer where the extended contact time with the formation results in ongoing dissolution of major constituents. This increase in concentrations from the recharge area down dip is expected. Uranium concentrations were small in all of the San Andres wells monitored during 2004 with a slightly higher value of 0.08 mg/l from well 928. Selenium concentrations in the San Andres aquifer vary from less than 0.005 to 0.04 mg/l. All measured molybdenum concentrations are less than 0.03 mg/l.

Figure 8.0-3 presents sulfate concentrations with time for Homestake's well 951 and Deep #1 and #2 wells. This data shows that sulfate concentrations in 2004 in well 951 and Homestake's #2 Deep well were similar to their historical average while a small increase in sulfate was observed in #1 Deep well.

5150' 923

1050' 928

6438.7

EAST FAULT

1545500

6438.8

151

19 20 / 30 29

20 21 / 29 28

21 22 / 28 27

COUNTY ROAD 63

22 23 / 27 26

22 23 / 26 25

HMC OFFICE

6439.5

LARGE-TAILINGS-PILE
(RECLAMATION IN PROGRESS)

1543500

6435.6

#1

HIGHWAY 605

COLLECTION POND

#2

LINED EVAP POND #2

LINED EVAP POND #1

SMALL TAILINGS PILE

1541500

PLEASANT-VALLEY ESTATES

908

545 995

30 29 / 31 32

COUNTY ROAD 25

29 28 / 32 33

28 27 / 33 34

927

MURRAY-ACRES

27 26 / 34 35

26 25 / 35 36

6438

6437

6436

1539500

6439.3

938

VALLE VERDE

991

987

986

955

822

BROADVIEW ACRES

6432.2

943

RAILROAD

1537500

FELICE-ACRES

THUNDERBIRD LANE

HIGHWAY-605

HIGHWAY-122

WEST FAULT

32 33 / 5 4

33 34 / 4 3

34 35 / 3 2

907

6439.4

6439

RALPH CARD ROAD

1535500

911

898

6436.3

535 534

6445.9

3075'

775'

1537500

473400 475400 477400 479400 481400 485400 487400 489400 491400

N

--LEGEND--

- SAN ANDRES WELL
- 943 FRESH-WATER INJECTION SUPPLY WELL
- 1050' OFFSET WELL
- 6477.5 DATA
- 6442 CONTOUR AND LABEL
- SAN ANDRES FLOW
- SUBCROP OF SAN ANDRES ALLUVIUM OVERLIES LIMESTONE

SCALE: 1"=1600'

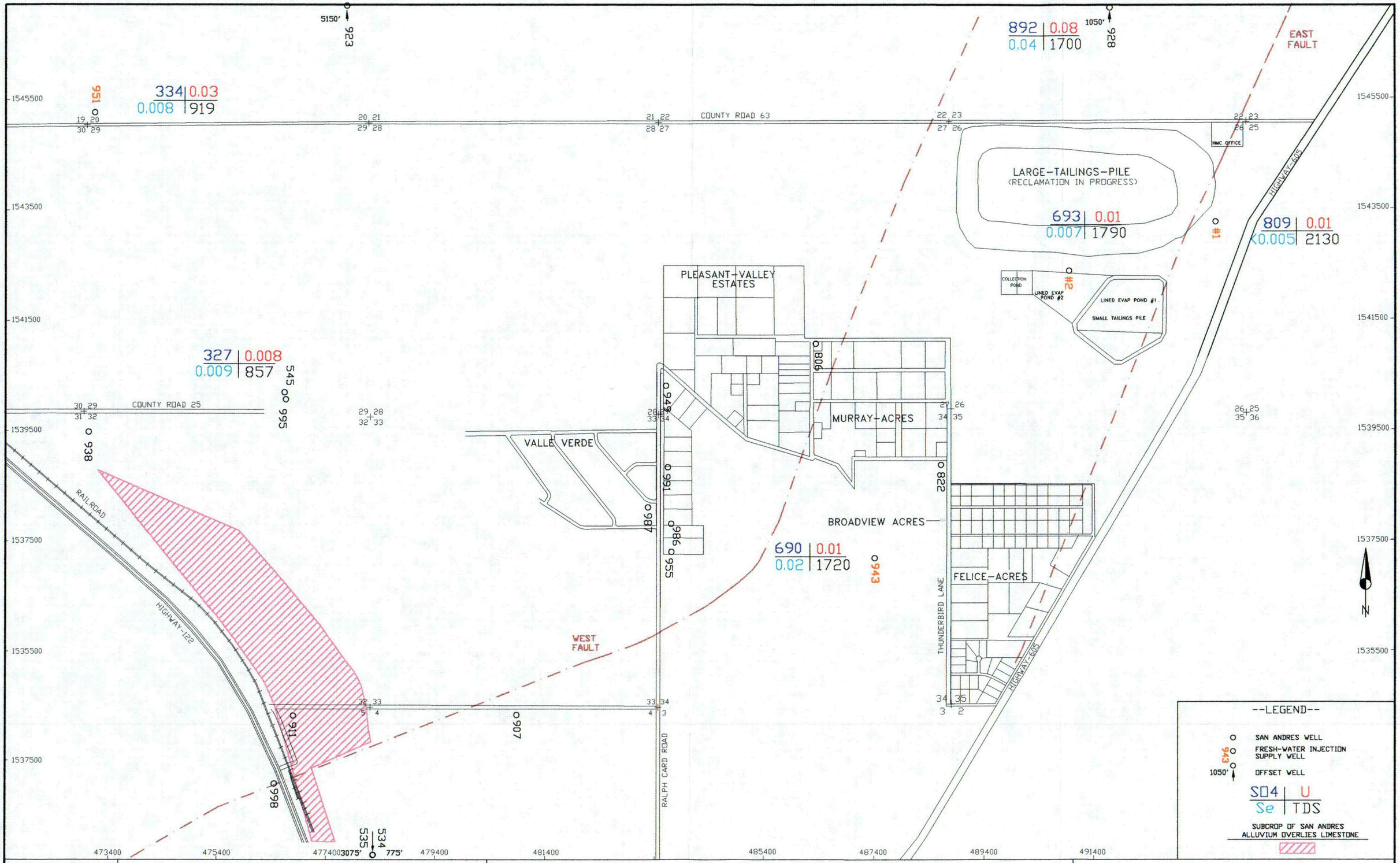
C:\PROJECTS\2004-06\SAN1600

DATE: 03/24/05

HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 8.0-1. LOCATION OF SAN ANDRES WELLS AND WATER-LEVEL ELEVATION FOR THE SAN ANDRES AQUIFER, 2004, FT-MSL

C173



SCALE: 1"=1600'
C:\PROJECTS\2004-06\SAN1600
DATE: 03/24/05

HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 8.0-2. WATER QUALITY FOR THE SAN ANDRES AQUIFER, 2004, mg/l

C174

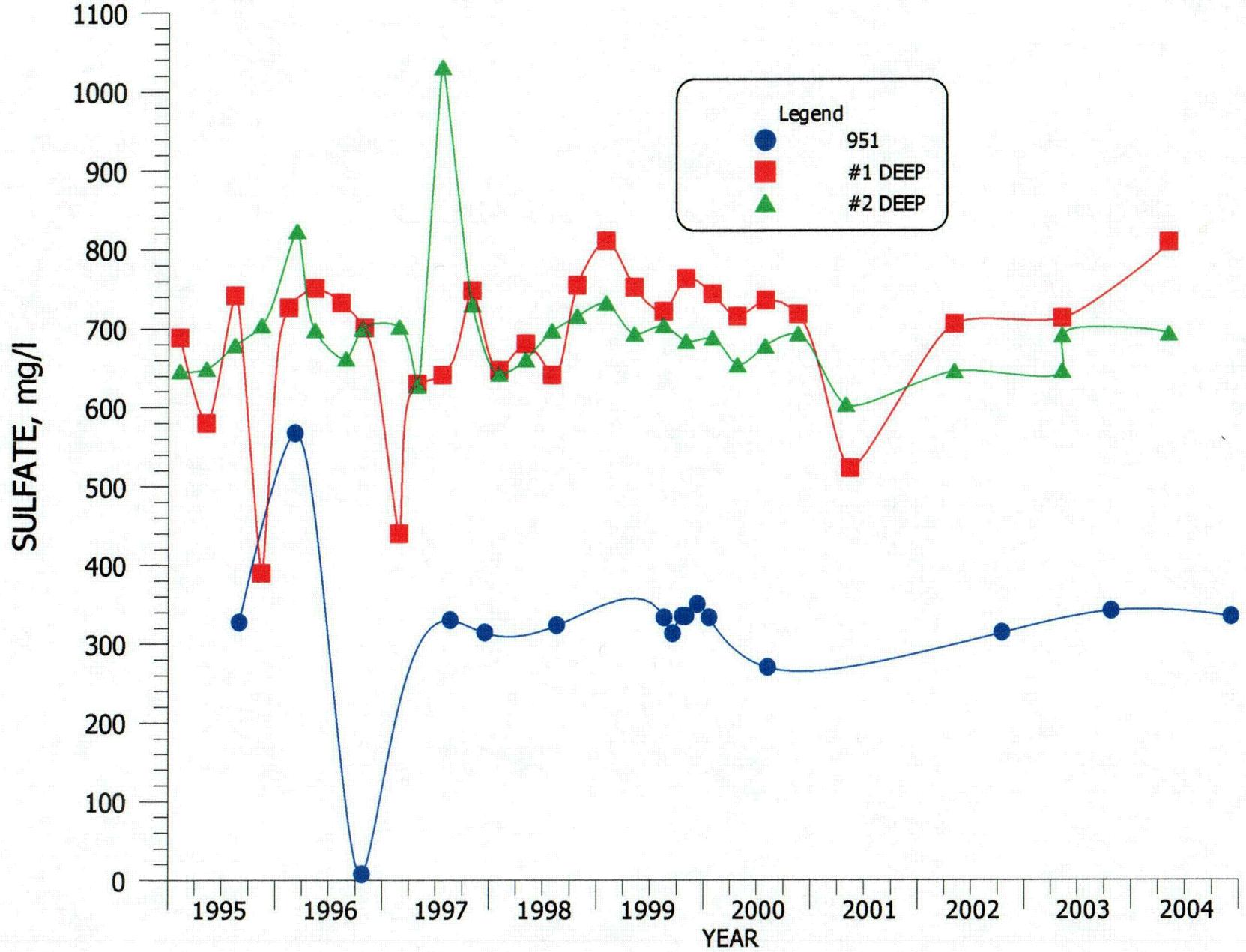


FIGURE 8.0-3. SULFATE CONCENTRATIONS FOR WELLS 951, #1 DEEP AND #2 DEEP.

TABLE 8.0-1. WELL DATA FOR THE SAN ANDRES WELLS.

WELL NAME	NORTH. COORD.	EAST. COORD.	WELL DEPTH (FT-MP)	CASING DIAM (IN)	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MP)	WATER LEVEL ELEV. (FT-MSL)	MP ABOVE LSD (FT)	MP ELEV. (FT-MSL)	DEPTH TO TOP OF SAN ANDRES (FT-LSD)	ELEV. TO TOP OF SAN ANDRES (FT-MSL)	CASING PERFOR-ATIONS	(FT-LSD)
#1 Deep	1543307	493633	1000.0	10.0	12/20/2004	148.18	6435.58	0.0	6583.76	130	6454	A	—
										303	6281	U	—
										433	6151	M	—
										597	5987	L	—
										955	5629	S	919-999
#2 Deep	1542424	490972	870.0	—	5/13/2003	134.06	6441.60	0.0	6575.66	110	6466	A	—
										800	5776	S	-
0534	1534589	476549	1000.0	16.0	12/14/2004	106.70	6445.87	0.0	6552.57	0	6553	S	-
0535	1530100	478450	198.0	12.0	12/14/2004	103.68	6436.32	0.0	6540.00	—	—	S	-
0545	1540220	476630	—	8.0	—	—	—	—	—	—	—	S	-
0806	1541120	486320	584.0	16.0	—	—	—	0.0	6567.00	90	6477	A	—
										520	6047	S	-
0822	1538920	488630	980.0	7.0	—	—	—	0.0	6557.00	790	5767	S	790-875
0907	1534250	480800	360.0	16.0	12/14/2004	106.24	6439.36	0.0	6545.60	123	6423	A	—
										262	6284	S	295-360
0911	1534350	476800	188.0	—	—	—	—	0.0	6552.60	—	—	S	-
0918	—	—	725.0	4.0	—	—	—	0.0	6702.40	620	6082	S	635-655
0919	—	—	628.0	5.0	—	—	—	0.0	6684.00	35	6649	A	—
										356	6328	S	364-571
0923	1552400	477900	330.0	5.0	4/6/1994	6464.97	157.63	0.0	6622.60	60	6563	A	—
										229	6394	S	234-330
0928	1548250	491700	864.0	—	12/14/2004	158.88	6438.72	1.2	6597.60	138	6458	A	—
										801	5795	S	-
0938	1539500	473040	—	—	12/14/2004	129.53	6439.27	0.0	6568.80	95	6474	A	—
										120	6449	S	-
0943	1537222	487407	978.0	18.0	12/8/2004	123.74	6432.17	0.0	6555.91	704	5852	S	703-978
0949	1540350	483600	551.0	—	—	—	—	0.0	6562.30	112	6450	A	—
										155	6407	L	—
										460	6102	S	400-493
										460	6102	S	505-551
0951	1545500	473200	275.0	10.0	12/8/2004	134.90	6438.80	0.9	6573.70	110	6463	A	—
										227	6346	S	241-275
0955	1537300	483700	498.0	5.0	11/3/1995	78.05	6471.95	0.2	6550.00	40	6510	A	—
										420	6130	S	385-498
0986	1537860	483750	467.0	5.0	11/2/1995	80.75	6569.25	0.8	6650.00	65	6584	A	—
										85	6564	L	—
										415	6234	S	420-467
0987	1538120	483270	500.0	5.0	11/3/1995	54.48	6595.52	1.0	6650.00	70	6579	A	—
										385	6264	S	425-470
0991	1538880	483630	500.0	—	11/8/1995	84.41	6566.59	1.4	6651.00	—	—	S	-

TABLE 8.0-1. WELL DATA FOR THE SAN ANDRES WELLS. (cont'd.)

WELL NAME	NORTH. COORD.	EAST. COORD.	WELL DEPTH (FT-MP)	CASING DIAM (IN)	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MP)	WATER LEVEL ELEV. (FT-MSL)	MP ABOVE LSD (FT)	MP ELEV. (FT-MSL)	DEPTH TO TOP OF SAN ANDRES (FT-LSD)	ELEV. TO TOP OF SAN ANDRES (FT-MSL)	CASING PERFOR-ATIONS (FT-LSD)
0995	1540115	476594	—	—	—	—	—	0.0	6474.00	—	—	S -
0998	1533080	476450	145.0	16.0	—	—	—	0.0	6650.00	—	—	S -

NOTE: A = Base of Alluvium
U = Upper Chinle, Top
M = Middle Chinle, Top
L = Lower Chinle, Top
S = San Andres Aquifer, Top
* = Abandoned

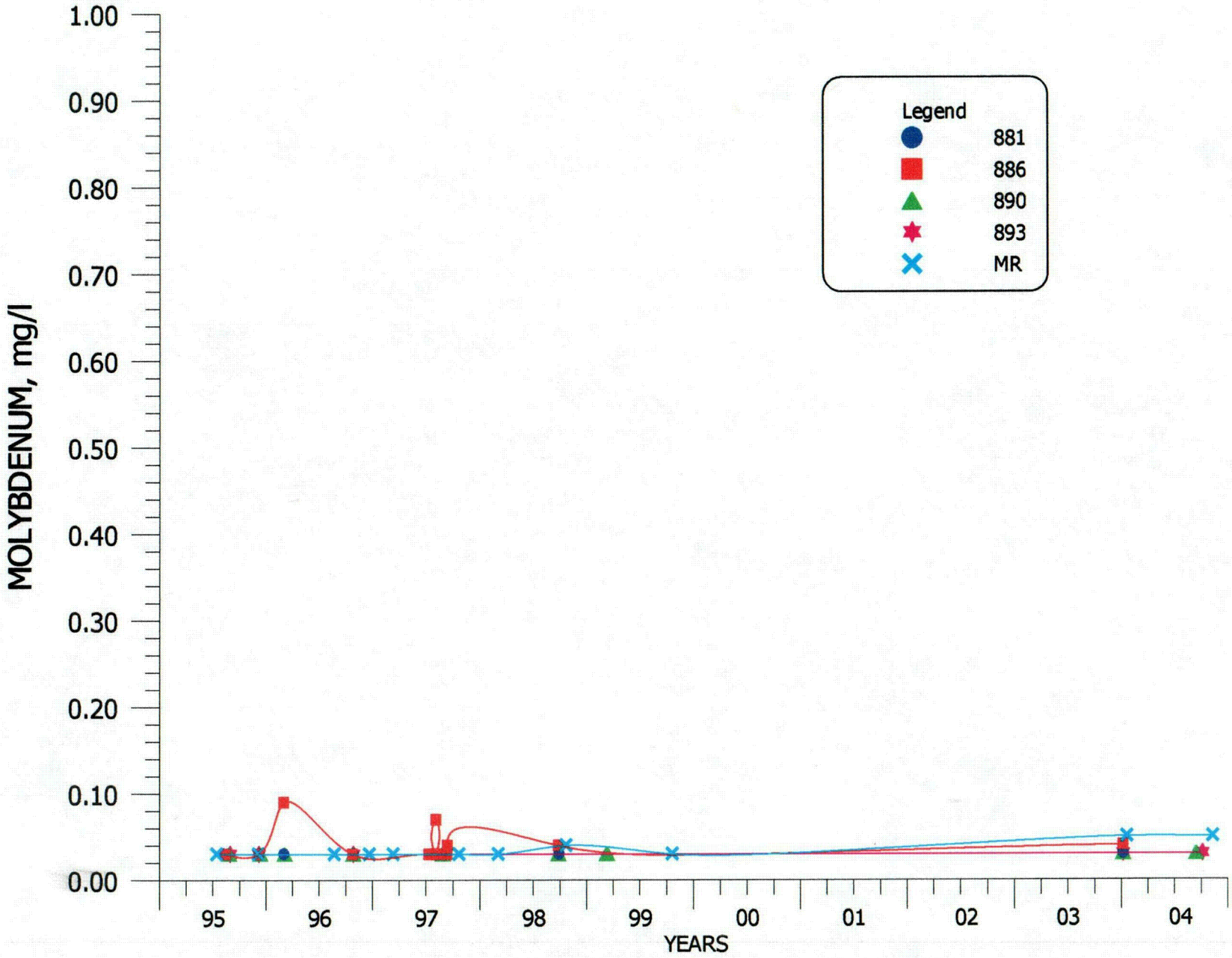


FIGURE 4.3-101. MOLYBDENUM CONCENTRATIONS FOR WELLS 881, 886, 890, 893 AND MR.

C176

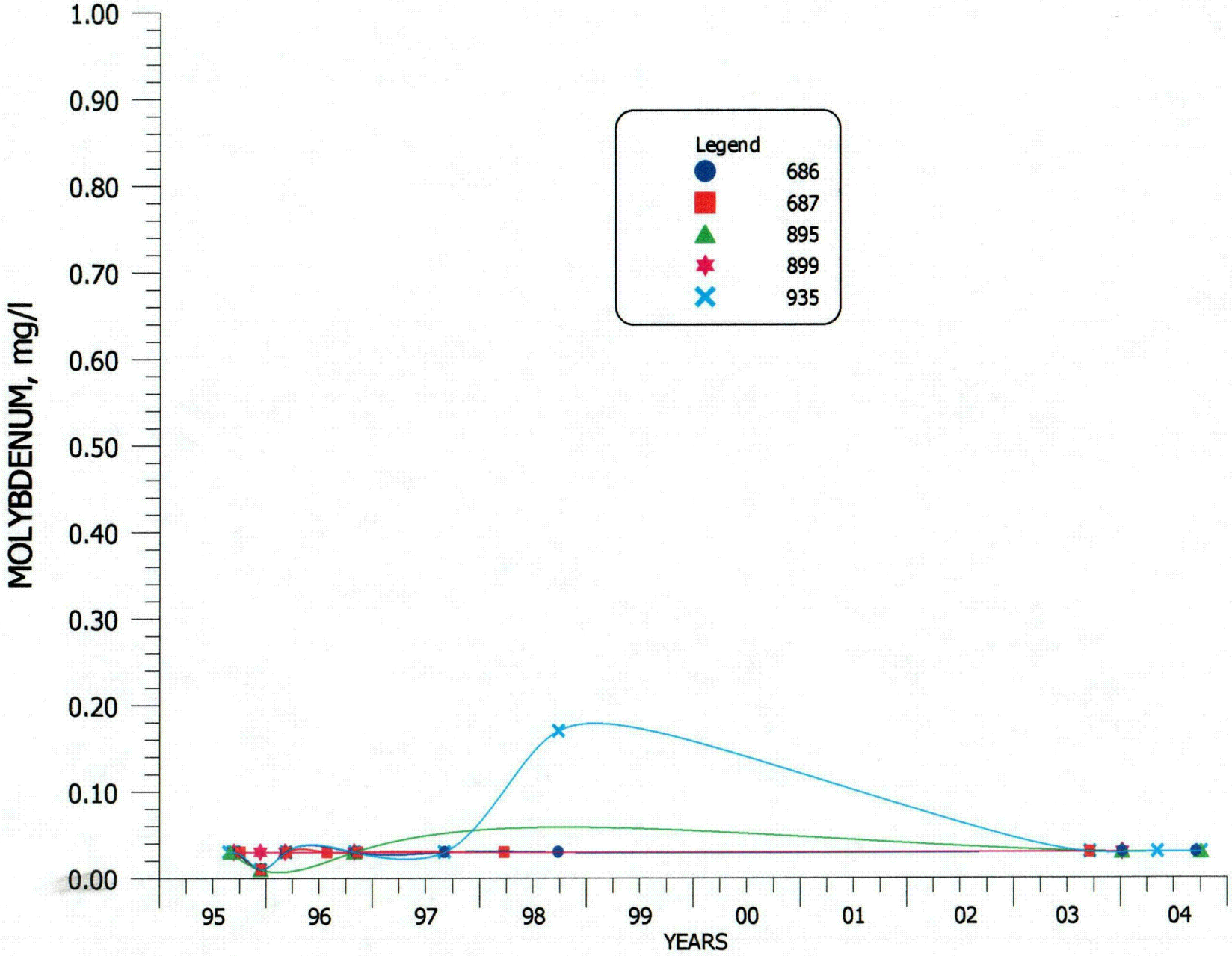


FIGURE 4.3-102. MOLYBDENUM CONCENTRATIONS FOR WELLS 686, 687, 895, 899 AND 935.

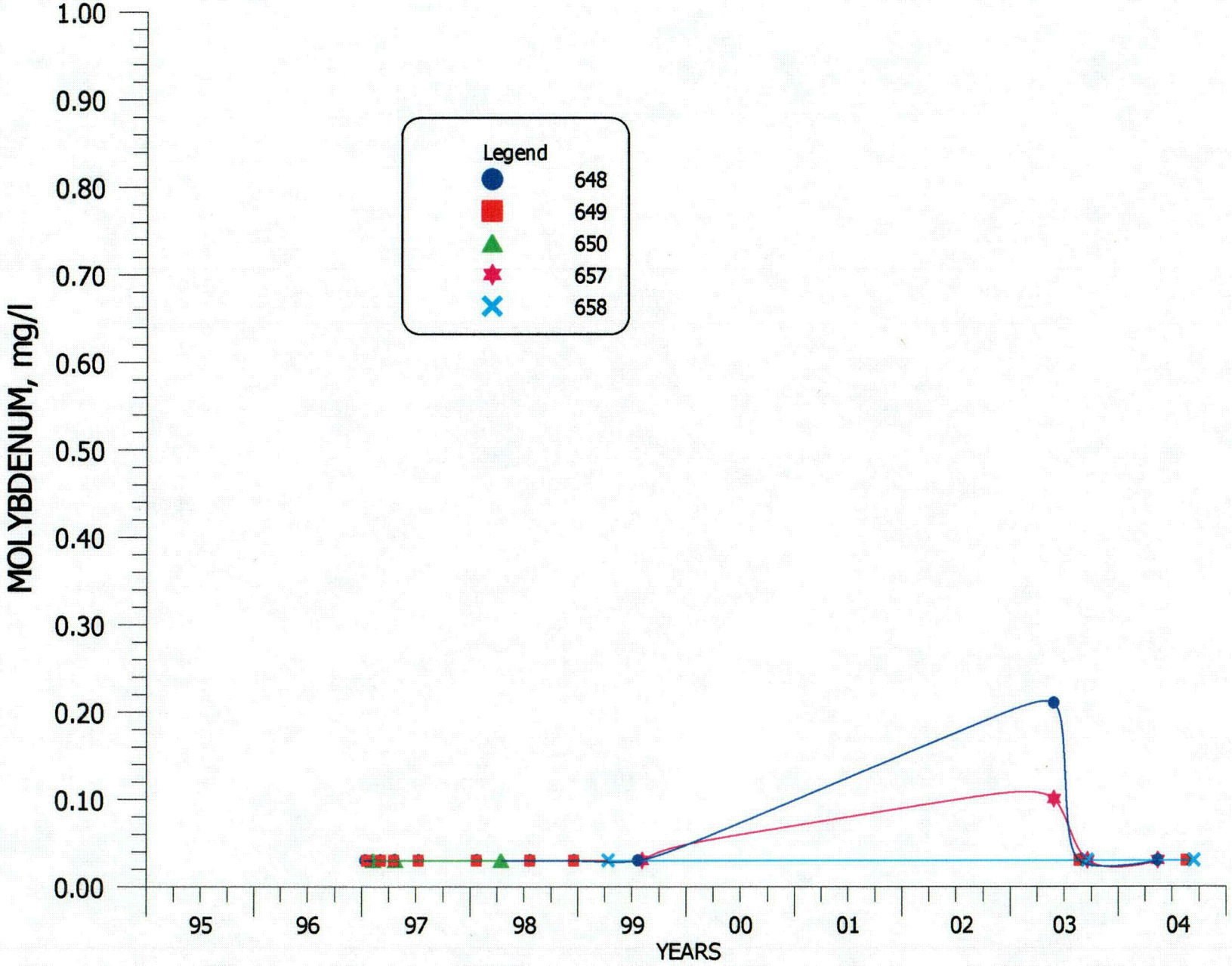


FIGURE 4.3-103. MOLYBDENUM CONCENTRATIONS FOR WELLS 648, 649, 650, 657 AND 658.

C178

COUNTY ROAD 63

COUNTY ROAD 25

LARGE-TAILINGS-PILE
(RECLAMATION IN PROGRESS)

COLLECTION POND

LINED EVAP POND #2

LINED EVAP POND #1

SMALL TAILINGS PILE

PLEASANT-VALLEY ESTATES

MURRAY-ACRES

VALLE VERDE

BROADVIEW ACRES

FELICE-ACRES

THUNDERBIRD LANE

RALPH CARD ROAD

RAILROAD

HIGHWAY-122

HIGHWAY-605

3000'

N

--LEGEND--

4.4 DATA

—10 CONTOUR AND LABEL

PROPOSED NRC SITE STANDARD
>23 mg/l

ALLUVIAL AQUIFER

SCALE: 1"=1600'	HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W	FIGURE 4.3-104. NITRATE CONCENTRATIONS OF THE ALLUVIAL AQUIFER, 2004, mg/l
C:\PROJECTS\ 2004-06\C-QAL04		
DATE: 03/23/05		

C179

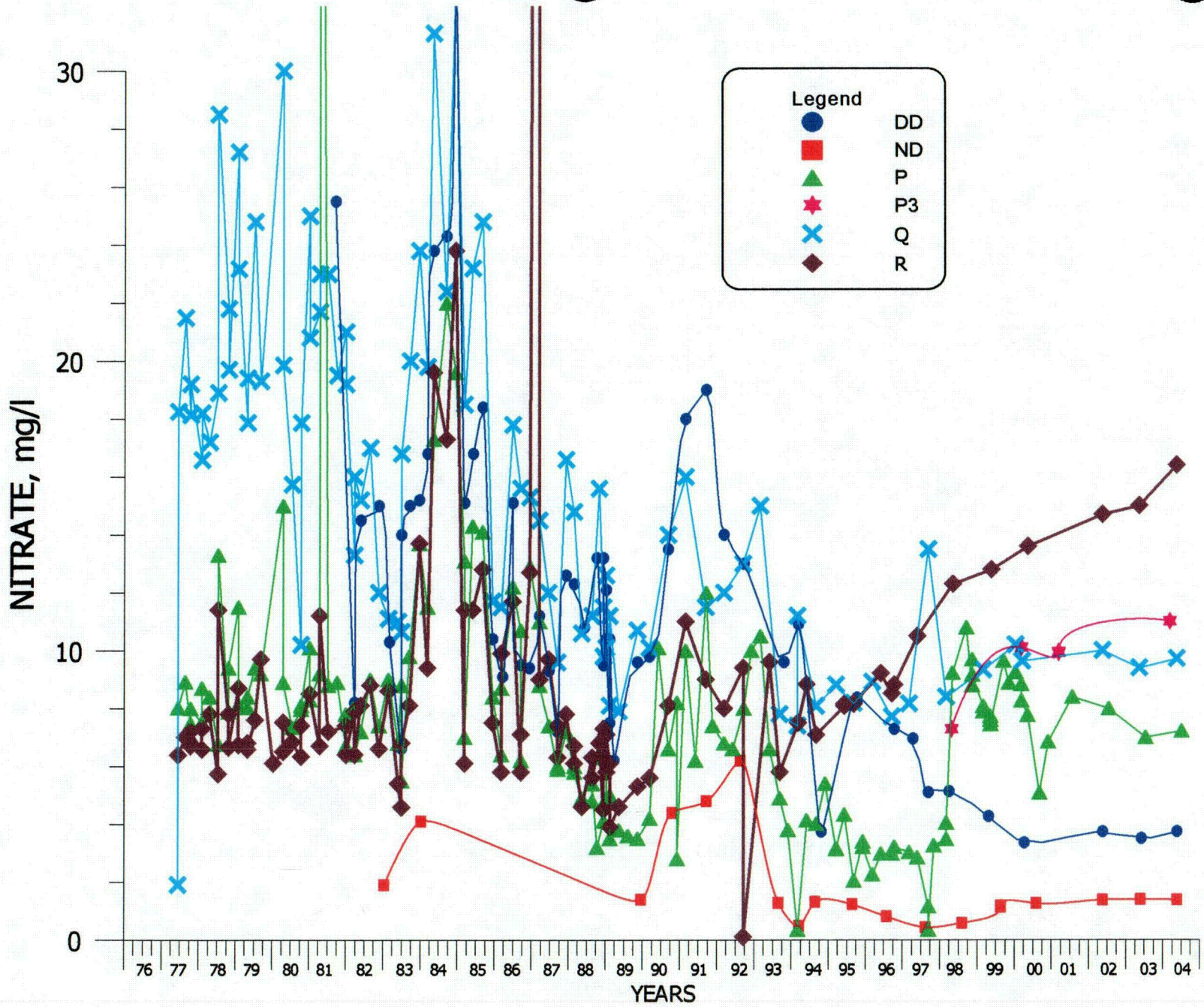


FIGURE 4.3-105. NITRATE CONCENTRATIONS FOR WELLS DD, ND, P, P3, Q AND R.

C180

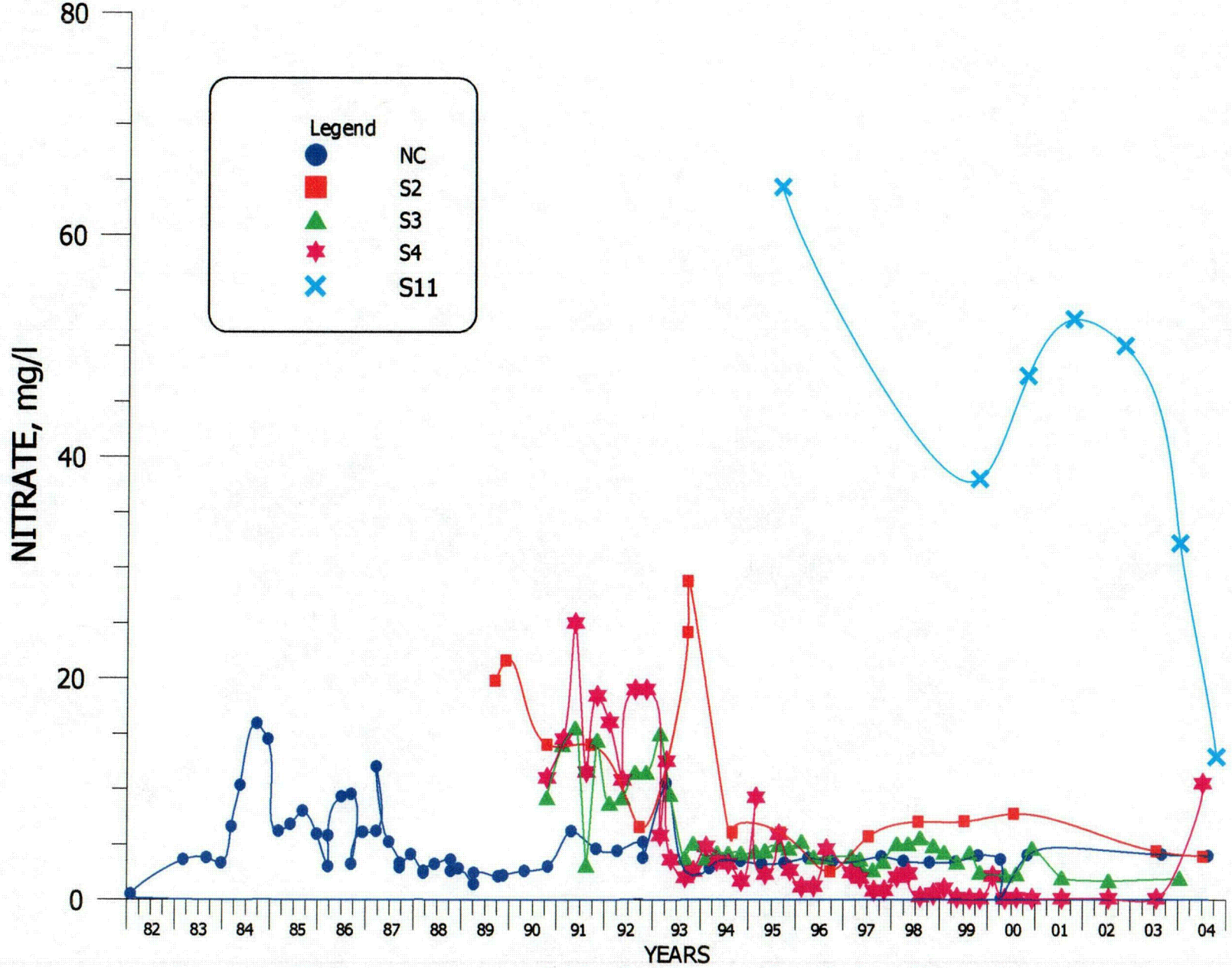


FIGURE 4.3-106. NITRATE CONCENTRATIONS FOR WELLS NC, S2, S3, S4 AND S11.

C181

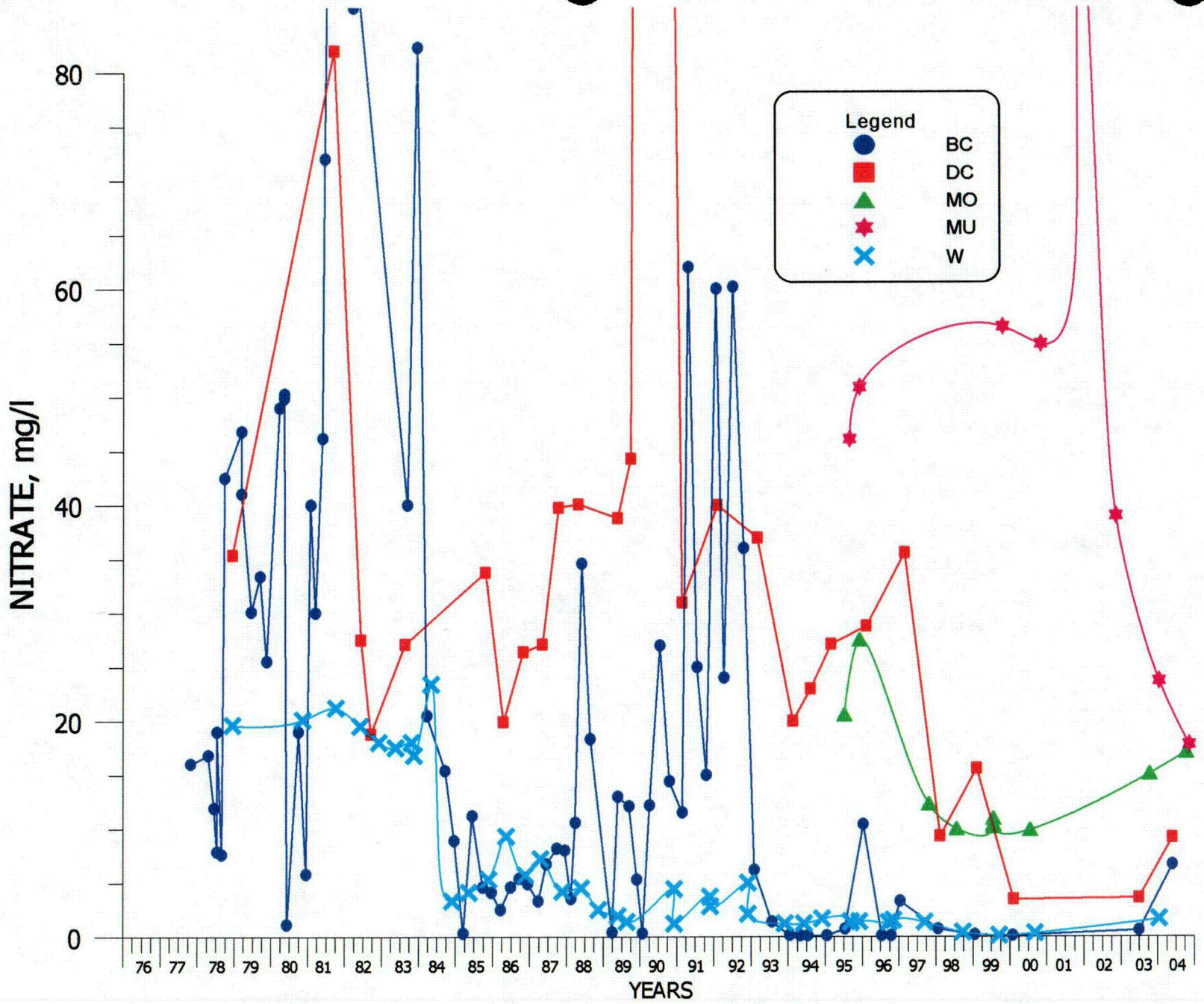


FIGURE 4.3-107. NITRATE CONCENTRATIONS FOR WELLS BC, DC, MO, MU AND W.

C182

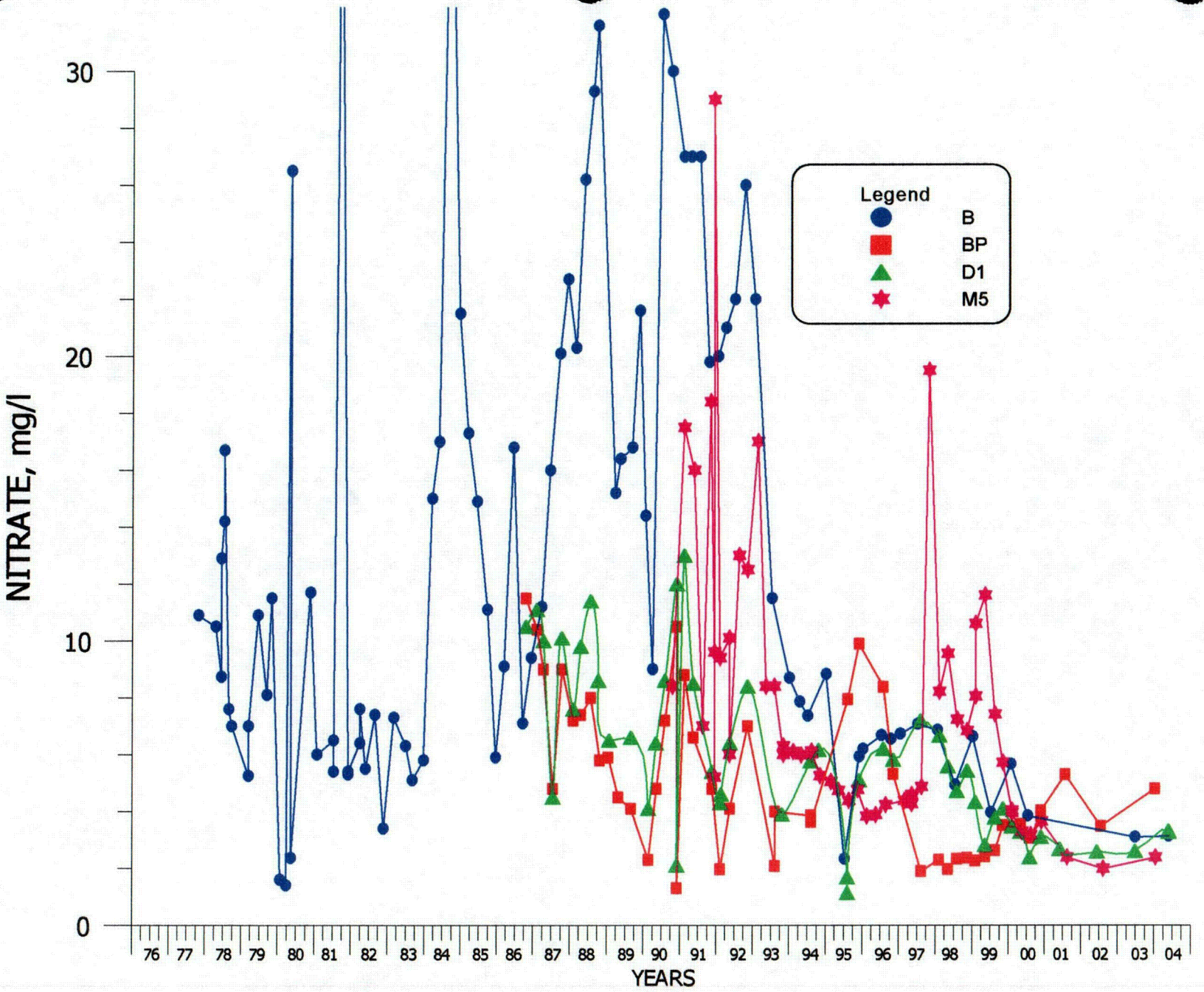


FIGURE 4.3-108. NITRATE CONCENTRATIONS FOR WELLS B, BP, D1 AND M5.

C183

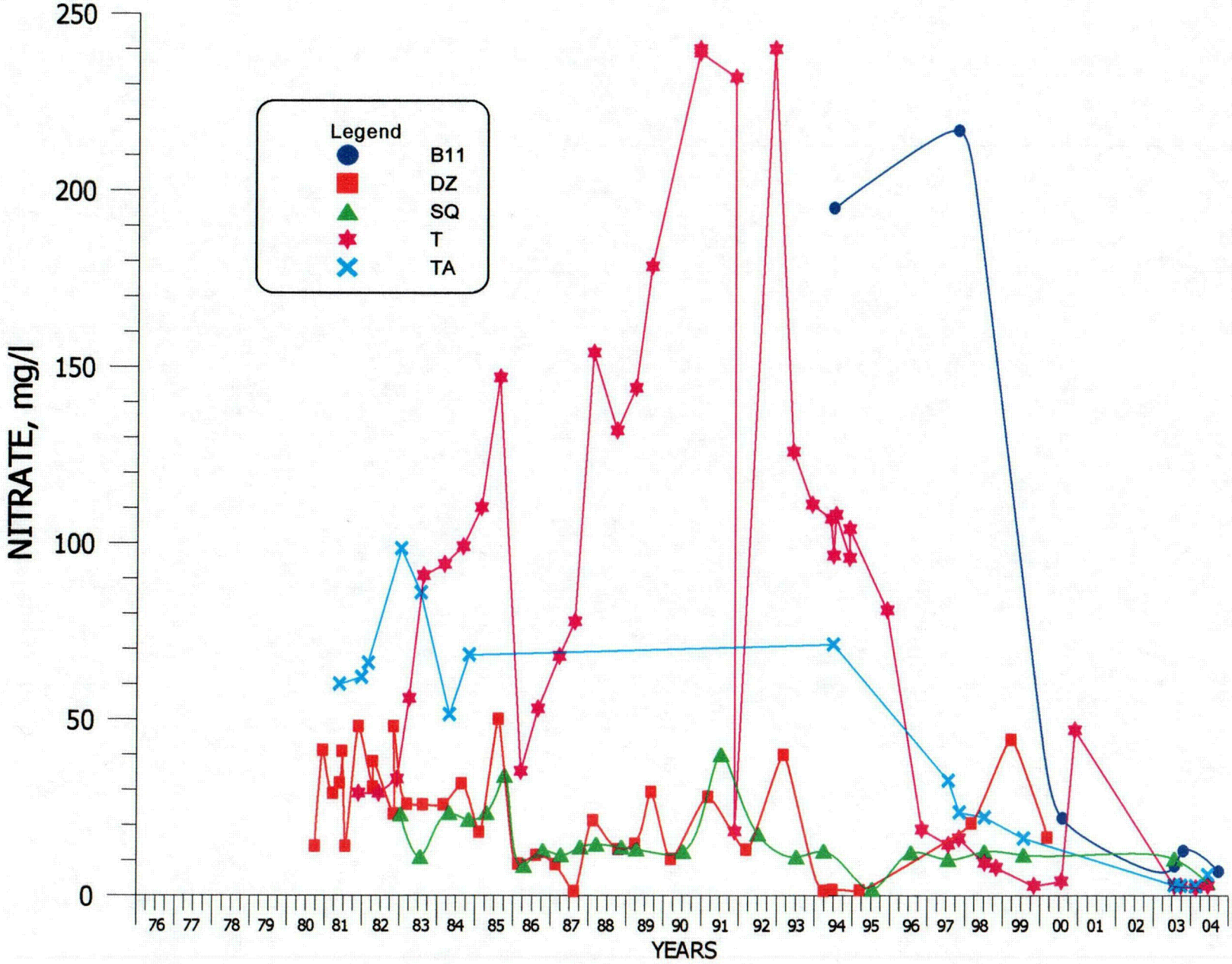


FIGURE 4.3-109. NITRATE CONCENTRATIONS FOR WELLS B11, DZ, SQ, T AND TA.

C184

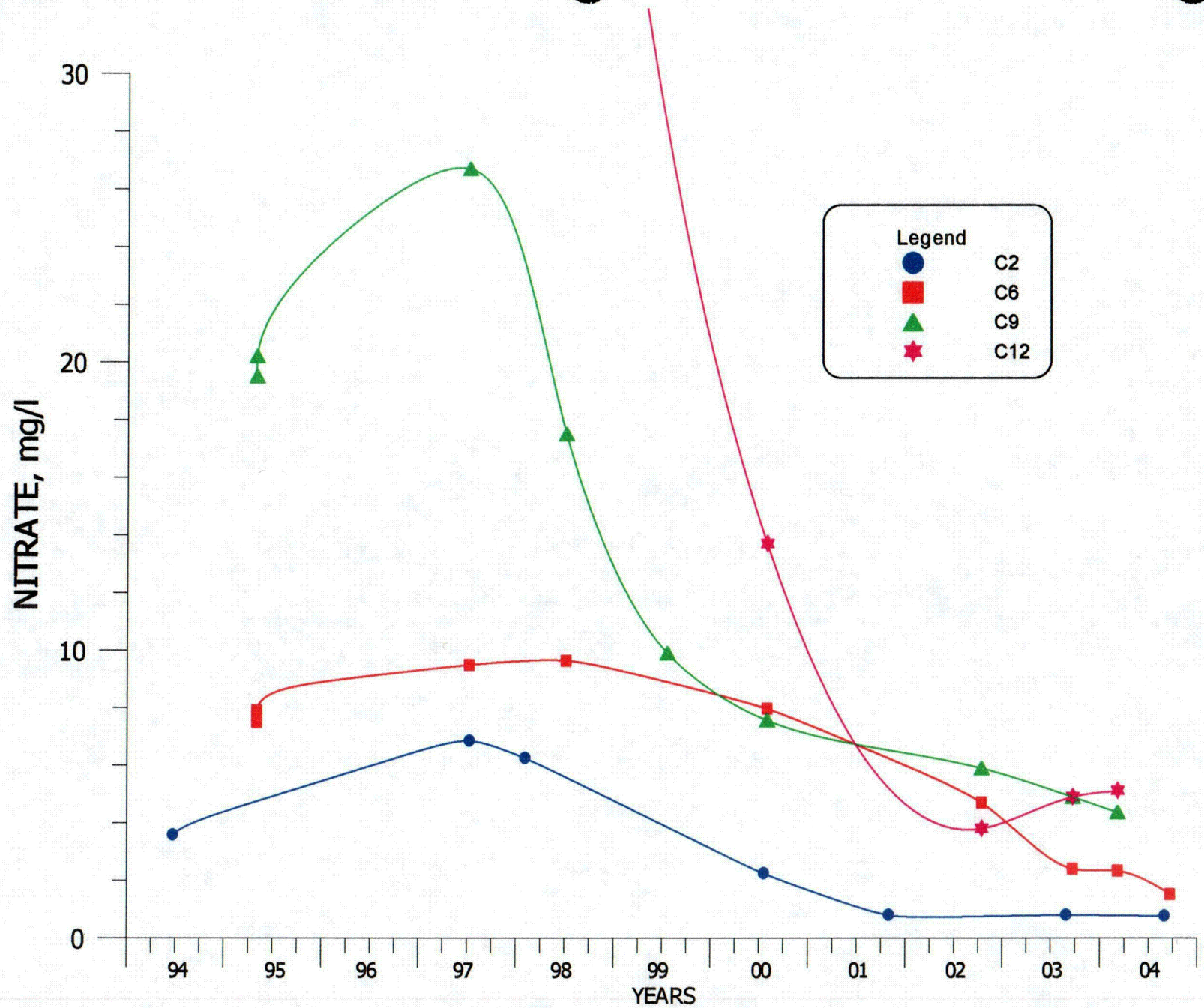


FIGURE 4.3-110. NITRATE CONCENTRATIONS FOR WELLS C2, C6, C9 AND C12.

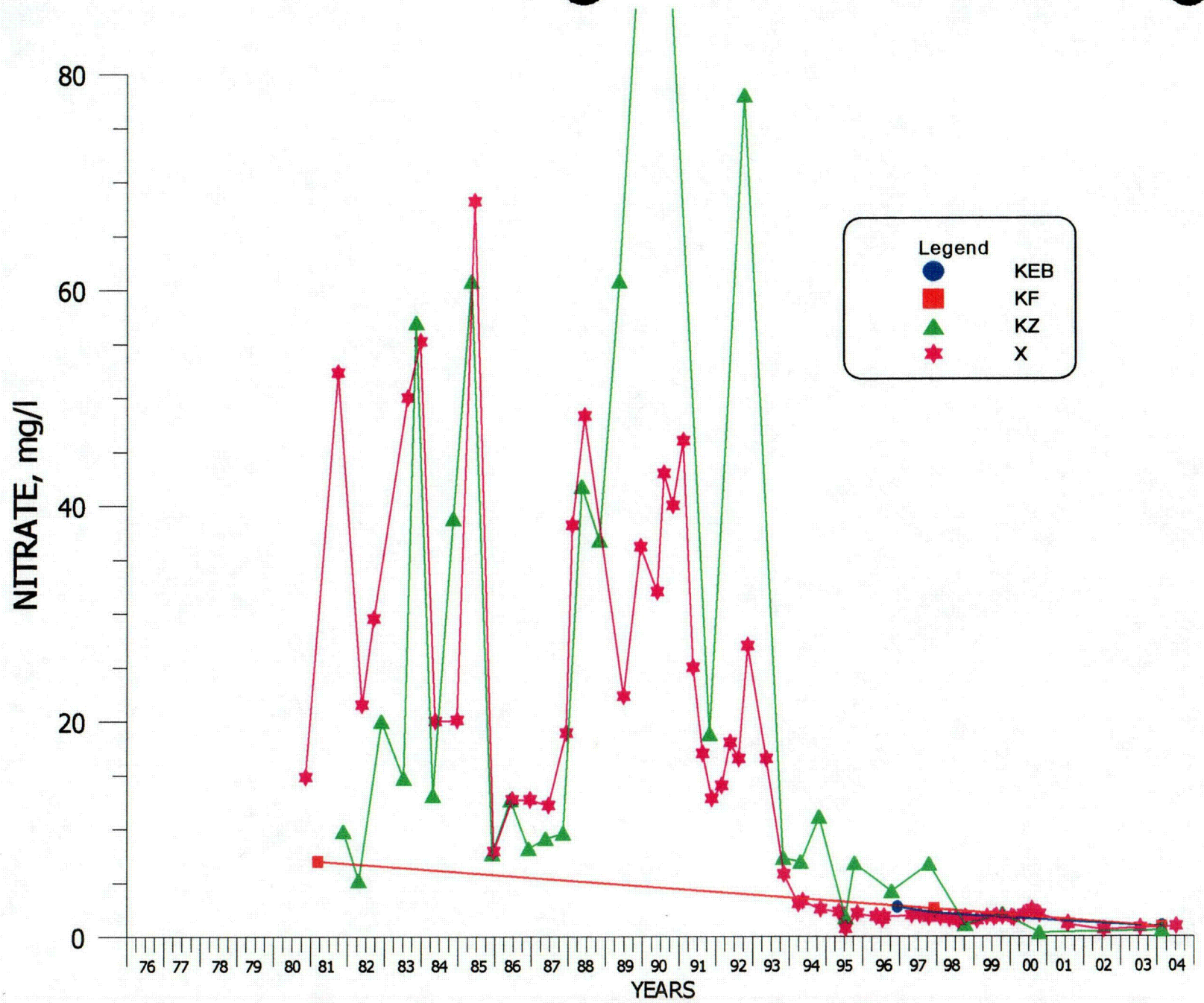


FIGURE 4.3-111. NITRATE CONCENTRATIONS FOR WELLS KEB, KF, KZ AND X.

C186

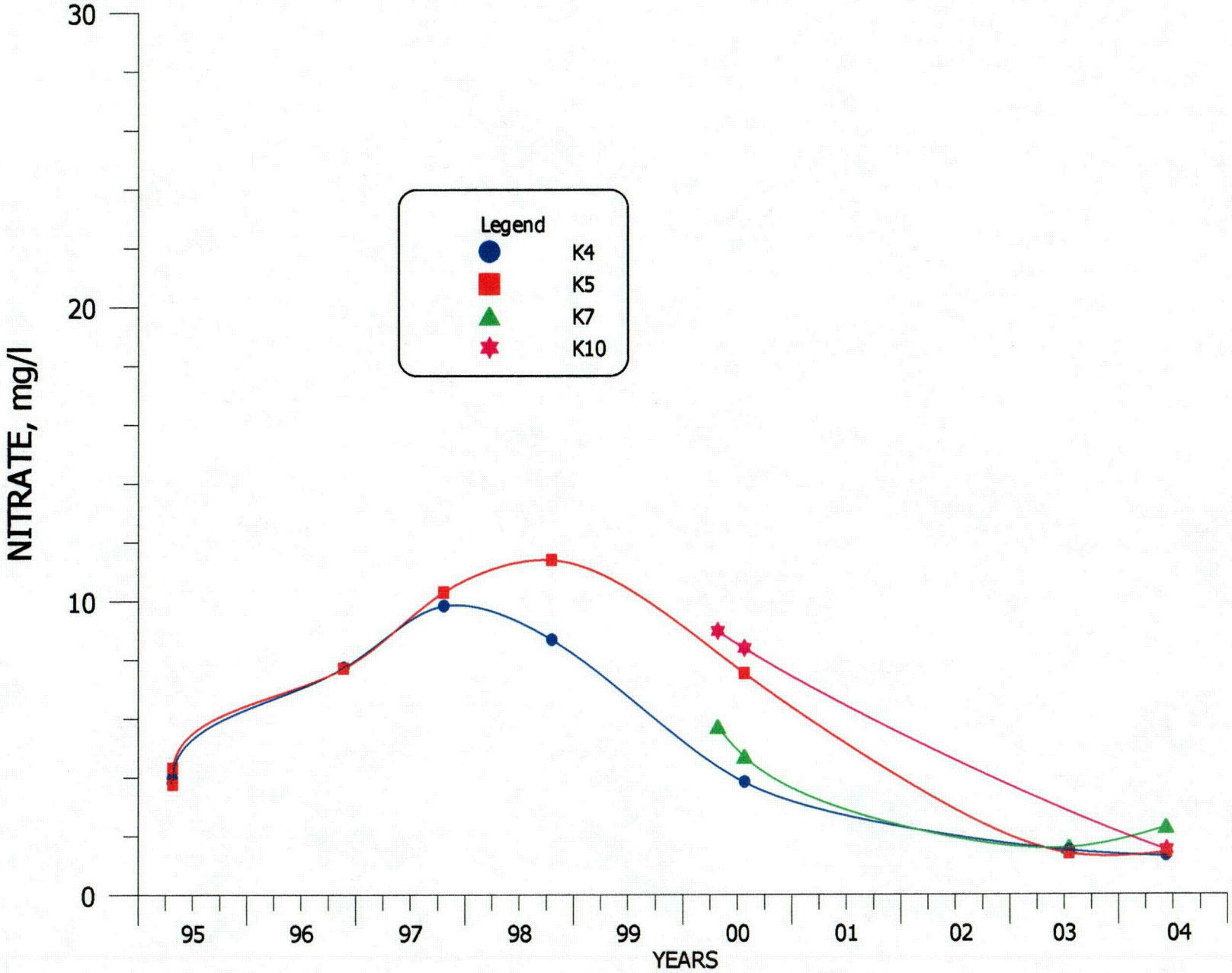


FIGURE 4.3-112. NITRATE CONCENTRATIONS FOR WELLS K4, K5, K7 AND K10.

C187

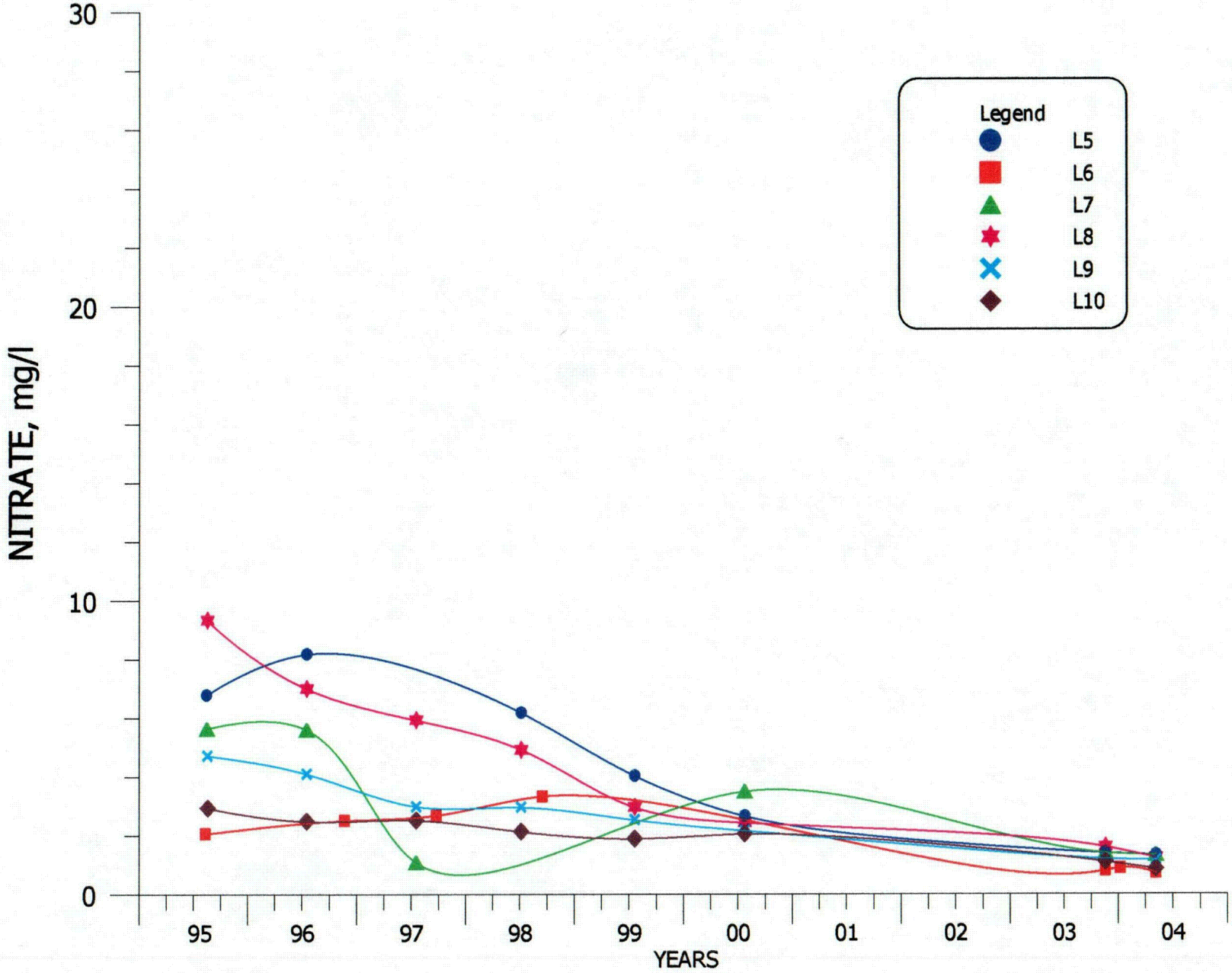


FIGURE 4.3-113. NITRATE CONCENTRATIONS FOR WELLS L5, L6, L7, L8, L9 AND L10.

C188

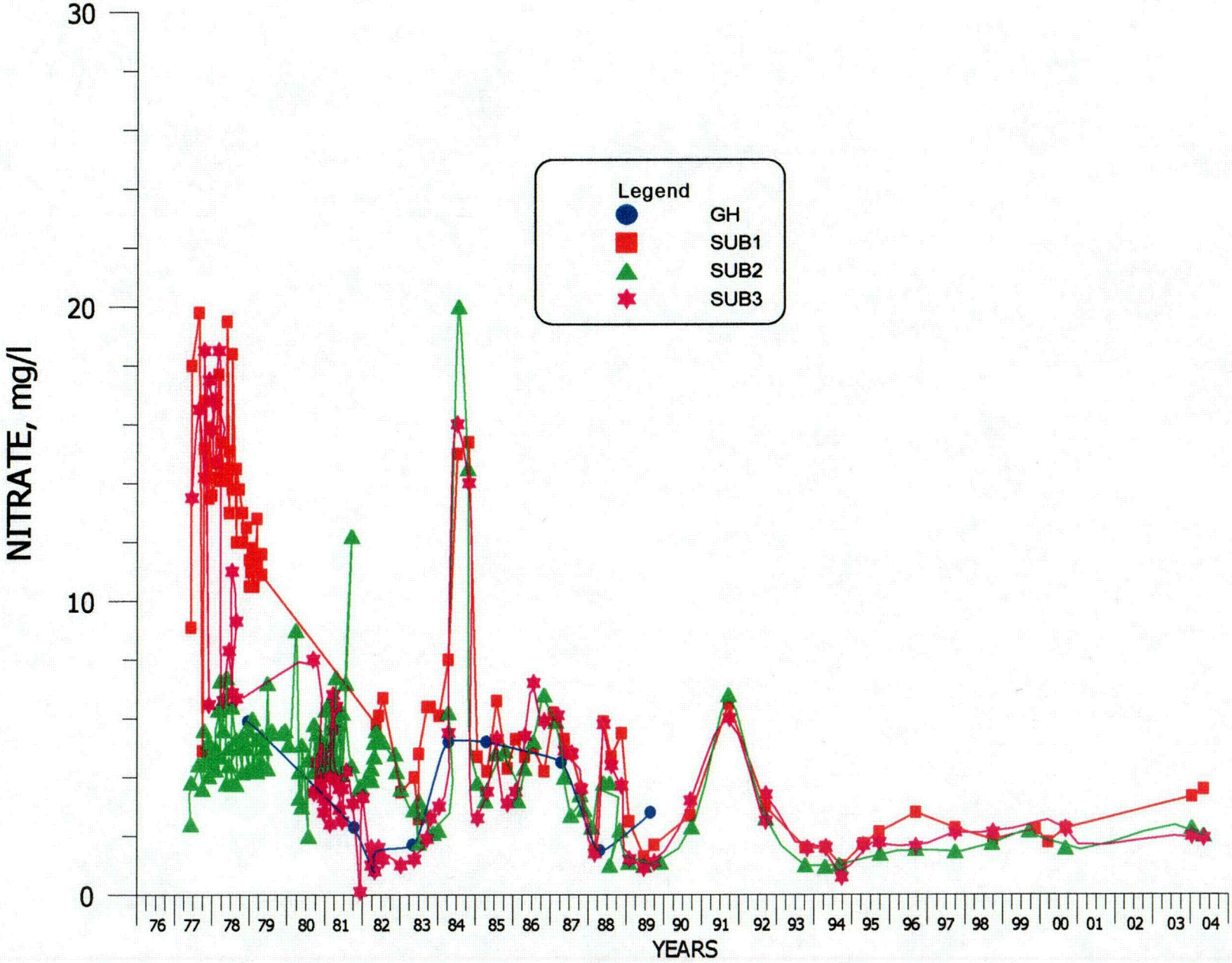


FIGURE 4.3-114. NITRATE CONCENTRATIONS FOR WELLS GH, SUB1, SUB2 AND SUB3.

C189

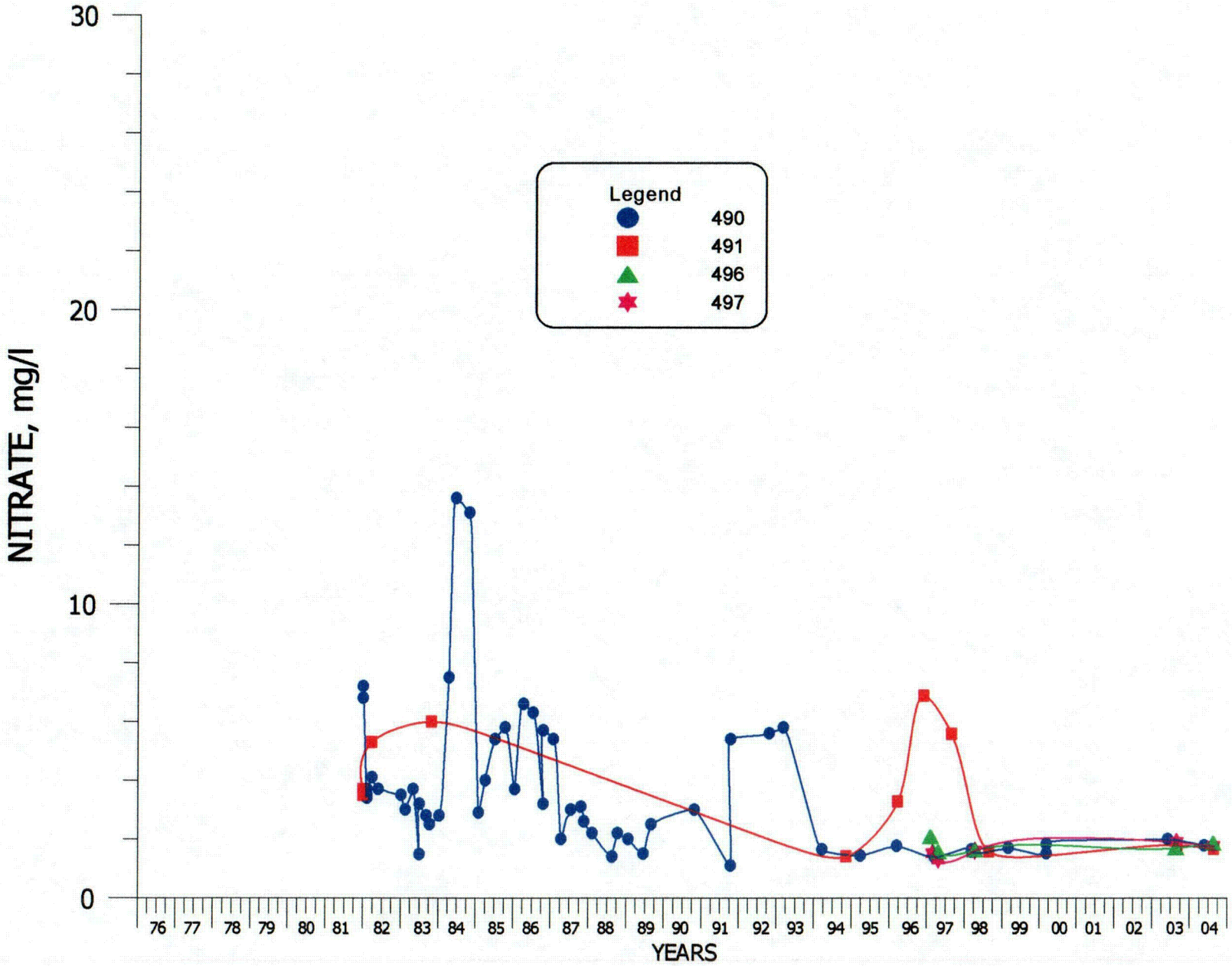
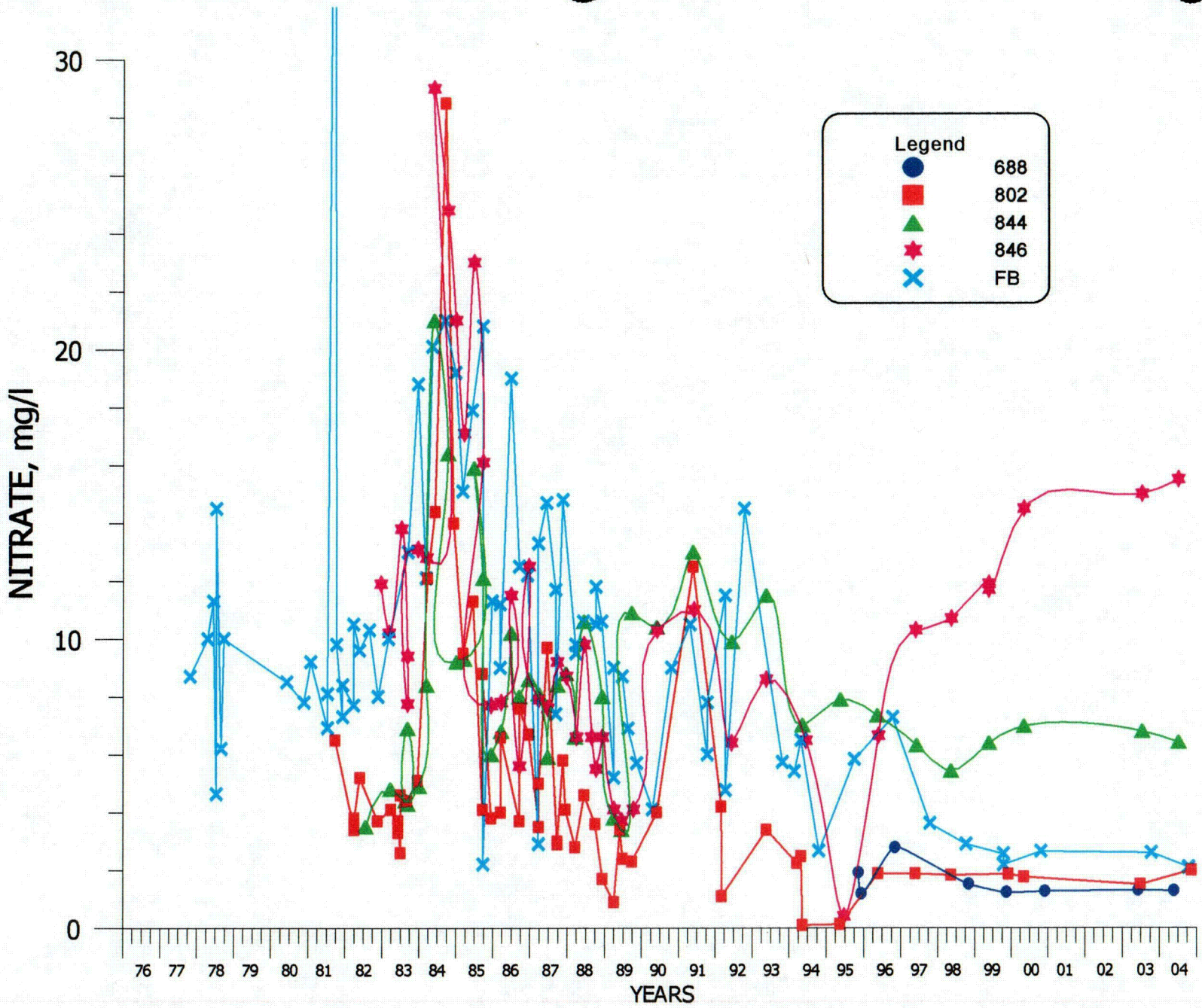


FIGURE 4.3-115. NITRATE CONCENTRATIONS FOR WELLS 490, 491, 496 AND 497.

C190



4.3-136

FIGURE 4.3-116. NITRATE CONCENTRATIONS FOR WELLS 688, 802, 844, 846 AND FB.

C191

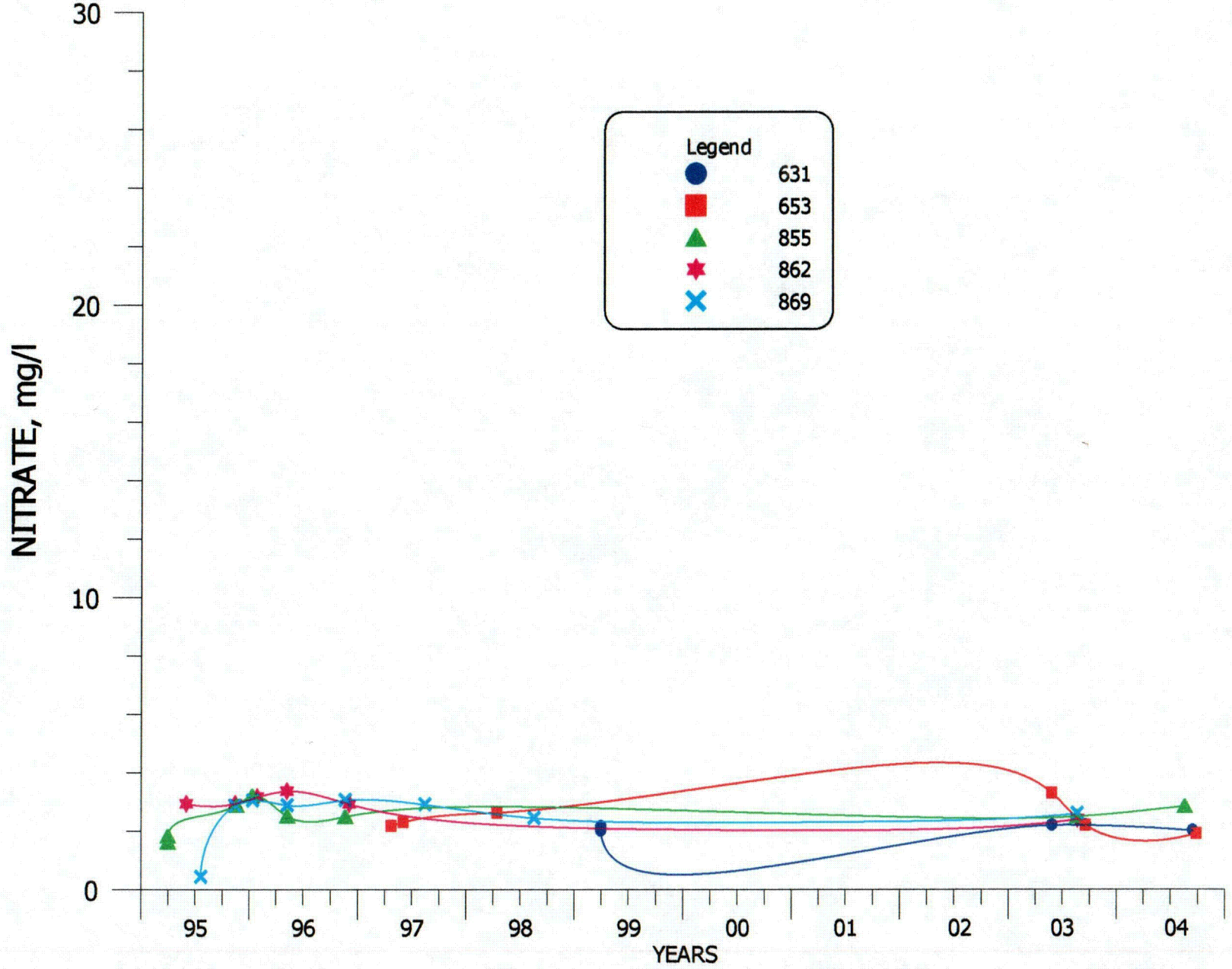


FIGURE 4.3-117. NITRATE CONCENTRATIONS FOR WELLS 631, 653, 855, 862 AND 869.

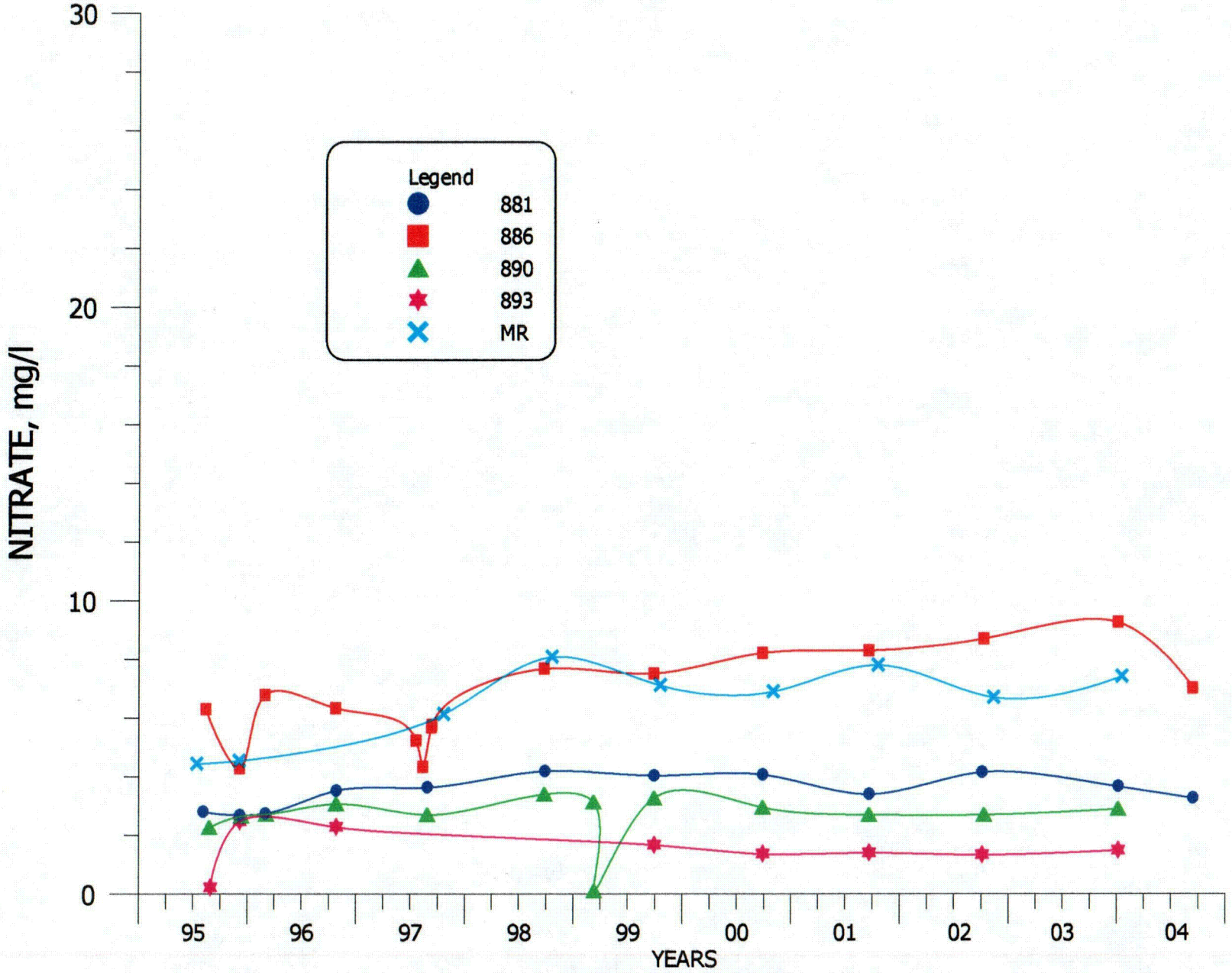


FIGURE 4.3-118. NITRATE CONCENTRATIONS FOR WELLS 881, 886, 890, 893 AND MR.

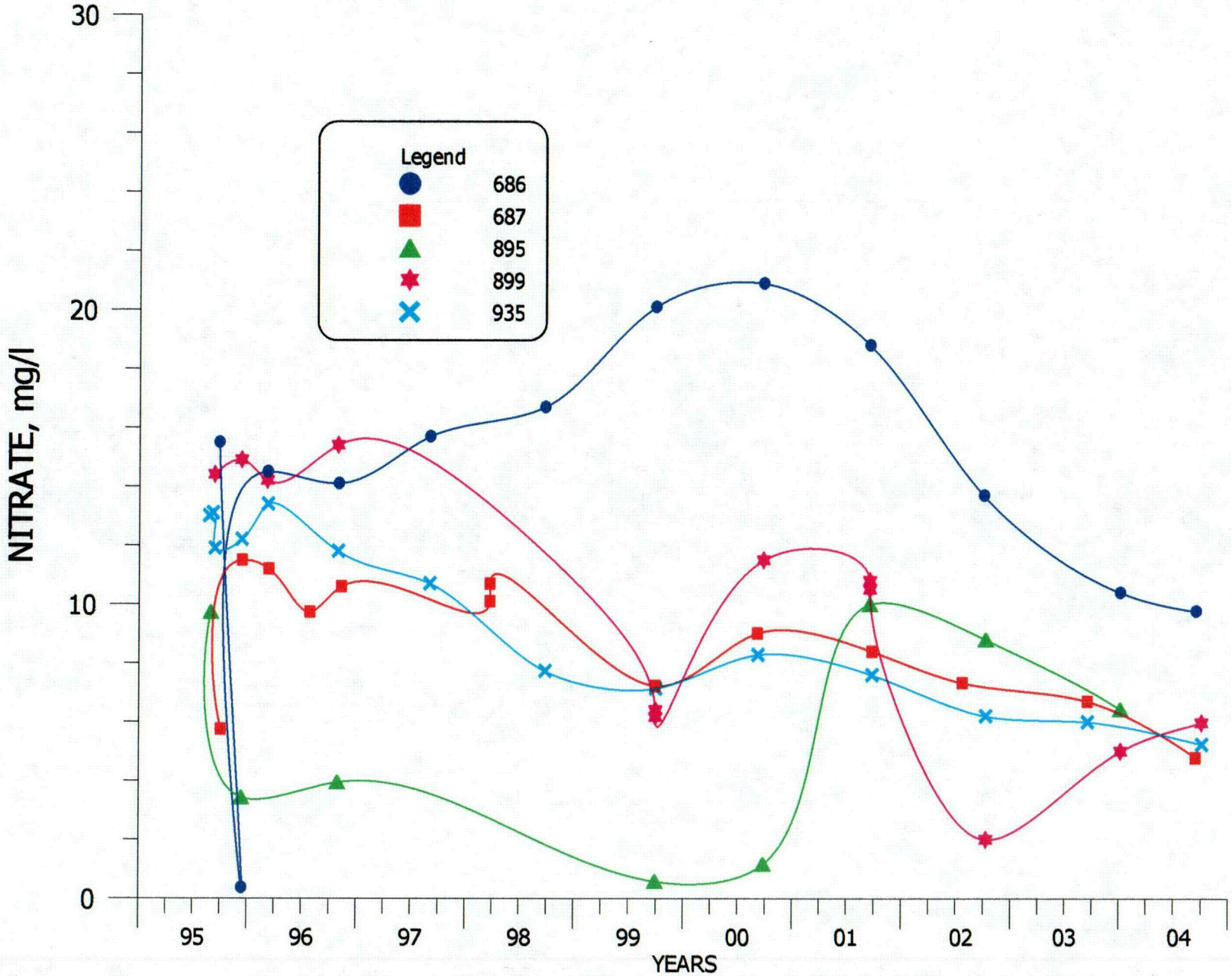


FIGURE 4.3-119. NITRATE CONCENTRATIONS FOR WELLS 686, 687, 895, 899 AND 935.

C194

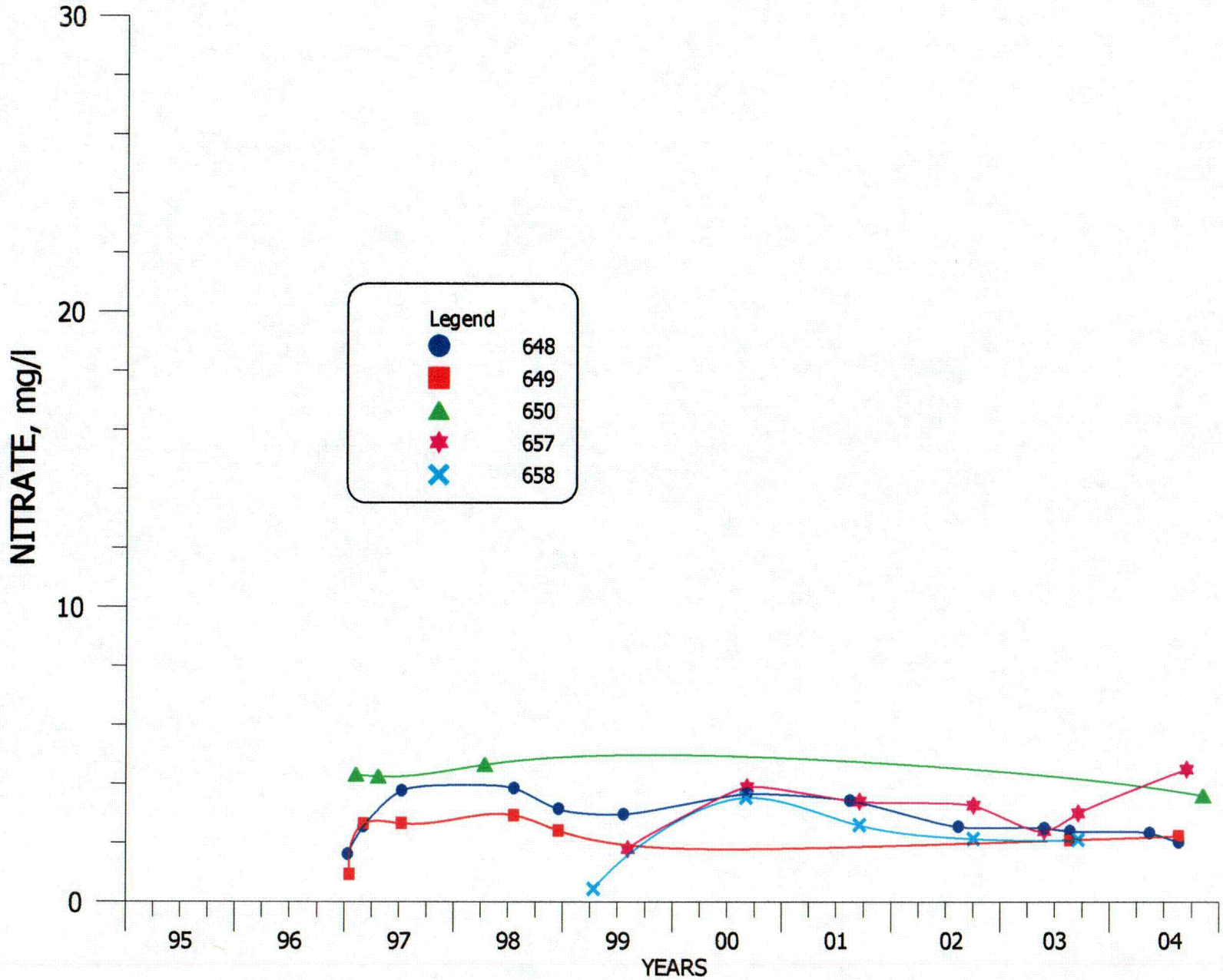


FIGURE 4.3-120. NITRATE CONCENTRATIONS FOR WELLS 648, 649, 650, 657 AND 658.

C95

COUNTY ROAD 63

COUNTY ROAD 25

LARGE-TAILINGS-PILE
(RECLAMATION IN PROGRESS)

SMALL TAILINGS PILE

COLLECTION POND

LINED EVAP POND #2

LINED EVAP POND #1

HMC OFFICE

PLEASANT-VALLEY ESTATES

VALLE VERDE

MURRAY-ACRES

BROADVIEW ACRES

FELICE-ACRES

THUNDERBIRD LANE

RALPH CARD ROAD

RAILROAD

HIGHWAY-122

HIGHWAY-605

--LEGEND--

2.7 RADIUM 228

0.2 RADIUM 226

EXISTING & PROPOSED NRC SITE STANDARD >5 pCi/l

ALLUVIAL AQUIFER

SCALE: 1"=1600'

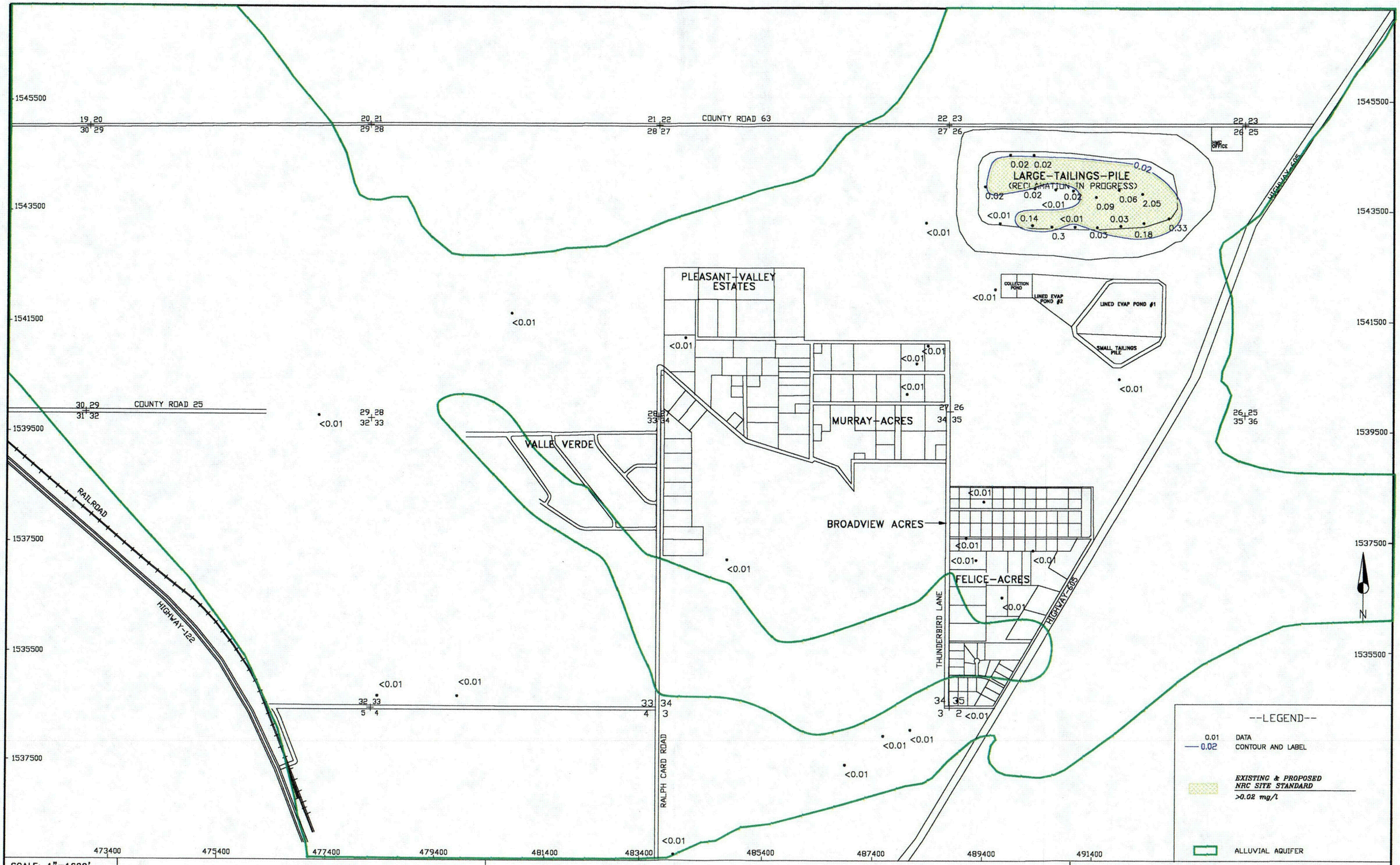
C:\PROJECTS\2004-06\C-QAL04

DATE: 03/23/05

HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 4.3-121. RADIUM-226 AND RADIUM-228 CONCENTRATIONS OF THE ALLUVIAL AQUIFER, 2004, pCi/l

C196



SCALE: 1"=1600'

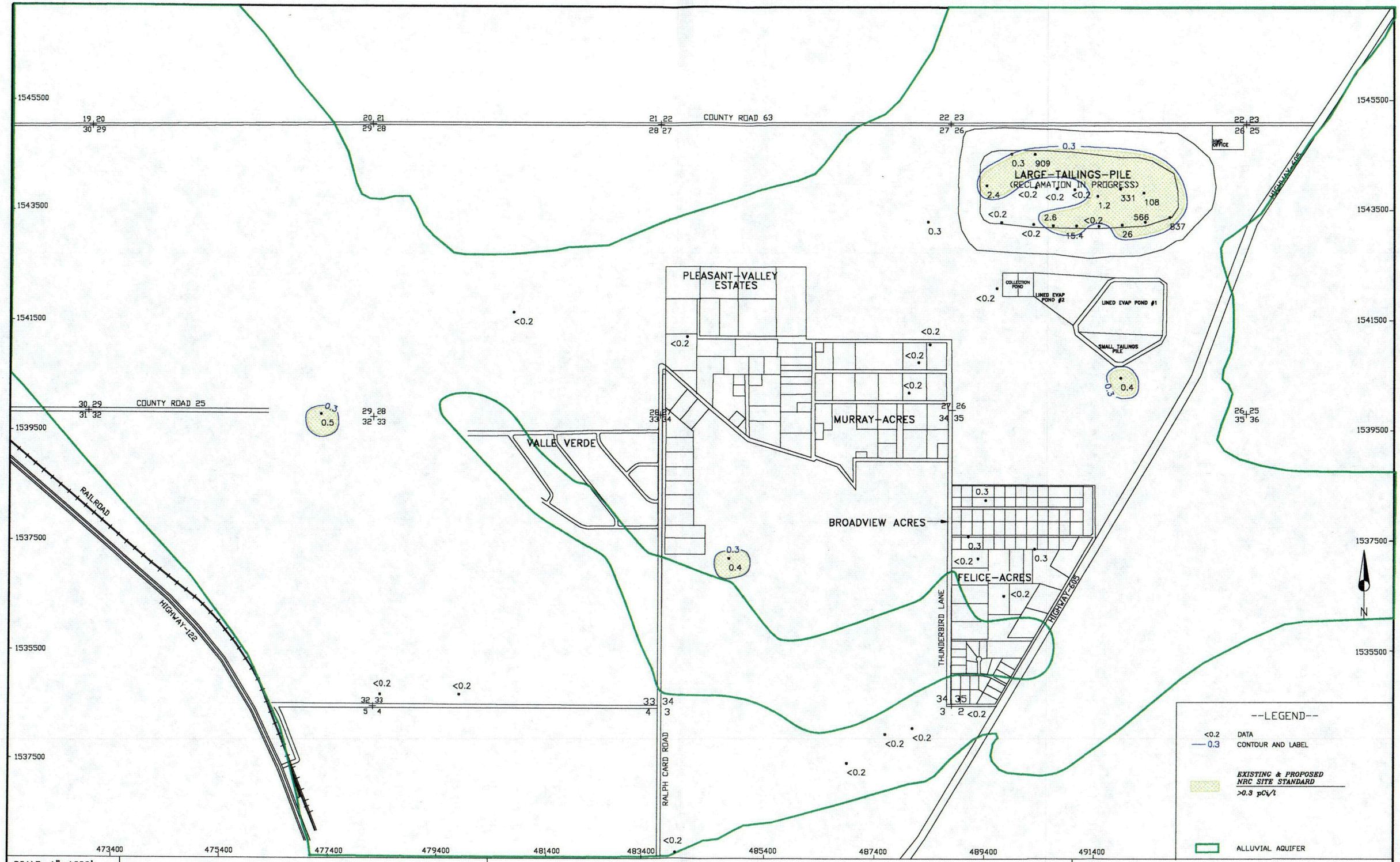
C:\PROJECTS\2004-06\C-QAL04

DATE: 03/23/05

HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 4.3-122. VANADIUM CONCENTRATIONS OF THE ALLUVIAL AQUIFER, 2004, mg/l

C197



SCALE: 1"=1600'

C:\PROJECTS\2004-06\C-QAL04

DATE: 03/23/05

HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 4.3-123. THORIUM-230 CONCENTRATIONS OF THE ALLUVIAL AQUIFER, 2004, pCi/l

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