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# TRANSMITTAL OF SOUTH PLUME GROUNDWATER RECOVERY SYSTEM EVALUATION REPORT FOR JANUARY 1, 1995, THROUGH JUNE 30, 1995

09/29/95

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REPORT

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Department of Energy
Fernald Environmental Management Project
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SEP 29 1995

DOE-1587-95

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

**TRANSMITTAL OF SOUTH PLUME GROUNDWATER RECOVERY SYSTEM EVALUATION REPORT FOR JANUARY 1, 1995, THROUGH JUNE 30, 1995**

Enclosed for your review is the South Plume Groundwater Recovery System Evaluation Report, covering the period January 1, 1995, through June 30, 1995. This document fulfills the reporting requirements defined in the Design, Monitoring, and Evaluation Program Plan (DMEPP) by summarizing the monitoring and operational activities and assessing the effectiveness of the South Plume recovery wellfield.

You will note that an improved format has been used for this submittal. The basis for the new format is twofold: 1) The U.S. Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (OEPA) comments on the April 1995 System Evaluation Report indicated a need to simplify the report by providing a more summary level presentation of the information, and 2) as part of the final site remedy, a substantial amount of additional groundwater data will require documentation as more recovery wellfields are brought on line. The Department of Energy, Fernald Area Office's goal in revising the format is to provide a comprehensive, consistent structure that will allow report users to quickly locate the same type of information in the same location of the report over each reporting period. This format is being introduced now to ensure that an efficient reporting structure is in place to encompass future expansions to the system. As part of this improvement, textual discussions have been reduced and the tabular and graphical presentations of the data have been expanded.

In addition to the new format, please note that the analytical data used to prepare the DMEPP System Evaluation Report (i.e., Appendix A of the report) is contained on a computer disk which is enclosed in the report. The data for Appendix A was complied with

dBase IV and this file format is compatible with any xBase program and Oracle. The computor disk is being supplied only to the U.S. EPA, OEPA, and their technical support subcontractors.

If you have any questions, please contact John Kappa (513) 648-3149 or Kathi Nickel (513) 648-3166.

Sincerely,

Johnny Reising

FN:Kappa

Johnny W. Reising
Fernald Remedial Action
Project Manager

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7207

# SOUTH PLUME REMOVAL ACTION DESIGN MONITORING EVALUATION PROGRAM PLAN

# SYSTEM EVALUATION REPORT FOR JANUARY 1, 1995 - JUNE 30, 1995

**OPERABLE UNIT 5**

**FERNALD ENVIRONMENTAL MANAGEMENT PROJECT**
**FERNALD, OHIO**


**OCTOBER 1995**

**U.S. DEPARTMENT OF ENERGY**
**FERNALD AREA OFFICE**

**DRAFT**

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# SOUTH PLUME REMOVAL ACTION
# DESIGN MONITORING EVALUATION PROGRAM PLAN

## SYSTEM EVALUATION REPORT
## FOR JANUARY 1, 1995 - JUNE 30, 1995

**OPERABLE UNIT 5**

**FERNALD ENVIRONMENTAL MANAGEMENT PROJECT**
**FERNALD, OHIO**

**OCTOBER 1995**

**U.S. DEPARTMENT OF ENERGY**
**FERNALD AREA OFFICE**

000004

**DRAFT**

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# EXECUTIVE SUMMARY

This System Evaluation Report summarizes the performance of the South Plume recovery wellfield during the period January 1, 1995 through June 30, 1995. This document fulfills the reporting requirements defined in the Design, Monitoring, and Evaluation Program Plan (DMEPP) of April 1993. The reporting schedule has been amended by correspondence between the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) and the Ohio EPA (OEPA); reports are now due in April and October of each year. Another change is the provision of Appendix A, the Summary of Analytical Detections, on disk. The disk is in the front pocket of the binder. New for this reporting period is the Mann-Kendall test for trend which was performed on the analytical data.

The South Plume wellfield is currently operates with Recovery Wells 3924, 3925, 3926, and 3927 pumping at a combined rate of 1400 gpm. During the reporting period, this pumping configuration was maintained 72 percent of the time. A total of 317 million gallons of water was pumped and 46.1 pounds of uranium were removed from the aquifer. Individual pump outages due to scheduled maintenance, power interruptions and limited mechanical failures affected the system approximately 28 percent of the available operating time.

The capture zone of the recovery wellfield is consistent with that of the last reporting period. The main body of the 20 $\mu$g/L uranium plume continues to be captured and the extent of the southernmost lobe of the plume that resides outside the capture zone remains essentially unchanged. The extent of the southern lobe of the plume outside the capture zone is defined by total uranium concentrations in Monitoring Well 2552. Total uranium concentrations in Monitoring Well 2552 increased slightly to 21 $\mu$g/L at the end of the reporting period compared to the 20 $\mu$g/L value (from October 1994) used to generate the total uranium plume map for the April 1995 DMEPP System Evaluation Report. Historically this well has exhibited concentrations of total uranium from approximately 20 to 25 $\mu$g/L. However, results of the Mann-Kendall test for trend on the data set for Well 2552 identify the data as exhibiting a significant decrease in trend.

Groundwater modeling performed as a result of EPA comments on the April 1995 System Evaluation Report indicated that the tip of the South Plume could not be captured by the existing recovery wellfield without adversely impacting the Paddys Run Road Site (PRRS) plume and that an additional

recovery well would be required to effect capture. Modeling also showed that this area of the uranium plume will naturally dissipate in two to three years to the point where total uranium concentrations are well below the EPA-proposed maximum contaminant level (MCL) of 20 μg/L. A colloidal boroscope is currently on order for use at the FEMP and will be used to accurately measure flow direction and groundwater velocity in this well. This work is currently scheduled for the fourth quarter of 1995.

The hydraulic, chemical, and radiological data collected during the reporting period is, in general, consistent with past reports. Evaluation of the data indicates that the South Plume recovery wells are exerting a negligible influence on the PRRS plume. Concentrations of arsenic in several monitoring wells located south of the recovery wellfield continue to fluctuate. Data collected south of the recovery wellfield and north of the PRRS show one anomaly; Monitoring Well 2900 exhibited increased sodium concentrations, a target analyte for the PRRS plume. Because Monitoring Well 2900 is located south of and close to the recovery wellfield it will continue to be monitored and the results discussed in the next report.

As presented to EPA and OEPA this summer, modeling has been performed to evaluate possible improvements to the existing system that would accelerate uranium mass removal from off-property portions of the plume. The results of the optimization study indicate that the installation of three extraction wells south of Willey Road, in a line parallel to and offset downgradient from the center of the plume, would increase uranium removal efficiency. Installation of a fourth well near the northeast lobe of the plume would achieve optimal capture. These proposed wells would be operated concurrently with Recovery Wells 3924 and 3925. This information was presented in detail at meetings among the DOE, EPA, OEPA and FERMCO on July 25 and September 5, 1995; further study and discussion on how these plans can be integrated into the final remedial alternative is needed before the study's recommendations are implemented. It is currently envisioned that optimization of the South Plume groundwater recovery system would occur according to the remedial design/remedial action schedules for Operable Unit 5.

# 1.0 OPERATIONAL SUMMARY

This section summarizes the operation of the recovery wellfield from January 1 through June 30, 1995. Under current operating conditions, Wells 3924 and 3925 are pumped at a rate of 300 gpm and Wells 3926 and 3927 are pumped at 400 gpm for a total system flow of 1400 gpm; (see Figure 1-1 for locations of all the DMEPP wells). Recovery Well 3928 has been shut down since December of 1994 at the suggestion of OEPA due to its distance from the 20 $\mu$g/L isopleth of the total uranium plume. During the first three weeks of January, operation of the wellfield was interrupted due to maintenance and repair activities. Over the entire reporting period the individual recovery wells operated from 87.5 to 90.9 percent of the available time and portions of the recovery system operated 99 percent of the time. The recovery system operated at the four-well, 1400 gpm configuration 72 percent of the time. For 27 percent of the time, alternate configurations were used to accommodate scheduled maintenance (17.5 percent) and mechanical breakdowns (9.5 percent). During these periods, the pumping rates of the operating wells were increased as needed to maximize capture. Electrical outages caused the entire recovery well system to be down for one percent of the available operating time.

On the following pages are operational summary sheets prepared for Recovery Wells 3924, 3925, 3926, 3927 and 3928. Monitoring data for these wells were collected at the individual well location. Data that are representative of the entire recovery wellfield were collected at the storm water retention basin (SWRB) valve house (a wellfield operational summary sheet follows those for the individual recovery wells). Due to the different flow measurement points, minor differences in the cumulative wellhead totals and the valve house measurements for total flow are common. Data from the valve house were used to plot daily total uranium concentrations in the South Plume discharge water for the reporting period (Figure 1-2), monthly average total uranium concentrations since the start-up of the recovery wellfield in 1993 (Figure 1-3), and the cumulative pounds of uranium removed versus the cumulative gallons pumped by the recovery wells (Figure 1-4).

A total of 319 million gallons of water was pumped during this reporting period and accounted for 46.1 pounds of uranium being removed from the aquifer; the average daily total uranium concentrations in the South Plume discharge water was 18.3 $\mu$g/L. While there were numerous short-term exceedances of this average, as shown in Figure 1-2, two were significant and appeared in more than one sample. One occurred from February 13-22 while Recovery Well 3927 was inoperative and

the other occurred from May 9-17 while the South Field pumping test was being conducted. The discharge water from these tests was mixed with South Plume discharge water ahead of the DMEPP's sampling point at the SWRB valve house, resulting in a detectable increase in uranium concentrations.

# WELL 3924
# OPERATIONAL SUMMARY SHEET

Reference Elevation (AMSL) - 531.9 (top of casing)
Northing Coordinate ('27) - 474,190.37
Easting Coordinate ('27) - 1,379,783.13

Hours in reporting period - 4344 Hours pumped - 3804
Hours not pumped - 540 Operational percent - 87.6

Monthly Measurements at Wellfield

| Month | Pumping Rate (gpm) | Million Gallons Pumped | Uranium Concentration (ppb) | Well Efficiency (lbs/M gal) |
|---|---|---|---|---|
| 1/95 | 359[a,b,c] | 8.5[b,c,d] | 65.0 | .54 |
| 2/95 | 300 | 9.7[d] | [e] | [e] |
| 3/95 | 300 | 10.4[d,f] | 52.0 | .43 |
| 4/95 | 300 | 13.0 | 47.0 | .39 |
| 5/95 | 300 | 13.1 | 44.0 | .37 |
| 6/95 | 300 | 13.9 | 46.0 | .38 |
| | | Total 68.6 | Average 50.8 | Average .42 |

[a]Average rate
[b]Well out of service for pump replacement - January 1-13, 1995
[c]Pumping rate of 400 gpm to compensate for shutdown of Recovery Well 3925 - January 13-24; pumping rate returned to 300 gpm - January 24, 1995
[d]Well shut down while repairs made to controller - February 23 - March 5, 1995
[e]No sample collected due to well maintenance during scheduled sampling period
[f]Well shut down while controller replaced - March 23-24, 1995

# WELL 3925
# OPERATIONAL SUMMARY SHEET

Reference Elevation (AMSL) - 540.3 (top of casing)
Northing Coordinate ('27) - 474,290.32
Easting Coordinate ('27) - 1,380,034.28

Hours in reporting period - 4344 Hours pumped - 3948
Hours not pumped - 396 Operational percent - 90.9

Monthly Measurements at Wellfield

| Month | Pumping Rate (gpm) | Million Gallons Pumped | Uranium Concentration (ppb) | Well Efficiency (lbs/M gal) |
|---|---|---|---|---|
| 1/95 | 372[a,b,c,d] | 7.3[b,c,d] | 28.0 | .23 |
| 2/95 | 300 | 12.1 | 28.0 | .23 |
| 3/95 | 300 | 13.5 | 26.0 | .22 |
| 4/95 | 300 | 13.1 | 28.0 | .23 |
| 5/95 | 300 | 13.6 | 33.0 | .28 |
| 6/95 | 300 | 13.1 | 30.0 | .25 |
| | | Total 72.7 | Average 28.8 | Average .24 |

[a]Average rate
[b]Well out of service during pump replacement at Well 3924 - January 1-6; to compensate, well pumped at 450 gpm - January 6-13, 1995
[c]Well pump replaced and well redevelopment performed - January 13-24, 1995
[d]Well back in service at 300 gpm - January 24, 1995

# WELL 3926
# OPERATIONAL SUMMARY SHEET

Reference Elevation (AMSL) - 585.0 (top of casing)
Northing Coordinate ('27) - 474,399.22
Easting Coordinate ('27) - 1,380,306.40

Hours in reporting period - 4344
Hours not pumped - 480
Hours pumped - 3864
Operational percent - 89.0

Monthly Measurements at Wellfield

| Month | Pumping Rate (gpm) | Million Gallons Pumped | Uranium Concentration (ppb) | Well Efficiency (lbs/M gal) |
|---|---|---|---|---|
| 1/95 | 352[a,b] | 6.6[b,c] | 6.5 | .05 |
| 2/95 | 400 | 14.8 | 5.0 | .04 |
| 3/95 | 400 | 17.8 | 5.1 | .04 |
| 4/95 | 400 | 16.7 | 5.6 | .05 |
| 5/95 | 400 | 16.8[d] | 6.2 | .05 |
| 6/95 | 400 | 15.2 | 5.9 | .05 |
| | | Total 87.9 | Average 5.7 | Average .05 |

[a]Average rate
[b]Pump borrowed for use in Well 3924 - January 1-18, 1995
[c]Well returned to service - January 18; pumped at 300 gpm - January 18-24; returned to 400 gpm - January 24, 1995
[d]Well shut down during a thunderstorm due to an electrical malfunction; well restarted next morning at 400 gpm - May 17-18, 1995

# WELL 3927
# OPERATIONAL SUMMARY SHEET

Reference Elevation (AMSL) - 589.0 (top of casing)
Northing Coordinate ('27) - 474,512.49
Easting Coordinate ('27) - 1,380,596.15

Hours in reporting period - 4344 Hours pumped - 3804
Hours not pumped - 540 Operational percent - 87.6

Monthly Measurements at Wellfield

| Month | Pumping Rate (gpm) | Million Gallons Pumped | Uranium Concentration (ppb) | Well Efficiency (lbs/M gal) |
|---|---|---|---|---|
| 1/95 | 506[a,b] | 15.2[b] | 1.6 | .01 |
| 2/95 | 400 | 10.3[c] | 1.4 | .01 |
| 3/95 | 400 | 18.0 | 1.2 | .01 |
| 4/95 | 400 | 13.3[d] | 1.3 | .01 |
| 5/95 | 400 | 17.1 | 1.4 | .01 |
| 6/95 | 400 | 15.5 | 1.2 | .01 |
| | | Total 89.4 | Average 1.4 | Average .01 |

[a]Average rate
[b]Well out of service during pump replacement at Well 3924 - January 1-6; returned to service - January 6; pumped at 550 gpm to compensate for shutdown of Well 3926 - January 6-24; returned to 400 gpm - January 24, 1995
[c]Well shut down due to unidentified cause - February 13-22; restarted at 400 gpm - February 22, 1995
[d]Well out of service during repair of control switch - April 5-11, 1995

# WELL 3928
# OPERATIONAL SUMMARY SHEET

Reference Elevation (AMSL) - 588.3 (top of casing)
Northing Coordinate ('27) - 474,608.92
Easting Coordinate ('27) - 1,380,841.74

Hours in reporting period - 4344 Hours pumped - 0
Hours not pumped - 4344 Operational percent - 0

Monthly Measurements at Wellfield[a]

| Month | Pumping Rate[a] (gpm) | Million Gallons Pumped[a] | Uranium Concentration[a] (ppb) | Well Efficiency[a] (lbs/M gal) |
|---|---|---|---|---|
| 1/95 | 0 | 0 | — | — |
| 2/95 | 0 | 0 | — | — |
| 3/95 | 0 | 0 | — | — |
| 4/95 | 0 | 0 | — | — |
| 5/95 | 0 | 0 | — | — |
| 6/95 | 0 | 0 | — | — |
| | | Total 0 | Average — | Average — |

[a]This recovery well is shut down because it is currently not needed to meet system objectives due to observed low concentrations of uranium in this well's discharge water when system was in operation. Recovery Well 3928 will be on standby in the event of future need.

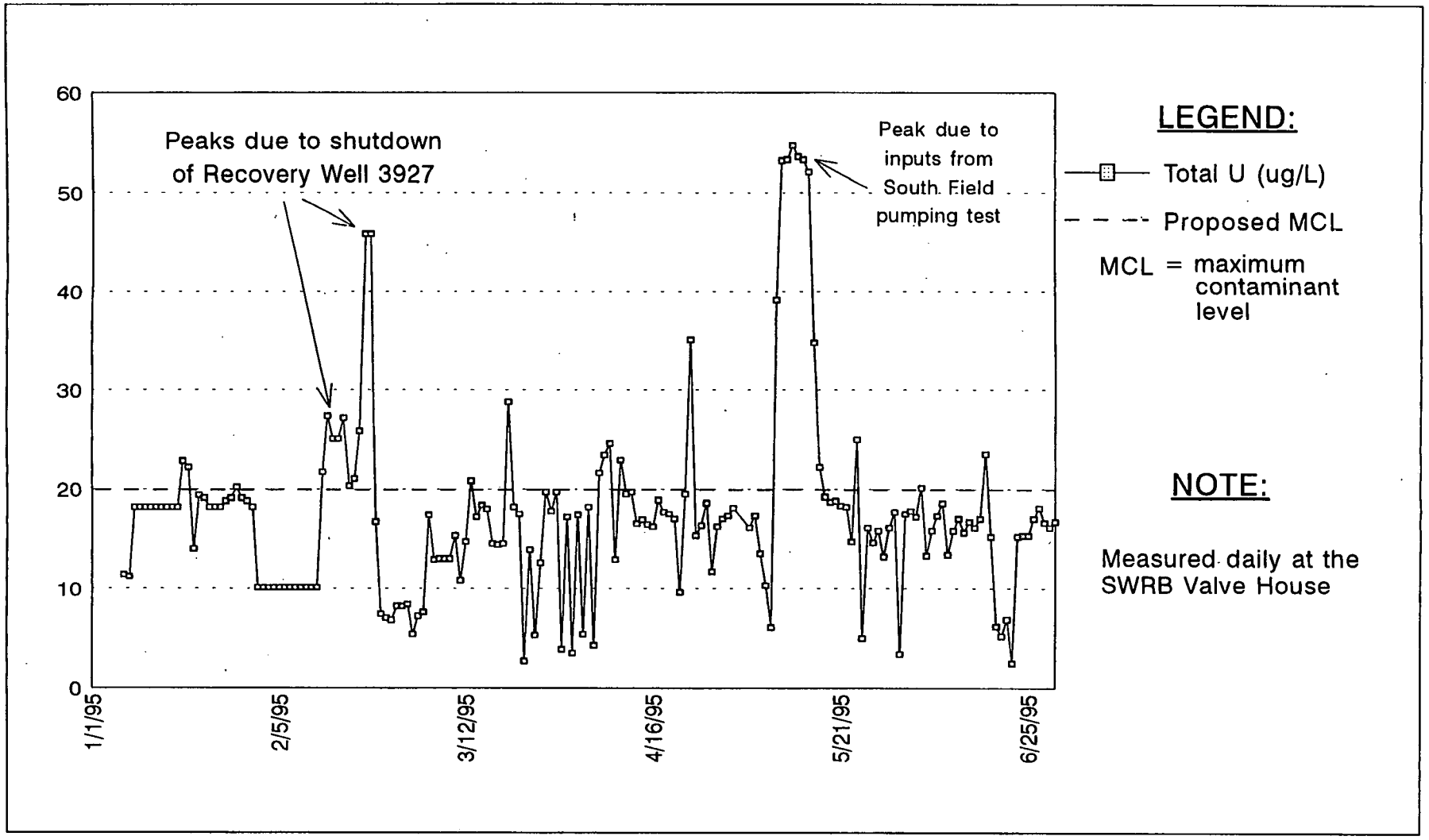
## WELLFIELD OPERATIONAL SUMMARY SHEET

Total gallons pumped this reporting period (M gal) - 319
Total uranium recovered this reporting period (lbs) - 46.1
Average system efficiency this reporting period - .15
Gallons pumped from August 1993 to June 1995 (billion gal) - 1.3
Uranium recovered from August 1993 to June 1995 (lbs) - 169.4
System efficiency from August 1993 to June 1995 (lbs/M gal) - .13

Monthly Measurements at Storm Water Retention Basin Valve House

| | Well Pumping Rates (gpm) | | | | | Total System Pumping Rate (gpm) | Total System Average Uranium Concentration (ppb) |
|---|---|---|---|---|---|---|---|
| Month | 3924 | 3925 | 3926 | 3927 | 3928 | | |
| 1/95 | 359[a] | 372[a] | 352[a] | 506[a] | 0 | 1400[b] | 18.1 |
| 2/95 | 300 | 300 | 400 | 400 | 0 | 1400 | 16.5 |
| 3/95 | 300 | 300 | 400 | 400 | 0 | 1400 | 17.7 |
| 4/95 | 300 | 300 | 400 | 400 | 0 | 1400 | 16.9 |
| 5/95 | 300 | 300 | 400 | 400 | 0 | 1400 | 25.2[c] |
| 6/95 | 300 | 300 | 400 | 400 | 0 | 1400 | 14.9 |

[a]Pumping rates are averaged.
[b]Despite higher individual recovery well pumping rates, total combined rate is 1400 gpm because a maximum of three wells were operating at any one time except during the last week of January when Wells 3924 and 3925 were pumping at 300 gpm each and Wells 3926 and 3927 were pumping at 400 gpm.
[c]This is higher than concentrations for the individual recovery wells in May and is attributed to the South Field pumping test input to the system.




SWRBTU3

Figure 1-2. Daily Total Uranium Concentration in South Plume Discharge Water, 1/95 - 6/95

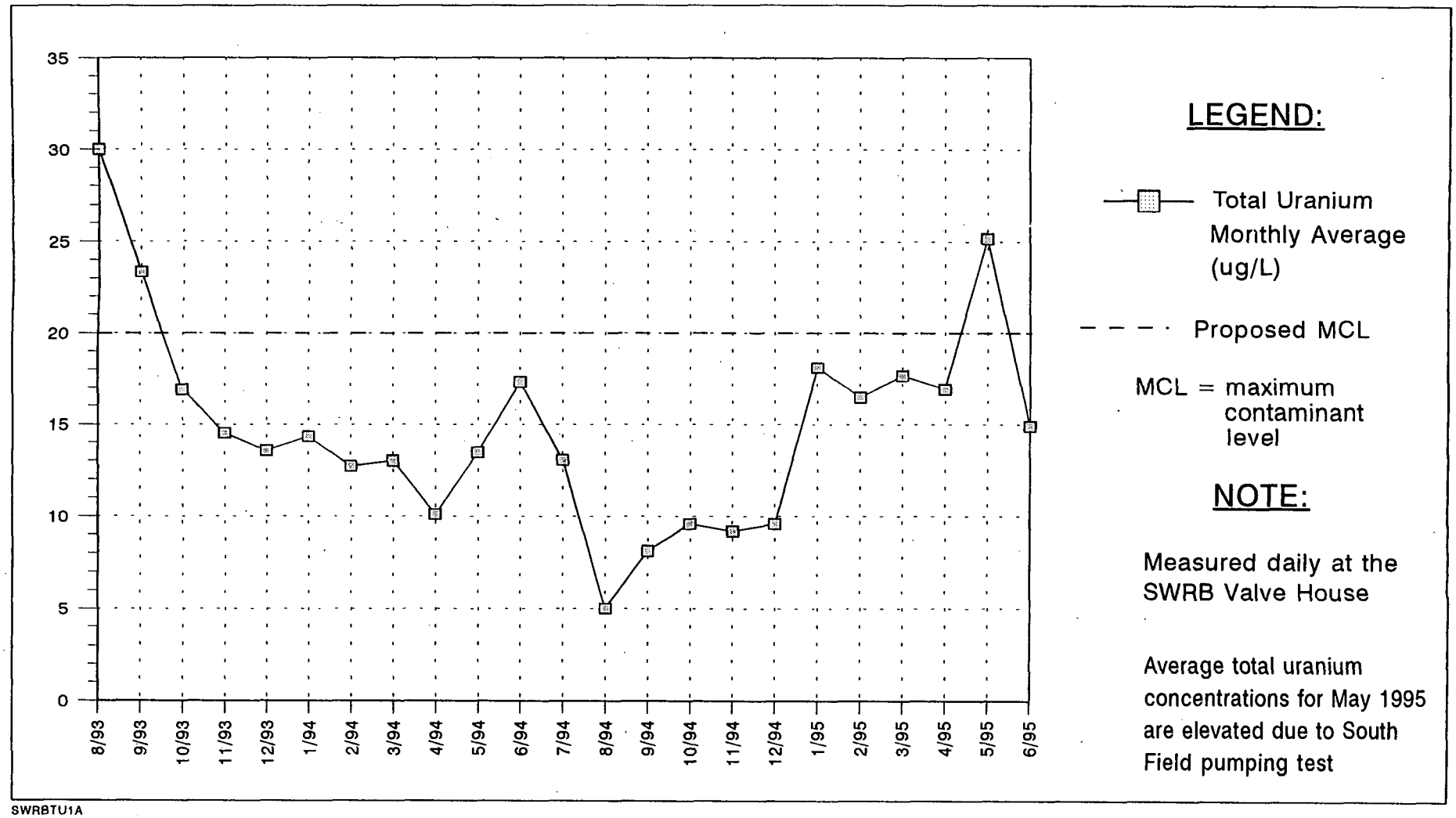



Figure 1-3. Monthly Average Total Uranium Concentration in South Plume Discharge Water, 8/93 - 6/95

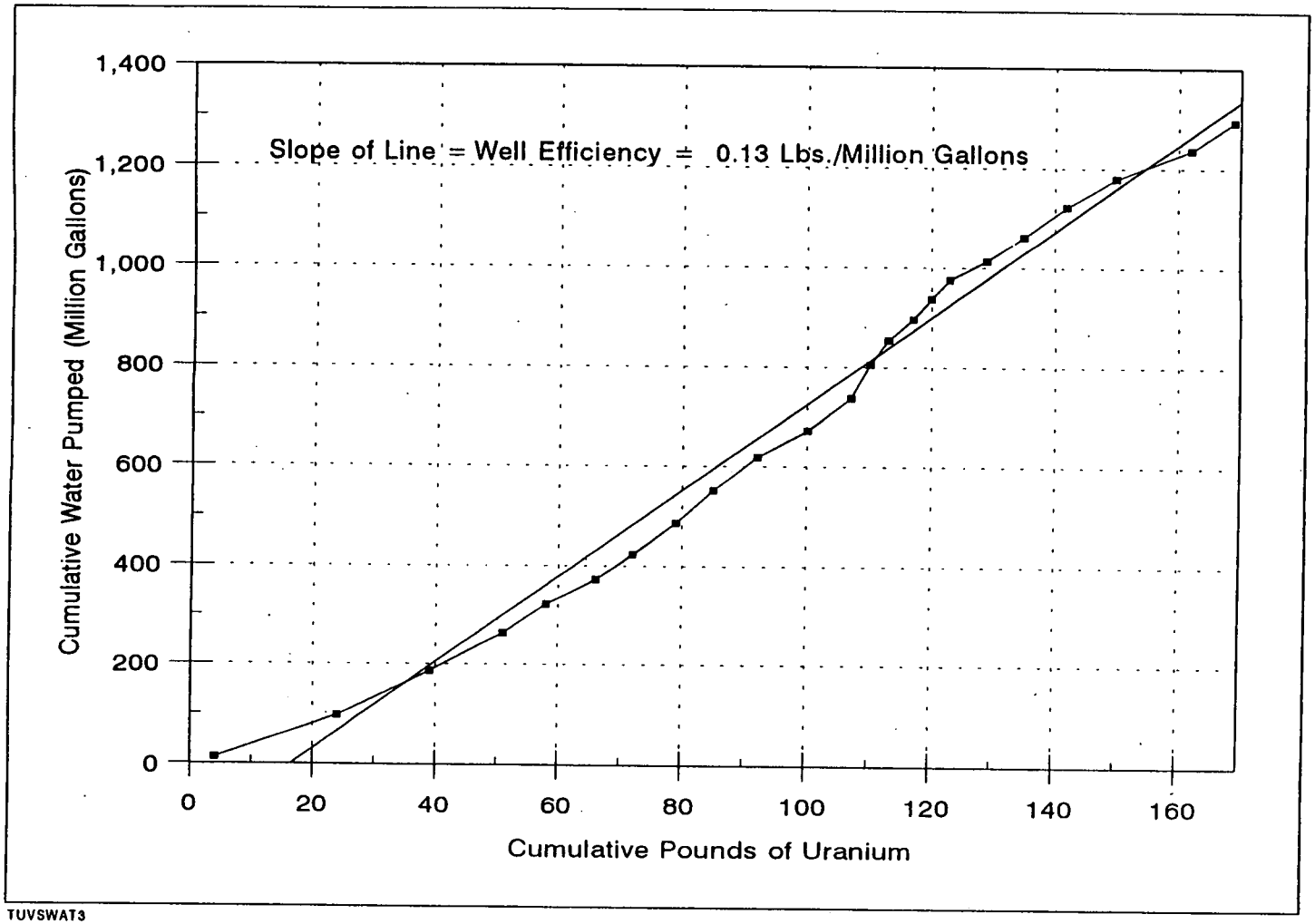



Figure 1-4. Total Uranium Removed vs Water Pumped
(August 1993 - June 1995)

## 2.0 MONITORING WELL SUMMARY

The original DMEPP monitoring network consisted of sampling 36 monitoring wells to measure groundwater elevation and water quality. Since that time one of the original monitoring points has been removed from the program (due to access restrictions and insufficient well screen length), six supplemental wells have been added to the groundwater elevation program (see Table 2-1), and 22 supplemental wells have been added to the groundwater quality sampling program (see Table 2-2). There are currently 41 monitoring wells used to collect water elevation data on a monthly basis. Due to the stability of the recovery wellfield pumping rate, the frequency of groundwater elevation measurements will change to quarterly for the next reporting period. If the recovery system operation changes (i.e., change in pumping rates), provisions have been made to collect monthly groundwater elevations as warranted. These data are used in Section 4.0 of this report to assess the effective capture of uranium-contaminated groundwater by the recovery wellfield.

There are currently 57 monitoring wells used to collect groundwater quality data for the DMEPP System Evaluation Report. The 22 wells added to the groundwater sampling program were selected to assist in maintaining definition of the extent of the contiguous 20 $\mu$g/L uranium groundwater plume. Figure 1-1 shows the location of those wells currently sampled that provide analytical results for the DMEPP and Table 2-2 identifies the constituents analyzed for. This information is used in Section 3.0 to prepare statistical summary tables and in Section 4.0 to provide contour maps of the uranium plume at the Type 2- and Type 3-well-depth intervals. Sampling of the DMEPP monitoring wells occurs on a quarterly basis. Additional sampling is performed based on data needs determined by analytical review of data as it becomes available.

## TABLE 2-1

## DMEPP MONITORING WELLS FOR THE GROUNDWATER ELEVATION PROGRAM

| Original Wells | Supplemental Wells/Date Added |
|---|---|
| 2002 | 2126 / 2/94 |
| 2061 | 2545 / 2/94 |
| 2093 | 2546 / 2/94 |
| 2095 | 2553 / 2/94 |
| 2125 | 2702 / 2/94 |
| 2128 | 3927 / 12/94 |
| 2394 | |
| 2396 | |
| 2543 | |
| 2544 | |
| 2548 | |
| 2549 | |
| 2552 | |
| 2624 | |
| 2625 | |
| 2636 | |
| 2880 | |
| 2881 | |
| 2897 | |
| 2898 | |
| 2899 | |
| 2900 | |
| 3062 | |
| 3093 | |
| 3095 | |
| 3125 | |
| 3128 | |
| 3396 | |
| 3624 | |
| 3636 | |
| 3880 | |
| 3881 | |
| 3897 | |
| 3898 | |
| 3899 | |
| 3900 | |
| Total 36 | 6 |

## TABLE 2-2

## DMEPP MONITORING WELLS AND ANALYTICAL PARAMETERS FOR THE GROUNDWATER SAMPLING PROGRAM

| Original Wells | Analytical Parameters[a] | Supplemental Wells/Date Added[b] | Analytical Parameters[a] |
|---|---|---|---|
| 2002 | A,B | 2015 / 2/94 (5/95) | A,B |
| 2061 | A,B | 2017 / 2/94 (5/95) | A,B |
| 2093 | A,B | 2060 / 2/95 (2/95) | A,B |
| 2095 | A,B | 2106 / 2/94[c] | A,B |
| 2125 | A,B | 21063 / 5/94 (5/95) | A,B |
| 2128 | A,B,C,D,E | 2166 / 5/95 (5/95) | A,B |
| 2544 | A,B | 2396 / 5/95 (5/95) | A,B |
| 2545 | A,B | 2398 / 1/94[c] | A,B |
| 2548 | A,B,C,D,E | 2434 / 1/94[c] | A,B |
| 2549 | A,B,C,D,E | 2550 / 2/94 (5/95) | A,B |
| 2624 | A,B | 2551 / 2/94 (5/95) | A,B |
| 2625 | A,B,C,D,E | 2552 / 2/94 (5/95) | A,B |
| 2636 | A,B,C,D,E | 2553 / 2/94 (5/95) | A,B |
| 2880 | A,B | 3015 / 2/94 (5/95) | A,B |
| 2881 | A,B | 3062 / (6/95)[d] | A,B |
| 2897 | A,B | 3106 / 2/94[c] | A,B |
| 2898 | A,B,C,D | 3396 / (6/95)[d] | A,B |
| 2899 | A,B,C,D | 3550 / 2/94 (5/95) | A,B |
| 2900 | A,B,C,D,E | 3551 / 2/94 (5/95) | A,B |
| 3093 | A,B | 3552 / 2/94 (5/95) | A,B |
| 3095 | A,B | 3689 [21194][e] / 2/95 (2/95) | A,B |
| 3125 | A,B | 4125 / (6/95)[d] | A,B |
| 3128 | A,B,C,D | | |
| 3624 | A,B | | |
| 3636 | A,B,C,D | | |
| 3880 | A,B | | |
| 3881 | A,B | | |
| 3897 | A,B | | |
| 3898 | A,B,C,D | | |
| 3899 | A,B,C,D | | |
| 3900 | A,B,C,D | | |
| 3924 | A,B,E | | |
| 3925 | A,B,E | | |
| 3926 | A,B | | |
| 3927 | A,B | | |
| 3928 | A,B | | |
| Total 36 | | 22 | |

**TABLE 2-2**
**(Continued)**

[a]A Dissolved oxygen, pH, specific conductance, temperature (analyzed in the field)
B Total uranium (analyzed at the on-site laboratory)
C Arsenic, phosphorus (total), potassium, sodium (PRRS inorganics)
D Benzene, cumene (isopropyl benzene), ethyl benzene, toluene, xylene (PRRS organics)
E Arsenic (collected on a weekly basis; see results in Appendix A for exact sample collection dates)

[b]Date added is when analytical results were first used in support of findings for the DMEPP. The date in parentheses is when the monitoring well was formally added to the DMEPP sampling program.

[c]Monitoring well is sampled under a separate program but provides the necessary analytical results on a sampling schedule compatible with the DMEPP.

[d]Monitoring well added to sampling list at end of month but was not sampled until after the reporting period ended.

[e]Well 21194 is a PRRS well immediately adjacent to the PRRS production Well 3689. Well 21194 replaced Well 3689 in March 1995.

## 3.0 ANALYTICAL DATA SUMMARY

Appendix A contains the analytical data used to prepare this report; see the enclosed disk. Appendix B contains concentration plots over time for unfiltered total uranium samples. The statistical summaries (the minimum, maximum, average and standard deviation) are presented in Tables 3-1 through 3-5 for total uranium, arsenic, phosphorus, potassium and sodium, which are analyzed for under the DMEPP. Based on a review of available data, five wells were determined to have outliers in their data sets during the August 27, 1993 through December 31, 1994 time frame. The outlier from Well 2624 displayed a minimum uranium concentration of 7.5 $\mu$g/L, a value 10 times lower than any other value measured from that well. The outlier from Well 3898 displayed a value of 180 $\mu$g/L and a reanalyzed value of 170 $\mu$g/L. All other samples collected from this well exhibited uranium concentrations ranging from nondetect to 2.4 $\mu$g/L. Samples from Wells 2548, 2900 and 3128 exhibited maximum arsenic concentrations considered outliers based on comparison with the low concentrations typically reported from these wells. The presence of the outliers skew the calculated averages and standard deviation for uranium and arsenic concentrations for these wells.

The Mann-Kendall trend test was recommended in the April 1993 DMEPP as the method to use to determine trend once sufficient data was available. Therefore, for this System Evaluation Report, the Mann-Kendall trend test was performed on unfiltered sample results in the data set, excluding outliers, from the August 27, 1993 through June 30, 1995 sampling period for total uranium, arsenic, phosphorus, potassium, and sodium. Tables 3-1 through 3-5 include summaries of the Mann-Kendall test results by analyte and location, the number of distinct sampling events used in the calculation of trend, and the probability that the trend calculated is due to chance. In preparing these tables only data with validation qualifiers "-," "J," "NV," "U," and "UJ" were used (see Appendix A). All "U" and "UJ" qualified data were used at one-half the reported value because these values represent the detection limit of the particular analysis. The time-ordered data are represented as $x_i$, $x_2$, ... $x_n$, where $x_k$ is the datum at time interval k. All possible differences are represented as $x_i - x_j$, where $i < j$. The Mann-Kendall test for trend assigns an integer (-1, 0, or 1) such that:

$$\text{sgn}(x_j - x_i) = \begin{cases} -1 & x_i > x_j \\ 0 & x_i = x_j \\ 1 & x_i < x_j \end{cases}$$

The Mann-Kendall statistic is then calculated as:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} sgn\,(x_j - x_i)$$

A value for S greater than one implies a possible upward trend, a value for S less than one implies a possible downward trend, and a value of S = 0 implies no trend.

The Mann-Kendall probability value gives the probability that the apparent trend is due to chance and not a real trend. A probability value of .05 indicates that there is only a 5 percent chance that the observed trend is simply an artifact of random fluctuation (random error) and not a trend at all. In other words, there is a 5 percent chance of declaring that there is a trend (upward or downward) when in actuality there is no trend. In Tables 3-1 through 3-5 the 5 percent (.05) level was used to determine if there was significant evidence of a trend and 10 percent (.10) was used to determine if there was a marginally significant evidence of a trend.

No statistical summaries or Mann-Kendall trend tests were performed on the volatile organic constituents (benzene, cumene, ethylbenzene, toluene and xylene) sampled for under the DMEPP because only one detection was noted for the reporting period. Toluene was detected in Well 3900 at 0.8 μg/L on June 21, 1995. For the period August 27, 1993 through December 30, 1994 toluene was detected in Wells 2898 (2.9 μg/L) and 2900 (3.4 and 3 μg/L). Also detected in Well 2900 were benzene (once at 1 μg/L) and xylene (once at 3 μg/L).

It has been discovered since the last reporting period that one of the contract laboratories was reporting nondetections of cumene without a quantitative detection limit. The instruments and methods used by the laboratory in question for this analysis commonly yield a detection capability below 5 μg/L. However, the laboratory did not determine a response factor for cumene during the analyses. Although the exact detection limit for cumene cannot be determined due to the lack of a response factor, reporting the historically achievable detection limit of 5 μg/L is a reliable and conservative approach. Because cumene was not reported by the laboratory, it can be stated that

neither cumene nor an isomer has been detected since system start-up in August 1993. The problem was caught and corrected during this reporting period, and all cumene results with quantified detection limits have been included in Appendix A.

In order to assist in the assessment of data collected since system start-up, Mann-Kendall test results with significant upward or downward trends identified from unfiltered samples for August 27, 1993 through June 30, 1995 have been compiled in Table 3-6 for total uranium, arsenic, phosphorus, potassium and sodium, along with specific comments for each trend.

An examination of the trend values for total uranium data (Table 3-6) shows that 11 wells have a significant downward trend while nine wells have significant upward trends. The 11 wells exhibiting significant decreases are located within the extent of the total uranium plume. Of particular note is Well 2552, identified by Mann-Kendall test results as exhibiting a significant decrease. This is the well that is used to document the extent of the southern lobe of the 20 $\mu$g/L isopleth of the plume defined by Type 2 wells. Recovery Well 3928, shut down in 1994 due to the low concentrations of total uranium in the discharge water, exhibited a decreasing trend. Of the nine wells that exhibited significant increases, eight of these wells are within the capture zone. Two of these wells are recovery wells and two are within the extent of the 20 $\mu$g/L isopleth of the plume. Of the remaining five wells, four had average uranium concentrations for this reporting period near background levels.

Well 2128 is the only well outside the capture zone to show a significant upward trend. Because Well 2625, which is upgradient of Well 2128 and downgradient of the recovery wells, exhibits no significant trend based on Mann-Kendall results (see Table 3-1), it is thought that the increase in uranium concentrations is not due to an excursion past the recovery wellfield. As shown on Plate E-77 of the Operable Unit 5 RI Report, Well 2128 is on the eastern edge of the portion of the uranium plume embedded within the PRRS plume. The increase in uranium concentrations in Well 2128 is explained by the southeastern migration of this embedded portion of the plume. Although the trend has been upward, uranium concentrations in this well are still below 20 $\mu$g/L. This well will continue to be monitored during the next reporting period.

An examination of the arsenic trend values in Table 3-6 shows only a significant upward trend in Well 2548 and is not attributed to the operation of the recovery wellfield. The remaining wells that exhibited fluctuating arsenic concentrations during the last reporting period were upgradient of

Well 2548 and were identified as having no significant trend by the Mann-Kendall results (Table 3-2). Well 2900, which is used as an early warning for potential capture of PRRS constituents, exhibited a significant downward trend in arsenic concentrations.

Mann-Kendall trend test results performed on the remaining PRRS constituents (phosphorus, potassium and sodium) are also presented in Table 3-6. No significant increasing trends were noted for phosphorus or potassium. Sodium, however, exhibited a significant increase in Wells 2636 and 3898. The increasing sodium concentrations at 2636 is due to this well's placement within the PRRS plume, but the increase at 3898 is not, due to the well's location northeast of the PRRS and east of the recovery wellfield (see Figure 1-1). Sodium concentrations in this well will be reassessed in the next System Evaluation Report. Additionally, a review of the basic statistics for this reporting period (see Table 3-5) identified Well 2900 as having a 32 percent increase in sodium concentrations although no trend was apparent. Because this is a PRRS constituent, the sodium data for Well 2900 will be evaluated further during the next reporting period.

## TABLE 3-1

## STATISTICS FOR TOTAL URANIUM

| | Sampling Period | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | August 27, 1993 - December 31, 1994 | | | | | January 1, 1995 - June 30, 1995 | | | | | August 27, 1993 - June 30, 1995 | | |
| Well No. | No. of Samples[a] | Min. (µg/L) | Max. (µg/L) | Avg. (µg/L) | SD | No. of Samples[a] | Min. (µg/L) | Max. (µg/L) | Avg. (µg/L) | SD | No. of Samples[a] | Probability | Trend[b] |
| 2002 | 15 | 1.8 | 2.7 | 2.3 | 0.3 | 3 | 2.2 | 2.6 | 2.3 | 0.2 | 18 | 0.440 | No Trend |
| 2015 | 4 | 160.0 | 170.0 | 162.5 | 4.3 | 1 | 140.0 | 140.0 | 140.0 | 0.0 | 5 | 0.080 | Down, Mar. |
| 2017 | 2 | 4.0 | 5.0 | 4.5 | 0.5 | 1 | 4.8 | 4.8 | 4.8 | 0.0 | 3 | | Insuf. Data |
| 2060 | 4 | 49.0 | 75.0 | 60.3 | 9.5 | 2 | 30.0 | 52.0 | 41.0 | 11.0 | 6 | 0.068 | Down, Mar. |
| 2061 | 15 | 200.0 | 380.0 | 280.7 | 50.5 | 3 | 160.0 | 170.0 | 166.7 | 4.7 | 17 | 0.001 | Down, Sig. |
| 2093 | 8 | 0.3 | 0.9 | 0.5 | 0.2 | 3 | 0.5 | 0.6 | 0.5 | 0.0 | 11 | 0.315 | No Trend |
| 2095 | 8 | 130.0 | 200.0 | 161.3 | 20.3 | 3 | 110.0 | 160.0 | 136.7 | 20.5 | 11 | 0.500 | No Trend |
| 2106 | 5 | 2.2 | 70.0 | 36.4 | 17.1 | 2 | 62.7 | 70.0 | 66.3 | 3.7 | 7 | 0.119 | No Trend |
| 21063 | 3 | 2.1 | 2.5 | 2.3 | 0.2 | 2 | 15.0 | 15.0 | 15.0 | 0.0 | 5 | 0.080 | Up, Mar. |
| 2125 | 8 | 8.8 | 41.0 | 24.9 | 12.1 | 3 | 10.0 | 25.0 | 15.0 | 7.1 | 11 | 0.002 | Down, Sig. |
| 2128 | 8 | 0.8 | 9.8 | 5.6 | 2.0 | 3 | 10.0 | 12.0 | 11.0 | 0.8 | 11 | 0.004 | Up, Sig. |
| 2166 | | | | | | 1 | 72.0 | 72.0 | 72.0 | 0.0 | 1 | | Insuf. Data |
| 2398 | 5 | 0.7 | 7.9 | 4.9 | 2.4 | 2 | 13.0 | 13.0 | 13.0 | 0.0 | 7 | 0.052 | Up, Mar. |
| 2434 | 5 | 1.2 | 4.5 | 2.0 | 1.2 | 2 | 1.2 | 1.3 | 1.3 | 0.0 | 7 | 0.191 | No Trend |
| 2544 | 15 | 0.6 | 21.0 | 9.6 | 6.0 | 3 | 4.5 | 6.2 | 5.1 | 0.8 | 17 | 0.101 | No Trend |
| 2545 | 8 | 20.0 | 81.0 | 47.3 | 21.3 | 3 | 35.0 | 54.0 | 44.7 | 7.8 | 10 | 0.146 | No Trend |
| 2548 | 8 | 0.3 | 5.5 | 3.2 | 1.7 | 3 | 2.0 | 2.6 | 2.3 | 0.2 | 11 | 0.155 | No Trend |
| 2550 | 4 | 73.0 | 82.0 | 77.5 | 3.2 | 2 | 72.0 | 76.0 | 74.0 | 2.0 | 6 | 0.235 | No Trend |
| 2551 | 4 | 12.0 | 30.0 | 21.0 | 6.5 | 2 | 16.0 | 28.0 | 22.0 | 6.0 | 6 | 0.136 | No Trend |
| 2552 | 4 | 20.0 | 24.0 | 22.0 | 1.4 | 2 | 18.0 | 21.0 | 19.5 | 1.5 | 6 | 0.048 | Down, Sig. |
| 2553 | 3 | 0.9 | 1.8 | 1.5 | 0.4 | 2 | 1.0 | 1.1 | 1.1 | 0.1 | 5 | 0.592 | No Trend |
| 2624 | 15 | 7.5 | 160.0[c] | 81.9 | 26.8 | 3 | 66.0 | 98.0 | 81.3 | 13.1 | 17 | 0.003 | Down, Sig. |

## TABLE 3-1
## (Continued)

| Well No. | Sampling Period: August 27, 1993 - December 31, 1994 No. of Samples[a] | Min. (µg/L) | Max. (µg/L) | Avg. (µg/L) | SD | January 1, 1995 - June 30, 1995 No. of Samples[a] | Min. (µg/L) | Max. (µg/L) | Avg. (µg/L) | SD | August 27, 1993 - June 30, 1995 No. of Samples[a] | Probability | Trend[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2625 | 7 | 0.9 | 3.7 | 2.4 | 0.9 | 3 | 2.4 | 8.2 | 4.9 | 2.4 | 10 | 0.190 | No Trend |
| 2636 | 6 | 0.5 | 3.9 | 2.1 | 1.2 | 3 | 0.8 | 1.9 | 1.2 | 0.5 | 9 | 0.344 | No Trend |
| 2880 | 15 | 0.4 | 0.8 | 0.6 | 0.1 | 3 | 0.8 | 1.0 | 0.9 | 0.1 | 18 | 0.081 | Up, Mar. |
| 2881 | 15 | 0.1 | 4.1 | 3.1 | 1.0 | 3 | 3.0 | 4.0 | 3.4 | 0.4 | 18 | 0.181 | No Trend |
| 2897 | 8 | 0.8 | 1.4 | 1.0 | 0.2 | 3 | 0.7 | 0.8 | 0.8 | 0.0 | 11 | 0.001 | Down, Sig. |
| 2898 | 8 | 1.7 | 3.6 | 2.8 | 0.8 | 3 | 2.2 | 3.1 | 2.6 | 0.4 | 11 | 0.241 | No Trend |
| 2899 | 7 | 0.9 | 1.8 | 1.5 | 0.3 | 3 | 1.9 | 2.0 | 1.9 | 0.0 | 10 | 0.001 | Up, Sig. |
| 2900 | 8 | 0.5 | 3.2 | 1.7 | 0.8 | 3 | 1.5 | 5.6 | 3.8 | 1.7 | 11 | 0.004 | Up, Sig. |
| 3015 | 4 | 0.9 | 1.3 | 1.2 | 0.1 | 1 | 1.1 | 1.1 | 1.1 | 0.0 | 5 | 0.325 | No Trend |
| 3062 | | | | | | [d] | | | | | | | |
| 3093 | 8 | 0.2 | 0.8 | 0.5 | 0.2 | 3 | 0.2 | 0.4 | 0.3 | 0.1 | 11 | 0.317 | No Trend |
| 3095 | 8 | 5.8 | 9.0 | 7.0 | 1.1 | 3 | 11.0 | 11.0 | 11.0 | 0.0 | 11 | 0.001 | Up, Sig. |
| 3106 | 5 | 1.0 | 13.4 | 4.4 | 4.8 | 2 | 1.2 | 1.4 | 1.3 | 0.0 | 7 | 0.386 | No Trend |
| 3125 | 8 | 43.0 | 77.0 | 53.3 | 11.2 | 3 | 45.0 | 82.0 | 60.5 | 15.6 | 11 | 0.018 | Up, Sig. |
| 3128 | 8 | 0.2 | 1.0 | 0.5 | 0.2 | 3 | 0.0 | 0.5 | 0.3 | 0.2 | 10 | 0.332 | No Trend |
| 3396 | | | | | | [d] | | | | | | | |
| 3550 | 4 | 5.3 | 6.1 | 5.9 | 0.3 | 2 | 3.6 | 4.6 | 4.1 | 0.5 | 6 | 0.018 | Down, Sig. |
| 3551 | 4 | 0.6 | 0.9 | 0.7 | 0.1 | 2 | 0.7 | 1.3 | 1.0 | 0.3 | 7 | 0.155 | No Trend |
| 3552 | | | | | | [d] | | | | | | | |
| 3624 | 8 | 0.2 | 0.7 | 0.4 | 0.1 | 4 | 0.5 | 0.8 | 0.6 | 0.1 | 12 | 0.024 | Up, Sig. |
| 3636 | 8 | 0.2 | 0.6 | 0.5 | 0.1 | 3 | 0.4 | 0.6 | 0.5 | 0.1 | 11 | 0.209 | No Trend |
| 3689 | 4 | 12.0 | 54.0 | 33.8 | 15.1 | 1 | 14.0 | 14.0 | 14.0 | 0.0 | 5 | 0.042 | Down, Sig. |
| 3880 | 8 | 0.1 | 0.4 | 0.3 | 0.1 | 3 | 0.9 | 2.3 | 1.5 | 0.6 | 11 | 0.033 | Up, Sig. |
| 3881 | 8 | 0.1 | 0.4 | 0.2 | 0.1 | 3 | 0.0 | 0.2 | 0.1 | 0.1 | 10 | 0.242 | No Trend |

## TABLE 3-1
## (Continued)

| Well No. | Sampling Period: August 27, 1993 - December 31, 1994 No. of Samples[a] | Min. (µg/L) | Max. (µg/L) | Avg. (µg/L) | SD | January 1, 1995 - June 30, 1995 No. of Samples[a] | Min. (µg/L) | Max. (µg/L) | Avg. (µg/L) | SD | August 27, 1993 - June 30, 1995 No. of Samples[a] | Probability | Trend[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3897 | 15 | 0.3 | 0.8 | 0.5 | 0.1 | 3 | 0.3 | 0.4 | 0.4 | 0.0 | 18 | 0.005 | Down, Sig. |
| 3898 | 8 | 0.1 | 180.0[c] | 22.2 | 57.8 | 3 | 0.5 | 0.7 | 0.6 | 0.1 | 11 | 0.100 | Up, Mar. |
| 3899 | 8 | 0.7 | 1.2 | 1.0 | 0.1 | 3 | 0.7 | 1.0 | 0.9 | 0.1 | 11 | 0.130 | No Trend |
| 3900 | 8 | 0.1 | 0.5 | 0.2 | 0.1 | 3 | 0.0 | 0.1 | 0.0 | 0.0 | 10 | 0.078 | Down, Mar. |
| 3924 | 14 | 52.0 | 180.0 | 93.3 | 27.2 | 6 | 44.0 | 65.0 | 50.5 | 6.9 | 20 | 0.001 | Down, Sig. |
| 3925 | 20 | 0.5 | 27.0 | 9.6 | 8.4 | 7 | 26.0 | 33.0 | 29.3 | 2.3 | 27 | 0.001 | Up, Sig. |
| 3926 | 20 | 1.5 | 4.0 | 2.6 | 0.6 | 8 | 4.9 | 6.5 | 5.7 | 0.6 | 27 | 0.002 | Up, Sig. |
| 3927 | 13 | 1.5 | 5.4 | 3.4 | 1.2 | 8 | 1.2 | 1.6 | 1.4 | 0.1 | 20 | 0.001 | Down, Sig. |
| 3928 | 15 | 1.3 | 3.9 | 2.3 | 0.9 | [e] | | | | | 15 | 0.001 | Down, Sig. |
| 4125 | 1 | 0.5 | 0.6 | 0.6 | 0.0 | [d] | | | | | | | |

[a]Variation in number of samples is due to resampling events, different sampling frequencies, and/or number of sampling events in reporting period.
[b]Up, Sig. = Up, Significant
Up, Mar. = Up, Marginal
No Trend = No Significant Trend
Down, Sig. = Down, Significant
Down, Mar. = Down, Marginal
Insuf. Data = Insufficient Data
[c]Probable outlier based on examination of historical data; therefore average and standard deviation (SD) are suspect.
[d]Well sampled after June 30, 1995
[e]Recovery well not in operation
Note: Blank spaces signify that those wells did not have data collected during that sampling period.

# TABLE 3-2

## STATISTICS FOR ARSENIC

| | Sampling Period | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | August 27, 1993 - December 31, 1994 | | | | | January 1, 1995 - June 30, 1995 | | | | | August 27, 1993 - June 30, 1995 | | |
| Well No. | No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | No. of Samples[a] | Probability | Trend[b] |
| 2128 | 59 | 0.003 | 0.200 | 0.009 | 0.010 | 26 | 0.002 | 0.057 | 0.009 | 0.010 | 85 | 0.110 | No Trend |
| 2548 | 60 | 0.001 | 0.706[c] | 0.018 | 0.014 | 17 | 0.010 | 0.093 | 0.018 | 0.014 | 77 | 0.030 | Up, Sig. |
| 2625 | 52 | 0.007 | 0.100 | 0.010 | 0.006 | 26 | 0.010 | 0.100 | 0.010 | 0.006 | 78 | 0.342 | No Trend |
| 2636 | 46 | 0.015 | 0.100 | 0.045 | 0.018 | 23 | 0.019 | 0.100 | 0.045 | 0.018 | 69 | 0.143 | No Trend |
| 2898 | 8 | 0.001 | 0.006 | 0.001 | 0.001 | 3 | 0.001 | 0.004 | 0.001 | 0.001 | 10 | 0.398 | No Trend |
| 2899 | 8 | 0.001 | 0.006 | 0.001 | 0.001 | 3 | 0.002 | 0.004 | 0.001 | 0.001 | 11 | 0.265 | No Trend |
| 2900 | 60 | 0.002 | 0.100[c] | 0.005 | 0.001 | 26 | 0.002 | 0.010 | 0.005 | 0.001 | 86 | 0.045 | Down, Sig. |
| 3128 | 7 | 0.001 | 0.234[c] | 0.002 | 0.001 | 3 | 0.002 | 0.004 | 0.002 | 0.001 | 11 | 0.014 | Down, Sig. |
| 3636 | 8 | 0.002 | 0.006 | 0.002 | 0.001 | 3 | 0.002 | 0.004 | 0.002 | 0.001 | 11 | 0.133 | No Trend |
| 3898 | 8 | 0.002 | 0.006 | 0.002 | 0.000 | 3 | 0.002 | 0.004 | 0.002 | 0.000 | 11 | 0.079 | Down, Mar. |
| 3899 | 8 | 0.001 | 0.006 | 0.002 | 0.001 | 3 | 0.002 | 0.004 | 0.002 | 0.001 | 11 | 0.317 | No Trend |
| 3900 | 8 | 0.003 | 0.006 | 0.003 | 0.001 | 3 | 0.002 | 0.006 | 0.003 | 0.001 | 11 | 0.292 | No Trend |
| 3924 | 33 | 0.010 | 0.010 | 0.005 | 0.001 | 23 | 0.002 | 0.010 | 0.005 | 0.001 | 56 | 0.379 | No Trend |
| 3925 | 44 | 0.010 | 0.010 | 0.005 | 0.000 | 23 | 0.010 | 0.010 | 0.005 | 0.000 | 67 | 0.500 | No Trend |

[a]Variation in number of samples is due to resampling events, different sampling frequencies, and/or number of sampling events in reporting period.
[b]Up, Sig. = Up, Significant
Up, Mar. = Up, Marginal
No Trend = No Significant Trend
Down, Sig. = Down, Significant
Down, Mar. = Down, Marginal
Insuf. Data = Insufficient Data
[c]Probable outlier based on examination of historical data; therefore average and standard deviation (SD) are suspect

## TABLE 3-3

## STATISTICS FOR PHOSPHORUS

| | Sampling Period | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | August 27, 1993 - December 31, 1994 | | | | | January 1, 1995 - June 30, 1995 | | | | | August 27, 1993 - June 30, 1995 | | |
| Well No. | No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | No. of Samples[a] | Probability | Trend[b] |
| 2128 | 8 | 0.10 | 6.40 | 3.27 | 1.97 | 3 | 0.09 | 1.39 | 0.67 | 0.54 | 10 | 0.054 | Down, Mar. |
| 2548 | 8 | 0.10 | 6.20 | 2.74 | 2.02 | 3 | 0.62 | 2.00 | 1.39 | 0.58 | 11 | 0.378 | No Trend |
| 2625 | 6 | 1.11 | 12.3 | 5.16 | 4.62 | 3 | 0.70 | 5.90 | 3.10 | 2.14 | 9 | 0.540 | No Trend |
| 2636 | 6 | 8.97 | 170.00 | 105.78 | 62.77 | 3 | 97.00 | 144.00 | 113.67 | 21.48 | 9 | 0.540 | No Trend |
| 2898 | 7 | 0.04 | 0.06 | 0.05 | 0.01 | 3 | 0.01 | 0.05 | 0.03 | 0.02 | 10 | 0.108 | No Trend |
| 2899 | 8 | 0.04 | 0.10 | 0.06 | 0.02 | 3 | 0.01 | 0.05 | 0.02 | 0.02 | 11 | 0.161 | No Trend |
| 2900 | 8 | 0.10 | 0.96 | 0.59 | 0.31 | 3 | 0.25 | 0.82 | 0.47 | 0.25 | 11 | 0.267 | No Trend |
| 3128 | 7 | 0.05 | 13.00 | 0.98 | 2.27 | 3 | 0.01 | 0.05 | 0.02 | 0.02 | 10 | 0.054 | Down, Mar. |
| 3636 | 8 | 0.05 | 0.23 | 0.09 | 0.06 | 3 | 0.02 | 0.05 | 0.03 | 0.01 | 11 | 0.015 | Down, Sig. |
| 3898 | 8 | 0.05 | 0.34 | 0.13 | 0.09 | 3 | 0.02 | 0.05 | 0.03 | 0.01 | 11 | 0.005 | Down, Sig. |
| 3899 | 8 | 0.05 | 0.83 | 0.20 | 0.25 | 3 | 0.14 | 0.31 | 0.24 | 0.07 | 11 | 0.500 | No Trend |
| 3900 | 7 | 0.05 | 0.10 | 0.06 | 0.02 | 3 | 0.01 | 0.13 | 0.06 | 0.05 | 10 | 0.242 | No Trend |

[a]Variation in number of samples is due to resampling events, different sampling frequencies, and/or number of sampling events in reporting period.
[b]Up, Sig. = Up, Significant
Up, Mar. = Up, Marginal
No Trend = No Significant Trend
Down, Sig. = Down, Significant
Down, Mar. = Down, Marginal
Insuf. Data = Insufficient Data

## TABLE 3-4

## STATISTICS FOR POTASSIUM

| Well No. | Sampling Period: August 27, 1993 - December 31, 1994 No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | January 1, 1995 - June 30, 1995 No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | August 27, 1993 - June 30, 1995 No. of Samples[a] | Probability | Trend[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2128 | 8 | 34.00 | 63.70 | 43.45 | 9.99 | 3 | 0.09 | 1.39 | 0.67 | 0.54 | 11 | 0.060 | Down, Mar. |
| 2548 | 8 | 20.30 | 35.00 | 27.62 | 5.90 | 3 | 0.62 | 2.00 | 1.39 | 0.58 | 11 | 0.081 | Down, Mar. |
| 2625 | 6 | 31.30 | 46.20 | 37.45 | 5.61 | 3 | 0.70 | 5.90 | 3.10 | 2.14 | 9 | 0.238 | No Trend |
| 2636 | 6 | 48.40 | 79.90 | 58.72 | 10.33 | 3 | 97.00 | 144.00 | 113.67 | 21.48 | 9 | 0.460 | No Trend |
| 2898 | 8 | 17.00 | 29.20 | 23.03 | 4.66 | 3 | 0.01 | 0.05 | 0.03 | 0.02 | 11 | 0.377 | No Trend |
| 2899 | 8 | 11.20 | 16.60 | 13.06 | 1.67 | 3 | 0.01 | 0.05 | 0.02 | 0.02 | 11 | 0.438 | No Trend |
| 2900 | 8 | 23.40 | 33.80 | 26.51 | 3.20 | 3 | 0.25 | 0.82 | 0.47 | 0.25 | 11 | 0.022 | Down, Sig. |
| 3128 | 7 | 8.43 | 12.00 | 10.90 | 1.15 | 3 | 0.01 | 0.05 | 0.02 | 0.02 | 10 | 0.408 | No Trend |
| 3636 | 8 | 11.10 | 15.10 | 12.39 | 1.16 | 3 | 0.02 | 0.05 | 0.03 | 0.01 | 11 | 0.121 | No Trend |
| 3898 | 8 | 7.00 | 14.60 | 8.75 | 2.31 | 3 | 0.02 | 0.05 | 0.03 | 0.01 | 11 | 0.240 | No Trend |
| 3899 | 8 | 8.00 | 14.60 | 10.42 | 1.55 | 3 | 0.14 | 0.31 | 0.24 | 0.07 | 11 | 0.241 | No Trend |
| 3900 | 8 | 5.00 | 10.80 | 8.26 | 2.20 | 3 | 0.01 | 0.13 | 0.06 | 0.05 | 11 | 0.155 | No Trend |

[a]Variation in number of samples is due to resampling events, different sampling frequencies, and/or number of sampling events in reporting period.
[b]Up, Sig. = Up, Significant
Up, Mar. = Up, Marginal
No Trend = No Significant Trend
Down, Sig. = Down, Significant
Down, Mar. = Down, Marginal
Insuf. Data = Insufficient Data

## TABLE 3-5

## STATISTICS FOR SODIUM

| Well No. | Sampling Period: August 27, 1993 - December 31, 1994 | | | | | Sampling Period: January 1, 1995 - June 30, 1995 | | | | | Sampling Period: August 27, 1993 - June 30, 1995 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | No. of Samples[a] | Min. (mg/L) | Max. (mg/L) | Avg. (mg/L) | SD | No. of Samples[a] | Probability | Trend[b] |
| 2128 | 8 | 34.00 | 63.70 | 43.45 | 9.99 | 3 | 28.10 | 36.60 | 32.80 | 3.53 | 11 | 0.500 | No Trend |
| 2548 | 8 | 20.30 | 35.00 | 27.62 | 5.90 | 3 | 18.20 | 27.20 | 22.33 | 3.71 | 11 | 0.081 | Down, Mar. |
| 2625 | 6 | 31.30 | 46.20 | 37.45 | 5.61 | 3 | 30.70 | 49.30 | 40.47 | 7.62 | 9 | 0.306 | No Trend |
| 2636 | 6 | 48.40 | 79.90 | 58.72 | 10.33 | 3 | 57.00 | 69.30 | 64.33 | 5.29 | 9 | 0.049 | Up, Sig. |
| 2898 | 8 | 17.00 | 29.20 | 23.03 | 4.66 | 3 | 19.40 | 21.40 | 20.43 | 0.73 | 11 | 0.500 | No Trend |
| 2899 | 8 | 11.20 | 16.60 | 13.06 | 1.67 | 3 | 21.40 | 22.90 | 22.03 | 0.63 | 11 | 0.092 | Up, Mar. |
| 2900 | 8 | 23.40 | 33.80 | 26.51 | 3.20 | 3 | 27.30 | 39.80 | 32.67 | 5.25 | 11 | 0.439 | No Trend |
| 3128 | 7 | 8.43 | 12.00 | 10.90 | 1.15 | 3 | 5.36 | 7.22 | 6.03 | 0.84 | 10 | 0.001 | Down, Sig. |
| 3636 | 8 | 11.10 | 15.10 | 12.39 | 1.16 | 3 | 9.14 | 11.30 | 9.95 | 0.96 | 11 | 0.060 | Down, Mar. |
| 3898 | 8 | 7.00 | 14.60 | 8.75 | 2.31 | 3 | 9.82 | 11.90 | 10.71 | 0.88 | 11 | 0.015 | Up, Sig. |
| 3899 | 8 | 8.00 | 14.60 | 10.42 | 1.55 | 3 | 6.74 | 12.10 | 9.61 | 2.09 | 11 | 0.175 | No Trend |
| 3900 | 8 | 5.00 | 10.80 | 8.26 | 2.20 | 3 | 5.71 | 6.79 | 6.39 | 0.41 | 11 | 0.439 | No Trend |

[a]Variation in number of samples is due to resampling events, different sampling frequencies, and/or number of sampling events in reporting period.
[b]Up, Sig. = Up, Significant
Up, Mar. = Up, Marginal
No Trend = No Significant Trend
Down, Sig. = Down, Significant
Down, Mar. = Down, Marginal
Insuf. Data = Insufficient Data

## TABLE 3-6

## SUMMARY OF SIGNIFICANT MANN-KENDALL TREND TEST RESULTS FOR SELECT ANALYTES (AUGUST 27, 1993 - JUNE 30, 1995)

| Well No. | No. of Samples | Probability | Trend[a] | Probable Cause |
|---|---|---|---|---|
| **Total Uranium** | | | | |
| 2061 | 17 | 0.001 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 2125 | 11 | 0.002 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 2128 | 11 | 0.004 | Up, Sig. | Natural migration of the uranium plume that is embedded within the PRRS plume |
| 2552 | 6 | 0.048 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 2624 | 17 | 0.003 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 2897 | 11 | 0.001 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 2899 | 11 | 0.001 | Up, Sig. | Not applicable; well is within the range of background values |
| 2900 | 11 | 0.004 | Up, Sig. | Within stagnation zone of recovery wellfield |
| 3095 | 11 | 0.001 | Up, Sig. | Screened interval of recovery wells and induced capture |
| 3125 | 11 | 0.018 | Up, Sig. | Screened interval of recovery wells and induced capture |
| 3550 | 6 | 0.018 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 3624 | 12 | 0.024 | Up, Sig. | Screened interval of recovery wells and induced capture |
| 3689 | 5 | 0.042 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 3880 | 11 | 0.033 | Up, Sig. | Proximity to eastern edge of total uranium plume |
| 3897 | 18 | 0.005 | Down, Sig. | Not applicable; well is within the range of background |
| 3924 | 20 | 0.001 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 3925 | 27 | 0.001 | Up, Sig. | Capture of area of plume with higher concentrations than originally at recovery well |
| 3926 | 27 | 0.002 | Up, Sig. | Capture of area of plume with higher concentrations than originally at recovery well |
| 3927 | 20 | 0.001 | Down, Sig. | Source removal and effectiveness of recovery wellfield[b] |
| 3928 | 15 | 0.001 | Down, Sig. | Proximity to plume, source removal and effectiveness of recovery wellfield |

**TABLE 3-6**
**(Continued)**

| Well No. | No. of Samples | Probability | Trend[a] | Probable Cause |
|---|---|---|---|---|
| **Arsenic** | | | | |
| 2548 | 77 | 0.030 | Up, Sig. | Location of well relative to PRRS plume |
| 2900 | 86 | 0.045 | Down, Sig. | Effective operation of recovery wellfield |
| 3128 | 11 | 0.014 | Down, Sig. | Depth and location relative to PRRS plume |
| **Phosphorous** | | | | |
| 3636 | 11 | 0.015 | Down, Sig. | Depth and location relative to PRRS plume |
| 3898 | 11 | 0.005 | Down, Sig. | Unknown. Will continue to evaluate. |
| **Potassium** | | | | |
| 2900 | 11 | 0.022 | Down, Sig. | Effective operation of recovery wellfield |
| **Sodium** | | | | |
| 2636 | 9 | 0.049 | Up, Sig. | Location of well relative to PRRS plume |
| 3128 | 11 | 0.001 | Down, Sig. | Depth and location relative to PRRS plume |
| 3898 | 11 | 0.015 | Up, Sig. | Unknown. Will continue to evaluate. |

[a]Up, Sig. = Up, Significant
Down, Sig. = Down, Significant
[b]Source removal refers to the 1986 installation of the SWRB which effectively reduced uranium loading of the aquifer by Paddys Run. The term effectiveness of recovery wellfield is a reference to the mass removal of uranium from the plume by the recovery system.

## 4.0 CAPTURE ASSESSMENT

One of the reporting requirements of the DMEPP is to determine if the recovery wellfield is serving as a complete hydraulic barrier to the migration of the total uranium plume by acting as a divide across the width of the 20 μg/L isopleth, thereby preventing uranium north of the recovery wellfield from migrating past it. This is accomplished by performing capture zone analyses using actual and modeled data and comparing these results. This comparison allows the use of modeled results to predict future capture based on hypothetical changes to the recovery well pumping rates and to assist in assessing various pumping configurations as needed.

Figures 4-1 and 4-2 show the June 1995 total uranium plume at the Type 2 and Type 3 well depths, respectively. The majority of the data used to create the figures was from the June 1995 sampling event although some areas required the use of May and July 1995 data to provide a more complete interpretation. The uranium plume depicted in Figure 4-1 compares favorably to the uranium plume depicted in Figure 3.1-2 of the April 1995 DMEPP System Evaluation Report; both figures are supported by the 1993 sampling data collected for the Operable Unit 5 remedial investigation. For this report the 20 μg/L total uranium isopleth (Type 2 well interval) data has been extended to the northeast (Figure 4-1) to show the northeastern lobe of the plume. When compared to 1993 sampling data collected for the Operable Unit 5 remedial investigation, the current contours defining this lobe indicate that it is continuing to migrate off FEMP property, as evidenced by increasing uranium concentrations in Monitoring Well 21063. However, this lobe remains within the capture zone of the wellfield based on modeling to verify its effective capture with current pumping rates, as presented later in this section.

The June groundwater elevation data was used to assess the effectiveness of the recovery wellfield in creating a hydraulic barrier across the width of the 20 μg/L total uranium isopleth. Figure 4-3 shows the range of variation of the flow divide over the operating period in relation to the June 1995 flow divide.

Groundwater elevation contours for Type 2 wells using the June water elevation data, drawdown created by the recovery wellfield, a determination of the flow divide are presented in Figure 4-4. A modeled capture zone for Type 2 wells is presented in Figure 4-5. The extent of capture shown in Figures 4-4 and 4-5 is similar. These results show that the width of the main body of the plume is

captured. As indicated in the last System Evaluation Report, the southernmost tip of the plume is still outside of the pumping-induced capture zone.

Groundwater elevation contours for Type 3 wells using June water elevation data and a determination of the flow divide and drawdown created are presented in Figure 4-6. A modeled capture zone for Type 3 wells is presented in Figure 4-7. A comparison of Figures 4-6 and 4-7 shows that, based on actual measured data, full capture of the 20 $\mu$g/L uranium isopleth is achieved while the model predicts that a portion of the $\geq$20 $\mu$g/L uranium plume at the Type 3 well depth is not captured. The variance between modeled and actual capture is not considered sufficient to warrant a recalibration of the model at this time; however, future recalibration may be performed to refine the model's ability to reflect actual conditions.

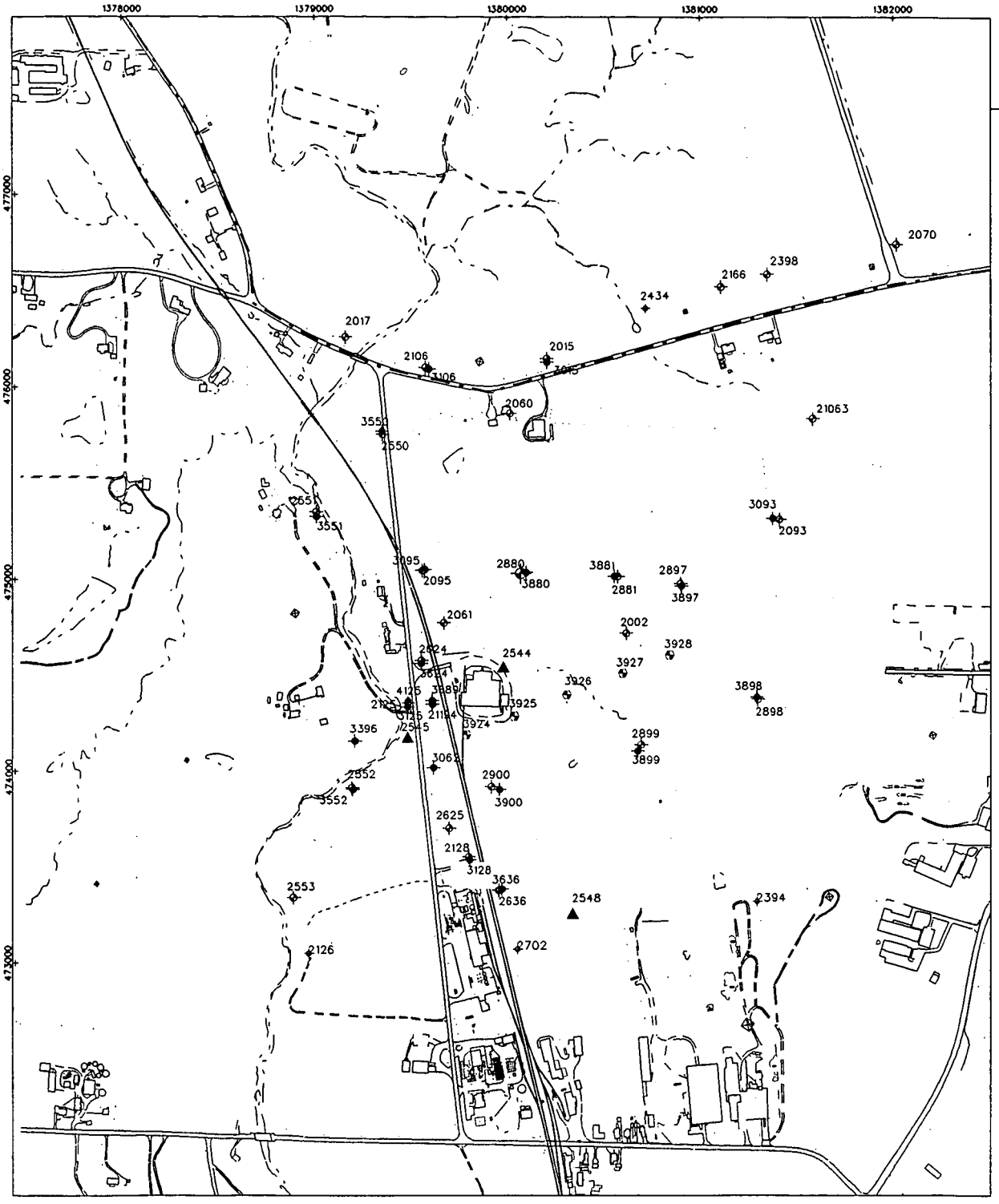
As depicted in Figure 4-4, the tip of the southwestern lobe of the uranium plume is still outside of the flow divide induced by the recovery wellfield. Based on the total uranium results for Well 2552, the 20 $\mu$g/L isopleth was expanded slightly when compared to the uranium plume presented in Figure 3.1-2 of the April 1995 DMEPP System Evaluation Report. Total uranium concentrations in Monitoring Well 2552 for June showed a slight increase (to 21 $\mu$g/L) compared to the October 1994 value (20 $\mu$g/L) used to generate the total uranium plume map for the previous report. Historically this well has exhibited concentrations of total uranium from less than 20 to 25 $\mu$g/L. However, as expected, results of the Mann-Kendall test for trend on the complete data set for Well 2552 identify the data as exhibiting a significant downward trend.

As was noted in meetings among the DOE, EPA, OEPA, and FERMCO on July 25 and September 5, 1995, modeling efforts show that the southwestern tip of the plume cannot be captured by the existing recovery wellfield without adversely impacting the PRRS plume (by higher pumping rates) or the installation of another extraction well. Because the small area of uranium contamination not being captured will dissipate naturally in approximately two to three years to a point where total uranium concentrations are well below the EPA-proposed MCL of 20 $\mu$g/L, it was agreed by the above-named parties that it was not cost effective to install an additional extraction well to capture this small area.

As mentioned earlier, a northeastern lobe of the uranium plume is migrating off FEMP property to the southeast (Figure 4-1). A concern raised at the July 25 meeting was whether capture of this lobe

is feasible without Recovery Well 3928 in operation. Because of the good comparability between modeled and actual groundwater flow data at the Type 2 well depth, modeled particle tracks were used to evaluate the extent of capture created without Recovery Well 3928 in operation. Tracks were generated with particles seeded in model blocks within the extent of the northeastern lobe of the plume. The model pumping scenario was the same as actual current operating conditions (i.e., Wells 3924 and 3925 pumped at 300 gpm, Wells 3926 and 3927 pumped at 400 gpm, and Well 3928 out of service). Figures 4-8, 4-9, 4-10 and 4-11 show elapsed times of 10, 20, 30 and 100 years, respectively, for the uranium particles. The modeling results show that the northeast lobe is contained within the zone of capture and that recovery of the uranium particles by the recovery wells is nearly complete after 30 years of operating the recovery wellfield. To be certain that no uranium particles by-passed the recovery wellfield, a 100-year particle track was performed (Figure 4-11) that confirms complete capture and recovery of the northeastern lobe of the plume by the operation of the four wells (i.e., without Well 3928).

Although the particle tracking suggests that this lobe would be captured by Wells 3926 and 3927, the DOE plans to install an additional recovery well within this lobe to optimize remediation efficiency. The schedule for installation of this well will be provided in the remedial design workplan.




LEGEND:

- FEMP BOUNDARY
- 3900 TYPE 3 MONITORING WELL
- 2900 TYPE 2 MONITORING WELL
- 2545 TYPE 2 PRRS PIEZOMETER
- 3926 RECOVERY WELL

SCALE

800 400 0 800 FEET

DRAFT

FIGURE 1-1. MONITORING WELLS THAT PROVIDE ANALYTICAL DATA FOR THE DMEPP PROGRAM

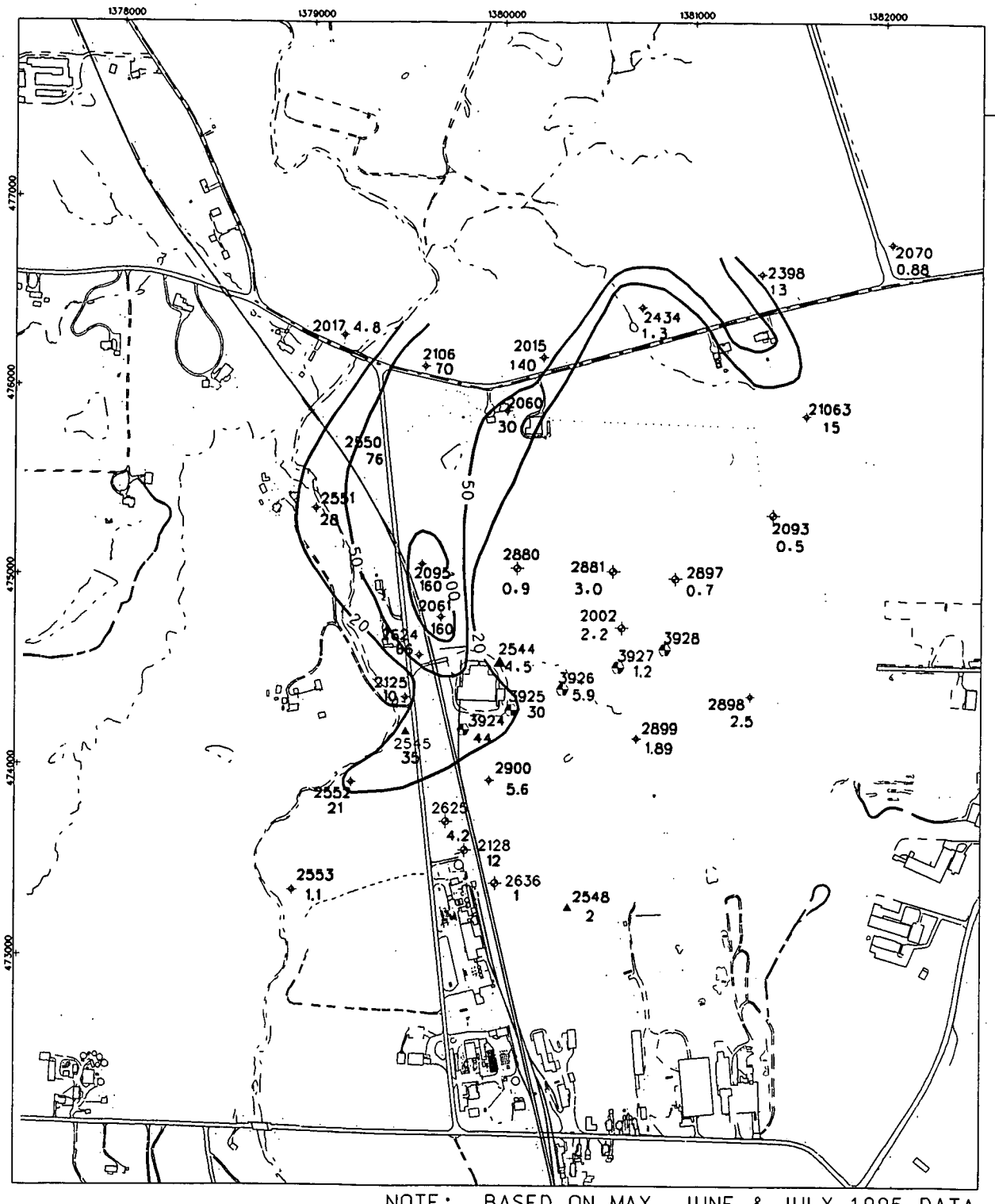
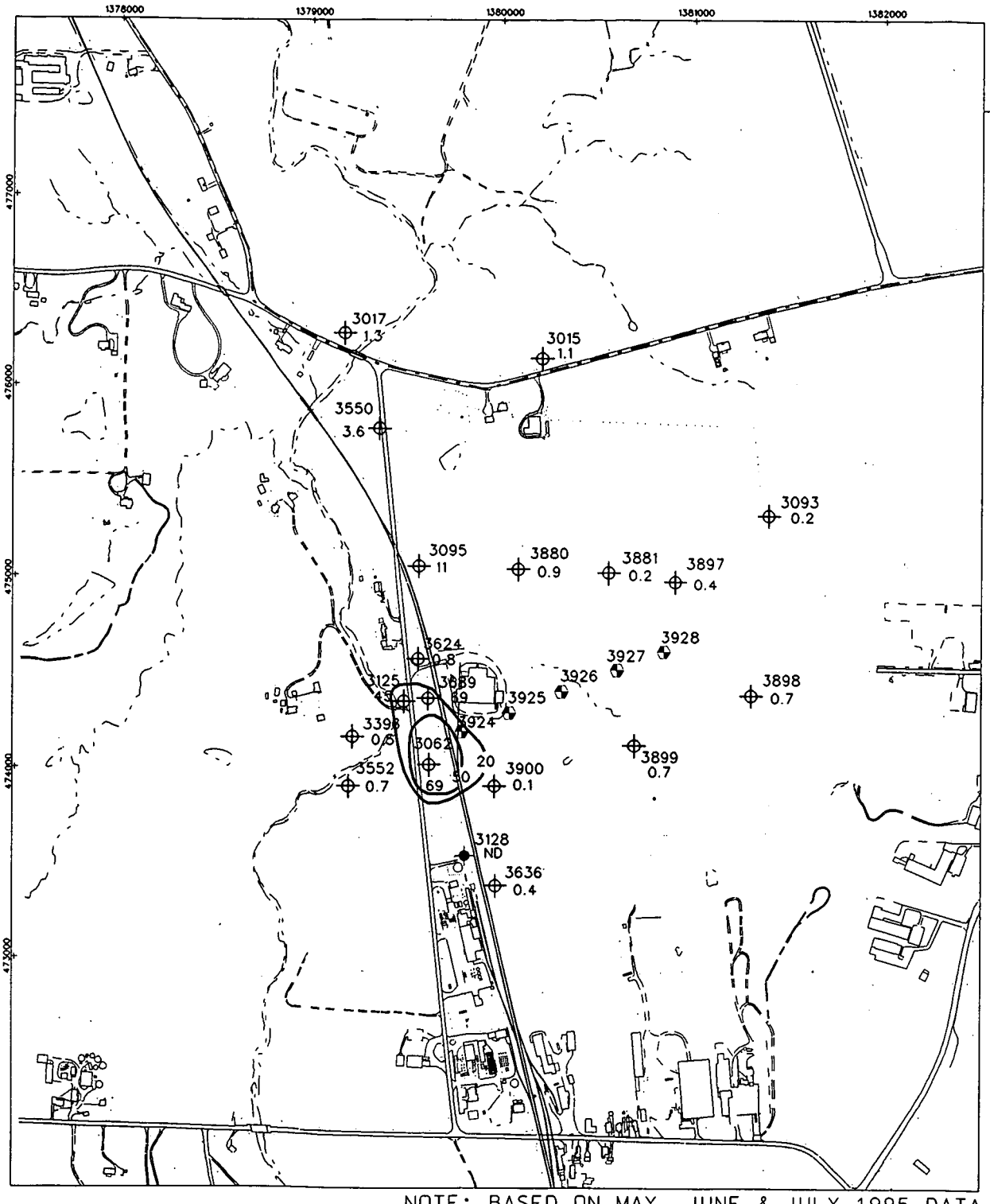



FIGURE 4-1.
JUNE 1995 TOTAL URANIUM PLUME TYPE 2 MONITORING WELLS




NOTE: BASED ON MAY, JUNE & JULY 1995 DATA

LEGEND:

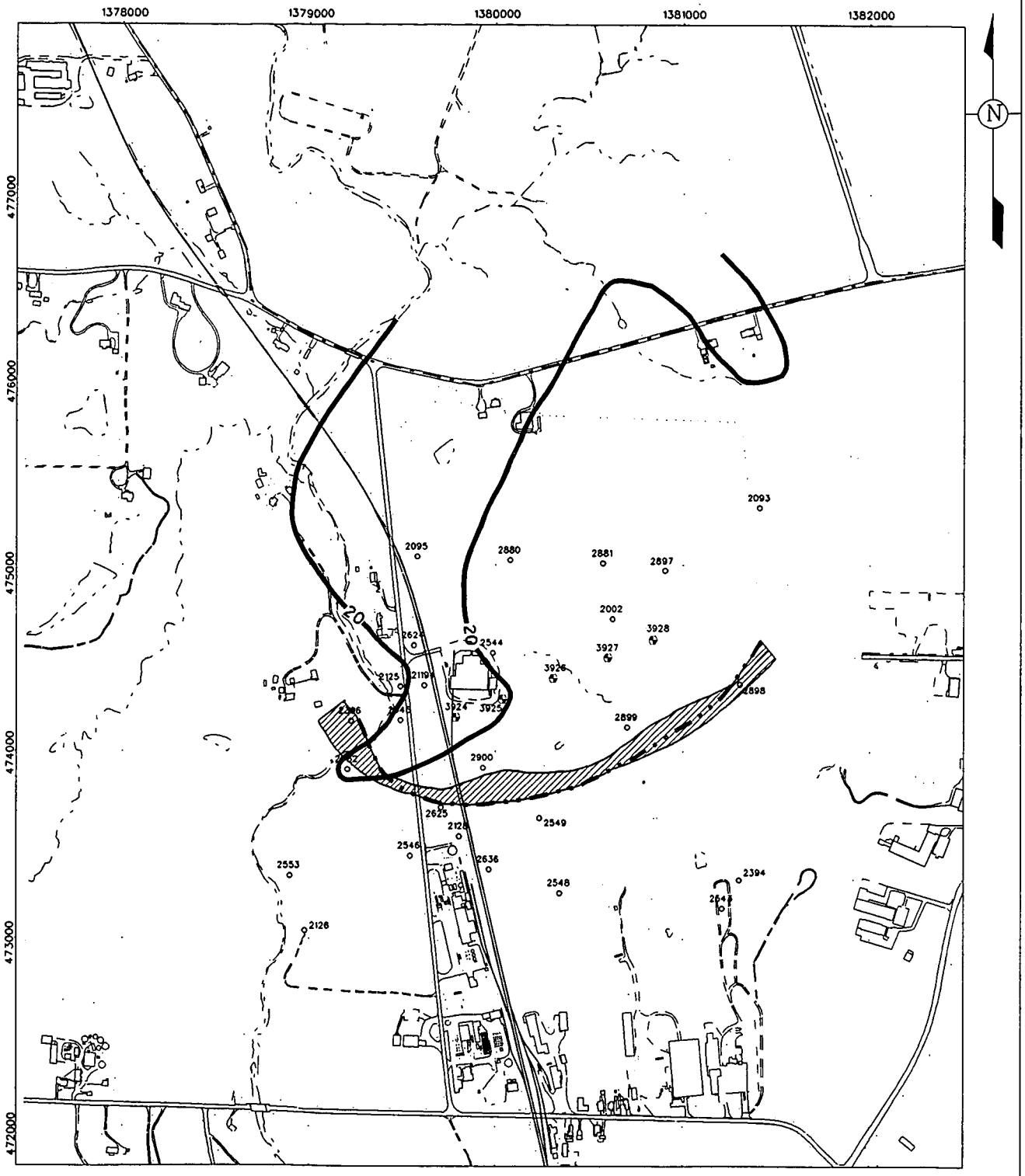
- FEMP BOUNDARY
- 50 — MICROGRAMS PER LITER (μg/L)
- 3636 / 0.4 — WELL NUMBER / TOTAL URANIUM CONCENTRATION (μg/L)

SCALE

800 400 0 800 FEET

DRAFT

FIGURE 4-2.
JUNE 1995 TOTAL URANIUM PLUME TYPE 3 MONITORING WELLS




LEGEND:

- FEMP BOUNDARY
- JUNE 1995 FLOW DIVIDE
- 20 µg/L TYPE 2 TOTAL URANIUM PLUME FOR JUNE 1995
- CAPTURE ZONE FLUCTUATION DURING REPORT PERIOD

SCALE

800 400 0 800 FEET

DRAFT

FIGURE 4-3.
EXTENT OF FLOW DIVIDE FLUCTUATIONS AT TYPE 2 WELL DEPTH INTERVAL, JANUARY 1995 - JUNE 1995

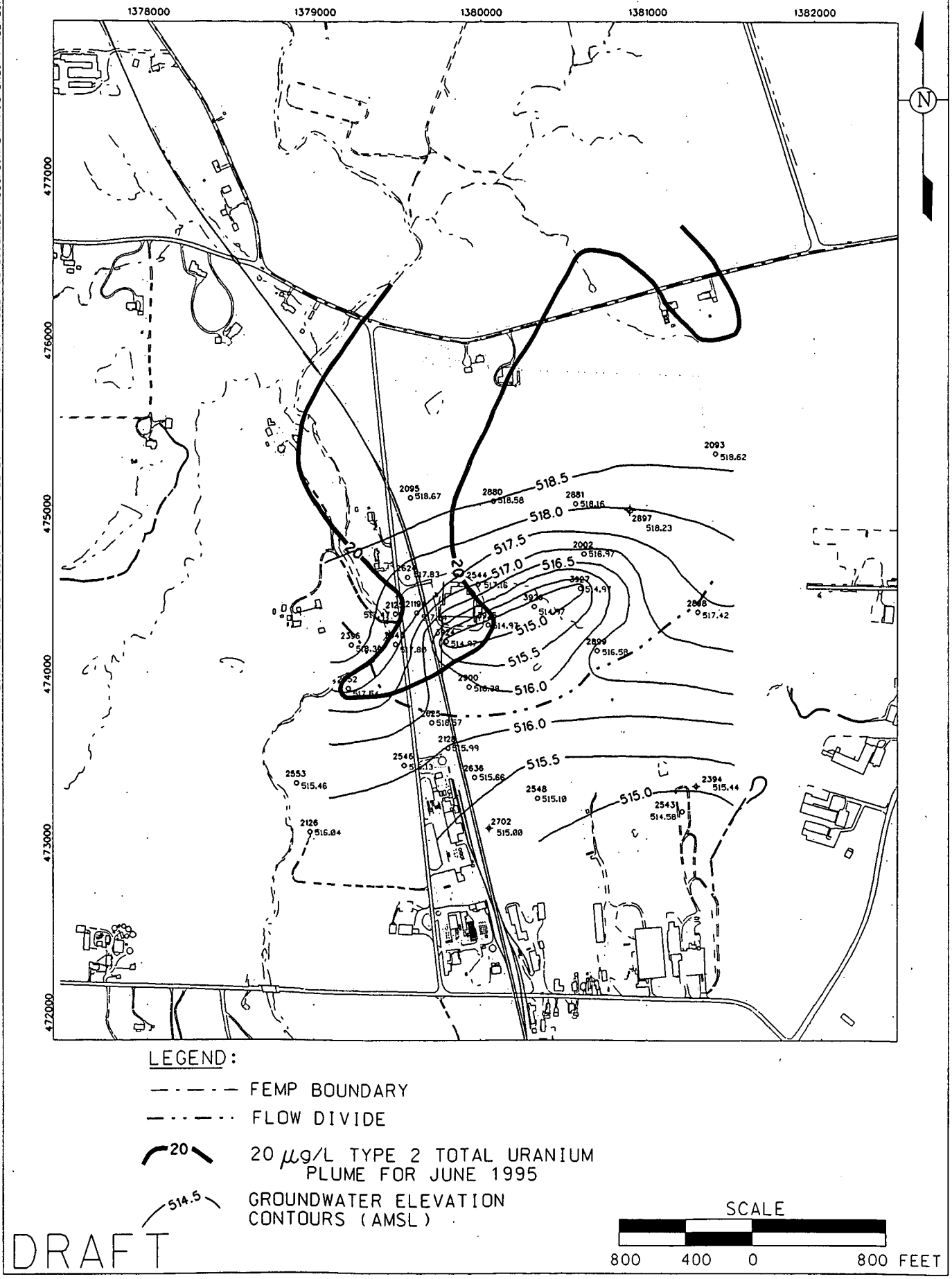
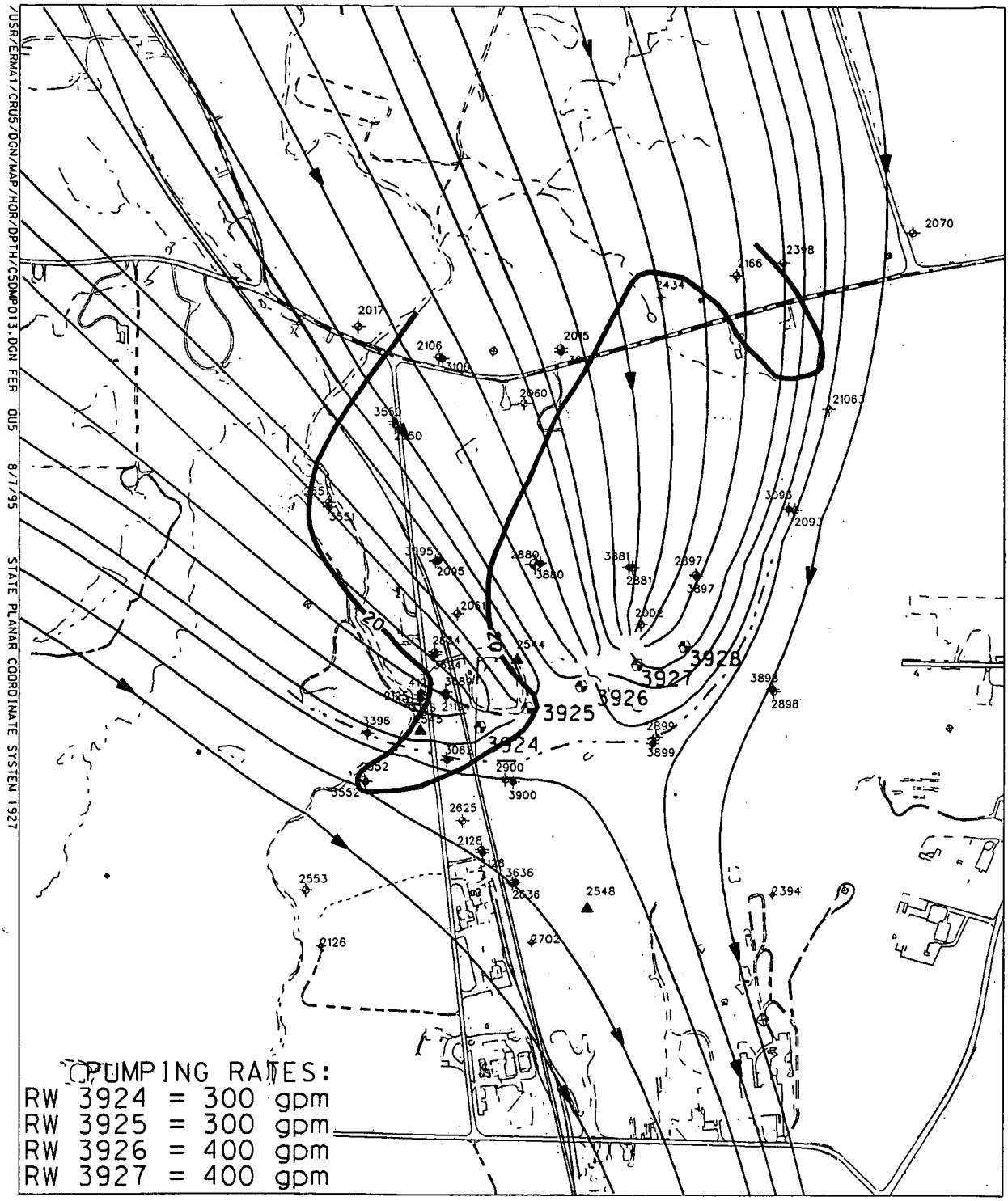



FIGURE 4-4.
JUNE 1995 GROUNDWATER ELEVATIONS TYPE 2 WELLS




LEGEND:

- FEMP BOUNDARY
- FLOW DIVIDE
- MODELED FLOW PATH (ARROW INDICATES DIRECTION)
- 20 — 20 μg/L TYPE 2 TOTAL URANIUM PLUME FOR JUNE 1995

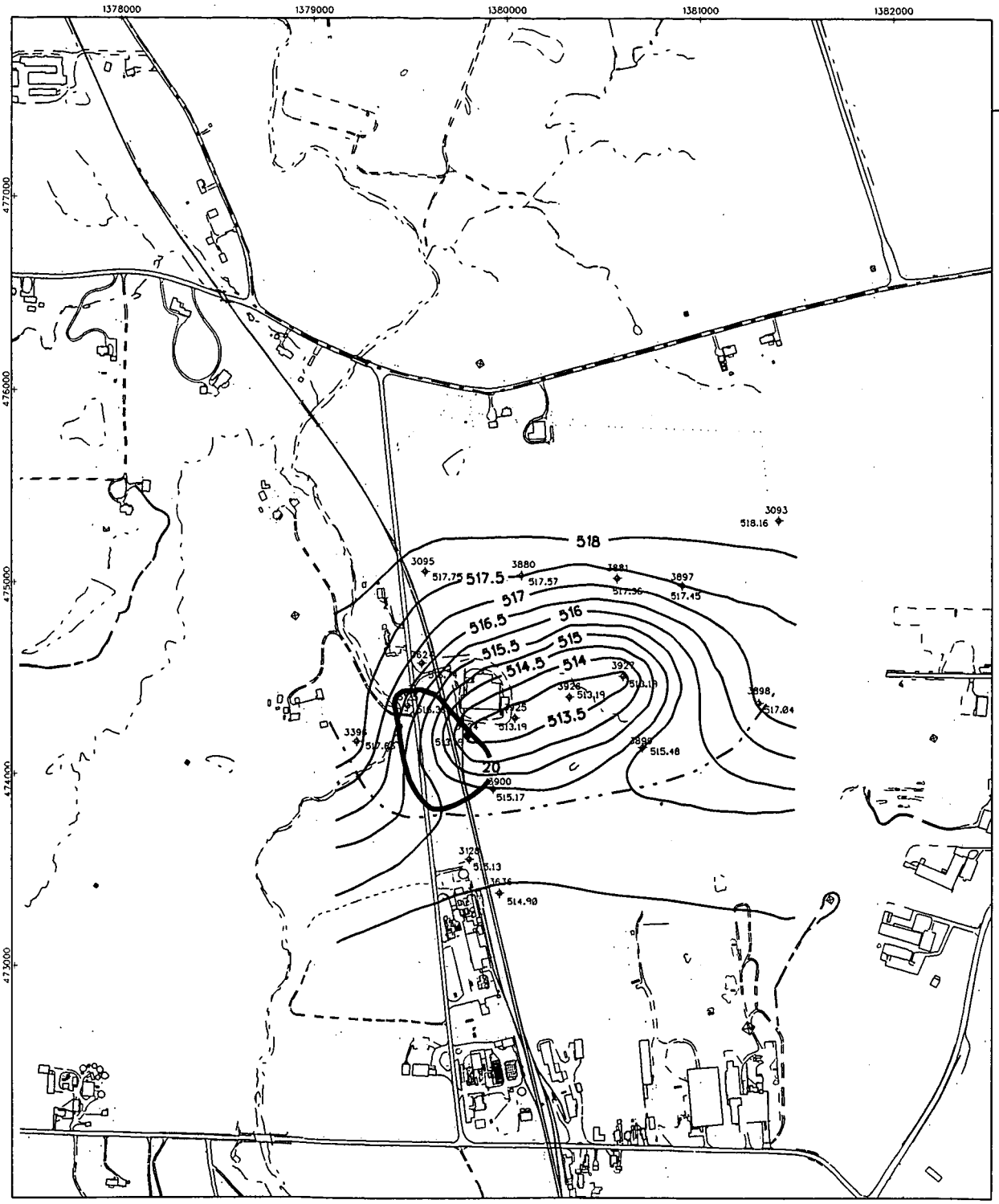
SCALE

800 400 0 800 FEET

DRAFT

FIGURE 4-5.
FOUR RECOVERY WELL PUMPING SCENARIO, TYPE 2 WELL DEPTH INTERVAL

/USR/ERMA1/CRU5/DGN/MAP/HOR/DPTH/C5DMP020 FER OU5 8/30/95 STATE PLANAR COORDINATE SYSTEM 1927




LEGEND:

FEMP BOUNDARY

FLOW DIVIDE

514.5 GROUNDWATER ELEVATION CONTOURS (AMSL)

20 JUNE 1995 20 µg/L TYPE 3 TOTAL URANIUM ISOPLETH

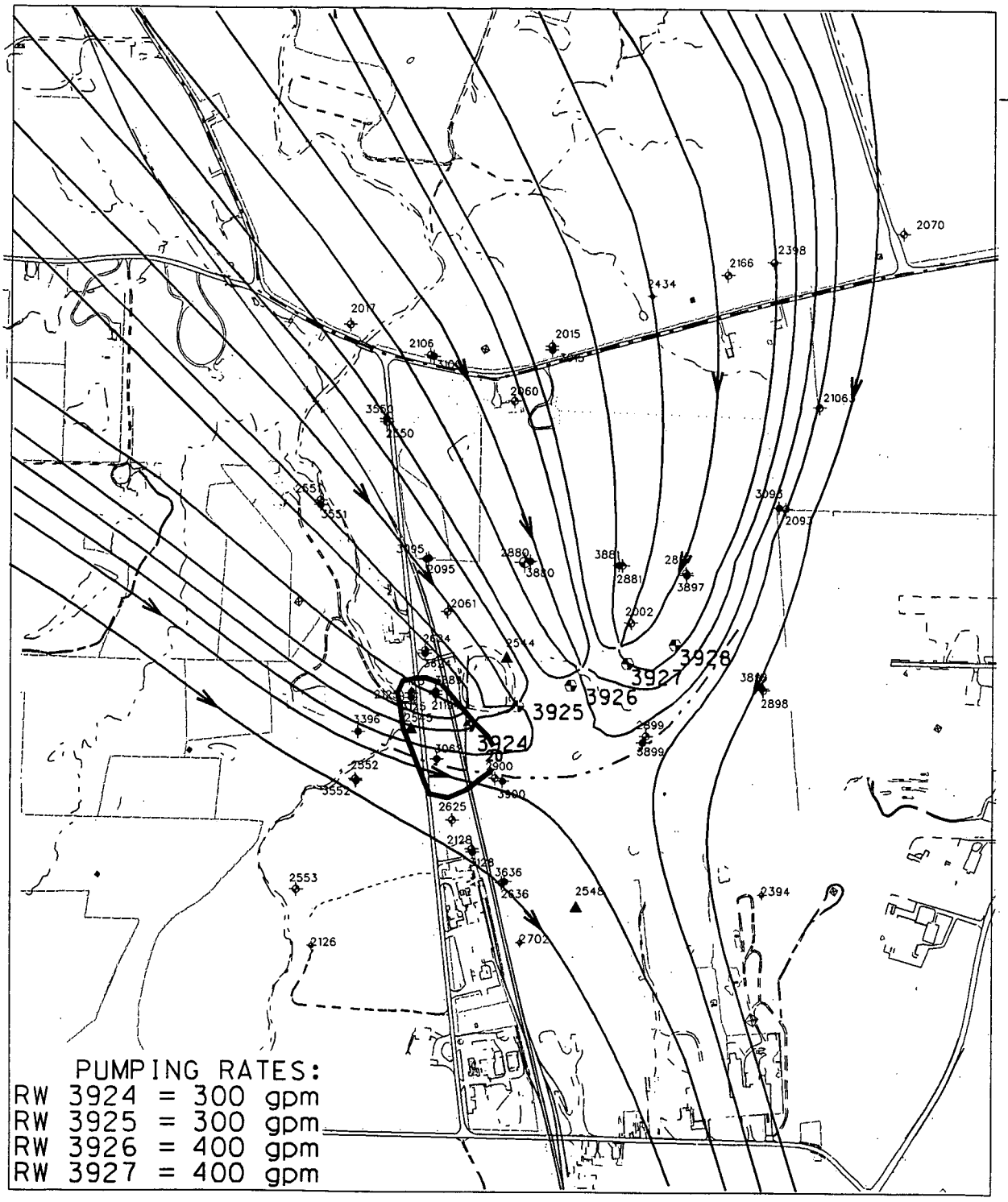
SCALE

800 400 0 800 FEET

DRAFT

FIGURE 4-6.
JUNE 1995 GROUNDWATER ELEVATIONS, TYPE 3 WELLS

/USR/ERMA1/CRUS/DGN/MAP/HOR/DPTH/CSDMP014.DGN FER 005 8/7/95 STATE PLANAR COORDINATE SYSTEM 1927




LEGEND:

FEMP BOUNDARY

FLOW DIVIDE

MODELED FLOW PATH
(ARROW INDICATES DIRECTION)

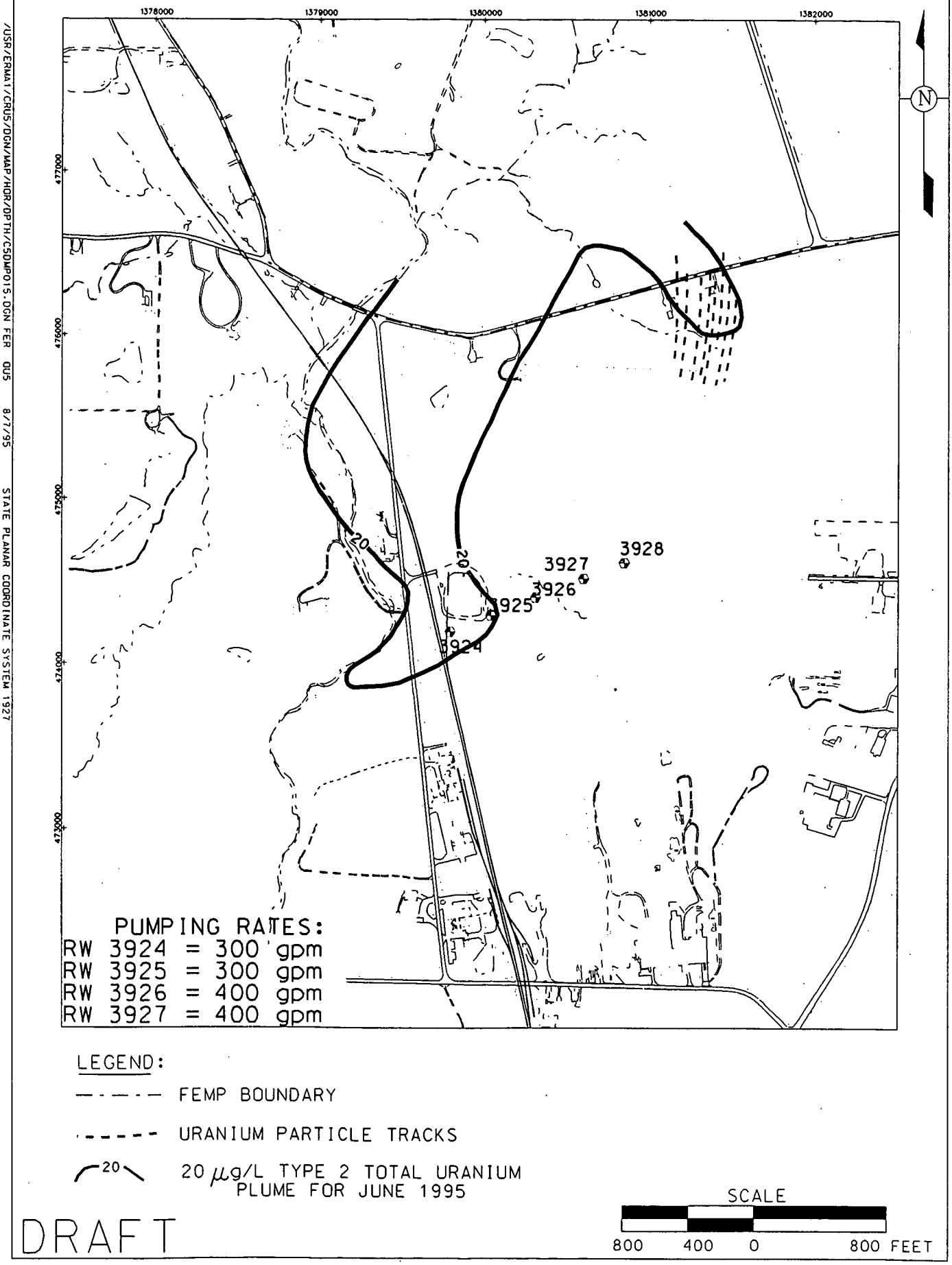
20 JUNE 1995 20 µg/L TYPE 3 TOTAL URANIUM ISOPLETH

SCALE

800 400 0 800 FEET

DRAFT

FIGURE 4-7.
FOUR RECOVERY WELL PUMPING SCENARIO
TYPE 3 WELL DEPTH INTERVAL




/USR/ERMA1/CRUS/DGN/MAP/HOR/DPTH/CSDMP015.DGN FER 005 8/7/95 STATE PLANAR COORDINATE SYSTEM 1927

FIGURE 4-8. MODELED URANIUM PARTICLE TRACKS, 10-YEAR TIME FRAME

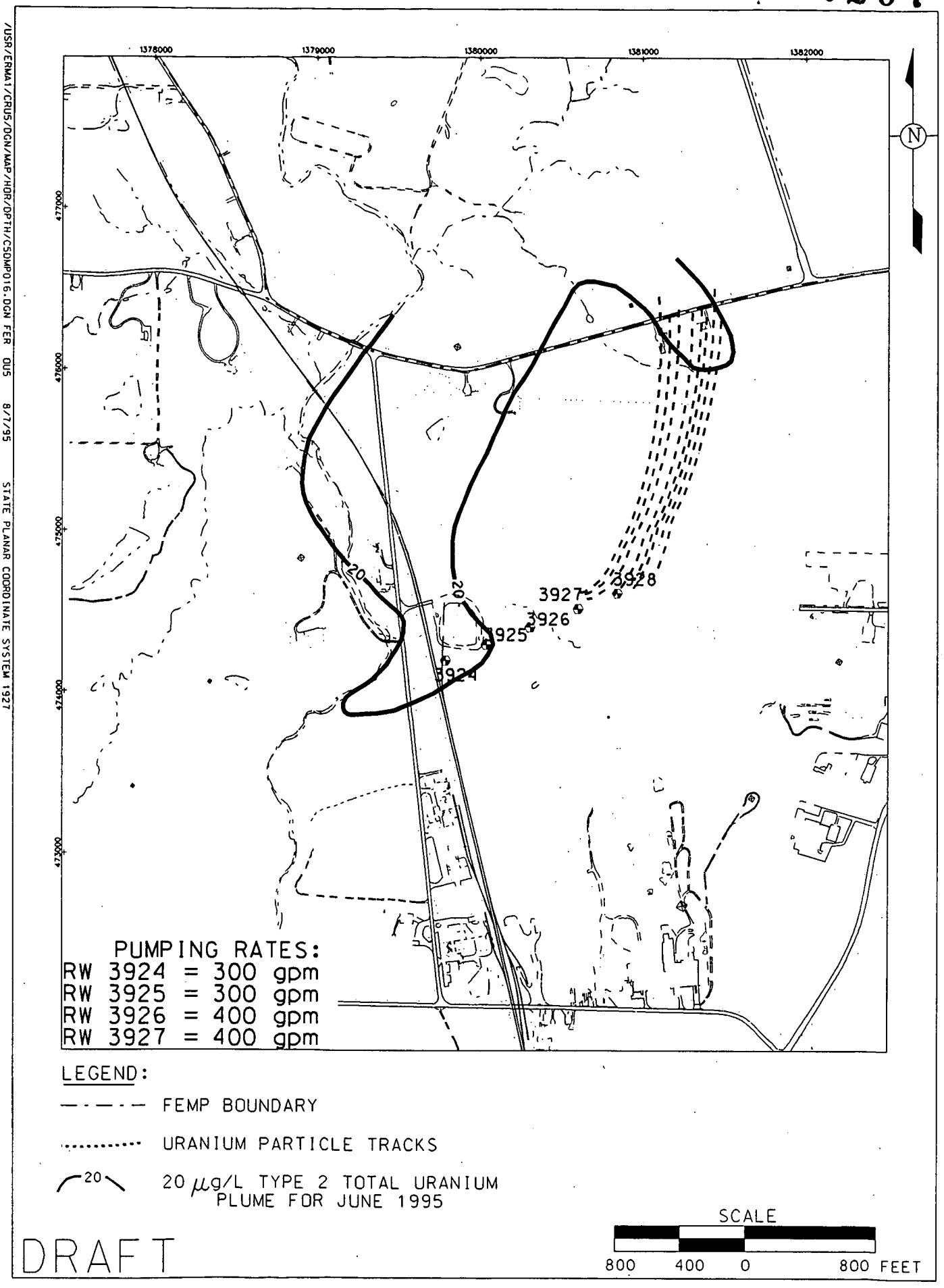
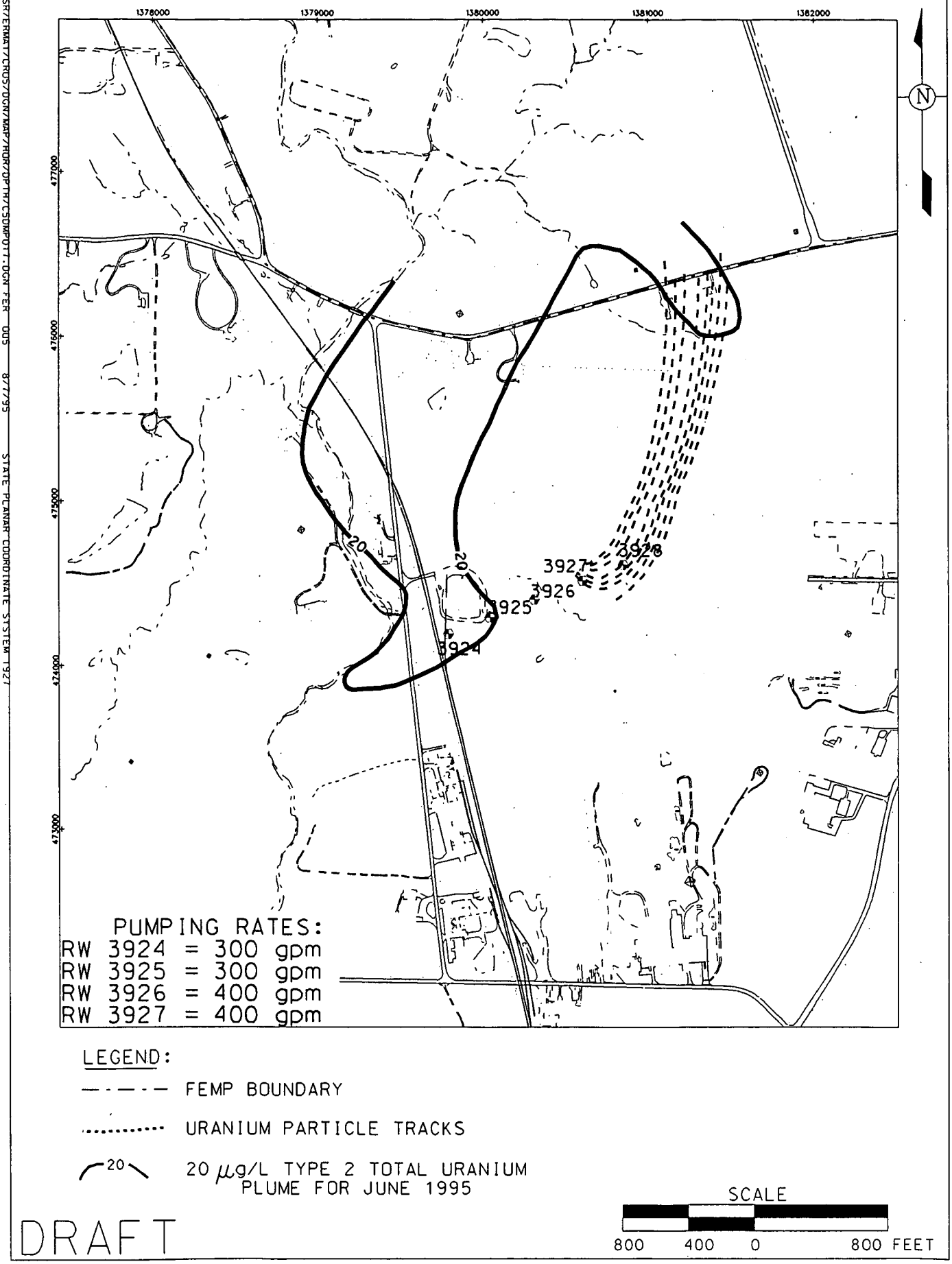
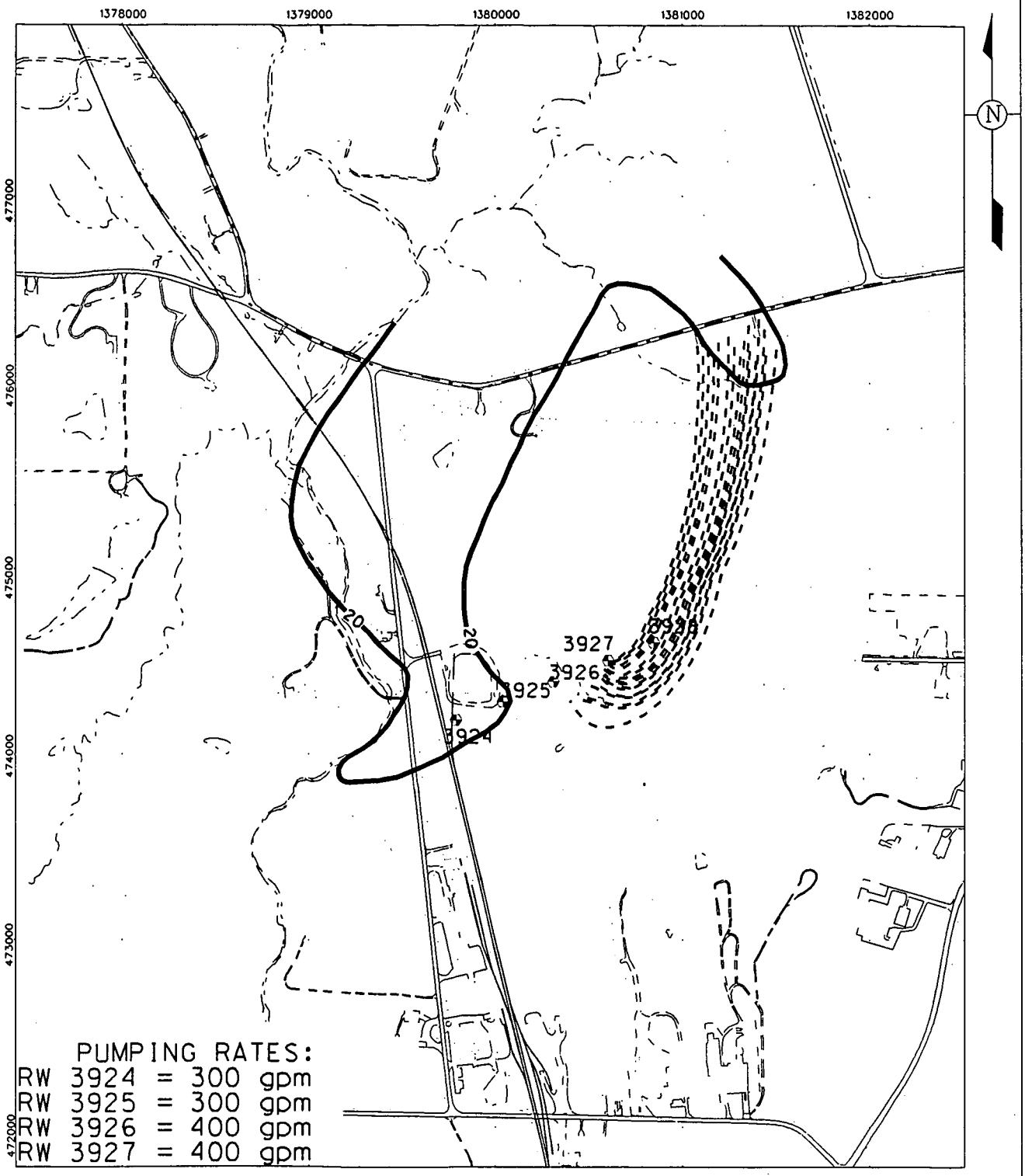



FIGURE 4-9. MODELED URANIUM PARTICLE TRACKS, 20-YEAR TIME FRAME




/USR/ERMAT/CRO57DGN/MAP7ROR/DPTH7CSUMPOTT.DGN PER 005 8/7/95 STATE PLANAR COORDINATE SYSTEM 1927

FIGURE 4-10. MODELED URANIUM PARTICLE TRACKS, 30-YEAR TIME FRAME




DRAFT

FIGURE 4-11. MODELED URANIUM PARTICLE TRACKS, 100-YEAR TIME FRAME

## 5.0 SUMMARY AND CONCLUSIONS

A total of 319 million gallons of water were pumped and 46.1 pounds of uranium were removed from the aquifer during the reporting period (January 1, 1995 through June 30, 1995). The average system efficiency was 0.15 pounds of uranium removed per million gallons of water pumped for the reporting period. Since operations began in 1993, a total of 1.3 billion gallons of water have been pumped and 169.4 lbs of uranium have been removed from the aquifer. The net system efficiency (August 23, 1993 to June 30, 1995) is 0.13. No change has occurred in the recovery wellfield's negligible influence on the PRRS plume or in the capture zone created by the recovery wellfield; i.e., full capture of the width of the uranium plume north of the recovery wellfield continues to be achieved.

As shown in Figure 4-4, the main body of the 20 $\mu$g/L total uranium plume continues to be captured and the extent of the southernmost lobe of the plume which resides outside the capture zone remains essentially unchanged (as defined by total uranium concentrations of 21 $\mu$g/L in Monitoring Well 2552 this reporting period). This lobe of the plume cannot be captured by the existing recovery wellfield without adversely impacting the PRRS plume. Groundwater modeling indicates that the small area of uranium contamination not being captured will dissipate naturally in approximately two to three years to a point where total uranium concentrations are well below the EPA-proposed MCL of 20 $\mu$g/L. There is agreement between DOE, USEPA and OEPA to not install an additional well to capture this area of contamination. However, plans have been developed to obtain detailed groundwater flow direction and velocity at this location (Well 2552) using a colloidal boroscope. The boroscope has been ordered and field monitoring is scheduled to begin during the fourth quarter of 1995.

Groundwater modeling results predict that the northeastern lobe of the uranium plume, which is migrating off property, is within the capture zone of the existing recovery wellfield. Potential improvements to the existing system of pumping wells that would accelerate uranium mass removal from off-property portions of the plume were presented to EPA and OEPA during the summer of 1995. Specifically, four additional off-property extraction wells are being considered as part of a South Plume optimization modeling study currently in progress (Figure 5-1). Three extraction wells would be installed south of Willey Road in a line parallel to and offset downgradient from the center of the plume to increase mass removal efficiency and a fourth well would be installed near the

northeast lobe so that optimal recovery of the lobe can be achieved. These four wells would be operated concurrently with existing Recovery Wells 3924 and 3925. This optimization scenario was presented in detail at meetings among the DOE, EPA, OEPA, and FERMCO on July 25 and September 5, 1995. It is currently envisioned that optimization of the South Plume groundwater recovery system would occur according to the remedial design/remedial action schedules for Operable Unit 5.

In conclusion, significant changes for this reporting period and recommendations for the next reporting period are bulleted below.

Operational changes of note during this reporting period include:

- Pumps have been replaced in Recovery Wells 3925 and 3927
- Recovery Well 3928 was inactive for entire reporting period per OEPA request
- Recovery wellfield pumping rates have been set at 1400 gpm (300 gpm for Wells 3924 and 3925 and 400 gpm for Wells 3926 and 3927)
- Uranium recovery efficiency of 0.15 pounds per million gallons pumped for the reporting period is up from the average recovery efficiency of 0.13 pounds per million gallons pumped since system startup
- An optimization study has been performed to evaluate the benefit of additional recovery wells on uranium removal efficiency
- Eighteen monitoring wells were formally added to the quarterly sampling program for uranium.
- Groundwater level measurements will be collected quarterly with provisions for monthly measurements if necessary.

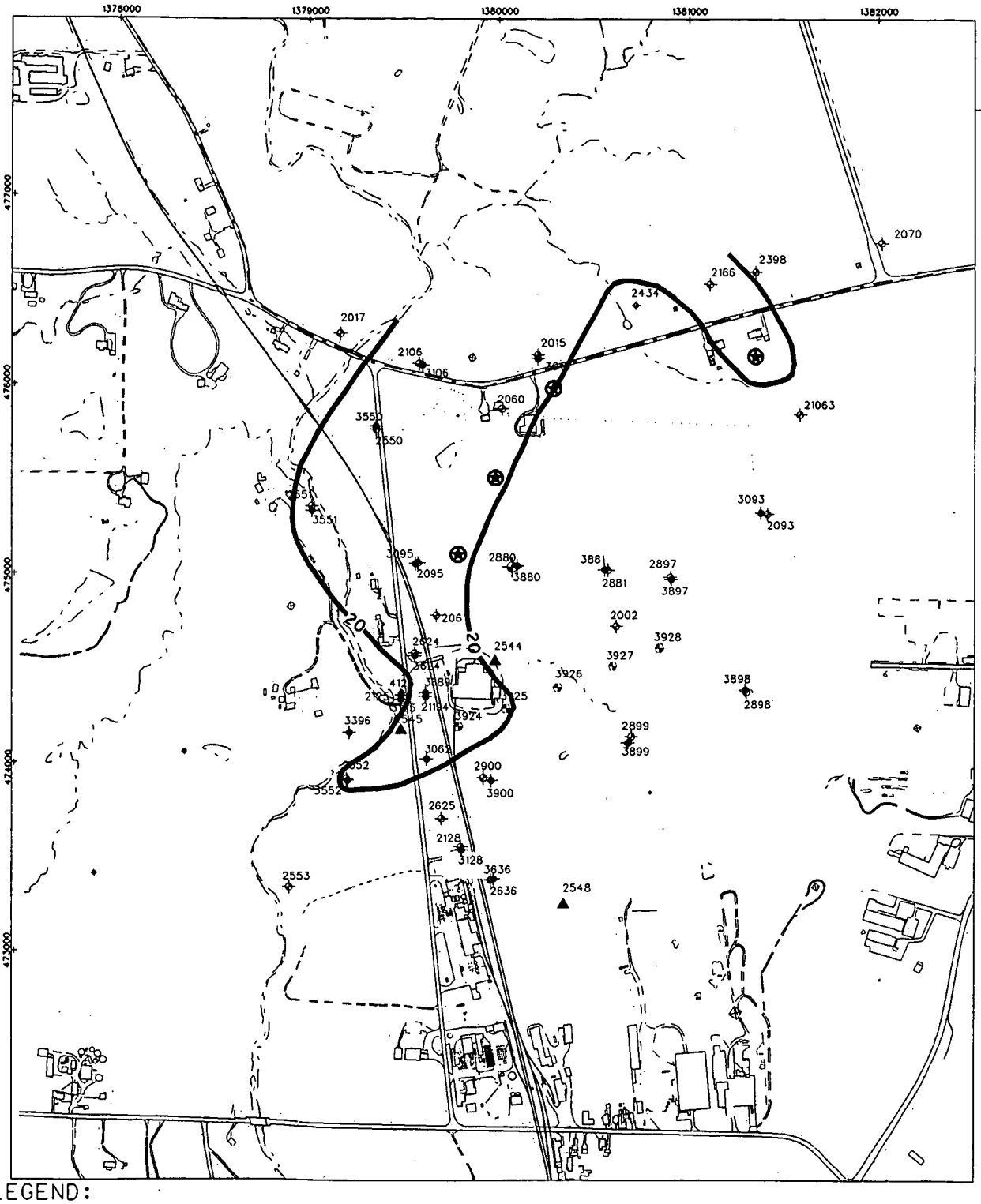
Changes in data analysis include:

- Mann-Kendall trend analysis tests have been performed for key parameters now that sufficient data has been collected, providing for a more quantitative interpretation.
- Trend analysis indicates nine wells show increasing uranium as discussed in Section 3.0
- Trend analysis indicates 11 wells show decreasing uranium as discussed in Section 3.0

- Analysis of data from Well 2552 supports the overall downward trend of uranium concentrations within the small southern lobe that resides outside the recovery wellfield capture zone
- The analytical data set for the DMEPP has been provided in electronic format
- Data analysis and modeling confirm that long-term capture of the northeast lobe can be maintained by pumping the four recovery wells at their current rates.

Recommendations and areas of focus for the next reporting period include:

- Continue operating the recovery wellfield at the established 1400 gpm rate
- Increase flexibility in scheduling sampling events so that maintenance activities do not preclude the collection of prescribed samples
- Perform the Mann-Kendall trend test on the expanding data sets
- Install new pumps and screens in Recovery Wells 3924 and 3926
- Continue to refine the streamlined reporting approach as necessary based on agency input
- Continue to evaluate dissipation of the southern lobe of the uranium plume which resides outside the capture zone of the recovery wellfield (Monitoring Well 2552)
- Continue monitoring recovery wellfield to ensure negligible influence to PRRS plume
- Continue to monitor concentrations in the northeastern lobe of the uranium plume (Monitoring Well 21063)
- Continue to evaluate capture of contiguous 20 $\mu$g/L uranium plume at the Type 2 and Type 3 well depths
- Use a colloidal boroscope to refine understanding of capture zone
- Continue to seek ways to improve the mechanical reliability of the system and to enhance the operating time of the system.




LEGEND:

- FEMP BOUNDARY
- 3900 TYPE 3 MONITORING WELL
- 2900 TYPE 2 MONITORING WELL
- 2545 TYPE 2 PRRS PIEZOMETER
- 3926 RECOVERY WELL
- PROPOSED EXTRACTION WELL LOCATION
- 20 20 μg/L TYPE 2 TOTAL URANIUM PLUME FOR JUNE 1995

DRAFT

SCALE

800 400 0 800 FEET

FIGURE 5-1. PROPOSED SOUTH PLUME OPTIMIZATION EXTRACTION WELL LOCATIONS

# APPENDIX A

## SUMMARY OF ANALYTICAL DETECTIONS

**(see disk in front pocket of binder)**

## VALIDATION QUALIFIERS

J — These data are considered quantitatively estimated, and may be biased due to effects reflected in the associated quality control results. Analyte identification is reliable, however, and EPA guidance allows the use of "J" qualified data to be used in baseline evaluation of risk assessment as well as nature and extent of contamination. This qualifier is also applied to organic data when the actual result is less than the contract required detection limit; these data are also considered quantitatively estimated. "J" may carry additional meaning when used in radiochemical validation; the Data Validation Summary Report further defines the use of this qualifier.

NV — These data are not validated. Reasons for nonvalidation can be found in the Data Validation Summary Report associated with the data set. These data cannot be used in risk assessment evaluation.

-(dash) — A dash (-) indicates that the result is CONFIDENT AS REPORTED; the validator did NOT assign any of the above qualifiers to the positive result. (NOTE: When an undetected result is not further qualified, the validator will still enter the "U" qualifier in the qualifier column.)

U — Data that were observed at levels less than the corresponding limit of detection were qualified as U, meaning not detected above the associated value. This qualifier is assigned by the laboratory, and it was also used as a validation qualifier when common field or laboratory blank contaminants were detected in a sample less than action level as defined by the validation criteria. For nature and extent, the U qualifier establishes the lowest concentration of an analyte that can confidently be defined as nondetect. If an analyte was not detected in a certain media of a specific waste area, the calculation for concentration source terms did not include one-half the sample quantitation limits. Like the laboratory qualifier U, one-half of the sample quantitation limit has been used as a surrogate in calculating the concentration term in risk calculations.

UJ — Data that were quantitatively estimated at levels less than the corresponding limit of detection.

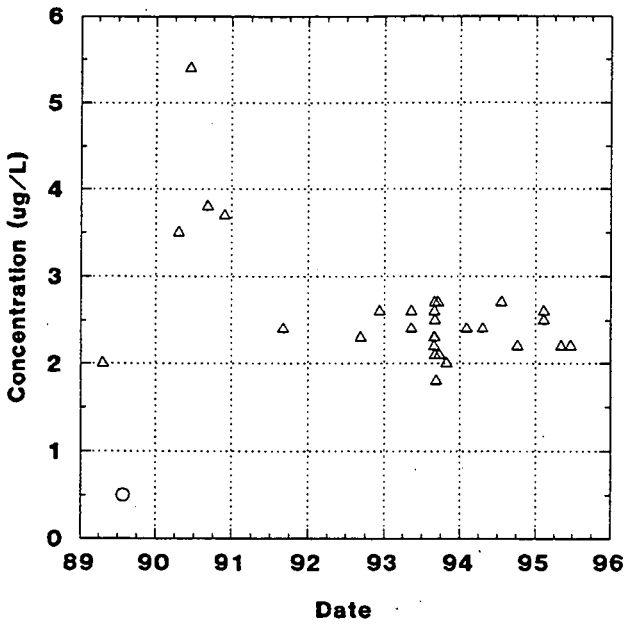
# APPENDIX B

## CONCENTRATION PLOTS
## FOR DMEPP MONITORING AND RECOVERY WELLS

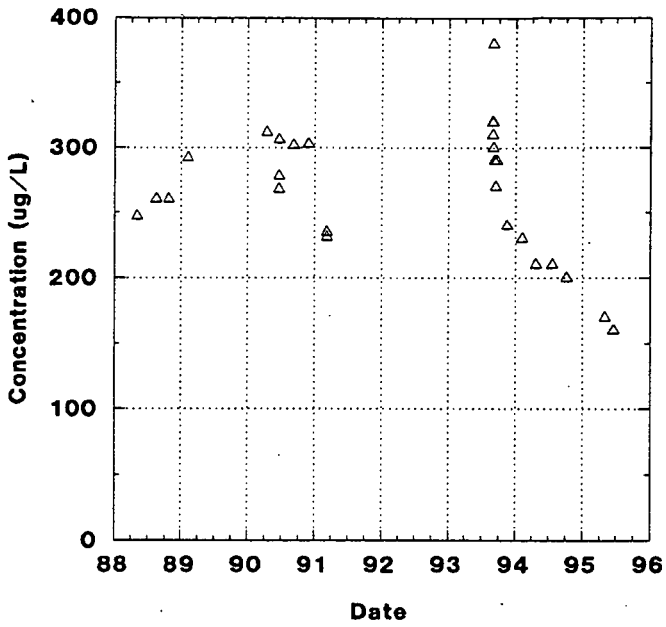
# TOTAL URANIUM

(Unfiltered Analytical Results)

## Well 2002

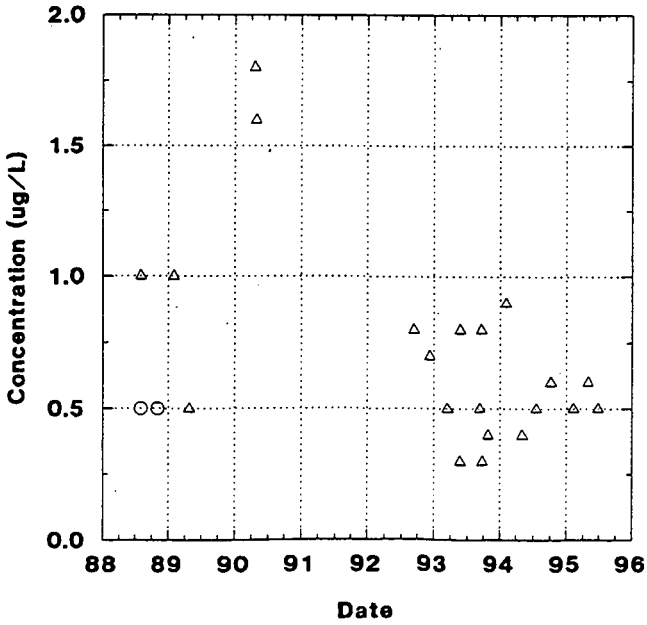



## Well 2061

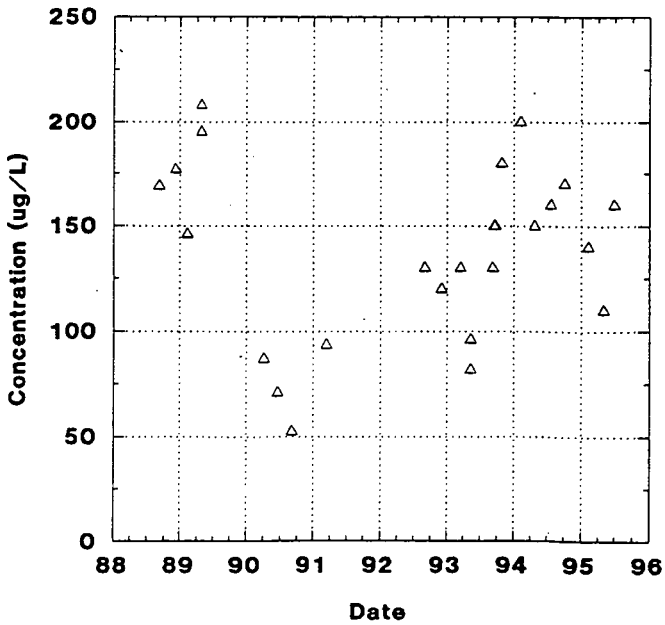



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2093

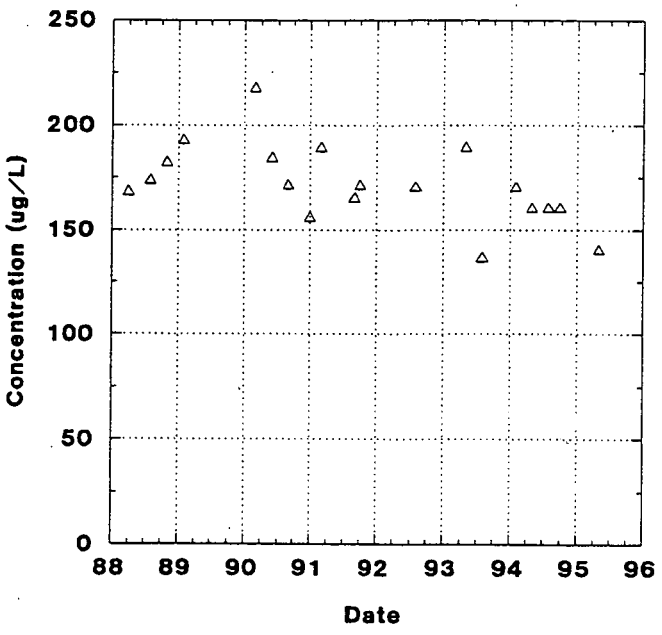



## Well 2095

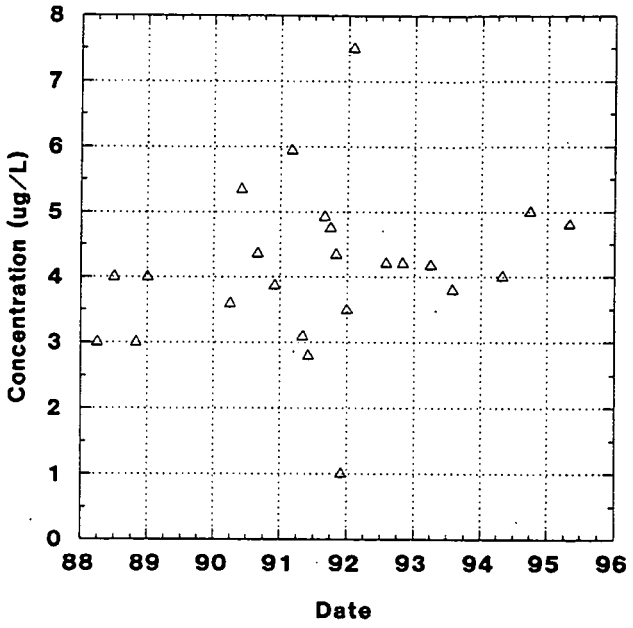


# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 2015

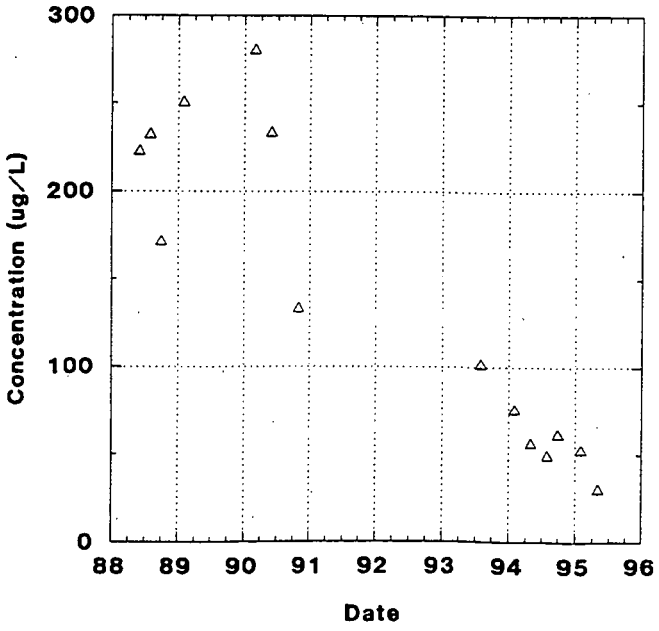



## Well 2017

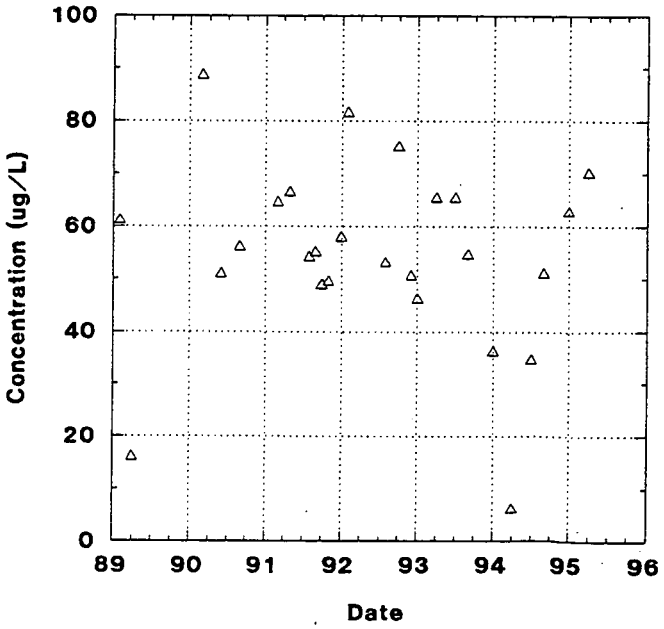



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2060




## Well 2106

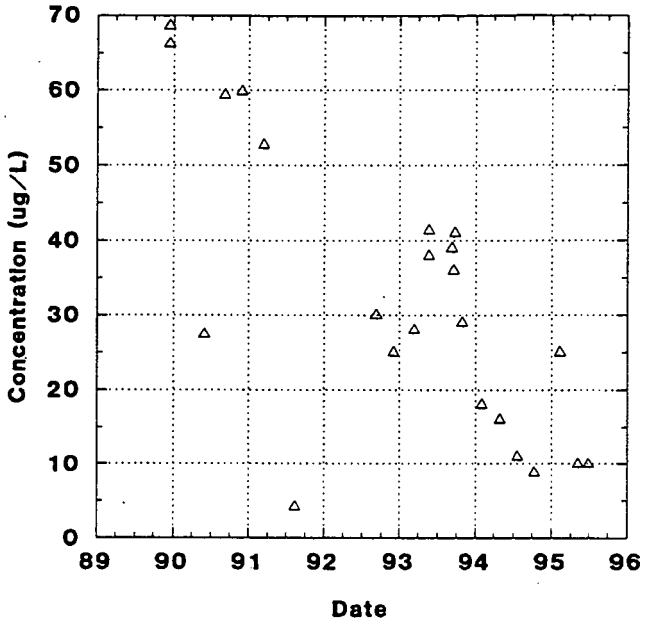


7207

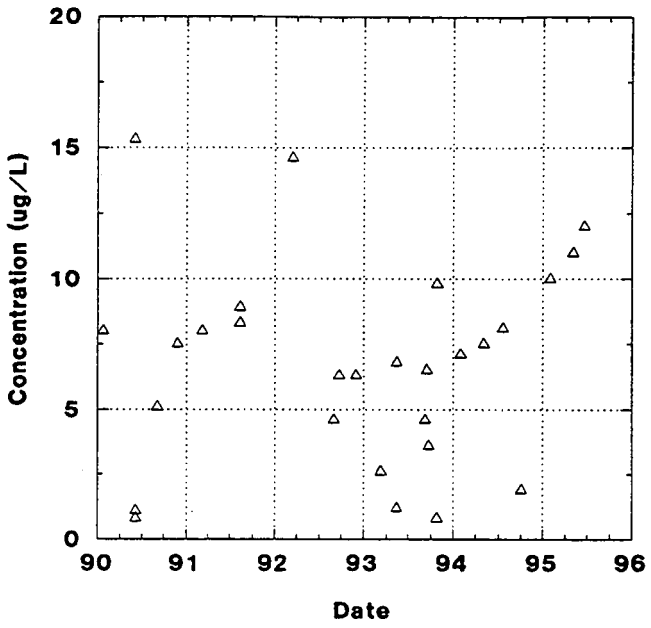
# TOTAL URANIUM

(Unfiltered Analytical Results)

## Well 2125

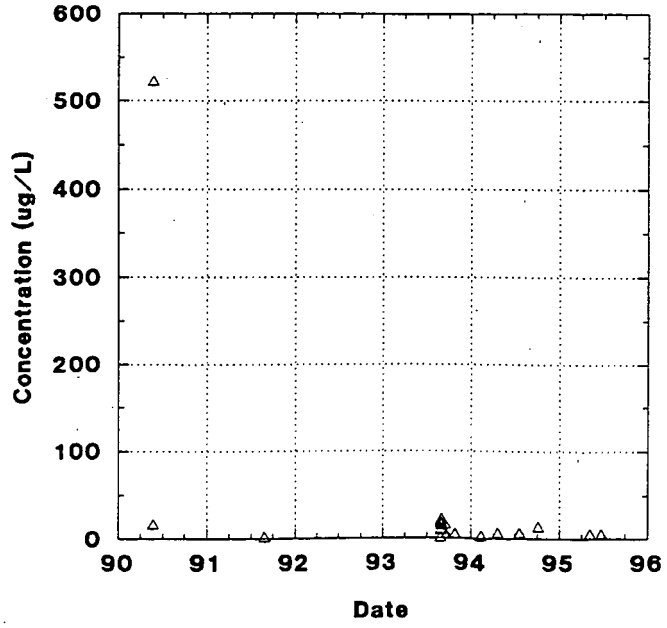



## Well 2128

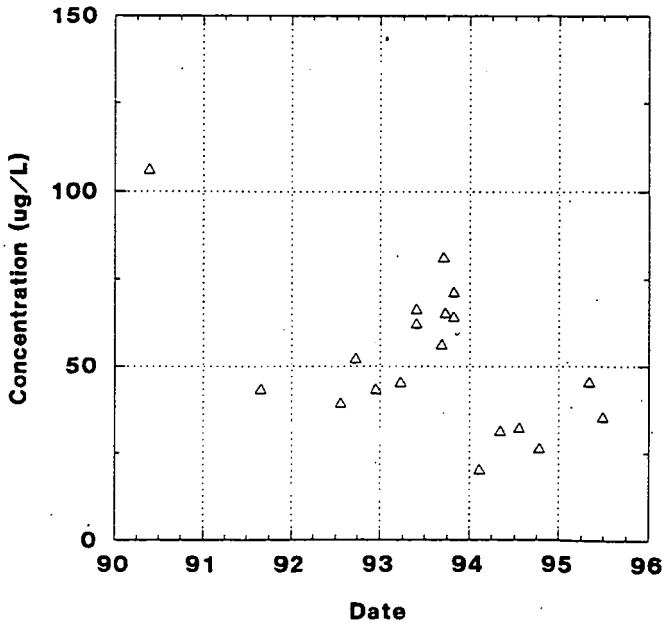



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2544

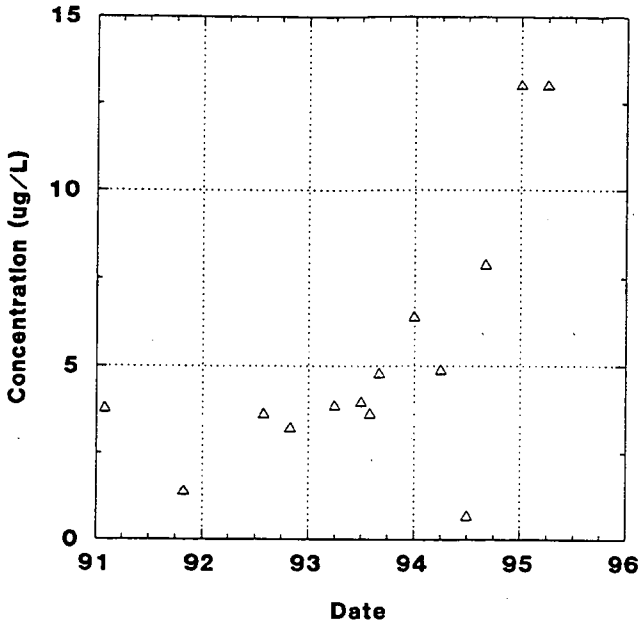



## Well 2545

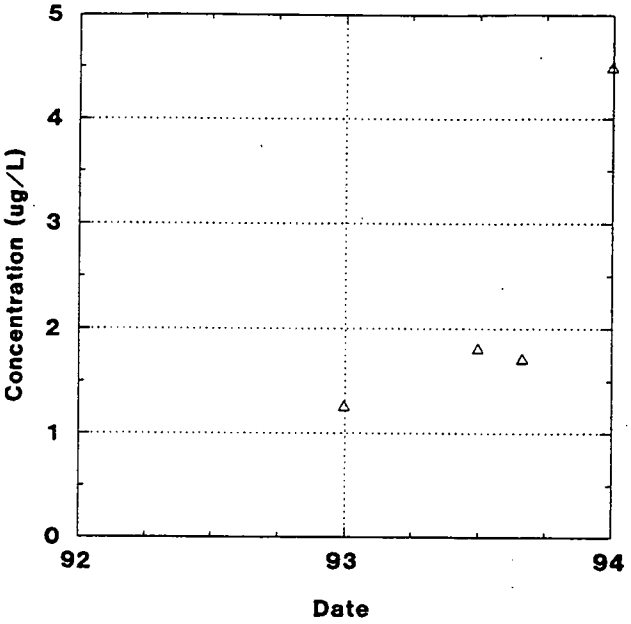


# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 2398

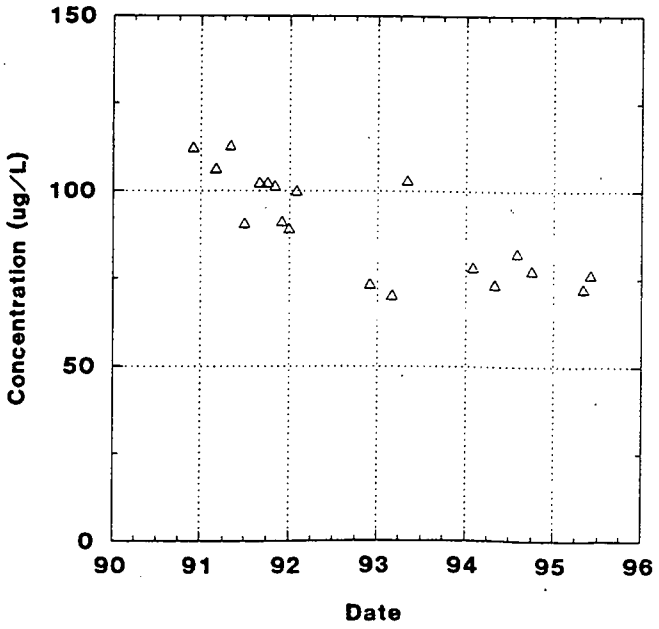



## Well 2434

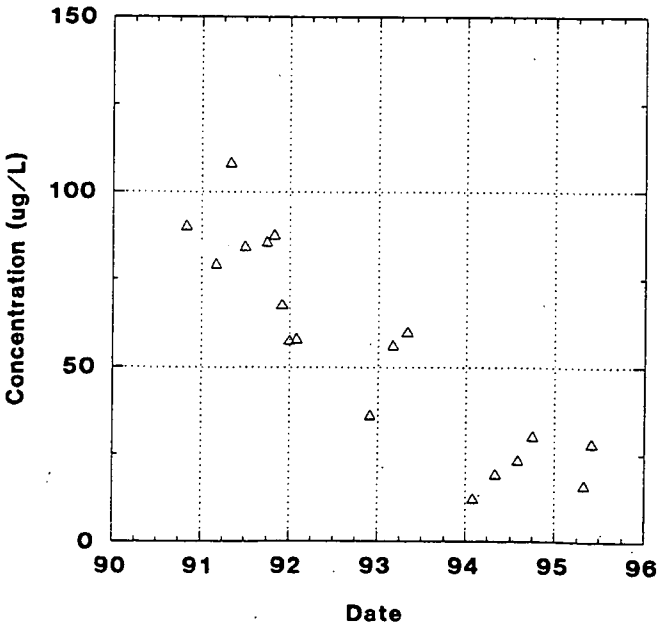



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2550

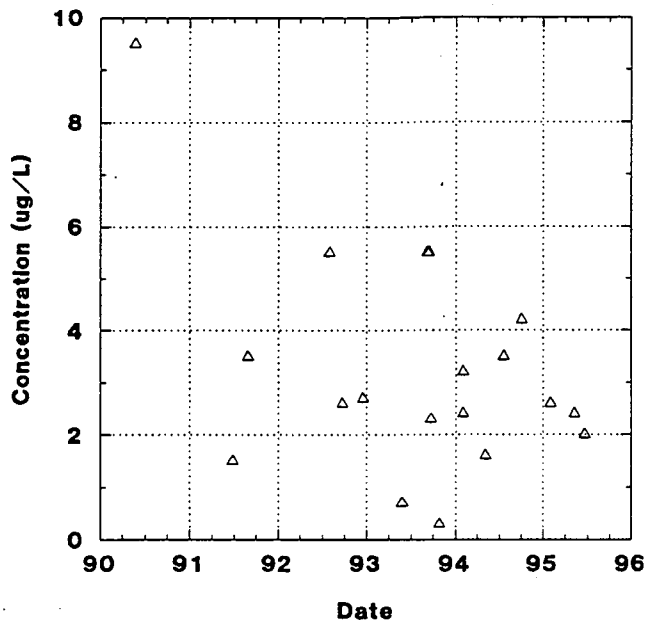



## Well 2551

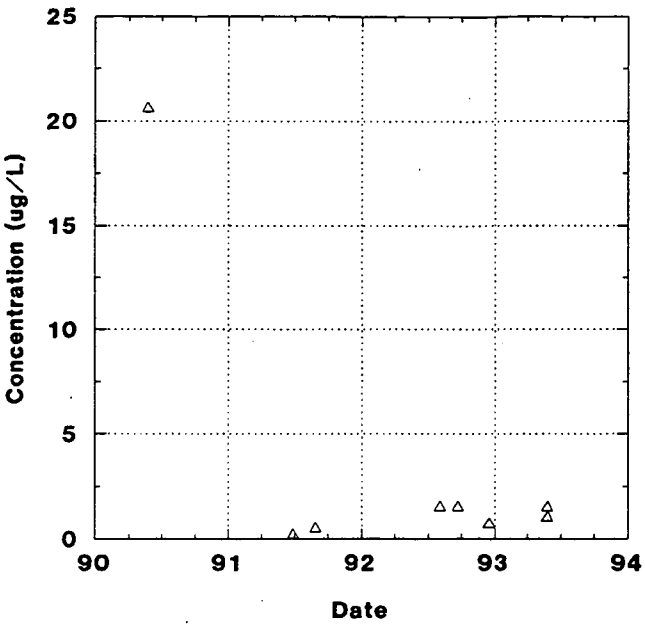


# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 2548

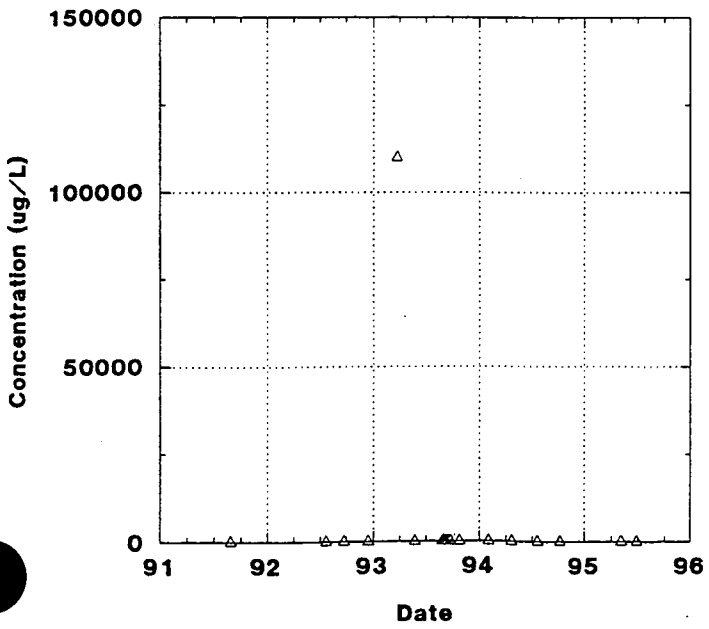



## Well 2549

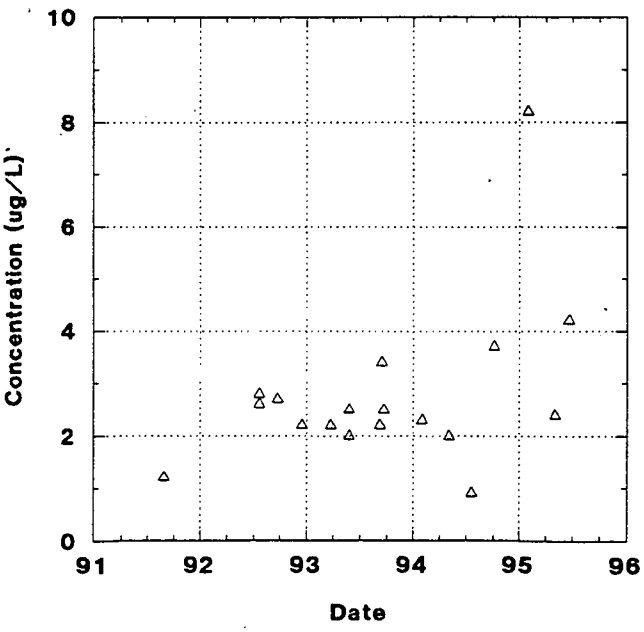



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2624

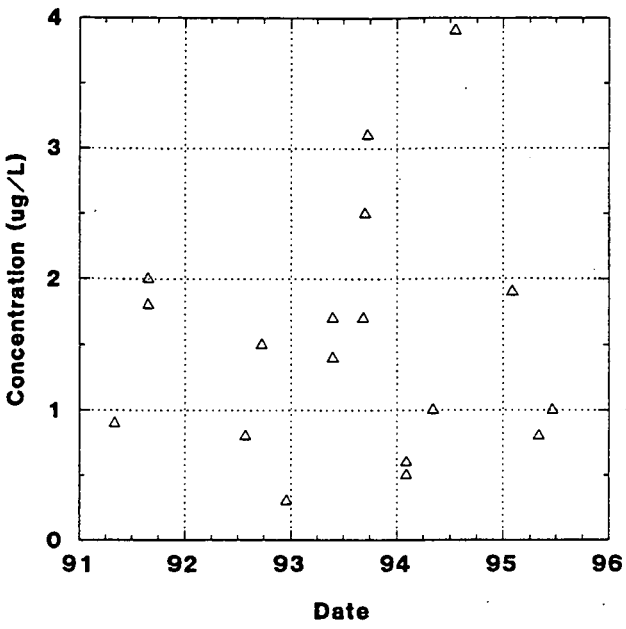



## Well 2625

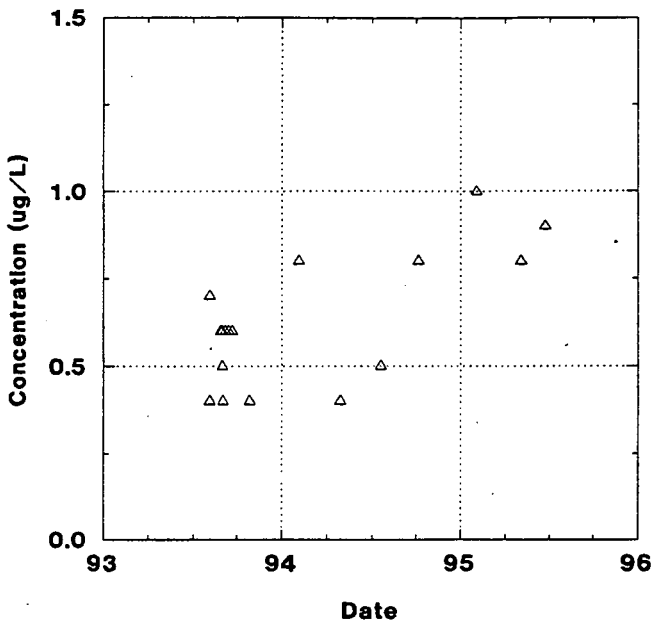


# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 2636

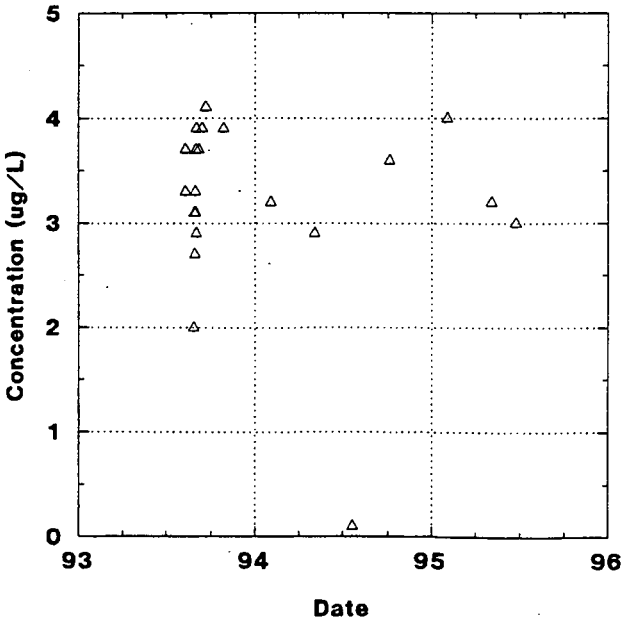



## Well 2880

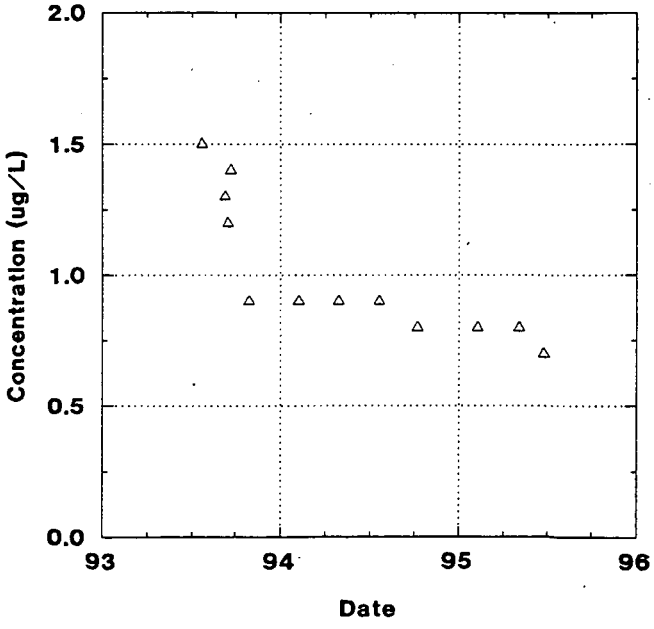



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2881



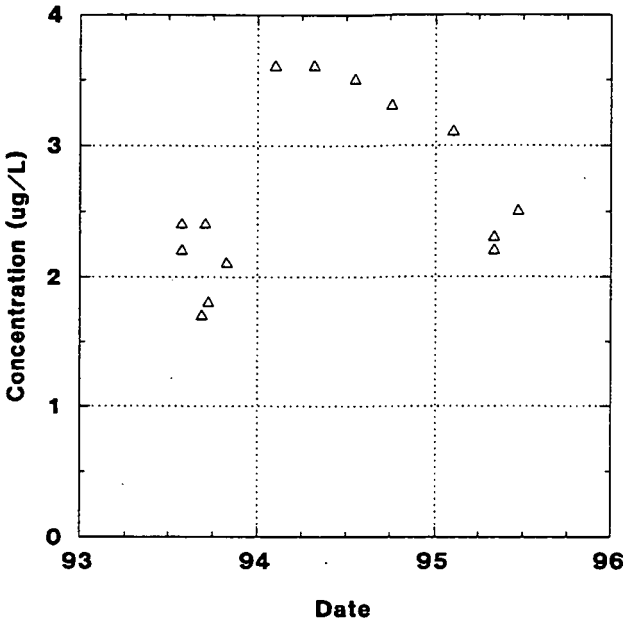

## Well 2897



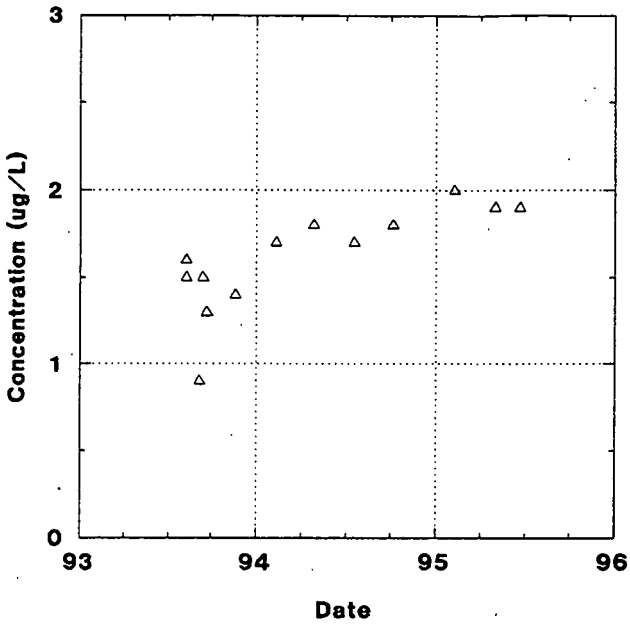
7207

# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 2898

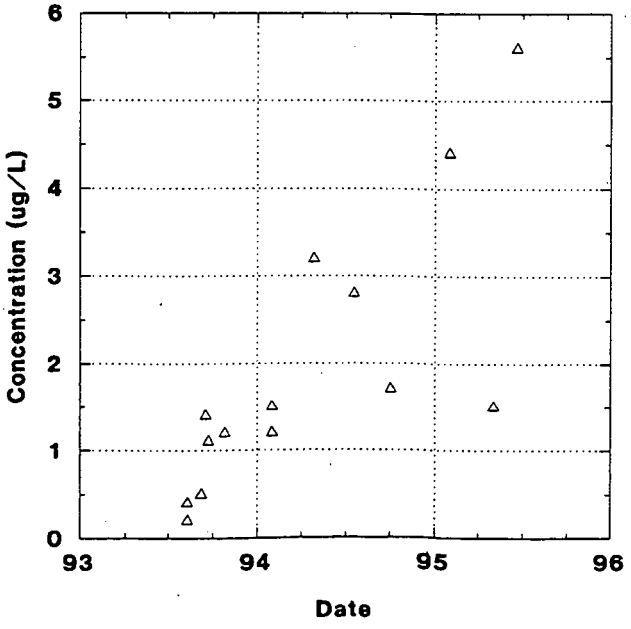



## Well 2899

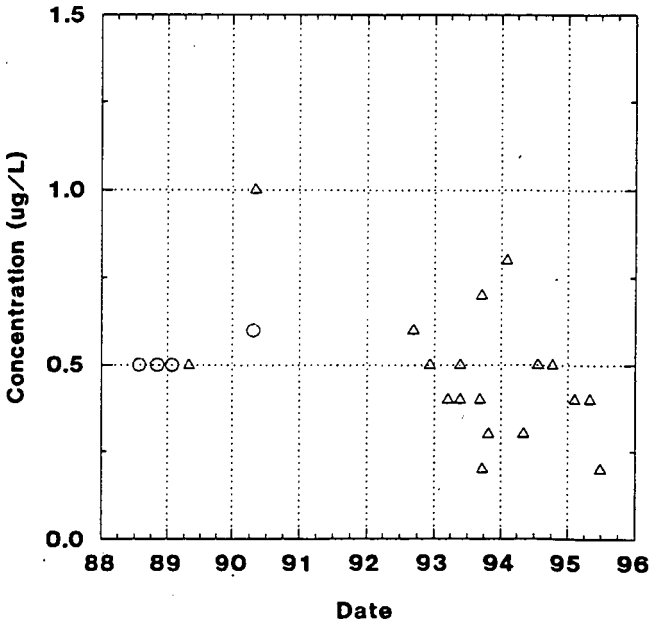



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 2900




## Well 3093

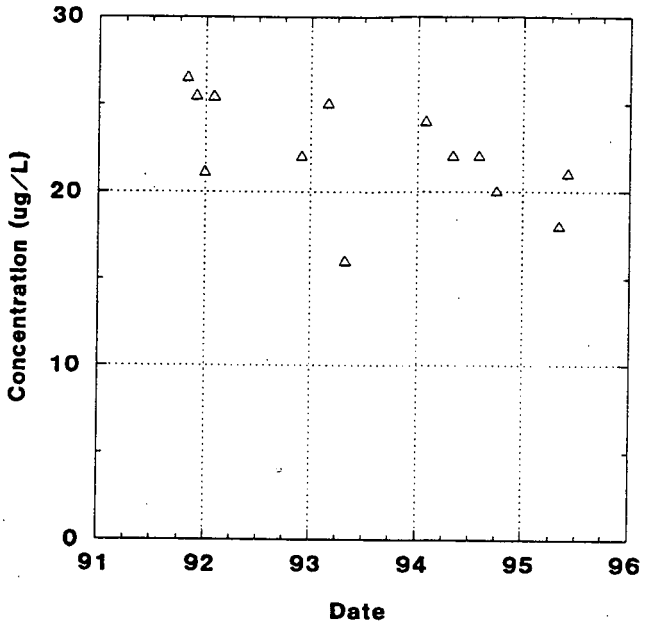



000085

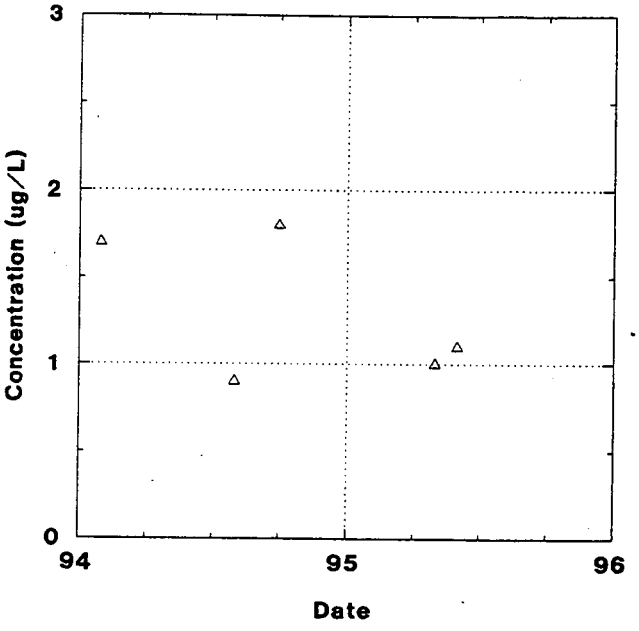
E 7207

# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 2552

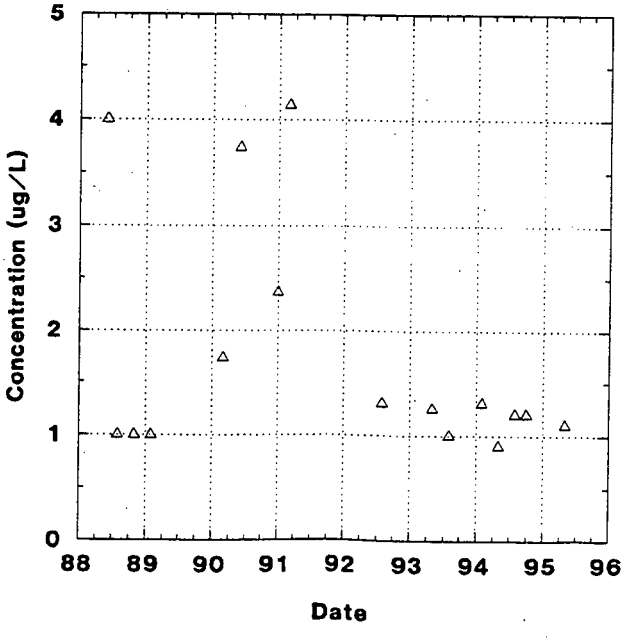



## Well 2553

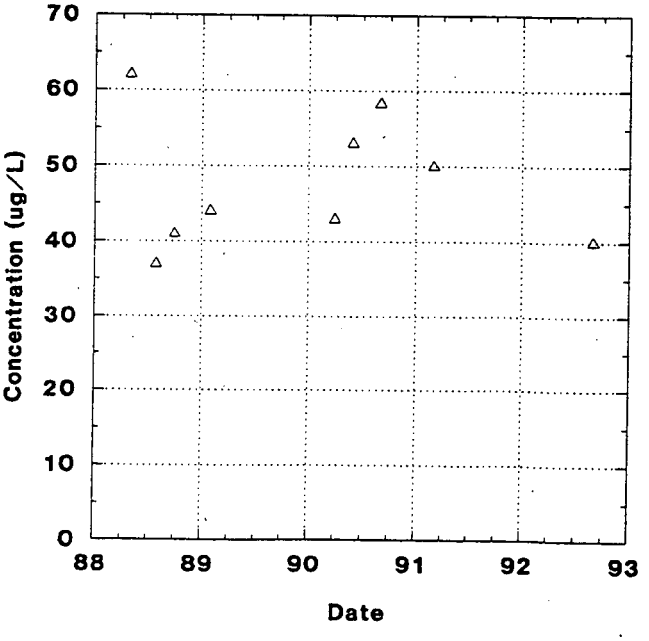



LEGEND: O No Detection (Detection Limit) Δ Detection

## Well 3015



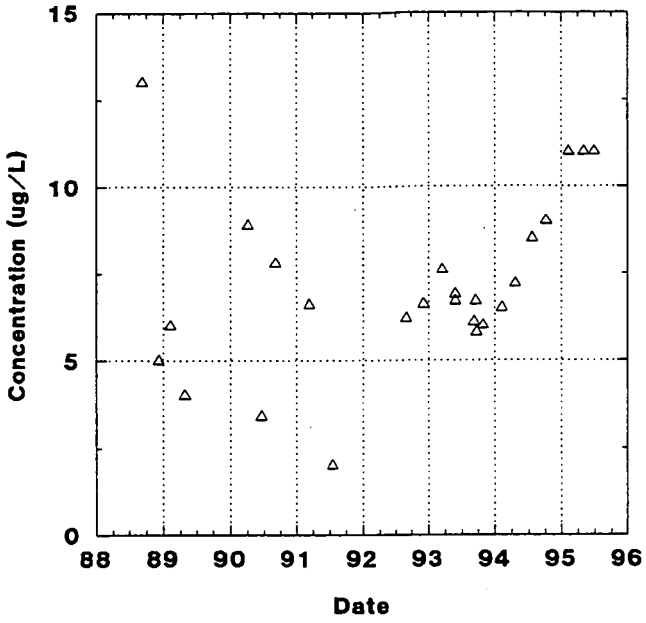

## Well 3062



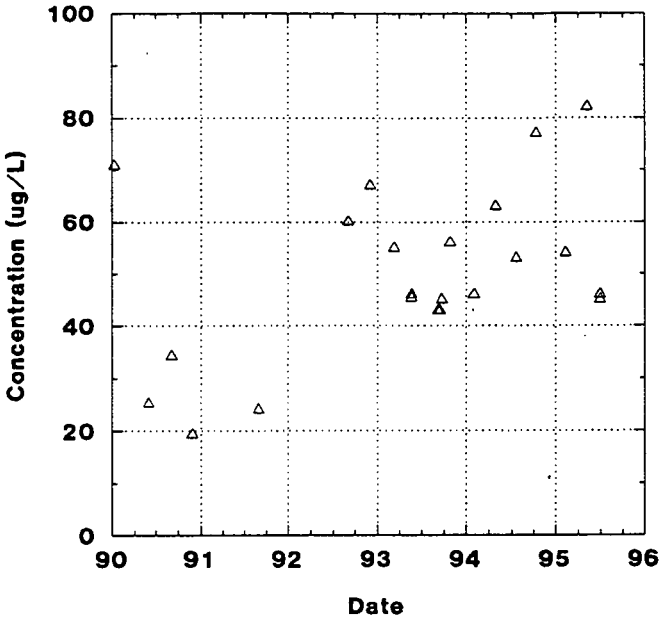
7207

# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 3095

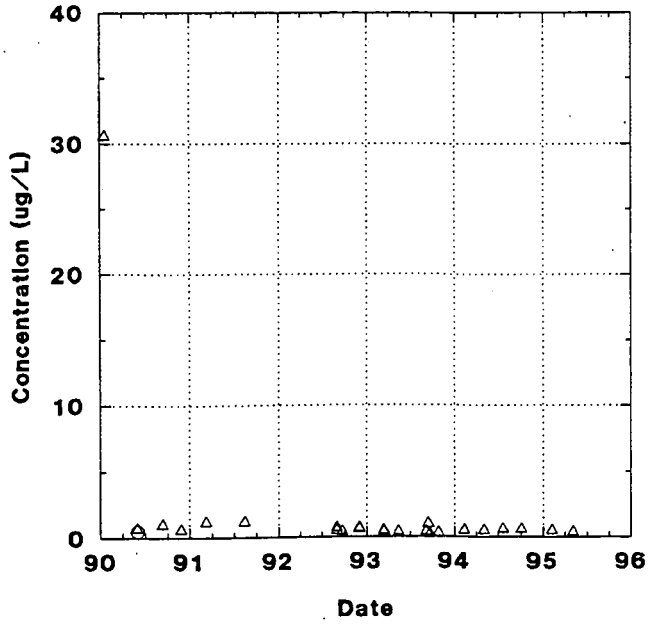



## Well 3125

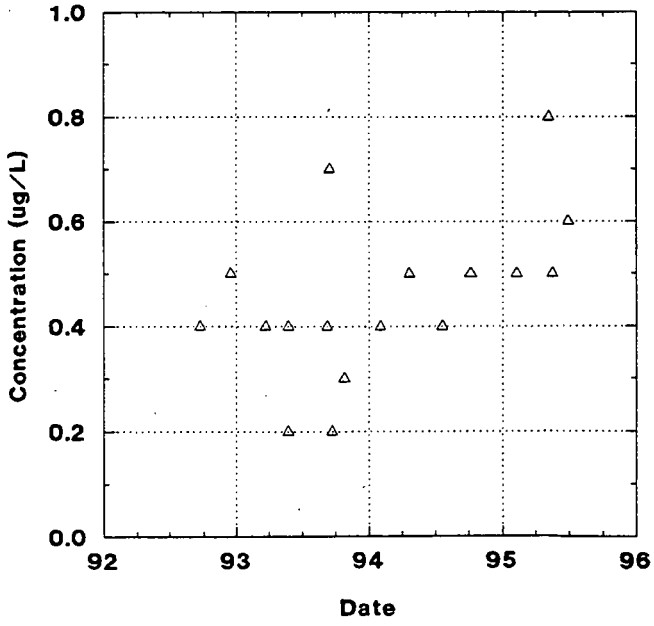



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 3128



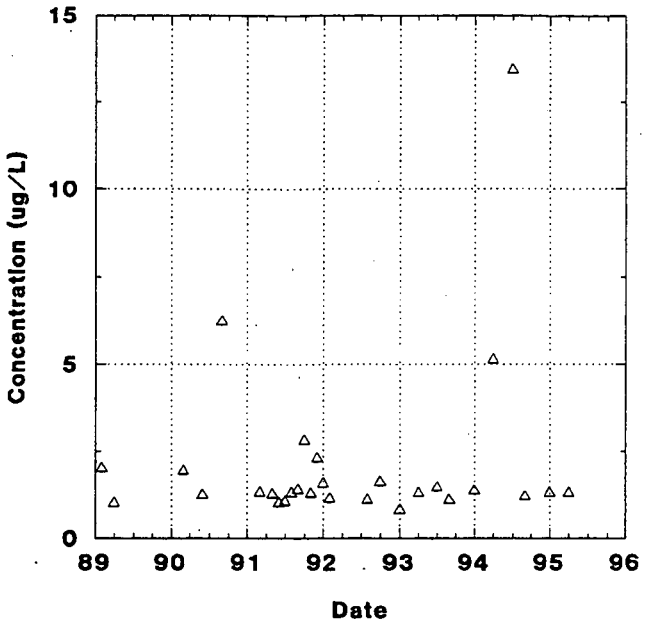

## Well 3624



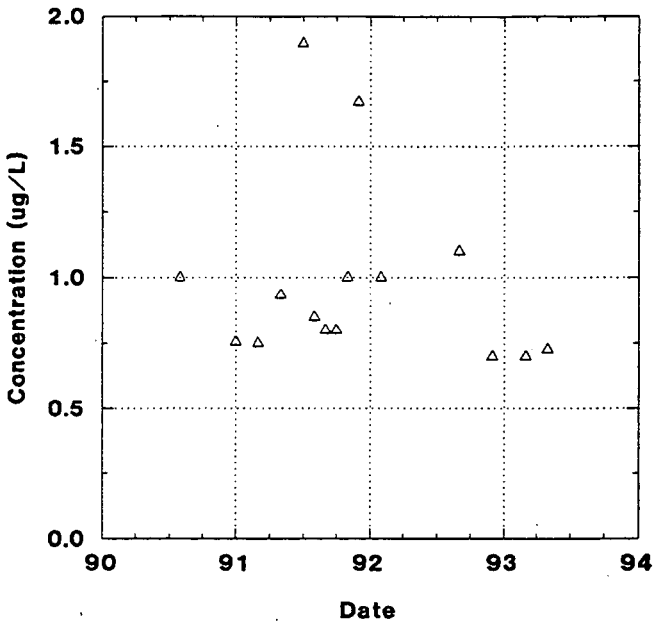

000067

# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 3106

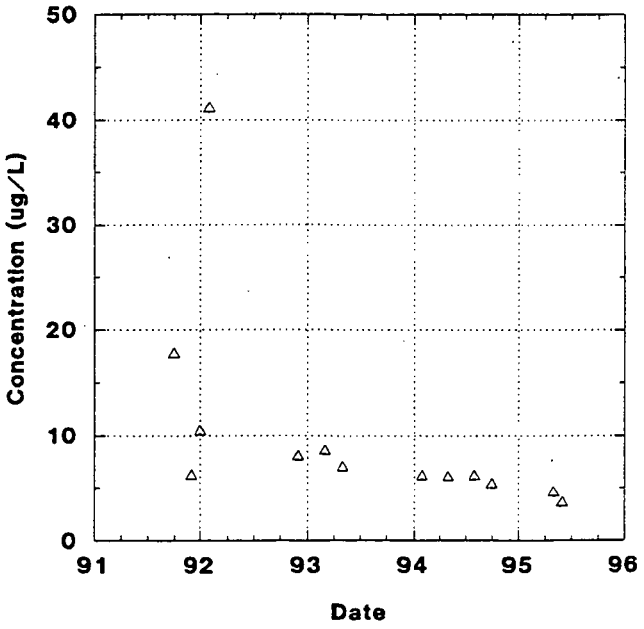



## Well 3396

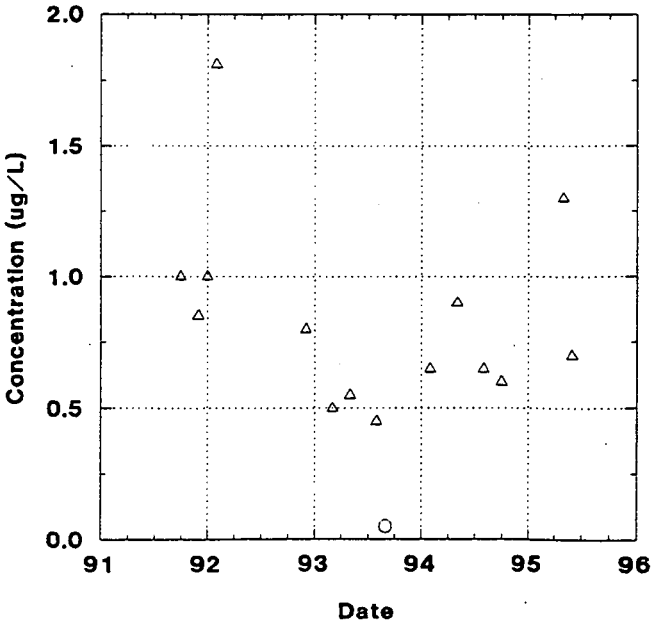



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 3550



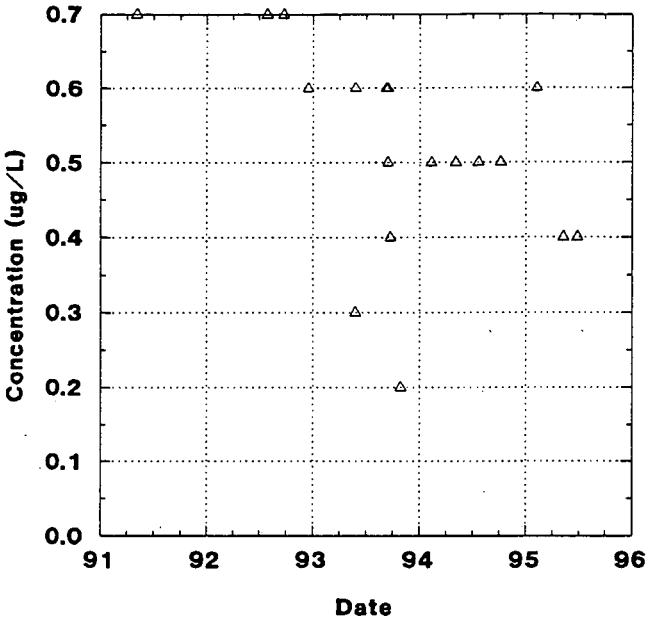

## Well 3551



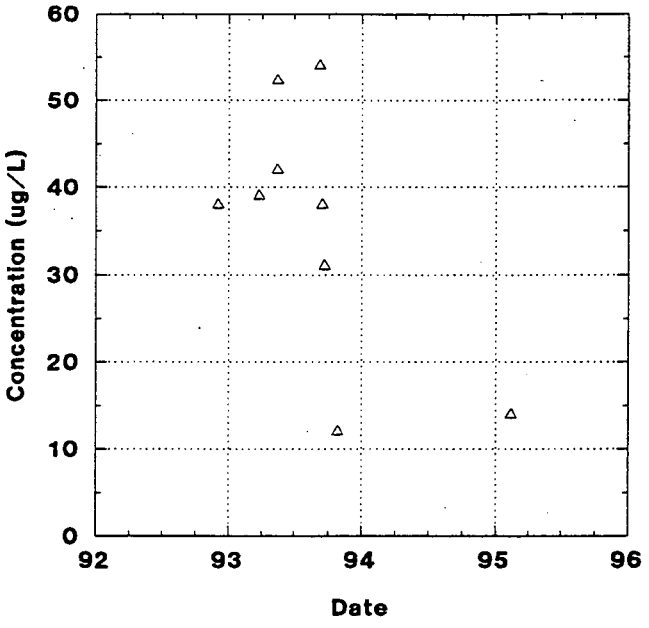
E 7207

# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 3636

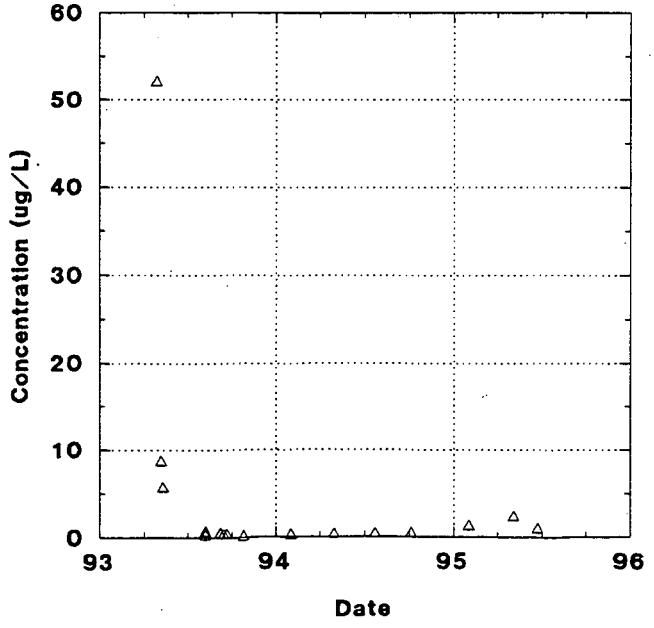



## Well 3689

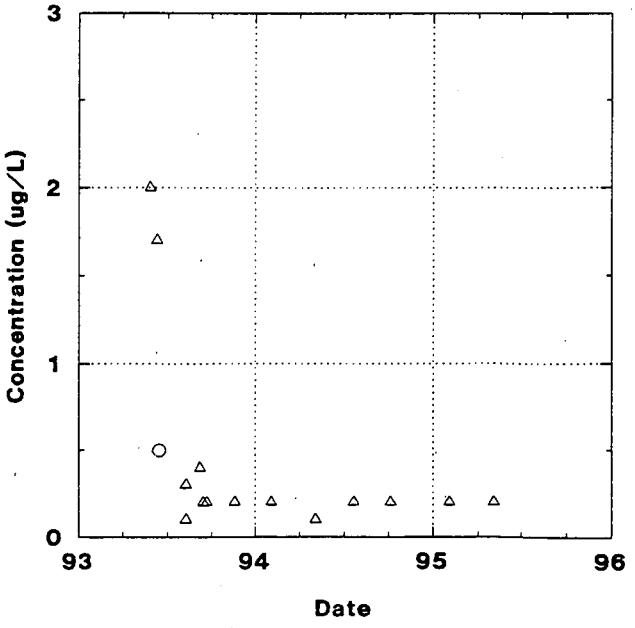



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 3880

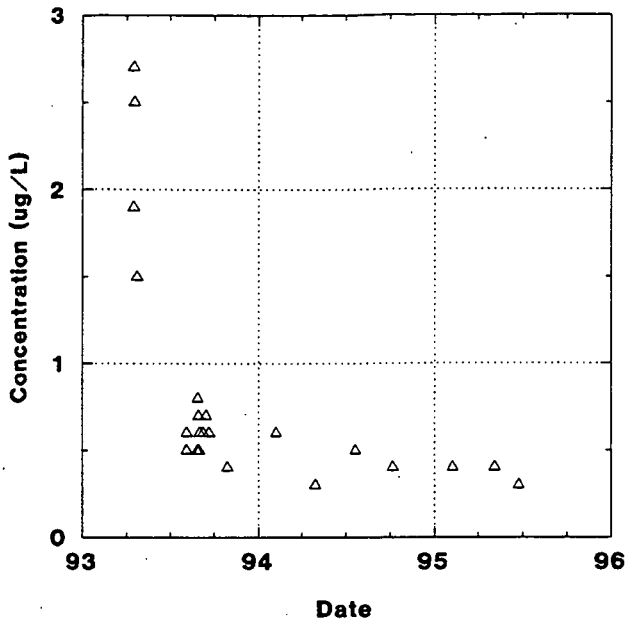



## Well 3881

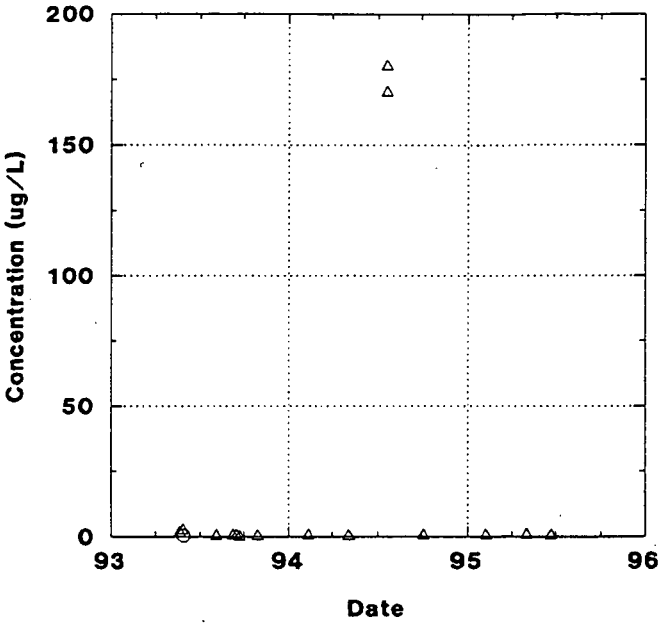


# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 3897

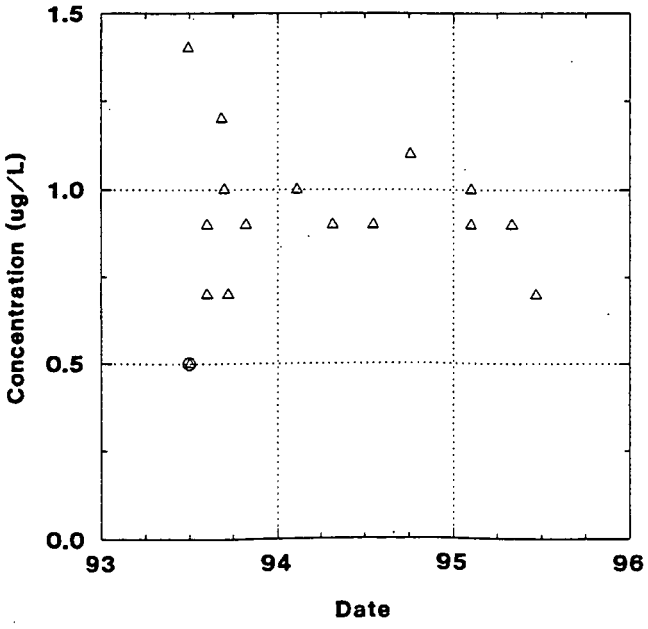



## Well 3898

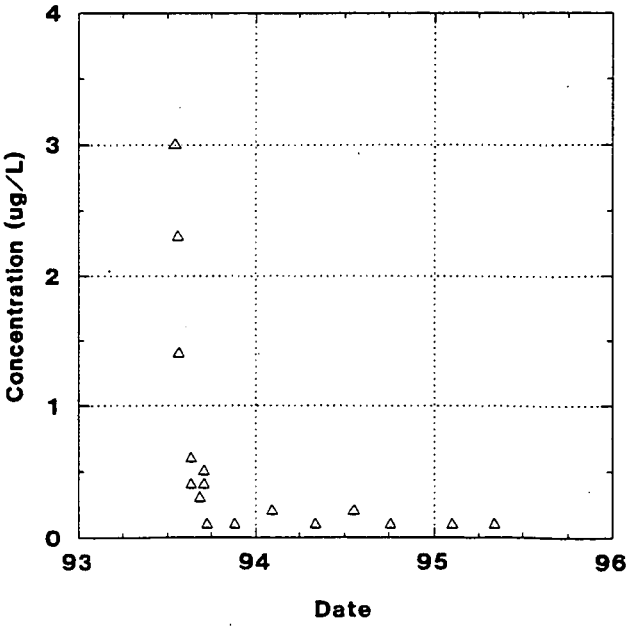



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 3899

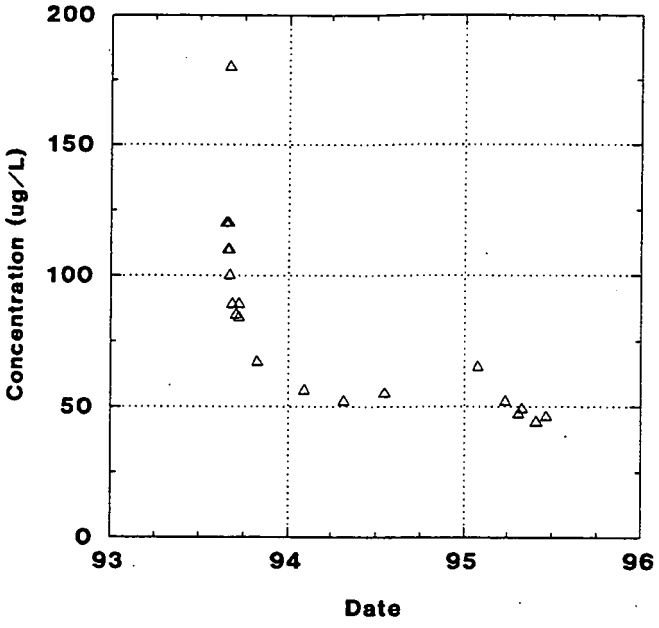



## Well 3900

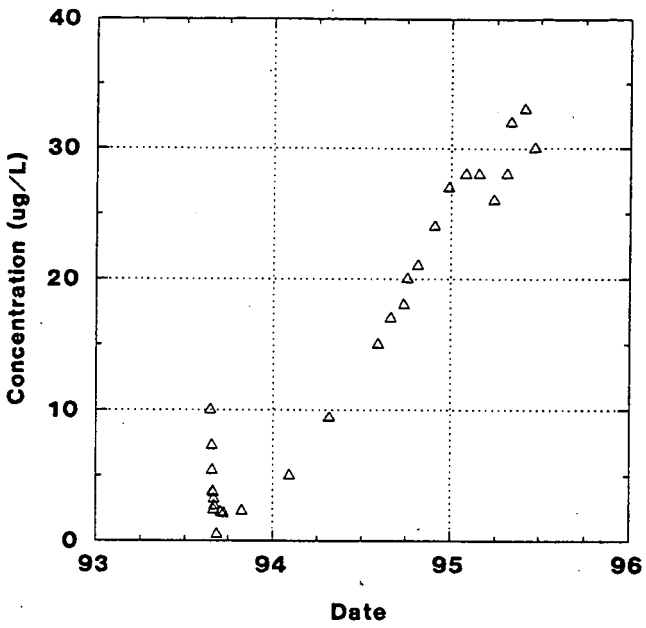


# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 3924

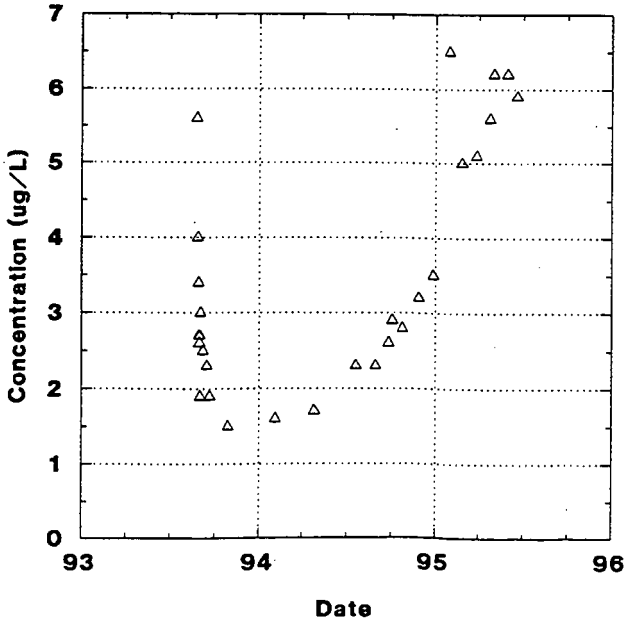



## Well 3925

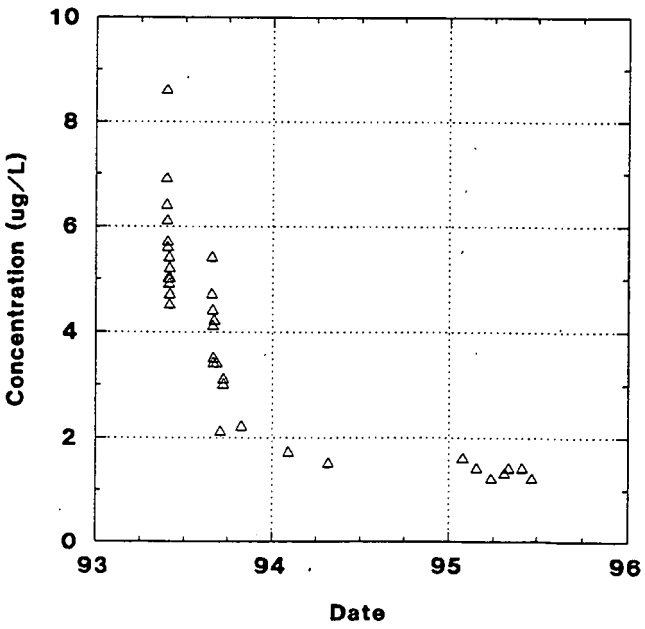



LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 3926

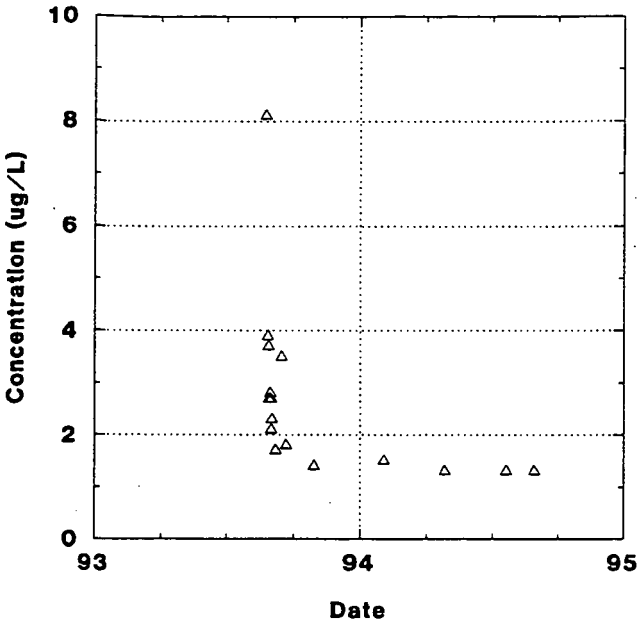



## Well 3927



# TOTAL URANIUM
(Unfiltered Analytical Results)

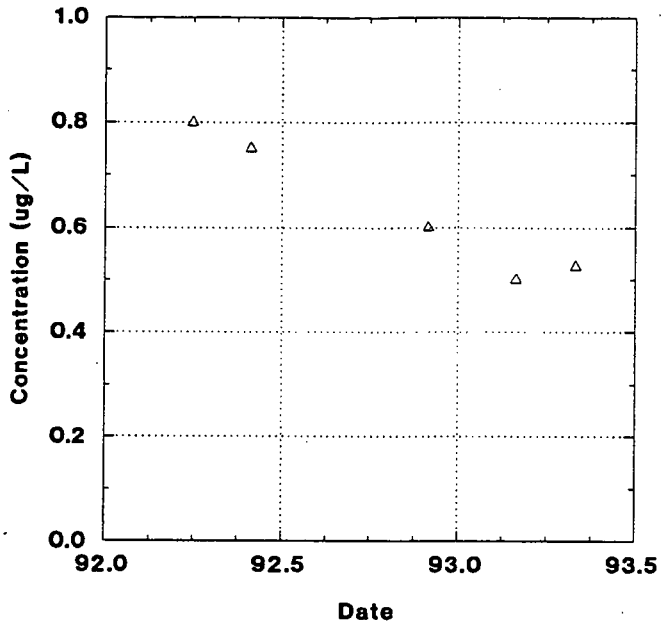
## Well 3928



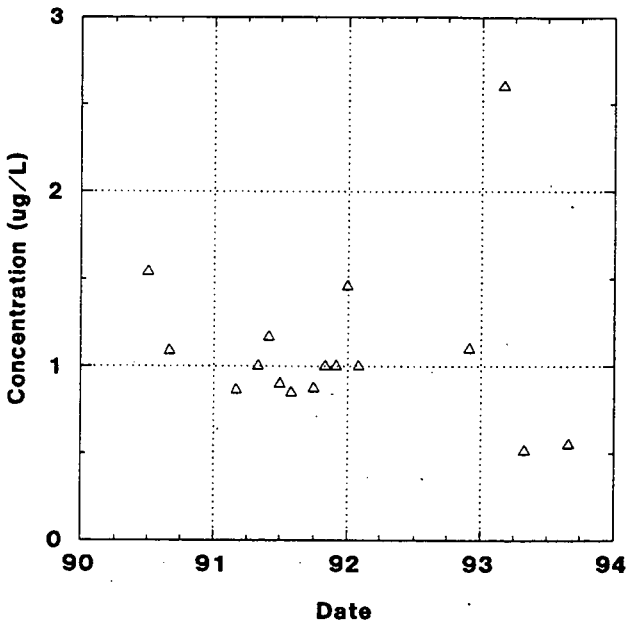

LEGEND: ○ No Detection (Detection Limit) △ Detection

# TOTAL URANIUM
(Unfiltered Analytical Results)

## Well 3552




## Well 4125




LEGEND: ○ No Detection (Detection Limit) Δ Detection

## Well 21063